The health and environmental impacts of hazardous wastes

IMPACT PROFILES

Final report

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Glossary of terms

The Act	*Hazardous Waste (Regulation of Exports and Imports) Act 1989*
ANZSIC	Australia and New Zealand Standard Industry Codes
Basel Convention	*The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*. The Convention puts an onus on exporting countries to ensure that hazardous wastes are managed in an environmentally sound manner in the country of import.
Controlled Waste	Waste that falls under the control of the Controlled Waste National Environment Protection Measure. Generally equivalent to hazardous waste, although definitional differences of the latter exist across jurisdictions
Controlled Waste NEPM	National Environment Protection (Movement of Controlled Waste between States and Territories) Measure.
CRT	Cathode ray tube
e-waste	Electrical and electronic equipment that has reached the end of its functional life. For the purposes of the scheme, this includes televisions and computers and their peripheral components
Hazard score	A quantification of comparative hazard (between wastes) expressed on a scale of 1 – 6 (in order of increasing hazard) , developed specifically for this project
Hazardous waste	A hazardous waste, as defined in the Australian Government's *National Waste Policy: Less waste, more resources* (2009), is a substance or object that exhibits hazardous characteristics, is no longer fit for its intended use and requires disposal. According to the Act, hazardous waste means: (a) waste prescribed by the regulations, where the waste has any of the characteristics mentioned in Annex III to the Basel Convention; or (b) wastes covered by paragraph 1(a) of Article 1 of the Basel Convention; or (c) household waste; or (d) residues arising from the incineration of household waste; but does not include wastes covered by paragraph 4 of Article 1 of the Basel Convention.
Interstate data	Data collected about hazardous waste generated in one jurisdiction and treated in another, through cross-border transport under the Controlled Waste NEPM
Intrastate data	Data collected about hazardous waste generated, transported and treated within the one jurisdiction
kt	Kilotonnes (thousands of tonnes)
LPCL	Low POP concentration limit
Mt	Megatonnes (millions of tonnes)
NEPM	*National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998*
NEPM codes	Alphanumeric codes, in the format A123, that are used to describe waste types under the Controlled Waste NEPM
PCB	Polychlorinated biphenyl
PFOS	Perfluorooctane sulfonate

POP	Persistent organic pollutant
POP-BDE	Persistent organic pollutants - bromodiphenyl ethers (various forms)
The Department	Department of the Environment
Tracking system	Jurisdiction-based hazardous waste tracking systems, which are in place in New South Wales, Queensland, South Australia, Western Australia and Victoria. These tracking systems can be either online, paper-based, or a combination of both these mechanisms.
Tracked data	Hazardous waste collected under the arrangements of a tracking system
Treatment	Treatment of waste is the removal, reduction or immobilisation of a hazardous characteristic to enable the waste to be reused, recycled, sent to an Energy from Waste facility or disposed.
Waste	(For data collation purposes) is materials or products that are unwanted or have been discarded, rejected or abandoned. Waste includes materials or products that are recycled, converted to energy, or disposed. Materials and products that are reused (for their original or another purpose without reprocessing) are not solid waste because they remain in use.
Waste arisings	Hazardous waste is said to ‘arise’ when it causes demand for processing, storage, treatment or disposal infrastructure.
Waste Code	Three-digit code typically used by jurisdictions to describe NEPM-listed wastes. These are also referred to as ’NEPM codes’ although it is noted that the actual codes do not appear in the NEPM itself.
Waste fate	Refers to the destination of the waste within the set of defined end points. It includes reuse, treatment, recycling, energy recovery, and disposal. Waste transfer and storage should not generally considered as a waste fate. The term fate does not infer that the waste material is destroyed or lost.
WEEE	Waste electrical and electronic equipment
Y-code	The Basel Convention’s waste coding or classification system which encompasses 47 wastes (Y1 – Y47).
Y+8	A term introduced to describe those wastes that are reported in controlled waste tracking in Australia, but do not have a logical conversion in Y code terms, so have been reported to Basel as 8 new codes: ‘Y+8’ 1-8.

1 Introduction

The *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* (Basel Convention), which regulates the movement of hazardous wastes across international boundaries, came into force in 1992, the same year that Australia became a signatory to it.

The Australian Government is obliged to submit an annual report to the Basel Secretariat containing the tonnages of hazardous wastes generated in the country each calendar year. The data must be reported using the Basel Convention's classification system known as Y-codes. State and territory governments collect this data as part of their regulatory role in managing hazardous waste and its potential for impact on the environment and human health, and use their own classification systems, which are based on those adopted nationally under the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure (Controlled Waste NEPM), referred to in this report as 'NEPM codes'.

A NEPM code to Basel Y-code conversion list is provided in ***Appendix A***, while a Basel Y-code to NEPM code conversion is shown at ***Appendix B***.

The Australian Government Department of the Environment commissioned Ascend Waste and Environment to prepare a collation of Australia-relevant knowledge on the health and environmental impacts of hazardous waste (actual and potential). This report presents that collation in the form of a catalogue of 49 individual hazardous waste *impact profiles*, designed to strengthen the knowledge of hazards, impacts, potential risks and the management of hazardous waste specifically relevant to Australia.

Impact profiles cover Y codes 1-45, and exclude Y46 (*waste collected from households*), Y47 (*residues from the incineration of household waste*) and Y14 (*waste chemical substances arising from research and development or teaching activities, including those which are not identified and/or are new and whose effects on human health and/or the environment are not known*). Of the additional eight wastes Australia reports to Basel (the so called 'Y+8'), three of these (waste containers, contaminated soils and contaminated sludges) have also been excluded because they, like Y14, are not hazard-specific so could have a range of impacts, and would be covered by other wastes in the list.

An important feature of each profile is a relative measure of hazard, called hazard score, described by a colour-coded bar graphic and numeric score from 0 to 6. This provides a comparative sense of the severity of hazard posed by each waste. The method used in compiling hazard scores is described in ***Appendix C***.

As an adjunct to the profiles catalogue, section 2 presents a brief report discussing those wastes considered to pose significant risks in the Australian context, through either their inherent hazard, the management challenges they pose or the sheer volume in which they are produced in each year.

2 Summary report: Australia's key hazardous waste impacts and risks

Of the 49 waste groups listed in the attached profiles, it is difficult to determine which ones have the most potential for impact or present the most significant risks in an Australian context. Overall tonnage contribution is a raw indicator that does not take account of the degree of hazard posed by the waste, while inherent hazard provides no indication of the potential for exposure, either to humans or the environment, and therefore risk to both. It seems logical that a combination of both hazard and tonnage (a proxy for exposure) is relevant to identifying key risk wastes, but a metric to do so is not clear. Typically risk is a measure of hazard and exposure, but exposure is variable depending on different circumstances that exposure to the waste could occur within.

Figure 1 provides an infographic of wastes, in this case as NEPM codes (because some Y codes cover multiple NEPM codes with different tonnage arisings and hazards). Each waste's hazard score is displayed alongside the 2013 tonnage. This allows quick identification of the most significant volume contributors on the left and the most significant hazard contributors on the right.

In hazard score terms, the top 10-12 wastes exhibit hazard characteristics of biohazard (clinical and related waste), chromium-based toxicity/ eco-toxicity (wood preserving chemicals and hexavalent chromium compounds), explosivity, or persistent (mainly chronic) debilitative impacts widely in the environment as well as to human health (dioxins and furans, pesticides, PCBs and other halogenated organic compounds). Looked at in pure volume terms, the top 10-12 wastes are completely different, and dominated by biosolids and contaminated soils (the latter is not listed in Figure 1, since no hazard score was possible).

Putting biosolids and soils to one side, the remaining top ten wastes (by tonnage of arisings in 2013) were:

1. Asbestos (790kt)
2. Grease trap waste (557kt)
3. Tyres (435kt)
4. Oily waters (416kt)
5. Alkali wastes (351kt)
6. Animal effluent and residues (342kt)
7. Waste oils (240kt)
8. Zinc compounds (211kt)
9. Lead compounds (133kt)
10. Non-toxic salts (91kt).

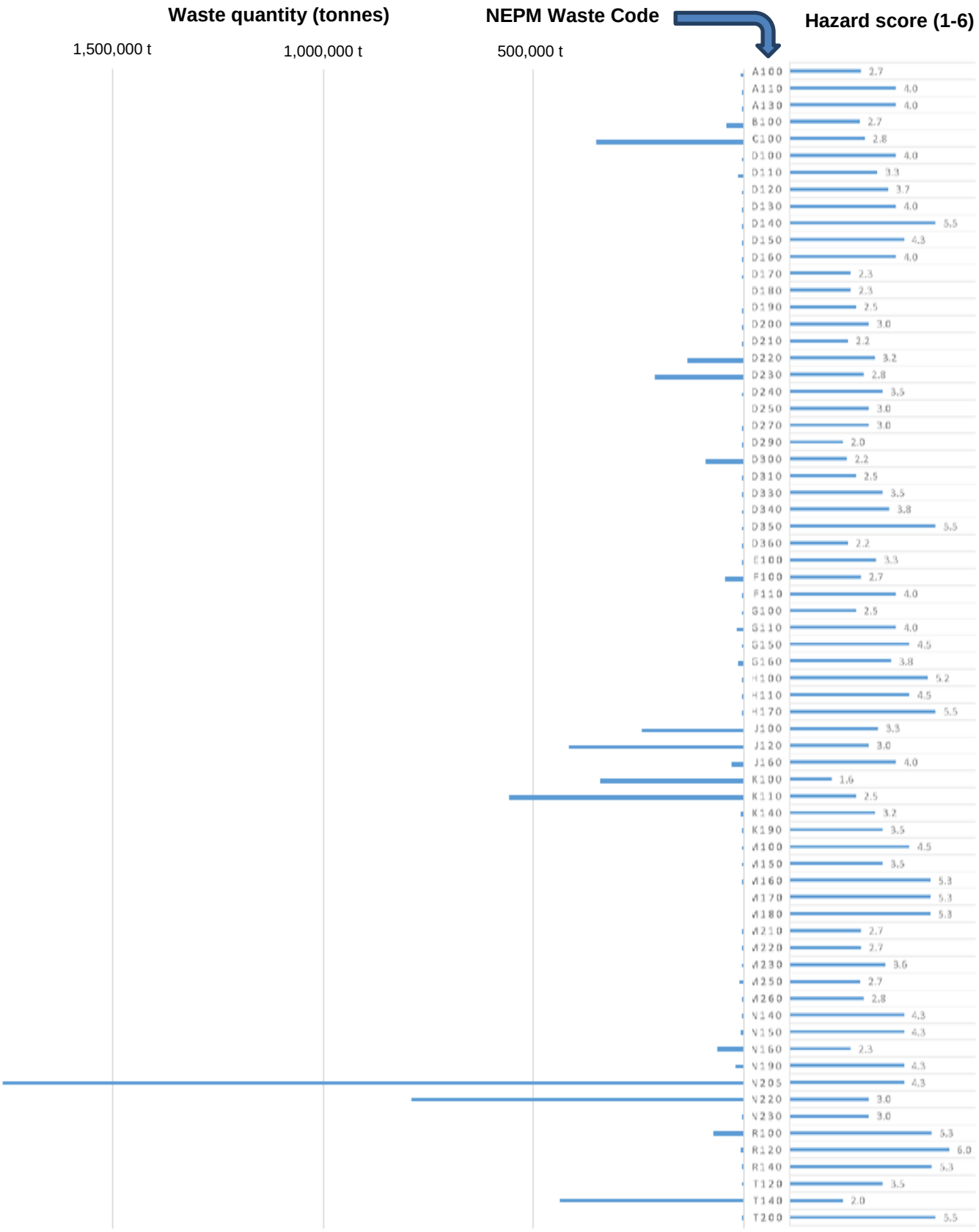
All wastes in this report are inherently hazardous, at least at some level. Tonnage is important in prioritising the potential for impact because, in a simplistic sense, as quantity increases the potential for exposure to hazards (across the population), and therefore risk also increases. However, from the above list there are a number of wastes that probably don't deserve 'high priority' status from a risk of impact perspective: very large tonnage/ low hazard wastes like animal effluent (K100), grease trap (K110) and tyres (T140); while D230 is unique in that its large volumes comes from a very small number of very specific sources, which limits the potential for exposure.

Taking a broader view that includes volume, hazard and professional opinion-based considerations such as specific problem wastes, current and future, the key wastes in terms of impact risk, critical to improved hazardous waste management in Australia, are:

1. Asbestos
2. Waste oil
3. Alkali wastes
4. Lead waste
5. Clinical and related wastes
6. Contaminated soils
7. Spent pot liner (SPL) waste
8. 'Contaminated' biosolids
9. Non-toxic salts [Coal seam gas (CSG) waste]
10. Persistent Organic Pollutants (POPs) waste.

These are described below with reference to their respective Basel and NEPM codes in parentheses).

Figure 1: Hazardous relative waste hazard versus quantity in 2013



1. Asbestos (Y36, N220)

Asbestos waste includes both end-of-life asbestos-containing building materials as well as soil that has been tested to demonstrate asbestos contamination. Since the latter may involve very low asbestos fibre concentrations and very high soil volumes, this greatly contributes to reported asbestos waste volumes.

Asbestos is one of the largest flows of hazardous waste in Australia, making up 11% of national hazardous waste arisings and posing significant health risks. There is no evidence to suggest the supply of waste asbestos is peaking or slowing.

The risks posed by asbestos are predominantly related to human health. Asbestos only poses a risk to health when asbestos fibres are breathed in. Inhaling asbestos fibres may cause asbestos-related disease and death. When asbestos fibres are breathed in, they can lodge in lung tissue and cause inflammation, scarring and some more serious asbestos-related diseases, which usually take many years, if not decades, to develop. The four major asbestos-related diseases, in increasing order of severity, are: pleural plaques, asbestosis, lung cancer and mesothelioma.

From the 1950s to the 1970s the most refined form of brown and blue asbestos was pumped into the roof cavities of more than 1,000 Canberra and NSW homes as insulation. Loose raw asbestos was touted as cheap and effective insulation. The product was called *Asbestosfluf*, and the company that installed it became known as Mr Fluffy. Despite an extensive Commonwealth Government asbestos removal program in the 1980s, in recent years twenty-seven Canberra families have had to leave their homes, which have been deemed unsafe to live in,. Recent assessment reports show that if there are fine cracks around cornices or halls, ceiling fibres are being released into living areas and potential onto clothing via cracks in wardrobes.

2. Waste oils (Y8, J100)

Waste mineral oils are used lubricating oils that come from industrial and domestic vehicle engines and machinery, and can be reclaimed or recovered and recycled for other uses. Tracking data suggests that about 3.5% of national hazardous waste volume is waste oil. Oil waste arisings continue to grow, almost doubling in the last 5 years, with some of this growth possibly due to metal and petroleum-based mining activities, which are significant industrial engine users.

Impacts from oils are mostly to the environment. Oil spills at sea have occurred historically with catastrophic impacts on local ecosystems. The infamous Exxon Valdez oil tanker incident in Alaska in 1989 was shocking in terms of both its scale and its impact. Immediate effects were the deaths of over 100,000 birds and mammals and 16,000 – 21,000 gallons were estimated to still remain on surrounding beaches as recently as 2014, 25 years later.

In March 2009 large quantities of fuel oil, other fuel and ammonium nitrate spilled from the MV Pacific Adventurer into the Coral Sea, north of Moreton Bay, Queensland, during Cyclone Hamish. Over the following days, the spill washed ashore along 60 km of coastline encompassing the Sunshine Coast, Moreton Bay, Bribie Island and Moreton Island. Queensland Premier Anna Bligh described the spill as "worst environmental disaster Queensland has ever seen". It took over 1,425 people 16 months to clean up the affected areas at a total cost of $4 million.

The Product Stewardship for Oil Program was introduced by the Australian Government in 2001. The arrangements comprise a levy-benefit system, where an 8.5 cents per litre levy on

new oil, helps fund the benefit – 50 cents per litre paid back to re-refiners and recyclers on the sale of 're-refined' waste oil. While the program has been successful, there is some uncertainty about the legitimacy of benefits claimed by the recycling industry, due to vagaries in definition of activities and outputs, leading to the current situation of a program that pays out more in benefits than it collects in usable levies.[1].

3. Alkali wastes (Y35, C100)

Alkali or alkaline wastes, otherwise known as *basic solutions or bases in solid form*, are produced in significant quantities from coal seam gas (CSG) extraction in Queensland, cement and lime kilns around Australia, aluminium smelting and as a surface cleaner/ degreaser in a range of industries as diverse as metal coating and finishing to fast food.

The main impacts of alkalis are to human health, felt acutely as a result of exposure to concentrated solutions. Exposure can result in severe burns to the skin, mouth, throat or eyes depending on the exposed area.

This waste is moderately significant nationally, at around 5% of all hazardous waste arising in 2013, with 64% of it coming from Queensland. Since about 2009 there has been exponential growth in Queensland arisings which, given a similar trend for non-toxic salts (the primary classification for CSG waste), is likely to be reflective of the rise of the CSG extraction industry in Queensland. The CSG industry produces around 95% of alkali waste in Queensland.

The main waste concern from CSG extraction is liquid, solid or sludge salt/ brine waste, discussed under '9. Non-toxic salts' below. However, 95% of the Queensland-generated alkali wastes are actually produced by the CSG industry, which equates to over 200,000 tonnes, which is about 4 times Queensland's total non-toxic salts arisings. This discrepancy is discussed further in '9' below.

4. Lead wastes (Y31/ D220)

A significant component of lead waste in Australia is from lead acid batteries. Leaded glass is another wastestream that has emerged from the e-waste recycling industry, where cathode ray television/ monitor (CRT) glass contains large quantities of lead.

While lead is ecotoxic, persistent and bioaccumulative in the environment, it is primarily a health impact consideration. Long-term exposure to lead can result in a variety of adverse health effects, mainly involving the central nervous system, major organs and effects on unborn babies. Health consequences from exposure are more significant in children aged 5 years or younger. Unborn children can be exposed through their mothers and harmful effects may include: premature birth, smaller babies, decreased mental ability, learning difficulties and reduced growth.

Lead waste generation in Australia is significant and growing. In 2013 lead waste made up around 2% of all hazardous waste generated. While lead acid battery recycling infrastructure has grown substantially in Australia in recent years, environmentally sound and cost-

[1] Byron, N, Aither (2013), for the Department of the Environment. Third independent review of the Product Stewardship (Oil) Act 2000 Final Report. Accessed on 29 May 102015 from: http://www.environment.gov.au/resource/third-independent-review- product-stewardship-oil-act-2000

effective solutions to the growing problem (in the short term at least) of leaded CRT-glass waste from the e-waste recycling industry remain.

5. Clinical (biohazardous) waste (Y & Y3/ R100 & R120)

Clinical and related wastes arise from medical, nursing, dental, veterinary, laboratory, pharmaceutical, podiatry, tattooing, body piercing, brothels, emergency services, blood banks, mortuary practices and other similar practices, and wastes generated in healthcare facilities or other facilities during the investigation or treatment of patients or research projects, which have the potential to cause disease, injury, or public offence.

Other wastes are also generated within health care settings. Waste pharmaceuticals, drugs and medicines are waste pharmaceutical products that have: passed their recommended shelf life; been discarded as off-specification batches; been returned by patients or discarded. These wastes are often generated directly from pharmacies, hospitals, medical centres and hospital dispensaries. A particularly notable pharmaceutical waste is waste cytotoxic drugs, or waste (including sharps) contaminated by cytotoxic drugs. A cytotoxic drug has carcinogenic (cancer-causing), mutagenic (increase mutations of genetic material) or teratogenic (birth defect) potential, and is commonly used in the treatment of cancer.

At around 1% of all hazardous waste in Australia, they are notable in volume terms. When combined with the extreme nature of their hazard, any discussion of priority hazardous wastes from a risk perspective must include them.

The hazardous nature of clinical waste is due to the presence of infectious agents and/or the presence of used sharps (for example, needles). Clinical waste should always be assumed to potentially contain a variety of pathogenic microorganisms, because the presence or absence of pathogens cannot be determined at the time the waste is produced. Pathogens in clinical waste that is not well managed may enter the human body through the skin, by inhalation or by ingestion.

Apart from fear of health hazards, the community is sensitive to the visual impact of this waste, particularly recognisable human body parts. In some other cultures, religious beliefs require human body parts to be returned to a patient's family and buried in cemeteries.

Health-care workers are particularly vulnerable to needle stick injury, through accidental puncture of the skin for the use, handling or disposal of sharps.

Australian states and territories tightly regulate the management of biohazardous wastes. However, because of the distributed nature of health care facilities and workers in Australia, and the consequences of poor handling of this waste are high, clinical or biohazardous waste as a constant source of human health risk.

6. Contaminated soils (N120)

As discussed above, contaminated soils are not covered in these profiles because their collectively variable hazards make discussing specific impacts impossible. However, produced at approximately 1.4Mt annually, they are impossible to ignore.

Their key potential impact is to the environment, and these profiles reference many instances of historical soil contamination that has had major consequences, and clean costs. Such examples are discussed in the "*Has anything happened before in Australia?*" section of the following profiles: Y5/ H170, Y6/ G160, Y11/ J160, Y27/ D170, Y29/ D120, Y31/ D220, Y33/ A130, Y34/ B100, Y36/ N220, Y41/ G150, Y42/ G110 and Y43/44/ M170/180.

‘Invisible’ wastes

A substantial quantity of hazardous waste is generated and managed onsite in industrial settings that does not appear in waste tracking data, making it ‘missing’ or ‘invisible’ in nationally reported estimates of waste arisings. Some of these wastes have also, historically, not been considered within the hazardous waste framework. Two major examples, in volume, potential impact and management complexity terms are described below.

7. Spent pot liner (SPL)

Spent pot lining (SPL) is a waste material generated from aluminium smelters, of which there are five in Australia. Aluminium smelting takes place in electrolytic cells that are known as pots. During the operation of the cell, substances, including aluminium and fluorides, are absorbed into the cell lining. After some years of operation, the pot lining fails and is removed. The removed material is SPL, a hazardous waste due to:

- the presence of fluoride and cyanide compounds that are leachable in water
- its corrosiveness – it exhibits high pH due to the presence of alkali metals and oxides
- its reactivity with water - producing inflammable, toxic and explosive gases. This last hazard in particular makes it difficult to handle and treat

Apart from the major human health hazard posed, the presence of fluorine in particular means that this waste has the potential for long-term toxic effects on the environment (fluorine is highly persistent) if poorly managed.

SPL does appear in waste tracking systems, variously as D300 (non-toxic salts), N205 (residues from industrial treatment and disposal operations) or, probably its most accurate classification, D110/ Y32 (inorganic fluorine compounds) as it appears in these profiles. This waste stream is likely to diminish over time - the tightening economics of the aluminium smelting industry in Australia have recently closed two smelters. But the primary issue, combined with the risk of human health and environmental impact, is the scale of long-term industry stockpiles – estimated to be in the order of 900,000 tonnes – sufficient to more than half fill the Melbourne Cricket Ground.

8. ‘Contaminated’ biosolids

Biosolids are a product of sewage sludge (the sludge collected from wastewater treatment) once it has undergone further treatment to reduce disease causing pathogens and volatile organic matter, producing a stabilised product. Biosolids have significant potential for beneficial reuse, which currently occurs throughout Australia. Suitable quality biosolids can be applied as a fertiliser to improve and maintain productive soils and stimulate plant growth.

They are not a controlled waste under the NEPM, nor are they assigned a Basel Y code, and consequently are not tracked in most jurisdictions, causing them historically to be ‘invisible’ in national hazardous waste estimates. At almost 1.5Mt nationally in 2013, biosolids take a lot of ‘hiding’, so they were included in Australia’s annual hazardous waste reporting to the Basel Convention from 2012 onwards under Y18/ *N205 Residues arising from industrial waste treatment/disposal operations*, along with other wastes that are reported to tracking systems under this category.

While not typically considered as hazardous waste, or even waste at all by some, it is widely accepted that some biosolids – particularly those generated in treatment plants servicing industrial areas – are contaminated with heavy metals at levels exceeding criteria set to

protect environmental and human health values, that would (if they were soils for example) would classify them as a hazardous waste.

Noting that a hazard risk versus resource value tension exists for biosolids, the application of state-based biosolids guideline chemical contaminant concentration levels should ensure that beneficial reuse applications match the quality of the biosolids in a 'fit for purpose' way.

Apart from the scale of the waste stream – the largest of all reported to Basel – an emerging problem is the reality that many biosolids guidelines applied by states and territories have inadequate coverage of hazardous chemicals. For example Western Australian and South Australian guidelines, do not consider arsenic, mercury or lead, although these are the heavy metals within much of Victoria's historical Western Treatment Plant biosolids stockpile that exceed hazardous waste concentration thresholds.

A bigger issue is the potential presence of chemicals only relatively recently determined to be an environmental concern, such as the new Stockholm Convention listings of POPs, which are known to be present in biosolids. Should these chemicals be present at levels high enough to cause concern, legislative change is foreseeable that could lead to a quite different set of biosolids management requirements in the near future.

Emerging wastes

Coal seam gas (CSG) waste and persistent organic pollutants (POPs) waste are two looming waste issues. The former has emerged in the last decade and is growing at unprecedented rates. The latter is waiting on the regulatory near-horizon.

9. Coals seam gas (CSG) waste

Coal seam gas (CSG) mining occurs predominantly in Queensland and to a lesser extent in NSW. Consequently, approximately 80% of CSG-based waste is generated in Queensland, in the Bowen and Surat Basins. These wastes are nominally captured in waste tracking systems as *D300 non-toxic salts*.

The CSG extraction process produces a range of wastes, but salty/ brine wastes are of most concern. CSG wastes are produced in very large tonnages and they are a difficult problem for the waste industry, which often relies on landfill. Water penetrating a landfill will mobilise any stored salt in the leachate stream, which creates a major environmental risk of groundwater infiltration and subsequent contamination of aquifers, especially given the volumes to be managed.

The alkali wastes discussion in '3' above notes that the Queensland CSG industry alone produces alkali waste at a rate that is over 4 times the state's non-toxic salts figure, This could be an issue of coding the same waste in two different ways, since salt wastes from CSG extraction may be alkaline. Regardless, given the large known onsite storages of CSG waste, which don't make their way onto national arisings figures (because they haven't hit the tracking system), the CSG industry currently and even more so in the future has an environmental management issue of unprecedented scale.

10. Persistent Organic Pollutants (POPs) waste

Referred to in the profile for Y45/ M160 *Organohalogen compounds other than substances referred to in this list*, POPs waste also shared a commonality with other waste types such as chlorophenols (Y39), halogenated solvents (Y41), dioxins and furans (Y43 and Y44), PCB-like compounds (Y10) and organochlorine pesticides (within Y4), due to the halogenated elements (typically fluorine, chlorine or bromine) in their structure.

The best examples of POPs are the new additions to the Stockholm Convention in 2009, the brominated flame retardants (BFR) polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCD), and perfluorooctanesulfonic acid (PFOS).

POPs are hazardous and environmentally persistent substances which can be transported between countries by the earth's oceans and atmosphere. POPs accumulate in living organisms and have been traced in the fatty tissues of humans and other animals. While impacts vary with each individual chemical species, human health effects tend to be chronic – some POPS are possible human carcinogens. Generally speaking, their environmental impact is of equivalent or greater concern - the PBDEs, PFOS and HBCD all demonstrate significant aquatic toxicity, persistence in the environment and tend towards biomagnification (increasing accumulation along the food chain). There is general international agreement that they require global action to reduce their impact on humans and the environment.

Banned since 2004, PBDEs have been historically added at percentage levels to plastics in a range of products including electrical and electronic equipment (EEE), furniture upholstery, automobile interiors, mattresses and carpet underlay. HBCD has been added to extruded and expanded polystyrene foams used in building insulation and PFOS, a fluorinated surfactant, has been primarily as a dispersant in firefighting foams.

These substances, when present in wastes such as end of life products presenting for disposal, are not technically regarded as hazardous wastes in Australia at present. E-waste is a good example of such a potentially PBDE-containing waste. This is because Australia is still undertaking its assessment processes to determine whether to ratify these new additions to the Stockholm Convention.

Another waste, one that was in the initial 12 listed under the Stockholm Convention, is hexachlorobenzene (HCB), a substantial and intractable stored quantity of which has been under close management by Orica at its Port Botany site for the last couple of decades. It has been long understood that existing Australian infrastructure for halogenated chemical treatment is inadequate for dealing with the Orica HCB waste, not to mention how it would cope with a new, related wastestream.

Lastly, as recently as May 2015, there were three more additions to the Convention – polychlorinated napthalenes, hexachlorobutadiene and pentachlorophenol. While ratification assessment processes for countries like Australia are lengthy and their ultimate decisions uncertain, indications are that POPs-containing wastes are an emerging consideration for Australian waste policymakers and waste managers alike, particularly given local limitations that currently exist in POPs-specific treatment infrastructure.

These issues indicate an emerging potential problem in relation to management of POP waste as it arises, and to the set of current infrastructure available to treat it in an environmentally sound manner.

Conclusion

Hazardous wastes have been regulated by state and territory governments in Australia for decades, leading to strong controls around licensing of facility operations that generate these wastes as well as those that treat, dispose or otherwise handle them. A deeper knowledge of what specific hazardous wastes are produced in Australia, from what sources they arise, which management pathways and fates they go to and what their human health and environmental impacts or consequences could be, pertinent to Australia, is only more recently growing. As information and data is being built upon through various co-operative Australian Government/ State and Territory Government projects, more co-operative management of national-scale issues is likely to occur.

The health and environmental impact profiles developed in this report contribute to a deeper, richer, more current and more broadly accessible understanding of hazardous wastes and their impacts in Australia.

3 Hazardous waste impact profiles

3.1 Clinical waste from medical care in hospitals, medical centres and clinics

Waste name: Clinical waste from medical care in hospitals, medical centres and clinics	**Basel waste category:Y1**	**Basel permit code: A4020**	**NEPM code: R100**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	**Extreme**
						>5.0
	Description of the waste	Clinical waste is waste arising from medical, nursing, dental, veterinary, laboratory, pharmaceutical, podiatry, tattooing, body piercing, brothels, emergency services, blood banks, mortuary practices and other similar practices, and wastes generated in healthcare facilities or other facilities during the investigation or treatment of patients or research projects, which have the potential to cause disease, injury, or public offence, and includes: sharps and non-sharps clinical waste.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Sharps can cause disease and/or injury and include: syringes, needles, lancets, scalpel blades and anything capable of cutting or penetrating the skin. Non-sharps clinical waste is potentially pathogenic and includes: - human blood or body fluids; - human tissue; - a clinical specimen (other than urine or faeces); - a laboratory culture; - tissue, carcasses or other waste arising from animals used for laboratory investigation or for medical or veterinary research; - materials or equipment contaminated with any of the above; - waste from patients known to have, or suspected of having a communicable disease. Pathogenicity is the capacity of a virus, bacteria or related organism to cause a disease. Clinical waste that has been containerised correctly will be present in yellow colour-coded bags, boxes (sharps) and bins. Clinical settings also produce pharmaceutical waste (covered by Y3) and can produce limited mercury wastes (Y29) from equipment such as thermometers, blood pressure gauges and other medical applications, products and chemicals.				
Why is it hazardous?	**Primary hazard**	H6.2: Infectious substances		Substances or wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animals or humans		
	Secondary hazard	H13: Capable of yielding another hazard or hazardous		Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics		

<table>
<tr><th colspan="2">Waste name:
Clinical waste from medical care in hospitals, medical centres and clinics</th><th>Basel waste category:Y1</th><th>Basel permit code: A4020</th><th>NEPM code: R100</th></tr>
<tr><td rowspan="3"></td><td></td><td>material</td><td colspan="3">listed above.</td></tr>
<tr><td>Other hazard(s)</td><td>N/A</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="3">N/A</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="4">Healthcare and related facilities such as those described under ‘Description of the waste’.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Like other hazardous wastes, clinical waste is regulated at the state and territory level in Australia. In general, clinical waste must be treated to render the waste non-hazardous prior to final disposal. Such treatment includes incineration, autoclaving, chemical disinfection and microwave irradiation, with shredding regularly used in conjunction with non-incineration techniques. Incineration is typically acceptable for all types of clinical waste, whereas other treatment methods are typically not suitable for some components of clinical waste, such as human tissue.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td colspan="2">1.0%</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>72,214</td><td>ACT:</td><td>207</td><td>NSW:</td><td>27,296</td></tr>
<tr><td>NT:</td><td>297</td><td>Qld:</td><td>24,630</td><td>SA:</td><td>5,775</td></tr>
<tr><td>Tas:</td><td>8</td><td>Vic:</td><td>10,711</td><td>WA:</td><td>3,289</td></tr>
<tr><td>Potential health impacts</td><td>Overview</td><td colspan="4">The hazardous nature of clinical waste is due to the presence of infectious agents and/or the presence of used sharps. Clinical waste should always be assumed to potentially contain a variety of pathogenic microorganisms, because the presence or absence of pathogens cannot be determined at the time the waste is produced. Pathogens in clinical waste that is not well managed may enter the human body through several routes:
- through a puncture, abrasion or cut in the skin
- through mucous membranes
- by inhalation
- by ingestion.
Apart from fear of health hazards, the community is sensitive to the visual impact of this waste, particularly recognisable human body parts. In some other cultures, religious beliefs require human body parts to be returned to a patient’s family and buried in cemeteries.
Health-care workers are particularly vulnerable to needle stick injury, through accidental puncture of the skin for the use, handling or disposal of sharps.
An additional health impact is in the form of air pollution, from</td></tr>
</table>

Waste name: Clinical waste from medical care in hospitals, medical centres and clinics	Basel waste category:Y1	Basel permit code: A4020	NEPM code: R100
		emissions of pollutants as constituents of flue gases from the incineration of clinical waste. It is noted however that stringent emission standards apply to operators of these incinerators by environmental regulators, through the use of advanced pollution control equipment.	
	Acute toxicity	**Extreme**: Dependant on the nature of exposure to the waste, its inherent pathogenicity and the extent of the disease threat posed by the infected waste. Acuteness of toxicity and impact risk (ranging from harmful to potentially fatal) dependent on the nature of the infecting virus, bacteria, etc.	
	Chronic toxicity	**Extreme**: Dependant on the nature of exposure to the waste, its inherent pathogenicity and the extent of the disease threat posed by the infected waste. Irreversability of toxic effects and impact risk (ranging from harmful to potentially fatal) dependent on the nature of the infecting virus, bacteria, etc.	
	Carcinogenicity	**Low**: Dependant on the nature of exposure to the waste and its inherent carcinogenicity. Cancer is not a communicable disease so it is extremely unlikely to be spread through contact with infectious wastes, even if they contain blood from a cancer sufferer. Theoretical risk from contamination of the clinical wastestream with residual cytotoxics, a related medical waste.	
	Reproductive toxicity	**Extreme**: Dependant on the nature of exposure to the waste, its inherent pathogenicity and the extent of the disease threat posed by the infected waste. Risk to the unborn child (ranging from harmful to potentially fatal) is dependent on the nature of the infecting virus, bacteria, etc.	
Workplace health & safety impacts	In the year 2000, sharps injuries to health-care workers worldwide were estimated to have caused about 66 000 hepatitis B, 16 000 hepatitis C and 200–5000 HIV infections among health-care workers[1]. It is estimated that more than two million health-care workers are exposed to needle stick injuries with infected sharps every year [1]. Sharps and needle stick injury incidents in Australia are estimated to affect at least 18,000 healthcare workers each year [2].		
Population scale impacts	The risk of a sharps injury among patients and the public is much lower, particularly in Australia, as there are tight controls around proper handling, storage, transport and treatment of infectious clinical waste. But globally, because the amount of waste produced is growing faster than the infrastructure to deal with it, it is thought that at least half the world's population is at risk from environmental, occupational or public-health exposure to poor clinical waste management [3]. Members of the public can be exposed to used syringes (waste) from careless discarding practices of intravenous drug users.		
Potential	**Overview**	The major hazard from clinical waste is impact to human health.	

<table>
<tr><th colspan="2">Waste name:
Clinical waste from medical care in hospitals, medical centres and clinics</th><th>Basel waste category:Y1</th><th>Basel permit code: A4020</th><th>NEPM code: R100</th></tr>
<tr><td rowspan="5">environment impacts</td><td></td><td colspan="3">However, environmental impacts are also possible, but not in the strictest sense of ecotoxicity, persistence and bioaccumulation. Clinical waste is typically an environmental health issue, in the sense that infectious agents can be transported through environmental channels (such as pollution or accidental contact with syringes discarded in public places) with an ultimate impact on human health.
Consequently the typical component measures of environmental impact are not directly applicable for this waste.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="3">N/A</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="3">N/A</td></tr>
<tr><td>Persistence</td><td colspan="3">N/A</td></tr>
<tr><td>Bioaccumulation</td><td colspan="3">N/A</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">Clinical waste in Australia is handled in a way that constrains the highest risk of impact (to human health) to those closest to handling the waste at the point of generation and onsite management in the health care industry.
Needle stick injuries occur in Australia at low relative frequency to the number of sharps handled in the health care system but, overall, the estimate of 18,000 needle stick injury incidents per year[2] (in Australian health care) is unacceptably high.
From time to time there are reports in the media of people standing on discarded hypodermic syringe needles in public places like beaches and parks.
The Syringe Tide[4] was an environmental disaster during 1987-88 in New Jersey and New York (USA) where significant amounts of medical waste, including hypodermic syringes, and raw garbage washed up onto beaches on the Jersey Shore, in New York City, and on Long Island.</td></tr>
<tr><td>What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Australian hospitals have stringent infection control policies and procedures in place to promote waste segregation and proper, puncture-proof containerisation at source, as well as management responsibility for infection control. Hospitals also have waste management plans, procedures and training programs that require strict handling practices, since the risks to waste staff can be overlooked in infection control training.
The Biohazard Waste Industry, as part of the Waste Management Association of Australia (WMAA), publishes a comprehensive Industry Code of Practice for the Management of Clinical and Related Wastes [5].</td></tr>
</table>

Waste name: Clinical waste from medical care in hospitals, medical centres and clinics	Basel waste category:Y1	Basel permit code: A4020	NEPM code: R100
	Industry – exposure controls	Best practice clinical waste management routinely employed in Australia involves the critical first step of waste separation and segregation in colour coded bags, bins and purpose-built waste containers, clear signage and training regarding the colour-coded system, minimal manual handling of waste containers, regular removal of waste containers from wards to (potentially refrigerated) storage and removal, transport and treatment by health care waste specialist contractors. All waste management staff are provided PPE such as protective clothing, gloves, eye protection and spill kits.	
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including clinical waste, through licensing, tracking and transport accreditation requirements. Governments also provide needle and syringe programs that include the widespread provision of safe syringe disposal containers in public places.	
	Community	The community is protected from infection risk from clinical waste in hospitals through the bin segregation system used by health care workers. This isolates the risk to receptacles that are either difficult for patients to access or clear as to their separation from the non-infectious waste stream. However, there is room for greater education around infection control and waste management in the home environment, given the rise of health care delivery alternatives, such as community nursing, day surgery and other home-based care. The public can telephone a Needle Clean Up Hotline[6] or local council for information on how to remove needles and syringes found in public places. If you find a needle and syringe and want to dispose of it yourself, find a hard plastic container with a screw top (such as a plastic juice, milk or soft drink bottle). Take the container to the syringe. Keep away from the sharp end of the needle. Carefully pick up the syringe by the barrel. Do not replace the cap on the needle. Needle point first, put the syringe in to the container and seal it tightly. Ring the Needle Clean Up Hotline[6] or local council in your area to arrange for the container to be collected. Alternatively, you can put the container with the needle and syringe inside in to a syringe disposal bin if one is nearby.	
References	1. Prüss-Üstün A, Rapiti E, Hutin Y (2005). Estimating the global burden of disease attributable to contaminated sharps injuries among health care workers. *American Journal*		

Waste name: Clinical waste from medical care in hospitals, medical centres and clinics	Basel waste category:Y1	Basel permit code: A4020	NEPM code: R100

of Industrial Hygiene, 48(6):482–490.

2. Alliance for Sharps Safety and Needlestick Prevention in Healthcare (2013). Accessed March 10, 2015 from: http://www.allianceforsharpssafety.org/2013/10/safety-is-a-frame-of-mind-for-healthcare-workers/#more-500

3. Harhay MO et al. (2009). Health care waste management: a neglected and growing public health problem worldwide. *Tropical Medicine and International Health,* 14(11):1414–1417.

4. The New York Times (Jul 12, 1988). "Beach Debris Still a Mystery; 77 Syringes Wash Up on S.I." Accessed March 12, 2015 from: http://www.nytimes.com/1988/07/12/nyregion/beach-debris-still-a-mystery-77-syringes-wash-up-on-si.html

5. Biohazard Waste Industry (2014). Industry Code of Practice for the Management of Biohazardous Waste (including Clinical & Related wastes), 7th Edition. *Waste Management Association of Australia*.

6. Australian Government Department of Health and Ageing (2005). Needle and syringe programs: Your questions answered, pp 19 – 22. Accessed March 11, 2015 from: http://www.health.gov.au/internet/main/publishing.nsf/Content/73934F5307F88EC7CA257BF0001E009F/$File/ques.pdf

7. EPA Victoria Industrial Waste Resource Guidelines (2009). Clinical and Related Waste – Operational Guidance. Accessed March 10, 2015 from http://www.epa.vic.gov.au/~/media/Publications/IWRG612%201.pdf

8. World Health Organization (2013). Safe management of wastes from health-care activities, edited by Y. Chartier et al, 2nd Edition. Accessed March 12, 2015 from: http://www.searo.who.int/srilanka/documents/ safe_management_of_wastes_from_ healthcare_activities.pdf

9. Latimer G, ENVIRON Australia (2014). Baseline Study for the Pacific Hazardous Waste Management Project – Healthcare Waste. Prepared for Secretariat of the Pacific Regional Environment Programme (SPREP).

3.2 Wastes from the production and preparation of pharmaceutical products

Waste name: Wastes from the production and preparation of pharmaceutical products		**Basel waste category:Y2**		**Basel permit code: A4010**		**NEPM code: R140**
What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	**Extreme**
						>5.0
	Description of the waste	This category of waste is similar in hazard and potential impact to Y3, *Waste pharmaceuticals, drugs and medicines*. As a result this profile to a large extent mirrors that of Y3. The key difference is the setting that it is generated – for Y2 this is at the pharmaceutical product manufacturing stage rather than the point in the lifecycle where the product is sold, administered or used (pharmacy or health care facility). Another difference is that as a manufacturing waste, there will be process wastes that may be raw materials-based rather than wastes of final manufactured products. A pharmaceutical product is a restricted drug or medicine.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Solid tablets, powdered solids, liquid medicines or solid and liquid chemical or physical process wastes.				
Why is it hazardous?	**Primary hazard**	H6.1: Poisonous (acute)		Substances or wastes liable to cause either death or serious injury or to harm human health if swallowed or inhaled or by skin contact.		
	Secondary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Other hazard(s)	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Main likely chemical contaminants			An enormous variety of potential organic and inorganic chemicals used in drug formulations.		
Where does it come from?	**Main sources**	Pharmaceutical and cosmetic product manufacturing or formulation facilities.				
How is it managed?	**Main fates**	Like other hazardous wastes, pharmaceutical product wastes are regulated at the state and territory level in Australia. Depending on the inherent risk of the waste, it often undergoes some form of				

<table>
<tr><th colspan="3">Waste name:
Wastes from the production and preparation of pharmaceutical products</th><th>Basel waste category:Y2</th><th>Basel permit code: A4010</th><th>NEPM code: R140</th></tr>
<tr><td></td><td></td><td colspan="4">chemical/ physical treatment before final fate of hazardous waste landfill disposal. As opposed to Y3, Y2 does not contain cytotoxic wastes so incineration is not typically a mandatory form of treatment.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score
(% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.02%</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Waste arising in 2013 (tonnes)</td><td colspan="5"></td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">Pharmaceutical products and their derivatives, precursor materials and wastes have the potential to cause harm to genetic material, cause birth defects or induce acute or chronic conditions of toxicity or poisoning, if taken outside medically supervised circumstances or inadvertently handled.
Product packaging is typically absent or damaged, making identification of the underlying drug difficult. This is why waste pharmaceuticals must be assumed to pose the highest carcinogenic, mutagenic or toxic potential, and handled with the utmost caution.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">Extreme: Dependant on the nature of exposure to the waste and its inherent toxicity. Acuteness of toxicity and impact risk (ranging from harmful to potentially fatal) dependent on the nature of the chemical or biological hazard posed by the pharmaceuticals present.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">Extreme: Dependant on the nature of exposure to the waste and its inherent toxicity. Irreversability of toxic effects and impact risk (ranging from harmful to potentially fatal) dependent on the nature of the chemical or biological hazard posed by the pharmaceuticals present.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">Extreme: Dependant on the nature of exposure to the waste and its inherent carcinogenicity.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">Extreme: Dependant on the nature of exposure to the waste and its inherent teratogenicity or potential effects on fertility, lactation and endocrine effects such as oestrogen and androgen disruption. Risk to the unborn child could range from harmful to potentially fatal.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">In the workplace, occupational exposure may occur where control measures fail or are not in place. Exposure may be through skin contact, skin absorption and inhalation of aerosols and drug particles resulting from the following activities:
- drug preparation
- handling waste</td></tr>
</table>

TOTAL:	**1,163**	**ACT:**	0	**NSW:**	371
NT:	0	**Qld:**	76	**SA:**	5
Tas:	0	**Vic:**	711	**WA:**	0

<table>
<tr><th colspan="7">Waste name:
Wastes from the production and preparation of pharmaceutical products
Basel waste category:Y2
Basel permit code: A4010
NEPM code: R140</th></tr>
<tr><td></td><td colspan="6">- transport and waste disposal, or
- spills.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="5">The major hazard from waste pharmaceuticals is impact to human health. However, environmental impacts are also possible, but not in the strictest sense of ecotoxicity, persistence and bioaccumulation. This waste is typically an environmental health issue, in the sense that toxic agents can be transported through environmental channels (such as pollution) with an ultimate impact on human health. There is the potential for increased target species immunity from antibiotics (for example), if waste antibiotics are exposed to populations of these species (such as mosquitos), which is also ultimately a human health issue.
Consequently the typical component measures of environmental impact are not directly applicable for this waste.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">N/A</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">N/A</td></tr>
<tr><td>Persistence</td><td colspan="5">N/A</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">N/A</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">The Biohazard Waste Industry, as part of the Waste Management Association of Australia (WMAA), publishes a comprehensive Industry Code of Practice for the Management of Clinical and Related Wastes [4].</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Staff may be required to handle hazardous substances such as strong acids, formaldehyde or antibiotic tablets that release dust when crushed. Appropriate measures must be taken to protect staff such as provision of a fume or powder cupboard, protective masks, goggles, clothing, footwear and gloves.[5]</td></tr>
<tr><td>Government</td><td colspan="5">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including waste pharmaceuticals, drugs and medicines, through licensing, tracking and transport accreditation requirements.</td></tr>
<tr><td>References</td><td colspan="6">1. World Health Organization (2013). Safe management of wastes from health-care activities, edited by Y. Chartier et al, 2nd Edition. Accessed March 12, 2015 from:</td></tr>
</table>

Waste name: Wastes from the production and preparation of pharmaceutical products	Basel waste category:Y2	Basel permit code: A4010	NEPM code: R140
	http://www.searo.who.int/srilanka/documents/ safe_management_of_wastes_from_healthcare_activities.pdf 2. Alliance for Sharps Safety and Needlestick Prevention in Healthcare (2013). Accessed March 10, 2015 from: http://www.allianceforsharpssafety.org/2013/10/safety-is-a-frame-of-mind-for-healthcare-workers/#more-500 3. World Health Organization. Waste from health-care activities, fact sheet No.253 (2011). Accessed March 12, 2015 from: http://www.who.int/mediacentre/factsheets/fs253/en/ 4. Biohazard Waste Industry (2014). Industry Code of Practice for the Management of Biohazardous Waste (including Clinical & Related wastes), 7th Edition. *Waste Management Association of Australia*. 5. The Society of Hospital Pharmacists of Australia. SHPA Practice Standard – Guidelines for Medicines Prepared in Australian Pharmacy Departments. Accessed April 8, 2015 from: http://www.shpa.org.au/lib/pdf/practice_standards/Manufacturing_standards_0610_ro.pdf		

3.3 Waste pharmaceuticals, drugs and medicines

Waste name: Waste pharmaceuticals, drugs and medicines		Basel waste category:Y3		Basel permit code: A4010 / A4020		NEPM code: R120
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
						>5.0
	Description of the waste	In addition to clinical waste, other wastes are generated within health care settings. These include waste pharmaceuticals, drugs and medicines: Waste pharmaceuticals, drugs and medicines are waste pharmaceutical products that have: passed their recommended shelf life; been discarded as off-spec batches; been returned by patients or discarded. A pharmaceutical product is a restricted drug or medicine. These wastes are often generated directly from pharmacies, hospitals, medical centres and hospital dispensaries. A particularly notable pharmaceutical waste is waste cytotoxic drugs, or waste (including sharps) contaminated by cytotoxic drugs. A cytotoxic drug has carcinogenic (cancer-causing), mutagenic (increase mutations of genetic material) or teratogenic (birth defect) potential, and is commonly used in the treatment of cancer.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Solid tablets, powdered solids, liquid medicines. The category also includes discarded items used in the handling of pharmaceuticals, such as bottles or boxes with residues, gloves, masks, connecting tubing, and drug vials. The most commonly used cytotoxic products used in healthcare are: azathioprine, chlorambucil, chlornaphazine, ciclosporin, cyclophosphamide, melphalan, semustine, tamoxifen, thiotepa and treosulfan.[1]				
Why is it hazardous?	Primary hazard	H6.1: Poisonous (acute)		Substances or wastes liable to cause either death or serious injury or to harm human health if swallowed or inhaled or by skin contact.		
	Secondary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Other hazard(s)	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Main likely chemical contaminants			An enormous variety of potential organic		

<table>
<tr><th colspan="2">Waste name:
Waste pharmaceuticals, drugs and medicines</th><th colspan="3">Basel waste category:Y3</th><th colspan="2">Basel permit code: A4010 / A4020</th><th colspan="2">NEPM code: R120</th></tr>
<tr><td></td><td colspan="3"></td><td colspan="4">and inorganic chemicals used in drug formulations.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="7">Healthcare and related facilities such as those described for Basel code Y1: Clinical waste from medical care in hospitals, medical centres and clinics.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="7">Like other hazardous wastes, waste pharmaceuticals, drugs and medicines are regulated at the state and territory level in Australia. These wastes must be treated to render the waste non-hazardous prior to final disposal. This treatment is usually incineration, which is regulated in most jurisdictions as the only acceptable method of treatment of cytotoxic and pharmaceutical waste.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td>0.08%</td><td colspan="6"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>5,426</td><td>ACT:</td><td>487</td><td>NSW:</td><td>2,051</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>1,782</td><td>SA:</td><td>372</td></tr>
<tr><td>Tas:</td><td>14</td><td>Vic:</td><td>720</td><td>WA:</td><td>0</td></tr>
<tr><td rowspan="2">Potential health impacts</td><td>Overview</td><td colspan="7">Cytotoxic drugs are therapeutic agents intended for, but not limited to, the treatment of cancer. These drugs are known to be highly toxic to cells, mainly through their action on cell reproduction. Many have proved to be carcinogens, mutagens or teratogens. Consequently waste containing these substances has the potential for extreme health impact.
Other drugs and medicines have the potential to cause harm to genetic material, cause birth defects or induce acute or chronic conditions of toxicity or poisoning, if taken outside medically supervised circumstances or inadvertently handled.
Often drug packaging may be absent or damaged, making identification of the underlying drug difficult. This is why waste pharmaceuticals must be assumed to pose the highest carcinogenic, mutagenic or toxic potential, and handled with the utmost caution.
An additional health impact is in the form of air pollution, from emissions of pollutants as constituents of flue gases from the incineration of clinical waste. It is noted however that stringent emission standards apply to operators of these incinerators by environmental regulators, through the use of advanced pollution control equipment.</td></tr>
<tr><td>Acute toxicity</td><td colspan="7">Extreme: Dependant on the nature of exposure to the waste and its inherent toxicity. Acuteness of toxicity and impact risk (ranging from harmful to potentially fatal) dependent on the nature of the chemical</td></tr>
</table>

Waste name: Waste pharmaceuticals, drugs and medicines		Basel waste category:Y3	Basel permit code: A4010 / A4020	NEPM code: R120
		or biological hazard posed by the pharmaceuticals present.		
	Chronic toxicity	**Extreme**: Dependant on the nature of exposure to the waste and its inherent toxicity. Irreversability of toxic effects and impact risk (ranging from harmful to potentially fatal) dependent on the nature of the chemical or biological hazard posed by the pharmaceuticals present.		
	Carcinogenicity	**Extreme**: Dependant on the nature of exposure to the waste and its inherent carcinogenicity. When not apparent through colour-coded (purple) and clearly identified packaging containerisation, this waste must be handled and managed as if it may contain cytotoxic material.		
	Reproductive toxicity	**Extreme**: Dependant on the nature of exposure to the waste and its inherent teratogenicity or potential effects on fertility, lactation and endocrine effects such as oestrogen and androgen disruption. Risk to the unborn child could range from harmful to potentially fatal.		
Workplace health & safety impacts	In the workplace, occupational exposure may occur where control measures fail or are not in place. Exposure may be through skin contact, skin absorption, inhalation of aerosols and drug particles, ingestion and needle stick injuries resulting from the following activities: - drug preparation - drug administration - handling patient waste - transport and waste disposal, or - spills. Sharps and needle stick injury incidents in Australia are estimated to affect at least 18,000 healthcare workers each year[1]. Similarly, waste management staff working in or servicing health care environments are prone to such accidental exposures, particularly if there has been breaches in containerisation protocols or damage to such containment between generation and handling by the waste manager.			
Population scale impacts	The risk of a sharps injury among patients and the public is much lower, particularly in Australia, as there are tight controls around proper handling, storage, transport and treatment of infectious clinical waste. Collection, transport and treatment of waste pharmaceuticals, drugs and medicines in Australia is strictly controlled and regulated, with destruction by incineration the only allowable treatment option. Exposure pathways for the general public are extremely limited.			
Potential environment impacts	**Overview**	The major hazard from waste pharmaceuticals, drugs and medicines is impact to human health. However, environmental impacts are also possible, but not in the strictest sense of ecotoxicity, persistence and bioaccumulation. This waste is typically an environmental health issue, in the sense that toxic agents can be transported through		

<table>
<tr><th colspan="2">Waste name:
Waste pharmaceuticals, drugs and medicines</th><th>Basel waste category:Y3</th><th>Basel permit code: A4010 / A4020</th><th>NEPM code: R120</th></tr>
<tr><td rowspan="5"></td><td></td><td colspan="3">environmental channels (such as pollution) with an ultimate impact on human health. There is the potential for increased target species immunity from antibiotics (for example), if waste antibiotics are exposed to populations of these species (such as mosquitos), which is also ultimately a human health issue.
Consequently the typical component measures of environmental impact are not directly applicable for this waste.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="3">N/A</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="3">N/A</td></tr>
<tr><td>Persistence</td><td colspan="3">N/A</td></tr>
<tr><td>Bioaccumulation</td><td colspan="3">N/A</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">Needle stick injuries occur in Australia at low relative frequency to the number of sharps handled in the health care system but, overall, the estimate of 18,000 needle stick injury incidents per year[2] (in Australian health care) is unacceptably high.
Public incidents of exposure to waste pharmaceuticals, drugs or medicines in Australia, are typically through individual cases of needle-stick injury from standing on hypodermic syringes in public places, discarded carelessly by needle users.
In June 2000, six children were diagnosed with a mild form of smallpox (vaccinia virus) after having played with glass ampoules containing expired smallpox vaccine at a garbage dump in Vladivostok (Russia)[3]. Although the infections were not life-threatening, the vaccine ampoules should have been treated before being discarded.</td></tr>
<tr><td>What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Australian hospitals have stringent policies and procedures in place to ensure segregation, signage, labelling and containerisation of these wastes, as well as clear management responsibility. Hospitals also have waste management plans, procedures and training programs that require strict handling practices.
The Biohazard Waste Industry, as part of the Waste Management Association of Australia (WMAA), publishes a comprehensive Industry Code of Practice for the Management of Clinical and Related Wastes[4].
Best practice standards have been developed in Australia[5]:
- The Society of Hospital Pharmacists of Australia (SHPA) Standards of Practice for the Safe Handling of Cytotoxic Drugs in Pharmacy Departments (2004)
- The Society of Hospital Pharmacists of Australia (SHPA) Standards of Practice for the Transportation of Cytotoxic Drugs from</td></tr>
</table>

Waste name: Waste pharmaceuticals, drugs and medicines		Basel waste category:Y3	Basel permit code: A4010 / A4020	NEPM code: R120
		Pharmacy Departments (2007)		
	Industry – exposure controls	As described in *The Society of Hospital Pharmacists of Australia (SHPA) Standards of Practice for the Safe Handling of Cytotoxic Drugs in Pharmacy Departments (2004)* [5]		
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including waste pharmaceuticals, drugs and medicines, through licensing, tracking and transport accreditation requirements. Following a series of trials the Commonwealth Department of Health provided funds to facilitate the collection and disposal of unwanted and out-of-date medicines from the Australian community. The National Return & Disposal of Unwanted Medicines Limited is a national not-for-profit company, registered specifically for this purpose. Known as the Return Unwanted Medicines (RUM) Project [6], the national scheme provides for unwanted and out-of-date medicines to be collected by community pharmacies from consumers. The medicines are then disposed of by high temperature incineration, which is the EPA approved method of disposal.		
	Community	See the Return Unwanted Medicines (RUM) Project [6].		
References	1. World Health Organization (2013). Safe management of wastes from health-care activities, edited by Y. Chartier et al, 2nd Edition. Accessed March 12, 2015 from: http://www.searo.who.int/srilanka/documents/ safe_management_of_wastes_from_healthcare_activities.pdf 2. Alliance for Sharps Safety and Needlestick Prevention in Healthcare (2013). Accessed March 10, 2015 from: http://www.allianceforsharpssafety.org/2013/10/safety-is-a-frame-of-mind-for-healthcare-workers/#more-500 3. World Health Organization. Waste from health-care activities, fact sheet No.253 (2011). Accessed March 12, 2015 from: http://www.who.int/mediacentre/factsheets/fs253/en/ 4. Biohazard Waste Industry (2014). Industry Code of Practice for the Management of Biohazardous Waste (including Clinical & Related wastes), 7th Edition. *Waste Management Association of Australia*. 5. The Society of Hospital Pharmacists of Australia. SHPA Practice Standards. Accessed March 12, 2015 from: http://www.shpa.org.au/Practice-Standards 6. The Return Unwanted Medicines (RUM) Project. Accessed March 12, 2015 from: http://www.returnmed.com.au 7. EPA Victoria Industrial Waste Resource Guidelines (2009). Clinical and Related Waste – Operational Guidance. Accessed March 10, 2015 from: http://www.epa.vic.gov.au/~/media/Publications/IWRG612%201.pdf 8. World Health Organization (2013). Safe management of wastes from health-care activities, edited by Y. Chartier et al, 2nd Edition. 9. Latimer G, ENVIRON Australia (2014). Baseline Study for the Pacific Hazardous Waste				

Waste name: Waste pharmaceuticals, drugs and medicines	Basel waste category:Y3	Basel permit code: A4010 / A4020	NEPM code: R120
	Management Project – Healthcare Waste. Prepared for Secretariat of the Pacific Regional Environment Programme (SPREP).		

3.4 Wastes from the production, formulation and use of biocides and phytopharmaceuticals

Waste name: **Wastes from the production, formulation and use of biocides and phytopharmaceuticals**	**Basel waste category:Y4**	**Basel permit code: A4030**	**NEPM code: H100**

What is it?	**Hazard score (0 – 6)**	Low	Medium	Moderate	High	**Extreme**
						>5.0*
	Description of the waste	Small quantities of feedstocks, intermediates, by-products and impurities, solvents and biocides resulting from production and formulation. Unused unwanted biocide formulations retained by users. Vegetable material remaining after extraction of phytopharmaceuticals, and by-products, solvents and other chemical substances such as acids and alkalis. A *biocide* is a substance or microorganism that kills or controls growth of living organisms. Biocides include antibiotics, pesticides, and antibacterials. Pesticide classification is often broken further into insecticides, herbicides, fungicides and growth promotants. A *phytopharmaceutical* is a pharmaceutical agent of plant origin. This component of Y4 has some similarities with Y2.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Most wastes in liquid form except for vegetable waste. Pesticide wastes can be due to historical activities where the active ingredients may be mixed or perhaps unknown, due to weathered container labelling.				
Why is it hazardous?	**Primary hazard**	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.			
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.			
	Other hazard(s)	N/A	N/A			
	Main likely chemical contaminants	Over 8,000 pesticide and veterinary products have been registered for use in Australian agriculture, horticulture, livestock, forestry, commercial premises, parks, homes and gardens[1]. Historical pesticides used in Australia were various organochlorine (OC) [2] and organophosphate (OP) pesticides (see Y37), the former banned in the late 1980's but still an issue due to their persistence and				

<table>
<tr><th colspan="2">Waste name:
Wastes from the production, formulation and use of biocides and phytopharmaceuticals</th><th>Basel waste category:Y4</th><th>Basel permit code: A4030</th><th>NEPM code: H100</th></tr>
<tr><td></td><td colspan="2"></td><td colspan="2">bioaccumulative effects.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="4">Biocides mainly produced overseas and formulated in Australia by a small range of companies. Vegetable material sourced locally, such as poppy straw and pods produced in Tasmania and used in opiate alkaloid production.
The wastes from such production/ formulation can come from agricultural chemical manufacturers and formulators, large scale facility managers (that use biocides) such as the military, airports and port operators and event-based agricultural or household collection drives (of waste chemicals) collected by the waste industry.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Manufacturing and formulating wastes are mostly collected by licensed operators and destroyed. Some going to trade waste but under licence agreements with water authorities.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.04</td><td colspan="4"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td colspan="5">TOTAL: 2,740 ACT: 23 NSW: 459</td></tr>
<tr><td colspan="5">NT: 0 Qld: 1,567 SA: 22</td></tr>
<tr><td colspan="5">Tas: 0 Vic: 670 WA: 0</td></tr>
<tr><td rowspan="3">Potential health impacts</td><td>Overview</td><td colspan="4">Determining potential health impact for this waste type is dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present, which can only be done generically, given the large number of possible chemicals that may be present. This assessment is somewhat skewed towards the potential for higher risk chemicals historically used as active ingredients, because some of these wastes can still appear in small quantities via collection programs. It is noted however that pesticide agents used today are more target-species directed in their effect and, as a consequence, less likely to be hazardous to human health.
Human health impacts are potentially high overall for this waste category, with potential to be very toxic (in both acute and chronic measures).</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">Extreme: Impact dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present. May be very toxic in contact with skin, if swallowed or by inhalation. Wastes from currently used chemicals are likely to have lower acute toxicity.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">Extreme: Impact dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present. Danger of serious damage to health by prolonged exposure if</td></tr>
</table>

Waste name: Wastes from the production, formulation and use of biocides and phytopharmaceuticals	Basel waste category:Y4	Basel permit code: A4030	NEPM code: H100
		swallowed, in contact with skin or through inhalation. Wastes from currently used chemicals are likely to have lower chronic toxicity.	
	Carcinogenicity	**Low**: There is no conclusive evidence linking cancer incidence with pesticides currently used in Australia [3]. However, in terms of the past, there are two pesticides that are known human carcinogens (arsenic compounds – see Y24 – and ethylene oxide), two probable carcinogens (ethylene dibromide and captafol) and a number of possible carcinogens (OCs, phenoxy herbicides and polychlorinated camphenes) [3]. Given the vast number of active agents that could fall into this category, overall the carcinogenic hazard is rated as low.	
	Reproductive toxicity	**Low**: Some pesticides (such as endosulfan) are potential endocrine disruptors (substances that alter function of the endocrine system and consequently cause adverse health effects in an intact organism). However, across the balance of all possible active agents that may be captured by the waste type, the potential for this impact is low.	
Workplace health & safety impacts	A number of international studies have found higher incidence and mortality rates from specific cancers among people occupationally exposed to pesticides, including farmers and pesticide applicators [4], pesticide manufacturing workers [5, 6], golf course superintendents [7] and market gardeners or orchardists [8]. There is, however, no increase in the incidence or mortality of these cancers among pest control workers (e.g. exterminators) [9]. It is not clear if pesticides are responsible for these elevated incidence rates, because workers in these sectors are also exposed to a range of other potential carcinogens, such as diesel exhaust, solvents, metals, grain dusts, zoonotic (transmissible from animals to humans) viruses and ultraviolet radiation, all of which could confound the relationship between pesticides and cancer. In addition, a study in Western Australia found that 78% of farm jobs have “no likelihood of pesticide exposure” [10].		
Population scale impacts	People can be exposed to pesticides that seep into the water supply or food chain, persisting for a long time in the environment. The persistent, residual and bioaccumulative nature of such compounds enables them to be measured in the human body, in blood and breast milk. The organochlorine DDT (possible carcinogen) has been extensively studied as a risk factor for breast cancer. It is banned in Australia and other parts of the world, but in the 1940s and 1950s, it was heavily used as an insecticide. Most epidemiological studies [11] do not support a conclusive link between DDT and cancer although there is some evidence that exposure in early life or adolescence could increase the longer-term risk of breast cancer [12] Epidemiological studies have similarly not supported a link between organochlorine pesticides in general and breast cancer [13].		
Potential environment impacts	**Overview**	Determining potential environmental impact for this waste type is dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present, which can only be done generically, given the large number of possible chemicals that may be present. This assessment is somewhat skewed towards the potential for	

Waste name: Wastes from the production, formulation and use of biocides and phytopharmaceuticals	Basel waste category:Y4	Basel permit code: A4030	NEPM code: H100

		higher risk chemicals to be present as active ingredients, tempered by the fact that pesticide agents used today are (generally speaking) less likely to have broad scale environmental impacts, if applied as intended. Use of biocides can pose an environmental threat and damage to non-target organisms. Contaminated soils and badly stored materials can also be of concern. Environmental impacts are potentially extreme overall for this waste category, particularly in the case of pesticide wastes from historical use, with potential to score highly in all four components of environmental impact below.
	Acute ecotoxicity	**Extreme**: Impact dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present. May be very toxic to aquatic organisms. For example endosulfan, an organochlorine still used on cotton crops, is very toxic to fish and can be toxic to birds. There may also be impact on non-target species such as bees and frogs when biocides are used.
	Chronic ecotoxicity	**Extreme**: Impact dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present. May cause long-term adverse effects in the aquatic environment. Soil contamination can be a source of ecotoxicity.
	Persistence	**Extreme**: Impact dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present. Has the potential to be highly persistent in the environment (for example the historically used organochlorine pesticides). Most current biocides are short-lived but exceptions include atrazine and other triazines.
	Bioaccumulation	**Extreme**: Impact dependent on the nature of the chemical hazard posed by the individual biocides or phytopharmaceuticals present. Some active ingredients have the potential to accumulate in biota (for example organochlorine pesticides), but these are no longer used.

Where are the risks of impacts most likely?	Generation	Transport	Storage	Treatment	Recovery	Final disposal
	High	Medium	Medium	Moderate	N/A	Low

Has anything happened before in Australia?	Historical disposal of pesticide containers and wastes throughout rural Australia has left a legacy of sites contaminated with a wide variety of pesticides. Below are three examples of impacts from pesticide use in Australia.[14] Organochlorine pesticides in export beef A number of pesticide residue violations were identified in Australian beef product exported to the USA in May 1987. The pesticides involved were the organochlorines, dieldrin and heptachlor. The problems were caused by animals grazing contaminated pasture, ingesting

Waste name: Wastes from the production, formulation and use of biocides and phytopharmaceuticals	Basel waste category:Y4	Basel permit code: A4030	NEPM code: H100

	contaminated feed or by being held in contaminated yards over a period of time. The persistence of organochlorines in soils and the bioaccumulation of residues in their fat tissues gave rise to eventual exceedances of maximum residue limits (MRL) and caused violations, which threatened Australia's beef export industry worth in excess of two billion dollars annually. Governments and industry responded quickly and significantly. The likely sources of contamination were identified and controlled. The National Residue Survey (NRS) was enhanced, a National Residue Data Base (NRDB) was established and a centralised computer system interactive with abattoirs, laboratories and animal health authorities developed. The cattle farm identity tail tag system already in place, capable of tracing cattle to the farm of origin was refined and trace back systems for sheep and pigs were utilised.[15] <u>Endosulfan (itself an OC pesticide) in cotton-growing</u> Records of fish kills in New South Wales and Queensland, from the 1970s to 1995, showed that fish kills were reported more often in cotton growing areas and during the growing season. Of the 98 total kills, 54% were from pesticides, with endosulfan implicated in almost 80% of these. <u>Brodifacoum, (active ingredient in "Ratsak")</u> First used in Australia in the late 1970s, brodifacoum is a powerful anti-coagulant rodenticide still widely used, although restricted to indoor applications. Brodifacoum is extremely toxic to many mammals and birds. Due to its extreme persistence within both target and non-target animals and the length of time to target death (3-18 days in mice) [16], brodifacoum presents a high secondary poisoning risk. In the USA over 80% of anticoagulant deaths recorded in a ten year period involved this toxin, with non-target species including squirrels, chipmunks, racoons, deer, and opossums.[16] In Australia secondary poisoning is typically limited to domestic animals such as dogs and cats, but there are a number of suspected secondary poisonings to predatory birds. Young and De Lai [17] attributed a major decline in predatory birds in North Queensland since 1992 to brodifacoum, coincident with its introduction to control rodents. Species of owls and harrier declined substantially from the Herbert River region in Queensland, with specimens found dead or dying with symptoms consistent with anticoagulant poisoning.[18]	
What control measures are in place to manage risks posed by this waste?	**Industry and Government – systematic controls**	Companies are licensed by State and Territories to discharge solutions of low concern to trade waste. Hazardous materials are destroyed by licensed contractors who offer a wide range of destruction technologies. Training and certification requirements apply in all states and territories in Australia for users of agricultural chemical products, as well as mandatory licensing and permitting for users of these chemicals in some states. Unwanted unused organochlorine pesticides are collected and destroyed under the ChemCollect programme funded by industry.
	Industry – exposure controls	Exposure to concentrated materials in production, formulation or extraction is avoided through the use of containment, ventilation and personal protective equipment.

Waste name: **Wastes from the production, formulation and use of biocides and phytopharmaceuticals**	**Basel waste category:Y4**	**Basel permit code: A4030**	**NEPM code: H100**
	Government	Workplace exposures and discharges to the environment are controlled under State and territory legislation. The Globally Harmonized System for labelling facilitates decision-making in industries handling particular substances.	
	Community	The safe way to dispose of potentially hazardous household chemicals (that may include pesticides) is through household collection events. For example, in NSW, the Household Chemical CleanOut event is a free service for the safe disposal of a range of household chemicals that could cause harm to human health and the environment if they are not disposed of correctly. CleanOut events are held at locations throughout NSW on specified dates throughout the year.	
References	1. Immig J. WWF-Australia and National Toxics Network (2010). *A list of Australia's most dangerous pesticides*. Accessed April 10, 2015 from: http://awsassets.wwf.org.au/downloads/fs025_a_list_of_australias_most_dangerous_pesticides_1jul10.pdf 2. Organochlorine pesticides typically include: aldrin, hexachlorobenzene, alpha BHC, beta BHC, gamma BHC (lindane), delta BHC, chlordane, DDT, DDD, DDE, dieldrin, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, methoxychlor and endosulfan (includes endosulfan I, endosulfan II and endosulfan sulphate) 3. Cancer Council Australia. *Position statement – pesticide and cancer*. Accessed April 10, 2015 from: http://wiki.cancer.org.au/policy/Position_statement_-_Pesticides_and_cancer#Appendix_1._Overview_of_pesticide_carcinogenicity_classifications 4. Weichenthal S, Moase C, Chan P. *A review of pesticide exposure and cancer incidence in the Agricultural Health Study cohort.* Environ Health Perspect 2010 Aug; 118(8):1117-25. [Abstract available at: http://www.ncbi.nlm.nih.gov/pubmed/20444670] 5. Van Maele-Fabry G, Duhayon S, Lison D. *A systematic review of myeloid leukemias and occupational pesticide exposure.* Cancer Causes Control 2007 Jun;18(5):457-78 [Abstract available at http://www.ncbi.nlm.nih.gov/pubmed/17443416]. 6. Van Maele-Fabry G, Duhayon S, Mertens C, Lison D. *Risk of leukaemia among pesticide manufacturing workers: a review and meta-analysis of cohort studies.* Environ Res 2008 Jan;106(1):121-37 [Abstract available at: http://www.ncbi.nlm.nih.gov/pubmed/18028905]. 7. Kross BC, Burmeister LF, Ogilvie LK, Fuortes LJ, Fu CM. *Proportionate mortality study of golf course superintendents.* Am J Ind Med 1996 May;29(5):501-6 [Abstract available at http://www.ncbi.nlm.nih.gov/pubmed/8732923]. 8. Littorin M, Attewell R, Skerfving S, Horstmann V, Möller T. *Mortality and tumour morbidity among Swedish market gardeners and orchardists.* Int Arch Occup Environ Health 1993;65(3):163-9 [Abstract available at: http://www.ncbi.nlm.nih.gov/pubmed/8282414]. 9. MacFarlane E, Benke G, Del Monaco A, Sim MR. *Cancer incidence and mortality in a historical cohort of Australian pest control workers*. Occup Environ Med 2009 Dec;66(12):818-23 [Abstract available at http://www.ncbi.nlm.nih.gov/pubmed/19553229]. 10. MacFarlane E, Glass D, Fritschi L. *Is farm-related job title an adequate surrogate for pesticide exposure in occupational cancer epidemiology?* Occup Environ Med 2009 Aug;66(8):497-501 [Abstract available at http://www.ncbi.nlm.nih.gov/pubmed/19221114]. 11. Australian Rural Health Research Collaboration, Beard J. *DDT and human health.* Sci Total Environ 2006 Feb 15;355(1-3):78-89 [Abstract available at http://www.ncbi.nlm.nih.gov/pubmed/15894351] 12. Cohn BA, Wolff MS, Cirillo PM, Sholtz RI. *DDT and breast cancer in young women: new*			

Waste name: Wastes from the production, formulation and use of biocides and phytopharmaceuticals	Basel waste category:Y4	Basel permit code: A4030	NEPM code: H100
	data on the significance of age at exposure. Environ Health Perspect 2007 Oct;115(10):1406-14 [Abstract available at: http://www.ncbi.nlm.nih.gov/pubmed/17938728] 13. Calle EE, Frumkin H, Henley SJ, Savitz DA, Thun MJ. *Organochlorines and breast cancer risk.* CA Cancer J Clin 2002 Sep;52(5):301-9 [Abstract available at: http://www.ncbi.nlm.nih.gov/pubmed/12363327] 14. Australian Academy of Technological Sciences and Engineering. *Pesticide use in Australia* (2002), p.138. Accessed April 10, 2015 from: http://www.atse.org.au/Documents/Publications/Reports/Climate%20Change/Pesticide%20Use%20in%20Aust%202002.pdf 15. Corrigan PJ, Seneviratna P (1990). Occurrence of organochlorine residues in Australian meat. *Australian Veterinary Journal*, 1990 Feb; 67(2):56-8. 16. McLeod L and Saunders G, NSW Department of Primary Industries (2013). *Pesticides used in the Management of Vertebrate Pests in Australia: A Review.* Accessed April 10, 2015 from: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/486187/Pesticides-used-in-the-management-of-vertebrate-pests-in-australia-a-review.pdf 17. Young J and De Lai L (1997). Population declines of predatory birds coincident with the introduction of Klerat rodenticide in North Queensland. *Aust Birdwatcher* **17** (3): 161 – 167. 18. MP Biomedicals Australasia Pty Limited (2005). Dieldrin Material Safety Data Sheet. Accessed April 10, 2015 from: http://www.t3db.ca/system/msds/attachments/000/001/425/original/T3D0017.pdf?1413587682 19. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report. 20. G.E. Totten, ed., *Steel Heat Treatment: metallurgy and technologies* (Boca Raton, Florida, 2007), 2nd ed. * Hazard score of >5.0 based on dieldrin, an organochlorine pesticide used up until the 1990s. This waste category is highly variable in hazard, because of the enormous number of active ingredients that may be present. It would be expected that the majority of wastes in this category arise from current-day product applications, which would generally have much lower hazard potential. However there are still selected applications of very hazardous pesticides in the present day, as well as limited occurrences of old stocks or contaminated materials from past pesticide use.		

3.5 Wastes from the manufacture, formulation and use of wood preserving chemicals

Waste name: **Wastes from the manufacture, formulation and use of wood preserving chemicals**		**Basel waste category:Y5**		**Basel permit code: A4040**		**NEPM code: H170**
What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	**Extreme**
						>5.0
	Description of the waste	The timber preservatives copper, chromium and arsenic and arsenic trioxide are used extensively to prevent damage caused by insects (termites, borers, beetles), wood rot and wood fungus. Chromated copper arsenate (CCA)-treated pine is the most common type of treated timber in Australia and its uses include decks, garden furniture, picnic tables, playground equipment, landscaping timbers, retaining walls, fences, gazebos and patios. It is recognisable by its green tinge, which fades with age. Chromium and arsenic are the primary compounds of concern in this category. Hexavalent compounds of chromium are reduced to the trivalent form in the presence of oxidisable organic matter such as timber and in living organisms - hence chromium's role in timber treatment. CCA treated timber has the potential to generate leachate that contains arsenic, chromium and copper pollutants. Hexavalent chromium may arise if treatment solutions are overused, providing opportunity for unreacted hexavalent chromium to be transferred to humans or the environment early in the life of post treatment timber products. Leachate management is of considerable concern when timber treated with CCA is stockpiled in large amounts or when disposed of to landfill. **CCA the chemical preservative, the leachate from CCA treated timber, and products from the combustion of CCA treated timber are classified as hazardous waste throughout Australia, due to the concentration of these heavy metals. However, while CCA treated timber is classified as hazardous waste in the EU, CCA timber itself is not a controlled waste under the NEPM in Australia; hence it may cross interstate borders without tracking.**[1] This category overlaps with Y21, Y22 and Y24, wastes of hexavalent chromium, copper and arsenic compounds respectively.				
	Waste form	Solid and liquid				
	Physical/ chemical description	In CCA formulations, copper acts as a fungicide, arsenic acts against insects and chromium fixes the chemicals in the timber to resist leaching. While Cr (III) is the predominant form of chromium in timber post treatment Cr (VI) is readily released during the fixation period when				

<table>
<tr><th colspan="2">Waste name:
Wastes from the manufacture, formulation and use of wood preserving chemicals</th><th colspan="2">Basel waste category:Y5</th><th colspan="2">Basel permit code: A4040</th><th colspan="2">NEPM code: H170</th></tr>
<tr><td></td><td></td><td colspan="6">freshly treated timber is curing.[2]
Waste CCA chemical preservative is present as liquid and CCA treated timber product wastes are solid. Disposal of CCA wood waste is a concern because burning produces toxic gases of these treatment chemicals, Cr (III) is converted to toxic Cr (VI) during combustion[2] and landfilling leaches these heavy metals.</td></tr>
<tr><td rowspan="4">Why is it hazardous?</td><td>Primary hazard</td><td colspan="2">H11: Toxic (delayed or chronic)</td><td colspan="4">Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.</td></tr>
<tr><td>Secondary hazard</td><td colspan="2">H12: Ecotoxic</td><td colspan="4">Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.</td></tr>
<tr><td>Other hazard(s)</td><td colspan="2">N/A</td><td colspan="4">N/A</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="4">Species of chromium, copper and arsenic.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="6">Wood product manufacturing and other CCA timber preservation processes.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.
Some reuse and recycling of CCA timber itself occurs and significant stockpiling may occur[1].</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td>0.01%</td><td colspan="5">Includes CCA chemical wastes – does not include intact CCA treated timber</td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>570</td><td>ACT:</td><td>0</td><td>NSW:</td><td>9</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>206</td><td>SA:</td><td>304</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>31</td><td>WA:</td><td>20</td></tr>
<tr><td rowspan="2">Potential health impacts</td><td>Overview</td><td colspan="6">Chromium (VI), as the potential worst case constituent of CCA treatment wastes, has been chosen to reference specific health impacts for this waste. The most common hazards of human exposure to Cr (VI) compounds are irritation of the skin, eyes, mouth, throat, lungs and intestines. Acute poisoning, through inhalation, can result in death. Cr (VI) is carcinogenic via inhalation.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Extreme: Very toxic and may be fatal by inhalation. Toxic if swallowed or in contact with skin – contact causes severe skin burns</td></tr>
</table>

Waste name: Wastes from the manufacture, formulation and use of wood preserving chemicals		Basel waste category:Y5	Basel permit code: A4040	NEPM code: H170
		and allergic reactions and severe eye damage.		
	Chronic toxicity	**Low**: May cause damage to organs through prolonged or repeated exposure if inhaled, but the consequences of acute effects will be most severe. On the skin, chromic acid can cause chronic ulcers known as 'chrome holes'.		
	Carcinogenicity	**High**: Classified as "sufficient evidence of carcinogenicity in humans" and inhaled hexavalent chromium is a known human carcinogen. Particularly with respect to lung cancer.		
	Reproductive toxicity	**High**: Suspected of damaging fertility or the unborn child and may cause genetic defects.		
Workplace health & safety impacts	Exposure to CCA impregnation solutions could arise as the result of splashes or as contaminated dust or wood fragments/ shavings. Occupational exposure to hexavalent chromium has been associated with lung cancer and arsenic is also classed as a human carcinogen.			
Population scale impacts	There has been ongoing media and public interest in the use of CCA-treated timber and the possible health risks it may present, particularly when used in settings where children may be exposed. Published results of scientific studies indicate that copper, chromium and arsenic slowly leach from CCA-treated timber products. All three metals pose a risk to human health and the environment. The Commonwealth Government body which registers chemicals for use, the Australian Pesticides and Veterinary Medicines Authority (APVMA), has released a draft report for public comment reviewing the risk CCA-treated timber poses to the community. The review found that at this stage it has insufficient information to be satisfied that continued use of CCA treated timber is safe when used in the manufacture of structures where the general community are likely to come in frequent close contact. As a result the APVMA is proposing that such use no longer be permitted.			
Potential environment impacts	**Overview**	Chromium (VI), as the potential worst case constituent of CCA treatment wastes, has been chosen to reference specific environmental impacts for this waste. It can have a high to moderate, acute toxic effect on plants, birds or land animals, and is very toxic to fish. This can mean death of animals, birds or fish and death or low growth rate in plants. Chromium (VI) does not breakdown or degrade easily and there is a high potential for accumulation of chromium (VI) in fish life. Cr (VI) is highly mobile, soluble and bioavailable in the environment.		
	Acute ecotoxicity	**Extreme**: Very toxic to aquatic organisms.		
	Chronic ecotoxicity	**Extreme**: May cause long-term adverse effects in the aquatic environment.		
	Persistence	**Extreme**: Very persistent in the environment.		

<table>
<tr><th colspan="7">Waste name:
Wastes from the manufacture, formulation and use of wood preserving chemicals
Basel waste category:Y5 | Basel permit code: A4040 | NEPM code: H170</th></tr>
<tr><td></td><td>Bioaccumulation</td><td colspan="5">High: Can accumulate in seafood.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">A wood treatment plant using the Copper Chrome Arsenic process operated in Armidale, NSW from approximately 1968 - 1980. Armidale papers had carried numerous reports of spills and accidents at the site during its operation. The land was rezoned and developed as a housing estate in the late 1980's. Onsite contamination of creosote was discovered during excavation activities for foundations of the first buildings, and follow up soil testing detected levels of arsenic up to 3800 ppm, chromium at 1950 ppm and copper at 1000 ppm, plus very high levels of polycyclic aromatic hydrocarbons.[3]
The developer successfully sued the Council for breaching its duty of care in approving the development of the land and was awarded $1,479,576 in damages and interest.[4] This, and other high profile cases of contaminated land in NSW, triggered new laws such as the Contaminated Land Management Act 1997 (NSW).</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">*The Australian environmental guidelines for copper chrome arsenate timber preservation plants*, was prepared jointly by the Australian and New Zealand Environment and Conservation Council (ANZECC) and The Timber Preservers Association of Australia (TPAA). This was superseded by the Australian/ New Zealand Standard *AS/NZS 2843.2:2000 Timber preservation plant safety code Part 2: Plant operation*, which promotes the safe operation of treatment plants and reduction of environmental and occupational hazards.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Potential industrial sources of hexavalent chromium waste have strict emissions control equipment in place, such as baghouse filters, fume controls and dust extraction equipment, as well as stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of chromium and arsenic.</td></tr>
<tr><td>Government</td><td colspan="5">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.
Timber treatment companies are licensed by state environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like chromium, copper and arsenic.</td></tr>
</table>

Waste name: Wastes from the manufacture, formulation and use of wood preserving chemicals	**Basel waste category:Y5**	**Basel permit code: A4040**	**NEPM code: H170**
	Community	The New Zealand Environmental Risk Management Authority (ERMANZ) and the Australian Pesticides and Veterinary Medicines Authority (APVMA) have suggested some common sense tips to minimise unnecessary exposure to CCA-treated timber: • Treated wood should never be burned in open fires, stoves, fireplaces, or residential boilers. • Always wash hands thoroughly after contact with any treated wood, especially before eating and drinking. • Food should not come into direct contact with any treated wood. • Precautions should be taken to wear protective gear when working with CCA-treated wood.[5]	
References	1. Environment Protection Authority South Australia (July 2008). Report on CCA treated timber in South Australia. Accessed March 15, 2015 from: http://www.epa.sa.gov.au/xstd_files/Waste/Report/cca.pdf 2. Environment Protection Authority South Australia (November 2004). Guideline 572/04: Copper chromated arsenate (CCA) timber waste – storage and management. Accessed March 15, 2015 from: http://www.epa.sa.gov.au/xstd_files/Waste/Guideline/guide_cca.pdf 3. Parliament of New South Wales, Hansard transcript 15 November 1991. Accessed March 15, 2015 from: http://www.parliament.nsw.gov.au/prod/parlment/hansart.nsf/V3Key/LA19911115029 4. McGrath C, Mending holes in the green safety net. *Precedent*, Issue 113, November/ December 2012. .Accessed March 15, 2015 from: http://envlaw.com.au/wp-content/uploads/green_safety_net.pdf 5. Environment Protection Authority New South Wales. Questions and answers on the wood preservation industry. Accessed March 15, 2015 from: http://www.epa.nsw.gov.au/licensing/qaswood.htm#1 6. Beder S (2003). Timber Leachates Prompt Preservative Review. *Engineers Australia* 75(6), June 2003, pp. 32-4. Accessed March 15, 2015 from: https://www.uow.edu.au/~sharonb/cca.html 7. Website, accessed March 15, 2015 from: http://baddevelopers.nfshost.com/Docs/treatedtimber.htm#Treatment 8. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Chromium VI compounds. Accessed March 14, 2015 from: http://www.npi.gov.au/resource/chromium-vi-compounds 9. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.	

3.6 Wastes from the production, formulation and use of organic solvent

<table>
<tr><th colspan="3">Waste name:
Wastes from the production, formulation and use of organic solvent</th><th>Basel waste category:Y6</th><th>Basel permit code: A3140</th><th>NEPM code: G160</th></tr>
<tr><td rowspan="5">What is it?</td><td rowspan="2">Hazard score
(0 – 6)</td><td colspan="4">Low | Moderate | Medium | High | Extreme
3.9 – 4.9</td></tr>
<tr><td colspan="4">Organic solvents are simply liquid organic chemicals that have the ability to dissolve other substances. This usually assists their role in an industrial application, such as cleaning and degreasing.
Solvents have three principal areas of use; as cleaning agents, as a raw material or feedstock in the production and manufacture of other substances, and as a carrying and/or dispersion medium in chemical synthetic processes.
Wastes deriving from solvents and their use may be either:
• relatively clean, derived from cleaning and washing processes
• inclusive of other reaction products and by products – from synthesis/manufacture of other substances
• highly aqueous wastes, from chemical processes, washing and extractions or
• be present as sludges from manufacturing by products, recycling residues and residues from cleaning processes.</td></tr>
<tr><td>Description of the waste</td><td colspan="4"></td></tr>
<tr><td>Waste form</td><td colspan="2">Typically liquid but may include sludges</td><td colspan="2"></td></tr>
<tr><td>Physical/ chemical description</td><td colspan="4">Many organic substances exhibit solvent type properties. Solvents display a very wide range of properties and characteristics. Many are flammable, some highly flammable, many are volatile and evaporate quite rapidly to give off vapours. Such vapours may be toxic or flammable - flammable vapours in confined spaces can be explosive.
Organic solvents include aliphatic hydrocarbons such as naphtha solvents, aromatic hydrocarbons such as benzene and xylenes, alcohols, glycols, epoxides, ketones and aldehydes. This category does not include those solvents and their wastes that contain halogens in their structure, such as fluorine, chlorine and bromine, as these compounds may have different toxicity characteristics. Halogenated organic solvents and their wastes are described by Y41.</td></tr>
<tr><td>Why is it hazardous?</td><td>Primary hazard</td><td>H3: Flammable liquids</td><td colspan="3">The word ‘flammable’ has the same meaning as ‘inflammable’. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc, but not including substances</td></tr>
</table>

<table>
<tr><th colspan="4">Waste name:
Wastes from the production, formulation and use of organic solvent</th><th>Basel waste category:Y6</th><th>Basel permit code: A3140</th><th>NEPM code: G160</th></tr>
<tr><td rowspan="4"></td><td colspan="2"></td><td colspan="4">or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.</td></tr>
<tr><td colspan="2">Secondary hazard</td><td>H11: Toxic (delayed or chronic)</td><td colspan="4">Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.</td></tr>
<tr><td colspan="2">Other hazard(s)</td><td>H12: Ecotoxic</td><td colspan="4">Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.</td></tr>
<tr><td colspan="3">Main likely chemical contaminants</td><td colspan="4">Other solvents, organic chemicals, petroleum residues, heavy metals, greases, dirt.</td></tr>
<tr><td>Where does it come from?</td><td colspan="2">Main sources</td><td colspan="5">Organic and Inorganic chemical manufacturing, fertiliser manufacturing, agrichemical formulation, motor vehicle manufacturing, adhesives manufacturing, metal coating and finishing, printing.</td></tr>
<tr><td>How is it managed?</td><td colspan="2">Main fates</td><td colspan="5">Waste solvents are often subject to reclamation, with any residues sent to energy recovery processes such as incineration or hazardous waste landfill.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td colspan="2" rowspan="2">Volume score
(% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.19%</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>13,730</td><td>ACT:</td><td>0</td><td>NSW:</td><td>761</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>11,195</td><td>SA:</td><td>26</td></tr>
<tr><td>Tas:</td><td>44</td><td>Vic:</td><td>1,705</td><td>WA:</td><td>0</td></tr>
<tr><td rowspan="2">Potential health impacts</td><td colspan="2">Overview</td><td colspan="5">Some organic solvents (such as benzene) have been replaced with other substances due to their carcinogenic properties, which is a primary health concern for these types of wastes Other toxic properties can be varied, and include being narcotic and possibly mutagenic or teratogenic.
The flammability risk also heightens the care in which this waste should be handled.</td></tr>
<tr><td colspan="2">Acute toxicity</td><td colspan="5">Low - medium: Harmful if swallowed – may cause lung damage. Vapours may cause drowsiness and dizziness. Acute effects may</td></tr>
</table>

Waste name: Wastes from the production, formulation and use of organic solvent		**Basel waste category:Y6**	**Basel permit code: A3140**	**NEPM code: G160**
		also range from an alcohol-like intoxication to narcosis (stupor or insensibility) which may lead to unconsciousness. May be irritating to skin.		
	Chronic toxicity	**Low - medium**: Both short and long term exposure to certain organic solvents has been found to be harmful to the kidney. Petroleum distillates, for example, gasoline, jet fuel and turpentine, are among the most toxic.		
	Carcinogenicity	**High**: Some organic solvents may cause cancer and heritable genetic damage. Benzene is the main organic solvent which has definitively been proven to cause cancer in humans from industrial use – the main cancer being leukaemia.		
	Reproductive toxicity	**Low**: Limited evidence of reproductive impacts – possible risk of impaired fertility.		
Workplace health & safety impacts	Inhalation is usually the most significant route of entry by which organic solvents enter the human body at work. Poor hygiene practices could result in skin absorption.			
Population scale impacts	Most non-industrial applications of benzene, a natural constituent of crude oil and one of the most elementary petrochemicals, have been limited by benzene's carcinogenicity. However, significant primary exposure occurs routinely in everyday activities, particularly relating to petrol (gasoline) or other fossil fuel use. These include petrol vapour exposure at fuel outlets, burning coal and oil, motor vehicle exhaust, cigarette smoke, wood burning fires, some adhesives and low concentrations in ambient air from all of these sources. Population exposure studies from any particular exposure pathway have proved difficult to ascribe health effects to a particular source/ activity due to the range of confounding variables. However, epidemiologic studies provide clear evidence of a causal association between exposure to benzene and a number of forms of leukaemia.			
Potential environment impacts	**Overview**	Organic solvents are highly toxic to aquatic environments. The risk of subsequent fire in the environment from a spill of this waste would also have broader environmental impacts.		
	Acute ecotoxicity	**High**: Toxic to aquatic organisms.		
	Chronic ecotoxicity	**Extreme**: May cause long-term adverse impacts in the aquatic environment.		
	Persistence	Low.		
	Bioaccumulation	Low.		

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Medium	Medium	Moderate	High	Low

Has anything	The contaminated site industry in Australia, in terms of identification, testing, classifying

Waste name: Wastes from the production, formulation and use of organic solvent	Basel waste category:Y6	Basel permit code: A3140	NEPM code: G160
happened before in Australia?	and remediating legacy waste impacts to land, was borne out of ground pollution from organic solvents or, more particularly, petroleum fuel leakages from underground storage tanks. Thousands of contaminated sites have been registered by environmental regulators across Australia and are in various stages of identification, quantification, remediation and clean up.		
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Companies that handle organic solvents and their wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants.	
	Industry – exposure controls	Potential industrial sources of organic solvent waste have strict emissions control and chemical handling equipment and systems in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of, and skin contact with, solvents and their wastes.	
	Government	Regulatory levels are set by state and territory government agencies for exposure of workers to a range of volatile organic substances. Similar controls for emissions of volatile organic compounds (VOCs) exist on companies through environmental licensing regimes.	
	Community	Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.	
References	1. UNEP (2002). Basel Convention. Technical Guidelines on Hazardous Waste from the Production and Use of Organic Solvents (Y6). Accessed March 21, 2015 from: http://www.basel.int/Portals/4/Basel%20Convention/docs/meetings/sbc/workdoc/old%20docs/tech-y6.pdf 2. Shell Trading International Ltd (2011). Naphtha (petroleum), solvent-refined light Material Safety Data Sheet. Accessed March 21, 2015 from: http://www.shell.com/content/dam/shell-new/local/corporate/trading-shipping/downloads/msds/in-country/uk-stasco/mogas-naphtha-petroleum-solvent-refined-light-cas-64741-84-0---stil---en.pdf 3. National Occupational Health and Safety Commission (1990). Australian Government. *Industrial Organic Solvents*. Accessed March 21, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/157/IndustrialOrganicSolvents_1990_PDF.pdf 4. US EPA. TEACH Chemical Summary – Benzene. Accessed March 21, 2015 from: http://www.epa.gov/teach/chem_summ/BENZ_summary.pdf		

3.7 Wastes from heat treatment and tempering operations containing cyanides

Waste name: Wastes from heat treatment and tempering operations containing cyanides		Basel waste category:Y7	Basel permit code: A4050	NEPM code: A110

What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
					3.9 – 4.9	
	Description of the waste	Molten inorganic salts used to ‘case harden’ or ‘face harden’ iron or low-carbon steel or to control temperature in the tempering process. There is overlap between this category and Y32 wastes (inorganic cyanides).				
	Waste form	Solid				
	Physical/ chemical description	A mixture of a cyanide (typically potassium cyanide) and a carbonate (typically potassium carbonate or barium carbonate), partly decomposed due to strong heating. Inorganic cyanides CASR 57-12-5.				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.			
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.			
	Other hazard(s)	H4.1: Flammable solids	Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.			
	Main likely chemical contaminants		Inorganic cyanides			
Where does it come from?	Main sources	Objects were case hardened by immersion in the molten mixture at about 700^{o}C. The bath is used repeatedly until depleted of cyanide, the most active ingredient. Process no longer used in Australia, so limited industrial sources of this waste.				
How is it managed?	Main fates	After cooling the solid is either broken up and disposed of as solid hazardous waste or dissolved in water for subsequent treatment to render it non-hazardous.				
How much is generated in Australia?	Volume score (% of national tonnes in 2013)	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%
		0.0002%				

Waste name: Wastes from heat treatment and tempering operations containing cyanides			**Basel waste category:Y7**		**Basel permit code: A4050**		**NEPM code: A110**
	Waste arising in 2013 (tonnes)	**TOTAL:**	**13**	**ACT:**	0	**NSW:**	0
		NT:	0	**Qld:**	13	**SA:**	0
		Tas:	0	**Vic:**	0	**WA:**	0

Potential health impacts	**Overview**	This process is no longer used in Australia so there are no implications for human or environmental health. Cyanides are highly toxic if ingested or inhaled and can be absorbed through the skin. Solid cyanides in contact with acids are converted to gaseous hydrogen cyanide and exposure can occur via this route (Eight hour time weighted exposure limit 11 mg/m^3. Other uses of cyanide may result in its release to waterways where it can pose a hazard to human health and environmental species.
	Acute toxicity	**Extreme**: Very high acute toxicity.
	Chronic toxicity	**Low - medium**: Long term exposure to low levels of cyanide may cause deafness, vision problems and loss of muscle coordination.
	Carcinogenicity	Cyanides are not known to be carcinogenic.
	Reproductive toxicity	Cyanides do not exhibit reproductive toxicity.
Workplace health & safety impacts	This process is no longer used in Australia so there are no implications for human or environmental health. Other processes using cyanides, such as electroplating or gold recovery may cause exposure to cyanides.	
Population scale impacts	This process is no longer used in Australia so there are no implications for human or environmental health but other uses of cyanide may cause such impacts.	
Potential environment impacts	**Overview**	This process is no longer used in Australia so there are no implications for human or environmental health. However, other uses of cyanide may result in its release to waterways.
	Acute ecotoxicity	**Extreme**: Cyanides have high toxicity to animal species.
	Chronic ecotoxicity	**Low**: Cyanides can exhibit chronic effect on aquatic organisms.
	Persistence	**Low**: A number of environmental processes destroy cyanides so they cannot be regarded as persistent.
	Bioaccumulation	Cyanides are not bioaccumulative.

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Medium	Medium	Moderate	N/A	Low
Has anything happened	No incidents reported in recent years.					

Waste name: Wastes from heat treatment and tempering operations containing cyanides	Basel waste category:Y7	Basel permit code: A4050	NEPM code: A110
before in Australia?			
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Past users were well-versed in safe handling of cyanides.	
	Industry – exposure controls	Since the process is no longer used in Australia there are no specific controls. Controls exist for other uses of cyanide such as in electroplating and gold recovery.	
	Government	Workplace regulatory levels are in place.	
	Community	Community exposure to cyanide used in gold recovery can occur where cyanide is present in tailings that are discharged to tailings dams.	
References	1 G.E. Totten, ed., *Steel Heat Treatment: metallurgy and technologies* (Boca Raton, Florida, 2007), 2nd ed. 2. Cyanide – information on handling, storage and first aid (2014): www.commerce.wa.gov.au/publications/cyanide-information-storage-handling-and-first-aid. 3. S.P. Ayodeji, T.E. Aboye and S.O. Olanrewaju, Investigation of Surface Hardness of Steels in Cyanide Salt Bath Heat Treatment Process, *Proceedings of the International MultiConferenceof Engineers and Computer Scientists 2011Vol II, IMECS 2011.*		

3.8 Waste mineral oils unfit for their originally intended use

Waste name: Waste mineral oils unfit for their originally intended use		Basel waste category: Y8	Basel permit code: A3020	NEPM code: J100
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme: 3.1 – 3.8		
	Description of the waste	Waste mineral oils are used lubricating oils come from industrial and domestic vehicle engines and machinery, and can be reclaimed or recovered and recycled for other uses.		
	Waste form	Predominantly liquid but also includes oily rags (solid) and contaminated greases.		
	Physical/ chemical description	Liquid, black and viscous material with, petroleum odour. May present as solids in the form of oily rags or used oil filters.		
Why is it hazardous?	Primary hazard	H3: Flammable liquids	The word 'flammable' has the same meaning as 'inflammable'. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.	
	Secondary hazard	'Spreading' potential to blanket environmental media, such as surface waters, when spilled, causing environmental impacts related to 'oiling' of animals and oxygen depletion of impacted waters.		
	Other hazard(s)	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
		H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Main likely chemical contaminants		Iron, manganese and heavy metals.	
Where does it come from?	Main sources	Mining; manufacturing (various, including food, petroleum & metal coating), transport; retail (vehicle servicing shops) and the waste sector.		

<table>
<tr><th colspan="3">Waste name:
Waste mineral oils unfit for their originally intended use</th><th>Basel waste category:Y8</th><th>Basel permit code: A3020</th><th>NEPM code: J100</th></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Waste oils are usually either reused or recycled (re-refined but may also be composted or sent to some other form of biodegradation. They may also be combusted for energy recovery.</td></tr>
<tr><td rowspan="3">How much is generated in Australia?</td><td>Volume score
(% of national tonnes in 2013)</td><td colspan="4"><table><tr><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr><tr><td></td><td></td><td>3.35%</td><td></td><td></td></tr></table></td></tr>
<tr><td>Waste arising in 2013 (tonnes)</td><td colspan="4"><table><tr><td>TOTAL:</td><td>240,630</td><td>ACT:</td><td>1,510</td><td>NSW:</td><td>29,449</td></tr><tr><td>NT:</td><td>1,392</td><td>Qld:</td><td>72,504</td><td>SA:</td><td>1,267</td></tr><tr><td>Tas:</td><td>Not available</td><td>Vic:</td><td>23,413</td><td>WA:</td><td>111,096</td></tr></table></td></tr>
<tr><td colspan="2">These estimates are taken from jurisdictional tracking data collected as part of Australia's Basel 2013 report. These numbers appear to be an underestimate, in part due to regulatory exemption from tracking in NSW and potential exemption in Victoria, but also due to the fact that Tas, NT and ACT have no tracking system and rely on Controlled Waste NEPM data. No reliable data is available for Tasmania, given its exports of oils are very low and expected to be dwarfed by management options within Tasmania.</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">In addition to being a fire hazard, exposure to waste oils may give rise to acute or chronic health impacts.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">Low – medium: High vapour or mist concentrations may be harmful if inhaled. High concentrations of vapour or mist may irritate the respiratory tract (nose, throat, and lungs). Direct contact may cause irritation to skin or eyes. May be harmful or fatal if swallowed.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">Low – medium: Prolonged or repeated inhalation of oil mist may cause oil pneumonia, lung tissue inflammation, and/or fibrous tissue formation. Prolonged or repeated eye contact may cause inflammation of the membrane lining the eyelids and covering the eyeball. Prolonged or repeated skin contact may cause drying, cracking, redness, itching, and/or swelling.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">High: Contains substances that are known carcinogens. There may be hydrocarbon and chlorinated solvents; metals, and polynuclear aromatic hydrocarbons present which are listed as known, probable, or possible carcinogens.
Risk of cancer depends on duration and level of exposure.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">High: Repeated exposure may impair fertility or cause harm to the unborn child.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">Common exposure risk to workers involved in motor vehicle or other mechanical repairs, machine shops and maintenance of industrial machinery. Inhalation is a significant route of entry into the body at work, most likely to contribute to chronic impacts. Skin contact is a more likely form of entry for acute effects - poor hygiene practices could result in skin absorption.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Waste mineral oils unfit for their originally intended use</th><th>Basel waste category:Y8</th><th>Basel permit code: A3020</th><th>NEPM code: J100</th></tr>
<tr><td rowspan="6">Potential environment impacts</td><td>Overview</td><td colspan="3">Oil spills at sea have occurred throughout history with catastrophic impacts on local ecosystems. The infamous Exxon Valdez oil tanker incident in Alaska in 1989 was shocking in terms of both its scale and its impact. Immediate effects were over 100,000 birds and mammals were killed[1] and 16,000 – 21,000 gallons were estimated to still remain on surrounding beaches as recently as 2014, 25 years later.[2]
Dissolved oxygen starvation is a symptom of high organic loading of waters, such as occurs with oil spills, which effects fish populations both as a physical surface barrier to the atmosphere and from unnaturally active biochemical processes in response to degradation of the organic waste discharge.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="3">High: Oils can cause devastating physical effects such as coating animals and plants with oil and suffocating them by oxygen depletion, foul shorelines, clog water treatment plants and catch fire when ignition sources are present.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="3">High: Can destroy future and existing food supplies, breeding animals and habitats.</td></tr>
<tr><td>Persistence</td><td colspan="3">Medium: Oils will biodegrade in the environment, the rate dependent on the type of oil spilled, but can form products that linger in the environment for many years.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="3">Low: Does not bioaccumulate in fish.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Medium</td><td>Medium</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">Spills of oils can occur on a scale varying from a vehicle or truck sized accident or spill incident, all the way through to oil tanker spills at sea. In either case the environmental damage that can result is due to oil's immiscibility with water, and its consequent tendency to spread across large distances by blanketing the surface of waterways.
While there have been no oil spill environmental disasters of the scale of the Exxon Valdez, Australia has a large oil industry and there have been several large oil spills. Three examples are described here.[3]
Kirki oil tanker spill (WA, 1991)
On 21 July 1991, the Greek tanker Kirki lost its bow off the coast of Western Australia (WA). During the incident and the subsequent tow of the tanker to a safe haven some 17,280 tonnes of light crude was lost. Serious pollution of the West Australian coast was avoided due to the dual combination of severe weather conditions and the effects of the Leeuwin Current in dispersing the 7,900 tonnes of oil lost during the initial stages of the spill off Cervantes and Jurien Bay.
The response to the Kirki spill involved in excess of 100 experts in salvage, pollution clean-up and emergency response. In addition, to supplement existing stockpiles,</td></tr>
</table>

Waste name: Waste mineral oils unfit for their originally intended use	Basel waste category:Y8	Basel permit code: A3020	NEPM code: J100

	significant quantities of equipment from Brisbane, Geelong and Port Adelaide were moved by air and road to Perth, Fremantle, Jurien Bay and Dampier (for the cargo transfer process) at very short notice. This was Australia's largest oil spill at sea, by volume. **Montara Wellhead Platform spill (WA, 2009)** On Friday 21 August 2009, the Montara Wellhead mobile drilling unit located 140 miles offshore from the NW Australian coast, had an uncontrolled release of hydrocarbons from one of the platform wells. Consequently oil escaped to the surface and gaseous hydrocarbons escaped into the atmosphere. It was estimated that 64 tonnes per day (400 barrels) of crude oil were initially being lost, amounting to 4,750 tonnes in total. The leak continued until 3 November 2009 and response operations continued until the well was capped on 3 December 2009 (105 days). A total of 844,000 litres of product was recovered. It is estimated that some 493,000 litres of this oil-water mixture was oil. Conservation group WWF described this as "Australia's worst oil spill." **MV Pacific Adventurer spill (Qld, 2009)** In March 2009, the 2009 southeast Queensland oil spill occurred, when 230 tonnes of fuel oil, 30 tonnes of other fuel and 31 shipping containers containing 620 tonnes of ammonium nitrate spilled from the MV Pacific Adventurer into the Coral Sea, north of Moreton Bay during Cyclone Hamish. Over the following days, the spill washed ashore along 60 km of coastline encompassing the Sunshine Coast, Moreton Bay, Bribie Island and Moreton Island. Queensland Premier Anna Bligh described the spill as "worst environmental disaster Queensland has ever seen". It took over 1,425 people 16 months to clean up the affected areas at a total cost of $4 million.	
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Industries that handle or store significant amounts of waste oils are licensed by environmental regulators to control industrial processes, tanks and equipment to prevent environmental emissions. The waste oil recycling industry has operated within the Product Stewardship for Oil Program (PSO) (see 'Government' below) for over a decade.
	Industry – exposure controls	Potential industrial sources of these wastes have strict emissions control equipment, site engineering and contingency plans in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), relating to inhalation of oil mists and skin contact.
	Government	The Product Stewardship for Oil Program (PSO) was introduced by the Australian Government in 2001 to provide incentives to increase used oil recycling. The Program aims to encourage the

Waste name: Waste mineral oils unfit for their originally intended use	Basel waste category:Y8	Basel permit code: A3020	NEPM code: J100
		environmentally sustainable management and re-refining of used oil and its re-use. The arrangements comprise a levy-benefit system, where an 8.5 cents per litre levy on new oil, helps fund benefit payments to used oil re-refiners and recyclers. These arrangements provide incentives to increase used oil recycling and re-refining in the Australian community. State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements. In terms of marine oil spills, more stringent laws, rules, and guidelines, and increased vigilance by industry and regulators—has reduced accidental spills, at least in developed countries. For instance, studies of tanker spills have prompted regulations for the steady, ongoing replacement of single-hulled tankers in the world fleet with double-hulled tankers.[4]
	Community	Cars, trucks, farm machines and boats all need regular lubricating oil changes. It takes only one litre of oil to contaminate one million litres of water and a single automotive oil change produces 4 to 5 litres of used oil. By pouring your used oil back into an empty oil container and taking it to your local used oil facility for recycling (which can be located by contacting your local council), you are helping to conserve a valuable resource and protect the environment.	
References	1. Graham, S (2003). Environmental Effects of Exxon Valdez Spill Still Being Felt. *Scientific American*. 2. PBS Newshour article, March 24, 2014. *25 years later, scientists still spot traces of oil from Exxon Valdez spill*. Accessed 23 April, 2015 from: http://www.pbs.org/newshour/updates/25-years-later-scientists-remember-exxon-valdez-spill/#the-rundown 3. Australian Government, Australian Maritime Safety Authority. Major historical incidents. Accessed 23 April, 2015 from: https://www.amsa.gov.au/environment/major-historical-incidents/ 4. Farrington, J and McDowell, J. Woods Hole Oceanographic Institution. *Mixing Oil and Water: Tracking the sources and impacts of oil pollution in the marine environment*. Oceanus Magazine, Vol. 43, No.1, November 2004. Accessed 23 April 2015 from: http://www.whoi.edu/oceanus/feature/mixing-oil-and-water 5. 'Used oil' MSDS: Accessed 23 April 2015 from: http://www.planning.nsw.gov.au/asp/pdf/06_0022_response_to_submissions_part_2.pdf		

3.9 Waste oils/water, hydrocarbons/water mixtures, emulsions

Waste name: Waste oils/water, hydrocarbons/water mixtures, emulsions	**Basel waste category:Y9**	**Basel permit code: A4060**	**NEPM code: J120**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
			2.6 – 3.0			
	Description of the waste	This category describes the core waste Y8 (waste oils) in the context of mixtures with water, which may result in high water content with residual levels of oil contamination and mixtures of hydrocarbon materials and water (oily water), or mixtures of same that have formed an emulsion – oil droplets dispersed (but not dissolved) in water (the continuous phase). This category describes oil contents in water up to a maximum of 50% oil and typically substantially below this. Wastes include truck and vehicle washwaters, skimmer and interceptor waters, vehicle coolant waters and potentially shipping bilge water.				
	Waste form	Liquid				
	Physical/ chemical description	Oil has similar properties and risks to the environment as a 'contaminant' in water than it does as a neat material. However, oily waters may not be as obviously tainted, which could result in ingestion risks of oil products (for human health) and dissolved oxygen impacts in the marine environment. Oil and water emulsions cause oil to sink and disappear from the surface, giving the visual illusion that it is gone and the threat to the environment has ended.				
Why is it hazardous?	**Primary hazard**	H13: Capable of yielding another hazard or hazardous material	Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any other hazardous characteristics.			
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.			
	Other hazard(s)	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.			
	Main likely chemical contaminants		Oils, hydrocarbons, heavy metals, other organic pollutants.			
Where does it come from?	**Main sources**	Metal ore and petroleum mining, metal processing and refining, aircraft maintenance, fossil fuel electricity supply, vehicle wash services (retail), vehicle servicing (retail).				

<table>
<tr><th colspan="2">Waste name:
Waste oils/water, hydrocarbons/water mixtures, emulsions</th><th colspan="6">Basel waste category:Y9 | Basel permit code: A4060 | NEPM code: J120</th></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">Chemical/ physical and biological treatment to remove the hydrocarbon content, then the water is reused or recycled for another purpose. Some wastewaters are discharged to sewer under regulatory agreements.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score
(% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td colspan="4">5.79%</td><td colspan="2"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>416,523</td><td>ACT:</td><td>1,554</td><td>NSW:</td><td>97,481</td></tr>
<tr><td>NT:</td><td>489</td><td>Qld:</td><td>195,079</td><td>SA:</td><td>3,903</td></tr>
<tr><td>Tas:</td><td>64</td><td>Vic:</td><td>63,866</td><td>WA:</td><td>54,088</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="6">This overview and component assessment of potential human health impacts from oily waters is based on the risks associated with the oil component of the mixture or emulsion.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Low – medium: May be harmful or fatal if swallowed.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Low – medium: Prolonged or repeated skin contact may cause drying, cracking, redness, itching, and/or swelling.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">Medium: Oil component contains substances that are known carcinogens. There may be hydrocarbon and chlorinated solvents; metals, and polynuclear aromatic hydrocarbons present which are listed as known, probable, or possible carcinogens.
Risk of cancer depends on duration and level of exposure but also route of exposure, since lwater contaminated with low levels of oil is more likely to be swallowed than neat oil, particularly if it is from contamination of a drinking water supply.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">High: Repeated exposure may impair fertility or cause harm to the unborn child.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="7">Common exposure risk to workers involved in motor vehicle or other mechanical repairs, machine shops and maintenance of industrial machinery. Skin contact is a likely form of entry for acute effects - poor hygiene practices could result in skin absorption of contaminants in water.</td></tr>
<tr><td>Potential environment impacts</td><td>Overview</td><td colspan="6">This overview and component assessment of potential environmental impacts from oily waters is based on the risks associated with the oil component of the mixture or emulsion.
Dissolved oxygen starvation is a symptom of high organic loading of waters, such as occurs with spills of oil-laden wastewaters, which effects fish populations due to unnaturally active biochemical processes in response to degradation of the waste discharge, which is high in biochemical oxygen demand (BOD)</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Waste oils/water, hydrocarbons/water mixtures, emulsions</th><th colspan="2">Basel waste category:Y9</th><th>Basel permit code: A4060</th><th>NEPM code: J120</th></tr>
<tr><td rowspan="4"></td><td>Acute ecotoxicity</td><td colspan="4">Low: While oils can cause devastating physical effects such as coating animals and plants with oil, oily waters have more subtle effects more likely to be chronic.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="4">High: Can destroy future and existing food supplies, breeding animals and habitats.</td></tr>
<tr><td>Persistence</td><td colspan="4">Medium: Oils will biodegrade in the environment, the rate dependent on the type of oil spilled, but can form products that linger in the environment for many years.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="4">Low: Does not bioaccumulate in fish.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Medium</td><td>Medium</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">No oily water incidents identified in Australia, but diffuse pollution of waterways with oil/ water mixtures occurs every day, through stormwater run-off that includes millions of oil drips and leaks from vehicles, unburnt fuels in engine exhausts washed out of the atmosphere in rain and leaked fuel-contaminated waters from outboard engines of small boats and pleasure craft.</td></tr>
<tr><td rowspan="2">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="4">Industries that collect significant amounts of oil contaminated waters are licensed by environmental regulators to control industrial processes, tanks and equipment to prevent environmental emissions.
These waters are typically recycled after oil separation through technologies such as flotation separation, filtration, ultrafiltration and reverse osmosis.</td></tr>
<tr><td>Government</td><td colspan="4">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.</td></tr>
<tr><td>References</td><td colspan="5">1. Farrington, J and McDowell, J. Woods Hole Oceanographic Institution. Mixing Oil and Water: Tracking the sources and impacts of oil pollution in the marine environment. Oceanus Magazine, Vol. 43, No.1, November 2004. Accessed 23 April 2015 from: http://www.whoi.edu/oceanus/feature/mixing-oil-and-water
2. 'Used oil' MSDS: Accessed 23 April 2015 from: http://www.planning.nsw.gov.au/asp/pdf/06_0022_response_to_submissions_part_2.pdf
3. Australian Government. Water for the Future. Water Treatment and Reuse. Accessed 24 April 2015 from: http://www.environment.gov.au/system/files/resources/73c2bfb0-2879-4915-b744-90d7169cc192/files/weo-water-treatment-and-reuse.pdf</td></tr>
</table>

3.10 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)

Waste name: **Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)**		**Basel waste category:Y10**	**Basel permit code: A3180**	**NEPM code: M100**
What is it?	**Hazard score (0 – 6)**	Low | Moderate | Medium | **High** | **Extreme** **3.9 – 4.9**		
	Description of the waste	Polychlorinated biphenyls were removed from service in the 1980s and 1990s, but there remained paraffin oil contaminated with commercial polychlorinated biphenyl (PCB) mixtures. Polychlorinated terphenyls (PCTs) and polybrominated biphenyls (PBBs) are not known to have been used in Australia.		
	Waste form	Liquid		
	Physical/ chemical description	High boiling point dilute solution of the chlorinated substances in paraffin oil.		
Why is it hazardous?	**Primary hazard**	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
	Other hazard(s)	H3: Flammable liquids	The word ‘flammable’ has the same meaning as ‘inflammable’. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.	
	Main likely chemical contaminants		Commercial PCB mixture.	
Where does it come from?	**Main sources**	The waste was generated in the electricity industry where PCBs were used as insulating and heat-conducting fluids in transformers		

<table>
<tr><th colspan="3">Waste name:
Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)</th><th>Basel waste category:Y10</th><th>Basel permit code: A3180</th><th>NEPM code: M100</th></tr>
<tr><td></td><td></td><td colspan="4">and other electrical installations. Starting in the late 1980s the equipment was drained and refilled with paraffin oil. Because PCBs were not completely removed, the result was a solution of PCBs in paraffin oil. PCBs were also used in small items such as capacitors and fluorescent-lighting ballasts.
PCBs have been shown to be present in materials such as caulking compounds in Europe but data are lacking for this potential source of waste in Australia.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Under a national PCB Management Plan introduced in 1996 the contaminated oil has been removed and PCBs and other contamination (or more usually the whole mixture) has been destroyed. In 2004 the substance was listed under the Stockholm Convention on persistent organic pollutants (to which Australia is a signatory). Strict requirements placed on use, import, and destruction.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.06%</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Waste arising in 2013 (tonnes)</td><td colspan="5">TOTAL: 4,142 ACT: 25 NSW: 2,028</td></tr>
<tr><td colspan="5">NT: 168 Qld: 1,556 SA: 27
Tas: 22 Vic: 308 WA: 7</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">Toxic by skin contact or inhalation of fumes. PCBs are almost ubiquitous in the Australian environment, being present in low concentrations in fish, animal fats (including butter) and in personal body-burdens although no health effects can be attributed explicitly to their presence in diet.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">Low: PCBs can produce skin pigmentation and affect liver function.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">High: May cause damage to organs through prolonged or repeated exposure.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">Extreme: Listed as a likely carcinogen.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">Low – medium: Possible reproductive toxin.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">Personal protective equipment required.</td></tr>
</table>

<table>
<tr><th colspan="8">Waste name:
Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Basel waste category:Y10
Basel permit code: A3180
NEPM code: M100</th></tr>
<tr><td>Population scale impacts</td><td colspan="7">No impact on broader population. PCBs may have been used as components of caulking compounds with subsequent slow release to the environment. This has been demonstrated in Europe but not in Australia.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="6">Toxic to marine organisms and to other species who are exposed in the food chain.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="6">Extreme: PCBs are acutely toxic to aquatic organisms.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="6">Extreme: PCBs are developmental and reproductive toxins in most animal species.</td></tr>
<tr><td>Persistence</td><td colspan="6">Extreme: PCBs are persistent, with half-lives greater than 10 years.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="6">Extreme: PCBs are bioaccumulative and concentrations undergo biomagnification up the food chain.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="7">Release to the environment before the impact of bans on the use of PCBs and the implementation of the PCB Management Plan have resulted in very low level contamination of the environment and contributions to the chemical body burden of Australians. The substance has a long half-life and so concentrations are decreasing slowly.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="6">Industry has complied with the specifications of the PCB management plan for effective management and destruction of PCB wastes.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="6">Personal protective equipment and waste-handling by licensed companies.</td></tr>
<tr><td>Government</td><td colspan="6">PCBs are listed under the Stockholm Convention on persistent organic pollutants, to which Australia is a signatory. States and territories control the tracking and reporting of PCB waste under auspices of the national PCB Management Plan (1996).</td></tr>
<tr><td>Community</td><td colspan="6">The PCB Management Plan was developed through consultation with representatives of environment groups, industries involved in the production, use and destruction of hazardous wastes, and governments.</td></tr>
<tr><td>References</td><td colspan="7">1. Polychlorinated Biphenyls management Plan, revised 2003: www.nepc.gov.au/system/files/resources/</td></tr>
</table>

Waste name: Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)	Basel waste category:Y10	Basel permit code: A3180	NEPM code: M100
	2. States and territories control the tracking and reporting of PCB waste. For example, Polychlorinated biphenyls (PCB) management (EPA Victoria, 2009): www.epa.vic.gov.au/~/media/Publications/IWRG643%201.pdf.		

3.11 Waste tarry residues arising from refining, distillation and any pyrolytic treatment

Waste name: Waste tarry residues arising from refining, distillation and any pyrolytic treatment	**Basel waste category:Y11**	**Basel permit code: A3190**	**NEPM code: J160**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
					3.9 -4.9	
	Description of the waste	The waste consists of high-boiling material remaining after volatile substances have been removed.				
	Waste form	Viscous liquid or gummy solid.				
	Physical/ chemical description	The main components are high molecular weight hydrocarbons, often polymeric in nature, but oxygenated species may also be present and impurities such as black carbon and heavy metals may be present, together with compounds of sulphur and phosphorus.				
Why is it hazardous?	**Primary hazard**	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants			Polycyclic aromatic hydrocarbons (PAH) and heavy metals.		
Where does it come from?	**Main sources**	Tarry residues are produced in the refining of petroleum, re-refining of lubricating oils, production of metallurgical coke or town gas by pyrolysis of coal.				
How is it managed?	**Main fates**	Much of the material is disposed of by combustion, with subsequent disposal of ash to landfill after appropriate treatment. Some has been used as road-making material. Past use for production of carbon black pigment. Spills and leaks at gasworks have resulted in contaminated sites.				
How much is generated in Australia?	**Volume score (% of national tonnes in 2013)**	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%
		0.38%				
	Waste arising in 2013 (tonnes)	**TOTAL:**	**27,599**	**ACT:**	0	**NSW:** 8,612
		NT:	19	**Qld:**	178	**SA:** 18,628

Waste name: Waste tarry residues arising from refining, distillation and any pyrolytic treatment		Basel waste category:Y11		Basel permit code: A3190		NEPM code: J160	
		Tas:	19	**Vic:**	132	**WA:**	12
Potential health impacts	**Overview**	Public exposure to polycyclic aromatic hydrocarbons generated by combustion processes including automobile exhausts, tobacco smoking and uncontrolled combustion is widespread. Consequently most exposure to PAHs is from fine particulate matter that is more readily inhaled or ingested. That is not the case with tarry matter, which poses risks from direct contact with the material or with soil contaminated with it. In the workplace, naphthalene is taken as the indicator component with an eight hour time weighted exposure limit of 10 ppm with short term exposure not to exceed 15 ppm. The Australian Drinking Water Quality Guideline is $10x10^{-9}$ g/L for the potent carcinogen benzo(a)pyrene. Heavy metals such as zinc, copper, cobalt and others are often present in tarry matter, especially coal tar. The hazards associated with these components of tarry matter are described in other profiles.					
	Acute toxicity	**Low**: Phenols present in the mixture can cause skin irritation.					
	Chronic toxicity	**High**: Various components of the PAH mixture are known or suspected carcinogens with long term irreversible effects.					
	Carcinogenicity	**Extreme**: The PAH mixture includes known carcinogens.					
	Reproductive toxicity	**Low**: There is no evidence of reproductive toxicity.					
Workplace health & safety impacts	Personal protective equipment.						
Population scale impacts	No widespread impacts						
Potential environment impacts	**Overview**	Most exposure to PAHs is from fine particulate matter that is more readily inhaled or ingested. Low risk because the viscosity of the tarry residue material limits its dispersal to and in the environment.					
	Acute ecotoxicity	**Extreme**: The PAH mixture is toxic to marine organisms and birds. Dispersal of tarry matter into the environment, especially into water, would pose the same threat as an oil spill from a production well, storage or transport would be.					
	Chronic ecotoxicity	Insufficient data are available for chronic effects on environmental species.					
	Persistence	**Extreme**: The PAHs are persistent and only slowly degraded in the environment.					
	Bioaccumulation	**Extreme**: PAHs are known to be bioaccumulative.					

Waste name: Waste tarry residues arising from refining, distillation and any pyrolytic treatment	**Basel waste category:Y11**	**Basel permit code: A3190**	**NEPM code: J160**			
Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Moderate	Moderate	Medium	N/A	Low
Has anything happened before in Australia?	Sites in Australia where town gas was produced from coal have been heavily contaminated by tarry matter. During remediation of the sites the tarry matter containing PAHs and heavy metals was removed to secure landfills. A recent example (2012-2014) is remediation of the site of the Toowoomba, Qld, gasworks (www.thiess.com.au/projects/toowoomba-gasworks-remediation-project/detail.					
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	No systematic controls of industrial management of tarry wastes have been identified.				
	Industry – exposure controls	Appropriate PPE is used by workers in the sampling, removal and remediation of sites contaminated with tarry residue waste.				
	Government	State and territory environment agencies require residues destined for secure landfill as hazardous waste to be solidified and to meet specifications for content and leachability of hazardous components.				
	Community	The tarry materials are industrial wastes that the community is not normally exposed to.				
References	1. Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment (2002): www.dec.ny.gov/regulations/2594.html. 2. Information for the Investigation of Former Gasworks Sites (Department of Environment and Conservation, NSW, 2005): www.environment.nsw.gov.au/resources/clm/gasworks05237.pdf. 3. Australian Oil Recyclers Association: http://aora.asn.au/index.php.					

3.12 Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish

Waste name: **Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish**	**Basel waste category:Y12**	**Basel permit code: A4070**	**NEPM code: F100**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
			2.6 – 3.0			
	Description of the waste	Waste from production and formulation of printing inks has been reduced as a consequence of the introduction of water-based inks by the major Australian manufacturer. A parallel innovation is the introduction of vegetable oils and vegetable-based resins as vehicles for printing inks, again avoiding organic vapours (wastes). There is no manufacture of dyes or coloured pigments in Australia but titanium dioxide pigment is produced from titanium minerals by reaction with chlorine, separation of titanium tetrachloride, and generation of titanium oxide from it with recovery of chlorine. When ilmenite, $FeTiO_3$, is treated with chlorine, iron chloride is also formed, leading to production of iron oxide as a waste. Rutile, TiO2, is less often used but some producers convert ilmenite to 'synthetic rutile' with low iron content that allows generation of iron oxide waste at an earlier stage. Paint and other surface coatings are produced in substantial quantities in Australia. Most paint now consists of water-based emulsions of polymeric material. Wastes are generated during the use of inks, paints and surface coatings. A significant quantity of waste paint exists in the hands of homeowners. Along with other domestic material such as pesticides and solvents, this unused unwanted paint is collected from time to time by local government operating in conjunction with industry and state or territory governments. Waste from glues and adhesives may contain polymeric materials and solvents such as toluene.				
	Waste form	Solid and liquid				
	Physical/ chemical description	In refining of titanium minerals for preparation of titanium dioxide pigment, solid iron oxide Fe_2O_3 is produced for disposal. The solid waste generated during use of paints and surface coatings consists of polymeric material such as polyacrylates and methacrylates, together with pigments and small quantities of substances like plasticizers and anti-oxidants.				
Why is it hazardous?	**Primary hazard**	H3: Flammable liquids	The word 'flammable' has the same meaning as 'inflammable'. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or			

Waste name: Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish	**Basel waste category:Y12**	**Basel permit code: A4070**	**NEPM code: F100**

			suspension (for example, paints, varnishes, lacquers, etc, but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.
	Other hazard(s)	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
	Main likely chemical contaminants		Acrylate and methacrylates polymers, solvents such as toluene.
Where does it come from?	**Main sources**	Wastes are generated in production by poor process management and by the need to reprocess batches that do not meet specification. Solid polymer containing pigment is generated by over-spray in coating of metal (notably, in the automobile industry) and the leather industry as well as waste material from paint manufacturing itself metal coating and finishing and the printing industry.	
How is it managed?	**Main fates**	Wastes generated in production of paints and surface coatings are kept to a minimum by quality control (QC) and, where necessary, recycling into the process. This means that little waste is generated so only small quantities are transferred to licensed disposal companies. Solids are used as minor components in raw materials for cement production. Solvents are recovered and after distillation used in cleaning operations. When solvents are unable to be recovered they are transferred to disposal companies for combustion with other solvent wastes. Contaminated material such as cleaning rags and paper are landfilled as hazardous waste. Trials have been conducted on the incorporation of solid waste generated by overspray into cement kiln feedstock but most such waste is still sent to landfill.	
How much is generated in Australia?	**Volume score (% of national tonnes in 2013)**	<1% | 1 – 5% | 5 – 10% | 10 – 20% | ≥ 20%	
		0.61%	

Waste name: Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish	**Basel waste category:Y12**	**Basel permit code: A4070**	**NEPM code: F100**

	Waste arising in 2013 (tonnes)	**TOTAL:**	**44,110**	**ACT:**	206	**NSW:**	12,424
		NT:	86	**Qld:**	11,154	**SA:**	2,236
		Tas:	0	**Vic:**	16,960	**WA:**	1,043

Potential health impacts	**Overview**	The advent of water-based paints and coatings has greatly reduced the hazards that were associated with solvents incorporated into oil-based paints. Similarly, vegetable oils have replaced petroleum products in most printing inks.
	Acute toxicity	**Low**: There is small risk from the presence of unpolymerized monomers such as butyl acrylate in water-based paints. Its presence accounts for the smell of new paint.
	Chronic toxicity	**Low**: Solvents present in oil-based paints, some inks and solvent-based surface coatings can contribute to chronic toxicity.
	Carcinogenicity	**Low - medium**: No carcinogenic effects are known for common constituents of inks, paints and surface coatings, although limited specialty (oil based) coatings may contain solvents with the potential for carcinogenicity.
	Reproductive toxicity	**Low**: No impact on reproduction is expected from common constituents of these industrial products.
Workplace health & safety impacts	Where solvents other than water are involved there is a need for good workplace ventilation, system closed to the maximum extent, and availability of personal protective equipment where waste must be dealt with.	
Population scale impacts	There are no population-wide risks arising from the production formulation and use of these industrial products.	
Potential environment impacts	**Overview**	Constituents of inks, paints and surface coatings etc. are seldom released to the environment, except for organic solvents that contribute to the Volatile Organic Compounds (VOC) pollutant load which is the source of ozone in the lower atmosphere.
	Acute ecotoxicity	**High**: Spills into aquatic environments constitute a form of waste that could have acute toxic effects on biota.
	Chronic ecotoxicity	**High**: Spills could have long term impact on the aquatic environment. Ozone formation from emissions of volatile organic compounds in paint solvents is also a form of chronic environmental impact.
	Persistence	None of the constituents is persistent.
	Bioaccumulation	None of the constituent sis bioaccumulative.

Where are the risks of	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**

Waste name: **Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish**			**Basel waste category:Y12**	**Basel permit code: A4070**		**NEPM code: F100**
impacts most likely?	High	Moderate	Moderate	Medium	N/A	Low
Has anything happened before in Australia?	No major incidents have been reported. Risks to human health and the environment from these industrial products are very low.					
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Solvent- and oil-based materials posed flammability hazards during production, transport and use, but the advent of water-based materials has largely removed this hazard.				
	Industry – exposure controls	Aromatic solvents such as toluene require measures to limit exposure of workers, but the other components of these products do not require more than minimal caution.				
	Government	Regulatory levels are set by government agencies for exposure of workers to a range of volatile organic substances. For example, the eight hour exposure concentration for methyl methacrylates is 100 ppm. Industry and governments are working together to develop a voluntary product stewardship programme to take back unused paint.				
	Community	Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.				
References	1. Titanium Dioxide and Titanium Dioxide Pigment (1997): www.chemlink.com.au/titanium.htm. 2. R.H. Leach et al. eds, The Printing Ink Manual (Springer 1993) available as eBook. 3. Modern printing Ink Manufacture (c.2010): http://letterpressprinting.com.au/page11.htm. 4. Understanding Paint: www.paintquality.com/en/understanding-paint/water-based-vs-solvenbt-based.					

3.13 Wastes from production, formulation and use of resins, latex, plasticizers, glues/ adhesives

Waste name: **Wastes from production, formulation and use of resins, latex, plasticizers, glues/ adhesives**	**Basel waste category:Y13**	**Basel permit code: A3050**	**NEPM code: F110**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
					3.9 -4.9	
	Description of the waste	These products all involve polymers either as solid materials or dissolved in organic solvents or dispersed in the form of latex in water. Waste can consist of monomers used in production of the polymers, waste products from the production site, or waste generated in or after use of the products. Plasticizers may be present in the solid products. A prominent use of resins, mainly epoxies, is in production of fibreglass for use in interior construction, boats, surfboards and other equipment. Post-consumer waste is unlikely to be accepted by the recycling industry.				
	Waste form	Solid and liquid				
	Physical/ chemical description	The classes of polymers involved in such products include polyesters in which cross-linking is achieved by incorporation of polyols and polyacid monomers, or unsaturated monomers that provide cross-linking points in the polymer chain. Small quantities of styrene, maleic anhydride and epoxides such as ethylene and propylene oxide may also be incorporated into copolymers. A second group are the epoxy resins that involve specific monomers. Hotmelt adhesives commonly used for gluing cardboard cartons are manufactured from ethyl-vinyl acetate copolymers. Phenol-formaldehyde and melamine-formaldehyde resins are adhesives for production of wood composites. Low molecular weight polymers such as polymethyl methacrylates and some polyurethanes may also find use as resins. Glues and adhesives may be solvent-based or water-based. In the first category, the active component may be a polymer of intermediate molecular weight, and the carrier is a flammable solvent such as toluene or petroleum spirit. Water-based adhesives normally consist of stabilized emulsions of polyvinyl alcohol (PVOH) in water, the polymer being derived from polyvinyl acetate.				
Why is it hazardous?	**Primary hazard**	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary	H12: Ecotoxic		Substances or wastes which if released		

Waste name: Wastes from production, formulation and use of resins, latex, plasticizers, glues/ adhesives	Basel waste category:Y13	Basel permit code: A3050	NEPM code: F110

	hazard		present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
	Other hazard(s)	N/A	N/A
	Main likely chemical contaminants		The polymers are the main components of waste derived from manufacture and use of these products and they are non-hazardous. In some cases chemical additives may be present, such as flame retardants (PBDEs) or plasticizers (e.g. phthalate esters).
Where does it come from?	**Main sources**	Some waste is generated at the site of production but since this is an economic loss the quantity is minimized by the normal industrial practices of Quality Control. Manufacturers of resins, latex, plasticizers, glues and adhesives are the main producers of this waste, along with major users of these products such as plastic product manufacturers, motor vehicle, boat and caravan manufacturers, other fibreglass product manufacturers and the construction industry to a small extent.	
How is it managed?	**Main fates**	Chemical/ physical treatment to immobilise the hazard (if required), then the stabilised material is usually disposed of in hazardous waste landfill. Some waste may undergo energy recovery through blending into waste-derived fuels.	
How much is generated in Australia?	**Volume score (% of national tonnes in 2013)**	<1% / 1 – 5% / 5 – 10% / 10 – 20% / ≥ 20% 0.07%	

Waste arising in 2013 (tonnes)	**TOTAL:**	**4,792**	**ACT:**	7	**NSW:**	2,170
	NT:	2	**Qld:**	881	**SA:**	442
	Tas:	0	**Vic:**	447	**WA:**	843

Potential health impacts	**Overview**	The polymeric materials have very low toxicity mainly on account of their low solubility. Some monomers pose workplace hazards – methyl methacrylates, various isocyanates (components of polyurethanes) and styrene. Fat-soluble additives present in commercial products may be of more concern, including plasticizers such as phosphate esters or phthalates, and flame retardants such as polybrominated compounds (see Y45). Some of the latter are banned under multi-national environment agreements such as the Stockholm Convention on persistent organic pollutants but others remain on, or are just now

Waste name: Wastes from production, formulation and use of resins, latex, plasticizers, glues/ adhesives	Basel waste category:Y13	Basel permit code: A3050	NEPM code: F110

		entering, the market.
	Acute toxicity	**Medium - high**: Polymers and additives do not exhibit acute toxicity but monomers such as methyl methacrylate, isocyanates and styrene do. Similarly, formaldehyde used in, or released from, phenol-formaldehyde resins is acutely toxic.
	Chronic toxicity	**Medium – high**: Developmental effects may eventuate from exposure to flame retardants.
	Carcinogenicity	**Low**: Polymers, monomers and additives are not carcinogenic.
	Reproductive toxicity	**Low**: Some additives such as the brominated flame retardants and certain phthalate esters can affect reproduction but these effects have not been demonstrated in humans.
Workplace health & safety impacts	The main substances of concern for industrial health and safety are styrene, methyl methacrylates and isocyanates (see Y+3 *Other Organic Chemicals*).	
Population scale impacts	Broader impacts of additives may come about by release of these substances and plastics containing them to the environment and subsequent uptake by food species.	
Potential environment impacts	**Overview**	Long-range transport to colder regions of the planet and bioaccumulation of flame retardants has been observed.
	Acute ecotoxicity	Polymers and additives do not exhibit acute toxicity.
	Chronic ecotoxicity	**Medium**: Pathways have been shown to exist whereby additives can be carried by and sequestered by plastic litter and then released into the food chain.
	Persistence	**Medium - high**: Many of the additives and other sequestered fat-soluble chemicals are persistent.
	Bioaccumulation	**Medium – high:** Many of the additives and other sequestered fat-soluble chemicals are bioaccumulative.

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Moderate	Moderate	Medium	N/A	Low

Has anything happened before in Australia?	No specific incidents are known. See Y+3 *Other organic chemicals* for a spill of ethyl acrylate, a related compound.	
What control measures are in place to manage risks	**Industry – systematic controls**	The amenity and toxicity hazards of reactive monomeric substances are recognized in industry and subject to workplace controls. Where flammable solvents are involved in production of glues and adhesives appropriate precautions need to be taken.

Waste name: Wastes from production, formulation and use of resins, latex, plasticizers, glues/ adhesives	Basel waste category:Y13	Basel permit code: A3050	NEPM code: F110
posed by this waste?	**Industry – exposure controls**	Exposure controls are common in larger industrial organizations, but not present in many small-to-medium enterprises (SME) nor implemented by home-operators and single traders. Exposure to glass fibres when fibre-glass products are cut or abraded is more of a hazard than exposure to the resins themselves.	
	Government	Regulatory levels are set by government agencies for exposure of workers to a range of volatile organic substances. For example, the eight hour exposure concentration for methyl methacrylates is 100 ppm.	
	Community	Community members may be exposed to waste monomers when undertaking construction or maintenance work with commercially-available two-component mixtures that form polyesters, polyurethanes or epoxies. Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.	
References	1. Methyl acrylate – product safety assessment (Dow Chemical, 2010): https.msdssearch.dow.com 2. Safe Working with Fibreglass (CSBP, Allen Borham, 2009: http://csbp.com.au/Media/Contractor-resources/Saftey/GM-11-031-47.aspx 3. Results from Australia were reported by E.M. Chua et al., 'Assimilation of Polybrominated Diphenyl Ethers from Microplastics by the Marine Amphipod, *Allorchestes compressa*', *Environmental Science and Technology*, 48 (2014), S127-S134.		

3.14 Wastes of an explosive nature not subject to other legislation

Waste name: **Wastes of an explosive nature not subject to other legislation**	**Basel waste category:Y15**	**Basel permit code: A4080**	**NEPM code: T200, D340, D350, E100**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	**Extreme**
						>5.0
	Description of the waste	In addition to NEPM code T200, which is a direct translation to this y-code, this is a catch-all category that captures a number of wastes classified in Australia under the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure, but not reflected in any Basel Y codes. The other NEPM wastes are: • D340 Perchlorates • D350 Chlorates • E100 Waste containing peroxides other than hydrogen peroxide. The common property of this waste category is the potential to cause fire or explosion on account of the presence of strong oxidising chemicals. Strong regulation in Australia is applied to most explosive substances: nitroglycerine for military purposes, cordite for military and recreational ammunition, pentanitro-erythritol (PETN) for fuse manufacture, primary explosives such as lead azide, lead styphnate and mercury fulminate for detonators, and ammonium nitrate for mining and quarrying. Black powder, the traditional mixture of saltpetre, sulphur and charcoal is little used these days. Explosive substances also subject to regulation include chlorate and perchlorate salts and some peroxides such as methyl ethyl ketone peroxide used as a polymerization initiator.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Most of the substances derive their explosive power from the presence of chlorine, nitrogen or oxygen in high oxidation states. Nitro groups are present in organic nitrate esters such as nitroglycerine (glyceryl trinitrate), and in nitro-aromatics such as trinitrotoluene (TNT). The nitrate ion is the oxidant in ammonium nitrate. Primary explosives rely on high-energy structures of nitrogen or oxygen.				
Why is it hazardous?	**Primary hazard**	H1: Explosive	An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.			

<table>
<tr><th colspan="2">Waste name:
Wastes of an explosive nature not subject to other legislation</th><th>Basel waste category:Y15</th><th>Basel permit code: A4080</th><th>NEPM code: T200, D340, D350, E100</th></tr>
<tr><td rowspan="3"></td><td>Secondary hazard</td><td>H5.1: Oxidizing</td><td colspan="2">Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or contribute to, the combustion of other materials.</td></tr>
<tr><td>Other hazard(s)</td><td>H11: Toxic (delayed or chronic)</td><td colspan="2">Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="2">Nitro compounds, chlorates and perchlorates.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="3">The production and use of all explosive materials are subject to regulation in Australia. Sources are primarily chemical manufacturing, metal product manufacturing, water supply drainage & sewerage and oil and gas extraction. Also, soap and detergent manufacture and ‘crisp’ manufacturing (as in potato crisps and related snack foods) are sources which arises in small amounts annually.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="3">Wastes are mostly contained within the industries themselves and destroyed under controlled conditions.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td colspan="3"><table><tr><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr><tr><td>0.03%</td><td colspan="4"></td></tr></table></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td colspan="3"><table><tr><td>TOTAL:</td><td>2,441</td><td>ACT:</td><td>0</td><td>NSW:</td><td>10</td></tr><tr><td>NT:</td><td>0</td><td>Qld:</td><td>2,329</td><td>SA:</td><td>3</td></tr><tr><td>Tas:</td><td>0</td><td>Vic:</td><td>81</td><td>WA:</td><td>18</td></tr></table></td></tr>
<tr><td rowspan="3">Potential health impacts</td><td>Overview</td><td colspan="3">Since it used in the paper industry, sodium chlorate is taken as an example (see MSDS – reference 3, below).</td></tr>
<tr><td>Acute toxicity</td><td colspan="3">Extreme: Sodium chlorate is an irritant to the skin and to mucous membranes (eyes, throat and nose) if dust is inhaled. Humans appear to be more susceptible than animals to acute effects of ingestion of sodium chlorate with doses of 100 grams or more invariably fatal.
If ingested, sodium chlorate affects the oxygen-carrying capacity of the blood and can cause dizziness and damage to internal organs.
The risk of explosion presents an immediate and significant health risk.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="3">Low: Chronic effects may result from repeated exposure to these wastes. For example perchlorates can potentially inhibit iodide</td></tr>
</table>

Waste name: Wastes of an explosive nature not subject to other legislation	Basel waste category:Y15	Basel permit code: A4080	NEPM code: T200, D340, D350, E100

		uptake by the thyroid and result in a decrease in thyroid hormone.
	Carcinogenicity	Sodium chlorate is not carcinogenic.
	Reproductive toxicity	**Low**: The effects of sodium chlorate on blood can result in reproductive effects.
Workplace health & safety impacts	Protection against dust is essential, particularly because of this category's explosivity, although these chemicals are usually handled in solution.	
Population scale impacts	There are no population-scale impacts because exposure to sodium chlorate is confined to industrial settings.	
Potential environment impacts	**Overview**	Very little information is available on the environmental impacts of sodium chlorate.
	Acute ecotoxicity	**Medium**: Sodium chlorate exhibits low acute toxicity to animals by ingestion of dust exposure. The former use of sodium chlorate as a weedicide shows that it can be toxic to plant life, especially grasses.
	Chronic ecotoxicity	No information is available about chronic toxicity of sodium chlorate.
	Persistence	Sodium chlorate is not persistent in the environment since it is readily reduced to chloride.
	Bioaccumulation	Sodium chlorate is not bioaccumulative.

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Moderate	Moderate	Medium	N/A	Low

Has anything happened before in Australia?	No incidents involving sodium chlorate are known in Australia. However, the Bali bombing in 2002 involved potassium chlorate, probably diverted illegally from safety match production (an industry not replicated in Australia).	
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Manufacturers of explosives for commercial, sporting or military purposes are tightly regulated in Australia. Some substances used by firework manufacturers are also controlled under security regulations. Some of these chemicals have other – examples are sodium chlorate that is used to generate chlorine dioxide for paper pulp bleaching, and ammonium nitrate used as nitrogenous fertilizer – and so regulations extend to those industries, too.
	Industry – exposure controls	Most of the substances are not toxic and most industry controls are directed at avoidance of explosive risks and illegal diversion (theft).

Waste name: Wastes of an explosive nature not subject to other legislation		Basel waste category:Y15	Basel permit code: A4080	NEPM code: T200, D340, D350, E100
	Government	Under Australia's National Code of Practice for Chemicals of Security Concern there are 11 chemicals considered high risk. The list includes sodium and potassium chlorates, perchlorates, and nitrates and sodium azide, Most of the chemical substances in the list of 96 chemicals of security concern are those that could be involved in chemical weapons and do not possess explosive potential. Ammonium nitrate is separately regulated by state and territory governments.		
	Community	Community members are not involved in management of these industrial chemicals.		
References	1. www.nationalsecurity.gov.au/ChemicalSecurity/Pages/default.aspx. 2. Explosives and fireworks – example of state regulations and guidance: www.dmp.wa.gov.au/6684.aspx. 3. Sodium chlorate: http://www.hillbrothers.com/msds/pdf/n/sodium-chlorate.pdf			

3.15 Wastes from production, formulation and use of photographic chemicals and processing materials

Waste name: Wastes from production, formulation and use of photographic chemicals and processing materials	**Basel waste category:Y16**	**Basel permit code: A4090**	**NEPM code: T120**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	**High**	**Extreme**
				3.1 – 3.8		
	Description of the waste	Wastes from photographic processes include chemical substances used in developing and fixing the image.				
	Waste form	Liquid				
	Physical/ chemical description	Waste solutions contain variable amounts of phenolic (such as hydroquinone) or other substances used in developing the image after the latent image is created by light-induced changes in the silver salts on the surface of the photographic medium. After fixing, the silver image remains on the photographic medium. Fixer waste contains unused sodium thiosulfate and silver salts,				
Why is it hazardous?	**Primary hazard**	H8: Corrosives		Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Main likely chemical contaminants			Phenols, thiosulfate and silver.		
Where does it come from?	**Main sources**	A number of chemical substances are used in film and print photography. Traditional black-and-white photography employed light-sensitive film and paper that was coated with an emulsion (usually comprising gelatine) of silver halide. Exposure to light began the process of reducing silver ions to silver metal, and this was accelerated and completed with a 'developer' (usually a phenol or heterocyclic equivalent such as a pyrazolidone). The print was then 'fixed' with 'hypo' (sodium thiosulfate) that dissolved unexposed silver halide. Wastes from the fixing process contains silver ions. Film use has declined since the advent of the digital camera and is				

<table>
<tr><th colspan="3">Waste name:
Wastes from production, formulation and use of photographic chemicals and processing materials</th><th>Basel waste category:Y16</th><th>Basel permit code: A4090</th><th>NEPM code: T120</th></tr>
<tr><td></td><td></td><td colspan="4">now confined to medical imaging (X-ray and MRI), dentistry, industrial radiography, and a small market sector of ‘art’ photographers and enthusiasts.
Colour printing from digital files is now provided by machines located in department stores or stationery suppliers. No silver is involved.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Medical and industrial X-ray images are captured on film in automatic processors that use traditional chemical solutions. Wastes are collected for disposal (and recovery of silver where feasible) by licensed companies. Small quantities of waste generated by artists and enthusiasts are normally discarded to sewer like trade waste. Silver, because of its intrinsic value, is recovered from X-ray films by specialist companies and recycled, at an indicative rate of 4kg/ tonne of film.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="5">Volume score (% of national tonnes in 2013)

Waste arising in 2013 (tonnes)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.01%</td><td colspan="4"></td></tr>
<tr><td>TOTAL:</td><td>826</td><td>ACT:</td><td>20</td><td>NSW:</td><td>144</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>159</td><td>SA:</td><td>10</td></tr>
<tr><td>Tas:</td><td>7</td><td>Vic:</td><td>476</td><td>WA:</td><td>9</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">Chemicals in the developer can cause skin irritation. Thiosulfates are toxic by ingestion. Silver ions are oxidants.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">Medium: Irritation to exposed unprotected skin. Harmful if swallowed. Risk of serious eye damage.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">High: Irritation from prolonged exposure. Possible risk of irreversible effects.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">Low: Limited evidence of a carcinogenic effect. But possibility of cancer or mutagen-causing effects from some chemicals used in the fixing process.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">Photographic chemicals do not exhibit reproductive toxicity.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">In the workplace these photographic processes are carried out in closed systems so exposure is minimal and would only occur during charging and cleaning equipment.</td></tr>
<tr><td>Population scale impacts</td><td colspan="5">Mild hazards exist for photographic enthusiasts who do not take steps to protect themselves by, for example, wearing water-resistant gloves while handling solutions and damp papers.</td></tr>
<tr><td>Potential environment</td><td>Overview</td><td colspan="4">Thiosulfates are toxic to a wide range of organisms, and silver ions can cause irritation of tissues. Because silver is valuable it is</td></tr>
</table>

<table>
<tr><th colspan="7">Waste name:
Wastes from production, formulation and use of photographic chemicals and processing materials
Basel waste category:Y16
Basel permit code: A4090
NEPM code: T120</th></tr>
<tr><td rowspan="5">impacts</td><td></td><td colspan="5">recovered from wastes for reuse so little enters the environment.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">High: It is not commonly realised that thiosulfate is about as toxic as cyanide, although it does not give rise to volatiles like hydrogen cyanide and so the toxicity is only evidenced on ingestion.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">High: Only silver poses a chronic hazard, since other photographic chemical substances have short half-lives in the environment.</td></tr>
<tr><td>Persistence</td><td colspan="5">High: Silver ion is persistent.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">None of the photographic chemicals are bioaccumulative.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>Medium</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">No incidents involving photographic chemicals have been reported.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">Closed systems are routinely used. Colour printing, following digital photography, is now done by dry processes in which dyes are transferred from a ribbon to the polymer-coated paper blank. No silver is involved, and no developer or fixer solution.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">A number of companies in Australia collect X-ray films and destroy them using a thermal process that allows recovery of silver.</td></tr>
<tr><td>Government</td><td colspan="5">State and local governments encourage and assist with collection of X-ray films.</td></tr>
<tr><td>Community</td><td colspan="5">Community groups such as Scouts collect X-ray films for disposal.</td></tr>
<tr><td>References</td><td colspan="6">1. Http://recyclingnearyou.com.au/xray/.
2. C. Swedlund and E.Y. Swedlund, Photography, a handbook of history, materials and processes (New York: Holt, Rinehart and Winston, 2nd ed., 1981.
3. Photographic Industry (OECD Emission Scenario Document) 2004. DOI: 10.1787/9789264221222-en.
4. Ilford Photo. MSDSs for various Photographic developer and fixer chemicals used in Australia. Accessed April 2015 from:</td></tr>
</table>

Waste name: Wastes from production, formulation and use of photographic chemicals and processing materials	Basel waste category:Y16	Basel permit code: A4090	NEPM code: T120
	http://www.ilfordphoto.com/healthandsafety/datasheet.asp?n=1		

3.16 Wastes resulting from surface treatment of metals and plastics

Waste name: Wastes resulting from surface treatment of metals and plastics		**Basel waste category:** Y17		**Basel permit code:** Dependant on chemicals used		**NEPM code:** A100
What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
			2.6 – 3.0			
	Description of the waste	The wastes derive from overspray of coating materials together with excess material removed in cleaning of equipment. Surface treatments of metals provide protection against corrosion. After thorough cleaning of the surface (an alkaline or acid wash) a coating of manganese, zinc or iron phosphate is applied. Zinc chromate is commonly used for aluminium surfaces but some coatings contain chromate, fluoride and other anionic species (see MSDS for Alodine 1200S). Plastic items may be coated with protective films applied as powder (followed by thermal fusion) or spray (in the case of polyurethane). Chemical coatings are being replaced by surface modification techniques, especially in the case of non-polar materials such as polyethylene and polypropylene. These use plasma or corona discharge to improve adhesion of inks, adhesives and sealants to the treated surface.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Waste from metal coating can contain metal phosphates or chromates (see Y21 *Hexavalent chromium compounds*). Waste from surface treatment of plastics consists of polymers such as polyurethanes.				
Why is it hazardous?	**Primary hazard**	H8: Corrosives		Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Main likely chemical contaminants			Some metals such as Ni, Cr and Zn.		

Waste name: Wastes resulting from surface treatment of metals and plastics		**Basel waste category:** Y17				**Basel permit code:** Dependant on chemicals used		**NEPM code:** A100	
Where does it come from?	**Main sources**	The main sources of this waste are: marine fishing; in the context of shipyards and slipways; mining: including coal and gold mining; petroleum refining; metal manufacturing and, to a large extent, metal coating and finishing: such as electroplaters and galvanisers.							
How is it managed?	**Main fates**	Non-toxic materials such as the metal phosphates and polyurethanes are disposed to landfill. Chromates would be immobilised and disposed at hazardous waste landfill.							
How much is generated in Australia?	**Volume score (% of national tonnes in 2013)**	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%			
		0.07%							
	Waste arising in 2013 (tonnes)	**TOTAL:**	**5,080**	**ACT:**	0	**NSW:**	110		
		NT:	0	**Qld:**	4,466	**SA:**	87		
		Tas:	0	**Vic:**	0	**WA:**	416		
Potential health impacts	**Overview**	The only coating materials of health concern are the chromates.							
	Acute toxicity	**Extreme**: Acute toxicity of chromates is associated with their oxidizing power. They can cause skin burns and damage to eyes and other sensitive tissues.							
	Chronic toxicity	**Low – medium**: Chronic effects can include allergic responses and chronic obstructive pulmonary disease.							
	Carcinogenicity	**High**: Chromates are carcinogenic, especially by inhalation of chromium-containing dusts.							
	Reproductive toxicity	**High**: Suspected of damaging fertility or the unborn child and may cause genetic defects.							
Workplace health & safety impacts	Personal protective equipment is needed by workers handling chromates.								
Population scale impacts	No population impacts for these industrial chemicals.								
Potential environment impacts	**Overview**	Chromium toxicity from chromates use extends to other animal species in the environment. This can mean death of animals, birds or fish and death or low growth rate in plants. Chromium (VI) does not breakdown or degrade easily and there is a high potential for accumulation of chromium (VI) in fish life. Cr (VI) is highly mobile, soluble and bioavailable in the environment.							
	Acute ecotoxicity	**Extreme**: Very toxic to aquatic organisms.							
	Chronic ecotoxicity	**Extreme**: May cause long-term adverse effects in the aquatic environment.							

<table>
<tr><th colspan="3">Waste name:
Wastes resulting from surface treatment of metals and plastics</th><th>Basel waste category: Y17</th><th>Basel permit code: Dependant on chemicals used</th><th>NEPM code: A100</th></tr>
<tr><td rowspan="2"></td><td colspan="2">Persistence</td><td colspan="3">High: Chromium compounds are persistent in the environment and could contaminate water.</td></tr>
<tr><td colspan="2">Bioaccumulation</td><td colspan="3">Chromium is not bioaccumulated.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">Chromium releases from the chemical industry have been reported (see Y21) but not from the metal surface treatment sector.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td colspan="2">Industry – systematic controls</td><td colspan="3">Higher risk workplaces like chrome plating and associated metal industries, where worker exposure to Cr (VI) compound wastes may be possible, routinely monitor at-risk staff via blood or respiratory testing.
Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like Cr (VI).</td></tr>
<tr><td colspan="2">Industry – exposure controls</td><td colspan="3">Potential industrial sources of hexavalent chromium waste have strict emissions control equipment in place, such as baghouse filters, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of chromium.
The advent of trivalent, as opposed to hexavalent (chromate) surface treatment is limiting exposure to the most hazardous species.</td></tr>
<tr><td colspan="2">Government</td><td colspan="3">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.</td></tr>
<tr><td colspan="2">Community</td><td colspan="3">The community is not exposed to wastes from the use of metal surface treatment substances such as chromates.</td></tr>
<tr><td>References</td><td colspan="5">1. www.henkelna.com/adhesives/complete-product-line-21163.htm.
2. www.telfordinfustries.com.au/system/products/pdf1/0000/0404/Alodine_1200S.pdf.
3. Protective coatings for plastic items www.rhinolinings.com.au/industrial.
4. www.epw.com.au/trivalent.html.
5. SafeWork Australia: Health Monitoring for Exposure to hazardous Chemicals. Guide for persons Conducting a Business or Undertaking</td></tr>
</table>

Waste name: Wastes resulting from surface treatment of metals and plastics		Basel waste category: Y17	Basel permit code: Dependant on chemicals used	NEPM code: A100
	(www.safeworkaustralia.gov.au/.)			

3.17 Residues arising from industrial waste disposal operations

<table>
<tr><th colspan="2">Waste name:
Residues arising from industrial waste disposal operations</th><th>Basel waste category:Y18</th><th>Basel permit code: Dependant on residue characteristics</th><th>NEPM code: N205 (also N150, N160)</th></tr>
<tr><td rowspan="3"></td><td rowspan="2">Hazard score
(0 – 6)</td><td>Low | Moderate | Medium | High | Extreme</td><td></td><td></td></tr>
<tr><td colspan="2">3.9 - 4.9</td><td></td></tr>
<tr><td>Description of the waste</td><td colspan="3">This is a catch-all waste category that captures a number of wastes classified in Australia under the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure, but not reflected in any Basel Y codes. The most significant contribution by volume comes from biosolids, a material not specifically classified by either the Basel Convention or NEPM. This collection of wastes is:
N205 Residues arising from industrial waste treatment/disposal operations
Biosolids
N150 Fly ash, excluding fly ash generated from Australian coal fired power stations
N160 Encapsulated, chemically-fixed, solidified or polymerised wastes
Residues arising from industrial waste treatment/disposal operations
This is a broad category of treatment residues that may contain residual hazardous material from chemical/ physical treatment plants, thermal treatment residues such as bottom ash, landfill leachate and tailings from colliery washeries.
Biosolids
The vast majority of waste in this category by tonnage is biosolids (80%), a product of sewage sludge (the sludge collected from wastewater treatment) once it has undergone further treatment to reduce disease causing pathogens and volatile organic matter, producing a stabilised product.
Biosolids are typically 75-80% water in their ‘wet’ state, compared to sewage sludge which is approximately 97% water.
Suitable quality biosolids can be applied as a fertiliser to improve and maintain productive soils and stimulate plant growth.
Fly ash
Fly ash is a residue generated from combustion that comprises particles so fine they mix and rise with combustion flue gases in chimneys and post-combustion chambers of thermal plant, and are captured by particle filtration equipment such as electrostatic precipitators. Fly ash usually refers to ash produced during</td></tr>
<tr><td>What is it?</td><td colspan="4"></td></tr>
</table>

Waste name: Residues arising from industrial waste disposal operations		Basel waste category:Y18	Basel permit code: Dependant on residue characteristics	NEPM code: N205 (also N150, N160)
		combustion of coal, which makes the NEPM classification of “fly ash, excluding fly ash generated from Australian coal fired power stations” somewhat curious. **Encapsulated, chemically-fixed, solidified or polymerised wastes** Chemical/ physical treatment plants, an industry known as ‘waste treaters’, are oftern used as an intermediate processing step to remove/ reduce or ameliorate the hazard in wastes, to enable lawful final disposal. This category contains those wastes that are outputs from such treatment processes, which may be encapsulated chemically or physically for recycling into other uses or for safe landfill disposal.		
	Waste form	Typically solid and sludge but liquid in some cases.		
	Physical/ chemical description	**Residues arising from industrial waste treatment/disposal operations** This category contains a variety of waste residues in a variety of physical and chemical forms, sometimes as outputs of processes designed to reduce the hazard – either through volume reduction (such as incineration) or hazard amelioration (chemical/ physical treatment). These output residues may be of reduced hazard (compared to inputs) or increased hazard (such as a concentration process). **Biosolids** Biosolids may have their own distinctive odour depending on the type of treatment it has been though. Some biosolids have a stronger odour that may be offensive to some people, while most biosolids have a slightly musty, ammonia odour. Sulphur and ammonia compounds (both plant nutrients) in biosolids are normally the cause of these odours. **Fly ash** Fly ash is characterised by the fineness of its particles, as opposed to ‘bottom ash’ from combustion processes, which falls to the bottom of combustion chambers. Fly ash often contains hazardous materials such as heavy metals at low concentrations derived from their composition in input fuel – either as constituent of fine combustion particles or as gaseous combustion products themselves. The major constituents are crystalline silica and oxides of iron and calcium.		

Waste name: **Residues arising from industrial waste disposal operations**		**Basel waste category:Y18**	**Basel permit code: Dependant on residue characteristics**	**NEPM code: N205 (also N150, N160)**
		Encapsulated, chemically-fixed, solidified or polymerised wastes These wastes are usually solid as the fixing matrix can be materials such as concrete, polymers or purified low hazard chemical compounds/ commodities.		
Why is it hazardous?	**Primary hazard**	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Are biosolids hazardous?	Biosolids is a special case. It is not a controlled waste under the NEPM and consequently is not tracked in all jurisdictions. However, because of the potential for contaminants such as heavy metals and other organic pollutants to be present, above criteria set to protect environmental and human health values, biosolids have been included in Australia's annual hazardous waste reporting to the Basel Convention as a precaution. Biosolids guidelines exist in all jurisdictions that allow appropriate beneficial uses of biosolids matched to their inherent hazard (with respect to chemical contaminants such as heavy metals like cadmium, lead and mercury). While it is highly conservative to classify biosolids as hazardous waste, it is logical that those biosolids with concentrations of these pollutants above the highest classification levels outlined in biosolids guidelines may be deemed to be hazardous waste. A good analogy is that soils, if contaminated to the same extent, would be classified as contaminated soils (another controlled waste) in all jurisdictions in Australia.		
	Main likely chemical contaminants		Many organic pollutants, inorganic pollutants and heavy metals.	
Where does it come from?	**Main sources**	**Residues arising from industrial waste treatment/disposal operations** Chemical/ physical treatment plants, incineration, landfill leachate, wastewater treatment plants, fossil fuel, electricity supply, collieries, Defence, coal seam gas extraction, aluminium smelting, petroleum refining. **Biosolids** Wastewater treatment plants.		

<table>
<tr><th colspan="2">Waste name:
Residues arising from industrial waste disposal operations</th><th>Basel waste category:Y18</th><th>Basel permit code: Dependant on residue characteristics</th><th>NEPM code: N205 (also N150, N160)</th></tr>
<tr><td></td><td></td><td colspan="3">Fly ash
Incineration, meat processing, cement kilns, coal-fired power stations (despite the waste classification name), asphalt plants, iron and steel manufacturing and petroleum refining.
Encapsulated, chemically-fixed, solidified or polymerised wastes
Physical/ chemical treatment plants, petroleum refining, chemical manufacturing.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="3">Residues arising from industrial waste treatment/disposal operations
Other chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill. Also hazardous waste landfill directly.
Biosolids
Biosolids may be productively used depending on their quality, measured against state-based guidelines, for uses such as agricultural land application, landscaping or land rehabilitation. Biosolids contaminated above guideline levels (in contaminants such as heavy metals, for example) may be stockpiled onsite at treatment plants or landfilled.
Fly ash
Fly ash is either stored in onsite storage ponds or landfills, hazardous waste landfilled off-site or managed as a reuse product in concrete, structural fill or road base.
Encapsulated, chemically-fixed, solidified or polymerised wastes
Hazardous waste landfill. Some wastes may be sufficiently ameliorated to allow reuse in applications such as concrete, road base or building products.</td></tr>
<tr><td rowspan="3">How much is generated in Australia?</td><td>Volume score (% of national tonnes in 2013)</td><td colspan="3"><table><tr><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr><tr><td></td><td></td><td></td><td></td><td>25.46%</td></tr></table></td></tr>
<tr><td>Waste arising in 2013 (tonnes)</td><td colspan="3"><table><tr><td>TOTAL:</td><td>1,830,611</td><td>ACT:</td><td>51,768</td><td>NSW:</td><td>429,902</td></tr><tr><td>NT:</td><td>5,101</td><td>Qld:</td><td>528,700</td><td>SA:</td><td>188,844</td></tr><tr><td>Tas:</td><td>30,334</td><td>Vic:</td><td>451,357</td><td>WA:</td><td>144,604</td></tr></table></td></tr>
<tr><td>Individual waste arisings</td><td colspan="3">The numbers above refer to all four waste types. A brief national level breakdown for each is provided below.
Residues arising from industrial waste treatment/disposal operations (N205)</td></tr>
</table>

Waste name: Residues arising from industrial waste disposal operations		Basel waste category:Y18	Basel permit code: Dependant on residue characteristics	NEPM code: N205 (also N150, N160)
		293,411 tonnes = 20% of this category and 4.1% of national tonnes overall in 2013 **Biosolids*** 1,468,883 tonnes (on a 'wet' basis) = 80% of this category and 20.4% of national tonnes overall in 2013 **Fly ash (N150)**** 5,001 tonnes = 0.3% of this category and 0.07% of national tonnes overall in 2013 **Encapsulated, chemically-fixed, solidified or polymerised wastes (N160)** 62,901 tonnes = 3% of this category and 0.9% of national tonnes overall in 2013 oooooo * Tonnages of biosolids that may be deemed 'contaminated biosolids' have been estimated to be 266,653 'wet' tonnes, or 18% of total biosolids produced in 2013[1]. ** Actual quantities of fly ash generated from coal-fired electricity generation in Australia, which are largely managed onsite and therefore not deemed a hazardous waste for the purpose of tracking, are likely to dwarf this tonnage by approximately three orders of magnitude[2].		
Potential health impacts	**Overview**	The least toxic wastes in this category with respect to human health impacts are likely to be biosolids, which contributes 80% of the category's volume. Encapsulated wastes, by definition, should have their hazards contained, rendering them very low impact to human health. Industrial waste treatment/disposal residues and fly ash have the potential for higher human health impact, on account of the chemical contaminants that may be present and, in the case of fly ash, the inhalation risk of fine particles that may contain these contaminants. While the likely levels of heavy metal contaminants in fly ash are low, the concentrating effect of fly ash collection means that they may be present at levels 10 times greater than in the original coal.[2] Another consideration of fly ash is its major constituent – crystalline silica – can cause chronic health problems through prolonged inhalation.		
	Acute toxicity	**Low**.		
	Chronic toxicity	**Medium - high**: Heavy metal contaminants are likely to be present in fly ash at low concentrations, but crystalline silica is a major constituent. If fly ash handling creates dust, inhalation of crystalline silica can cause silicosis.		

<table>
<tr><th colspan="3">Waste name:
Residues arising from industrial waste disposal operations</th><th>Basel waste category:Y18</th><th>Basel permit code: Dependant on residue characteristics</th><th>NEPM code: N205 (also N150, N160)</th></tr>
<tr><td rowspan="2"></td><td>Carcinogenicity</td><td colspan="4">Medium - high: Crystalline silica has been classified as a human lung carcinogen. Some heavy metals such as cadmium, with the potential to be present in fly ash or other industrial residues at low concentrations, may cause cancer through prolonged inhalation.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">Low.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">Residues such as fly ash present an inhalation risk due to the potential for very fine particles to penetrate deep into the lungs. However, workplaces with large scale combustion processes such as boilers or incinerators typically have very stringent controls in place such as enclosed hoppers. Although crystalline silica is a large constituent of fly ash, worker inhalation exposure risk is much greater in industries such as sand blasting, foundries and construction, due to close worker involvement in cutting, grinding or other abrasive activities.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="4">Encapsulated wastes, by definition, should have their hazards contained, rendering them low environmental impact.
Industrial waste treatment/disposal residues, fly ash and biosolids (if known to be contaminated) have the potential for higher environmental impact, on account of the persistent and bioaccumulative nature of heavy metals and (in the case of contaminated biosolids) the potential for low levels of persistent organic pollutants (POPs) to be present.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="4">Low.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="4">Low - medium: Dependent on the concentration of heavy metals or other contaminants in the waste.</td></tr>
<tr><td>Persistence</td><td colspan="4">High: Heavy metals and POPs (potentially at low concentrations in biosolids) are highly persistent in the environment.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="4">Medium: Heavy metals and POPs (potentially at low concentrations in biosolids) can bioaccumulate to varying degrees in the environment.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Medium</td><td>Medium</td><td>Medium</td><td>Moderate</td><td>N/A</td><td>Moderate</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">Unable to identify specific incidents that would reflect this broad waste category.</td></tr>
</table>

Waste name: Residues arising from industrial waste disposal operations		Basel waste category:Y18	Basel permit code: Dependant on residue characteristics	NEPM code: N205 (also N150, N160)
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Higher risk workplaces with large scale combustion processes and waste treatment plants, where worker exposure to some of these residual wastes may be possible, are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants.		
	Industry – exposure controls	Potential industrial sources of these wastes have strict emissions control equipment in place, such as baghouse filters, dust extraction systems, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of such wastes.		
	Government	Regulators, such as State departments of Health and Environment strictly control the application, production and quality of biosolids		
References	1. Blue Environment, Ascend Waste and Environment and Randell Environmental Consulting (2015). Hazardous waste infrastructure needs and capacity assessment, draft report (not yet published) for the Australian Government Department of the Environment. 2. KMH Environmental (2014), report prepared for the Australian Government Department of the Environment. Hazardous Waste Data Summary (2010/11) Final Report. Accessed 24 April 2015 from: http://www.environment.gov.au/protection/national-waste-policy/publications/hazardous-waste-data-assessment 3. US Geological Survey (1997). Fact Sheet FS-163-97: Radioactive Elements in Coal and Fly Ash: Abundance, Forms, and Environmental Significance. Accessed 27 April, 2015 from: http://pubs.usgs.gov/fs/1997/fs163-97/FS-163-97.pdf 4. US Department of Labor, Occupational Safety and Health Administration (2002). OSHA Fact Sheet: Crystalline Silica Exposure Health Hazard Information. Accessed 27 April 2015 from: https://www.osha.gov/OshDoc/data_General_Facts/crystalline-factsheet.pdf 5. Sunstate Cement Ltd. MSDS for Fly Ash. Accessed 27 April 2015 from: http://www.sunstatecement.com.au/downloads/flyash_msds.pdf 6. Australia and New Zealand Biosolids Partnership (ANZBP) website. Questions & Answers (FAQ) about biosolids in Australia and New Zealand. Accessed 27 April 2015 from: http://www.biosolids.com.au/q-a-aust-nz.php			

3.18 Metal carbonyls

Waste name: Metal carbonyls		Basel waste category:Y19		Basel permit code: A1040		NEPM code: D100
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
					3.9 - 4.9	
	Description of the waste	Metal carbonyls are regarded as extremely hazardous due to both their toxicity and their flammability. Nickel carbonyl is the most common metal carbonyl, which has been used as a catalyst or coating agent in the mining/ mine processing and manufacturing industries and is extremely toxic to humans.				
	Waste form	Liquid (and occasionally solid)				
	Physical/ chemical description	Most metal carbonyls as neat chemicals are colourless or pale yellow volatile liquids, although they may occasionally exist as solids. They may have a pungent odour and are highly water soluble, which contributes to their mobility and toxicity. Metal carbonyls include nickel carbonyl, cobalt carbonyl and iron pentacarbonyl.				
Why is it hazardous?	Primary hazard	H6.1: Poisonous (acute)		Substances or wastes liable to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.		
		H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H3: Flammable liquids		Liquids which give off a flammable vapour at temperatures of not more than 60.5^{0}C, closed cup test, or not more than 65.5^{0}C, open\-cup test.		
	Other hazard(s)	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Main likely chemical contaminants			Nickel, cobalt, manganese		
Where does it come from?	Main sources	Electricity supply, gas extraction, mining, mine processing, petroleum refining and inorganic chemical manufacturing.				
How is it managed?	Main fates	Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill. Metal carbonyls are also put through specialist recycling/reclamation processes.				
How much is	Volume score	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%

Waste name: Metal carbonyls		Basel waste category:Y19		Basel permit code: A1040		NEPM code: D100	
generated in Australia?	(% of national tonnes in 2013)	0.01%					
	Waste arising in 2013 (tonnes)	TOTAL:	373	ACT:	0	NSW:	0
		NT:	67	Qld:	243	SA:	48
		Tas:	0	Vic:	13	WA:	2

Potential health impacts	Overview	Metal carbonyls are very toxic to humans by inhalation The Merck Index (the authoritative encyclopaedia of chemical compounds and substances) describes one of the chemicals in this category, nickel carbonyl, as "one of the most toxic chemicals encountered in industrial processes." Long term effects such as carcinogenicity and reproductive impacts are possible. Metal carbonyls are also extremely flammable, and will rapidly vaporise (at room temperature) if spilled, which also acts to increase the inhalation hazard.
	Acute toxicity	**Extreme**: Very toxic by inhalation. Primary routes of exposure are via inhalation and skin absorption. Inhalation may be fatal. Metal carbonyls affect tissue directly and they also break down to toxic carbon monoxide and products of the metal, which have additional toxic effects.
	Chronic toxicity	**Low**.
	Carcinogenicity	**Medium**: Material is a probable carcinogen in humans. May cause lung and nasal sinus cancer. Shown to cause lung cancer in animals.
	Reproductive toxicity	**High**: May cause harm to the unborn child.
Workplace health & safety impacts	Low use chemical/ waste generated in Australia. No specific workplace impacts known.	
Population scale impacts	Low use chemical/ waste generated in Australia. No specific population scale impacts known.	
Potential environment impacts	Overview	Metal carbonyls such as nickel carbonyl are both acutely and chronically toxic to organisms in an aquatic environment.
	Acute ecotoxicity	**Extreme**: Very toxic to aquatic organisms.
	Chronic ecotoxicity	**Extreme**: May cause long-term adverse effects in the aquatic environment.
	Persistence	**Low**.
	Bioaccumulation	**Medium**.

Where are the risks of impacts most likely?	Generation	Transport	Storage	Treatment	Recovery	Final disposal
	High	Medium	Medium	Medium	Medium	Low

Waste name: Metal carbonyls		Basel waste category:Y19	Basel permit code: A1040	NEPM code: D100
Has anything happened before in Australia?	No evidence found of an Australian incident.			
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Companies that handle metal carbonyls and their wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants.		
	Industry – exposure controls	Potential industrial sources of metal carbonyl waste have strict emissions control and chemical handling equipment and systems in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of, and skin contact with, pollutants.		
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements. Metal carbonyls are part of this hazardous waste control regime.		
	Community	The National Pollutant Inventory, a legislated community right to know reporting program (http://www.npi.gov.au), includes nickel carbonyl as one of the chemical pollutants it tracks for emissions to air, water and land, and transfers of waste, in Australia. No nickel carbonyl emissions were reported in Australia in its most recent year, 2013/14		
References	1. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – nickel carbonyl. Accessed March 14, 2015 from: http://www.npi.gov.au/resource/nickel-carbonyl 2. Strem Chemicals Inc. MSDS for nickel carbonyl. Accessed March 14, 2015 from: http://www.strem.com/catalog/msds/28-1150 3. Ni carbonyl risk phrases. Accessed March 14, 2015 from: http://www.inchem.org/documents/ukpids/ukpids/ukpid68.htm 4. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.			

3.19 Beryllium; beryllium compounds

Waste name: Beryllium; beryllium compounds		Basel waste category:Y20		Basel permit code: A1010, A1020		NEPM code: D160
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
					3.9 - 4.9	
	Description of the waste	Waste from machining of alloys of beryllium with copper or aluminium. E-waste. Emissions to air from coal-burning. Because beryllium alloys are used in electrical and electronic equipment, beryllium may be present as a minor component of E-waste.				
	Waste form	Solid				
	Physical/ chemical description	Beryllium-containing wastes may be mixed with other components in solid E-waste. The species emitted to air by coal-fired power stations is beryllium oxide, BeO (CASR# 1304-56-9) that is very high-melting and almost insoluble in water.				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H4.1: Flammable solids		Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants			Beryllium metal.		
Where does it come from?	Main sources	Beryllium is used as a moderator and reflector of neutrons in nuclear reactors such as that operated by ANSTO at Lucas Heights, NSW. Post-service this would become part of a nuclear waste stream. Pure beryllium metal is used to make aircraft disc brakes from which it would be abraded and so enter the environment. Copper alloys containing beryllium are widely used in electrical connectors and relays, springs, precision instruments, aircraft engine parts, tools, cable-housing and moving parts such as wheels. Beryllium-containing alloys have also been used in some sporting goods. Beryllium oxide is used in specialty glasses and ceramics. In Australia these uses are very small and are mainly confined to electronic equipment. The major source of waste beryllium and compounds in Australia is emissions to air from coal-burning. These amount to approximately 4000 kg/year. The solid beryllium oxide would be widely dispersed and remain in the environment. The mineral beryl (beryllium aluminium silicate) occurs widely and can be found at some minesites. Because of its insolubility it is				

<table>
<tr><th colspan="3">Waste name:
Beryllium; beryllium compounds</th><th>Basel waste category:Y20</th><th>Basel permit code: A1010, A1020</th><th>NEPM code: D160</th></tr>
<tr><td></td><td></td><td colspan="4">cannot be regarded as a hazardous material.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Beryllium is a minor component of E-waste but is unlikely to be recovered – the main aim being to recover precious metals - so any beryllium would become part of consolidated mixed wastes going to landfill. There is no active management of emissions to air or of on-site mining waste.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.0001%</td><td colspan="4"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td colspan="5"></td></tr>
<tr><td colspan="5">TOTAL: 5 ACT: 0 NSW: 0
NT: 0 Qld: 1 SA: 0
Tas: 0 Vic: 4 WA: 0</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">The effects of beryllium on human health are not well understood. Breathing beryllium-containing dust can cause inflammation of the lungs and repeated exposure can bring about sensitization of the lungs, leading to permanent damage, and skin sensitization leading to inflammation and ulcers. Beryllium is considered to have cancer-causing potential. Because beryllium is mostly bound in alloys that are incorporated into devices, the risk of exposure is negligible.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">Extreme: Damage to respiratory tract.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">Extreme: Irritation and sensitization of lungs and skin on prolonged exposure.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">High: Possible carcinogen.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">No information available.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">Control of dusts containing beryllium. The eight hour time weighted workplace exposure limit is 0.002 mg/m^3.</td></tr>
<tr><td>Population scale impacts</td><td colspan="5">Beryllium is contained in manufactured equipment and may represent a hazard during assembly or disassembly, but the general population is not at risk from exposure to industrial products. There could be health impacts of exposure to beryllium oxide that is emitted to air and remains in the environment, but no impacts have been reported.</td></tr>
<tr><td rowspan="3">Potential environment impacts</td><td>Overview</td><td colspan="4">Beryllium oxide is released to the environment as fine dust that will be incorporated into soils. The resulting risk to plant and animal species is very low risk.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="4">Low - medium: Beryllium can be harmful to animals, especially aquatic animals, and slow growth of plants.</td></tr>
<tr><td>Chronic</td><td colspan="4">Low – medium: No data are available on long-term effects of</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Beryllium; beryllium compounds</th><th>Basel waste category:Y20</th><th>Basel permit code: A1010, A1020</th><th>NEPM code: D160</th></tr>
<tr><td rowspan="3"></td><td>ecotoxicity</td><td colspan="3">exposure to beryllium in the environment but it is expected that these will be of similar type to the acute toxicity albeit at reduced potency. The Australian water Quality Guideline for Fresh and Marine waters (1992) is 4x10-6 g/L in fresh water which approximates the maximum solubility of beryllium oxide.</td></tr>
<tr><td>Persistence</td><td colspan="3">Extreme: Beryllium in the environment as beryllium oxide is persistent.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="3">Low: There is limited evidence of bioaccumulation of beryllium.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">Health concerns arose in 2005 over waste (dust) from copper-beryllium alloys in material used by the Australian defence forces.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Beryllium and beryllium compounds have few industrial uses and there is no widespread legislative or regulatory control over their use. While emissions from coal-burning power stations are reported to the National Pollutant Inventory, no specific action is taken to control or reduce emissions.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="3">Australian defence industries are alert to the dangers posed by finely divided beryllium alloys and take active steps to educate the workforce and provide suitable personal protective equipment.</td></tr>
<tr><td>Government</td><td colspan="3">Beryllium and beryllium compounds have few industrial uses and there is no widespread legislative or regulatory control over their use.</td></tr>
<tr><td>Community</td><td colspan="3">No community action is required to address the dispersion of beryllium in the environment.</td></tr>
<tr><td>References</td><td colspan="5">1. Toxicological profile for beryllium (2002) www.atsdr.cdc.gov/toxprofiles/tp4.pdf.
2. Beryllium Science and Technology Association. www.beryllium.eu.
3. World health organization beryllium profile. www.who.int/ipcs/publications/cicad/en/cicad32.pdf.
4. Managing health Effects of beryllium Exposure (National Academies Press (US)2008). www.ncbi.nih.gov/books/NBK214769/.
5. M, Brisson et al. (eds), Beryllium: environmental analysis and monitoring (Cambridge: Royal Society of Chemistry, c2009).</td></tr>
</table>

3.20 Hexavalent chromium compounds

Waste name: Hexavalent chromium compounds		Basel waste category:Y21		Basel permit code: A1040		NEPM code: D140
What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
						>5.0
	Description of the waste	Hexavalent chromium (Cr) compounds are those with chromium present in one of its two common oxidation states - +6 or Cr (VI). Cr (VI) is used in chrome plating, timber treatment (see Y5), brick and refractory linings and dyes. The other common oxidation state is trivalent chromium (+3) or Cr (III), used in leather tanning, pigments and catalysts. Chromium metal (oxidation state of 0) is also used in industrial processes, particularly steel manufacturing. Cr (VI) compounds and therefore wastes are highly hazardous, due to the toxicity of the hexavalent state, compared with the trivalent state. They are also powerful oxidising agents, highly irritant and corrosive. While Y21 concerns itself only with Cr (VI), the NEPM code *D140 Chromium compounds (hexavalent and trivalent)* captures Cr (III) as well. This is likely to be as a precautionary measure, since Cr oxidation state may not be clearly known from a waste and environmental criteria are often expressed in terms of total chromium.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Common Cr (VI) compounds include ammonium dichromate, barium chromate, chromium trioxide, chromic acid, lead chromate, sodium dichromate, potassium dichromate, sodium chromate, and zinc chromate. Most Cr (VI) compounds/ wastes are soluble in water (with the exception of barium chromate and lead chromate) and are typically yellow/ orange in colour. Cr (VI) is a powerful oxidising agent under acidic conditions, which in turn reduces itself to Cr (III) in such a chemical reaction. However, Cr (VI) solutions are much less oxidising under alkaline conditions.				
Why is it hazardous?	**Primary hazard**	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	H5.1 Oxidising		Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or		

<table>
<tr><th colspan="2">Waste name:
Hexavalent chromium compounds</th><th colspan="3">Basel waste category:Y21</th><th colspan="2">Basel permit code: A1040</th><th>NEPM code: D140</th></tr>
<tr><td rowspan="2"></td><td></td><td colspan="5">contribute to, the combustion of other materials.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="5">Cr (III)</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="6">Chrome plating, steel manufacturing, casting and foundries, timber treatment, leather tanning (primarily Cr III), chemical manufacturing and aerospace industries.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill. Some Cr liquid wastes are discharged to sewer under regulatory agreements.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td>0.02%</td><td colspan="5"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>1,630</td><td>ACT:</td><td>0</td><td>NSW:</td><td>612</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>195</td><td>SA:</td><td>9</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>725</td><td>WA:</td><td>90</td></tr>
<tr><td rowspan="4">Potential health impacts</td><td>Overview</td><td colspan="6">The most common hazards of human exposure to Cr (VI) compounds are irritation of the skin, eyes, mouth, throat, lungs and intestines. Acute poisoning, through inhalation, can result in death. Cr (VI) is carcinogenic via inhalation.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Extreme: Very toxic and may be fatal by inhalation. Toxic if swallowed or in contact with skin – contact causes severe skin burns and allergic reactions and severe eye damage.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Low: May cause damage to organs through prolonged or repeated exposure if inhaled, but the consequences of acute effects will be most severe.
On the skin, chromic acid can cause chronic ulcers known as ‘chrome holes’.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">High: Classified as “sufficient evidence of carcinogenicity in humans” and inhaled hexavalent chromium is a known human carcinogen. Particularly with respect to lung cancer.</td></tr>
<tr><td>Workplace health & safety impacts</td><td>Reproductive toxicity</td><td colspan="6">High: Suspected of damaging fertility or the unborn child and may cause genetic defects.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="7">Chromic acid, commonly used in electroplating and surface finishing, is a strong irritant and corrosive. Exposure usually arises as the result of splashes, as a mist of chromic acid coated bubbles of hydrogen or as chromic acid contaminated dust. Cr (VI) may also be liberated as a fume during welding of steel.
Occupational exposure to hexavalent chromium has been associated with lung cancer.</td></tr>
<tr><td>Population</td><td colspan="7">The general population is exposed to chromium by inhaling ambient air, ingesting food, and</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Hexavalent chromium compounds</th><th>Basel waste category:Y21</th><th>Basel permit code: A1040</th><th>NEPM code: D140</th></tr>
<tr><td>scale impacts</td><td colspan="4">drinking water containing chromium. Dermal exposure of the general public to chromium can occur from skin contact with certain consumer products or soils that contain chromium. The primary route of non-occupational workers, however, is food ingestion, although this risk is low. Present-day workers in chromium-related industries can be exposed to chromium concentrations two orders of magnitude higher than the general population.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="3">Chromium (VI) can have a high to moderate, acute toxic effect on plants, birds or land animals, and is very toxic to fish. This can mean death of animals, birds or fish and death or low growth rate in plants. Chromium (VI) does not breakdown or degrade easily and there is a high potential for accumulation of chromium (VI) in fish life.
Cr (VI) is highly mobile, soluble and bioavailable in the environment.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="3">Extreme: Very toxic to aquatic organisms.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="3">Extreme: May cause long-term adverse effects in the aquatic environment.</td></tr>
<tr><td>Persistence</td><td colspan="3">Extreme: Very persistent in the environment.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="3">Chromium is not bioaccumulated.</td></tr>
<tr><td rowspan="3">Where are the risks of impacts most likely?

Has anything happened before in Australia?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td colspan="5">In 2011 a malfunction at Orica's Kooragang Island synthetic ammonia production plant (near Newcastle) resulted in the release of hexavalent chromium (in the form of sodium chromate particles) over parts of Stockton. The company was fined $768,000 over this and a series of related chemical spills and safety breaches that occurred within months of each other.
As much as 10kg of dissolved hexavalent chromium was estimated to have escaped from the front stack and, after the plant was washed down, arsenic levels in waste holding ponds had risen above the legal discharge limit of 0.05 milligrams a litre and were accidently discharged to the Hunter River (see Y24).</td></tr>
<tr><td rowspan="2">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Higher risk workplaces like chrome plating and associated metal industries, where worker exposure to Cr (VI) compound wastes may be possible, routinely monitor at-risk staff via blood or respiratory testing.
Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like Cr (VI).</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="3">Potential industrial sources of hexavalent chromium waste have strict emissions control equipment in place, such as baghouse filters, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of chromium.</td></tr>
</table>

Waste name: Hexavalent chromium compounds	Basel waste category:Y21	Basel permit code: A1040	NEPM code: D140
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements. In major Australian reticulated water supplies, total chromium concentrations range up to 0.03 mg/L, with typical concentrations being less than 0.005 mg/L. The Health Guideline Value for chromium in Australian drinking water is set at 0.05 mg/L. If measurements by water reticulation authorities of total chromium exceed this value then a separate analysis for hexavalent chromium is undertaken.	
References	1. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Chromium VI compounds. Accessed March 14, 2015 from: http://www.npi.gov.au/resource/chromium-vi-compounds 2. Australian Pesticides and Veterinary Medicines Authority (APVMA) Part one: Toxicology Assessment. Accessed March 15, 2015 from: http://apvma.gov.au/sites/default/files/arsenic-phase-8-tox.pdf 3. CSIROpedia (2011). Tanning waste minimisation processes. Accessed March 15, 2015 from: http://www.csiropedia.csiro.au/display/CSIROpedia/Tanning+waste+minimisation+processes 4. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. Toxicological Profile for Chromium. Accessed April 15, 2015 from: http://www.atsdr.cdc.gov/toxprofiles/tp7-c2.pdf 5. Sigma Aldrich (2015). Chromium (VI) oxide Material Safety Data Sheet. Accessed April 13, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=675644&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F675644%3Flang%3Den 6. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.21 Copper compounds

Waste name: Copper compounds		Basel waste category:Y22		Basel permit code: various Cu code options	NEPM code: D190
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
		0 – 2.5				
	Description of the waste	Copper (Cu) is a ductile metal with very high thermal and electrical conductivity. Pure copper is soft and malleable; a freshly exposed surface has a reddish-orange colour. It is used as a conductor of heat and electricity in a wide range of electrical and electronics products, a building material (such as in water pipes), and a constituent of various metal alloys. It is biostatic, meaning bacteria will not grow on it. For this reason it has long been used to line parts of ships to protect against barnacles and mussels. There are many other uses for copper in industrial applications. Copper compounds are used in a plethora of applications. These include: dyes, catalysts, preservatives, in metallurgy, fuel additive, in electroplating, battery electrodes, fungicides, anti-fouling marine paints, flame proofing and in wood preservation (see Y5). Copper wastes are both solids, such as refinery slags and flue dusts, water-treatment sludges and liquids such as washings from shipyard barnacle removal and spent solutions from refinery acid-plant processes and scientific research activities.				
	Waste form	Solid, sludge and liquid				
	Physical/ chemical description	Copper compounds can exhibit either +1 oxidation state (cuprous) or +2 (cupric). The former oxidises to the latter relatively easily – the latter is much more stable. Common compounds are copper (II) acetate, copper (II) chloride, copper (II) sulfate, copper (II) oxide, copper (I) oxide, copper (I) cyanide and copper (1) chloride. Copper can react with strong oxidants like chlorates, bromates and iodates, causing an explosion hazard.				
Why is it hazardous?	Primary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Secondary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Main likely chemical contaminants			Other metals such as Zn, Cd, Hg, Pb and Ni.		

<table>
<tr><th colspan="2">Waste name:
Copper compounds</th><th colspan="6">Basel waste category:Y22</th><th>Basel permit code: various Cu code options</th><th>NEPM code: D190</th></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="8">Copper smelting and refining; shipyards and ports; organic chemical manufacturing, inorganic chemical manufacturing, Scientific research activities.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="8">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.
Significant copper metal recycling and recovery occurs, largely in the form of e-waste (see ‘Community’), which is a significant source of copper alongside virgin mining of the metal.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="5">Volume score (% of national tonnes in 2013)

Waste arising in 2013 (tonnes)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td><td colspan="3"></td></tr>
<tr><td>0.01%</td><td colspan="7"></td></tr>
<tr><td>TOTAL:</td><td>789</td><td>ACT:</td><td>0</td><td>NSW:</td><td>9</td><td colspan="2"></td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>419</td><td>SA:</td><td>53</td><td colspan="2"></td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>302</td><td>WA:</td><td>6</td><td colspan="2"></td></tr>
<tr><td rowspan="4">Potential health impacts</td><td>Overview</td><td colspan="8">Copper must be absorbed in small amounts on a daily basis to maintain good health. However, high levels of copper can be harmful to health.</td></tr>
<tr><td>Acute toxicity</td><td colspan="8">Low: Harmful if swallowed in excessive quantities, although this can be negated because vomiting is automatically triggered by its irritating effect on the gastrointestinal tract.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="8">High: Copper compounds may be irritating to eyes and skin. Cumulative exposure to high levels can damage the liver and kidneys.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="8">Low: Unlikely to be carcinogenic.</td></tr>
<tr><td>Workplace health & safety impacts</td><td>Reproductive toxicity</td><td colspan="8">No reproductive toxicity exhibited.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="9">Occupational sources of copper may result from copper mining and ore processing, by inhaling high levels of copper dust and fumes. Other occupational exposures can occur in agriculture, water treatment, and industries such as electroplating where soluble copper compounds are employed.</td></tr>
<tr><td>Population scale impacts</td><td colspan="9">Exposure to copper can be in many forms, as it is so ubiquitous in consumer products and applications. Population based data is mostly present in the literature with respect to chronic low copper dietary impacts, due to its role as a trace element in nutrition.
One avenue of exposure is via drinking water from the presence of copper hot water piping, especially if the water has been sitting in the pipes for some hours. After the water is run for a while, the concentration of copper in the water decreases. The Australian drinking water guideline for copper is 1 mg/L [1]. This limit has been set to prevent laundry staining and a disagreeable taste from copper in drinking water, which in itself is a form of</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Copper compounds</th><th colspan="2">Basel waste category:Y22</th><th colspan="2">Basel permit code: various Cu code options</th><th>NEPM code: D190</th></tr>
<tr><td></td><td colspan="6">protection from toxicity.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="5">Copper is a known toxin to fish species, particularly in its more prevalent Cu (II) ionic form.
Fish and crustaceans are 10 to 100 times more sensitive to the toxic effects of copper than are mammals.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">Low: Harmful to aquatic organisms.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">High: May cause long-term adverse impacts in the aquatic environment. Chronic impacts have regularly been associated with salmon populations.</td></tr>
<tr><td>Persistence</td><td colspan="5">High: Highly persistent in the environment.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">High: Copper is expected to bioaccumulate in fish tissues.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Medium</td><td>Moderate</td><td>Low</td><td>Moderate</td><td>Medium</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">In April 2010 the Northern Territory media reported that copper concentrate (approximately 30-60% copper) had been spilled during use of the bulk ore ship loading facility, a conveyer belt and portable loading mechanism with a chute, at East Arm Wharf in Darwin Harbour. The media alleged that substantial amounts of copper concentrate were spilled onto the wharf hard stand, where dust posed a hazard to human health and directly into the water where it constituted aquatic pollution.
The NT EPA conducted an investigation and concluded that a number of incidents involving copper concentrate pollution of the air and water environment of Darwin Harbour occurred, and enforcement action was successfully undertaken against both Darwin Port Corporation and the miner of the ore, Oz Minerals Ltd.</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">Higher risk workplaces like metal smelters, metal coating and metal processing industries, where worker exposure to Cu compound wastes may be possible, are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like Cu.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Potential industrial sources of Cu waste have strict emissions control equipment in place, such as baghouse filters, dust extraction systems, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of copper.</td></tr>
<tr><td>Government</td><td colspan="5">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through</td></tr>
</table>

Waste name: Copper compounds		Basel waste category:Y22	Basel permit code: various Cu code options	NEPM code: D190
		licensing, tracking and transport accreditation requirements.		
	Community	The National Television and Computer Recycling Scheme involves a combination of government regulation and industry action to take responsibility for the collection and recycling of waste televisions, computers, printers and computer products. Under the Scheme, householders and small business can drop-off these items for free at designated access points, which may include permanent collection sites, take-back events or through a mail-back option. While not expressly classified as a Y22/ D190 waste, e-waste contains significant amounts of copper, which are recovered for downstream recycling.		
References	1. Australian Government. National Health and Medical Research Council. *Australian Drinking Water Guidelines (2004)*. Accessed March 20, 2015 from: http://www.nhmrc.gov.au/guidelines-publications/eh34 2. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Copper and compounds. Accessed March 20, 2015 from: http://www.npi.gov.au/resource/copper-and-compounds 3. Melpat International Pty Ltd. (2013). Copper sulphate Material Safety Data Sheet. Accessed April 20, 2015 from: http://www.melpat.com.au/documents/CopperSulphate_MSDS_001.pdf 4. Safe Work Australia. Hazardous Substances Information System (HSIS). Accessed April 20, 2015 from: http://hsis.safeworkaustralia.gov.au 5. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.			

3.22 Zinc compounds

Waste name: Zinc compounds		Basel waste category:Y23	Basel permit code: A1080*	NEPM code: D230
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme **2.6 – 3.0**		
	Description of the waste	Zinc (Zn) is a metallic element that is relatively abundant in the earth's crust as a zinc ore such as sphalerite, a zinc sulfide mineral. Australia has large mineable deposits of zinc, commonly called a 'base' metal. Zinc is mainly used as a protective coating for iron and steel (galvanising). It is further used for the production of zinc alloys (e.g. brass), rolled zinc, zinc dust (a pigment and a reducing agent), and zinc compounds (e.g. zinc oxide). Zinc wastes are usually solids and can present as waste slag from smelting operations, spent filter cartridges from electroplating or dusts from metal manufacturing and processing activities.		
	Waste form	Solid		
	Physical/ chemical description	Zinc metal is brittle at ambient temperatures but malleable at 100 to 150°C. It can also be rolled at these temperatures. It is a reasonable conductor of electricity. Zinc forms many alloys such as brass (with copper). Elemental zinc is stable under ordinary conditions of use and storage. However, zinc is listed below to exhibit some self-heating properties - moist zinc dust can react exothermically and ignite spontaneously in air. Zinc oxide the most widely zinc compound in industrial applications.		
Why is it hazardous?	**Primary hazard**	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Secondary hazard	H4.2: Substances or wastes liable to spontaneous combustion	Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.	
		H4.3: Substances or wastes which, in contact with water emit flammable gases	Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities	
	Other hazard(s)	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects,	

<table>
<tr><th colspan="2">Waste name:
Zinc compounds</th><th colspan="3">Basel waste category:Y23</th><th colspan="2">Basel permit code: A1080*</th><th colspan="2">NEPM code: D230</th></tr>
<tr><td rowspan="2"></td><td></td><td colspan="6">including carcinogenicity.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="6">Copper, Lead, Mercury, Cadmium, arsenic, antimony.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="8">Basic iron and steel manufacturing; Copper, Silver, Lead and Zinc smelting and refining; Metal coating and finishing, Inorganic chemical manufacturing.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="8">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.
Some metal recycling and recovery occurs.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score
(% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td><td colspan="3"></td></tr>
<tr><td colspan="2">2.9%</td><td colspan="6"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>211,455</td><td>ACT:</td><td>0</td><td>NSW:</td><td>364</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>675</td><td>SA:</td><td>91,339</td></tr>
<tr><td>Tas:</td><td>111,170</td><td>Vic:</td><td>7,034</td><td>WA:</td><td>873</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="8">Zinc is an essential trace element in the diet of all living organisms from bacteria to humans. Either too little zinc or too much zinc can be harmful, causing health problems.
Unlike its heavy metal counterparts such as lead, mercury and cadmium, zinc exhibits quite low human health impacts. It is similar to copper in this regard.</td></tr>
<tr><td>Acute toxicity</td><td colspan="8">Low:</td></tr>
<tr><td>Chronic toxicity</td><td colspan="8">Low:</td></tr>
<tr><td>Carcinogenicity</td><td colspan="8">Not carcinogenic.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="8">Low:</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="9">Occupational exposure to higher than normal zinc levels may occur when breathing zinc dust or fumes at industrial sites such as smelters, galvanising facilities or metal manufacturing plants.</td></tr>
<tr><td>Population scale impacts</td><td colspan="9">None included due to zinc’s relatively low potential for health impacts.</td></tr>
<tr><td rowspan="2">Potential environment impacts</td><td>Overview</td><td colspan="8">The toxicity of zinc in water is influenced by water hardness and pH, with lower toxicity encountered in waters with higher water hardness and lower pH, and vice versa. Generally, zinc and its salts have high acute and chronic toxicity to aquatic life in polluted waters.
Insufficient data are available to evaluate or predict the effects of zinc and its compounds to plants, birds, or land animals.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="8">High: Toxic to aquatic organisms.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Zinc compounds</th><th colspan="2">Basel waste category:Y23</th><th colspan="2">Basel permit code: A1080*</th><th>NEPM code: D230</th></tr>
<tr><td rowspan="3"></td><td>Chronic ecotoxicity</td><td colspan="5">High: May cause long term toxic effects in the aquatic environment.</td></tr>
<tr><td>Persistence</td><td colspan="5">Extreme: Like other base or heavy metals, zinc does not break down in the environment.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">Low: Tendency to bioaccumulate is low.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Medium</td><td>Moderate</td><td>Low</td><td>Moderate</td><td>Medium</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">Historical mining and metal processing operations have resulted in serious heavy metal pollution in a number of areas in Australia, some of which involve zinc. These include the King River (mainly Cu, also Zn, Pb and Cd) and the Derwent River estuary (mainly Zn and Cd, also Hg) in Tasmania; as well as Captains Flat and Molongolo River in New South Wales (mainly Zn, also Cu, Cd, Pb and As). These have resulted in legacy pollution of waters, sediments, fish and other aquatic life.[1]</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">Higher risk workplaces like metal smelters, metal coating and metal processing industries, where worker exposure to Zn compound wastes may be possible, are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like Zn.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Potential industrial sources of Zn waste have strict emissions control equipment in place, such as baghouse filters, dust extraction systems, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of zinc.</td></tr>
<tr><td>Government</td><td colspan="5">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.</td></tr>
<tr><td>References</td><td colspan="6">1. Hutchinson T and Meema K (ed), Lead, Mercury, Cadmium and Arsenic in the Environment, Chapter 13 (Hart B and Lake P). John Wiley and Sons Ltd (1987). Accessed April 17, 2015 from: http://dge.stanford.edu/SCOPE/SCOPE_31/SCOPE_31_2.08_Chapter13_187-216.pdf

2. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Zinc and compounds. Accessed March 19, 2015 from: http://www.npi.gov.au/resource/zinc-and-compounds

3. Sigma Aldrich (2013). Zinc Material Safety Data Sheet. Accessed April 19, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=324930&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F324930%3Flang%3Den

4. Safe Work Australia. Controlling Risks associated with Electroplating.

5. National Environment Protection Council (1999). National Pollutant Inventory Technical</td></tr>
</table>

Waste name: Zinc compounds		Basel waste category:Y23	Basel permit code: A1080*	NEPM code: D230
	Advisory Panel Final Report.			

** Relevant only if zinc residues contain lead or cadmium at significant concentrations*

3.23 Arsenic; arsenic compounds

Waste name: Arsenic; arsenic compounds		Basel waste category:Y24		Basel permit code: A1010, A1030		NEPM code: D130
What is it?	Hazard score (0 – 6)	Low	Medium	Moderate	High	Extreme
					3.9 – 4.9	
	Description of the waste	Arsenic and arsenic compounds have been used in Australia in manufacturing and formulating chemicals used in wood preservation and pesticide applications, although arsenic is no longer used in pesticides in Australia. Arsenic may also be used in specific glassmaking applications; such as to produce clear glass, free from the green stain of iron impurity. Arsenic also occurs naturally in mineral form, usually with sulphur and valuable metals such as copper and gold – for example geologists often look for arsenic in soil as a means of locating an ore body[1]. Solid arsenic wastes can result from smelting for other metals, where arsenic is present in the ore.				
	Waste form	Solid				
	Physical/ chemical description	Elemental arsenic is unlikely to occur in pure form in Australia as most of its applications are either in its trivalent (As III, called arsenites) or pentavalent (As V, called arsenates) oxidation states, both typically present as solids. The former is its most hazardous form and the simplest trivalent arsenic compound, arsine gas, is extremely toxic.				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants			Other heavy metals could be present.		
Where does it come from?	Main sources	Glass manufacturing, metal smelting, mining, inorganic chemical manufacturing and manufacturers/ formulators of copper chrome arsenate (CCA) wood preservative (see Y5).				
How is it managed?	Main fates	Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.				
How much is generated in Australia?	Volume score (% of national tonnes in 2013)	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%
		0.003%				

<table>
<tr><th colspan="3">Waste name:
Arsenic; arsenic compounds</th><th colspan="2">Basel waste category:Y24</th><th colspan="2">Basel permit code: A1010, A1030</th><th colspan="2">NEPM code: D130</th></tr>
<tr><td rowspan="4"></td><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>200</td><td>ACT:</td><td>0</td><td>NSW:</td><td>0</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>126</td><td>SA:</td><td>1</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>73</td><td>WA:</td><td>0</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="6">The most common hazards of human exposure to arsenic compounds are:
• Irritation of the skin, eyes, mouth, throat and lungs.
• Chronic poisoning, including cancer of the skin and lungs.
• Acute poisoning that may result in death.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">High: Toxic by inhalation – the most likely exposure route - irritation of the nose, throat and lungs, impaired respiration and perforation of the nasal septum have been reported in smelter workers[2]. Toxic if swallowed and can be fatal.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Extreme: Chronic arsenic poisoning due to exposure to compounds such as calcium arsenate and copper acetoarsenate, is characterised by weakness, loss of appetite, gastro-intestinal disturbances, numbness and tingling of the extremities. Chronic exposure to arsenic trioxide may lead to liver damage and skin disorders such as keratoses and pigmentation.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">Extreme: Can cause cancer in humans, particularly skin cancer, and has also been associated with increases in the incidence of various other types of cancers, such as lung cancer among copper smelter and pesticide workers[2].</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">High: Possible reproductive and teratogenic effects.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="7">Occupational exposure studies have been conducted on adults working in copper smelters in the 1940s-1960s, following their health impacts through to the 1990s[3]. Definitive links were established between arsenic, a by-product of copper smelting, and lung cancer via inhalation. The pathway of exposure for these workers was mainly via inhalation of arsenic dusts but could also have been from arsenic trioxide vapours. Occupational and environmental controls have virtually eliminated these workplace risks today, at least in Australia.</td></tr>
<tr><td>Population scale impacts</td><td colspan="7">Elevated arsenic concentrations in water have been indicated as a public health hazard in many countries where individuals rely on groundwater for drinking purposes[4]. Australian cities maintain high levels of water quality so such epidemiological observations have not occurred in Australia. It is possible however, that more remote areas located near abandoned mine workings could have elevated natural arsenic levels in the soil and, as a result, drinking water supplies in these areas may be contaminated.</td></tr>
<tr><td>Potential environment</td><td>Overview</td><td colspan="6">Arsenic exhibits toxic effects in the environment as well as on human health. It is persistent and bioaccumulative and can exhibit long-term toxic effects in the aquatic environment similar to related heavy</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Arsenic; arsenic compounds</th><th colspan="2">Basel waste category:Y24</th><th colspan="2">Basel permit code: A1010, A1030</th><th>NEPM code: D130</th></tr>
<tr><td rowspan="5">impacts</td><td></td><td colspan="5">metals.
Arsenic levels in groundwater from either naturally high surrounding mineralogy, from mining run-off of high-arsenic ores and from other forms of pollution are a problem in some parts of the world.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">Moderate: Toxic to aquatic organisms.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">High: May cause long-term adverse effects in the aquatic environment.</td></tr>
<tr><td>Persistence</td><td colspan="5">Extreme: Very persistent in the environment</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">High: Can accumulate in seafood.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Medium</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">Effluent containing high levels of arsenic leaked into the Hunter River from Orica’s Kooragang Island chemical plant (in Newcastle) in 2011. Arsenic had not been used on the site since 1993, however, during a clean-up of a hexavalent chromium spill on the site the week prior (see Y21), approximately 1.2 million litres of washwater containing old deposits of arsenic leaked into a storage pond and drained into the Hunter River.[5]</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">Higher risk workplaces like metal smelters, where worker exposure to arsenic or other airborne pollutants may be possible, routinely monitor at-risk staff via blood or urine-based testing.
Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like arsenic.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Potential industrial sources of arsenic waste have strict emissions control equipment in place, such as baghouse filters and electrostatic precipitators. Additionally at-risk workers wear appropriate personal protective equipment (PPE).</td></tr>
<tr><td>Government</td><td colspan="5">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.
Australian drinking water guidelines set a maximum level of arsenic at 0.01mg/L. Australian drinking water monitoring shows results are typically between <0.001 and 0.03 mg/L[6], although levels above 0.01mg/L are not commonly encountered.</td></tr>
<tr><td>References</td><td colspan="6">1. What is the role of arsenic in the mining industry? Accessed March 10, 2015 from: http://www.miningfacts.org/Environment/What-is-the-role-of-arsenic-in-the-mining-industry/
2. National Occupational Health and Safety Commission, Commonwealth of Australia</td></tr>
</table>

Waste name: Arsenic; arsenic compounds	Basel waste category:Y24	Basel permit code: A1010, A1030	NEPM code: D130

(1989). Arsenic and its compounds. Accessed March 13, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/22/ArsenicAndItsCompounds_1989_PDF.pdf

3. Hughes M, Beck B, Chen Y, Lewis A and Thomas D (2011). Arsenic Exposure and Toxicology: A Historical Perspective. *Toxicol. Sci.* 2011: 123 (2): 305-332. First published online: July 12, 2011. Accessed April 13, 2015 from: http://toxsci.oxfordjournals.org/content/123/2/305.full

4. Smith AH, Lingas EO, Rahman M. (2000). Contamination of drinking-water by arsenic in Bangladesh: a public health emergency. *Bull. World Health Organ* 2000;78:1093-1103.

5. Newcastle Herald, 19 August 2011. *Orica spills arsenic into Hunter River*. Accessed April 13, 2015 from: http://www.theherald.com.au/story/474359/orica-spills-arsenic-into-hunter-river/

6. Arsenic in drinking water, a Queensland Health Fact Sheet (2012). Accessed March 10, 2015 from: http://www.health.qld.gov.au/ph/documents/ehu/fs-arsenic.pdf

7. Sigma Aldrich (2015). Arsenic (III) Oxide Material Safety Data Sheet. Accessed April 13, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=311383&brand=SIAL&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Fsial%2F311383%3Flang%3Den

8. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.

3.24 Selenium; selenium compounds

Waste name: Selenium; selenium compounds		Basel waste category:Y25		Basel permit code: A1010, A1020		NEPM code: D240
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
				3.1 – 3.8		
	Description of the waste	Trace amounts of selenium are essential for humans and most diets usually provide enough selenium to meet the daily requirement. Diets lacking selenium have resulted in heart problems and muscle pain. Diets with too much selenium can be harmful at levels 5 to 10 times higher than the daily requirement. Uses in electronics and photography account for the majority of selenium use, followed by the glass industry, then pigments (in plastics, paints, dyes, enamels, inks and textiles). Selenium dioxide is the most widely used selenium compound in industry. It is used as an oxidising agent in drug and other chemical manufacture, a catalyst in organic syntheses, and an anti-oxidant in lubricating oils. In Australia, selenium waste is low in volume and limited to a small number of industrial processes, typically involving metal processing and/ or recycling.				
	Waste form	Solid				
	Physical/ chemical description	Selenium is an odourless metalloid (an element which has both metallic and non-metallic properties) like arsenic and antimony but most closely resembling tellurium. It can be a grey (the 'metallic' and most stable form), red or black solid. Selenium can be present in sulfide minerals and also iron oxide minerals. However is among the rarer elements on Earth. Common selenium salts such as selenium dioxide, selenium disulphide and selenium hexafluoride are either slightly water soluble or insoluble.				
Why is it hazardous?	Primary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Secondary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants			As, S and heavy metals		
Where does it come from?	Main sources	Inorganic chemical manufacturing, metal smelting, metal recycling.				

<table>
<tr><th colspan="2">Waste name:
Selenium; selenium compounds</th><th>Basel waste category:Y25</th><th>Basel permit code: A1010, A1020</th><th>NEPM code: D240</th></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="3">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.
Limited recycling and recovery of selenium may occur in Australia.</td></tr>
<tr><td rowspan="3">How much is generated in Australia?</td><td>Volume score
(% of national tonnes in 2013)</td><td colspan="3"><table><tr><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr><tr><td>0.001%</td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Waste arising in 2013 (tonnes)</td><td colspan="3"><table><tr><td>TOTAL:</td><td>40</td><td>ACT:</td><td>0</td><td>NSW:</td><td>32</td></tr><tr><td>NT:</td><td>0</td><td>Qld:</td><td>1</td><td>SA:</td><td>7</td></tr><tr><td>Tas:</td><td>0</td><td>Vic:</td><td>0</td><td>WA:</td><td>0</td></tr></table></td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="3">Selenium is a trace element essential in a human diet but can be harmful at levels only 5 to 10 times the daily recommended intake. For example, Accidentally swallowing a large quantity of selenium supplement pills could be life-threatening without immediate medical treatment.</td></tr>
<tr><td>Acute toxicity</td><td colspan="3">High: Toxic by inhalation and if swallowed. Acute and fatal toxicities have occurred with accidental or suicidal ingestion of gram quantities of selenium. Clinically significant selenium toxicity was reported in 13 individuals after taking supplements that contained 27.3 milligrams (instead of micrograms) per tablet due to a manufacturing error.[1]</td></tr>
<tr><td>Chronic toxicity</td><td colspan="3">High: Danger of cumulative effect. Chronic selenium toxicity (selenosis) may occur with smaller doses of selenium over long periods of time. The most frequently reported symptoms of selenosis are hair and nail brittleness and loss.[1]</td></tr>
<tr><td>Carcinogenicity</td><td colspan="3">Low: Selenium is not known to have carcinogenic effects, although one specific selenium compound, selenium sulfide, may be carcinogenic.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="3">Low: Not known to have reproductive effects.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="4">Low use chemical/ waste generated in Australia. No specific workplace impacts known.</td></tr>
<tr><td>Population scale impacts</td><td colspan="4">Exposure to selenium mainly takes place through food, because selenium is naturally present in grains, cereals and meat. Humans need to absorb certain amounts of selenium daily, in order to maintain good health.
No specific population scale impacts from excessive selenium were identified, although a number of references cited the impacts on populations with low selenium diets. For example, epidemiological studies have reported an inverse association between selenium levels in the blood and cancer occurrence.[2]</td></tr>
<tr><td>Potential</td><td>Overview</td><td colspan="3">Selenium can be toxic, particularly to livestock that eat plants that</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Selenium; selenium compounds</th><th>Basel waste category:Y25</th><th>Basel permit code: A1010, A1020</th><th>NEPM code: D240</th></tr>
<tr><td rowspan="5">environment impacts</td><td></td><td colspan="3">accumulate selenium to high levels.
Selenium can cause significant reproductive problems to fish and aquatic-dependent wildlife as a result of its ability to bioaccumulate.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="3">Low.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="3">High: May cause long-term adverse effects in the aquatic environment. Selenium can cause significant reproductive problems to fish and aquatic-dependent wildlife as a result of its ability to bioaccumulate.</td></tr>
<tr><td>Persistence</td><td colspan="3">Extreme: Very persistent in the environment</td></tr>
<tr><td>Bioaccumulation</td><td colspan="3">Extreme: Highly bioaccumulative but this effect is dependent upon the type of selenium at the source, the chemistry and biology of the receiving environment.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">There are no reported incidents involving selenium compounds in Australia. However, in the US there were with two high-profile incidents in the 1980s. Belews Lake, North Carolina, suffered a severe fish die-off and the loss of 16 of 20 species of fish as a result of 10 years of discharging ash from a coal-fired power plant directly into the lake. The second selenium event was when severe deformities were observed in birds at Kesterson Wildlife Refuge, California, which was contaminated with selenium in agricultural drainage water.[3]</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Higher risk workplaces like metal smelters, where worker exposure to selenium or other airborne pollutants may be possible, routinely monitor at-risk staff via blood or urine-based testing.
Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like selenium.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="3">Potential industrial sources of selenium waste have strict emissions control equipment in place, such as baghouse filters, scrubbing systems, electrostatic precipitators and mist eliminators. Additionally at-risk workers wear appropriate personal protective equipment (PPE).</td></tr>
<tr><td>Government</td><td colspan="3">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.</td></tr>
<tr><td>References</td><td colspan="5">1. Linus Pauling Institute Micronutrient Information Center, Oregon State University. Accessed April 17, 2015 from: http://lpi.oregonstate.edu/mic/minerals/selenium
2. United States Environmental Protection Agency (USEPA) (2000). Selenium compounds</td></tr>
</table>

Waste name: Selenium; selenium compounds	Basel waste category:Y25	Basel permit code: A1010, A1020	NEPM code: D240
	hazard summary. Accessed April 17, 2015 from: http://www.epa.gov/airtoxics/hlthef/selenium.html 3. Exponent (2010). Selenium Fact Sheet. Accessed on April 17, 2015 from: http://www.tva.com/kingston/exponent/Selenium%20fact%20sheet.pdf 4. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Selenium and compounds. Accessed March 17, 2015 from: http://www.npi.gov.au/resource/selenium-compounds 5. Safework Australia. Hazardous Substances Information System (HSIS). Accessed April 17, 2015 from: http://hsis.safeworkaustralia.gov.au 6. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.25 Cadmium; cadmium compounds

Waste name: Cadmium; cadmium compounds		Basel waste category:Y26		Basel permit code: A1010, A1020		NEPM code: D150
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
					3.9 – 4.9	
	Description of the waste	Cadmium (Cd) is an extremely toxic metal commonly found in industrial workplaces. Due to its low permissible exposure limit, overexposures may occur even in situations where trace quantities of cadmium are found. Cadmium is used extensively in electroplating. Cadmium is also found in some industrial paints and may represent a hazard when sprayed. Operations involving removal of cadmium paints by scraping or blasting may pose a significant hazard. More contemporary uses of cadmium are in some types of batteries, electronic equipment (as semi-conductors) and as the relatively stable cadmium telluride in solar panels. Cadmium is present as an impurity in products such as non-ferrous metals (zinc, lead and copper), iron and steel, fossil fuels (coal, oil, gas, peat and wood), cement, and phosphate fertilisers. Contamination of soil, sediments and waterways is a historical problem, primarily from the use of Cd-contaminated phosphate fertilisers, deliberate land application and disposal of biosolids/ wastewater effluent and atmospheric deposits from fossil fuel combustion. Cadmium wastes may arise from end of life products mentioned above plus industrial residues, liquors and sludges from their production.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). In Australia cadmium oxide has been used in electroplating, and is found in semiconductors, batteries and in glass and ceramic glazes. Cadmium chloride is the 'cadmium yellow' pigment and cadmium sulfide is used in the electronics industry for photocells and light emitting diodes. In water some of the compounds will be quite soluble (cadmium chloride) and others will be insoluble (cadmium oxide). As fine powder cadmium metal will burn, releasing toxic fumes of cadmium oxide.				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects,		

Waste name: Cadmium; cadmium compounds		Basel waste category:Y26	Basel permit code: A1010, A1020	NEPM code: D150
			including carcinogenicity.	
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Other hazard(s)	N/A	N/A	
	Main likely chemical contaminants		Other heavy metals and metalloids such as tellurium, arsenic and antimony. Commonly found in zinc deposits and phosphate rock.	
Where does it come from?	**Main sources**	The main industrial sources of cadmium related hazardous waste are electricity supply, aerospace industries, ports, defence activities, fertiliser manufacturing, metal mining and metal processing. The largest waste from these industrial sources are end of life nickel cadmium (NiCad) batteries. Cadmium may also be present in spent catalyst waste and other metal processing residues. Significant contributions of cadmium in waste come through more distributed and traditionally non-hazardous streams such as e-waste, biosolids and agricultural fertiliser run-off. These streams are not reflected in hazardous waste arising volumes of cadmium; cadmium compounds.		
How is it managed?	**Main fates**	End of life NiCad batteries are increasingly undergoing recycling, as is e-waste. Other forms of cadmium waste undergo chemical/ physical treatment to immobilise the hazard, then the stabilised material is disposed of in hazardous waste landfill. Some Cd liquid wastes may be discharged to sewer under regulatory agreements, which will require the meeting of low concentration limits for Cd.		
How much is generated in Australia?	**Volume score (% of national tonnes in 2013)**	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%
		0.0004%				
	Waste arising in 2013 (tonnes)	**TOTAL:** 31	**ACT:** 0	**NSW:** 8		
		NT: 0	**Qld:** 8	**SA:** 4		
		Tas: 2	**Vic:** 1	**WA:** 8		
Potential health impacts	**Overview**	Cadmium is a very toxic and carcinogenic heavy metal, which is ubiquitous (but generally at low levels) in the environment, food and water supplies, primarily from historical pollution, and industrial workplaces.		
	Acute toxicity	**Extreme**: Very toxic by inhalation – can be fatal. Toxic if swallowed.		

Waste name: Cadmium; cadmium compounds		Basel waste category:Y26	Basel permit code: A1010, A1020	NEPM code: D150
	Chronic toxicity	**Extreme**: Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed. Breathing air with lower levels of cadmium over a number of years results in a build-up of cadmium in the kidney, and if sufficiently high, may result in kidney disease.		
	Carcinogenicity	**Extreme**: Known to cause cancer in humans. Lung cancer has been found in some studies of workers exposed to cadmium in the air and studies of rats that breathed in cadmium.		
	Reproductive toxicity	**Low**: Possible risk of impaired fertility and harm to the unborn child.		
Workplace health & safety impacts	In the workplace, people are exposed where cadmium is used or generated as a by-product, such as in battery manufacturing and recycling, some forms of painting and sandblasting, metal soldering, welding or other activities in metal manufacturing and refining. There is the potential for airborne cadmium exposure anywhere where fossil fuels are combusted.			
Population scale impacts	People are exposed to cadmium primarily through their diet, since cadmium is absorbed and bioaccumulated into plant and animal foods that people eat, from contamination of soil and to a lesser extent water. People are exposed to higher amounts of cadmium by breathing cigarette smoke.			
Potential environment impacts	**Overview**	Cadmium is toxic to a wide range of micro-organisms. In the marine environment, the presence of sediment, high concentrations of dissolved salts or organic matter all reduce the toxic impact. Conversely zinc, which is commonly is present in cadmium-containing wastes, increases the toxicity of cadmium to aquatic invertebrates. Industrial and agricultural cadmium discharges to air and water has led to wide-reaching contamination of soil, sediment, groundwaters and surface waters.		
	Acute ecotoxicity	**Extreme**: Very toxic to aquatic organisms.		
	Chronic ecotoxicity	**Extreme**: May cause long-term adverse effects in the aquatic environment.		
	Persistence	**Extreme**: Very persistent in the environment. Cadmium does not break down in the environment, but may be affected by physical and chemical processes that modify its mobility, bioavailability, and residence time in different environmental media.		
	Bioaccumulation	**Extreme**: Strongly bioaccumulative, particularly in terrestrial environments through plant soil uptake and the animal food chain.		

Where are the risks of impacts most likely?	Generation	Transport	Storage	Treatment	Recovery	Final disposal
	High	Moderate	Moderate	Medium	Medium	Low

<table>
<tr><th colspan="2">Waste name:
Cadmium; cadmium compounds</th><th>Basel waste category:Y26</th><th>Basel permit code: A1010, A1020</th><th>NEPM code: D150</th></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="4">Cadmium is commonly found with other heavy metal wastes, such as those relating to zinc, lead and mercury, and there have been historical heavy metal environmental incidents and impacts in Australia that have involved cadmium. The most notable have been associated with the mining and metal processing industry. On a smaller scale there have also been examples of localised pollution by electroplating wastes and metal-based pigments.
Historical mining operations have resulted in serious heavy metal pollution in a number of areas in Australia. These include the King River (mainly Cu, also Zn, Pb and Cd) and the Derwent River estuary (mainly Zn and Cd, also Hg) in Tasmania; as well as Captains Flat and Molonglo River in New South Wales (mainly Zn, also Cu, Cd, Pb and As). These have resulted in legacy pollution of waters, sediments, fish and other aquatic life.</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Higher risk workplaces like metal smelters and mine processing industries, where worker exposure to Cd compound wastes may be possible, routinely monitor at-risk staff via blood and urine testing.
Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like Cd.
NiCad batteries are a large source of cadmium-containing hazardous waste. Battery recycling is a growing industrial sector in Australia dedicated to the recovery of a number of valuable commodities such as precious and heavy metals, including cadmium. The Australian Battery Recycling Initiative (ABRI) has been formed by a group of battery manufacturers, recyclers, retailers, government bodies and environment groups to promote the collection, recycling and safe disposal of all batteries.
See “Community” section regarding e-waste recycling.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="3">Potential industrial sources of Cd waste have strict emissions control equipment in place, such as baghouse filters, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of cadmium.</td></tr>
<tr><td>Government</td><td colspan="3">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.
See “Community” section regarding e-waste recycling.</td></tr>
</table>

Waste name: Cadmium; cadmium compounds		Basel waste category:Y26	Basel permit code: A1010, A1020	NEPM code: D150
	Community	The National Television and Computer Recycling Scheme involves a combination of government regulation and industry action to take responsibility for the collection and recycling of waste televisions, computers, printers and computer products. Under the Scheme, householders and small business can drop-off these items for free at designated access points, which may include permanent collection sites, take-back events or through a mail-back option. While not expressly classified as a Y26/ D150 waste, e-waste contains a number of heavy metals in printed circuit boards in particular, which are recovered for downstream recycling.		
References	1. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Cadmium and compounds. Accessed March 17, 2015 from: http://www.npi.gov.au/resource/cadmium-and-compounds 2. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. Toxicological Profile for Cadmium. Accessed April 17, 2015 from: http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=15 3. Sigma Aldrich (2015). Cadmium oxide Material Safety Data Sheet. Accessed April 17, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=202894&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F202894%3Flang%3Den 4. International Cadmium Association (ICdA). Cadmium exposure and human health. Accessed April 17, 2015 from: http://www.cadmium.org/pg_n.php?id_menu=5 5. Safework Australia. Hazardous Substances Information System (HSIS). Accessed April 17, 2015 from: http://hsis.safeworkaustralia.gov.au 6. Hutchinson T and Meema K (ed), *Lead, Mercury, Cadmium and Arsenic in the Environment*, Chapter 13 (Hart B and Lake P). John Wiley and Sons Ltd (1987). Accessed April 17, 2015 from: http://dge.stanford.edu/SCOPE/SCOPE_31/SCOPE_31_2.08_Chapter13_187-216.pdf 7. Australian Battery Recycling Initiative (ABRI) website. Accessed April 17, 2015 from: http://www.batteryrecycling.org.au/home 8. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.			

3.26 Antimony; antimony compounds

Waste name: Antimony; antimony compounds		Basel waste category:Y27		Basel permit code: A1010, A1020		NEPM code: D170
What is it?	Hazard score (0 – 6)	Low	Medium	Moderate	High	Extreme
		0 – 2.5				
	Description of the waste	The vast majority of antimony is used in manufacturing processes for plastics and polymers where, in its trioxide, pentoxide, or (especially) sodium antimonite form, it functions as a fire retardant. It is also mixed into alloys and used in lead storage batteries, solder, sheet and pipe metal, motor bearings, castings, semiconductors, and pewter. Antimony has been mined in Australia several times in the past. Antimony wastes is produced in extremely small quantities in Australia.					
	Waste form	Solid, but may be in liquid form (as in mine tailings).				
	Physical/ chemical description	Antimony is a brittle silver-white metal that occurs in soil and rocks in certain parts of the world. It may present as waste in mine tailings.				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants			Other mined metal species and heavy metals present in the ore body such as arsenic and mercury.		
Where does it come from?	Main sources	There are approximately two antimony mines currently operating in Australia. The very small quantities of antimony-related waste are likely to come from either these sources or other mining such as iron ore or gold mining, given that antimony minerals are often found with arsenic, iron, silver and sulphur, as well as gold.				
How is it managed?	Main fates	Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.				
How much is	Volume score	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%

<table>
<tr><th colspan="3">Waste name:
Antimony; antimony compounds</th><th colspan="2">Basel waste category:Y27</th><th colspan="2">Basel permit code: A1010, A1020</th><th colspan="2">NEPM code: D170</th></tr>
<tr><td rowspan="4">generated in Australia?</td><td>(% of national tonnes in 2013)</td><td colspan="6">0.0001%</td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>4</td><td>ACT:</td><td>0</td><td>NSW:</td><td>0</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>0</td><td>SA:</td><td>0</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>0</td><td>WA:</td><td>4</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="6">Its toxicity highly depends upon chemical form and oxidation state with +III compounds exerting greater toxicity than +V compounds. Antimony compounds show toxic properties similar to those of arsenic, though typically less severe. Exposure to antimony can result in a variety of adverse health effects, but it must be at quite high levels, which is unlikely in most industrial settings.
It is noted that Antimony can have beneficial effects when used for medical reasons. It has been used as a medicine to treat people infected with tropical parasites.[1]</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Low: Harmful if inhaled or swallowed – breathing high levels for a long time can irritate eyes and lungs and can cause heart and lung problems, stomach pain, diarrhoea, vomiting, and stomach ulcers. Ingesting large doses of antimony can cause vomiting.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Low: Likely to have low to negligible chronic effects.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">Low: Studies are inconclusive as to its human carcinogenicity, hence antimony has not been classified as carcinogenic. However, antimony trioxide is carcinogenic in animal experiments and is regarded as 'possibly carcinogenic to humans'.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">Low: There is a lack of conclusive information in the literature about reproductive toxicity of antimony, hence this impact is rated as low.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="8">Gross exposure to antimony compounds over long periods, usually the sulfide (SbS_3) or the oxide (Sb_2O_3) has occurred in antimony miners and in antimony process workers overseas, although rarely studied. No specific information exists for Australian antimony mining and related waste, which is limited.</td></tr>
<tr><td>Population scale impacts</td><td colspan="8">Antimony has been implicated in the cause of cot deaths, or Sudden Infant Death Syndrome (SIDS) by Richardson in 1990 [2]. It was claimed that antimony compounds used in fireproofing cot furnishings amongst other additives was primarily responsible for SIDS due to the action of a fungus (Scopulariopsis brevicaulis) growing on polyvinyl chloride cot mattress covers. This causal role of antimony in SIDS was ultimately refuted due to lack of evidence[3].</td></tr>
<tr><td>Potential environment impacts</td><td>Overview</td><td colspan="6">Little information is available on the transformations and transport of antimony in. air, water and soil. The mobility of antimony in soils is not clearly understood. Some studies indicate that antimony is highly mobile, while others conclude that it strongly adsorbs to soil. In water, it usually adheres to sediments.</td></tr>
</table>

<table>
<tr><th colspan="3">Waste name:
Antimony; antimony compounds</th><th>Basel waste category:Y27</th><th>Basel permit code: A1010, A1020</th><th>NEPM code: D170</th></tr>
<tr><td rowspan="2"></td><td colspan="2">Acute ecotoxicity</td><td colspan="3">Low: May be toxic to aquatic organisms.</td></tr>
<tr><td colspan="2">Chronic ecotoxicity, Persistence & bioaccumulation</td><td colspan="3">Medium: May cause long-term adverse effects in the aquatic environment. Most antimony compounds show little or no tendency to accumulate in aquatic life. Some plants, mosses, lichens and fungi are able to accumulate antimony compounds.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Medium</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">A former antimony processing plant in Urunga NSW, which operated between 1969 and 1974, was abandoned in 1974 without clean up or remedial work. Tailings and mill waste water were discharged onto the wetland foreshore area during the plant operations. The tailings and adjoining environment are contaminated by a range of heavy metals, particularly arsenic, antimony and mercury. A belt of dead Melaleuca trees characterises the periphery of the tailings deposit. The tailings area is devoid of vegetation, and is periodically inundated by flood water and/or surface runoff. Preliminary works on the long-anticipated remediation of the contaminated antimony site at Urunga commenced in December 2014.</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td colspan="2">Industry – systematic controls</td><td colspan="3">Mining or manufacturing companies likely to use or produce antimony compounds are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like antimony.</td></tr>
<tr><td colspan="2">Industry – exposure controls</td><td colspan="3">Potential industrial sources of arsenic waste have strict emissions control equipment in place, such as baghouse filters and electrostatic precipitators. Additionally at-risk workers wear appropriate personal protective equipment (PPE).</td></tr>
<tr><td colspan="2">Government</td><td colspan="3">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.</td></tr>
<tr><td>References</td><td colspan="5">1. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Antimony and compounds. Accessed March 14, 2015 from: http://www.npi.gov.au/resource/antimony-and-compounds
2. Richardson BA. Cot mattress biodeterioration and SIDS. Lancet. 1990;335:670.
3. SIDS and Kids. National Scientific Advisory Group (NSAG) (2005). Information Statement: Speculation concerning toxic gas from mattresses. Accessed March 14, 2015 from: http://www.sidsandkids.org/wp-content/uploads/SIDS_SafeSleeping_A4_IS_ToxicGasesLR1web1.pdf
4. GHD (2012). Former Antimony Processing Plant- Urunga NSW Detailed Investigation Report for NSW Catchment and Lands- Crown Lands. Accessed March 10, 2015 from: http://www.lpma.nsw.gov.au/about_crown_land/publications/exhibition_and_</td></tr>
</table>

Waste name: Antimony; antimony compounds	Basel waste category:Y27	Basel permit code: A1010, A1020	NEPM code: D170
	information/information2/?a=197582 5. Sigma Aldrich (2015). Antimony Material Safety Data Sheet. Accessed April 13, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=266329&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F266329%3Flang%3Den 6. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.27 Tellurium; tellurium compounds

Waste name: Tellurium; tellurium compounds		Basel waste category:Y28		Basel permit code: A1010, A1020		NEPM code: D250
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
				3.1 – 3.8		
	Description of the waste	Tellurium is a brittle and rare, silver-white metalloid which looks similar to tin and has similar chemistry to selenium. Tellurium is typically present in industrial applications and mineralogy as salts of tellurium, such as tellurides. Tellurium is used in in steel and copper alloys to improve machinability, and increasingly in solar panels (as cadmium telluride) and as a semiconductor material. Tellurium and tellurium compounds are considered to be mildly toxic and need to be handled with care, although acute poisoning is rare. Its primary hazard is ecotoxicity in the aquatic environment. Tellurium can be found in anode sludges produced during the electrolytic refining of blister copper and also as a component of dusts from blast furnace refining of lead. In Australia, these sludges and dusts are how tellurium is likely to present currently as hazardous waste, although their concentrations will likely be lower than other metals of concern, such as lead.				
	Waste form	Solid and sludge				
	Physical/ chemical description	When crystalline, tellurium is silvery-white and when it is in pure state it has a metallic lustre which resists oxidation and is non-volatile. Tellurium is one of the rarest stable solid elements in the Earth's crust – three times rarer than gold. It is sometimes found in its native form, but is more often found as the tellurides of gold such as calaverite and krennerite. Cadmium telluride from solar panels is one of the most likely forms of tellurium for human health or environmental exposure. It has very low solubility in water and is very stable at high temperatures. Consequently cadmium telluride is reported as having much lower environmental mobility and toxicity than other forms of cadmium.				
Why is it hazardous?	Primary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Secondary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Other hazard(s)	N/A		N/A		

Waste name: Tellurium; tellurium compounds	Basel waste category:Y28	Basel permit code: A1010, A1020	NEPM code: D250

	Main likely chemical contaminants			Heavy metals such as Pb, Cd, Cu and Zn.			
Where does it come from?	**Main sources**	Literature quotes a number of industrial sources. Those applicable in Australia include various types of metal smelters and refineries, steel manufacturing and foundry industries. No tellurium wastes are reported in Australian hazardous waste generation data. This may be due to the fact that tellurium-containing wastes are likely to be classified according to other more dominant species present, such as copper, lead, zinc or cadmium. Perhaps the biggest issue with tellurium is a future one. The rapid rise of solar panels has excellent upside from a clean energy generation perspective, but presents a potential waste challenge in the years ahead when a critical mass of solar panels reach end of life. Tellurium's rarity may drive recycling efforts, which are not prevalent at present.					
How is it managed?	**Main fates**	Likely to be chemical/ physical treatment to immobilise the hazard, then the stabilised material would be disposed of in hazardous waste landfill.					
How much is generated in Australia?	**Volume score (% of national tonnes in 2013)**	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%	
		Not reported					
	Waste arising in 2013 (tonnes)	**TOTAL:**	**0**	**ACT:**	0	**NSW:**	0
		NT:	0	**Qld:**	0	**SA:**	0
		Tas:	0	**Vic:**	0	**WA:**	0
Potential health impacts	**Overview**	Tellurium and tellurium compounds are considered to be mildly toxic and need to be handled with care, although acute poisoning is rare. Tellurium poisoning is particularly difficult to treat as many chelation agents used in the treatment of metal toxicities will increase the toxicity of tellurium. Tellurium is not reported to be carcinogenic.					
	Acute toxicity	**Low**: Harmful by inhalation, in contact with skin and if swallowed. Humans exposed to even small concentrations in air exude a foul garlic-like odour known as "tellurium breath."[1] Tellurium is metabolized by the body to dimethyl telluride, $(CH_3)_2Te$, a volatile compound with a highly pungent garlic-like smell.					
	Chronic toxicity	**None known**					
	Carcinogenicity	**None known**					
	Reproductive toxicity	**None known**					
Workplace health & safety	Inhalation of dusts from metal refining operations is a possible source of workplace exposure to tellurium compounds. Such exposure has been linked to the 'garlic breath'						

<table>
<tr><th colspan="2">Waste name:
Tellurium; tellurium compounds</th><th>Basel waste category:Y28</th><th>Basel permit code: A1010, A1020</th><th>NEPM code: D250</th></tr>
<tr><td>impacts</td><td colspan="4">phenomenon, which is reported as a good indicator of tellurium ‘poisoning’, even at mild levels.[2]
Should a future recycling industry emerge for dealing with end of life solar panels, there may be a new issue of potential exposure. While the cadmium telluride chemical structure found in solar panels would appear to be a relatively safe way to ‘contain’ cadmium toxicity (see ‘Physical/ chemical description’), highly concentrated H_2SO_4 and H_2O_2 are needed to extract and recover Cd and Te in the recycling process. Not only are these strong acids and their wastes hazardous, toxic hydrogen telluride gas and cadmium salts would be formed, which would need to be carefully managed.</td></tr>
<tr><td>Population scale impacts</td><td colspan="4">No population scale impacts identified.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="3">Tellurium and compounds must be rated as strongly toxic to the aquatic environment, based on hazard criteria associated with cadmium telluride. However, there is a suggestion in the literature that this is overly cautious[3], based on the toxicities exhibited by cadmium salts generally, rather than actual toxicity of cadmium telluride, the most likely form of tellurium to impact the environment.
Recent aquatic toxicity testing showed no effects (lethal or sublethal) from cadmium telluride at aquatic saturation for zebrafish over 96 hours. [4]
The environmental impacts from tellurium compounds are only recently beginning to be investigated.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="3">Extreme: Very toxic to aquatic organisms.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="3">Extreme: May cause long-term adverse effects in the aquatic environment.</td></tr>
<tr><td>Persistence</td><td colspan="3">Low.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="3">Low: Not known to be bioaccumulative.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Low</td><td>Low</td><td>N/A</td><td>Low</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="4">There was no evidence found of an Australian environmental incident relating to tellurium. However, in the gold rush of 1893, diggers in Kalgoorlie discarded a pyritic material which got in their way as they searched for pure gold. The Kalgoorlie waste was thus used to fill in potholes or as part of sidewalks. Three years passed before it was realized that this waste was calaverite, a mineral form of gold telluride ($AuTe_2$). This led to a second gold rush in 1896 which included mining the streets.[5]</td></tr>
<tr><td>What control measures are in place to manage risks</td><td>Industry – systematic controls</td><td colspan="3">Companies that handle tellurium containing wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants.</td></tr>
</table>

Waste name: Tellurium; tellurium compounds		Basel waste category:Y28	Basel permit code: A1010, A1020	NEPM code: D250
posed by this waste?	**Industry – exposure controls**	Potential industrial sources of waste tellurium or its compounds have strict emissions control equipment in place, as required by workplace health and safety and environmental regulators. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of tellurium.		
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.		
References		1. Lide, D. R., ed. (2005). CRC Handbook of Chemistry and Physics (86th ed.). Boca Raton (FL): CRC Press. 2. Lightfoot N (2012). Laurentian University, Sudbury, Canada. Occupational tellurium exposure and garlic odour. *Occupational Medicine* (Impact Factor: 1.47). 12/2010; 61(2):132-5. 3. Surawut C, Manaskorn R, Thantip P, Chanathip P, Chulalak C, Pongkiatkul P (2012). Review of Environmental, Health and Safety of CdTe Photovoltaic Installations throughout Their Life-Cycle. Accessed on 16 April, 2015 from: http://www.pv-thin.org/wp-content/uploads/2013/09/CdTe-peer-review_-Thailand.pdf 4. Kaczmar, S., Evaluating the read-across approach on CdTe toxicity for CdTe photovoltaics, SETAC North America 32nd Annual Meeting, Boston, November 2011. 5. America 32nd Annual Meeting, Boston, November 2011.Fortey, Richard (2004). The Earth: An Intimate History. *Harper Perennial*. p. 230. 6. Crystran Ltd (2012). MSDS for cadmium telluride. Accessed on 16 April 2015 from: http://www.crystran.co.uk/userfiles/files/cadmium-telluride-cdte-msds.pdf		

3.28 Mercury; mercury compounds

Waste name: Mercury; mercury compounds		Basel waste category:Y29		Basel permit code: A1010, A1030		NEPM code: D120
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
				3.1 – 3.8		
	Description of the waste	Mercury is used in its pure form in thermometers and barometers, some batteries, fluorescent lighting, as a catalyst in the chemical manufacturing industry, in thermostats, dental amalgams and. It is also used in the mining industry to extract gold and silver ores. Mercuric chloride is used in the manufacture of disinfectants, as a catalyst, in photography and embalming. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments. Wastes of mercury compounds in Australia include end of life fluorescent light tubes and healthcare sources, as well as spent catalysts from chemical, petrochemical and mining industries.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or salts, which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds, the most hazardous form of mercury. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make. Metallic mercury is a dense liquid that vaporizes easily at room temperature. Mercury vapours are colourless and odourless, though they can be seen with the aid of an ultraviolet light.				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants			Other heavy metals		
Where does it come from?	Main sources	Mercury containing lamps from targeted collection programs are a key source of mercury waste. Industrial sources include electricity generation, chemical manufacturing, petroleum refining, mining and public utilities such as hospitals, research institutions and rail				

<table>
<tr><th colspan="3">Waste name:
Mercury; mercury compounds</th><th>Basel waste category:Y29</th><th>Basel permit code: A1010, A1030</th><th>NEPM code: D120</th></tr>
<tr><td></td><td></td><td colspan="4">infrastructure.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Mercury recycling exists in Australia, for separation and recycling of metallic mercury from all sources. However, the majority end of life mercury-containing lighting finds in way into municipal solid waste landfill, from disposal within the general waste stream.
Mercury may also be present at low levels in other hazardous waste, which will undergo chemical/ physical treatment to immobilise the hazard, then the stabilised material will be disposed of in hazardous waste landfill.</td></tr>
<tr><td rowspan="6">How much is generated in Australia?</td><td rowspan="6">Volume score (% of national tonnes in 2013)

Waste arising in 2013 (tonnes)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.03%</td><td colspan="4"></td></tr>
<tr><td>TOTAL:</td><td>2,191</td><td>ACT:</td><td>17</td><td>NSW:</td><td>1,684</td></tr>
<tr><td>NT:</td><td>51</td><td>Qld:</td><td>324</td><td>SA:</td><td>28</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>45</td><td>WA:</td><td>43</td></tr>
<tr><td></td><td></td><td colspan="4"></td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">Eating fish contaminated with mercury has caused poisoning in humans. Organic forms of mercury are subject to bioaccumulation and bioconcentration in the food chain and higher aquatic organisms may contain significant amounts of mercury.
Organic mercury compounds are more toxic than inorganic mercury compounds. Methylmercury can cross biological membranes, especially in the brain, spinal cord, peripheral nerves and the placenta with foetuses appearing to be at higher risk than adults.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">High: Very toxic by inhalation, in contact with skin and if swallowed. Acute mercury poisoning is usually caused by soluble inorganic salts. High levels of mercury vapour are extremely irritating to the lung and may cause erosive bronchitis, bronchiolitis or pneumonia.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">High: Danger of cumulative effect. Chronic mercury toxicity is more frequently seen than acute toxicity, due to its cumulative nature. Tremors, mental disturbances and gingivitis (inflammation of the mucous membranes surrounding the teeth) have been reported following occupational exposure. Both metallic mercury and mercury compounds have given rise to contact dermatitis.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">Negligible. Mercury is not a human carcinogen.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">High: May cause harm to the unborn child.
Delayed achievement of developmental milestones, and a history of seizures and abnormal reflexes were seen in infants born to women affected in an Iraqi poisoning episode where methylmercury treated wheat was eaten.</td></tr>
</table>

<table>
<tr><th colspan="3">Waste name:
Mercury; mercury compounds</th><th>Basel waste category:Y29</th><th>Basel permit code: A1010, A1030</th><th>NEPM code: D120</th></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">Workplace environments presenting the largest potential sources of occupational exposure to mercury include chlorine-alkali production facilities, mining and processing operations and the manufacture and use of instruments containing liquid mercury. Occupational exposure is mainly via inhalation of vapour.</td></tr>
<tr><td>Population scale impacts</td><td colspan="5">Potential sources of mercury exposure for the general population include inhalation from ambient air, ingestion in water and foodstuffs, and dental and medical treatments. Of these, dietary exposure is the major source of non-occupational exposure, often through eating fish or shellfish contaminated with methylmercury. The next most likely source of mercury exposure to the general population is via in-mouth releases and ingestion from dental fillings. Increased breath levels of mercury ranging from 0.1 to 16.2 ng/L (mean 8.2) were detected in 167 people with dental restoration as compared to 0.008 to 0.1 ng/L (mean 0.06) in five people with no amalgams.[1]
There is transfer of inorganic mercury from blood to breast milk and a Swedish study suggested that exposure of infants to mercury from this source was mainly from the mother's amalgam fillings. [2]</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td colspan="2">Overview</td><td colspan="3">Both mercury and its compounds have high acute (short-term) and have high chronic (long-term) toxicity on aquatic life. There is insufficient data to determine the acute toxicity of mercury and its compounds on plants, birds or land animals. Mercury and its compounds are highly persistent in water and the environment and will concentrate in the tissues of fish. These concentrations will be considerably higher than the water from which the fish is taken.</td></tr>
<tr><td colspan="2">Acute ecotoxicity</td><td colspan="3">High: Toxic to aquatic organisms.</td></tr>
<tr><td colspan="2">Chronic ecotoxicity</td><td colspan="3">Extreme: May cause long-term adverse effects in the aquatic environment.</td></tr>
<tr><td colspan="2">Persistence</td><td colspan="3">Extreme: Very persistent in the environment.</td></tr>
<tr><td colspan="2">Bioaccumulation</td><td colspan="3">Extreme: Strongly bioaccumulative, especially in shellfish and fish.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Medium</td><td>Moderate</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">Minamata disease was first discovered in Minamata city in Kumamoto prefecture, Japan, in 1956, when the local populace ate shellfish and fish containing bioaccumulated mercury. Famously, it was caused by the release of methylmercury in industrial wastewater from the Chisso Corporation's chemical factory, which continued from 1932 to 1968.
In Australia
Orica’s Port Botany chemical plant in Sydney released mercury vapour into the atmosphere in September 2011, breaching environmental standards for nine hours. The mercury vapour was associated with mercury which had polluted the soil on the Orica site, due to leaking pipes.
In December 2011, Orica suffered another mercury leak at Port Botany. In a series of</td></tr>
</table>

Waste name: Mercury; mercury compounds		Basel waste category:Y29	Basel permit code: A1010, A1030	NEPM code: D120
	samples of air, the EPA recorded a mercury level of 0.0049 grams per cubic metre; more than double the regulatory limit of 0.002 grams per cubic metre. The site of the breach was the thermal desorption stack at the company's waste remediation plant, which was actually closed when the breach occurred.			
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Product stewardship is taking shared responsibility for reducing the environmental, health and safety footprint of manufactured goods and materials across the life cycle of a product. FluoroCycle[3] is an Australian Government accredited voluntary product stewardship scheme that seeks to increase the national recycling rate of waste mercury-containing lamps. It is administered by Lighting Council Australia The scheme targets the commercial and industrial sectors where the bulk of waste lamps are generated. Mercury-containing lamps are recycled to recover the mercury, as well as the glass, plastic and phosphor powder, they contain.		
	Industry – exposure controls	Potential industrial sources of waste mercury or its compounds have strict emissions control equipment in place, as required by workplace health and safety and environmental regulators. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of mercury.		
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements. The Minamata Convention[4] on is a global treaty to protect human health and the environment from the adverse effects of mercury, agreed in 2013. The Convention includes a ban on new mercury mines, the phase-out of existing ones, control measures on air emissions and the international regulation of the informal sector for artisanal and small-scale gold mining. The Food Standards Code[5] prescribes limits for total mercury in foods of 0.5 ppm for fish and shellfish, and 0.03 ppm for all other foods.		
	Community	Mercury is a potent neurotoxin and exposure should be avoided. The short-term nature of the potential exposure to mercury from a broken CFL or fluorescent tube – particularly after effective clean-up of lamp material – does not constitute a significant health risk to exposed adults, pregnant women or children. The United States Environmental Protection Agency provides a suggested procedure for cleaning up a broken CFL at: http://www2.epa.gov/cfl/cleaning-broken-cfl. Several states have household chemical collection programs and/or		

Waste name: Mercury; mercury compounds		Basel waste category:Y29	Basel permit code: A1010, A1030	NEPM code: D120
		drop-off points that accept domestic quantities of CFLs and fluorescent tubes for recycling. Planet Ark's *Recycling Near You* hotline on 1300 733 712 or their website at www.recyclingnearyou.com.au shows where CFLs and other mercury-containing lamps can be recycled.		
References		1. Queensland Government Queensland Health (2002). Public Health Guidance Note: Mercury. Accessed April 16, 2015 from: http://www.health.qld.gov.au/ph/Documents/ehu/2666.pdf 2. Oskarsson A, Schutz A, Skerfving S, Hallen IP, Ohlin B, Lagerkvist BJ. Total and inorganic mercury in breast milk and blood in relation to fish consumption and amalgam fillings in lactating women. *Archives of Environmental Health* 1996; 51: 234- 241. 3. Lighting Council of Australia. FluoroCycle product stewardship scheme. Accessed April 16, 2015 from: http://www.fluorocycle.org.au/index.php 4. United Nations Environment Programme (UNEP) (2013). Minamata Convention on Mercury. Accessed on April 16, 2015 from: http://www.mercuryconvention.org/Convention 5. Food Standards Australia New Zealand. Food Standards Code. Accessed on 16 April 2015 from: http://www.foodstandards.gov.au/code/Pages/default.aspx 6. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services (1993). Toxicological Profile for Mercury. Accessed April 15, 2015 from: http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=24 7. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Mercury and compounds. Accessed April 16, 2015 from: http://www.npi.gov.au/resource/mercury-compounds 8. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.29 Thallium; thallium compounds

Waste name: Thallium; thallium compounds		Basel waste category:Y30		Basel permit code: A1010, A1030		NEPM code: D180
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
		0 – 2.5				
	Description of the waste	Thallium and thallium compounds are used in products and in the manufacturing of electronics and infrared optical lenses. It also has uses in medicine in nuclear cardiography. It was previously used as a pesticide for rats and ants however the use of this is now prohibited in most developed nations[1]. Thallium is generated as a by-product from the mining and industries of other minerals, namely from the smelting of copper, lead or zinc and through coal power generation where it is a trace contaminant of the raw material[2].				
	Waste form	Solid and liquid				
	Physical/ chemical description	Thallium is a soft and malleable silvery-white metal which is found in trace amounts in the natural environment (<0.7 ppm). When exposed to air for short periods of time, thallium will develop a blue-grey tinge. If left in air it will develop a heavy oxide and in the presence of water will form hydroxide. Thallium and thallium compounds are radioactive[3].				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.			
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.			
	Other hazard(s)	N/A	N/A			
	Main likely chemical contaminants		Thallium is likely to be a contaminant of other metals.			
Where does it come from?	Main sources	Australia does not mine thallium directly however it is produced as a by-product of ore smelting. Small amounts of thallium waste are likely to be present in electronics and commercial medical imaging equipment[2].				
How is it managed?	Main fates	No data is kept on the generation or fate of thallium waste. Waste should be treated to immobilise the hazard before being disposed of in hazardous waste landfill.				
How much is	Volume score	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%

<table>
<tr><th colspan="3">Waste name:
Thallium; thallium compounds</th><th colspan="2">Basel waste category:Y30</th><th colspan="2">Basel permit code: A1010, A1030</th><th colspan="2">NEPM code: D180</th></tr>
<tr><td rowspan="4">generated in Australia?</td><td rowspan="4">(% of national tonnes in 2013)

Waste arising in 2013 (tonnes)</td><td colspan="7">0%</td></tr>
<tr><td>TOTAL:</td><td>0</td><td>ACT:</td><td>0</td><td>NSW:</td><td>0</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>0</td><td>SA:</td><td>0</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>0</td><td>WA:</td><td>0</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="7">The most common route of thallium exposure occurs through inhalation or ingestion of dust particles or through water and food contamination. In its pure form, thallium is tasteless and odourless. Short and long-term exposure can result in a variety of adverse health effects, mainly involving the central nervous system, gastro-intestinal system and major organs. Thallium is more toxic to humans than mercury, cadmium, lead, copper or zinc and has been responsible for many accidental and occupational poisonings[4].</td></tr>
<tr><td>Acute toxicity</td><td colspan="7">High: Very harmful if inhaled or swallowed. Ingesting thallium over a can result in issues with the gastro-intestinal system, nervous system, lungs, heart, liver and kidneys[1]. It can also cause death[5].</td></tr>
<tr><td>Chronic toxicity</td><td colspan="7">High: Long-term exposure to thallium can result in issues with the nervous system, such as numbness of extremities, joint pain and fatigue.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="7">Low: There is insufficient evidence to suggest that thallium is carcinogenic to humans.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="7">Low: There is insufficient evidence to suggest that thallium causes reproductive or birth defects to humans.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="8">Occupational exposure to high levels of thallium can result in harmful effects. A study in 1986 on cement plant workers found that they exhibited numbness and tingling in fingers and toes and muscle cramps as a result of inhaling thallium[6].
Another study in 1998 found that a worker who handled thallium-containing raw materials for glass manufacturing over a period of four years suffered from alopecia, abdominal pain, diarrhoea and numbness and tingling in hands and feet. Thallium levels in hair samples were considered to be very high and it was concluded that the worker had suffered from chronic poisoning due to the occupational exposure to thallium dust[7].</td></tr>
<tr><td>Population scale impacts</td><td colspan="8">Areas around cement plants, ore smelters, coal burning power plants and brick works are likely to contain high levels of atmospheric deposition of thallium[8]. Studies in the 1980's found that populations living near cement factories in Germany had increased concentrations of thallium in urine and hair. In this example, the major route for the intake of thallium was through the consumption vegetables and fruit grown in private gardens contaminated with dust fall from emissions of a cement plant which contained thallium. Nervous system paralysis, sleep disorders, headaches and fatigue were found to be major health effects associated with thallium levels in urine and hair when compared with a control population[9].</td></tr>
</table>

<table>
<tr><th colspan="3">Waste name:
Thallium; thallium compounds</th><th>Basel waste category:Y30</th><th>Basel permit code: A1010, A1030</th><th>NEPM code: D180</th></tr>
<tr><td></td><td colspan="5">Thallium and thallium compounds can transfer from soils to crops and will accumulate in food crops[4].</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="4">Thallium was previously used as a pesticide in rat bait as it is highly toxic. It is also toxic and bioaccumulative in aquatic organisms. While Thallium is a natural element it is only found in trace amounts and is released to the environment through smelting and coal-burning. It remains in the air, water and soil and is not readily broken down[1, 5].</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="4">High: Toxic to aquatic organisms and land animals[10, 11]</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="4">High: Long-term exposure leads to reduced growth rates in aquatic organisms[12].</td></tr>
<tr><td>Persistence</td><td colspan="4">Extreme: It is persistent in air, water and soil and does not break down[1].</td></tr>
<tr><td>Bioaccumulation</td><td colspan="4">Moderate: Accumulates in aquatic organisms, land animals and plants.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Medium</td><td>Medium</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">No specific Australian incidents have been identified.</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="4">Higher risk workplaces like smelters and coal burning power plants, where worker exposure to thallium or other airborne pollutants may be possible, routinely monitor at-risk staff via blood or urine-based testing. Thallium concentrations must be below specified risk guidelines to ensure the worker is safe to continue working in the exposed environment[13].
Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like thallium.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="4">Potential industrial sources of thallium waste are have strict emissions control equipment in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE).
Australia also has national standards in place regarding the exposure limits for atmospheric contaminants in the occupational environment. These relate to average atmospheric contaminants over an eight hour day and apply to a 40 hour week. The current limits for thallium and thallium compounds are 0.1 mg/m^3 of air. This limit acts as a national guideline and may vary between states and territories.</td></tr>
<tr><td>Government</td><td colspan="4">State and territory governments regulate the management of</td></tr>
</table>

Waste name: Thallium; thallium compounds	Basel waste category:Y30	Basel permit code: A1010, A1030	NEPM code: D180
		hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.	
References	1. United States Department of Health and Human Services Agency for Toxic Substances and Disease Registry (2013). Toxic Substances Portal – Thallium. Accessed April 15, 2015 from: http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=308&tid=49 2. Royal Australian Chemical Institute (2011). Thallium. Accessed April 15, 2015 from: https://www.raci.org.au/document/item/492 3. Lenntech (2015). Thallium – Tl. Accessed April 15, 2015 from: http://www.lenntech.com/periodic/elements/tl.htm 4. John Peter AL and Viraraghavan T (2005). Thallium: a review of public health and environmental concerns. *Environmental International*, 31(4): 493–501. 5. Strem Chemicals Inc. (2011). Material Safety Data Sheet – Thallium. Accessed April 15, 2015 from: http://www.strem.com/catalog/msds/81-8200 6. Ludolph A, Elger CE, Sennhenn R and Bertram HP (1986). Chronic thallium exposure in cement plant workers: Clinical and electrophysiological data. *Trace Elements in Medicine* 3:121–125. 7. Hirata M, Taoda A, Ono-Ogasawara M, Takaya M and Hisanaga N (1998). A probable case of chronic occupational thallium poisoning in a glass factory. *Industrial Health*, 36(3): 300–303. 8. Kazantzis G (2000). Thallium in the Environment and Health Effects. *Environmental Geochemistry and Health*, 22(4): 275–280. 9. Brockhaus A, Dolgner R, Ewers U, Kramer U, Soddermann H and Wiegand H (1981). Intake and health effects of thallium among population living in the vicinity of a cement plant emitting thallium containing dust. *International Archives of Occupational and Environmental Health*, 48(4): 375–389. 10. Zitko V, Carson WV and Carson WG (1975). Thallium: Occurrence in the environment and toxicity to fish. *Bulletin of Environmental Contamination and Toxicology*, 13(1):22–30. 11. Lan C-H and Lin T-S (2005). Acute toxicity of trivalent thallium compounds to *Daphnia magna*. *Exotoxicology and Environmental Safety*, 61(3): 432–435. 12. Borgmann U, Cheam V, Norwood WP and Lechner J (1998). Toxicity and bioaccumulation of thallium in *Hyalella azteca*, with comparison to other metals and prediction of environmental impact. *Environmental Pollution*, 99(1): 105–114. 13. Safe Work Australia (2013). Thallium – Hazardous Chemicals Requiring Health Monitoring. Accessed April 15, 2015 from: http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/hm-thallium		

3.30 Lead; lead compounds

Waste name: Lead; lead compounds		Basel waste category:Y31		Basel permit code: A1010, A1020		NEPM code: D220
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
				3.1 – 3.8		
	Description of the waste	Lead and lead compounds are used in a wide variety of products and manufacturing processes. Lead is used in the production of batteries, metal products such as fishing weights, electronics and alloys and devices to shield x-rays. Lead compounds are used in the manufacturing of a range of products including electronic parts, plastics, rubbers and metals. Lead is also used in pigments, dyes, paints and coatings. Lead occurs naturally in mineral form, usually with Zinc and Silver. According to Geoscience Australia, Australia has the world's largest deposits of both lead and zinc and as a result, both are mined and used locally and exported[1]. A significant component of lead waste in Australia is from lead acid batteries. Leaded glass is another wastestream that has emerged from the e-waste recycling industry, where cathode ray television/ monitor (CRT) glass contains large quantities of lead.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Lead is a soft bluish-white silvery grey metallic solid that occurs naturally in mineral form. It tarnishes on exposure to air. It is very soft and malleable, easily melted, cast, rolled and extruded. It reacts with hot nitric acid, boiling sulfuric or hydrochloric acids and can be attacked by pure water and weak organic acids in the presence of oxygen. The physical and chemical properties of lead compounds are varied[2].				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants			Other heavy metals could be present		
Where does it come from?	Main sources	Lead, silver, copper and zinc mining and refining, lead acid battery recycling and recovery, e-waste collection and recycling. metal recycling, iron and steel manufacturing, Lead and lead compounds are used in the production of consumer				

<table>
<tr><th colspan="2">Waste name:
Lead; lead compounds</th><th colspan="6">Basel waste category:Y31</th><th colspan="2">Basel permit code: A1010, A1020</th><th colspan="2">NEPM code: D220</th></tr>
<tr><td></td><td></td><td colspan="10">products such as batteries, electronics, metal products and devices to shield X-rays[2].
Lead was previously present in petroleum, paints, ceramics, caulking and pipe solder.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="10">Recycling of lead batteries or leaded CRT glass through smelting and reclamation.
Less economical quantities and waste forms containing lead will undergo chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score
(% of national tonnes in 2012-13)</td><td><1%</td><td colspan="2">1 – 5%</td><td colspan="2">5 – 10%</td><td colspan="2">10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td colspan="4">1.85%</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Waste arising in 2012-13 (tonnes)</td><td>TOTAL:</td><td>101,086</td><td>ACT:</td><td>226</td><td>NSW:</td><td>32,085</td></tr>
<tr><td>NT:</td><td>410</td><td>Qld:</td><td>23,876</td><td>SA:</td><td>9,259</td></tr>
<tr><td></td><td>Tas:</td><td>10,413</td><td>Vic:</td><td>20,120</td><td>WA:</td><td>4,697</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="10">The most common route of lead exposure occurs through inhalation or ingestion of lead dust, particles or exhaust. Lead can act as an irritant when it comes in contact with skin or eyes.
Long-term exposure to lead can result in a variety of adverse health effects, mainly involving the central nervous system, major organs and effects on unborn babies. Health consequences from exposure are more significant in children aged 5 years or younger[2].</td></tr>
<tr><td>Acute toxicity</td><td colspan="10">Low: Slightly hazardous in cases of skin or eye contact (irritant), through inhalation or ingestion[3].</td></tr>
<tr><td>Chronic toxicity</td><td colspan="10">Extreme: Lead mostly affects the nervous system however can impact upon almost every organic in the body. Exposure may cause paralysis in fingers, wrists or ankles as well increases in blood pressure. It may cause anaemia, malnutrition, abdominal pain and colic. High levels of exposure can severely damage the brain and kidneys and may cause death in adults[2].</td></tr>
<tr><td>Carcinogenicity</td><td colspan="10">Low: Inorganic lead is likely to be carcinogenic to humans. There is insufficient evidence to suggest that organic lead is carcinogenic to humans.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="10">High: Unborn children can be exposed through their mothers and harmful effects may include: premature birth, smaller babies, decreased mental ability, learning difficulties and reduced growth. Some effects may persist beyond childhood. Exposure to high levels of lead may cause miscarriage in pregnant women. In men, exposure may affect sperm production[2].</td></tr>
</table>

Waste name: Lead; lead compounds			Basel waste category: Y31	Basel permit code: A1010, A1020	NEPM code: D220
Workplace health & safety impacts	Occupational exposure studies have been carried out on adults working in lead smelters over a prolonged period of time. In 1992, Gerhardsson et al[4] carried out a study to compare kidney function of a group of lead smelter workers with one that had no occupational exposure to lead. It was found that the group of smelter workers had significantly higher concentrations of blood and urine lead however were not experiencing significant differences in kidney function. While this study did not find a causal link between lead exposure and kidney function, other studies have found that long-term adult exposure resulting in high blood lead concentrations can result in decreased nerve conduction, gastro-intestinal issues, anaemia, cognitive impairment, psychological dysfunction and behaviour changes[5].				
Population scale impacts	In many developed countries, background levels of lead are seen to be unavoidable however these are often at low enough quantities to not cause any associated health issues. The accumulation of lead in soils, dust, air and water is more concentrated around cities and towns where lead mining or smelting occurs. Communities in Port Pirie, Mount Isa, Broken Hill and Lake Macquarie (among others) have increased levels accumulated lead as a result of mining or smelting activities[5]. The accumulation of lead was found to be a significant contributor to increased levels of blood lead found in children from Port Pirie, South Australia. The town has been the site of a lead smelter for over 100 years and the accumulation of lead materials was seen to be the pathway for a variety of health issues associated with children born and raised in the town. This resulted in the establishment of the Port Pirie Lead Implementation Program and an Environmental Health Centre to help to reduce the amount of Lead that children were adsorbing and therefore the associated health issues[6].				
Potential environment impacts	**Overview**	Lead occurs naturally in the environment and does not decompose. Lead compounds are changed by sunlight, air and water and their toxicity is dependent on the compound. Lead is persistent and bioaccumulative and can exhibit long term toxic effects in plants, birds and land animals.			
	Acute ecotoxicity	**Low**: In soft water it is highly poisonous to plants, birds or land animals.			
	Chronic ecotoxicity	**Extreme**: Lead has long term effects on animal life leading to decreased lifespan, reproductive problems, lower fertility and changes in appearance and behaviour. Can also result in low growth rate in plants.			
	Persistence	**Extreme**: Very persistent in the environment. Most lead released to air, water or sediment will strongly attach to other particles and may remain for many years.			
	Bioaccumulation	**Extreme**: Can accumulate in living tissue of land animals, birds and fish.			

Where are the risks of impacts most	Generation	Transport	Storage	Treatment	Recovery	Final disposal
	High	Medium	Medium	Moderate	N/A	Low

Waste name: Lead; lead compounds		Basel waste category: Y31	Basel permit code: A1010, A1020	NEPM code: D220
likely?				
Has anything happened before in Australia?	The lead smelter in Port Pirie South Australia, in the northern Spencer Gulf, has a long history of operation. It has historically been a large sources of lead and other heavy metal emissions the surrounding air, water and land environment. The northern Spencer Gulf region has a substantial legacy of heavy metal pollution. Studies conducted over a number of decades have shown elevated levels of metals in the upper section of the gulf, particularly in Germein Bay near Port Pirie.[10] However, practices at the smelter have been vastly improved in recent years and this has helped to reduce the amount of heavy metals entering the marine environment. Slowing or reversing the effects of historical practices in the region will take many years.			
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Higher risk workplaces like lead smelters and mines, where worker exposure to lead or other airborne pollutants may be possible, routinely monitor at-risk staff via blood or urine-based testing. Lead concentrations must be below specified risk guidelines to ensure the worker is safe to continue working in the exposed environment[7]. Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like lead.		
	Industry – exposure controls	Potential industrial sources of lead waste have strict emissions control measures in place through the use of plant equipment such as engineering controls (extraction ventilation) and isolation of processes. Additionally at-risk workers should wear appropriate personal protective equipment (PPE)[7]. Australia also has national standards in place regarding the exposure limits for atmospheric contaminants in the occupational environment. These relate to average atmospheric contaminants over an eight hour day and apply to a 40 hour week. The current limits for lead and lead substances are: 0.15 mg/m^3 of air for tetramethyl lead, 0.1 mg/m^3 of air for tetraethyl lead, 0.15 mg/m^3 of air for lead arsenate, 0.15 mg/m^3 of air for lead dust and fumes and 0.05 mg/m^3 of air for lead chromate[8]. These limits act as a national guideline and may vary between states and territories.		
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements. Australian drinking water guidelines set a maximum level of lead at 0.01mg/L. Australian drinking water monitoring shows results typically range from less than 0.005 mg/L to 0.01 mg/L[9].		
References	1. Geoscience Australia (2015). Zinc-Lead-Silver. Accessed April 14, 2015 from http://www.ga.gov.au/scientific-topics/minerals/mineral-resources/aimr/zinc-lead-silver			

Waste name: Lead; lead compounds	Basel waste category:Y31	Basel permit code: A1010, A1020	NEPM code: D220

2. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Lead and compounds. Accessed April 14, 2015 from http://www.npi.gov.au/resource/lead-compounds

3. Science Lab (2013). Material Safety Data Sheet – Lead MSDS. Accessed April 14, 2015 from http://www.sciencelab.com/msds.php?msdsId=9927204

4. Gerhardsson L, Chettle DR, Englyst V, Nordberg GF, Nyhlin H, Scott MC, Todd AC and Vesterberg O (1992). Kidney effects in long term exposed lead smelter workers. *British Journal of Industrial Medicine*, 49: 186–192.

5. Armstrong A, Anderson L, Synnot A, Burford B, Waters E, Bao Le L, Weightman A, Morgan H, Turley R and Steele E (2014). Evaluation of evidence related to exposure to lead. Accessed April 15, 2015 from https://www.nhmrc.gov.au/_files_nhmrc/file/your_health/lead/evaluation_of_evidence_related_to_exposure_to_lead_140716.pdf

6. Body PE, Inglis G, Dolan PR, Mulcahy DE (1991). Environmental lead: A review. *Critical Reviews in Environmental Control*, 20(5-6): 299–310.

7. Victorian WorkCover Authority (2000). Code of Practice for Lead. Accessed March 14, 2015 from: https://www.worksafe.vic.gov.au/__data/assets/pdf_file/0005/12488/COP26_lead.pdf

8. Safe Work Australia (1995). Adopted National Exposure Standards For Atmospheric Contaminants In The Occupation Environment [NOHSC: 1003 (1995)]. Accessed March 14, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/237/AdoptedNationalExposureStandardsAtmosphericContaminants_NOHSC1003-1995_PDF.pdf

9. Australian Government National Health and Medical Research Council (2015). National Water Quality Management Strategy: Australian Drinking Waste Guideline 6 version 3.1 updated March 2015. Accessed April 14, 2015 from: https://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh52_australian_drinking_water_guidelines_150413.pdf

C

10. EPA South Australia (2005). Heavy metal contamination in the northern Spencer Gulf—a community summary. Accessed 27 April 2015 from: http://www.epa.sa.gov.au/xstd_files/Water/Report/heavy_metal.pdf

3.31 Inorganic fluorine compounds excluding calcium fluoride

Waste name: Inorganic fluorine compounds excluding calcium fluoride		Basel waste category:Y32	Basel permit code: A2020	NEPM code: D110
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme: 3.1 – 3.8		
	Description of the waste	Inorganic fluorine compounds are used in a variety of industrial and manufacturing processes. The primary source of waste is from industries that use compounds in production and these may include the aluminium industry, oil drilling and refining (petroleum) industry, the chemical and plastic industries, agricultural and pesticide manufacturers and manufacturers of metal parts. Emissions from these industries will generally be to the air. Other emissions to the soil and water may occur from metal cleaning operations, glass and enamel manufacturing and glazing and fluoride enhanced water. Fluorine compounds are also present in consumer products such as toothpaste, pesticides and ceramic and glass polishing, etching and frosting materials[1]. Spent pot liner waste (SPL) from aluminium smelting contains leachable fluorides and cyanides (see Y33).		
	Waste form	Solid and liquid		
	Physical/ chemical description	Elemental fluorine is a naturally occurring element in the earth however it is unlikely to be found in nature as it is too reactive. Fluorine is likely to be found in nature as part of the mineral fluorspar (or calcium fluoride), which is excluded from this category. Inorganic fluorine compounds include a wide range of chemical compounds with fluorine as the base element. These may include compounds formed with hydrogen, metals, non-metals and noble gases. An example of a compound of fluorine is hydrogen fluoride, a colourless gas with a strong irritating odour. Hydrogen fluoride is used to manufacture other fluorine based chemicals and will dissolve in water to make hydrofluoric acid[1].		
Why is it hazardous?	Primary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
	Other hazard(s)	N/A	N/A	
	Main likely chemical contaminants		Other inorganic salts such as chlorides and sulphates.	
Where does it	Main sources	Aluminium smelting, chemical and plastics industries, oil drilling and		

<table>
<tr><th colspan="2">Waste name:
Inorganic fluorine compounds excluding calcium fluoride</th><th colspan="6">Basel waste category:Y32</th><th colspan="2">Basel permit code: A2020</th><th>NEPM code: D110</th></tr>
<tr><td>come from?</td><td></td><td colspan="9">refining (petroleum), coal-fired electricity generation, metal, glass and enamel manufacturing.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="9">SPL recycling is in its infancy and, large stockpiles currently exist.
Other fluorine containing wastes will likely be managed by hazardous waste landfill.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td><td colspan="4"></td></tr>
<tr><td>0.18%</td><td colspan="8"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>13,167</td><td>ACT:</td><td>0</td><td>NSW:</td><td>6,174</td><td colspan="3"></td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>988</td><td>SA:</td><td>7</td><td colspan="3"></td></tr>
<tr><td>Tas:</td><td>96</td><td>Vic:</td><td>5,892</td><td>WA:</td><td>10</td><td colspan="3"></td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="9">The most common hazards of human exposure to inorganic fluorine compounds are:
• irritation of skin, eyes, mouth, throat and lungs.
• chronic poisoning of the central nervous system and major organs</td></tr>
<tr><td>Acute toxicity</td><td colspan="9">High: Toxic by inhalation, ingestion and touch. Contact with skin or eyes can result in severe burns and eye damage. Inhalation or ingestion will result in irritation to nose, throat and lungs[2].</td></tr>
<tr><td>Chronic toxicity</td><td colspan="9">High: Chronic poisoning due to exposure to fluorine compounds is characterised by issues with the central nervous system and major organs such as the heart, lungs or kidney[2].</td></tr>
<tr><td>Carcinogenicity</td><td colspan="9">Moderate: Some fluorine compounds may have carcinogenic effects.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="9">Low: There is insufficient evidence to suggest that inorganic fluorine causes reproductive or birth defects to humans.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="10">A number of occupational exposure studies have been conducted on adults working in industries with high levels of exposure to inorganic fluorine compounds. These studies have established definitive links between inorganic fluorine compounds and incidences of acute and chronic diseases. A long-term seven year study carried out to evaluate the respiratory effects of fluorine compounds on exposed workers at an enamel enterprise found a significant correlation between exposure and incidence of chronic bronchitis and other chronic respiratory diseases[3]. Other studies have found that occupational asthma in the aluminium industry is primarily due to gaseous or particulate fluorine compounds[4, 5].</td></tr>
<tr><td>Population scale impacts</td><td colspan="10">Elevated fluorine concentrations in the atmosphere and in drinking water are likely to occur in close proximity to production and processing facilities that use fluorine compounds[1]. However, little recent information is available to suggest that fluorine compounds have resulted in larger, population scale impacts.</td></tr>
<tr><td>Potential environment</td><td>Overview</td><td colspan="9">Fluorine compounds exhibit long-term toxic effects on the environment as well as being persistent. Industrial production and processing are the</td></tr>
</table>

Waste name: Inorganic fluorine compounds excluding calcium fluoride		Basel waste category:Y32	Basel permit code: A2020	NEPM code: D110		
impacts		largest emission contributor to environmental fluorine compounds and areas surrounding plants often display higher fluorine concentrations.				
	Acute ecotoxicity	**Low**: Insufficient evidence is available to determine the acute toxicity of fluorine compounds to plants or animals but the effects are thought to be low.				
	Chronic ecotoxicity	**Extreme**: Large quantities of fluorine compounds can lower the pH of ecosystems for extended periods of time. Concentrated compounds, such as hydrogen fluoride, are very corrosive and would significantly burn plants and animals exposed to it.				
	Persistence	**Extreme**: Fluorine compounds are highly persistent and will take the form of a gas, liquid or solid in a variety of ecosystems. Industrial emissions can produce elevated concentrations in the atmosphere.				
	Bioaccumulation	Limited evidence of bioaccumulation.				
Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Medium	Medium	Moderate	N/A	Low
Has anything happened before in Australia?	A large number of hydrofluoric acid workplace incidents and accidents in recent decades in Australia are reported in Appendix C of NICNAS's Hydrofluoric Acid (HF) Priority Existing Chemical Assessment Report No.19, [9]					
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Higher risk workplaces like the aluminium industry, where worker exposure to fluorine compounds may be possible, routinely monitor at-risk staff via blood or urine-based testing. Such companies are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of pollutants like lead.				
	Industry – exposure controls	Potential industrial sources of fluorine compound waste have strict emissions control measures in place through the use of plant equipment such as engineering controls (extraction ventilation). Additionally at-risk workers are required to wear appropriate personal protective equipment (PPE). Emergency facilities to manage the exposure of staff, such as eye wash stations, should also be readily available[6]. Australia also has national standards in place regarding the exposure limits for atmospheric contaminants in the occupational environment. These relate to average atmospheric contaminants over an eight hour day and apply to a 40 hour week. The current limits for fluorine compounds are 1.6 mg/m^3 of air for fluorine and 2.5 mg/m^3 of air for fluoride. These limits act as a national guideline and may vary between states and territories[7].				

Waste name: Inorganic fluorine compounds excluding calcium fluoride		Basel waste category:Y32	Basel permit code: A2020	NEPM code: D110
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements. Australian drinking water guidelines set a maximum level of fluoride at 1.5mg/L. Australian drinking water monitoring shows results typically range from less than 0.05 mg/L to 1.5 mg/L[8].		
References	1. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Fluoride compounds. Accessed April 16, 2015 from: http://www.npi.gov.au/resource/fluoride-compounds-sources-emissions 2. New Jersey Department of Health and Senior Services (2004). Hazardous substance fact sheet – Potassium fluoride. Accessed April 16, 2015 from http://nj.gov/health/eoh/rtkweb/documents/fs/1565.pdf 3. Viragh E, Viragh H, Laczka J and Coldea V (2006). Health effects of occupational exposure to fluorine and its compounds in a small-scale enterprise. *Industrial Health*, 44(1): 64–68. 4. Fritschi L, Sim MR, Forbes A, Abramson MJ, Benke G, Musk WA and de Klerk NH (2003). Respiratory symptons and lung-function changes with exposure to five substances in aluminum smelters. *International Archives of Occupational and Environmental Health*, 76(2): 103–110. 5. O'Donnell TV (1995). Asthma and respiratory problems – a review. *The Science of the Total Environment*, 163(1-3): 137–145. 6. Australian Government National Occupation Health and Safety Commission (1989). Hydrogen Fluoride. Accessed April 16, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/155/HydrogenFluoride_1989pdf.pdf 7. Safe Work Australia (1995). Adopted National Exposure Standards For Atmospheric Contaminants In The Occupation Environment [NOHSC: 1003 (1995)]. Accessed March 14, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/237/AdoptedNationalExposureStandardsAtmosphericContaminants_NOHSC1003-1995_PDF.pdf 8. Australian Government National Health and Medical Research Council (2015). National Water Quality Management Strategy: Australian Drinking Waste Guideline 6 version 3.1 updated March 2015. Accessed April 14, 2015 from: https://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh52_australian_drinking_water_guidelines_150413.pdf 9. National Industrial Chemicals Notification and Assessment Scheme (2001). Hydrofluoric Acid (HF) Priority Existing Chemical Assessment Report No.19. Accessed April 27 2015 from : http://www.nicnas.gov.au/__data/assets/pdf_file/0015/4380/PEC_19_Hydrofluoric-Acid_Full_Report_PDF.pdf			

3.32 Inorganic cyanides

Waste name: Inorganic cyanides		Basel waste category:Y33	Basel permit code: A4050	NEPM code: A130
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme		3.9 – 4.9
	Description of the waste	Solutions of sodium and potassium cyanides are used in processes that do not result in their complete transformation or destruction and they are present in wastes from such processes.		
	Waste form	Solid and liquid		
	Physical/ chemical description	Since they are water soluble and used as solutions, the wastes present as solutions containing cyanides and may also contain metal species derived from other components of the applications that employed the cyanide.		
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Other hazard(s)	H4.1: Flammable solids	Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.	
	Main likely chemical contaminants		Sodium and potassium cyanide, metals.	
Where does it come from?	Main sources	Sodium and potassium cyanides are used in mining in the recovery of gold (mainly) and silver by circulating a cyanide solution through piles of crushed rock. Gold and silver cyanide salts are adsorbed from this solution by activated carbon which is further processed to release gold and silver. The same cyanides are used in electroplating and finishing of metals such as chromium and nickel. Cyanides remain in solution after much of the metal has been removed.		
How is it managed?	Main fates	When concentrations of gold (or less often, silver) in the circulating solution falls below economic levels the solid, which still contains cyanide, is transferred to a tailings dam. In some cases the concentration of cyanide is allowed to decrease as natural processes take effect, but increasingly the cyanide in the waste stream is destroyed by treatment with Caro's acid (sulphuric acid plus hydrogen peroxide).		

<table>
<tr><th colspan="2">Waste name:
Inorganic cyanides</th><th colspan="6">Basel waste category:Y33</th><th colspan="2">Basel permit code: A4050</th><th colspan="2">NEPM code: A130</th></tr>
<tr><td></td><td></td><td colspan="10">Cyanide remaining in the plating bath is destroyed by treatment with hypochlorite before the liquid is discharged to sewer as trade waste. Before final disposal the remaining metals are precipitated and the resulting sludge may be treated to recover metals or transferred as hazardous waste to secure landfill.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td><td colspan="6"></td></tr>
<tr><td>0.001%</td><td colspan="10"></td></tr>
<tr><td rowspan="2">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>108</td><td>ACT:</td><td>0</td><td>NSW:</td><td>1</td><td>NT:</td><td>0</td><td>Qld:</td><td>15</td><td>SA:</td><td>13</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>26</td><td>WA:</td><td>52</td><td colspan="4"></td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="10">These water-soluble cyanides are extremely toxic to humans, and toxic effects can also be experienced from fume or mist containing cyanides and gaseous hydrogen cyanide that might exist in equilibrium with the dissolved species.</td></tr>
<tr><td>Acute toxicity</td><td colspan="10">Extreme: Ingestion of small quantities of cyanide leads to failure of the central nervous and respiratory systems and rapid death.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="10">Low- medium: Long-term exposure to lower concentrations of cyanide can affect many body functions.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="10">Cyanides are not known to be carcinogenic.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="10">Cyanides do not exhibit reproductive toxicity.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="11">Good ventilation of the workplace and implementation of safe working practices is essential where cyanides are handled. Codes of conduct exist for transport of cyanides used in the mining industry. Provision of personal protective equipment may be necessary where spills or leaks occur.</td></tr>
<tr><td>Population scale impacts</td><td colspan="11">There are no impacts on the wider community from these industrial chemicals.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="10">Cyanides are toxic to all animal species.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="10">Extreme: Acute effects can be observed when animals have access to tailings dams in which cyanide-containing material is concerned. Fences can restrict access of many species but birds may still be at risk.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="10">High: Cyanides exhibit high long-term chronic toxicity to aquatic life.</td></tr>
<tr><td>Persistence</td><td colspan="10">Low: Cyanides are destroyed in the environment, mainly by oxidation, and so are not persistent.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="10">Cyanides are not bioaccumulative.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Inorganic cyanides</th><th colspan="2">Basel waste category:Y33</th><th colspan="2">Basel permit code: A4050</th><th>NEPM code: A130</th></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">High concentrations of cyanide in a tailings dam in central NSW led to the deaths of several thousand birds in 1995. Many birds were killed in 2003 when containers of sodium cyanide on a truck travelling to a WA mine cracked and released cyanide. Sodium cyanide was released to the harbour from production facility in Gladstone Qld in 2012. In the period 1990-2015 Australia has experienced release of cyanide due to transport accidents on three occasions. Several thousand litres of cyanide solution spilled in Northern Territory in 2002, poisoning birds and dingoes. Solid cyanide was released after a train derailment in 1992 in NSW (100 tonnes) and a truck accident in Northern Territory in 2007.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td colspan="2">Industry – systematic controls</td><td colspan="4">The mining industry subscribes to a Cyanide Code of Practice that provides detailed specification of industry practice.</td></tr>
<tr><td colspan="2">Industry – exposure controls</td><td colspan="4">Workplace controls involve education of the workforce, provision of personal protective equipment, and regular monitoring of the work environment. Controls over the content of an access to tailings dams are increasingly stringent. For example, at the Cowal mine in central NSW, the dam is surrounded by two-metre high wire mesh fence, buried 0.5 metres deep and also an electrified fence.</td></tr>
<tr><td colspan="2">Government</td><td colspan="4">Safe Work Australia provides guidance to the use of dangerous chemicals in the electroplating industry and advocates a six-point plan for elimination of hazards: elimination, substitution, isolation, engineering controls, administrative controls, personal protective equipment.,

Mining operations are conducted under license from state and territory governments. Licenses increasingly require lower levels of cyanide in tailings dams and/or complete destruction of cyanide before discharge. Legislation also applies to transport to hazardous good such as cyanide.</td></tr>
<tr><td colspan="2">Community</td><td colspan="4">Some mines have community consultative bodies that contribute to best practice management of many aspects of the mining and treatment operations including cyanide management.</td></tr>
<tr><td>References</td><td colspan="6">1. Guidance note: controlling hazards in the electroplating industry: www.commerce.wa.gov.au/sites/default/files/atoms/files/guide_electroplating.pdf.
2. Pollution Prevention and Control. Technologies for Plating Operations: www.nmfrac.org/bluebook/sec623.htm.
3. Cyanide management (Leading practice Sustainable Development program for the Mining Industry, 2008): www.industry.gov.au/resource/Documents/LDSDP/LPSDP-</td></tr>
</table>

Waste name: Inorganic cyanides	Basel waste category:Y33	Basel permit code: A4050	NEPM code: A130
	CyanideHandbook.pdf. 4. www.worksafe.vic.gov.au/safety-and-prevention/health-and-safety-topics/dangerous-goods.		

3.33 Acidic solutions or acids in solid form

Waste name: Acidic solutions or acids in solid form		Basel waste category:Y34	Basel permit code: A4090	NEPM code: B100
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme **2.6 – 3.0**		
	Description of the waste	Acidic solutions and acid solid waste can take a large variety of forms including, but not limited to: sulfuric acid, hydrochloric acid, nitric acid, phosphoric acid, chromic acid, hydrofluoric acid, mixed inorganic and organic acids[1]. As a result, waste materials can originate from a range of sources with the most common being manufacturing of other chemicals, fertilisers, electronics and metal. Most acidic solutions and solids do not occur freely in nature. Some are found in active volcanic areas while others, like phosphoric acid, can be found in soft drinks, human and animal food and cleaning agents[2, 3, 4, 5].		
	Waste form	Solid and liquid		
	Physical/ chemical description	As this category of is so broad, the chemical and physical description is not the same across different types. A sample of acid solutions or solids are described below: • Nitric acid – is corrosive, transparent (colourless or slightly yellow) and has an acrid, pungent odour. It is a highly reactive with organic plastics and many metals and will fume in moist air[4]. • Phosphoric acid – is a non-combustible, colourless, odourless and hygroscopic crystal. Commercial phosphoric acid is a viscous solution in water. It is corrosive to ferrous metals and alloys and will readily react with metals to form flammable hydrogen gas[3]. • Sulfuric acid: is a clear, colourless, oily liquid which is very reactive and corrosive. It is soluble in water and ethyl alcohol and due to its strong reactivity it may ignite organic materials if mixed together[2].		
Why is it hazardous?	Primary hazard	H8: Corrosives	Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.	
	Secondary hazard	H6.1: Poisonous (acute)	Substances or wastes liable to cause either death or serious injury or to harm human health if swallowed or inhaled or by skin contact.	
	Other hazard(s)	H10: Liberation of toxic gases in contact with air or water	Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.	
	Main likely chemical contaminants		Likely to be found with a variety of other chemicals.	

<table>
<tr><th colspan="2">Waste name:
Acidic solutions or acids in solid form</th><th>Basel waste category:Y34</th><th>Basel permit code: A4090</th><th>NEPM code: B100</th></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="3">Metal coating and finishing; metal refining; primary metal and metal product manufacturing and coal mining, plus a range of manufacturing activities.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="3">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill. Some liquid wastes are discharged to sewer, after neutralisation, under regulatory agreements.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td colspan="3"><table><tr><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr><tr><td>0.56%</td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td colspan="3"><table><tr><td>TOTAL:</td><td>40,464</td><td>ACT:</td><td>0</td><td>NSW:</td><td>14,522</td></tr><tr><td>NT:</td><td>33</td><td>Qld:</td><td>14,092</td><td>SA:</td><td>718</td></tr><tr><td>Tas:</td><td>32</td><td>Vic:</td><td>7,173</td><td>WA:</td><td>3,894</td></tr></table></td></tr>
<tr><td>Waste arising in 2013 (tonnes)</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="3">The potential health impacts of acidic solutions and solids are widely varied. As a result, a range has been described for the potential impacts. While it is difficult to draw conclusions for all substances in the category, exposure generally results in high to extreme acute and chronic toxicity in the form of severe skin burns and irritation to the eyes, nose, throat and lungs. Exposure to concentrated forms may lead to death. Repeated exposure may cause permanent damage to internal organs. Some (but not all) have been found to have severe carcinogenic effects on humans[2, 3, 4, 5].</td></tr>
<tr><td>Acute toxicity</td><td colspan="3">High – Extreme
Most will result in severe corrosive burns when contacted with skin or ingested. Irritating to eyes, nose, throat and lungs if inhaled. Exposure to concentrated forms can cause circulatory collapse which may lead to death.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="3">Medium – High
Repeated exposures may cause permanent damage to the lungs, circulatory system and teeth. Long-term skin exposure may cause dermatitis.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="3">Low – Extreme
Sulfuric acid was found to be carcinogenic to humans through occupational exposure[7].</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="3">Low - Medium
There is little evidence to suggest that acidic solutions or solids have large effects on reproduction.</td></tr>
<tr><td>Workplace health &</td><td colspan="4">The majority of exposure incidences around acid solutions and solids occur in the workplace where the chemicals are used in production, manufacturing or cleaning. Exposure is often due to</td></tr>
</table>

Waste name: Acidic solutions or acids in solid form	Basel waste category:Y34	Basel permit code: A4090	NEPM code: B100

safety impacts	chemical spills resulting in severe skin or eye chemical burns. Gases emitted by acid solutions also present an occupational exposure risk. In a study of workers from a zinc galvanising plant who were exposed to hydrochloric acid fumes through processes within the plant, 90% were found to have dental erosion of the incisor teeth[8]. Other studies have concluded that occupational exposure to acid fumes are strongly associated with tooth surface loss[9].		
Population scale impacts	The general public may be exposed to small quantities of some acidic solutions or solids through the consumption of food and soft drinks or through the use of cleaning agents in the home. Some acids may also be present in small quantities in the atmosphere, especially around industries producing or using such substances. As a result of this, the population scale impacts of acidic solutions or solids are likely to be small. Such exposure incidents are likely to be as a result of accidental contact with the skin or through ingestion.		
Potential environment impacts	**Overview**	The potential environmental impacts of acidic solutions and solids are widely varied. As a result, a range has been described for the potential impacts. While it is difficult to draw conclusions for all substances in the category, exposure generally results in acute impacts such as plants or animals. Some substances are also corrosive to other minerals such as carbonates (like limestone) and all aluminosilicates (such as clay and igneous rock). The Impacts felt by a particular ecosystem will be dependent on the concentration of the substance in water, soil or the air [2, 3, 4, 5].	
	Acute ecotoxicity	**Low** Exposure to some acids will result in chemical burns to plants or animals. Some may also corrode other minerals such as limestone, clay and igneous rock.	
	Chronic ecotoxicity	**Low** Larger quantities of some acids can lower the pH of aquatic environments for extended periods of time, posing a potential risk to aquatic organisms.	
	Persistence	**Low – Medium** Some acids may result in acid rain. For example when sulfuric or hydrochloric acid enters the atmosphere it reacts with other chemicals to form salts. The acid particles then dissolve in clouds, fog, rain or snow forming dilute acidic solutions. This then falls to the soil as acid rain.	
	Bioaccumulation	**Low – Medium** Most acids do not bioaccumulate in the environment because of their highly reactive nature.	

Where are the risks of impacts most likely?	Generation	Transport	Storage	Treatment	Recovery	Final disposal
	High	Moderate	Moderate	Medium	N/A	Low

<table>
<tr><th colspan="2">Waste name:
Acidic solutions or acids in solid form</th><th>Basel waste category:Y34</th><th>Basel permit code: A4090</th><th>NEPM code: B100</th></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="4">At Kingston, south of Brisbane, a former gold mine was used to dispose of acid sludge, cyanide and oil processing wastes and finally municipal waste in the period from 1936–1967. Residential and commercial development on, and adjacent to, these areas occurred in subsequent decades. In 1982 high levels of acid in the soil were found. In 986 residents started to notice black sludge beginning to seep into their gardens and began to complain of health problems. Surrounding soils and ground-water were also found to be contaminated.
A community organisation called RATS (Residents Against Toxic Substances) was formed, who claimed increased leukaemia and other diseases were being diagnosed in Kingston, and began a self-funded civil action.
The State Government responded by ordering a review of all scientific and medical evidence, offered full health tests for residents and announced the government would rehabilitate the site and pay for families to be moved away. After thorough investigation, more than 20 houses were required to be relocated to allow for the affected areas to be capped and sealed. This was completed in 1991. The total cost of this operation to date, including relocating infrastructure, the engineering required to seal the site and on-going monitoring, is approximately $8 million.</td></tr>
<tr><td rowspan="2">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Each acidic solution or solid has different routine procedures in place to prevent negative health effects of exposure. Some higher risk workplaces, where worker exposure to acidic solutions or solids may be possible, routinely monitor at risk staff. Exposure standards for at risk workers must be below specified risk guideline to ensure the worker is safe to continue working in the exposed environment.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="3">Each acidic solution or solid has different exposure controls in place to prevent negative health effects of exposure.
Potential industrial sources of acidic waste have strict emissions control measures in place through the use of plant equipment such as engineering controls (extraction ventilation) and isolation of processes. Additionally, for most acids, at-risk workers should wear appropriate personal protective equipment (PPE) [10].
Australia also has national standards in place regarding the exposure limits for atmospheric contaminants in the occupational environment. These relate to average atmospheric contaminants over an eight hour day and apply to a 40 hour week[11]. For example, the current limits for vapour from some acidic solutions include:
• Nitric Acid – 5.2 mg/m^3 of air
• Phosphoric Acid – 1 mg/m^3 of air
• Sulfuric Acid – 1 mg/m^3 of air
These limits act as a national guideline and may vary between states and territories.</td></tr>
</table>

Waste name: Acidic solutions or acids in solid form	Basel waste category:Y34	Basel permit code: A4090	NEPM code: B100
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements. Some acidic solutions and salts have guidelines for fresh and marine water quality. For example, the guideline states that phosphate (derived from phosphoric acid) should not exceed 10 to 100 micrograms per litre. There is also a general range for the pH of fresh water from 6.5 to 9. Many acidic solutions have the ability to greatly impact the pH level of aquatic ecosystems beyond this range and so their release should be regulated[12]. Australian drinking water guidelines state that sulfuric acid and hydrochloric acid can be used to correct pH and to reduce corrosive properties of Australian drinking water. There are no limit levels for contaminants for other acidic solutions[13].
References	1. New South Wales Environment Protection Authority (2013). Waste codes & descriptions. Accessed April 16, 2015 from: http://www.epa.nsw.gov.au/owt/wclist.htm 2. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Sulfuric acid. Accessed April 16, 2015 from: http://www.npi.gov.au/resource/sulfuric-acid 3. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Phosphoric acid. Accessed April 16, 2015 from: http://www.npi.gov.au/resource/phosphoric-acid 4. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Nitric acid. Accessed April 16, 2015 from: http://www.npi.gov.au/resource/nitric-acid 5. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Hydrochloric acid. Accessed April 16, 2015 from: http://www.npi.gov.au/resource/hydrochloric-acid 6. United States Geological Survey (1993). Storage, transportation, handling and disposal of Hydrochloric Acid. Accessed April 16, 2015 from: http://water.usgs.gov/admin/memo/policy/wrdpolicy94.006.html 7. International Agency for Research on Cancer (IARC). Occupational exposures to mists and vapors form sulfuric acid and other strong inorganic acids. Accessed April 16, 2015 from: http://www.inchem.org/documents/iarc/vol54/01-mists.html 8. Remun B, Koster P, Houthuu D, Boleij J, Willems H, Brunekreef B and Van Loveren C (1982). Zinc chloride, zinc oxide, hydrochloric acid exposure and dental erosion in a zinc galvanizing plant in the Netherlands. *The Annals of Occupational Hygiene*, 25(3): 229–307. 9. Tuominen ML, Tuominen RJ, Fubusa F and Mgalula N (2006). Tooth surface loss and exposure to organic and inorganic acid fumes in workplace air. *Community Dentistry and Oral Epidemoilogy*, 19(4): 217–220. 10. Queensland Government (2011). Safe Handling & Storage of Hydrochloric Acid. Accessed April 16, 2015 from: 11. Safe Work Australia (1995). Adopted National Exposure Standards For Atmospheric Contaminants In The Occupation Environment [NOHSC: 1003 (1995)]. Accessed April 16, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/237/AdoptedNationalExposureStandardsAtmosphericContaminants_NOHSC1003-		

Waste name: Acidic solutions or acids in solid form	Basel waste category:Y34	Basel permit code: A4090	NEPM code: B100
	1995_PDF.pdf 12. Australian and New Zealand Environment and Conservation Council (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Accessed April 16, 2015 from: http://www.environment.gov.au/system/files/resources/53cda9ea-7ec2-49d4-af29-d1dde09e96ef/files/nwqms-guidelines-4-vol1.pdf 13. Australian Government National Health and Medical Research Council (2015). National Water Quality Management Strategy: Australian Drinking Waste Guideline 6 version 3.1 updated March 2015. Accessed April 14, 2015 from: https://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh52_australian_drinking_water_guidelines_150413.pdf 14. Queensland Government. Regulatory Impact Statement for SL 2000 No. 178. Accessed 27 April 2015 from: https://www.legislation.qld.gov.au/LEGISLTN/SLS/RIS_EN/2000/00SL178R2.pdf		

3.34 Basic solutions or bases in solid form

Waste name: Basic solutions or bases in solid form		Basel waste category:Y35	Basel permit code: A4090	NEPM code: C100
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme **2.6 – 3.0**		
	Description of the waste	Basic solutions and base solid waste can take a large variety of forms including, but not limited to: alkaline cleaners, potash, caustic soda, ammonium hydroxide, waste lime and cement and caustic neutralised waste[1]. As a result, waste materials can originate from a range of sources with the most common being cleaning agents, the manufacturing of other chemicals, fertilisers and metal treatment. Most basic solutions and solids do not occur freely in nature.		
	Waste form	Solid and liquid		
	Physical/ chemical description	As the category of basic solutions and solids is so broad, the chemical and physical description is not the same across different types. A sample of basic solutions or solids are described below: • Ammonium hydroxide – is a solution of ammonia in water. It is alkaline and corrosive and is highly reactive with oxidisers, acids and halogens[2]. • Potash – refers to potassium compounds and potassium-bearing materials. It occurs as either a solid or as a solution is clear liquid. It is caustic and highly alkaline and will react vigorously with acids and acid salts[3].		
Why is it hazardous?	**Primary hazard**	H8: Corrosives	Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.	
	Secondary hazard	H6.1: Poisonous (acute)	Substances or wastes liable to cause either death or serious injury or to harm human health if swallowed or inhaled or by skin contact.	
	Other hazard(s)	H10: Liberation of toxic gases in contact with air or water	Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.	
	Main likely chemical contaminants		Likely to be found with a variety of other chemicals.	
Where does it come from?	**Main sources**	Household and industrial cleaners, bleaching agents, disinfectants, the manufacturing of synthetic fibres, plastics, explosives, human and veterinary medicines, fertilisers, chemical compounds, metal treating operations, refrigeration and in the petroleum industry[2].		

<table>
<tr><th colspan="2">Waste name: Basic solutions or bases in solid form</th><th colspan="3">Basel waste category:Y35</th><th colspan="2">Basel permit code: A4090</th><th colspan="2">NEPM code: C100</th></tr>
<tr><td></td><td></td><td colspan="7">Major industrial sources in Australia are petroleum and gas extraction (particularly coal seam gas), aluminium smelting, cement and lime manufacturing, metal coating and finishing, fast food and food manufacturing (cleaning wastes), other manufacturing industries and potential alumina refining, through red mud.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="7">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill. Some liquid wastes are discharged to sewer, after neutralisation, under regulatory agreements.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td colspan="2">4.88%</td><td colspan="5"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>351,011</td><td>ACT:</td><td>450</td><td>NSW:</td><td>4,165</td></tr>
<tr><td>NT:</td><td>303</td><td>Qld:</td><td>223,589</td><td>SA:</td><td>27,674</td></tr>
<tr><td>Tas:</td><td>1</td><td>Vic:</td><td>6,497</td><td>WA:</td><td>88,333</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="7">The main impacts of basic solutions or solids occur in an acute manner as a result of exposure to concentrated solutions. Exposure can result in severe burns to the skin, mouth, throat or eyes depending on the exposed area.</td></tr>
<tr><td>Acute toxicity</td><td colspan="7">Extreme: Exposure to high concentrations of some basic solutions can cause skin irritation and burns. Swallowing concentrated solutions can cause burns in the mouth, throat and stomach and could lead death. Splashes of liquid solution to the eyes can cause burns and blindness[2, 4].</td></tr>
<tr><td>Chronic toxicity</td><td colspan="7">Low: There is little evidence to suggest that repeated exposure to basic solutions will cause chronic long-term damage.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="7">Low: There is little evidence to suggest that basic solutions or solids have carcinogenetic effects.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="7">Low: There is little evidence to suggest that basic solutions or solids have reproductive effects.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="8">The majority of exposure incidences around basic solutions and solids occur in the workplace where the chemicals are used in production, manufacturing or cleaning or in transportation. Exposure is often due to chemical spills resulting in severe skin or eye chemical burns[2].</td></tr>
<tr><td>Population scale impacts</td><td colspan="8">Some bases may be present in small quantities in the atmosphere, especially around industries producing or using such substances. As a result of this, the population scale impacts of basic solutions or solids are likely to be small. Such exposure incidents are likely to be as a result of accidental contact with the skin or through ingestion.</td></tr>
<tr><td>Potential environment</td><td>Overview</td><td colspan="7">The main environmental impacts of basic solutions or solids occur in an acute manner as a result of exposure to concentrated solutions.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name: Basic solutions or bases in solid form</th><th colspan="2">Basel waste category:Y35</th><th colspan="2">Basel permit code: A4090</th><th>NEPM code: C100</th></tr>
<tr><td rowspan="5">impacts</td><td></td><td colspan="5">Exposure can lead to impacts upon birds, fish and plants[2].</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">High: At high concentrations, some basic solutions and solids can have acute impacts upon birds, fish and plants resulting in reduced growth rate and death.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">Low: Some basic solutions and solids may result in long-term impacts upon aquatic organisms, reducing their lifespan, lowering fertility and causing reproductive problems.</td></tr>
<tr><td>Persistence</td><td colspan="5">Low: There is little evidence to suggest that basic solutions or solids are persistent in the natural environment.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">Low: There is little evidence to suggest that basic solutions or solids are bioaccumulative.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">As much as 1.7 ML of sodium hydroxide solution overflowed from a refinery tank as a ship was unloading at Alcoa’s Kwinana jetty, in WA in June 2004. The spill was contained in an earthen spill compound. It cost the company $366,000 to clean up after the incident and they were fined $11,000.</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">Each basic solution or solid has different routine procedures in place to prevent negative health effects of exposure. Some higher risk workplaces, where worker exposure to acidic solutions or solids may be possible, routinely monitor at risk staff. Exposure standards for at risk workers must be below specified risk guideline to ensure the worker is safe to continue working in the exposed environment.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Each basic solution or solid has different exposure controls in place to prevent negative health effects of exposure.
Potential industrial sources of basic waste have strict emissions control measures in place through the use of plant equipment such as engineering controls (extraction ventilation) and isolation of processes. Additionally, for most bases, at-risk workers should wear appropriate personal protective equipment (PPE).</td></tr>
<tr><td>Government</td><td colspan="5">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.
Some basic solutions and solids have guidelines for fresh and marine water quality. For example, there is a general range for the pH of fresh water from 6.5 to 9. Many basic solutions have the ability to greatly impact the pH level of aquatic ecosystems beyond this range and so their release should be regulated[5].</td></tr>
</table>

Waste name: Basic solutions or bases in solid form	Basel waste category:Y35	Basel permit code: A4090	NEPM code: C100
References	1. New South Wales Environment Protection Authority (2013). Waste codes & descriptions. Accessed April 16, 2015 from: http://www.epa.nsw.gov.au/owt/wclist.htm 2. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheet – Ammonia (total). Accessed April 16, 2015 from: http://www.npi.gov.au/resource/ammonia-total 3. Milestone (2012). Material Safety Data Sheet – Caustic Potash 28%. Accessed April 16, 2015 from: http://www.msdsonline.com.au/msds/msdsview.asp?Std=1&ID=05b48cf0-62e8-40f6-bba3-7ec2a0a7d2d4 4. Japan Soda Industry Association (2006). Safe Handling of Caustic Soda (Sodium Hydroxide). Accessed April 16, 2015 from: http://www.jsia.gr.jp/data/handling_01e.pdf 5. Australian and New Zealand Environment and Conservation Council (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Accessed April 16, 2015 from: http://www.environment.gov.au/system/files/resources/53cda9ea-7ec2-49d4-af29-d1dde09e96ef/files/nwqms-guidelines-4-vol1.pdf 6. Department of Consumer and Employment Protection, Government of Western Australia. Dangerous Goods Incident Logs, 2004. Accessed 27 April, 2015 from: http://www.dmp.wa.gov.au/documents/Reports/DG_IncidentLogs2004.pdf 7. Article from High Beam Research, April 12, 2015. Accessed 27 April 2015 from: http://www.highbeam.com/doc/1G1-131389172.html		

3.35 Asbestos (dust and fibres)

Waste name: Asbestos (dust and fibres)		Basel waste category:Y36	Basel permit code: A2050	NEPM code: N220		
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
			2.6 – 3.0			
	Description of the waste	Asbestos is the name given to a group of naturally occurring minerals found in rock formations. Three types of asbestos were mined in Australia: white (chrysotile), blue (crocidolite) and brown (amosite) asbestos. Asbestos mining was completely stopped in Australia by1983 but it is still mined in large quantities at many locations worldwide. Mined asbestos only represented a small proportion of the asbestos used in Australia (about 5%) with the bulk imported. The majority of asbestos (90%) used throughout the world, including Australia, was white asbestos. Australia banned the use or import of blue and brown asbestos or asbestos products in the mid-1980s, and banned all manufacture or import of white asbestos products in December 2003. Asbestos-containing building products are classified as either 'friable' (soft, crumbly) or 'bonded' (solid, rigid, non-friable). Friable asbestos products may be as much as 100% asbestos fibres and can become airborne and inhalable very easily. Bonded products such as asbestos cement sheet (otherwise known as 'fibro') contain approximately 15% asbestos fibres, bonded with cement and do not normally release fibres into the air when in good condition. Houses built before the mid-1980s are highly likely to have asbestos-containing products, between mid-1980s and 1990 likely, and after 1990 unlikely. Asbestos is one of the largest flows of hazardous waste in Australia and poses significant health risks. Asbestos waste includes both end of life asbestos-containing building materials as well as soil that has been tested to demonstrate asbestos contamination. Since the latter may involve very low asbestos fibre concentrations and very high soil volumes, this greatly contributes to reported asbestos waste volumes.				
	Waste form	Solid.				
	Physical/ chemical description	Asbestos fibres are strong, heat resistant and have insulating properties. Clumps of mined asbestos can be broken down into loose fibres or fibre bundles, and can be mixed with other materials, such as cement, to produce a variety of building products. Up to 90% of the asbestos produced in or imported into Australia was used for the manufacture of building products, especially asbestos cement materials. Asbestos fibres are not visible to the naked eye but, they are very light, remain airborne for a long time, and can be carried by wind and air currents over large distances. They are generally not broken down to other compounds and remain virtually unchanged over long				

<table>
<tr><th colspan="2">Waste name:
Asbestos (dust and fibres)</th><th colspan="2">Basel waste category:Y36</th><th colspan="2">Basel permit code: A2050</th><th colspan="2">NEPM code: N220</th></tr>
<tr><td></td><td></td><td colspan="6">periods.</td></tr>
<tr><td rowspan="4">Why is it hazardous?</td><td>Primary hazard</td><td colspan="2">H11: Toxic (delayed or chronic)</td><td colspan="4">Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.</td></tr>
<tr><td>Secondary hazard</td><td colspan="2">N/A</td><td colspan="4">N/A</td></tr>
<tr><td>Other hazard(s)</td><td colspan="2">N/A</td><td colspan="4">N/A</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="4">Other inorganic and organic pollutants, in the case of asbestos-containing contaminated soil.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="6">State-based waste data collection and tracking systems do not differentiate between waste asbestos-containing products and asbestos-containing contaminated soil.
Sources of either waste are: non-residential building construction, demolition contractors, commercial and residential asbestos removal services, property development services, hospitals, Defence and other numerous sectors involved in asbestos removal from their buildings.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">Asbestos waste is disposed of at landfills licensed by environmental regulators to receive asbestos waste.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td colspan="4">11.00%</td><td colspan="2"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>790,692</td><td>ACT:</td><td>0</td><td>NSW:</td><td>531,100</td></tr>
<tr><td>NT:</td><td>4,973</td><td>Qld:</td><td>115,323</td><td>SA:</td><td>18,934</td></tr>
<tr><td>Tas:</td><td>10,597</td><td>Vic:</td><td>57,733</td><td>WA:</td><td>52,031</td></tr>
<tr><td>Potential health impacts</td><td>Overview</td><td colspan="6">Asbestos only poses a risk to health when asbestos fibres are breathed in. Inhaling asbestos fibres may cause asbestos-related disease and death.
When asbestos fibres are breathed in, they may remain deep within the lungs. They can lodge in lung tissue and cause inflammation, scarring and some more serious asbestos- related diseases, which usually take many years, if not decades, to develop.
The four major asbestos-related diseases, in increasing order of severity, are:
• Pleural plaques: areas of white, smooth, raised scar tissue on the outer lining of the lung, internal chest wall and diaphragm. May be the earliest sign of asbestos exposure.
• Asbestosis: a chronic condition caused by inflammation or scarring in the lungs that causes shortness of breath, coughing</td></tr>
</table>

Waste name: Asbestos (dust and fibres)		Basel waste category:Y36	Basel permit code: A2050	NEPM code: N220
		and permanent lung damage. May be caused by heavy, prolonged exposure to asbestos. • **Lung cancer**: risk of developing lung cancer is increased in people who also smoke or have a pre-existing lung disease. • **Mesothelioma**: a rare form of cancer of the tissue that lines the body cavities, particularly the chest and abdominal cavities. In Australia, about 90% of all mesothelioma patients have a confirmed history of significant asbestos exposure.		
	Acute toxicity	**High**: Toxic by inhalation.		
	Chronic toxicity	**Extreme**: Danger of serious damage to health by prolonged exposure.		
	Carcinogenicity	**Extreme**: Crocidolite (blue asbestos), amosite (brown asbestos) and chrysotile (white asbestos), as fibres respectively, are all known to be human carcinogens via inhalation risk.		
	Reproductive toxicity	There are no reproductive toxicity impacts from exposure to asbestos.		
Workplace health & safety impacts	The risk factors for contracting asbestos-related disease are simply the total number of fibres breathed in over a lifetime. Most people who develop asbestos-related diseases have worked on jobs where they frequently breathed in large amounts of asbestos fibres. For example, in the past, construction workers using unsafe practices may have frequently encountered asbestos fibre levels well above background levels. The current regulated workplace limit (over an eight-hour period) is 100 fibres per litre of air (which is between 500 and 10 000 times background levels). In the past, workers in asbestos milling or mining often encountered fibre concentrations a million times higher than background levels (see 'Has anything happened before in Australia?' – Wittenoom).			
Population scale impacts	We are all exposed to low levels of asbestos in the air we breathe every day. Ambient or background air usually contains between 10 and 200 asbestos fibres in every 1000 litres (or cubic metre) of air (equivalent to 0.01 to 0.20 fibres per litre of air). However, most people do not become ill from this exposure, because the levels of asbestos present in the environment are very low. Most people are also exposed to higher levels of asbestos at some time in their lives; for example, in their workplace, community or home. However, for most people, this kind of infrequent exposure is also unlikely to result in any ill effects. A very small number of asbestos-related disease cases occur each year in people who have not worked with asbestos products. The low number of cases makes it difficult to determine the exact cause of the disease or the likely exposure event, but unsafe handling of asbestos materials in the home may have contributed to some of these cases.			
Potential environment impacts	**Overview**	The risks posed by asbestos are predominantly related to human health. However, the same risks apply to animals in the vicinity of sources of asbestos fibres, both pets and wild animals. When asbestos is released into the environment it contaminates the air, water and soil. Asbestos can travel for long distances in the air before it settles into water or on land, thus contaminating areas far away from its source. Fibres sit on top of the soil, where it can easily		

<table>
<tr><th colspan="2">Waste name:
Asbestos (dust and fibres)</th><th colspan="2">Basel waste category:Y36</th><th colspan="2">Basel permit code: A2050</th><th>NEPM code: N220</th></tr>
<tr><td></td><td></td><td colspan="5">be disturbed and redistributed into the air.</td></tr>
<tr><td></td><td>Acute ecotoxicity</td><td colspan="5">Low.</td></tr>
<tr><td></td><td>Chronic ecotoxicity</td><td colspan="5">Low.</td></tr>
<tr><td></td><td>Persistence</td><td colspan="5">High.</td></tr>
<tr><td></td><td>Bioaccumulation</td><td colspan="5">Low.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Medium</td><td>Moderate</td><td>N/A</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">Wittenoom, WA
Wittenoom is an area in the Pilbara region of Western Australia that carried out asbestos mining during the 1930's up until 1966, which produced tailings that contain varying amounts of residual blue asbestos fibres (crocidolite). The stockpiles of tailings have been eroded and dispersed over the years since the mining operations have ceased and now extend for several kilometres downstream from the actual mine sites. Tailings were also historically removed from the stockpiles and used on roads and around the town site as fill.
The 1990 Midnight Oil song ‘Blue Sky Mine’ was inspired by Wittenoom and its deadly mining industry. It’s estimated that more than 20,000 people lived at Wittenoom before the mine closed in 1966. Asbestos-related diseases have killed more than 2000 former workers and family members of Wittenoom, a death toll that continues to rise.
In 2007, the state government withdrew Wittenoom’s town status—disconnecting services like water and electricity—but a small group of residents stayed. Today they number just three.
Remnants of blue asbestos (the most deadly of all types of asbestos) are still present throughout the Wittenoom Asbestos Contaminated Area, presenting a serious risk to human health. The Department of Environment and Conservation has classified the town and gorge as contaminated and "not suitable for any form of human occupation” and that access to the area “should be prevented.”[1]
Mr Fluffy, Canberra ACT
From the 1950s to the 1970s the most refined form of brown and blue asbestos was pumped into the roof cavities of more than 1,000 Canberra and NSW homes as insulation. Loose raw asbestos was touted as cheap and effective insulation. The product was called asbestosfluf, and the company that installed it became known as Mr Fluffy.
Twenty-seven Canberra families have now left their homes, which have been deemed unsafe to live in, despite an extensive Commonwealth Government asbestos removal program in the 1980s. Recent assessment reports show that if there are fine cracks around cornices or halls, in wardrobes, ceiling fibres are being released into living areas.
The ACT Government has recently decided to borrow $1 billion from the Commonwealth Government to facilitate a buyback and demolition of every single Mr Fluffy house in the ACT – a decision which has now also been replicated in NSW.</td></tr>
</table>

Waste name: Asbestos (dust and fibres)		Basel waste category:Y36	Basel permit code: A2050	NEPM code: N220
What control measures are in place to manage risks posed by this waste?	**Industry controls**	Practices and controls for the management of asbestos exposure in the workplace are detailed in Safe Work Australia's Model Code of Practice - *How to Manage and Control Asbestos in the Workplace*, 2011, available at: http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/manage-control-asbestos-cop.		
	Government	The Australian Parliament passed legislation in June 2013 to establish an independent statutory authority, the Asbestos Safety and Eradication Agency (the Agency). The Agency began operations on 1 July 2013 and will provide a focus on issues which go beyond work health and safety to encompass transport, environmental (including storage and disposal) and public health issues and ensure asbestos issues receive the attention and focus needed to drive change across all levels of government. The broad functions of the Agency include advocating, coordinating, monitoring and reporting on the implementation of the National Strategic Plan for Asbestos Awareness and Management (Plan) which has been developed in consultation with Commonwealth, state and territory and local governments and a range of non-governmental stakeholders. The Plan can be found on the Agency's website at: www.asbestossafety.gov.au. Various Work Health and Safety (WHS) or Occupational Health and Safety (OHS) acts, regulations, codes of practice, certification requirements and other legislation and guidance exist in each state and territory and at the national level to regulate the workplace risks of asbestos. State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.		
	Community	Asbestos is all around us at home and at work, so knowledge of the risks is important for everyone. • Know where asbestos-containing products could be in your home. If in doubt, get products tested, or for safety's sake, assume it is asbestos. • Maintain asbestos-containing products in good condition, such as through use of paint or other surface finishes, enclosures and capping. • Replace asbestos cement materials if they are damaged or are being temporarily dismantled for any reason. Ensure all friable asbestos is removed only by a licensed asbestos removalist. • Get advice from your local government environmental health officer, or state or territory government, on safe handling and		

Waste name: Asbestos (dust and fibres)		Basel waste category:Y36	Basel permit code: A2050	NEPM code: N220
		disposal of asbestos-containing products, and on the use of appropriate protective equipment. • Engage a licensed asbestos removalist when undertaking major home renovations or demolitions where asbestos may be present. In some states, homeowners also require a licence for removal of asbestos-containing materials. • Ordinary dust masks are not effective in preventing the inhalation of asbestos fibres and dust. You should wear either a half-face filter respirator fitted with a class P1 or P2 filter cartridge, or a class P1 or P2 disposable respirator appropriate for asbestos.		
References		1. The West Australian newspaper, article March 5, 2013: *Wittenoom closure nears*. Accessed 24 April 2015 from: https://au.news.yahoo.com/thewest/regional/north-west/a/16300082/wittenoom-closure-nears/ 2. The West Australian newspaper, article July 15, 2013: *The last people standing*. Accessed 24 April 2015 from: https://au.news.yahoo.com/thewest/a/18007972/the-last-people-standing/ 3. ABC Radio National, 10 August 2014. Background Briefing: *Asbestos: The Mr Fluffy fiasco*. Accessed 24 April 2015 from: http://www.abc.net.au/radionational/programs/backgroundbriefing/2014-08-10/5649508 4. The Canberra Times newspaper, article January 2, 2015: *Andrew Kefford, the ACT bureaucrat combating Mr Fluffy.* Accessed 24 April, 2015 from: http://www.canberratimes.com.au/act-news/andrew-kefford-the-act-bureaucrat-combating-mr-fluffy-20150102-12d5gp.html 5. Environmental Health Standing Committee (enHealth), Asbestos: A guide for householders and the general public, Australian Health Protection Principal Committee, Canberra, 2013. Accessed 24 April 2015 from: http://www.health.gov.au/internet/publications/publishing.nsf/Content/asbestos-toc/$FILE/asbestos-feb13.pdf 6. Safe Work Australia. Hazardous Substances Information System (HSIS). Accessed April 20, 2015 from: http://hsis.safeworkaustralia.gov.au 7. Safe Work Australia. Model Code of Practice - *How to Manage and Control Asbestos in the Workplace*, 2011.Accessed 24 April 2015 from: http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/manage-control-asbestos-cop. 8. Work Safe Victoria. Compliance Code – Removing asbestos in workplaces. Edition No.1, September 2008. Accessed 24 April, 2015 from: https://www.worksafe.vic.gov.au/__data/assets/pdf_file/0018/9234/cc_asbestos_remove.pdf 9. Government of Western Australia Department of Lands. Wittenoom: Asbestos contamination and management. Accessed 24 April 2015 from: http://www.lands.wa.gov.au/Wittenoom 10. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.36 Organic phosphorus compounds

Waste name: Organic phosphorus compounds		Basel waste category:Y37		Basel permit code: A3130		NEPM code: H110
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
					3.9 – 4.9	
	Description of the waste	Esters of phosphoric acid and thiophosphoric acid involving a range of organic groups are used in industrial and agricultural applications.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Triphenyl and tricresyl phosphates are used as lubricants and plasticizers. These substances as well as halogenated derivatives are used as flame retardant additives for plastics. All such esters are high-boiling liquids. Esters and thioesters of thiophosphoric acid are used as pesticides. These are liquids or low-melting solids normally used in solution in organic solvents are as aqueous emulsions.				
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.		
	Secondary hazard	H12: Ecotoxic		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.		
	Other hazard(s)	N/A		N/A		
	Main likely chemical contaminants	Triaryl phosphate esters. Phosphate esters such as Diazinon, Azinphos-methyl, Chlorpyrifos and Dichlorvos.				
Where does it come from?	Main sources	Triaryl phosphates are blended with plastic materials to make them less brittle and to provide flame retardancy. The organophosphate pesticides are used in spray applications in orchards and horticulture, in disinfection of buildings and equipment, and in dipping and jetting of animals for pest control. In spray applications some of the pesticide attaches to non-target species and soil. Dipping solutions may be spilled during handling and overspray can occur with jetting.				
How is it managed?	Main fates	Triaryl phosphate esters are minor components of the plastic waste stream. Spent dip wash is held in a bunded area to allow slow degradation by natural process in soils.				
How much is	Volume score	<1%	1 – 5%	5 – 10%	10 – 20%	≥ 20%

<table>
<tr><th colspan="3">Waste name:
Organic phosphorus compounds</th><th colspan="2">Basel waste category:Y37</th><th colspan="2">Basel permit code: A3130</th><th colspan="2">NEPM code: H110</th></tr>
<tr><td rowspan="4">generated in Australia?</td><td>(% of national tonnes in 2013)</td><td colspan="6">0.01%</td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>676</td><td>ACT:</td><td>0</td><td>NSW:</td><td>7</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>51</td><td>SA:</td><td>54</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>13</td><td>WA:</td><td>550</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="6">Triaryl phosphates have low toxicity but may be absorbed through the skin.
The organophosphate pesticides are inhibitors of the enzyme acetyl cholinesterase and act by inducing muscle paralysis. They may be absorbed through the skin and are dangerous by inhalation or ingestion.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Low: Triaryl phosphates have low acute toxicity.
Extreme: The organophosphate pesticides are acutely toxic, inducing symptoms salivation, lachrymation, vomiting and laboured breathing.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Low: Triaryl phosphates have low chronic toxicity but see below for reproductive effects.
Medium: Chronic effects of longer term exposure to organophosphate pesticides are of the same type as the acute effects and result from decreased levels of the relevant enzyme causing reduced muscular control. Such effects may be induced by slow-release formulations of the organophosphate pesticides that are designed to maintain very low concentrations of the substances in indoor environments.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">Neither the triaryl phosphates nor the organophosphate pesticides are carcinogenic</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">Medium: Triaryl phosphates have reproductive toxicity, the mechanism of which is unknown.
The organophosphate pesticides do not pose a reproductive risk to humans.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="8">Workplace exposure must be avoided to the maximum extent possible. Spray and jetting applications pose particular risks and require the use of face masks. Periodic testing of workers is recommended by Safe Work Australia.</td></tr>
<tr><td>Population scale impacts</td><td colspan="8">Permitted residue levels for organophosphate pesticides on grains and other vegetable products are typically a few mg per kilogram on treated product and withholding intervals of typically 7 days after treatment.</td></tr>
<tr><td>Potential environment impacts</td><td>Overview</td><td colspan="6">No significant data are available on the environmental impacts of triaryl phosphates.
Organophosphate pesticides are toxic to animal species.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Organic phosphorus compounds</th><th colspan="2">Basel waste category:Y37</th><th colspan="2">Basel permit code: A3130</th><th>NEPM code: H110</th></tr>
<tr><td rowspan="4"></td><td>Acute ecotoxicity</td><td colspan="5">Extreme: As for humans, the toxicity consists of muscle impacts caused by enzyme inhibition. Very toxic in aquatic environments.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">Extreme: As for humans, continued exposure results in low level impacts of the same kind as acute poisoning. May cause long term adverse impacts in the aquatic environment.</td></tr>
<tr><td>Persistence</td><td colspan="5">Low: Triaryl phosphates are slowly degraded in the environment and so are not persistent.
Organophosphate pesticides are not persistent in the environment, but some degradation products are toxic and have longer lifetimes.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">Low: Triaryl phosphates are slowly degraded in the environment and in living systems so bioaccumulation is not expected.
Organophosphate pesticides are destroyed in the body and so are not bioaccumulative.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">Workplace exposures with poisoning of various extents are reported to state poisons centres.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">There are no controls over uses of triaryl phosphates but organophosphate pesticides are highly regulated. Their use requires the approval of the Australian Pesticides and Veterinary Medicines Authority (APVMA) which reviews their status from time to time as new evidence emerges. A number have been deregistered in recent years but there are still approximately 20 such compounds in use. APVMA has set the maximum daily intake of Dichlorvos, for example, at 0.0001 mg/kg body weight/day. Dichlorvos-containing products are listed under Schedules 5-7 depending on concentration.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">An enzyme-based product developed by CSIRO and Orica and marketed as Landmark™ is available for destruction of organophosphate residues in water and soils.</td></tr>
<tr><td>Government</td><td colspan="5">State and territory regulations govern uses of organophosphate pesticides. National oversight is maintained by the government agency APVMA.</td></tr>
<tr><td>Community</td><td colspan="5">Community may be exposed through spray drift or from inappropriate use of domestic products containing organophosphate pesticides.</td></tr>
<tr><td>References</td><td colspan="6">1. Dichlorvos Chemical review: http://apvma.gov.au/node/12491.</td></tr>
</table>

Waste name: Organic phosphorus compounds	Basel waste category:Y37	Basel permit code: A3130	NEPM code: H110
	2. G.W. Levot, 'Effective Remediation of Diazinon from Spent Sheep Dip Wash by Disposal on Land', *Australian Journal of Experimental Agriculture* 47(1) (2007), 13-16. 3. Organophosphates:: Health Surveillance. Guide for Employers. www.commerce.wa.gov.au/sites/dedfault/files/atoms/files/organophosphates_hs.pdf. 4. Landmark: www.csiropedia.csiro.au/pages/viewpage.action?pageId=426045. 5. For triphenyl phosphate: http://pubchem.ncbi.nim.nih.gov/compound/triphenyl_phosphate#section=Related-substances.		

3.37 Organic cyanides

Waste name: Organic cyanides		Basel waste category:Y38	Basel permit code: A4050	NEPM code: M210
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme **2.6 – 3.0**		
	Description of the waste	'Organic cyanides' is a misnomer since the cyanide ion (CN^-) that characterises inorganic cyanides and is the source of their toxicity is not involved. These substances are correctly described as nitriles in which the cyano group (-CN) is covalently bonded to carbon and cannot be detached as cyanide ion. Acetonitrile (CH_3CN) is used as a solvent and acrylonitrile (CH_2=CH-CN) is used as a monomer for polymer production in Australia. Ethanedinitrile (NC-CN), also known as cyanogen, is a fumigant that is available to replace methyl bromide (an ozone-depleting substance) in some uses in Australia.		
	Waste form	Liquid and gas		
	Physical/ chemical description	Acetonitrile is a liquid with boiling point 82^oC; acrylonitrile is a liquid with boiling point 79^oC; ethanedinitrile, boiling point -21^oC, is available as a gas.		
Why is it hazardous?	**Primary hazard**	H6.1: Poisonous (acute)	Substances or wastes liable to cause either death or serious injury or to harm human health if swallowed or inhaled or by skin contact.	
	Secondary hazard	H3: Flammable liquids	The word 'flammable' has the same meaning as 'inflammable'. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc, but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.	
	Other hazard(s)	N/A	N/A	
	Main likely chemical contaminants		Acetonitrile, acrylonitrile, ethanedinitrile.	
Where does it come from?	**Main sources**	Acetonitrile is used as a solvent in a range of applications, and the national Pollutant Inventory reveals emissions to air over the past five years averaging 570 kg/year. About 400 kg/year of acrylonitrile is used in the polymer (plastics) industry. The homopolymer, polyacrylonitrile, is used in fabrics. In Australia the main use is copolymerization with other monomers. The copolymer (ABS) is formed from acrylonitrile, butadiene and styrene. No information is available about usage of the new fumigant ethandinitrile.		

<table>
<tr><th colspan="3">Waste name:
Organic cyanides</th><th colspan="6">Basel waste category:Y38</th><th colspan="2">Basel permit code: A4050</th><th colspan="2">NEPM code: M210</th></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="10">The extremely small quantities of this waste that are generated in Australia are likely to be sent for thermal destruction or energy recovery.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="4">Volume score (% of national tonnes in 2013)

Waste arising in 2013 (tonnes)</td><td colspan="10"><table><tr><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr><tr><td>0.0002%</td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>TOTAL:</td><td>11</td><td>ACT:</td><td>0</td><td>NSW:</td><td>0</td><td>NT:</td><td>0</td><td>Qld:</td><td>9</td><td>SA:</td><td>0</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>0</td><td>WA:</td><td>2</td></tr>
<tr><td colspan="10"></td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="10">Nitriles can be inhaled as vapour or absorbed through skin. While some of their toxicity resembles that of inorganic cyanides, there is no chemical or biological pathway producing cyanide ions from the nitriles and commentaries to that effect are in error</td></tr>
<tr><td>Acute toxicity</td><td colspan="10">Extreme: Inhalation of acetonitrile affects mucous membranes and can produce cyanosis as oxygen in the blood is consumed. Higher concentrations affect the central nervous system producing headaches, numbness and tremors. Absorption through the skin may be a significant exposure route.
Acrylonitrile irritates the skin and eyes and acts as a central nervous system depressant and respiratory irritant.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="10">Extreme: Kidney and thyroid damage ensues after prolonged exposure to acetonitrile.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="10">Acetonitrile is not carcinogenic.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="10">Acetonitrile does not affect reproduction.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="11">The time weighted exposure limit for acetonitrile is 40 ppm (= 67 mg/m^3), with short term exposure permitted up to 60 ppm (= 101 mg/m^3). That for acrylonitrile is 2 ppm (4.3 mg/m^3).</td></tr>
<tr><td>Population scale impacts</td><td colspan="11">There were no population-scale impacts identified.</td></tr>
<tr><td rowspan="2">Potential environment impacts</td><td>Overview</td><td colspan="10">Acetonitrile and acrylonitrile released to air are minor components of the suite of Volatile Organic Compounds. Both are miscible with water and when released to the aqueous medium are transported widely and rapidly diluted below levels of concern. Ethane dinitrile is intended for use in closed systems such as those employed for fumigation of logs.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="10">Low: Acetonitrile exhibits slight acute toxicity to aquatic organisms. Acrylonitrile is highly toxic to aquatic organisms but data on its impacts on other lifeforms are lacking.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Organic cyanides</th><th colspan="2">Basel waste category:Y38</th><th colspan="2">Basel permit code: A4050</th><th>NEPM code: M210</th></tr>
<tr><td rowspan="3"></td><td>Chronic ecotoxicity</td><td colspan="5">Low: Acetonitrile exhibits slight chronic toxicity to aquatic organisms</td></tr>
<tr><td>Persistence</td><td colspan="5">Low: Acetonitrile and acrylonitrile have half-lives of a few days in the environment.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">Neither acetonitrile nor acrylonitrile is bioaccumulative.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Medium</td><td>Medium</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">No incidents in Australia have been identified.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">Health concerns are higher for acrylonitrile and ethane dinitrile on account of their toxicity than for acetonitrile.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Acetonitrile and acrylonitrile are generally used in closed systems so workers are not directly exposed during normal operations. Regulatory limits (see above) apply.</td></tr>
<tr><td>Government</td><td colspan="5">Workplace health and safety limits are promulgated by government agencies in States and Territories.</td></tr>
<tr><td>Community</td><td colspan="5">Since these are industrial chemicals with relatively small emissions to air, the exposure of the general public is slight.</td></tr>
<tr><td>References</td><td colspan="6">1. Public Release Summary on the Evaluation of the new Active Constituent Ethanedinitrile in the product Sterigas 1000 Fumigant (2013): http://archive.apvma.gov.au/registration/assessment/docs/prs_ethane-dinitrile.pdf.
2. Acetonitrile: http://pubchem.ncbi.nim.nih.gov/compound/acetonitrile#section=Top.
3. Toxic Substances Portal – Acrylonitrile (2013): www.atsdr.cdc.gov/toxprofiles/tp.asp?id=4478ctid=78.</td></tr>
</table>

3.38 Phenols; phenol compounds including chlorophenols

Waste name: Phenols; phenol compounds including chlorophenols		Basel waste category:Y39	Basel permit code: A3070	NEPM code: M150
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme	3.1 – 3.8	
	Description of the waste	Phenol is an industrial chemical that is used in the manufacture of resins, plastics, fibres, adhesives, iron, steel, aluminium, leather, and rubber. Chlorophenols are a small group of chemicals that substitute one or more hydrogen atoms in the aromatic ring structure with one or more chlorine atoms. Phenol is used in a variety of indoor products. It is used in general disinfectants and as a biocide in paints. It is also used in medicinal preparations such as mouth washes, throat lozenges, and shave creams. The largest single use of phenol is as an intermediate in the production of phenolic resins, which are low-cost, versatile, thermoset resins used in the plywood adhesive, construction, automotive, and appliance industries. Chlorophenols are commonly used in disinfectants as well as pesticides and herbicides. Pentachlorophenol (PCP), perhaps the most toxic of the chlorophenols, may have been used in wood preservation in Australia in decades past, but it is not currently approved for use as an agricultural or veterinary chemical in Australia. Phenol-containing wastes in Australia are usually spent materials from steel, other metal and other manufacturing industries. Phenols are also likely to be present in coal tars and other wastes from petroleum refining and processing industries.		
	Waste form	Solid and liquid		
	Physical/ chemical description	Phenol is a white crystalline mass which turns red or pink if exposed to air or light. It has a burning taste and a distinct aromatic, acrid odour. Phenol is combustible when exposed to heat, flame, or oxidizers and emits toxic fumes when heated.		
Why is it hazardous?	Primary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
	Other hazard(s)	N/A	N/A	
	Main likely chemical contaminants		N/A	

<table>
<tr><th colspan="2">Waste name:
Phenols; phenol compounds including chlorophenols</th><th colspan="6">Basel waste category:Y39 | Basel permit code: A3070 | NEPM code: M150</th></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="6">While some waste phenols come from chemical manufacturing, the major source of phenolic wastes in Australia is in spent foundry sands from ferrous and non-ferrous casting and foundries. This is due to the decomposition of phenolic resin binders during the metal pouring process.
Some phenolic waste comes from fossil fuel electricity supply.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">The small quantity of phenolic wastes generated in Australia are treated by thermal destruction.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td>0.02%</td><td colspan="5"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>1,110</td><td>ACT:</td><td>0</td><td>NSW:</td><td>145</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>955</td><td>SA:</td><td>0</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>8</td><td>WA:</td><td>2</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="6">Phenols can cause acute toxicity through contact with skin and mucous membranes. Since phenol is absorbed through the skin relatively quickly, systemic poisoning can occur in addition to the local caustic burns.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">High: Harmful if swallowed, in contact with skin or if inhaled. Causes skin and eye irritation dur to a protein-degenerating effect.
Pentachlorophenol (PCP), one of the most toxic phenolic compounds, can be fatal if inhaled or through skin contact. However, PCP has not been used in Australia for many decades.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">High: Chronic exposure to phenol could cause vertigo, digestive difficulties, skin eruptions, nervous problems and headaches.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">Low: PCP is suspected of causing cancer but exposure in Australia is unlikely. Other phenolic compounds are not classified as human carcinogens.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">Low: Suspected of causing genetic effects.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="7">Occupational exposure to phenolic compounds may occur during the production of phenol and its products, during the application of phenolic resins (wood and iron/steel industry) and during a number of other industrial activities. The highest concentration (up to 88 mg/m^3) was reported for workers in the ex-USSR quenching coke with phenol-containing waste water.
In Australia the most likely worker exposure is to the acrid fumes of decomposed phenolic resin binders, used on foundry sands in moulding and casting processes.</td></tr>
<tr><td>Population</td><td colspan="7">For the general population, cigarette smoke and smoked food products are the most</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Phenols; phenol compounds including chlorophenols</th><th colspan="2">Basel waste category:Y39</th><th colspan="2">Basel permit code: A3070</th><th>NEPM code: M150</th></tr>
<tr><td>scale impacts</td><td colspan="6">important sources of phenol exposure. Exposure by way of drinking-water and inadvertently contaminated food products is expected to be low; phenol has an objectionable smell and taste, which is not likely to be acceptable to the consumer.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="5">Phenols are very toxic in the environment. Acute toxic effects may include the death of animals, birds, or fish, and death or low growth rate in plants. Longer term effects may include shortened lifespan, reproductive problems, lower fertility, and changes in appearance or behaviour.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">Extreme: Very toxic to aquatic life.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">Extreme: Toxic to aquatic life with long lasting effects.</td></tr>
<tr><td>Persistence</td><td colspan="5">Low: Limited ability to persist in the environment.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">High: Will accumulate to some extent in fish and sediments.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Medium</td><td>Medium</td><td>Moderate</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">A worker was killed when a pipe burst and sprayed him with molten phenol in a horrific workplace accident in Melbourne’s west in May 2011. The man was working on pipes outside the Nufarm herbicide manufacturing facility in Laverton North when one exploded, dousing him in phenol which he also probably ingested. The man suffered a cardiac arrest in the decontamination shower and was unable to be revived.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="5">Companies that handle phenolic compounds and their wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="5">Potential industrial sources of phenol based wastes have strict emissions control and chemical handling equipment and systems in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of wastes such as fumes, which may have an acrid stench.</td></tr>
<tr><td>Government</td><td colspan="5">Regulatory levels are set by state and territory government agencies for exposure of workers to a range of volatile organic substances. Similar controls for emissions of volatile organic compounds (VOCs) exist on companies through environmental licensing regimes.</td></tr>
<tr><td>Community</td><td colspan="5">Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.</td></tr>
<tr><td>References</td><td colspan="6">1. Australian Government Department of the Environment. National Pollutant Inventory</td></tr>
</table>

Waste name: Phenols; phenol compounds including chlorophenols	Basel waste category:Y39	Basel permit code: A3070	NEPM code: M150
	Fact Sheet – phenol. Accessed March 24, 2015 from: http://www.npi.gov.au/resource/phenol 2 Guidechem MSDS for 4-Chlorophenol. Accessed 24 April, 2015 from: http://www.guidechem.com/msds/106-48-9.html 3. Sigma Aldrich (2015). 2- Chlorophenol Material Safety Data Sheet. Accessed April 24, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=185779&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F185779%3Flang%3Den 4. US Department of Transportation. Federal Highway Administration. User Guidelines for Waste and Byproduct Materials in Pavement Construction – Foundry Sand. Publication number: FHWA-RD-97-148. Accessed 24 April 2015 from: http://www.fhwa.dot.gov/publications/research/infrastructure/structures/97148/fs1.cfm 5. EPA South Australia (2014). Licensing Guidelines: Environmental management of foundries. Accessed 24 April 2015 from: http://www.epa.sa.gov.au/xstd_files/Air/Guideline/guide_foundries.pdf 6. The Age newspaper, May 19, 2011. *Man dies after chemical pipe bursts*. Accessed 24 April, 2015 from: http://www.theage.com.au/victoria/man-dies-after-chemical-pipe-bursts-20110519-1eu2g.html 7. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.39 Ethers

Waste name: Ethers		Basel waste category:Y40	Basel permit code: A3080	NEPM code: G100		
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
		0 – 2.5				
	Description of the waste	Ethers are excellent organic solvents (see Y42), liquid organic chemicals that have the ability to dissolve other substances. Ethers are classified separately to both organic solvents and halogenated organic solvents (Y41), probably because of their particularly high flammability (linked to their high volatility and auto-oxidation potential) and their low environmental impact compared to petroleum based solvents. As well as a solvent, ethyl ether is used as a volatile starting fluid for diesel engines and petrol engines in cold weather. Dimethyl ether is used as a spray propellant and refrigerant. Methyl tert-butyl ether (MTBE) is a petrol additive that boosts the octane number and reduces the amount of nitrogen-oxide pollutants in the exhaust. The ethers of ethylene glycol are used as solvents and plasticizers. Ethers are also important in medicine and pharmacology, especially for use as anaesthetics. Ethers present as wastes in Australia in small quantities from very industry-specific applications.				
	Waste form	Volatile liquid				
	Physical/ chemical description	Ethers are a class of organic compounds characterized by an oxygen atom bonded to two hydrocarbon groups, similar in structure to water; an oxygen atom bonded to two hydrogen atoms. At room temperature, ethers are colourless liquids that tend to characterised by their strong odour – ranging from pleasant to 'sickly sweet' to unpleasant. They are relatively unreactive, and as a result they are useful as solvents for fats, oils, waxes, perfumes, resins, dyes, gums, and hydrocarbons. Ethers, like alcohols, are relatively soluble in water compared to other organic solvents. They are highly flammable and can auto-oxidise to form organic peroxides such as diethyl ether peroxide - opened bottles of diethyl ether can build up dangerous levels of these peroxides in months.				
Why is it hazardous?	Primary hazard	H3: Flammable liquids	The word 'flammable' has the same meaning as 'inflammable'. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc, but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not			

<table>
<tr><th colspan="2">Waste name: Ethers</th><th colspan="2">Basel waste category:Y40</th><th colspan="2">Basel permit code: A3080</th><th colspan="2">NEPM code: G100</th></tr>
<tr><td rowspan="4"></td><td></td><td colspan="2"></td><td colspan="4">more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.</td></tr>
<tr><td>Secondary hazard</td><td colspan="2">H11: Toxic (delayed or chronic)</td><td colspan="4">Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.</td></tr>
<tr><td>Other hazard(s)</td><td colspan="2">H13: Capable of yielding another hazard or hazardous material</td><td colspan="4">Capable, by any means, after disposal, of yielding another material. In the case of some ethers, they can form explosive organic peroxides in contact with light, heat and oxygen in shelf-life timeframes.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="4">Other organic chemicals, as ethyl is a very effective solvent.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="6">Printing industry, pathology and diagnostic imagery services, scientific research services and higher education.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">Waste solvents are often subject to reclamation, but due to the high flammability of ethers this will either be blended into a waste derived fuel for energy recovery or incinerated.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td>0.02%</td><td colspan="5"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>1,463</td><td>ACT:</td><td>0</td><td>NSW:</td><td>0</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>145</td><td>SA:</td><td>6</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>1,295</td><td>WA:</td><td>17</td></tr>
<tr><td rowspan="3">Potential health impacts</td><td>Overview</td><td colspan="6">Ethers are extremely flammable liquids and vapours. They may also be prone to auto-oxidise to dangerous organic peroxides, diethyl ether peroxide, which are thermally unstable. Consequently ethers must be used stored and handled and disposed of with extreme care.
MTBE gives water an unpleasant taste at very low concentrations, and thus can render large quantities of groundwater non-potable. MTBE is often introduced into water-supply aquifers by leaking underground storage tanks (USTs) at gasoline stations or by gasoline containing MTBE spilled onto the ground. The higher water solubility and persistence of MTBE cause it to travel faster and farther than many other components of gasoline when released into an aquifer.[</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Medium – high: Harmful if swallowed. Causes serious eye irritation and may cause drowsiness or dizziness.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Low: Prolonged exposures may result in headache, drowsiness,</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Ethers</th><th colspan="4">Basel waste category:Y40</th><th>Basel permit code: A3080</th><th>NEPM code: G100</th></tr>
<tr><td rowspan="4"></td><td></td><td colspan="6">excitation, and psychic disturbances.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">Low: MTBE and similar ethers are not classified as carcinogenic, due to limited evidence in human or animal studies. But according to the US EPA, MTBE is a potential human carcinogen at high doses.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">Low- medium: Teratogenic effects (ability to disturb the development of an embryo or foetus) are possible.</td></tr>
<tr><td></td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="7">Though MTBE has been used as a fuel additive since 1979, there have been no long-term studies of the ability of MTBE to cause cancer or other long term effects in workers exposed to high concentrations. People who might have been exposed to MTBE at work often have also been exposed to a number of other chemicals, which makes studying this issue difficult.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="6">MTBE and other ethers are not a significant from an ecotoxicity point of view, but MTBE gives water an unpleasant taste at very low concentrations, which can render large quantities of groundwater non-potable. MTBE is often introduced into water-supply aquifers by leaking underground storage tanks (USTs) at petrol stations or by fuels containing MTBE spilled onto the ground. The higher water solubility and persistence of MTBE cause it to travel faster and farther than many other components of petrol when released into an aquifer.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="6">Low: Negligible to low toxicity to aquatic life.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="6">Low: Negligible to low toxicity to aquatic life.</td></tr>
<tr><td>Persistence</td><td colspan="6">Extreme: MTBE in particular does not break down easily making it problematic to clean up once contamination occurs.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="6">Ethers do not bioaccumulate in the aquatic environment.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td colspan="2">Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td colspan="2">Medium</td><td>Medium</td><td>Moderate</td><td>High</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="7">While no ether related incidents were identified in Australia, MTBE in particular has been implicated in explosions and groundwater contamination elsewhere in the world:

Tanker explosion Saudi Arabia

The chemical tanker Stolt Valor was carrying a cargo of methyl tertiary butyl ether (MTBE) when it exploded in the Persian Gulf in March 2012 killing one crew member [1]. MTBE was also the same cargo that exploded on the Bow Mariner in 2004, an incident that sparked a series of initiatives aimed at ending often catastrophic explosions on chemical tankers.

MTBE in groundwater USA

MTBE emerged as a significant issue for water utilities in the US in 1996 when it was detected in groundwater supplies for the city of Santa Monica only two years after it was introduced into fuel supplies in California [2]. The contamination was traced to leaking</td></tr>
</table>

Waste name: Ethers		Basel waste category:Y40 Basel permit code: A3080 NEPM code: G100
	underground fuel storage tanks. Groundwater pollution involving MTBE in the US has ballooned since that time. The cost to oil companies to clean up the MTBE in wells in Santa Monica was ultimately $423 million, settled in May 2008.[2]	
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Companies that handle organic solvents and their wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants. The printing industry, a significant generator of solvent wastes, established a code of practice in Victoria in 1996, aimed at reducing solvent emissions to the atmosphere. In 2004 this was replaced with an EPA Victoria information bulletin.[3]
	Industry – exposure controls	Potential industrial sources of organic solvent waste have strict emissions control and chemical handling equipment and systems in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of, and skin contact with, solvents and their wastes.
	Government	Regulatory levels are set by state and territory government agencies for exposure of workers to a range of volatile organic substances. Similar controls for emissions of volatile organic compounds (VOCs) exist on companies through environmental licensing regimes. *The Fuel Quality Standards Act 2000* provides a legislative framework for setting national fuel quality and fuel quality information standards for Australia[4]. These standards include a restriction on MTBE use in Australian fuel to 1% by volume, which compares to 3-7% usage in imported fuel and as high as 10-15% in the US[5] prior to its ban in a number of states from 2000 onwards.[6] Prior to national action, Queensland, South Australia and Western Australia had already put in place bans on MTBE in petrol in response to perceived environmental risks.
	Community	Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.
References	1. Falck website article. Explosion on the chemical tanker Stolt Valor. Accessed April 24, 2015 from : https://www.falck.com/en/timeline-events/2012_2 2. Los Angeles Times article, 8 May, 2008: *$423-million MTBE settlement is offered*. Accessed April 21, 2015 from: http://articles.latimes.com/2008/may/08/local/me-mtbe08 3. EPA Victoria information bulletin, publication 940, February 2004. *Minimising VOC emissions form the printing industry*. Accessed March 21, 2015 from: http://www.epa.vic.gov.au/~/media/Publications/940.pdf 4. Australian Government Department of the Environment. Petrol fuel quality standard.	

Waste name: Ethers	Basel waste category:Y40	Basel permit code: A3080	NEPM code: G100
	Accessed April 24, 2015 from: http://www.environment.gov.au/topics/environment-protection/fuel-quality/standards/petrol 5. Energy Information Administration. Status and Impact of State MTBE Bans. Accessed 24 April 2015 from: http://www.eia.gov/oiaf/servicerpt/mtbeban/table1.html 6. CRC Australia. MTBE Debate for Australia. *Health Stream, Public Health Newsletter of the CRC for Water Quality and Treatment*, Issue 23, September 2001. 7. Ethyl ether MSDS (1997). Accessed 24 April, 2015 from: http://hazard.com/msds/mf/baker/baker/files/e2340.htm 8. Sigma Aldrich (2015). Diethyl ether Material Safety Data Sheet. Accessed April 24, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=472484&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F472484%3Flang%3Den 9. UNEP (2002). Basel Convention. Technical Guidelines on Hazardous Waste from the Production and Use of Organic Solvents (Y6). Accessed March 21, 2015 from: http://www.basel.int/Portals/4/Basel%20Convention/docs/meetings/sbc/workdoc/old%20docs/tech-y6.pdf 10. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.40 Halogenated organic solvents

Waste name: Halogenated organic solvents		Basel waste category:Y41	Basel permit code: A3150	NEPM code: G150
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme 3.9 – 4.9		
	Description of the waste	Organic solvents are simply liquid organic chemicals that have the ability to dissolve other substances. This usually assists their role in an industrial application, such as cleaning and degreasing. Halogenated organic solvents specifically describe those organic solvents that include the halogens, mainly fluorine, chlorine and bromine, in their chemical structure. Solvents have three principal areas of use; as cleaning agents, as a raw material or feedstock in the production and manufacture of other substances, and as a carrying and/or dispersion medium in chemical synthetic processes. Wastes deriving from solvents and their use may be either: • relatively clean, derived from cleaning and washing processes • inclusive of other reaction products and by products – from synthesis/manufacture of other substances.	
	Waste form	Liquid		
	Physical/ chemical description	Many organic substances exhibit solvent type properties. Solvents display a very wide range of properties and characteristics. Many are flammable, some highly flammable, many are volatile and evaporate quite rapidly to give off vapours. Such vapours may be toxic or flammable - flammable vapours in confined spaces can be explosive. Halogenated organic solvents include chloroform, dichloromethane, carbon tetrachloride, trichloroethylene, tetrachloroethylene (known as perchloroethylene or 'perc'), 1,1,1- trichloroethane and chlorobenzene. Halogenated organic solvents tend to be more of a health and environmental concern than non-halogenated organic solvents.		
Why is it hazardous?	Primary hazard	H3: Flammable liquids	The word 'flammable' has the same meaning as 'inflammable'. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc, but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.	
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the	

<table>
<tr><th colspan="2">Waste name:
Halogenated organic solvents</th><th colspan="2">Basel waste category:Y41</th><th colspan="2">Basel permit code: A3150</th><th colspan="2">NEPM code: G150</th></tr>
<tr><td rowspan="3"></td><td></td><td colspan="2"></td><td colspan="4">skin, may involve delayed or chronic effects, including carcinogenicity.</td></tr>
<tr><td>Other hazard(s)</td><td colspan="2">H12: Ecotoxic</td><td colspan="4">Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="4"></td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="6">Dry cleaning, pharmaceutical product manufacturing, aerospace industries, fertiliser manufacturing</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">Waste solvents are often subject to reclamation, with any residues sent to energy recovery processes such as incineration or hazardous waste landfill.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td>0.02%</td><td colspan="5"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>1,263</td><td>ACT:</td><td>3</td><td>NSW:</td><td>216</td></tr>
<tr><td>NT:</td><td>2</td><td>Qld:</td><td>391</td><td>SA:</td><td>93</td></tr>
<tr><td>Tas:</td><td>202</td><td>Vic:</td><td>178</td><td>WA:</td><td>178</td></tr>
<tr><td rowspan="4">Potential health impacts</td><td>Overview</td><td colspan="6">Halogenated organic solvents generally more toxic than non-halogenated organics.
Given that more than one organic solvent may be present in a waste (e.g. paint thinners may contain toluene, xylene, ethylbenzene, methyl ethyl ketone and acetone) there is potential for additive or synergistic effects.
The flammability risk also heightens the care in which this waste should be handled.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">High: Toxic if swallowed. Irritating to eyes; irritating to skin. May cause an allergic skin reaction.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">High: Chlorinated organic solvents, such dichloromethane and trichloroethane are noted for their harmful effects on the heart. Chloroform and carbon tetrachloride are toxic to the liver and some chlorinated solvents may damage the kidneys.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">High: May cause cancer. Dichloromethane and tetrachloroethylene are classified as possible human carcinogens.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">Low: Limited evidence of reproductive impacts – possible risk of impaired fertility.</td></tr>
<tr><td>Workplace health & safety</td><td colspan="7">As organic solvents are volatile (i.e. tend to evaporate), inhalational exposure is an important exposure pathway to be considered when assessing the health hazards that</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Halogenated organic solvents</th><th colspan="2">Basel waste category:Y41</th><th colspan="2">Basel permit code: A3150</th><th>NEPM code: G150</th></tr>
<tr><td>impacts</td><td colspan="6">solvents may present.
Dry cleaning workers may have increased potential risk of developing chronic conditions from inhlation of halogenated organic solvents due to the quantities of ‘perc’ used in the industry.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="5">Organic solvents are highly toxic to aquatic environments. The risk of subsequent fire in the environment from a spill of this waste would also have broader environmental impacts.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">High: Toxic to aquatic organisms.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">Extreme: May cause long-term adverse impacts in the aquatic environment.</td></tr>
<tr><td>Persistence</td><td colspan="5">Low.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">Low.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Medium</td><td>Medium</td><td>Moderate</td><td>High</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">Groundwater contamination in Sydney
Remediation began in 2005 after production of chlorinated solvents by ICI (now Orica) over many years resulted in significant contamination of the Botany aquifer, a high quality sand aquifer located below the eastern suburbs of Sydney, New South Wales. The main chemical contaminant found in groundwater around the site was 1,2-dichloroethane, a persistent organic pollutant and by-product of the manufacture of PVC. Orica has built a A$167 million Groundwater Treatment Plant (GTP) to achieve containment of this contamination and provide high quality industrial water to Botany Industrial Park.
Water produced by Orica's GTP saves Sydney's potable water supply around 5 megalitres per day (approx 0.5% of Sydney's water demand). Residents in the area are banned from accessing the groundwater.
Chemical drums wash ashore in Victoria
On Victoria’s Bass Coast, a large number of toxic drums containing 1,2-Dichlorobenzene xylenol, a substance very toxic to aquatic creatures washed up on beaches during May 2009 presumably fallen off a passing container ship.</td></tr>
<tr><td>What control measures are in place to manage risks posed by this</td><td>Industry – systematic controls</td><td colspan="5">Companies that handle organic solvents and their wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants.</td></tr>
</table>

Waste name: Halogenated organic solvents		Basel waste category:Y41	Basel permit code: A3150	NEPM code: G150
waste?	**Industry – exposure controls**	Potential industrial sources of organic solvent waste have strict emissions control and chemical handling equipment and systems in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of, and skin contact with, solvents and their wastes.		
	Government	Regulatory levels are set by state and territory government agencies for exposure of workers to a range of volatile organic substances. Similar controls for emissions of volatile organic compounds (VOCs) exist on companies through environmental licensing regimes.		
	Community	Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.		
References	1. UNEP (2002). Basel Convention. Technical Guidelines on Hazardous Waste from the Production and Use of Organic Solvents (Y6). Accessed March 21, 2015 from: http://www.basel.int/Portals/4/Basel%20Convention/docs/meetings/sbc/workdoc/old%20docs/tech-y6.pdf 2. Solvents Australia Pty Ltd (2010). Trichloroethylene Material Safety Data Sheet. Accessed March 21, 2015 from: http://www.solvents.net.au/index_htm_files/Trichloroethylene.pdf 3. Solvents Australia Pty Ltd (2010). Perchloroethylene Material Safety Data Sheet. Accessed March 21, 2015 from: http://www.solvents.net.au/index_htm_files/Perchloroethylene.pdf 4. National Occupational Health and Safety Commission (1990). Australian Government. *Industrial Organic Solvents*. Accessed March 21, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/157/IndustrialOrganicSolvents_1990_PDF.pdf 5. The Age newspaper article, May 21, 2009. *Mass decontamination as toxic drums continue to wash ashore*. Accessed 23 April 2015 from: http://www.theage.com.au/national/mass-decontamination-as-toxic-drums-continue-to-wash-ashore-20090520-bfpn.html 6. Queensland Government Queensland Health. Public Health Guidance Note – Organic Solvents. Accessed March 21, 2015 from: http://www.health.qld.gov.au/ph/Documents/ehu/2688.pdf			

3.41 Organic solvents excluding halogenated solvents

Waste name: Organic solvents excluding halogenated solvents		Basel waste category:Y42	Basel permit code: A3140	NEPM code: G110
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High: 3.9 – 4.9 / Extreme		
	Description of the waste	Organic solvents are simply liquid organic chemicals that have the ability to dissolve other substances. This usually assists their role in an industrial application, such as cleaning and degreasing. Solvents have three principal areas of use; as cleaning agents, as a raw material or feedstock in the production and manufacture of other substances, and as a carrying and/or dispersion medium in chemical synthetic processes. Wastes deriving from solvents and their use may be either: • relatively clean, derived from cleaning and washing processes • inclusive of other reaction products and by products – from synthesis/manufacture of other substances.		
	Waste form	Liquid		
	Physical/ chemical description	Many organic substances exhibit solvent type properties. Solvents display a very wide range of properties and characteristics. Many are flammable, some highly flammable, many are volatile and evaporate quite rapidly to give off vapours. Such vapours may be toxic or flammable - flammable vapours in confined spaces can be explosive. Organic solvents include aliphatic hydrocarbons such as naphtha solvents, aromatic hydrocarbons such as benzene and xylenes, alcohols, glycols, epoxides, ketones and aldehydes. This category does not include those solvents and their wastes that contain halogens in their structure, such as fluorine, chlorine and bromine, as these compounds may have different toxicity characteristics. Halogenated organic solvents and their wastes are described by Y41.		
Why is it hazardous?	Primary hazard	H3: Flammable liquids	The word ‘flammable’ has the same meaning as ‘inflammable’. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc, but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.	
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects,	

<table>
<tr><th colspan="2">Waste name:
Organic solvents excluding halogenated solvents</th><th colspan="2">Basel waste category:Y42</th><th colspan="2">Basel permit code: A3140</th><th colspan="2">NEPM code: G110</th></tr>
<tr><td rowspan="3"></td><td></td><td colspan="2"></td><td colspan="4">including carcinogenicity.</td></tr>
<tr><td>Other hazard(s)</td><td colspan="2">H12: Ecotoxic</td><td colspan="4">Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="4">Other solvents, organic chemicals, petroleum residues, heavy metals, greases, dirt.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="6">Organic chemical manufacturing, coal seam gas extraction, petroleum refining, motor vehicle manufacturing, printing, food manufacturing, aerospace industries, hospitals, research facilities.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="6">Waste solvents are often subject to reclamation, with any residues sent to energy recovery processes such as incineration or hazardous waste landfill.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td>0.21%</td><td colspan="5"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>14,842</td><td>ACT:</td><td>64</td><td>NSW:</td><td>4,498</td></tr>
<tr><td>NT:</td><td>17</td><td>Qld:</td><td>2,000</td><td>SA:</td><td>279</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>3,334</td><td>WA:</td><td>4,649</td></tr>
<tr><td rowspan="4">Potential health impacts</td><td>Overview</td><td colspan="6">Some organic solvents (such as benzene) have been replaced with other substances due to their carcinogenic properties, which is a primary health concern for these types of wastes Other toxic properties can be varied, and include being narcotic and possibly mutagenic or teratogenic.
The flammability risk also heightens the care in which this waste should be handled.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Low - medium: Harmful if swallowed – may cause lung damage. Vapours may cause drowsiness and dizziness. Acute effects may also range from an alcohol-like intoxication to narcosis (stupor or insensibility) which may lead to unconsciousness.
May be irritating to skin.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Low - medium: Both short and long term exposure to certain organic solvents has been found to be harmful to the kidney. Petroleum distillates, for example, gasoline, jet fuel and turpentine, are among the most toxic.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">High: Some organic solvents may cause cancer and heritable genetic damage. Benzene is the main organic solvent which has definitively been proven to cause cancer in humans from industrial use – the</td></tr>
</table>

Waste name: Organic solvents excluding halogenated solvents		Basel waste category:Y42	Basel permit code: A3140	NEPM code: G110		
		main cancer being leukaemia.				
	Reproductive toxicity	**Low**: Limited evidence of reproductive impacts – possible risk of impaired fertility.				
Workplace health & safety impacts	Inhalation is usually the most significant route of entry by which organic solvents enter the human body at work. Poor hygiene practices could result in skin absorption.					
Population scale impacts	Most non-industrial applications of benzene, a natural constituent of crude oil and one of the most elementary petrochemicals, have been limited by benzene's carcinogenicity. However, significant primary exposure occurs routinely in everyday activities, particularly relating to petrol (gasoline) or other fossil fuel use. These include petrol vapour exposure at fuel outlets, burning coal and oil, motor vehicle exhaust, cigarette smoke, wood burning fires, some adhesives and low concentrations in ambient air from all of these sources. Population exposure studies from any particular exposure pathway have proved difficult to ascribe health effects to a particular source/ activity due to the range of confounding variables. However, epidemiologic studies provide clear evidence of a causal association between exposure to benzene and a number of forms of leukaemia.					
Potential environment impacts	**Overview**	Organic solvents are highly toxic to aquatic environments. The risk of subsequent fire in the environment from a spill of this waste would also have broader environmental impacts.				
	Acute ecotoxicity	**High**: Toxic to aquatic organisms.				
	Chronic ecotoxicity	**Extreme**: May cause long-term adverse impacts in the aquatic environment.				
	Persistence	Low.				
	Bioaccumulation	Low.				
Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Medium	Medium	Moderate	High	Low
Has anything happened before in Australia?	The contaminated site industry in Australia, in terms of identification, testing, classifying and remediating legacy waste impacts to land, was borne out of ground pollution from organic solvents or, more particularly, petroleum fuel leakages from underground storage tanks. Thousands of contaminated sites have been registered by environmental regulators across Australia and are in various stages of identification, quantification, remediation and clean up.					
What control measures are in place to manage risks	**Industry – systematic controls**	Companies that handle organic solvents and their wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants.				

Waste name: Organic solvents excluding halogenated solvents		Basel waste category:Y42	Basel permit code: A3140	NEPM code: G110
posed by this waste?	**Industry – exposure controls**	Potential industrial sources of organic solvent waste have strict emissions control and chemical handling equipment and systems in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of, and skin contact with, solvents and their wastes.		
	Government	Regulatory levels are set by state and territory government agencies for exposure of workers to a range of volatile organic substances. Similar controls for emissions of volatile organic compounds (VOCs) exist on companies through environmental licensing regimes.		
	Community	Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.		
References	1. UNEP (2002). Basel Convention. Technical Guidelines on Hazardous Waste from the Production and Use of Organic Solvents (Y6). Accessed March 21, 2015 from: http://www.basel.int/Portals/4/Basel%20Convention/docs/meetings/sbc/workdoc/old%20docs/tech-y6.pdf 2. Shell Trading International Ltd (2011). Naphtha (petroleum), solvent-refined light Material Safety Data Sheet. Accessed March 21, 2015 from: http://www.shell.com/content/dam/shell-new/local/corporate/trading-shipping/downloads/msds/in-country/uk-stasco/mogas-naphtha-petroleum-solvent-refined-light-cas-64741-84-0---stil---en.pdf 3. National Occupational Health and Safety Commission (1990). Australian Government. *Industrial Organic Solvents*. Accessed March 21, 2015 from: http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/157/IndustrialOrganicSolvents_1990_PDF.pdf 4. US EPA. TEACH Chemical Summary – Benzene. Accessed March 21, 2015 from: http://www.epa.gov/teach/chem_summ/BENZ_summary.pdf			

3.42 Any congener of polychlorinated dibenzo-furan

Waste name: Any congener of polychlorinated dibenzo-furan		Basel waste category:Y43	Basel permit code: A4110	NEPM code: M170
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme: <5.0		
	Description of the waste	This waste category shares virtually identical characteristics to Y44. Polychlorinated dibenzofurans are not manufactured as commercial products but are generated in manufacture of some chemicals. They are also produced in combustion processes and released to the environment, usually as particulate matter, from there they are taken up by biota and bioaccumulated.		
	Waste form	Solid and liquid		
	Physical/ chemical description	In polychlorinated dibenzofurans, all or some of the eight hydrogen atoms on the dibenzofuran skeleton are replaced by chlorine atoms. There are 135 members of this family (known as congeners), having different arrangements of chlorine atoms. They are solids with appreciable vapour pressures.		
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Other hazard(s)	N/A	N/A	
	Main likely chemical contaminants		polychlorinated dibenzo-p-dioxins	
Where does it come from?	Main sources	Polychlorinated dibenzofurans are formed in combustion of most fuels – that is, under oxidative conditions – from carbon, hydrogen and chlorine atoms present in the fuels. Smouldering rather than outright burning is a major source of polychlorinated dibenzofurans, but in high-temperature processes they are known to form during the cool-down of combustion gases. They are also produced in forest fires. They are also produced during metal smelting and refining operations and in chemical processes involving the chlorination of organic substances. Some products of such processes are contaminated with polychlorinated dibenzofurans. In terms of solid or liquid wastes (rather than gaseous emissions) no reporting occurred in Australia in 2013, although it is possible that these pollutants may be present in extremely low concentrations in other wastes.		
How is it	Main fates	Inadvertent production of polychlorinated dibenzofurans is minimised		

<table>
<tr><th colspan="3">Waste name:
Any congener of polychlorinated dibenzo-furan</th><th>Basel waste category:Y43</th><th>Basel permit code: A4110</th><th>NEPM code: M170</th></tr>
<tr><td>managed?</td><td></td><td colspan="4">by control of fuel mixtures and by rapid cool-down of flue gases. Polychlorinated dibenzofurans can be separated from chemical products such as 2,4-dichlorophenol and destroyed together with other chlorinated wastes in plasma arc facilities.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0%</td><td colspan="4"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>0</td><td>ACT:</td><td>0</td><td>NSW:</td><td>0</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>0</td><td>SA:</td><td>0</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>0</td><td>WA:</td><td>0</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">All polychlorinated dibenzofurans exhibit toxicity. The congener are assigned relative toxicities <1 relative to 2,3,7,8-tetrachloro-dibenzodioxin and a total equivalent toxicity (TEQ) is computed for a mixture based on analytical determination of the congener content.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">High: The major symptom of poisoning is chloracne, a persistent skin rash.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">Extreme: Chronic effects of exposure to these substances include hormonal changes and liver damage.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">Extreme: Polychlorinated dibenzofurans are human carcinogens.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">High: Exposure to polychlorinated dibenzofurans can cause miscarriages and birth defects.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">The polychlorinated dibenzofurans are not generally regarded as workplace hazards except in cases of chemical manufacture where they may be present in a small number of products and wastes in Australia.</td></tr>
<tr><td>Population scale impacts</td><td colspan="5">Levels of polychlorinated dibenzofurans and dibenzodioxins in the blood of Australians are low by international standards and lower than those of New Zealand. Mean values from a 2004 study were 10.9 pg TEQ g-1 lipid. The main sources are fatty foods in which the chlorinated substances have been bioaccumulated.</td></tr>
<tr><td rowspan="4">Potential environment impacts</td><td>Overview</td><td colspan="4">Polychlorinated dibenzofurans are widely disseminated around the globe and are listed as persistent organic pollutants under the Stockholm Convention.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="4">Low – medium: Polychlorinated dibenzofurans are toxic to animals, but the toxicity varies with species.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="4">Medium: Polychlorinated dibenzofurans cause reproductive effects in animals.</td></tr>
<tr><td>Persistence</td><td colspan="4">High: Polychlorinated dibenzofurans are persistent in the environment.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Any congener of polychlorinated dibenzo-furan</th><th colspan="2">Basel waste category:Y43</th><th>Basel permit code: A4110</th><th>NEPM code: M170</th></tr>
<tr><td></td><td>Bioaccumulation</td><td colspan="4">Extreme: Polychlorinated dibenzofurans are bioaccumulated especially in marine species and birds where they are found in fatty tissues.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>Moderate</td><td>Moderate</td><td>Medium</td><td>N/A</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="6">No poisoning by polychlorodibenzodioxins has been reported in Australia.

However, dioxins and furans contaminated Sydney Harbour in the 1950s and 1960s, leaving a pollution legacy that will last for decades to come[3]. This was largely from an industrial site (eventually owned by Union Carbide) at Homebush Bay. From 1928 until its closure in 1986, the site was used for the manufacture of a wide range of chemicals, including timber preservatives, herbicides, pesticides and plastics. From 1949 until 1976, the site was used to manufacture the herbicides 2,4,5-T and 2,4-D, the ingredients for Agent Orange that was used as a defoliant in the Vietnam War.

To expand the area available for industrial use, extensive reclamation and dredging of Homebush Bay commenced in 1939 and continued up until 1970. As a result of both chemical manufacturing and the use of contaminated fill for reclamation, soil and groundwater on the site were contaminated by various chemicals, including dioxins. This occurred until about 1970, when site management was improved to comply with the Clean Waters Act 1970 (NSW). In 1987, the then NSW State Pollution Control Commission served Union Carbide with a notice under the Environmentally Hazardous Chemicals Act 1985 (NSW) to remediate part of the site. Extensive remediation of the site has since been carried out.

Dioxins from the site have spread throughout the sediments at the bottom of Sydney Harbour and Port Jackson. Dioxins formed as a by-product of the manufacture of timber preservatives and 2,4,5-T at the site have been linked by a characteristic chemical profile to the dioxin contamination in other parts of Sydney Harbour, and the site appears to be the major source of these contaminants in the harbour.

Given the bioaccumulative nature of dioxins, the only practicable means to ‘remove’ the contaminants from the marine food chain is to allow other, clean sediments to cover the contaminants. For much of the harbour, this process will take decades.

Fishing bans have been in place around Homebush Bay since 1989, and were extended to parts of the Parramatta River in 1990. The extent of contamination from the site was not recognised until 2006, when all commercial fishing was banned in Sydney Harbour after tests revealed elevated levels of dioxin in fish and crustaceans in the harbour.

Recreational fishing in the Harbour has not been banned but, based on advice from an expert panel, the NSW government recommends that no fish or crustaceans caught west of the Sydney Harbour Bridge should be eaten. For fish caught east of the Sydney Harbour Bridge, there are also restrictions suggested.

A study by the then NSW Department of Environment, Climate Change and Water suggested that much of Sydney Harbour remains contaminated by dioxins at levels that will make eating fish from much of the harbour unsafe for decades.</td></tr>
</table>

Waste name: Any congener of polychlorinated dibenzo-furan		Basel waste category:Y43	Basel permit code: A4110	NEPM code: M170
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Control of fuel composition and appropriate management of flue gases has seen annual emissions of polychlorinated dibenzofurans and dibenzodioxins in Australia fall steadily from 0.11 kg in 2009/2010 to 0.049 kg in 2013/2014. Companies that combust significant quantities of fossil fuels in boilers and high temperature equipment are licensed by environmental regulators to control industrial processes and equipment so as to tightly limit environmental emissions of these pollutants.		
	Industry – exposure controls	Industry exposure is limited to a small number of facilities operating chlorination processes and managing exposure to polychlorinated dibenzofurans.		
	Government	The National Dioxins Programme conducted during the first decade of this century surveyed polychlorinated dibenzofuran and dibenzodioxin content of Australian soils, foods, wildlife and human milk and blood.		
	Community	There is no explicit community action but declining levels of emissions will reduce impact on the community.		
References	1. National Dioxin Programme: www.environment.gov.au/protection/chemicals-management/dioxins 2. A. Mudhoo et al., 'Dioxins and Furans: sources, impacts and rmediation', in E. Lichtfouse, J. Schwarzbauer and D. Robert, eds., *Pollutant diseases, remediation and recycling* (Springer, Wien, 2013). 3. McGrath C, Mending holes in the green safety net. *Precedent*, Issue 113, November/ December 2012. .Accessed March 15, 2015 from: http://envlaw.com.au/wp-content/uploads/green_safety_net.pdf			

3.43 Any congener of polychlorinated dibenzo-p-dioxin

Waste name: Any congener of polychlorinated dibenzo-p-dioxin		Basel waste category:Y44	Basel permit code: A4110	NEPM code: M180
What is it?	Hazard score (0 – 6)	Low / Moderate / Medium / High / Extreme		<5.0
	Description of the waste	This waste category shares virtually identical characteristics to Y43. Polychlorinated dibenzodioxins are not manufactured as commercial products but are generated in manufacture of some chemicals. They are also produced in combustion processes and released to the environment, usually as particulate matter, from there they are taken up by biota and bioaccumulated		
	Waste form	Solid and liquid		
	Physical/ chemical description	In polychlorinated dibenzodioxins, all or some of the eight hydrogen atoms on the dibenzodioxin skeleton are replaced by chlorine atoms. There are 75 members of this family (known as congeners), having different arrangements of chlorine atoms. They are solids with appreciable vapour pressures.		
Why is it hazardous?	Primary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.	
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.	
	Other hazard(s)	N/A	N/A	
	Main likely chemical contaminants		polychlorinated dibenzo-furans	
Where does it come from?	Main sources	Polychlorinated dibenzodioxins are formed in combustion of most fuels – that is, under oxidative conditions – from carbon, hydrogen and chlorine atoms present in the fuels. Smouldering rather than outright burning is a major source of polychlorinated dibenzodioxins, but in high-temperature processes they are known to form during the cool-down of combustion gases. They are also produced in forest fires. They are also produced during metal smelting and refining operations and in chemical processes involving the chlorination of organic substances. Some products of such processes are contaminated with polychlorinated dibenzodioxins. In terms of solid or liquid wastes (rather than gaseous emissions) no reporting occurred in Australia in 2013, although it is possible that these pollutants may be present in extremely low concentrations in other wastes.		
How is it	Main fates	Inadvertent production of polychlorinated dibenzodioxins is		

<table>
<tr><th colspan="3">Waste name:
Any congener of polychlorinated dibenzo-p-dioxin</th><th>Basel waste category:Y44</th><th>Basel permit code: A4110</th><th>NEPM code: M180</th></tr>
<tr><td>managed?</td><td></td><td colspan="4">minimised by control of fuel mixtures and by rapid cool-down of flue gases. Polychlorinated dibenzodioxins can be separated from chemical products such as 2,4-dichlorophenol and destroyed together with other chlorinated wastes in plasma arc facilities.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0%</td><td colspan="4"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>0</td><td>ACT:</td><td>0</td><td>NSW:</td><td>0</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>0</td><td>SA:</td><td>0</td></tr>
<tr><td>Tas:</td><td>0</td><td>Vic:</td><td>0</td><td>WA:</td><td>0</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="4">The 2,3,7,8-tetrachloro congener is the most toxic: other congeners are assigned relative toxicities <1 and a total equivalent toxicity (TEQ) is computed for a mixture based on analytical determination of the congener content.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">High: The major symptom of poisoning is chloracne, a persistent skin rash.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">Extreme: Chronic effects of exposure to these substances include hormonal changes and liver damage.</td></tr>
<tr><td>Carcinogenicity</td><td colspan="4">Extreme: Polychlorinated dibenzo-p-dioxins are human carcinogens.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="4">High: Exposure to polychlorinated dibenzofurans can cause miscarriages and birth defects.</td></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="5">The polychlorinated dibenzodioxins are not generally regarded as workplace hazards except in cases of chemical manufacture where they may be present in a small number of products and wastes in Australia.</td></tr>
<tr><td>Population scale impacts</td><td colspan="5">Levels of polychlorinated dibenzodioxins and dibenzofurans in the blood of Australians are low by international standards and lower than those of New Zealand. Mean values from a 2004 study were 10.9 pg TEQ g-1 lipid. The main sources are fatty foods in which the chlorinated substances have bioaccumulated.</td></tr>
<tr><td rowspan="4">Potential environment impacts</td><td>Overview</td><td colspan="4">Polychlorinated dibenzodioxins are widely disseminated around the globe and are listed as persistent organic pollutants under the Stockholm Convention.</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="4">Low – medium: Polychlorinated dibenzodioxins are toxic to animals, but the toxicity varies with species.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="4">Medium: Polychlorinated dibenzodioxins cause reproductive effects in animals.</td></tr>
<tr><td>Persistence</td><td colspan="4">High: Polychlorinated dibenzodioxins are persistent in the environment.</td></tr>
</table>

Waste name: Any congener of polychlorinated dibenzo-p-dioxin							**Basel waste category:Y44**	**Basel permit code: A4110**	**NEPM code: M180**
	Bioaccumulation	**Extreme**: Polychlorinated dibenzodioxins are bioaccumulated especially in marine species and birds where they are found in fatty tissues.							
Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**			
	High	Medium	Medium	Moderate	N/A	Low			
Has anything happened before in Australia?	No poisoning by polychlorodibenzodioxins has been reported in Australia. However, dioxins and furans contaminated Sydney Harbour in the 1950s and 1960s, leaving a pollution legacy that will last for decades to come[3]. This was largely from an industrial site (eventually owned by Union Carbide) at Homebush Bay. From 1928 until its closure in 1986, the site was used for the manufacture of a wide range of chemicals, including timber preservatives, herbicides, pesticides and plastics. From 1949 until 1976, the site was used to manufacture the herbicides 2,4,5-T and 2,4-D, the ingredients for Agent Orange that was used as a defoliant in the Vietnam War. To expand the area available for industrial use, extensive reclamation and dredging of Homebush Bay commenced in 1939 and continued up until 1970. As a result of both chemical manufacturing and the use of contaminated fill for reclamation, soil and groundwater on the site were contaminated by various chemicals, including dioxins. This occurred until about 1970, when site management was improved to comply with the Clean Waters Act 1970 (NSW). In 1987, the then NSW State Pollution Control Commission served Union Carbide with a notice under the Environmentally Hazardous Chemicals Act 1985 (NSW) to remediate part of the site. Extensive remediation of the site has since been carried out. Dioxins from the site have spread throughout the sediments at the bottom of Sydney Harbour and Port Jackson. Dioxins formed as a by-product of the manufacture of timber preservatives and 2,4,5-T at the site have been linked by a characteristic chemical profile to the dioxin contamination in other parts of Sydney Harbour, and the site appears to be the major source of these contaminants in the harbour. Given the bioaccumulative nature of dioxins, the only practicable means to 'remove' the contaminants from the marine food chain is to allow other, clean sediments to cover the contaminants. For much of the harbour, this process will take decades. Fishing bans have been in place around Homebush Bay since 1989, and were extended to parts of the Parramatta River in 1990. The extent of contamination from the site was not recognised until 2006, when all commercial fishing was banned in Sydney Harbour after tests revealed elevated levels of dioxin in fish and crustaceans in the harbour. Recreational fishing in the Harbour has not been banned but, based on advice from an expert panel, the NSW government recommends that no fish or crustaceans caught west of the Sydney Harbour Bridge should be eaten. For fish caught east of the Sydney Harbour Bridge, there are also restrictions suggested. A study by the then NSW Department of Environment, Climate Change and Water suggested that much of Sydney Harbour remains contaminated by dioxins at levels that will make eating fish from much of the harbour unsafe for decades.								

Waste name: Any congener of polychlorinated dibenzo-p-dioxin		Basel waste category:Y44	Basel permit code: A4110	NEPM code: M180
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Control of fuel composition and appropriate management of flue gases has seen annual emissions of polychlorinated dibenzodioxins and dibenzofurans in Australia fall steadily from 0.11 kg in 2009/2010 to 0.049 kg in 2013/2014.		
	Industry – exposure controls	Industry exposure is limited to a small number of facilities operating chlorination processes and managing exposure to polychlorinated dibenzodioxins.		
	Government	The National Dioxins Programme conducted during the first decade of this century surveyed polychlorinated dibenzodioxin and dibenzofuran content of Australian soils, foods, wildlife and human milk blood.		
	Community	There is no explicit community action but declining levels of emissions will reduce impact on the community.		
References	1. National Dioxin Programme: www.environment.gov.au/protection/chemicals-management/dioxins. 2. A. Mudhoo et al., 'Dioxins and Furans: sources, impacts and rmediation', in E. Lichtfouse, J. Schwarzbauer and D. Robert, eds., *Pollutant diseases, remediation and recycling* (Springer, Wien, 2013). 3. McGrath C, Mending holes in the green safety net. *Precedent*, Issue 113, November/ December 2012. .Accessed March 15, 2015 from: http://envlaw.com.au/wp-content/uploads/green_safety_net.pdf			

3.44 Organohalogen compounds other than substances referred to in this list (e.g. Y39, Y41, Y42, Y43, Y44)

Waste name: Organohalogen compounds other than substances referred to in this list (e.g. Y39, Y41, Y42, Y43, Y44)	**Basel waste category:Y45**	**Basel permit code: various – depends on substance**	**NEPM code: M160**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	**Extreme**
						<5.0
	Description of the waste	The common property of this waste type is that it contains organic chemicals that contain halogen elements (usually fluorine, chlorine, bromine) as significant components in their structure. This waste type shares commonality with other waste types such as chlorophenols (Y39), halogenated solvents (Y41), dioxins and furans (Y43 and Y44), PCB-like compounds (Y10) and organochlorine pesticides (within Y4). The presence of the halogen species is usually the reason for the property of interest – and the reason for the toxicity. Examples of organohalogen active ingredients are the Stockholm Convention[1] listed pollutants; the brominated flame retardants (BFR) polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCD), and perfluorooctanesulfonic acid (PFOS). (While not part of this category, many of the organochlorine pesticides are also listed on the convention) Banned since 2004, PBDEs have been historically added at percentage levels to ABS plastics in a range of products including electrical and electronic equipment (EEE), furniture upholstery, automobile interiors, mattresses and carpet underlay. HBCD has been added to extruded and expanded polystyrene foams used in building insulation and PFOS, a fluorinated surfactant, has been primarily as a dispersant in firefighting foams. These substances, when present in wastes such as end of life products presenting for disposal, are not technically regarded as hazardous wastes in Australia at present. E-waste is a good example of such a potentially PBDE-containing waste. This is because Australia is still undertaking its assessment processes to determine whether to ratify these new additions to the Stockholm Convention. Another waste that could be described by this category is hexachlorobenzene (HCB), a substantial and intractable stored quantity of which has been under close management by Orica at its Port Botany site for the last couple of decades. It is noted that HCB waste could equally be classified under code Y4.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Varies with each substance. Common feature is a large degree of halogenation in the chemical structure; for example PFOS is $C_8F_{17}SO_3H$. Wastes may be solids (product type wastes), liquid (neat chemicals or				

Waste name: Organohalogen compounds other than substances referred to in this list (e.g. Y39, Y41, Y42, Y43, Y44)	Basel waste category:Y45	Basel permit code: various – depends on substance	NEPM code: M160

		concentrates) or sludges ('wet' biosolids or industrial process sludges).	
Why is it hazardous?	**Primary hazard**	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.
	Other hazard(s)	N/A	N/A
	Main likely chemical contaminants		Wastes containing organohalogen chemicals may also contain other substances of concern at trace levels, such as e-waste which includes circuitry with low levels of heavy metals.
Where does it come from?	**Main sources**	Current waste volumes reported by jurisdictional tracking systems are very small, and come from organic and inorganic chemicals manufacturing, fossil fuel electricity supply and scientific research services. There is also some mis-coded halogenated organic solvents (Y41) amongst the data. Of greater importance is the waste that could reside in this category if Australia ratifies the new addition chemicals (PBDEs, HBCD and PFOS) to the Stockholm Convention. Should this occur then a range of wastes could emerge – e-waste bound for disposal, biosolids contaminated with of these 3 pollutants, end of life building insulation panels and firefighting foam concentrates and washwaters, for example.	
How is it managed?	**Main fates**	Stockholm listed chemicals, outside of specific exemption scenarios, must be destroyed or managed in an environmentally sound manner. At present this is predominantly through a limited number of thermal destruction technology plants, with any process residues (very small quantities) sent to hazardous waste landfill.	
How much is generated in Australia?	**Volume score (% of national tonnes in 2013)**	<1% / 1 – 5% / 5 – 10% / 10 – 20% / ≥ 20% 0.0003%	
	Waste arising in 2013 (tonnes)	**TOTAL:** 20 — **ACT:** 0 — **NSW:** 0 **NT:** 0 — **Qld:** 15 — **SA:** 0 **Tas:** 4 — **Vic:** 1 — **WA:** 0	

Waste name: Organohalogen compounds other than substances referred to in this list (e.g. Y39, Y41, Y42, Y43, Y44)	Basel waste category:Y45	Basel permit code: various – depends on substance	NEPM code: M160
Potential health impacts	**Overview**	Health impacts vary greatly with individual substances, as this category is a catch-all for a wide range of wastes. *Consequently the health impact summaries below err on the side of worst case substances*. Also, the health and environmental impacts of some of these chemicals are only very recently becoming understood. Some of the information below is assumed based on animal studies rather than strong human-based evidence. However the emerging Stockholm chemical wastes have common properties relating to health, generally relating to chronic toxicity.	
	Acute toxicity	**Medium - High**: Likely to be toxic if swallowed and contact may cause skin and eye irritation.	
	Chronic toxicity	**High**: Repeated ingestion of some of these substances/ wastes may cause liver and thyroid toxicity, based on definitive evidence in animal studies.	
	Carcinogenicity	**Medium**: Most of the evidence is speculative, due to limited human studies, but many of the chemicals classified in this category are listed as possible human carcinogens.	
	Reproductive toxicity	**Medium**: Studies on animals and humans have shown that some PBDEs can act as endocrine system disruptors and may even be teratogenetic (able to disturb the growth and development of an embryo or foetus).	
Workplace health & safety impacts	Wide scale consumer product use at work, such as of computers and office furniture, could result in low levels of exposure to organohalogen substances or wastes in the workplace, although their containment within the product will limit this potential. An exception to this is the e-waste dismantling industry, where there may be excessive handling or breakage of plastic components that contain BFR chemicals. Also, firefighting has historically involved the handling of PFOS in concentrate form.		
Population scale impacts	The concentrations of PBDEs in human blood, breast milk, and body fat indicate that most people are exposed to low levels of PBDEs, and many of these chemicals are known to be highly persistent and bioaccumulative. More significant impacts appear to occur in the environment than directly on human health.		
Potential environment impacts	**Overview**	Environmental impacts vary with individual substances, as this category is a catch-all for a wide range of wastes. *Consequently the environmental impact summaries below err on the side of worst case substances*. However highly halogenated organic compounds such as the PBDEs, PFOS and HBCD all demonstrate significant aquatic toxicity and persistence in the environment, as well as tending towards biomagnification (increasing accumulation along the food chain). Many of the more recent listings on the Stockholm Convention have occurred due to these pernicious environmental (more so than health) impacts.	

Waste name: Organohalogen compounds other than substances referred to in this list (e.g. Y39, Y41, Y42, Y43, Y44)	**Basel waste category:Y45**	**Basel permit code: various – depends on substance**	**NEPM code: M160**

	Acute ecotoxicity	**Extreme**: Very toxic to aquatic organisms
	Chronic ecotoxicity	**Extreme**: Very toxic to aquatic life with long lasting effects
	Persistence	**Extreme**: Highly persistent in the environment. For PBDEs, compounds with less bromine atoms in their structure are more persistent in the environment than higher brominated congeners.
	Bioaccumulation	**Extreme**: For PBDEs, compounds with less bromine atoms in their structure tend to bioaccumulate more than higher brominated congeners.

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Moderate	Moderate	Medium	N/A	Low

Has anything happened before in Australia?

Fiskville fire training facility - PFOS

The Victorian Country Fire Authority's (CFA) Fiskville Training College has been used as a training facility by CFA since the 1970's. Activities undertaken at the site include the storage and handling of chemicals used in fire training, live fire training and the storage, treatment and disposal of water resulting from live fire training. PFOS was used in firefighting foams used at the site until 2007.

Concerns were raised about the site in 2011 in connection with rates of cancer amongst site workers. Monash University released a study in January 2015 which examined cancer and death rates among 606 people who worked at the site between 1971 and 1999 and showed there were 69 cancer cases that resulted in 16 deaths. When compared to the Victorian population there was found to be a significantly higher risk of cancer for the nearly 100 full-time workers at the site.

In March 2015, the CFA permanently closed the facility, after PFOS was found in water tanks used for firefighter training, and in other locations on the site, at levels higher significantly higher than recommended in drinking water, in addition to the chemical's detection in nearby Lake Fiskville and in fish specimens taken from the lake. At the time of writing, a state Parliamentary Inquiry continues to examine the history of the site, the lessons to be learned and consider compensation.

Dumping of chemical warfare agents at sea

In 1983 a vessel trawling east of Brisbane trawled a 1 tonne cylinder of **mustard gas**, Mustard gas, bis(2-chloroethyl) sulfide, was a chemical warfare agent (CWA) used in World War II capable of severe skin, eye and mucosal pain and irritation (chemical burns) and is highly mutagenic and carcinogenic.

It appears at least 21,000 tons of Chemical Warfare munitions were dumped into Australian seas at the end of World War II by the United States Army and the defence forces of Australia. The sea dumping of all significant amounts of CWA war stocks had occurred by the end of 1946, aside from the dumping of 1,634 tons of CWA off Victoria during August/September 1948. Records indicate there have been two ad-hoc dumping episodes

Waste name: Organohalogen compounds other than substances referred to in this list (e.g. Y39, Y41, Y42, Y43, Y44)	Basel waste category:Y45	Basel permit code: various – depends on substance	NEPM code: M160
	since then, one in 1965 and another in 1970. Mustard gas leaking at a slow rate through corroded containers will hydrolyse and should break down close to the dump positions. At worst, leaking mustard gas should only pose a threat to biota living on or near the discarded drums and artillery shells. The hydrolysis products are thought not to have a significant effect on fish and the dump sites do not correlate with designated marine sensitive environments.		
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	The production of octaBDE and pentaBDE in the United States ceased at the end of 2004 after the voluntary phase-out of these chemicals by the only U.S. manufacturer. In addition, the two U.S. producers and the main U.S. importer of decaBDE phased out the compound by the end of 2013, even though it is not yet listed on the Stockholm convention. While PFOS's addition to the Stockholm Convention has not yet been ratified by Australia, Australian firefighting authorities have largely discontinued its use, and are progressively sending remaining stockpiles of the concentrated chemical for thermal destruction.	
	Industry – exposure controls	Strict handling and personal protective equipment requirements apply, in accordance with Material Safety Data Sheets, to any workplace handling of chemicals in this category.	
	Government	In August 2010, nine new chemicals were added to the Stockholm Convention's annexes. These are the first chemicals to be added to the annexes since Australia signed up to the Convention in 2004. For Australia, an amendment to the annexes takes effect upon ratification of that amendment. Accordingly, Australia is now considering ratification, and to do so must undertake a domestic treaty making process. Australia supported the addition of the new POPs to the Convention following stakeholder consultation in early 2009.	
	Community	Flame retardants such as the PBDEs are examples of substances in this waste category with the most potential to impact the wider community, through the use and disposal of common consumer products like plastic computer and peripheral equipment casings and polyurethane foam found in furniture and car seat foams. However, the two PBDEs of concern, penta-BDE and octa-BDE, are two of approximately 70 substances used for flame retardancy in these products in the past. Similarly, these two PBDEs have not been used in any product applications since the mid-2000s, and possibly not since the late 1990s.	
References	1. UNEP. The Stockholm Convention on Persistent Organic Pollutants (POPs). Accessed April 21, 2015 from: http://chm.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx 2. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. Toxicological Fact Sheet for Polybrominated Diphenyl Ethers (2004).		

Waste name: Organohalogen compounds other than substances referred to in this list (e.g. Y39, Y41, Y42, Y43, Y44)	Basel waste category:Y45	Basel permit code: various – depends on substance	NEPM code: M160

Accessed April 21, 2015 from: http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=900&tid=94

3. United States Environmental Protection Agency. Technical Fact Sheet - Polybrominated Diphenyl Ethers (PBDEs) and Polybrominated Biphenyls (PBBs) (2004). Accessed April 21, 2015 from: http://www2.epa.gov/sites/production/files/2014-03/documents/ffrrofactsheet_contaminant_perchlorate_january2014_final_0.pdf

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6. Sigma Aldrich (2015). Hexabromocyclododecane Material Safety Data Sheet. Accessed April 21, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=144762&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F144762%3Flang%3Den

7. The Age newspaper, March 3, 2015. *CFA closes Fiskville training facility after chemical find*. Accessed April 21, 2015 from: http://www.theage.com.au/victoria/cfa-closes-fiskville-training-facility-after-chemical-find-20150302-13t68t.html

8. Premier of Victoria, Media Release 26 March 2015. *Fiskville Shut Forever*. Accessed April 21, 2015 from: http://www.premier.vic.gov.au/fiskville-shut-forever

9. Plunkett G. Australian Government Department of Defence (2003). *Chemical Warfare Agent Sea Dumping off Australia.* (http://www.mustardgas.org/Chemical-Warfare-Agent-Sea-Dumping-off-Australia.pdf)

10. Australian Government Department of the Environment. Stockholm Convention on Persistent Organic Pollutants (POPs). Accessed April 21, 2015 from: http://www.environment.gov.au/protection/chemicals-management/pops

11. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.

3.45 Other metal compounds (such as compounds of barium, cobalt, nickel and vanadium)

Waste name: Other metal compounds (such as compounds of barium, cobalt, nickel and vanadium)	**Basel waste category:Y+1**	**Basel permit code: N/A**	**NEPM code: D200, D210, D270, D290**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
			2.6 – 3.0			
	Description of the waste	This is a catch-all waste category that captures a number of wastes classified in Australia under the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure, but not reflected in any Basel Y codes. The NEPM wastes are: • D200 Cobalt compounds • D210 Nickel compounds • D270 Vanadium compounds • D290 Barium compounds (excluding barium sulphate). Nickel, cobalt and vanadium are metallic elements that are all heavily used as additives in steel and a wide range of alloys. Cobalt is also used to make artificial body parts such as hip and knee joints. Barium is different again – a metallic alkaline earth element that is never found in nature in its pure form, its high reactivity causes it to oxidise rapidly in air. Nickel and nickel compounds are used for nickel electroplating, to colour ceramics, to make batteries, for permanent magnet materials, and as catalysts. Cobalt and compounds are used in ceramics (cobalt carbonate), in electroplating (cobalt chloride and cobalt sulfate) and in semi-conductors, pigments and paints (cobalt oxide and sulfate). Barium is not an extensively used element, although its compounds are used by the oil and gas industries to make drilling mud, as a green colorant in fireworks and in making paint, tiles and rubber. Wastes of these metals and their compounds are small in quantity in Australia, and usually quite industry or process-specific.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Variable for each metal and their many compounds.				
Why is it hazardous?	**Primary hazard**	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.			
	Secondary hazard	H12: Ecotoxic	Substances or wastes which if released present or may present immediate or			

<table>
<tr><th colspan="2">Waste name:
Other metal compounds (such as compounds of barium, cobalt, nickel and vanadium)</th><th>Basel waste category:Y+1</th><th>Basel permit code: N/A</th><th>NEPM code: D200, D210, D270, D290</th></tr>
<tr><td></td><td></td><td></td><td colspan="2">delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.</td></tr>
<tr><td></td><td>Other hazard(s)</td><td>N/A</td><td colspan="2">N/A</td></tr>
<tr><td></td><td colspan="2">Main likely chemical contaminants</td><td colspan="2">Other metals</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="4">Ni
Motor vehicle manufacturing, glass manufacturing, aluminium smelting, metal coating and finishing,
Co
Aluminium smelting
Ba
Fabricated metal product manufacturing, explosives manufacturing, polymer product manufacturing, aircraft manufacturing and maintenance, scientific testing services.
V
None identified.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.
Some metal recycling and recovery may occur.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="5">Volume score (% of national tonnes in 2013)

Waste arising in 2013 (tonnes)</td><td colspan="4"><table><tr><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr><tr><td>0.02%</td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td colspan="4"><table><tr><td>TOTAL:</td><td>1,176</td><td>ACT:</td><td>0</td><td>NSW:</td><td>1</td></tr></table></td></tr>
<tr><td colspan="4"><table><tr><td>NT:</td><td>0</td><td>Qld:</td><td>183</td><td>SA:</td><td>813</td></tr></table></td></tr>
<tr><td colspan="4"><table><tr><td>Tas:</td><td>0</td><td>Vic:</td><td>81</td><td>WA:</td><td>97</td></tr></table></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">Potential health impacts</td><td>Overview</td><td colspan="3">Cobalt is part of vitamin B-12, and may be used in the treatment of anaemia. Similarly a small amount of dietary nickel is probably essential for humans, although it is not usually identified as a trace element for health.
Equally though, too much cobalt or nickel (more so than barium) can be harmful and can cause chronic health problems.
Unlike their heavy metal counterparts such as lead, mercury and cadmium, these metals generally exhibit quite low human health impacts.</td></tr>
<tr><td>Acute toxicity</td><td colspan="3">Low.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="3">High:</td></tr>
</table>

Waste name: Other metal compounds (such as compounds of barium, cobalt, nickel and vanadium)		**Basel waste category:Y+1**	**Basel permit code: N/A**	**NEPM code: D200, D210, D270, D290**
	Carcinogenicity	These metals are not known or suspected to be carcinogenic.		
	Reproductive toxicity	**Low**.		
Workplace health & safety impacts	Occupational exposure to high level of these metals may occur when breathing metallic dust or fumes at industrial sites such as smelters, galvanising facilities or metal manufacturing plants.			
Potential environment impacts	**Overview**	Nickel in particular has high acute and chronic toxicity to aquatic life, with cobalt similar and barium low. Insufficient data are available to evaluate or predict the effects of these metals and their compounds to plants, birds, or land animals. It is noted that very small amounts of nickel have been shown to be essential for normal growth and reproduction in some species of animals.		
	Acute ecotoxicity	**Extreme**: Could be very toxic to aquatic life.		
	Chronic ecotoxicity	**High**: May cause long term toxic effects in the aquatic environment.		
	Persistence	**Extreme**: Metals in this group will not break down in the environment.		
	Bioaccumulation	**Medium**: Varies between low (nickel) and medium (cobalt) potential to bioaccumulate, depending on the metal.		

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	Medium	Moderate	Low	Moderate	N/A	Low

Has anything happened before in Australia?	No specific incidents identified.	
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Higher risk workplaces like metal smelters, metal coating and metal processing industries, where worker exposure to metals and their compounds wastes may be possible, are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these types of pollutants.

Waste name: Other metal compounds (such as compounds of barium, cobalt, nickel and vanadium)	**Basel waste category:Y+1**	**Basel permit code: N/A**	**NEPM code: D200, D210, D270, D290**
	Industry – exposure controls	Potential industrial sources of these wastes have strict emissions control equipment in place, such as baghouse filters, dust extraction systems, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of metal dusts and powders.	
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.	
References	1. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheets for: nickel and cobalt, and compounds. Accessed March 22, 2015 from: http://www.npi.gov.au/resource/nickel-compounds and http://www.npi.gov.au/resource/cobalt-and-compounds respectively. 2. Sigma Aldrich (2013). Nickel powder Material Safety Data Sheet. Accessed April 22, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=266973&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F266973%3Flang%3Den 3. Chemical Book. Nickel (II) acetate tetrahydrate MSDS. Accessed 22 April, 2015 from: http://www.chemicalbook.com/ChemicalProductProperty_US_CB5378827.aspx 4. Royal Society of Chemistry Periodic Table – Vanadium. Accessed 22 April, 2015 from: http://www.rsc.org/periodic-table/element/23/vanadium 5. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.46 Other inorganic chemicals (such as inorganic sulfides, boron compounds, phosphorus compounds and non-toxic salts)

Waste name: Other inorganic chemicals (such as inorganic sulfides, boron compounds, phosphorus compounds and non-toxic salts)	**Basel waste category:Y+2**	**Basel permit code: N/A**	**NEPM code: D300, D310, D330, D360**

What is it?	**Hazard score (0 – 6)**	Low	Moderate	Medium	High	Extreme
				3.1 – 3.8		
	Description of the waste	This is a catch-all waste category that captures a number of wastes classified in Australia under the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure, but not reflected in any Basel Y codes. The NEPM wastes are: • D300 Non-toxic salts • D310 Boron compounds • D330 Inorganic sulfides • D360 Phosphorus compound excluding mineral phosphates. The vast majority of wastes in this category by tonnage is non-toxic salts, a waste category heavily dominated by the Coal Seam Gas (CSG) extraction industry, most commonly found in Queensland and New South Wales. CSG consists almost entirely of methane and is currently being extracted from coal seams in the Bowen and Surat Basins in Queensland, as well as in NSW. CSG in Queensland is usually liquefied to allow easier transport, such as by ship. Wastes of the other inorganic chemicals listed and their compounds are small in quantity in Australia, and usually quite industry or process-specific.				
	Waste form	Solid and liquid				
	Physical/ chemical description	Variable for each chemical waste group				
Why is it hazardous?	**Primary hazard**	H8: Corrosives	Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.			
	Secondary hazard	H11: Toxic (delayed or chronic)	Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.			

<table>
<tr><th colspan="6">Waste name:
Other inorganic chemicals (such as inorganic sulfides, boron compounds, phosphorus compounds and non-toxic salts)
Basel waste category:Y+2
Basel permit code: N/A
NEPM code: D300, D310, D330, D360</th></tr>
<tr><td rowspan="3"></td><td rowspan="2">Other hazard(s)</td><td>H4.1: Flammable solids</td><td colspan="3">Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.</td></tr>
<tr><td>H13: Capable of yielding another hazard or hazardous material</td><td colspan="3">Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="3">Other inorganic salts.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="4">98% of this waste category is made up of D300 Non-toxic salts. These are almost exclusively from Coal Seam Gas (CSG) mining and extraction.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.</td></tr>
<tr><td rowspan="5">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td colspan="2">1.29%</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>93,010</td><td>ACT:</td><td>0</td><td>NSW:</td><td>20,193</td></tr>
<tr><td>NT:</td><td>0</td><td>Qld:</td><td>56,372</td><td>SA:</td><td>505</td></tr>
<tr><td>Tas:</td><td>3,780</td><td>Vic:</td><td>1,088</td><td>WA:</td><td>11,071</td></tr>
<tr><td rowspan="3">Potential health impacts</td><td>Overview</td><td colspan="4">Common table salt is an edible product. However, even something so apparently benign can be harmful, especially by ingestion, at high levels over a period of time.
Most of these inorganic chemicals show moderate to high health effects, with inorganic sulfides being the most acutely and chronically toxic. This is especially so if sulfides are present in acidic conditions and hydrogen sulfide gas is formed.</td></tr>
<tr><td>Acute toxicity</td><td colspan="4">High- extreme: Inhalation of high concentrations of Hydrogen Sulfide can cause dizziness, headache, and nausea. Exposure to higher concentrations can result in respiratory arrest, coma, or unconsciousness. Exposure for more than 30 minutes at concentrations of greater than 600 ppm have been fatal.
Direct contact with liquid hydrogen sulfide may cause frostbite.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="4">High: Continuous inhalation of low concentrations of hydrogen sulfide may cause olfactory fatigue, so that the odour (usually distinctive ‘”rotten egg” gas) is no longer an effective warning of its</td></tr>
</table>

Waste name: Other inorganic chemicals (such as inorganic sulfides, boron compounds, phosphorus compounds and non-toxic salts)	**Basel waste category:Y+2**	**Basel permit code: N/A**	**NEPM code: D300, D310, D330, D360**

		presence. Severe exposures which do not result in death may cause long-term symptoms such as memory loss, paralysis of facial muscles, or nerve tissue damage.
	Carcinogenicity	These metals are not known or suspected to be carcinogenic.
	Reproductive toxicity	**Medium**: High levels of ingestion of sodium chloride over long periods of time can cause adverse reproductive effects in humans (fetotoxicity, abortion).
Workplace health & safety impacts	Occupational exposure to high level of these compounds may occur when breathing dust or fumes at industrial sites.	
Potential environment impacts	**Overview**	The main environmental issue with these chemicals are inorganic forms of sulfur, which can be acutely toxic in the aquatic environment.
	Acute ecotoxicity	**High**: Generally low toxicity except for hydrogen sulfide, which is acutely toxic to aquatic organisms.
	Chronic ecotoxicity	**Medium**: Generally low, except for boron
	Persistence	**Low**: These chemicals are generally not persistent in the environment, except for phosphorus compounds, which can persist if they are discharged into waters of low alkalinity.
	Bioaccumulation	These compounds do not bioaccumulate in the aquatic environment. However, boron is essential to plants where it does accumulate.

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Medium	Medium	Moderate	N/A	Low

Has anything happened before in Australia?	The Coal Seam Gas industry is a contentious one for many stakeholders, including communities located close the mining operations. For example, this website has been set up expressly to chronicle incidents within the sector in Australia: http://coalseamgasnews.org/wp-content/uploads/2012/10/Contaminated-sites-and-accidents-related-specifically-to-CSG-in-Australia.pdf. A good discussion of the potential human health and environmental impacts of CSG extraction,, rather than the non-toxic salts waste itself, can be found here: http://www.sbs.com.au/news/article/2012/04/16/qa-csiro-scientist-discusses-impacts-csg.

Waste name: Other inorganic chemicals (such as inorganic sulfides, boron compounds, phosphorus compounds and non-toxic salts)	**Basel waste category:Y+2**	**Basel permit code: N/A**	**NEPM code: D300, D310, D330, D360**
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	Higher risk workplaces like inorganic chemical industries, where worker exposure to metals and their compounds wastes may be possible, are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these types of pollutants.	
	Industry – exposure controls	Potential industrial sources of these wastes have strict emissions control equipment in place, such as baghouse filters, dust extraction systems, electrostatic precipitators and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of metal dusts and powders.	
	Government	State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.	
References	1. Australian Government Department of the Environment. National Pollutant Inventory Fact Sheets for: boron and compounds and phosphoric acid. Accessed March 22, 2015 from: http://www.npi.gov.au/resource/boron-and-compounds and http://www.npi.gov.au/resource/phosphoric-acid respectively. 2. Chemwatch MSDS AMC Sodium Chloride (2010). Accessed 22 April, 2015 from: http://www.aplng.com.au/pdf/factsheets/msds/AMC-Sodium-Chloride-MSDS.pdf 3. Sciencelab.com Inc. MSDS for Sodium Chloride. Accessed 22 April, 2015 from: http://www.sciencelab.com/msds.php?msdsId=9927593 4. SBS News, 27 February 2015. *Q&A: CSIRO scientist discusses impacts of CSG*. Accessed 22 April 2015 from: http://www.sbs.com.au/news/article/2012/04/16/qa-csiro-scientist-discusses-impacts-csg 5. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.		

3.47 Other organic chemicals

<table>
<tr><th colspan="2">Waste name:
Other organic chemicals</th><th colspan="3">Basel waste category:Y+3</th><th>Basel permit code: N/A</th><th>NEPM code:
M220, M230, M250, M260</th></tr>
<tr><td rowspan="5">What is it?</td><td>Hazard score
(0 – 6)</td><td>Low</td><td>Moderate</td><td>Medium</td><td>High</td><td>Extreme</td></tr>
<tr><td></td><td colspan="3">3.1 – 3.8</td><td colspan="2"></td></tr>
<tr><td>Description of the waste</td><td colspan="5">This is a catch-all waste category that captures a number of wastes classified in Australia under the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure, but not reflected in any Basel Y codes. The NEPM wastes are:
M220 Isocyanate compounds
M230 Triethylamine catalysts for setting foundry sands
M250 Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials
M260 Highly odorous organic chemicals (including mercaptans and acrylates).
The majority of wastes in this category by tonnage is surfactants.
The next highest contributor is triethylamine catalysts for setting foundry sands, generated in the foundry and steel machining industries. For nearly two decades, triethylamine and dimethylethylamine have been used as catalysts for phenolic urethane cold box binders in the foundry industry.
Wastes of the other organic chemicals listed are small in quantity in Australia, and usually quite industry or process-specific.</td></tr>
<tr><td>Waste form</td><td colspan="2">Solid and liquid</td><td colspan="2"></td></tr>
<tr><td>Physical/ chemical description</td><td colspan="5">Variable for each chemical waste group</td></tr>
<tr><td rowspan="2">Why is it hazardous?</td><td>Primary hazard</td><td colspan="2">H11: Toxic (delayed or chronic)</td><td colspan="2">Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.</td></tr>
<tr><td>Secondary hazard</td><td colspan="2">H3: Flammable liquids</td><td colspan="2">The word ‘flammable’ has the same meaning as ‘inflammable’. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc, but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
Other organic chemicals</th><th>Basel waste category:Y+3</th><th>Basel permit code: N/A</th><th>NEPM code:
M220, M230, M250, M260</th></tr>
<tr><td rowspan="3"></td><td></td><td></td><td colspan="3">more than 65.6°C, open-cup test.</td></tr>
<tr><td>Other hazard(s)</td><td>H12: Ecotoxic</td><td colspan="3">Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="3">Other organic chemicals and solvents, metals.</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="4">Surfactants (75%):
Organic and inorganic chemical manufacturing, aviation services, ports, shipyards, firefighting services, Defence, mining and mine processing, soap and detergent manufacturing.
Triethylamine catalysts (20%):
Machine tool and parts manufacturing, foundries.
Isocyanate compounds
Polyurethane foam manufacturing
Mercaptans and acrylates
Non-specified manufacturing.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="4">Chemical/ physical treatment to immobilise the hazard, then the stabilised material is usually disposed of in hazardous waste landfill.
Some of these wastes undergo by thermal destruction.</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td>0.20%</td><td colspan="4"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>14,272</td><td>ACT:</td><td>0</td><td>NSW:</td><td>9,687</td></tr>
<tr><td>NT:</td><td>28</td><td>Qld:</td><td>857</td><td>SA:</td><td>2,431</td></tr>
<tr><td>Tas:</td><td>6</td><td>Vic:</td><td>616</td><td>WA:</td><td>648</td></tr>
<tr><td>Potential health impacts</td><td>Overview</td><td colspan="4">The most toxic chemicals in this group are the triethylamine catalysts, which are both acutely and chronically toxic. Isocyanates are also quite toxic but the highest volume in the category are the least toxic - typically – surfactants, although this depend on the types of surfactants used.
The mercaptans and acrylates are volatile and sometimes gaseous substances known for their putrid garlic-like odour, detectable at very low air concentrations. Because this odour acts as a warning, it is unlikely to be present at high enough levels to cause extreme acute toxicity. Despite this, methyl mercaptan has been implicated in the accidental death of four employees and the hospitalization of a fifth at a DuPont facility in La Porte, Texas, near Houston, on 15</td></tr>
</table>

Waste name: Other organic chemicals		Basel waste category:Y+3	Basel permit code: N/A	NEPM code: M220, M230, M250, M260
		November 2014.[1]		
	Acute toxicity	**High**: Triethylamine catalysts are extremely flammable and vapours may form an explosive mixture with air. Toxic in contact with skin. Causes chemical burns to the respiratory tract (inhalation), gastrointestinal tract (ingestion), skin and eyes.		
	Chronic toxicity	**Medium**: Triethylamine catalysts and isocyanate compounds exhibit chronic health effects. Surfactants and the majority of odorous compounds used or produced in Australia show low chronic toxicity.		
	Carcinogenicity	**Low**: Some mercaptans and acrylates and the isocyanates show a possible risk of irreversible effects but information is insufficient to make conclusive judgement. Triethylamine catalysts and most surfactants used do not indicate carcinogenicity.		
	Reproductive toxicity	**Low**: Some mercaptans and acrylates and the isocyanates show a possible risk of reproductive effects. Triethylamine catalysts and most surfactants used do not indicate reproductive impacts..		
Workplace health & safety impacts	Occupational exposure to high level of these compounds may occur when breathing fumes at industrial sites such as polyurethane foam blowers (in the case of isocyanates) and skin contact with surfactants, such as formulating from concentrates without sufficient PPE.			
Potential environment impacts	**Overview**	Between two-thirds and three-quarters of the surfactants used in Australia are made from non-ionic surfactants. Original anionic surfactants proved resistant to degradation by bacteria at sewage treatment works causing rivers to suffer from foam. Anionics and non-ionics used today have better environmental performance although there are still potential impacts on waterways.		
	Acute ecotoxicity	**High**: Some surfactants and triethylamines are acutely toxic to aquatic life.		
	Chronic ecotoxicity	**High**: Some surfactants, triethylamines and mercaptans and acrylates may cause long-term adverse effects in the aquatic environment.		
	Persistence	**High**: Mercaptans and acrylates are the only organic chemicals in this category that are highly persistent in the environment.		
	Bioaccumulation	**High**: Mercaptans and acrylates are the only organic chemicals in this category that are highly bioaccumulative in aquatic biosystems, although the triethylamines exhibits some of these properties.		

Where are the risks of impacts most likely?	**Generation**	**Transport**	**Storage**	**Treatment**	**Recovery**	**Final disposal**
	High	Medium	Medium	Medium	N/A	Low

Has anything happened	Approximately 1080kg of ethyl acrylate was discharged onto the ground while a container ship was being unloaded by DP World stevedores at the Port of Melbourne in September

<table>
<tr><th colspan="2">Waste name:
Other organic chemicals</th><th>Basel waste category:Y+3</th><th>Basel permit code: N/A</th><th>NEPM code:
M220, M230, M250, M260</th></tr>
<tr><td>before in Australia?</td><td colspan="4">2007. The odours from the spill affected dock workers, emergency response officers and members of the public. More than 60 odour reports were received by EPA Victoria as a result of the incident, including calls from as far away as Essendon and Ascot Vale. Ethyl acrylate is used in fibreglass, adhesives and plastics.
This was a major pollution incident that lasted three days and affected air quality over a wide area of Melbourne. The company was ordered to pay $80,000 towards the construction of a community garden at Docklands, plus $10,000 in court costs.</td></tr>
<tr><td rowspan="4">What control measures are in place to manage risks posed by this waste?</td><td>Industry – systematic controls</td><td colspan="3">Companies that handle organic chemicals and their wastes are licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of these pollutants.</td></tr>
<tr><td>Industry – exposure controls</td><td colspan="3">Potential industrial sources of organic chemicals emissions and waste have strict emissions control and chemical handling equipment and systems in place. Additionally at-risk workers wear appropriate personal protective equipment (PPE), particularly relating to restricting exposure to airborne sources of, and skin contact with, solvents and their wastes.</td></tr>
<tr><td>Government</td><td colspan="3">Regulatory levels are set by state and territory government agencies for exposure of workers to a range of volatile organic substances. Similar controls for emissions of volatile organic compounds (VOCs) exist on companies through environmental licensing regimes.</td></tr>
<tr><td>Community</td><td colspan="3">Labels and containers of consumer products are required to carry advice on safe handling of the contents, although components are seldom identified.</td></tr>
<tr><td>References</td><td colspan="4">1. Reuters news article, 15 November 2015, Workers die after chemical leak at DuPont plant near Houston. Accessed 23 April, 2015 from: http://www.reuters.com/article/2014/11/16/us-usa-chemicals-death-idUSKCN0J001B20141116
2. Warren D and Selchan D (2010). An Industrial Hygiene Appraisal of Triethylamine and Dimethylethylamine Exposure Limits in the Foundry Industry. American Industrial Hygiene Association Journal, Volume 49, Issue 12, 1988.
3. Chemical Book. N,N-Dimethylethylamine Material Safety Data Sheet. Accessed 23 April 2015 from: http://www.chemicalbook.com/ProductMSDSDetailCB5236897_EN.htm
4. Sigma Aldrich (2013). Nickel powder Material Safety Data Sheet. Accessed April 22, 2015 from: http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=295515&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F295515%3Flang%3Den
5. National Environment Protection Council (1999). National Pollutant Inventory Technical Advisory Panel Final Report.</td></tr>
</table>

3.48 Controlled putrescible/ organic waste

Waste name: Controlled putrescible/ organic waste	Basel waste category:Y+4	Basel permit code: N/A	NEPM code: K100, K110, K140, K190

What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
				3.1 – 3.8		
	Description of the waste	This is a catch-all waste category that captures a number of wastes classified in Australia under the National Environment Protection (Movement of Controlled Waste between States and Territories) Measure, but not reflected in any Basel Y codes. The NEPM wastes are: • K100 Animal effluent and residues (abattoir effluent, poultry and fish processing wastes) • K110 Grease trap waste • K140 Tannery wastes (including leather dust, ash, sludges and flours) • K190 Wool scouring wastes These wastes are 'organic' in the sense that they are derived from living matter and are collectively called 'putrescible' because they are subject to putrefaction or biological decay. 'Controlled' means that they are subject to close management under Controlled Waste NEPM, as a result of their potential for adverse human health or environmental impact. This distinguishes them from other waste that is organic in nature but not 'controlled', such as kerbside green waste. The majority (99%) of wastes in this category by tonnage are made up of grease trap waste (61%) and animal effluent and residues (38%). Grease trap waste, or Grease *interceptor* trap waste, is waste from a grease interceptor used for the capture of food, grease and solids before entry to the sewer. These wastes include any solids that are derived from the treatment of this waste. It is primarily sourced from retail food business, such as restaurants and fast food outlets. Animal effluent and residues includes abattoir wastes such as manure from the stockyards and the partly digested paunch or stomach content, as well as similar waste components from poultry and fish processing activities.				
	Waste form	Solid, liquid and sludge				
	Physical/ chemical description	These wastes, particularly from animal processing, can have significant odour and visual amenity issues. Grease solids from cooking have similar properties to the more viscous and solid petroleum fractions, such as waste mineral oils (Y8) and waste tarry residues (Y11).				

<table>
<tr><th colspan="2">Waste name:
Controlled putrescible/ organic waste</th><th>Basel waste category:Y+4</th><th>Basel permit code: N/A</th><th>NEPM code:
K100, K110, K140, K190</th></tr>
<tr><td></td><td></td><td colspan="3">Grease has very poor solubility in water and separates from the liquid solution when cooled. Large amounts of oil and grease create congealment on the surface of tanks and clog pipes, as well as hampering effective treatment at wastewater treatment plants.</td></tr>
<tr><td rowspan="4">Why is it hazardous?</td><td>Primary hazard</td><td colspan="3">Odour amenity, pathogen potential and 'spreading' potential to blanket environmental media, such as surface waters, when spilled, causing environmental impacts.</td></tr>
<tr><td>Secondary hazard</td><td>H12: Ecotoxic</td><td colspan="2">Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.</td></tr>
<tr><td>Other hazard(s)</td><td>H3: Flammable liquids</td><td colspan="2">The word ‘flammable’ has the same meaning as ‘inflammable’. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc, but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test.</td></tr>
<tr><td colspan="2">Main likely chemical contaminants</td><td colspan="2">N/A</td></tr>
<tr><td>Where does it come from?</td><td>Main sources</td><td colspan="3">Animal effluent and residues
Abattoirs, broiler sheds and poultry processing facilities and fish processing facilities.
Grease trap waste
Restaurants, cafes and fast food outlets.</td></tr>
<tr><td>How is it managed?</td><td>Main fates</td><td colspan="3">Significant reuse or recycling of grease trap waste occurs.
Composting and bio-digestion methods are typically applied to recycle, reclaim or recovery energy from animal industry wastes, with some used as inputs into fertiliser products. Alternatively these wastes may be managed through landfill.</td></tr>
<tr><td rowspan="3">How much is generated in Australia?</td><td rowspan="2">Volume score (% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td>≥ 20%</td></tr>
<tr><td colspan="4">12.59%</td><td></td></tr>
<tr><td>Waste arising in 2013 (tonnes)</td><td colspan="5">TOTAL: 905,350 ACT: 5,024 NSW: 319,854
NT: 10,395 Qld: 255,770 SA: 72,118</td></tr>
</table>

Waste name: Controlled putrescible/ organic waste		Basel waste category:Y+4		Basel permit code: N/A		NEPM code: K100, K110, K140, K190	
		Tas:	22,150	**Vic:**	140,222	**WA:**	79,817
Potential health impacts	**Overview**	Grease trap waste is made up solids and sludges from cooking of both animal and vegetable oils, which are obviously edible oils. However, the cooking process degrades these oils and, in combination with residues of cooked foods, can form trace levels of harmful organic pollutants such as PAHs. Animal wastes share amenity characteristics with grease trap waste although more so, and contribute some risk of pathogenicity through ingestion. Despite these concerns the overall human health impacts from these wastes are smaller than the potential for environmental impacts.					
	Acute toxicity	Low					
	Chronic toxicity	Low					
	Carcinogenicity	Low					
	Reproductive toxicity	No reproductive toxicity impacts are expected from these wastes.					
Workplace health & safety impacts	Hygiene is important in both food preparation and processing industries, for the purposes of food standards and safety to the consumer as well as exposure to raw animal blood and associated carcass wastes of slaughtered animals.						
Potential environment impacts	**Overview**	Grease trap wastes have environmental impact properties similar to waste oils and tarry residues. There is evidence in the literature that food oil such as vegetable oil spills occur and impact the environment similar to petroleum oil spills.[1] Both grease trap and animal industry wastes share a common property of having high biochemical oxygen demand (BOD), due to their high biological organic content. BOD is a measure of the quantity of oxygen used by microorganisms in the oxidation of organic matter. Oxygen consumed in the decomposition process of organic wastes discharged to waterways robs other aquatic organisms of the oxygen they need to live. Consequently oxygen starvation is a symptom of high organic loading of waters, both as a physical surface barrier (oil pollution) and as an unnaturally active biochemical process in the vicinity of organic waste discharge.					
	Acute ecotoxicity	**High**: Animal fats and vegetable oils can cause devastating physical effects such as coating animals and plants with oil and suffocating them by oxygen depletion, foul shorelines, clog water treatment plants and catch fire when ignition sources are present.					
	Chronic ecotoxicity	**Low - medium**: Can destroy future and existing food supplies, breeding animals and habitats.					

<table>
<tr><th colspan="3">Waste name:
Controlled putrescible/ organic waste</th><th>Basel waste category:Y+4</th><th>Basel permit code: N/A</th><th>NEPM code:
K100, K110, K140, K190</th></tr>
<tr><td rowspan="2"></td><td colspan="2">Persistence</td><td colspan="3">Medium: Although vegetable oils in particular will biodegrade relatively quickly in the environment, large spills can form products that linger in the environment for many years.</td></tr>
<tr><td colspan="2">Bioaccumulation</td><td colspan="3">Low: Biological wastes such as these do not bioaccumulate in fish.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>High</td><td>High</td><td>Medium</td><td>Medium</td><td>Medium</td><td>Low</td></tr>
<tr><td>Has anything happened before in Australia?</td><td colspan="5">There are numerous historical incidents in Australia of illegal dumping of wastes like grease trap wastes and animal industry wastes.
While not illegal dumping per se, a rendering company in Wodonga, Victoria was fined $5841 for its stockpiling of 4,000 tonnes of rotting abattoir waste at a property on the city's outskirts in 2010. The fine was levied following the completion of EPA Victoria's investigation of community complaints about a stench coming from the property.
The EPA received eight complaints in a day about the odour coming from the property. The stockpiles of odorous waste material were identified as paunch — the contents of an animal's stomach, and sludge generated from the rendering process.</td></tr>
<tr><td rowspan="3">What control measures are in place to manage risks posed by this waste?</td><td colspan="2">Industry – systematic controls</td><td colspan="3">Animal and food processing industries, depending on their size and emissions characteristics, may be licensed by environmental regulators to control industrial processes and equipment so as to limit environmental emissions of odorous compounds and waste water discharge.</td></tr>
<tr><td colspan="2">Industry – exposure controls</td><td colspan="3">Potential industrial sources of these wastes have strict emissions control equipment in place, particularly to address odour issues, and stringent trade waste emissions agreements. Additionally at-risk workers wear appropriate personal protective equipment (PPE), relating to inhalation of odours and skin contact.</td></tr>
<tr><td colspan="2">Government</td><td colspan="3">State and territory governments regulate the management of hazardous waste in their respective jurisdictions in Australia. These place strict controls on the methods of transport, treatment and disposal of all hazardous wastes, including this waste, through licensing, tracking and transport accreditation requirements.
In Victoria the EPA has issued a classification for the management of grease interceptor trap waste to achieve the best environmental outcome. Under the classification, disposal of grease interceptor trap waste, or residual solids derived from the treatment of grease interceptor trap waste, is prohibited and this waste must be reused or recycled.</td></tr>
<tr><td>References</td><td colspan="5">1. US EPA website. Accessed March 22, 2015 from:: http://www2.epa.gov/emergency-response/vegetable-oils-and-animal-fats
2. North East Waste Forum. Fact Sheet – Grease trap waste. Accessed 23 April 2015</td></tr>
</table>

Waste name: Controlled putrescible/ organic waste	Basel waste category:Y+4	Basel permit code: N/A	NEPM code: K100, K110, K140, K190
	from: http://www.newaste.org.au/docs/ATOZ/GREASE%20TRAP%20WASTE.pdf 3. EPA Victoria (2009). INDUSTRIAL WASTE RESOURCE GUIDELINES — CLASSIFICATION FOR REUSE: GREASE INTERCEPTOR TRAP WASTE. Accessed 23 April 2015 from: http://www.epa.vic.gov.au/~/media/Publications/IWRG421.pdf 4. The Border Mail newspaper, July 21, 2010: $5840 fine for stinking Wodonga stockpile. Accessed 23 April, 2015 from: http://www.bordermail.com.au/story/52209/5840-fine-for-stinking-wodonga-stockpile/		

3.49 End of life tyres

Waste name: End of life tyres		Basel waste category: Y+8	Basel permit code: B3140		NEPM code: T140	
What is it?	Hazard score (0 – 6)	Low	Moderate	Medium	High	Extreme
		0 – 2.5				
	Description of the waste	Tyres or 'waste tyres' are used, discarded or rejected tyres that have reached the end of their useful life, i.e., when they can no longer be used for their original purpose, and are subsequently removed from a vehicle.				
	Waste form	Solid				
	Physical/ chemical description	Tyres are composed of approximately 75% rubber and, as waste, they are found in large stockpiles.				
Why is it hazardous?	Primary hazard	Tyres per se are not hazardous in the context of traditional human health and environmental impact measures shown in the headings below, which is why there is no quantitative score provided above. They are something of a special case. Their hazard comes about as a result of the practice of stockpiling large quantities of them, which introduces a serious fire risk (with characteristic thick black (and toxic) smoke and polluting run-off from fire extinguishing efforts).				
	Secondary hazard	Mosquito and other vermin-borne disease (health) risk, due to the stockpile's provision of an environment conducive to still water capture and breeding.				
	Why are tyre stockpile fires a risk?	Tyres are made from flammable materials, and when they are stored in a concentrated mass such as a stockpile, they pose a fire risk. Tyres are designed to absorb heat generated by the friction of road contact. While this makes their combustion point much higher (about twice that of materials such as paper or wood), their ability to absorb heat also makes them difficult to extinguish once ignited. Even if the open flames of the fire have been smothered, the stored heat in tyres can persist for an extended period, meaning there is a high chance of re-ignition. As tyre fires are difficult to control, they are often left to burn out under supervision, lasting several weeks or months, increasing the health and environmental impacts as well as risk of personal or property damage.				
Where does it come from?	Main sources	Passenger vehicle tyres (27%), truck tyres (30%) and off-the-road tyres (43%), such as those used on machinery or equipment used in areas such as forestry, agriculture, mining and construction and demolition, make up the total estimate of tyres that reached end of life in 2009/10 [1].				
How is it	Main fates	Domestic fates: recycling, energy recovery, civil engineering,				

<table>
<tr><th colspan="2">Waste name:
End of life tyres</th><th colspan="2">Basel waste category:
Y+8</th><th colspan="2">Basel permit code: B3140</th><th colspan="2">NEPM code:
T140</th></tr>
<tr><td>managed?</td><td></td><td colspan="6">licensed landfill and an unknown category made up of permanent stockpiles and illegal dumping
<u>Export fates</u>: reuse and retreading, recycling and energy recovery.
The rate of tyre recycling in Australia remains relatively low – recent Victorian data estimates recycling to account for 20% of all tyres generated as waste, with 26% exported and 54% unaccounted for and presumed to be either stockpiled or illegally dumped.[2]</td></tr>
<tr><td rowspan="4">How much is generated in Australia?</td><td>Volume score
(% of national tonnes in 2013)</td><td><1%</td><td>1 – 5%</td><td>5 – 10%</td><td>10 – 20%</td><td colspan="2">≥ 20%</td></tr>
<tr><td></td><td colspan="4">6.1%</td><td colspan="2"></td></tr>
<tr><td rowspan="3">Waste arising in 2013 (tonnes)</td><td>TOTAL:</td><td>435,233</td><td>ACT:</td><td>3,372</td><td>NSW:</td><td>104,212</td></tr>
<tr><td>NT:</td><td>5,636</td><td>Qld:</td><td>92,383</td><td>SA:</td><td>58,668</td></tr>
<tr><td>Tas:</td><td>10,000</td><td>Vic:</td><td>87,873</td><td>WA:</td><td>73,089</td></tr>
<tr><td rowspan="5">Potential health impacts</td><td>Overview</td><td colspan="6">Tyres per se are not hazardous in the context of traditional human health impact measures shown in the headings below and would consequently be rated very low.
However, these health impacts can occur from large stockpiles of tyres:
a) if a fire starts or
b) from incubating environments created by uncovered large tyre stores (stockpiles), which increase mosquito and vermin breeding, increasing the risk of diseases such as dengue fever and Ross River virus.</td></tr>
<tr><td>Acute toxicity</td><td colspan="6">Can result from inhalation of smoke from tyre fires, which emit characteristic thick black smoke containing dangerous soot-laden particulates from incomplete combustion, as well as other air pollutants.</td></tr>
<tr><td>Chronic toxicity</td><td colspan="6">Contraction of mosquito-borne diseases from the still-water breeding environments that tyre stockpiles provide. Aedes albopictus, a secondary dengue fever vector in Asia, has spread to North America and Europe largely due to the international trade in used tyres (a breeding habitat) [3].</td></tr>
<tr><td>Carcinogenicity</td><td colspan="6">Tyre fires emit black smoke, volatile organic compounds and hazardous pollutants, such as polycyclic aromatic hydrocarbons, dioxins, furans, hydrochloric acid, benzene, polychlorinated biphenyls, arsenic, cadmium, nickel, zinc, mercury, chromium and vanadium [4]. Many of these are carcinogens or suspected carcinogens.</td></tr>
<tr><td>Reproductive toxicity</td><td colspan="6">No definitive evidence of risk to the unborn child.</td></tr>
</table>

<table>
<tr><th colspan="2">Waste name:
End of life tyres</th><th colspan="2">Basel waste category:
Y+8</th><th colspan="2">Basel permit code: B3140</th><th>NEPM code:
T140</th></tr>
<tr><td>Workplace health & safety impacts</td><td colspan="6">N/A, unless in the event of fire – as above.</td></tr>
<tr><td>Population scale impacts</td><td colspan="6">Repeated exposure to smoke from fires in general result in increased cases of respiratory illness.
Increased breeding habitats for disease-bearing mosquito vectors contributes to an increase in cases of the disease.</td></tr>
<tr><td rowspan="5">Potential environment impacts</td><td>Overview</td><td colspan="5">Tyres per se are not hazardous in the context of traditional environmental impact measures shown in the headings below, and would consequently be rated very low.
However, environmental impacts can occur from large stockpiles of tyres, especially in relation to stockpile fires.
If burned, 1 million tyres will generate some 200,000 litres of run-off oil, as tyre combustion causes pyrolysis of the rubber, which results in oily decomposition waste that is both highly polluting and flammable. In addition to the problems caused by oil run-off, the waste may be carried by water, if it is used to extinguish the fire, or via percolation through the soil, reaching the groundwater or nearby streams. [4]
The leachate of pollutants with rainwater may also lead to soil and water contamination. This may occur through two atmospheric processes known as wash-out (small particles that cling together and are brought in by rainwater) and rain-out (larger particles that are directly affected by rainfall).</td></tr>
<tr><td>Acute ecotoxicity</td><td colspan="5">May occur from various toxic contaminants of run-off or wash-out/ rain-out from tyre stockpile fires, such as persistent organic pollutants (POPs) and heavy metals.</td></tr>
<tr><td>Chronic ecotoxicity</td><td colspan="5">May occur from various toxic contaminants of run-off or wash-out/ rain-out from tyre stockpile fires, such as persistent organic pollutants (POPs) and heavy metals.</td></tr>
<tr><td>Persistence</td><td colspan="5">May occur from various toxic contaminants of run-off or wash-out/ rain-out from tyre stockpile fires, such as persistent organic pollutants (POPs) and heavy metals.</td></tr>
<tr><td>Bioaccumulation</td><td colspan="5">May occur from various toxic contaminants of run-off or wash-out/ rain-out from tyre stockpile fires, such as persistent organic pollutants (POPs) and heavy metals.</td></tr>
<tr><td rowspan="2">Where are the risks of impacts most likely?</td><td>Generation</td><td>Transport</td><td>Storage</td><td>Treatment</td><td>Recovery</td><td>Final disposal</td></tr>
<tr><td>Low</td><td>Low</td><td>High</td><td>N/A</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Has anything</td><td colspan="6">In NSW, fire services estimate a total of 256 tyre fires have burnt since 2009, with an</td></tr>
</table>

Waste name: End of life tyres		Basel waste category: Y+8	Basel permit code: B3140	NEPM code: T140
happened before in Australia?	average of 50 a year.[2] Fire activity relative to this would also apply in other Australian states and territories. For example, in January 2015, an investigation was launched into a large stockpile of tyres which were burned in fires in Moyston, Victoria. Concerns were raised by the Environment Protection Authority who are investigating whether a pile of 30,000 tyres that caught fire was illegally dumped. [5] Overseas there have also been many examples of large tyre stockpile fires. A stockpile of 10million tyres illegally dumped near Knighton, Powys in Wales caught fire in 1989. Unable to access the area, fire fighters could not extinguish the blaze and it burnt for at least 15 years. Polluting leachate from the site contaminated drinking water supplies by polluting the River Teme.[6]			
What control measures are in place to manage risks posed by this waste?	**Industry – systematic controls**	In response to suspected illegal operators undercutting legitimate recyclers (who had the requisite licences, planning approvals and safety measures), the Australian Tyre Recycling Association developed a best practice standard of operation. Also see *Tyre Product Stewardship Scheme* and the formation of Tyre Stewardship Australia below.		
	Industry – exposure controls	N/A		
	Government	The Australian Government launched Tyre Stewardship Australia (TSA) on behalf of the tyre industry on 20 January 2014. TSA has been established by tyre importers to administer a national tyre product stewardship scheme. TSA will also promote environmentally sustainable collection and recycling of end-of-life tyres and explore and promote new uses for recycled end-of-life tyres. TSA will administer the tyre product stewardship scheme and conduct education, communication, compliance assessment and market development activities. The Australian Competition and Consumer Commission (ACCC) granted authorisation for the scheme for five years until 3 May 2018. The scheme is funded through an ACCC-authorised levy on the sale of tyres in Australia. Victoria is currently proposing regulations relating to the storage of waste tyres, as evidenced by their Regulatory Impact Statement comment process in late 2014 [2]. From 29 April 2015, tyre stockpiles in Victoria have been managed under the Environment Protection (Scheduled Premises and Exemptions) Regulations 2007 which will require an EPA works approval. In July 2015 NSW will commence new Waste Regulations to lower the licensing threshold for the storage of waste tyres and introduce tracking requirements on the movement of tyres to ensure end-of-life tyres are being sent to lawful facilities.		

Waste name: End of life tyres		Basel waste category: Y+8	Basel permit code: B3140	NEPM code: T140
	Community	N/A		
References	1. COAG Standing Council on Environment and Water. Study into domestic and international fate of end- of-life tyres, Final Report (2012). Hyder Consulting. 2. EPA Victoria Storage of waste tyres – Regulatory impact statement (RIS) (2014). Publication number 1576. 3. World Health Organization. Dengue and severe dengue, fact sheet No.117 (2015). Accessed March 12, 2015 from: http://www.who.int/mediacentre/factsheets/fs117/en/ 4. Secretariat of the Basel Convention. Revised technical guidelines for the environmentally sound management of used and waste pneumatic tyres (2011). 5. EPA Victoria. Media release: EPA investigates Moyston tyre stockpile fire (9 January 2015). Accessed March 12, 2015 from: http://www.epa.vic.gov.au/about-us/news-centre/news-and-updates/news/2015/january/09/epa-investigates-moyston-tyre-stockpile-fire 6. Environment Agency Wales: Regulation of Waste Management, p.31. Report prepared for the Auditor General for Wales by the National Audit Office Wales (2004). Accessed March 12, 2015 from: https://web.archive.org/web/20120308220156/http://www.wao.gov.uk/assets/englishdocuments/Environment_Agency_Wales_Waste_Management_agw_2004.pdf		

Appendix A

Basel Y-code to NEPM code conversion

Basel Convention		NEPM code[2]
Code	**Waste description (Annex 1)**	
Y1	Clinical wastes from medical care in hospitals, medical centres and clinics	R100
Y2	Wastes from the production and preparation of pharmaceutical products	R140
Y3	Waste pharmaceuticals, drugs and medicines	R120
Y4	Wastes from the production…... of biocides and phytopharmaceuticals	H100
Y5	Wastes from the manufacture…... of wood preserving chemicals	H170
Y6	Wastes from the production, formulation and use of organic solvent	G160
Y7	Wastes from heat treatment and tempering operations containing cyanides	A110
Y8	Waste mineral oils unfit for their originally intended use	J100
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsion	J120
Y10	Waste substances ….containing or contaminated with PCBs, PCTs, PBBs	M100
Y11	Waste tarry residues ... from refining, distillation and any pyrolytic treatment	J160
Y12	Wastes from production…... of inks, dyes, pigments, paints, etc.	F100
Y13	Wastes from production……resins, latex, plasticizers, glues, etc.	F110
Y14	Waste chemical substances arising ….. environment are not known	T100
Y15	Wastes of an explosive nature not subject to other legislation	T200, D340, D350, E100
Y16	Wastes from production, formulation and use of photographic chemicals…	T120
Y17	Wastes resulting from surface treatment of metals and plastics	A100
Y18	Residues arising from industrial waste disposal operations	N205, N150, N160, N230
	Wastes having as constituents …	
Y19	Metal carbonyls	D100
Y20	Beryllium; beryllium compounds	D160
Y21	Hexavalent chromium compounds	D140
Y22	Copper compounds	D190
Y23	Zinc compounds	D230
Y24	Arsenic; arsenic compounds	D130
Y25	Selenium; selenium compounds	D240
Y26	Cadmium; cadmium compounds	D150
Y27	Antimony; antimony compounds	D170
Y28	Tellurium; tellurium compounds	D250
Y29	Mercury; mercury compounds	D120
Y30	Thallium; thallium compounds	D180
Y31	Lead; lead compounds	D220
Y32	Inorganic fluorine compounds excluding calcium fluoride	D110
Y33	Inorganic cyanides	A130
Y34	Acidic solutions or acids in solid form	B100
Y35	Basic solutions or bases in solid form	C100
Y36	Asbestos (dust and fibres)	N220
Y37	Organic phosphorus compounds	H110
Y38	Organic cyanides	M210
Y39	Phenols; phenol compounds including chlorophenols	M150
Y40	Ethers	G100
Y41	Halogenated organic solvents	G150
Y42	Organic solvents excluding halogenated solvents	G110
Y43	Any congenor of polychlorinated dibenzo-furan	M170

Basel Convention		NEPM code[2]
Code	**Waste description (Annex 1)**	
Y44	Any congenor of polychlorinated dibenzo-p-dioxin	M180
Y45	Organohalogen compounds other than …(e.g. Y39, Y41, Y42, Y43, Y44)	M160
	Categories of wastes requiring special consideration (Annex II)	
Y46	Wastes collected from households	N/A[4]
Y47	Residues arising from the incineration of household wastes	N/A[5]
	Additional waste categories not included in Y-Codes ('+8')	
1	Other metal compounds	D200, D210, D270, D290
2	Other inorganic chemicals	D300, D310, D330, D360
3	Other organic chemicals	M220, M230, M250, M260
4	Controlled putrescible/ organic waste	K100, K110, K140, K190
5	Waste packages and containers containing Annex 1 substances in concentrations sufficient to exhibit Annex III hazard characteristics	N100
6	Soils contaminated with residues of substances in Basel Y-codes 19-45	N120
7	Sludges contaminated with residues of substances in Basel Y-codes 19-45	N140, N190
8	Tyres	T140

Notes:

1. *Taken from Annex III of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal*
2. *Translation of Y-code to NEPM code(s) as described in Reporting hazardous waste under the Basel Convention - guidance to states, territories and the Commonwealth (2014 version), Blue Environment, Ascend and REC (Table 4)*
3. *Y46 Wastes collected from households not classified as hazardous waste in Australia and is not within scope for this project*
4. *Y47 Residues arising from the incineration of household wastes not within scope of this project as, in the main, this is not carried out in Australia*

Appendix B

NEPM code to Basel Y-code conversion

'15' code	NEPM 15 description	'75' code	Waste description (NEPM Schedule A, List 1)	Y code
A	Plating and heat treatment	A100	Waste resulting from surface treatment of metals and plastics	Y17
		A110	Waste from heat treatment and tempering operations containing cyanides	Y7
		A130	Cyanides (inorganic)	Y33
B	Acids	B100	Acidic solutions or acids in solid form	Y34
C	Alkalis	C100	Basic solutions or bases in solid form	Y35
D	Inorganic chemicals	D100	Metal carbonyls	Y19
		D110	Inorganic fluorine compounds excluding calcium fluoride	Y32
		D120	Mercury; mercury compounds	Y29
		D130	Arsenic; arsenic compounds	Y24
		D140	Chromium compounds (hexavalent and trivalent)	Y21
		D150	Cadmium; cadmium compounds	Y26
		D160	Beryllium; beryllium compounds	Y20
		D170	Antimony; antimony compounds	Y27
		D180	Thallium; thallium compounds	Y30
		D190	Copper compounds	Y22
		D200	Cobalt compounds	Y+1
		D210	Nickel compounds	Y+1
		D220	Lead; lead compounds	Y31
		D230	Zinc compounds	Y23
		D240	Selenium; selenium compounds	Y25
		D250	Tellurium; tellurium compounds	Y28
		D270	Vanadium compounds	Y+1
		D290	Barium compounds (excluding barium sulphate)	Y+1
		D300	Non-toxic salts	Y+2
		D310	Boron compounds	Y+2
		D330	Inorganic sulfides	Y+2
		D340	Perchlorates	Y15
		D350	Chlorates	Y15
		D360	Phosphorus compounds excluding mineral phosphates	Y+2
E	Reactive chemicals	E100	Waste containing peroxides other than hydrogen peroxide	Y15
F	Paints, resins, inks, organic sludges	F100	Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	Y12
		F110	Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	Y13
G	Organic solvents	G100	Ethers	Y40
		G110	Organic solvents excluding halogenated solvents	Y42
		G150	Halogenated organic solvents	Y41
		G160	Waste from the production, formulation and use of organic solvents	Y6
H	Pesticides	H100	Waste from the production, formulation and use of biocides and phytopharmaceuticals	Y4
		H110	Organic phosphorous compounds	Y37
		H170	Waste from manufacture, formulation and use of wood-preserving chemicals	Y5
J	Oils	J100	Waste mineral oils unfit for their original intended use	Y8
		J120	Waste oil/water, hydrocarbons/water mixtures or emulsions	Y9
		J160	Waste tarry residues arising from refining, distillation, and any pyrolytic treatment	Y11

'15' code	NEPM 15 description	'75' code	Waste description (NEPM Schedule A, List 1)	Y code
K	Putrescible/ organic waste	K100	Animal effluent and residues (abattoir effluent, poultry and fish processing wastes)	Y+4
		K110	Grease trap waste	Y+4
		K140	Tannery wastes (including leather dust, ash, sludges and flours)	Y+4
		K190	Wool scouring wastes	Y+4
M	Organic chemicals	M100	Waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated naphthalenes, polychlorinated terphenyls and/or polybrominated biphenyls	Y10
		M150	Phenols, phenol compounds including chlorophenols	Y39
		M160	Organo halogen compounds—other than substances referred to in this Table	Y45
		M170	Polychlorinated dibenzo-furan (any congener)	Y43
		M180	Polychlorinated dibenzo-p-dioxin (any congener)	Y44
		M210	Cyanides (organic)	Y38
		M220	Isocyanate compound5	Y+3
		M230	Triethylamine catalysts for setting foundry sands	Y+3
		M250	Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials	Y+3
		M260	Highly odorous organic chemicals (including mercaptans and acrylates)	Y+3
N	Soil/ sludge	N100	Containers and drums that are contaminated with residues of substances referred to in this list	Y+5
		N120	Soils contaminated with a controlled waste	Y+6
		N140	Fire debris and fire wash waters	Y+7
		N150	Fly ash, excluding fly ash generated from Australian coal fired power stations	Y18
		N160	Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list	Y18
		N190	Filter cake contaminated with residues of substances referred to in this list	Y+7
		N205	Residues from industrial waste treatment/disposal operations	Y18
		N220	Asbestos	Y36
		N230	Ceramic-based fibres with physico-chemical characteristics similar to those of asbestos	Y18
R	Clinical and pharmaceutical	R100	Clinical and related wastes	Y1
		R120	Waste pharmaceuticals, drugs and medicines	Y3
		R140	Waste from the production and preparation of pharmaceutical products	Y2
T	Miscellaneous	T100	Waste chemical substances arising from research and development or teaching activities, including those which are not identified and/or are new and whose effects on human health and/or the environment are not known	Y14
		T120	Waste from the production, formulation and use of photographic chemicals and processing materials	Y16
		T140	Tyres	Y+8
		T200	Waste of an explosive nature not subject to other legislation	Y15

Appendix C

Approach to quantifying relative hazard

Hazard scoring method

To establish a defensible basis for quantifying relative hazard, a modified form of the National Pollutant Inventory's (NPI) risk scoring approach, which quantifies environmental and human health hazard, was used. The NPI Technical Advisory Panel (TAP) developed a risk scoring methodology[2] in the late 1990's for taking a long list of industrial chemical contaminants and comparatively assessing their risk so that they could be ranked for inclusion into the program. This approach is well suited to comparatively assess the hazards posed by a list of hazardous wastes, so that a default categorisation can be arrived at using a quantitative approach based on risk.

We used a modified version of the NPI TAP's risk scoring approach to quantify relative hazard, excluding assessment of potential exposure, as this is variable and dependant on management controls and its life-cycle stage. This exclusion defines it as hazard scoring approach.

- The general approach for each waste can be described as:
  - Score human health effects on a scale of 0 – 3 per dimension, quantified based on the allocated European risk phrases. The four component dimensions for human health are: acute toxicity, chronic toxicity, carcinogenicity and reproductive toxicity. Obtain a total human health score out of 3 by dividing all dimension scores by four (the total number of dimensions).
  - Score environmental effects on a scale of 0 – 3, quantified based on the allocated risk phrases. The component dimensions for human health are: acute toxicity, chronic toxicity, persistence and bioaccumulation. Obtain a total environmental score out of 3 by dividing all dimension scores by four (the total number of dimensions).
  - Add the two component scores together to obtain a hazard score (out of a possible 6).

A worked example is shown for the waste *Metal Carbonyls* below in Figure C.1 overleaf.

Hazard scores were calculated by sourcing EC risk phrases for each hazardous waste (or substance for those wastes whose hazard is clearly substance- based, such as 'lead and lead compounds' or 'Polychlorinated dibenzo-furan (any congener)' for example). For those not overtly substance-based (such as 'clinical and related waste'), industry knowledge and desktop research was used to understand the waste's salient properties, so sound professional judgement could be made about the primary hazard posed by the waste. Once the primary hazard was clear, this was sufficient to undertake hazard scoring for these wastes.

Apart from the TAP report itself, key references for this work were material safety data sheets, Safe Work Australia's Hazardous Substance Information System database and a number of other literature references such as the World Health Organisation's health and safety guides.

The resulting hazard scores for each waste are shown in each impact profile, accompanied by a colour-based scoring graphic, or 'hazard scoring bar', based on six ranges of hazard score as follows:

[2] Rae, I (1999), National Pollutant Inventory Technical Advisory Panel. *Final report to the National Environment Protection Council.*

Hazard grouping	
	Extreme hazard: >5.0
	High hazard: 3.9 - 4.9
	Medium hazard: 3.1 - 3.8
	Moderate hazard: 2.6 - 3.0
	Low hazard: 0 - 2.5
	No hazard score applied

A key thing to note about the default waste categorisation table is that it is built on generic assumptions about waste contaminants, properties and industrial processes. Particularly in the case of wastes with chemical contaminants (for example lead; lead compounds), there is no account taken of the concentration of the contaminant in the waste – because this is entirely variable - which in turn varies the scale of hazard posed. Because individual wastes will vary, scoring is by nature precautionary; the core assumption is:

Hazard of the contaminant (or primary influencing hazard property) = hazard of the waste.

In the case where a waste is primarily a lead-containing waste, but the lead concentration is typically low compared to hazardous waste contaminant criteria, it is assumed that such a waste would not be classified as hazardous in the first place.

Figure C.1 Example hazard scoring approach for Y10 Metal Carbonyls

Y19 Metal Carbonyls

Data:

- Primary hazardous characteristic: H6.1 Poisonous (acute)
- Risk phrases applicable to nickel carbonyl[11] (most toxic of metal carbonyls and most commonly used – precautionary principle):
  - For human health:
    - R26
    - R40
    - R61
  - For environment:
    - R50, R51, R52
    - R53

From NPI TAP:

Hazard Score = human health score (out of 3) + environment score (out of 3)
Human health score = [AT + CT + C + RT]/4
Environment score = [AT + CT + P + B]/4, where:

- AT = acute toxicity
- CT = chronic toxicity
- C = carcinogenicity score
- P = Persistence score
- B = Bioaccumulation score

Calculation of hazard score: (by reference to NPI TAP report pages 11 – 19 for risk score values (0 – 3)

Human health score = [3.0 + 2.0 + 1.0 + 3.0]/4
= 2.3
Environment score = [3.0 + 3.0 + 0 + 0]/4
= 1.5
Hazard Score = 2.3 + 1.5
= 3.8

[11] MSDS for nickel carbonyl: http://www.strem.com/catalog/msds/28-1150