

Hazardous Waste in Australia

Final report, version 2

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Hazardous Waste in Australia

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Abbreviations & glossary

The Act	<i>Hazardous Waste (Regulation of Exports and Imports) Act 1989</i>
AFFF	Aqueous film forming foams
ANZSIC	Australia and New Zealand Standard Industry Codes
Basel Convention	<i>The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal</i> . 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.
CPT	Chemical or physical treatment (facility)
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.
DoE	The Australian Government Department of the Environment
EPS	Expanded polystyrene
Hazardous waste	A hazardous waste, as defined in the Australian Government's <i>National Waste Policy: Less waste, more resources</i> (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	<i>National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998</i>
PCB	Polychlorinated biphenyl
PFOS	Perfluorooctane sulfonate
POP	Persistent organic pollutant
POP-BDE	Persistent organic pollutants - bromodiphenyl ethers (various forms)
Projection groups	The classification system adopted for generating the projections of waste arisings (closely follows the NEPM categories. Projection groups may also be referred to as 'waste groups' where the context refers only to the waste grouping and not the waste group projection.
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 be considered a waste fate. The term fate does not infer that the waste material is destroyed or lost.

Executive summary

Following a commitment in the *National Waste Policy: Less Waste, More Resources*, from June to July 2014 the Australian Government Department of the Environment (DoE) commissioned a series of projects to be delivered by Blue Environment Pty Ltd, in association with Ascend Waste and Environment Pty Ltd and Randell Environmental Consulting Pty Ltd (REC), related to hazardous waste in Australia. These projects share a common thread of an extensive current and historical data collection, compilation and analysis requirement. They were:

1. **The Hazardous waste infrastructure needs and capacity project:** The project has three parts:
 - a. prepare projections of hazardous waste arisings and fates over the coming 20 years.
 - b. consult with industry to estimate Australia's current hazardous waste infrastructure capacity, its distribution and expected future.
 - c. combine the results of the first two parts to identify the extent to which current infrastructure meets future needs, considering the nature and locations of particular infrastructure.
2. **Basel report 2013:** Compile data for Australia's 2013 Basel Report, which reported Australia's hazardous waste generation data from all jurisdictions to the Basel Secretariat in Geneva Switzerland.
3. **Hazardous Waste in Australia:** As an extension to Basel Report 2013, produce a new public data set with the following key outputs:
 - a. 2013 data (and the ability to view it as 2012-13 data) on hazardous waste arisings, main sources and fates
 - b. analysis and commentary on the data through the compilation of a comprehensive report, to be called Hazardous Waste in Australia (HWiA), that provides a rich picture of hazardous waste in Australia
 - c. a documented and tested protocol for independent validation of hazardous waste data supplied by the jurisdictions.

These were later combined and collectively referred to as the ***Hazardous Waste Infrastructure and Data Project (HWIDP)***. Item 2 was delivered in November 2014, along with item 3c. Item 1 is separately reported. Item 3 (a and b) is the subject of this report.

A snapshot of national hazardous waste arisings¹ in Australia in 2012-13, by waste group for each jurisdiction, is given in Table ES1. Section 4 of the report analyses each of these 23 waste groups in detail; describing the waste, its major sources, arisings, historical arisings trends, fate and analysis and commentary to provide insight into issues that the data may uncover.

Other wastes are of particular interest because they are not neatly captured by waste tracking systems, due to issues such as inconsistent classification, large-scale onsite or offsite storage (stockpiling), historical consideration outside of the hazardous waste framework or simply because the waste is only recently hitting the regulatory radar. These wastes include coal seam gas (CSG) wastes, persistent organic pollutants (POPs) waste, spent potlining (SPL) waste, fly ash, red muds and biosolids. Issues surrounding

¹ In this project, hazardous waste is said to 'arise' when it is delivered to processing, storage, treatment, or disposal infrastructure. This is distinct from 'waste generation', a term commonly used in waste reporting, in that if waste is transported to more than one site it may 'arise' more than once.

these wastes and the challenges they present are discussed, although they are not materially captured in the hazardous waste data presented and analysed in this report.

Table ES1: National hazardous waste arisings, 2012-13 (tonnes) – by waste group¹

Waste groups	Waste arising (tonnes)								
	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	National
Plating & heat treatment	0	109	0	4,698	102	0	44	1,000	5,953
Acids	0	13,258	23	13,616	622	36	9,244	4,009	40,808
Alkalis	220	3,968	197	195,544	49,391	1	7,143	82,913	339,377
Mercury & compounds	12	190	26	370	23	0	21	63	705
Lead & compounds ²	226	32,085	410	23,876	9,259	10,413	20,120	4,697	101,086
Non-toxic salts	0	17,443	0	47,727	4,465	3,535	2,354	9,689	85,213
Other inorganic chemicals	0	2,976	61	4,494	71,416	103,212	16,462	928	199,549
Reactive chemicals	0	88	0	44	3	0	72	0	207
Paints, resins, inks, organic sludges	171	19,135	80	13,340	2,877	0	20,250	2,175	58,028
Organic solvents	68	3,749	9	14,321	543	385	7,590	5,856	32,522
Pesticides	15	319	0	2,062	255	0	644	980	4,275
Oils	2,800	157,496	1,431	262,601	13,874	231	96,027	164,702	699,160
Animal effluent and residues (+ food processing waste)	0	94,799	3,070	85,874	21,429	6,601	49,265	17,406	278,443
Grease trap waste	5,856	183,158	5,930	130,688	41,413	12,762	99,811	65,003	544,619
Tannery & wool scouring wastes									
Other organic chemicals	24	10,798	175	4,360	3,669	20	872	695	20,613
Contaminated soils	1,953	529,900	6,355	284,967	238,750	66	347,901	3,483	1,413,375
Other industrial treatment residues ³	0	23,361	0	198,750	65,707	0	15,862	9,932	313,612
Asbestos	20	365,050	4,911	115,902	18,877	10,573	74,132	51,148	640,613
Other soil/sludges	9	37,341	35	26,575	1,580	11	51,788	21,525	138,863
Clinical & pharmaceutical	562	26,552	216	25,877	6,503	27	12,378	3,184	75,299
Tyres	3,298	102,590	5,513	90,219	56,788	9,971	85,993	70,179	424,551
Other miscellaneous	73	2,675	173	3,306	380	15	1,838	495	8,954
Total	15,307	1,627,040	28,615	1,549,211	607,926	157,859	919,811	520,062	5,425,826

Notes:

1. Refer to Appendix A.3 for full NEPM code breakdown
2. Lead; lead compounds waste adjusted from source data
3. Other industrial treatment residues adjusted from source data
4. Tannery & wool scouring wastes are excluded from this table due to commercial confidentiality concerns

Findings

The following key messages were drawn from an analysis of arisings, sources and fates for hazardous wastes generated in 2012-13, an assessment of historical trend data and an evaluation of the status of some other wastes of particular interest that are not well-represented by tracking systems.

1. Overall hazardous waste arisings volumes appear to be increasing

National hazardous waste annual arisings datasets reported for the last three years, excluding biosolids, total the following respectively:

- 4.6 million tonnes in 2010-11
- 5.3 million tonnes in 2011-12
- 5.4 million tonnes in 2012-13.

While there is fluctuation evident, overall arisings have increased by 19% over these three years.

2. New wastes with new challenges are emerging

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.

CSG wastes are interesting as an emerging waste because a) there are very large tonnages involved and b) salty waters, brines or solid salts are a difficult problem for the waste industry, which often relies on landfill. While they are present in significant quantities in arisings numbers, these are probably dwarfed by what is currently in storage, awaiting an acceptable fate option. The rapid growth in CSG wastes would appear to be evident in trend charts for Other D (Inorganic fluorine compounds), D300 (non-toxic salts) and N205b (industrial residues), particularly over the last five or so years.

Three 'new' potentially hazardous waste streams may emerge over the next five years should the Australian Government determine to ratify the recent listing of a number of new chemicals onto the Stockholm Convention on Persistent Organic Pollutants, and a fourth is a long-term legacy issue in Australia. Broadly speaking, the Stockholm Convention requires POP-containing wastes to be destroyed. From a fate perspective, ratification of the new Stockholm POPs could massively increase the demand on infrastructure capacity that already appears to be inadequate for the estimated current generation of polluted firewaters (a PFOS waste stream). It has been long understood that existing Australian infrastructure for halogenated chemical treatment is inadequate for dealing with the Orica HCB waste in technology, scale and cost.

3. Interstate waste movements appear to be absent from arisings data

Through the process of interrogation of tracking data, three examples of major arisings anomalies were uncovered in the New South Wales, Victorian and Queensland datasets; for lead acid batteries, waste oils and pesticides, respectively. All three wastes have the same characteristic: their respective national markets are dominated by treatment facilities concentrated in a particular state, which gives rise to large one-way movements of interstate waste.

In each case the receiving state appears to capture better data on the import than the sending state does on the export. In fact two of these examples show the receiving state collects the only data on the interstate movement.

This may point to a broader question of whether wastes bound for interstate export are captured properly or at all in sending states' estimates of arisings from their tracking systems, which are used to provide their respective Basel reports. It seems that the receiving state takes carriage of the tracking data, which makes sense from a regulatory risk management point of view but leaves a hole in the arisings data of the originating state. This may be occurring because the receiving state has more incentive to record the movement – it not only has legal carriage of the waste should there be a pollution event or accident but also has the responsibility to report all waste received into its jurisdiction, specifically from ever other jurisdiction, in its annual NEPM report.

This represents a systemic weakness in generation data reported to Basel, which appears to either under-report or completely omit waste that is transported interstate. This has most impact in cases where the interstate-sent component of a jurisdiction's total arising is large, such is the case with lead acid batteries.

4. Regulatory exemptions mask waste arisings

Spent lead acid battery acid wastes destined for reuse and used oil going for re-refining in NSW are two examples of a significant volume waste having a waste tracking exemption. Five such exemptions apply in NSW², each as a 'blanket' approach across the entire waste type (and management fate) specified in the exemption. Used oil transporters in Victoria may also apply for an exemption from using transport certificates, and the Victorian data suggest that many do.

These situations, particularly the blanket ones in NSW, create major holes in tracking system data on waste arisings. Sometimes these holes are not obvious without deeper investigation of the data; for example NSW oils figures still include about 29,000 tonnes of oil arisings – of which analysis suggests 25,000 tonnes to be legitimately going to non-recycling fates which are not exempt.

Further analysis indicates that between NSW and Victoria, due to their respective exemptions, as much as 175,000 tonnes of waste oil is absent from tracking data. Putting this 'hole' into perspective, it would make a very large addition to the reported figure nationally of 271,297 in 2012-13.

5. Differences in jurisdictional approaches to hazardous waste management adversely affect data quality

In addition to the regulatory exemptions discussed above, other jurisdictional differences in approach affect data quality. Although the general approach to classification and management of hazardous wastes across jurisdictions is relatively consistent, historically evolved differences can make data collection, collation and comparison difficult. This is still leading to pockets of questionable data quality, particularly at a jurisdictional level, such as:

- Key waste streams, such as contaminated soil, asbestos, waste oils, lead acid batteries and grease trap waste are not captured in full or at all in some states due to classification and/or tracking differences.
- Tasmania, the Northern Territory and the ACT have no tracking system, leading to under-reporting of hazardous waste quantities.
- South Australia does not report disposal or treatment information, and Western Australia did not provide such data due to confidentiality reasons, although some data is tracked. This constrains analysis to the waste arisings end of the data.
- South Australia cannot differentiate between waste movements within the state and those exported as both sets of data use certificate numbers with the same prefix.

² They are listed, in accordance with clause 91 of the *Protection of the Environment Operations (Waste) Regulation 2014*, here: <http://www.epa.nsw.gov.au/wasteregulation/exemptions.htm>

- Asbestos data is not historically tracked in New South Wales, and Western Australia has no reliable asbestos data.
- Close examination of Victorian tracking data indicates the presence of even more Victorian-specific waste codes than were previously understood. For example it was previously thought that Victoria tracked four codes under the H category (pesticides), one more than in the NEPM. Tracking data shows 10 different H codes have historically been used in Victoria, although the practice appears to have stopped in 2014, due to EPA Victoria's IT system upgrades.

6. Jurisdictional fate categories are inconsistent and inadequate for national analysis

The fate categories applied to enable all three states' data to be used in this project were:

- recycling
- chemical/ physical treatment
- landfill
- biodegradation
- incineration
- storage or transfer.

This approach, and the way primary data is recorded in these tracking systems, introduces a level of ambiguity that limits the value of the fate assessment. These ambiguities have led to a number of what could be interpreted as odd fates in the reported data.

- Pesticides that go to recycling, but could have been placed in the incineration category.
- Animal and food processing wastes are mostly recorded as recycling, but further analysis suggests the actual fate could be composting, which could either be described as biodegradation or recycling.
- PCBs are recorded as predominantly chemical/ physical treatment, yet they are destroyed almost exclusively by thermal decomposition processes such as plasma arc. This would appear to be a reflection of the fate types available in the data. While similar to incineration, PCB destruction facilities are not well captured in the headings available so allocation to chemical/ physical treatment seems to have occurred.
- Queensland data reports power station ash going to be blended into a mulch product as chemical/ physical treatment, when recycling would probably be a better choice.
- Grease trap waste in Queensland is recorded as going to chemical/ physical treatment as the highest fate proportion, but if the outputs of what is likely to be relatively basic treatment find another use, then it probably should be recycling.

These inconsistencies are in part to do with the limiting number of high level fates the project team was able to use in data analysis. But some blame also rests with the underlying Basel 'D and R' codes, which are either not very clear or used differently between jurisdictions and users of tracking certificates.

7. Significant tracking certificate errors exist in tracking data

Sections 4.1 to 4.23 highlight numerous examples of certificate errors, which can lead to poor data and interpretation outcomes.

For lead waste (lead acid batteries) in the NSW tracking system there were two single certificates of 22,480 tonnes and 23,500 tonnes respectively. Since the next largest single certificate entry in over 1,500 lead acid battery records is 34 tonnes, combined with the physical limitations of what a truck can actually

carry, these two are highly likely to be data mistakes. Correct quantities may well be 22,480 and 23,500 kg instead.

For N205b *Other industrial treatment residues*, closer inspection of tracking data suggests that 16% of Queensland's waste is miscoded sewage sludge, which creates a small double-counting issue considering that biosolids, the processed version of sewage sludge, is separated out of this dataset (as N205a).

Queensland N205b data also contains miscoded CSG waste (that should be D300) and over 80% of Queensland's C100 (*Basic solutions or bases in solid form*) data is from the CSG industry which raises a question of whether this is a different waste altogether than the salty wastes of D300 (non-toxic salts) or whether this is miscoding.

There are many other examples of what appear to be mistakes made by those filling out waste transport certificates, in terms of quantities, waste types, industry source codes and, regularly, the treatment or fate types chosen (as discussed in Finding 6). For these two example wastes in particular, the consequences are many tens of thousands of tonnes in the wrong place, absent or creating falsely high tonnages.

8. Large volumes of problem wastes are 'hidden' outside of tracking systems

A substantial quantity of hazardous waste is generated and managed onsite in industrial settings and does not appear in waste tracking data. These wastes include spent potlining (SPL) waste, fly ash, red mud and biosolids, all of which have problematic management issues. For example:

- For SPL:
 - It is difficult to handle and treat due to its hazard – one of several issues being its reactivity with water, leading to the production of flammable, toxic and explosive gases.
 - Through consultation with industry in the *Hazardous Waste Infrastructure Needs and Capacity Assessment* project, it became apparent that the primary issue with this waste was the scale of the stockpile - industry estimates stockpiles of 900,000 tonnes of this hazardous waste – sufficient to more than half fill the Melbourne Cricket Ground.
- For biosolids:
 - Biosolids mostly fall outside of the tracking process, which means they are 'missing' from hazardous waste consideration. They are not typically considered as hazardous waste, or even waste at all by some, but they can contain contaminants such as heavy metals and even POPs, that would make them a hazardous waste based on NSW or Victorian waste contaminant classification/ categorisation concentrations.
 - 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.

Recommendations

Below are recommendations that may assist in addressing some of the key issues identified in Section 6.

Recommendation 1: Interstate transport data should be included in jurisdictional arisings figures used for Basel reporting

A more thorough understanding is required of the treatment of interstate movements of waste by jurisdictions, from a data tracking perspective, to ensure future Basel reports and other national data collations of hazardous waste reflect accurate arisings, regardless of where the arisen waste's fate is located.

Subsequent meetings with jurisdictions to de-brief about the broader set of projects would be an ideal setting to clarify these current arrangements so collection systems can be tailored to fully capture interstate-bound arisings data.

Recommendation 2: The impact of regulatory exemptions on arisings data needs to be better understood

Transport certificate exemptions such as those for lead acid batteries, oils and other wastes in NSW need to be further explored to ascertain their potential to result in under-reported arisings data. This will ensure future Basel reports and other national data collations of hazardous waste reflect accurate arisings and may result in a requirement for further data adjustments to future data collation methods.

Subsequent meetings with jurisdictions to de-brief about the broader set of projects would be an ideal setting to clarify these current arrangements, particularly if other non-tracking data sources are available to jurisdictions.

Recommendation 3: Jurisdictions should work together to improve fate categories and use them consistently

Fate allocations in tracking systems, including the underlying D and R codes, should be a very important topic of shared discussion between current and potential tracking system jurisdictions. The current categories and how they are used in industry are highly inconsistent, ambiguous and unhelpful to everyone concerned. The way this data is currently collected makes sensible use of fate data very difficult.

Revision of fate categories is an important issue that will be raised in subsequent de-brief meetings with jurisdictions.

Recommendation 4: Emerging and 'hidden' wastes management planning is overdue

State and federal governments should critically assess some of the wastes of particular concern raised in this report, to enable future management priorities to be established.

Recommendation 5: Opportunities exist to better manage data

Jurisdictions could get great insights from this project and the shared approaches of other jurisdictions that may assist in the way they manage hazardous waste tracking data. This is a primary objective of the next round of this project involving jurisdictional debriefing.

1. Introduction

1.1 Project background and context

The *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* (referred to hereafter as the Basel Convention), which regulates the movement of hazardous wastes across international boundaries, came into force in 1992. 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, as well as in their own country. These obligations are placed on countries that are party to the Convention. One hundred and fifty-one countries have ratified the Basel Convention as at December 2002. Australia signed the Convention in 1992.

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. This data provides a baseline and backdrop to discussions about Australia's progress with efforts to better manage its hazardous waste. 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.

Following a commitment in the *National Waste Policy: Less Waste, More Resources*, from June to July 2014 the Australian Government Department of the Environment (DoE) commissioned a series of studies to be delivered by Blue Environment Pty Ltd, in association with Ascend Waste and Environment Pty Ltd and Randell Environmental Consulting Pty Ltd (REC), related to hazardous waste in Australia, with a common thread of an extensive current and historical data collection, compilation and analysis requirement. They were:

1. **The Hazardous waste infrastructure needs and capacity project:** The project has three parts:
 - a. Prepare projections of hazardous waste arisings and fates over the coming 20 years.
 - b. Consult with industry to estimate Australia's current hazardous waste infrastructure capacity, its distribution and expected future.
 - c. Combine the results of the first two parts to identify the extent to which current infrastructure meets future needs, considering the nature and locations of particular infrastructure.
2. **Basel report 2013:** Compile data for Australia's 2013 Basel Report, which reported Australia's hazardous waste generation data from all jurisdictions to the Basel Secretariat in Geneva Switzerland.
3. **Hazardous Waste in Australia (HWiA):** As an extension to Basel Report 2013, produce a new annual public data set with the following key outputs:
 - a. 2013 data (and the ability to view it as 2012-13 data) on hazardous waste arisings, main sources and fates plus
 - b. Analysis and commentary on the data through the compilation of a comprehensive report that provides a rich picture of hazardous waste in Australia.
 - c. A documented and tested protocol for independent validation of hazardous waste data supplied by the jurisdictions.

These were later combined and collectively referred to as the ***Hazardous Waste Infrastructure and Data Project (HWIDP)***.

Item 2 was delivered in November 2014, along with item 3c. Item 1 is separately reported. Item 3 (a and b) is the subject of this report.

1.2 Project outputs

As required, this report includes:

- data on hazardous waste sources (e.g. ANZSIC codes)
- data on hazardous waste fates
- historical trend analysis
- commentary on the data.

The analysis is underpinned by the Basel 2013 Microsoft Excel data file, *Collation workbook for Basel data 2013 v5 - final (issued)*, submitted in November 2014.

Time-series data available for analysis covers:

- the last three years, 2010-11, 2011-12 and 2012-13, as a complete national hazardous waste data set
- Jurisdictions' historical data as available, which ranges from the last 4 years to the last 15 years, depending on what New South Wales, Queensland, South Australia, Victoria and Western Australia were able to provide.

1.3 Report structure

This report is structured as follows:

- An introduction to the project, its scope and context amongst the broader *Hazardous Waste Infrastructure and Data Project (HWIDP)* (**Section 1**).
- A summary of the project's method and key definitions that are critical to understanding of the data and interpretation applied to this project, as well as key limitations to the approach (**Section 2**).
- A national overview of waste arisings, sources and fate for 2012-13 data, plus summary level historical trends ranging as far back as jurisdictional data allows (**Section 3**).
- Analysis of each waste group in detail: describing the waste, its major sources, arisings, historical arisings trends, fate and analysis and commentary to provide insight into issues that this data may uncover (**Section 4**).
- Investigation into wastes of particular interest, those wastes that may not be well-covered by tracking systems or are a new and emerging concern, that each have unique management challenges (**Section 5**).
- Summary of findings (**Section 6**).
- Recommendations (**Section 7**).

2. Project approach

Data from jurisdictional tracking systems was foundational to all HWIDP projects. Waste tracking systems in Qld, NSW, SA, Vic and WA require companies generating, transporting and treating or disposing hazardous waste to provide a record to government of each transaction to which they are a party. These systems were established to ensure that hazardous waste is appropriately managed.

Data from these systems was collected, collated and analysed, together with other jurisdictional waste data. *Hazardous Waste in Australia* uses 2013 and 2012-13 arisings data, historical arisings data, source data (where available) for 2012-13 and fate data for 2012-13. This represents the first time that jurisdictional data on hazardous waste data from across Australia has been analysed in a time series.

Details about data, terminology, waste groupings and how they have been applied are discussed in Section 2.1. Section 2.2 discusses data sources used and their respective limitations, while Section 2.3 provides an overview of the uncertainties involved in data used for this project.

2.1 Key definitions

Hazardous waste terminology

The term ‘hazardous waste’ is used by the Commonwealth to describe wastes that exhibit hazardous characteristics, and is widely used in the community. The term is taken to correspond with the wastes that the states and territories (the jurisdictions) regulate as requiring particularly high levels of management and control. The jurisdictions use varied terminology to describe these wastes, reflecting the fact that some are tracked and controlled not because they are hazardous in the normal sense of the word, but rather because they pose risks to public amenity (e.g. through odour). All these wastes are nevertheless considered to be hazardous wastes within the scope of the study. The terms used by the jurisdictions are:

- regulated waste (Queensland)
- trackable waste (New South Wales)
- prescribed waste (Victoria)
- listed waste (South Australia and NT)
- controlled waste (ACT, Tasmania and Western Australia).

Regulating and tracking hazardous waste in Australia

Whereas the Australian Government has responsibilities in relation to hazardous waste under the *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (the Act) and the National Waste Policy, regulation of hazardous waste management is mainly the responsibility of the states and territories (the jurisdictions). In order to ensure appropriate management of these wastes, the five largest jurisdictions (NSW, Qld, SA, Vic and WA) operate systems for ‘cradle to grave’ tracking of the movement of each consignment of hazardous waste from point of generation to treatment or disposal. Tracking certificates include the type and quantity of waste, the dates, and the producer, transporter and details of the receiving facility. A copy is sent to the government. The jurisdictions agreed to allow the use of the large data sets generated by their tracking systems in this study, under confidentiality agreements.

The reporting year used for data in this report

For the purposes of reporting to the Basel Convention calendar year data is required and consequently adopted. The calendar year relevant to data in this report is **2013**. For all other purposes in this report the reporting year used was the **2012-13** financial year, to better align with historical hazardous waste datasets and other similar data. 2012-13 is also the most recent financial year where data was provided or available for all jurisdictions.

Data was collected in 6-monthly blocks to allow data collation at either calendar or financial year level.

The meaning of waste ‘arising’

In this project, hazardous waste is said to ‘arise’ when it is delivered to processing, storage, treatment, or disposal infrastructure. This is distinct from ‘waste generation’, a term commonly used in waste reporting, in that if waste is transported to more than one site it may ‘arise’ more than once. The data presented in this report is of waste arising, which is consistent with data from the jurisdictional tracking systems. It should be noted that until a waste is moved offsite, it does not arise. Waste that is created on a site and remains stored there has not arisen.

The meaning of waste ‘source’

The source of waste describes where it is generated from, which could be a location (geographical source) or a company or industry sector (who produced it). Both this and historical reports describe geographical source at the high level of states and territories. However, to provide a greater level of understanding of the data, this report takes the industry sector approach where possible. Reporting industry source is not always possible due to the need to protect the commercial confidentiality of individual waste-producing companies and due to limitations in the level of detail recorded in jurisdictional tracking systems.

Industry sectors are shown in this report using the Australian and New Zealand Standard Industry Code (ANZSIC) system where quantitative data exists. Jurisdictional tracking systems typically allow for inclusion of ‘waste origin’ in transport certificates, which is generally equivalent to ANZSIC code, but both provision of this information and its accuracy is typically limited.

The meaning of waste ‘fate’

Waste fate is the destination of the waste within a set of defined end points. It generically includes reuse, treatment, recycling, energy recovery, and disposal. Fate data was only available from New South Wales, Victoria and Queensland, and the categories of fate used were not entirely consistent. Consequently a lowest common denominator approach was taken to decide fate categories, to allow comparative analysis between these states. The categories applied to enable all three states’ data to be used were:

- recycling
- chemical/ physical treatment
- landfill
- biodegradation
- incineration
- storage or transfer.

This approach, and the way primary data is recorded in the tracking systems, introduces a level of ambiguity that limits the value of the fate assessment. For example:

- Recycling includes resource recovery, reclamation and energy recovery, since there is no ‘energy recovery’ fate category. This can lead to fate mapping of an incineration process, for example, not to incineration but to recycling, because the thermal treatment process may either recover energy or use the waste (in some small or large part) as recovered fuel.
- Biodegradation is a category on its own, but composting of organic material could be coded as either biodegradation or recycling, because the biodegradative process produces another beneficial use for the waste.
- Chemical/ physical treatment processes typically describe chemical processes (e.g. oxidation, reduction, precipitation, neutralisation, etc.) and physical treatments (e.g. sedimentation, filtration,

adsorption, immobilisation, etc.). If the outputs from simple chemical/ physical treatment find a further use, the fate could also be described as recycling.

- Incineration is an unnecessarily narrow categorisation – thermal destruction would have been more useful – because POPs destruction facilities such as those that use plasma arc are left without an accurate fate category – under the current headings they could be deemed to reside in chemical/ physical treatment, which is not the purpose of that category.

These issues are limitations of the data as recorded in tracking systems and how far it can be interpreted.

For the purposes of mapping fate data to current infrastructure types, to enable comparison of current capacity with future capacity need, the companion project *Hazardous Waste Infrastructure Needs and Capacity Assessment* report has taken these fates and adjusted them to assumed fates.

International imports and exports of waste

Waste arisings/ generation data should include:

1. waste that is generated within a jurisdiction and destined for a fate located within that jurisdiction
2. waste that is generated within a jurisdiction and destined for a fate located outside that jurisdiction, in another Australian state or territory
3. waste that is generated within a jurisdiction and destined for a fate located out of the country, via international export under the permit system of the *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (the Hazardous Waste Act).

The first two types of arisings are intended to be captured by this project. Notwithstanding this, a key finding from this work has identified shortfalls in the reporting of '2', as discussed in the Key Messages (Section 6.3).

Internationally exported wastes, via the Hazardous Waste Act's permitting system, are not included in this project explicitly because they are generally not captured in underlying jurisdictional tracking data. Similarly, imports of waste into Australia under the same permitting system are not explicitly recorded in jurisdictional fate data, although the *Hazardous Waste Infrastructure Needs and Capacity Assessment* report indirectly considers such imports, as part of assessing treatment infrastructure's current and potential capacity. It is possible (depending on the route of transport) that movements by road to/ from a port from/to a facility within Australia could be somewhat 'hidden' but captured within current reported interstate/ intrastate data.

Regardless, the relative contributions of imports and exports to Australia's hazardous waste tonnages are very small.

The NEPM and its waste classification systems

Hazardous waste produced in a particular jurisdiction may move to another for storage, treatment or disposal. The *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998* (the NEPM) was established to ensure that hazardous wastes transported between jurisdictions are properly identified, transported, and otherwise handled. Among other things, the NEPM established a coding system to be used for these wastes. Many of the jurisdictions' own waste classification systems have been subsequently updated to fully or mostly mirror the NEPM list. The NEPM classification system has two levels:

- the 'NEPM 75' list contained in Schedule A, List 1 of the NEPM
- the 'NEPM 15' list, which aggregates the NEPM 75 and is used for reporting purposes.

The NEPM 15 and 75 lists provide the foundation for the waste groups used in this project (see *Classifications of waste and infrastructure applied in this project* below).

Basel Convention Y-codes

Basel Y-codes are a pre-determined waste classification system for reporting under the Basel Convention. For Australian data, which is collected by states and territories first using their own classification systems, this must undergo a two-stage translation: to Controlled Waste NEPM codes (common Australian system) and then further to Basel Y-codes. This translation process was established by the authors in a 2012 project for the Department and is further described in jurisdictional guidance developed as part of that work.³

After the 'translation' process outlined in this guidance was applied, a number of NEPM codes remained that were suitable for reporting but could not be readily mapped to Basel Y-codes. The answer was to create eight new descriptions for reporting to the Basel Secretariat, referred to as 'Y+8' codes (Y+1 through to Y+8), made up from groupings of the outstanding NEPM codes as described in **Appendix A.3**.

Two Basel Y-codes stand out as different from the rest, in the context of Australia's report:

- Y46 *Wastes collected from households* is not considered in this report's analysis, although it has been estimated by the authors of this report and is included at Appendix A.3 for completeness.
- Y47 *Residues arising from the incineration of household wastes* has not been either estimated or included in any part of this report. 'Energy-from-waste' based incineration technologies (of mixed waste) are only in their infancy in Australia, and while they should generate volumes for Y47, this data is likely to be captured amongst NEPM codes such as N205 (residues arising from...) and N150 (fly ash) which makes it difficult to isolate. Currently volumes of such waste generated in Australia, particularly if the 'household waste' definition is to be taken literally, would be extremely small.

Classifications of waste applied in this project

In order to facilitate an assessment of future infrastructure need and existing capacity of a large number of wastes for the *Hazardous waste infrastructure needs and capacity project*, a more condensed classification of waste was needed. The project team defined 29 'waste groups' that are mostly consistent with the 'NEPM 15' heading level list, but with some categories disaggregated where a component waste was likely to arise in large or highly uncertain amounts, has particular management requirements, or is of particular interest for some other reason.

This project is concerned primarily with waste arisings data and the fate of these arisings. Six of the *Hazardous waste infrastructure needs and capacity project's* 29 waste groups do not currently arise per se, in any significant quantity, at least in terms of hazardous waste transport and tracking *en route* to the existing hazardous waste infrastructure set. These are the 'other organohalogen compounds: PFOS, POP-BDEs, HBCD and HCB, plus 'contaminated' biosolids and lithium-ion batteries. These additional wastes are touched upon in Section 4.5 Emerging Wastes.

Consequently, data presentation and analysis for this project focuses on 23 of the 29 waste groups. These are set out in Table 1 and are expounded in **Appendix A.1** (including the additional six mentioned above) to show their connection to relevant NEPM 75 codes that they collapse to.

³ Blue Environment in partnership with Ascend Waste and Environment and Randell Environmental Consulting (2014). Reporting hazardous waste under the Basel Convention - guidance to states, territories and the Commonwealth.
<http://www.environment.gov.au/protection/publications/improving-australias-reporting-hazardous-waste-basel-convention>

Table 1: Waste groups used for *Hazardous Waste in Australia*

Waste group	Closest NEPM category
1 Plating & heat treatment	A
2 Acids	B
3 Alkalis	C
4 Mercury & compounds	D120
5 Lead & compounds	D220
6 Non-toxic salts	D300
7 Other inorganic chemicals	Other D
8 Reactive chemicals	E
9 Paints, resins, inks, organic sludges	F
10 Organic solvents	G
11 Pesticides	H
12 Oils	J
13 Animal effluent and residues (+ food processing waste)	K100
14 Grease trap waste	K110
15 Tannery & wool scouring wastes	K140 & 190
16 Other organic chemicals	Other M
17 Contaminated soils	N120
18 Other industrial treatment residues*	N205b
19 Asbestos	N220
20 Other soil/sludges	Other N
21 Clinical & pharmaceutical	R
22 Tyres	T140
23 Other miscellaneous	Other T

* Does not include biosolids as discussed in *Biosolids in a hazardous waste context*

Hazardous Waste in Australia shared its data collection task with the other two projects, so its data analysis follows both the detailed and condensed groupings as follows:

- **Waste arisings**
 - Section 3.1 of this report lists waste arisings by the waste groups of Table 1.
 - **Appendix A.2** provides the 2013 Basel report data, in Basel Y-codes. This report does not conduct further analysis of this data in the Basel Y-code format.
 - **Appendix A.3** provides 2012-13 national hazardous waste data, broken down in a detailed NEPM 75 level of collation. All data analysis is carried out is on foundation NEPM code data, with aggregation to the 'condensed' waste groups as described above for fate analysis and waste trends.
- **Waste sources**

Where source data is available, this is described for each waste at the waste group level.
- **Fate of wastes**

Fate is presented in this report based under the six fate headings described in 'The meaning of waste 'fate'' above, and by the waste group.
- **Waste trends**

Where data exists, historical trends are provided in this report based on the waste group level by jurisdiction.

The *Hazardous waste infrastructure needs and capacity project's* waste groups are used in the circumstances above due to the sensible balance it strikes between complexity (the 75 NEPM classifications) and overly aggregated simplicity (the 15 NEPM headings). This also provides consistency

between the sister projects of the broader study. For readers requiring waste arisings data at the NEPM 75 level of detail, **Appendix A.3** should be used.

Biosolids in a hazardous waste context

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 may be contaminated above guideline levels or recovered as a resource for various beneficial uses.

The concepts of ‘biosolids’ and ‘contaminated biosolids’, and how they fit into the context of hazardous waste have the potential to be confusing. For the current series of projects conducted by the project team, the following describes how this waste has been differently interpreted and applied:

- **Basel Reporting** (see **Appendix A.3**): All biosolids are reported as a hazardous waste (as a subsection of ‘Y+4 Putrescible/ organic waste’), as a conservative measure in line with reporting of other wastes not typically deemed ‘hazardous’ in Australia, such as (Basel code) *Y46 Wastes collected from households*.
- **Hazardous Waste Infrastructure Needs and Capacity Assessment project**: A portion of biosolids- (*contaminated biosolids*) are treated as a hazardous waste, as a subsection of N205 ‘industrial treatment residues’. More specifically:
 - **Arisings**: For the purposes of this project, arisings do not include biosolids (either total or contaminated), as they are not regulated as hazardous in jurisdictional tracking systems. (However, to provide a NEPM code dataset directly comparable with Basel 2013 data, total biosolids are included in **Appendix A.2** as a subsection of N205 ‘industrial treatment residues’.)
 - **Historical trends of arisings**: For the purposes of this project, historical trends do not include biosolids (either total or contaminated), as they are not regulated as hazardous in jurisdictional tracking systems.
 - **Projections of arisings**: Because it is logical that those biosolids with concentrations of pollutants above the highest classification levels outlined in biosolids guidelines may be deemed to be hazardous waste, *contaminated biosolids* (as N205a) are estimated for the baseline year and subsequent projections over the 20 year period.
 - **Fate**: Actual fate data (from Vic, NSW and Qld) does not include biosolids of any kind, therefore attributions of arisings to fate do not include either total or contaminated biosolids. A table (and corresponding chart) in the report map the assumed fate, which is landfill.
- **Hazardous Waste in Australia** (this report), other than for the Basel report figures for 2013 (see above), follows the same convention as the *Hazardous Waste Infrastructure Needs and Capacity Assessment project*, since it uses the same waste groups. This applies to arisings, sources, historical trends and fates.

Confidential and commercial-in-confidence information

The tracking system data used in this project for developing waste projections is submitted to the jurisdictions under legal commitments to protect confidentiality. The jurisdictions, in turn, agreed to provide tracking system data for this project under agreements that required the project team to maintain commercial confidences. Tracking system data was analysed to examine tonnages of waste arisings by waste code, year and jurisdiction – if this was made publicly available, in some cases companies might be able to work out the scale of rival’s operations.

Strategies used to prevent this were:

- The presentation of arisings, historical trends, sources and fates at the waste group level, which is definitionally aggregated more broadly than what has been published in past years’ Basel reporting and related data projects

- This report is the first time national hazardous waste data has been broken down to a level of source information that identifies industry sectors, so the risk of revealing confidential company level information (by deduction) increases. To prevent this, the project team has completed a 2012-13 data review of generators for each waste group to identify where there are less than three companies, and aggregated information in such cases accordingly. This aggregation has only been required in one instance.

2.2 Data sources and limitations

A summary of the characteristics of the data received from each jurisdiction is given in Table 2. 'Data dumps' encompassing several million transactions over several years were received from Qld, NSW, Vic and WA. Each of the other jurisdictions provided data, but in lesser amounts or already collated to annual tonnages. The NT and Tas provided data from reports of interstate transport (i.e. NEPM reports). Additional data from landfill reports was provided in some cases where a hazardous waste is not tracked, as shown in the table.

Table 2: Metadata of the jurisdictional hazardous waste data received

Jurisdiction	Date range	Date	Waste type	Quantity	Source industry	Fate	Jurisdiction of generation apparent?	Comprehensive coverage of arisings?	Comments
ACT	2013	✓	✓				✓	✓	Data collated by waste type
NSW	2010-2014	✓	✓	✓	✓*	✓	✓	✓	Full 'data dump' (280,000 entries). Asbestos & contaminated soil data from landfill reports.
NT	2012-2014	✓	✓	✓		✓	✓		Covered only inter-state transfers
Qld	1999-2013	✓	✓	✓	✓*	✓	✓	✓	Full 'data dump' of 30 files, each with up to 83 worksheets, each with up to 65,000 entries. Contaminated soil data from landfill reports.
SA	2006-2014		✓	✓	✓			✓	Data collated by waste type
Tas	2012-2013	✓	✓	✓			✓		Covered only inter-state transfers
Vic	2003-2014	✓	✓	✓	✓	✓	✓	✓	Full 'data dump' (1.6 million entries). Some pre-2003 asbestos and contaminated soil data included from landfill reports.
WA	1999-2014	✓	✓	✓		✓*	✓	✓	Full 'data dump' (1.3 million entries)

Notes: Date ranges did not always encompass the entire calendar year.

An asterisk means the data in this field could not be readily analysed due to incompleteness or other reasons.

This report involved an unprecedented collection, compilation and assessment of hazardous waste data in Australia. However, as Table 2 shows, there was significant variability in the characteristics of the data received. This limited the comprehensiveness of the analysis that could be carried out.

Table 3 lists some of the challenges faced during the collection, collation and analysis process. These are explored in greater depth in Appendix A.3 of the *Hazardous waste infrastructure needs and capacity*

assessment report. Despite these challenges, a far-reaching insight was obtained from the data set into the trends in hazardous waste data arisings and the sources and treatments of the different waste types.

Table 3: Data challenges, effects and responses

Data challenge	Response to this challenge / effects on the analysis
Differences in the methods used by jurisdictions to track and classify waste types	These challenges are canvassed in Appendix A.3 of the <i>Hazardous Waste Infrastructure Needs and Capacity Assessment</i> report, together with an account, for each issue, of why this was problematic for the analysis, an estimate of the scale of the issue, a discussion of how it has been dealt with in the past, and a description of how it was dealt with in completing this analysis.
Multiple counting of waste	
Potential storage release spikes (which undermine the interpretation of trends)	
Definitional challenges such as whether to report onsite disposal	
Differences in measurement methods (mass, volume, numbers of items)	
Differences in the methods used by jurisdictions to classify treatment types and source industries.	These differences limited and complicated the analyses, requiring multiple conversions to common platforms. In some cases the conversions were based on estimates.
Apparently imperfect levels of industry compliance with waste tracking requirements, especially in the early years of system operation.	This reduced the reliance that could be placed on the data baseline and apparent trends.
Apparent differences in the codes that reporters use in describing similar wastes.	
Potential variability in how users nominate a category for a particular waste type.	

Data uncertainty is discussed in detail in the *Waste Infrastructure Needs and Capacity Assessment* report, in Section 4.2.

3. Waste arisings, sources, trends and fate – overview

Data was collected in six-monthly blocks, allowing aggregation by either 2012-13 financial year or 2013 calendar year. The bulk of the analysis in this report is based on the 2012-13 financial year data set, to align with historical trend data and to be consistent with the *Hazardous waste infrastructure needs and capacity assessment* report. The difference between calendar year collation and financial year collation is typically minor overall, but can vary from waste to waste.

This section presents 2012-13 data collated for waste arisings, waste sources and waste fates, plus historical trends in arisings, in a national overview style. Detailed investigation of these data for individual waste groups is provided in Section 4.

3.1 Underlying data for this report

There are three Microsoft Excel files that provide primary data for this report:

1. *Collation workbook for Basel data 2013 v5 - final (issued)*: from which Basel-reported arisings data for the 2013 calendar year is sourced, as well as the January – June 2013 half-year for 2012-13 financial year reporting (of NEPM code '75' arisings) discussed in Section 3.2.
2. *Improving-australias-reporting-hazardous-waste-basel-convention-data*: from which Basel reported-data for the 2012 calendar year was sourced in a previous project carried out by the project team⁴. The July – December half-year block is used for 2012-13 financial year reporting (of NEPM code '75' arisings) discussed in Section 3.2.
3. *National data collation v9*: in which all jurisdictional tracking data is summarized for historical arisings, trend graphs, source data and fate tonnages, and expressed in terms of the 23 waste groups introduced in Section 2.1 *Classifications of waste applied in this project*.

How different data sources are used in this report

2012-13 arisings

This report is based on the most recent, most jurisdictionally complete and most closely verified and, where necessary, adjusted arisings dataset available to the project team. In calendar year terms this is Australia's Basel 2013 report (from '1' above), while in financial year terms this is the 2012-13 national collation sourced from the relevant six-month blocks of both '1' and '2' above. The 2012-13 arisings dataset in this report (Tables 4, 5 & 6) varies slightly from its '1' and '2' source data above (**Appendices A.2 and A.3**), in the following areas:

- Biosolids are excluded (as discussed in Section 2.1 *Biosolids in a hazardous waste context*), leaving only N205b.
- D220 Lead; lead compounds has been adjusted (see Section 4.5) to more accurately reflect jurisdictional contributions.
- Waste group K140 & K190 *Tannery and wool scouring wastes* has been excluded from quantitative analysis (tables 4, 5 & 6) due to commercial confidentiality concerns.

Note that the complete NEPM code 75 and Y code datasets in **Appendices A.2 and A.3** provide all data unchanged, without modification for biosolids or lead. This is to remain consistent with data already

⁴ Blue Environment in partnership with Ascend Waste and Environment and Randell Environmental Consulting (2014). Reporting hazardous waste under the Basel Convention - guidance to states, territories and the Commonwealth.
<http://www.environment.gov.au/protection/publications/improving-australias-reporting-hazardous-waste-basel-convention>

submitted to Basel for the 2013 report. For analysis purposes the report body uses 2012-13 data, corrected for these three waste groups, presented in the 23 waste group formats.

Historical arisings

Granular processes of analysis, checking and adjusting for gaps in data (supplied mainly from jurisdictional tracking systems) occurred in both the 2012 and 2013 Basel data collection processes, to produce a dataset of the best quality the underlying data would allow. Historical arisings are sourced exclusively from 'data dumps' of tracking system records, to which these corrections and adjustments have not been applied because, apart from the very large effort involved to do that, it is not possible to intelligently adjust historical data that arose under different circumstances to the present. For trend purposes, this does not matter much, as long as the data's limitations are appropriately reflected in the presentation and analysis.

Consequently, all historical trends presented in this report and underlying data files are based solely on unadjusted jurisdictional tracking data, noting that some state data sets for some wastes are excluded from trend graphs due to known data limitations. ***This means that 2012-13 arisings in historical trend reports may be different from the 2012-13 arisings data set in this section (and the report's appendices).***

2012-13 fate and source data

All fate and source data in this report is extracted exclusively from tracking data, for 2012-13, since no fate or source data is available from any other source. Totals for fate tonnages for 2012-13 for a particular waste may be different to arisings figures for that waste, due to a) the tracking versus adjusted data differences explained above and b) missing fate information in waste tracking certificates.

3.2 Overall waste arisings

Hazardous waste arisings data for Australia has been collected, collated and presented in detail, against individual NEPM and Basel classification systems, in the appendices to this report as follows:

- **Appendix A.2** provides the 2013 Basel report data, in Basel Y-codes, as well as in six-monthly blocks to allow financial year disaggregation.
- **Appendix A.3** provides 2012-13 national hazardous waste data, at the detailed NEPM 75 classification level, as well as in six-monthly blocks to allow calendar year disaggregation.

A snapshot of national hazardous waste arisings in Australia in 2012-13, by waste group for each jurisdiction, is given in Table 4. The same information aggregated to NEPM headings is shown in Table 5.

Table 6 expresses the waste group tonnages as a percentage contribution from each jurisdiction, plus a totalled contribution per waste group as a percentage of overall national data.

Figures 1-3 present tabulated data in graphical form, as total hazardous waste arisings per jurisdiction, hazardous waste arisings in waste groups, with jurisdictional proportions and hazardous waste arisings in NEPM '15' waste headings, with jurisdictional proportions, respectively.

Table 4: National hazardous waste arisings, 2012-13 (tonnes) – by waste group¹

Waste groups	Waste arising (tonnes)								
	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	National
Plating & heat treatment	0	109	0	4,698	102	0	44	1,000	5,953
Acids	0	13,258	23	13,616	622	36	9,244	4,009	40,808
Alkalis	220	3,968	197	195,544	49,391	1	7,143	82,913	339,377
Mercury & compounds	12	190	26	370	23	0	21	63	705
Lead & compounds ²	226	32,085	410	23,876	9,259	10,413	20,120	4,697	101,086
Non-toxic salts	0	17,443	0	47,727	4,465	3,535	2,354	9,689	85,213
Other inorganic chemicals	0	2,976	61	4,494	71,416	103,212	16,462	928	199,549
Reactive chemicals	0	88	0	44	3	0	72	0	207
Paints, resins, inks, organic sludges	171	19,135	80	13,340	2,877	0	20,250	2,175	58,028
Organic solvents	68	3,749	9	14,321	543	385	7,590	5,856	32,522
Pesticides	15	319	0	2,062	255	0	644	980	4,275
Oils	2,800	157,496	1,431	262,601	13,874	231	96,027	164,702	699,160
Animal effluent and residues (+ food processing waste)	0	94,799	3,070	85,874	21,429	6,601	49,265	17,406	278,443
Grease trap waste	5,856	183,158	5,930	130,688	41,413	12,762	99,811	65,003	544,619
Tannery & wool scouring wastes									
Other organic chemicals	24	10,798	175	4,360	3,669	20	872	695	20,613
Contaminated soils	1,953	529,900	6,355	284,967	238,750	66	347,901	3,483	1,413,375
Other industrial treatment residues ³	0	23,361	0	198,750	65,707	0	15,862	9,932	313,612
Asbestos	20	365,050	4,911	115,902	18,877	10,573	74,132	51,148	640,613
Other soil/sludges	9	37,341	35	26,575	1,580	11	51,788	21,525	138,863
Clinical & pharmaceutical	562	26,552	216	25,877	6,503	27	12,378	3,184	75,299
Tyres	3,298	102,590	5,513	90,219	56,788	9,971	85,993	70,179	424,551
Other miscellaneous	73	2,675	173	3,306	380	15	1,838	495	8,954
Total	15,307	1,627,040	28,615	1,549,211	607,926	157,859	919,811	520,062	5,425,826

Notes: 1. Refer to Appendix A.3 for full NEPM code breakdown

2. Lead; lead compounds waste adjusted from source data

3. Other industrial treatment residues adjusted from source data to remove biosolids

4. Tannery & wool scouring wastes are excluded from this table due to commercial confidentiality concerns

Figure 1: National hazardous waste arisings, 2012-13 (tonnes) – by jurisdiction

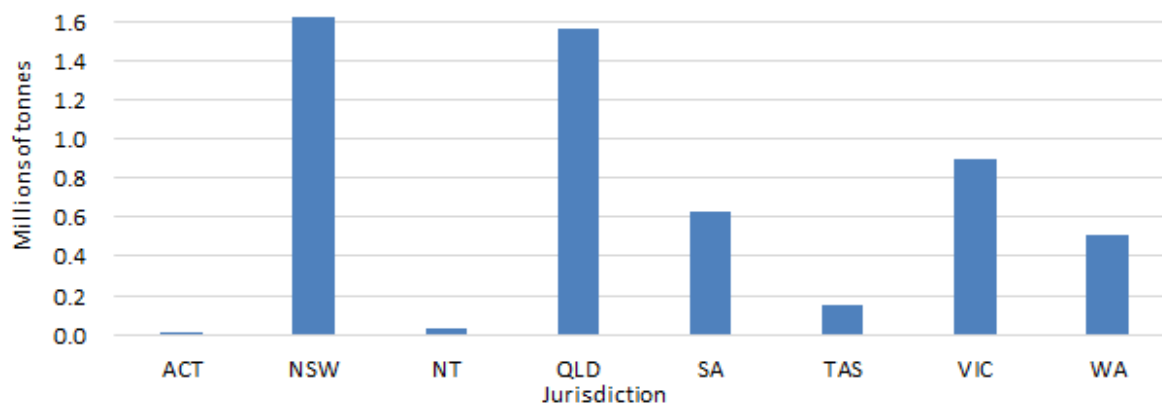


Figure 2: National hazardous waste arisings, 2012-13 (tonnes) – by waste group and jurisdiction

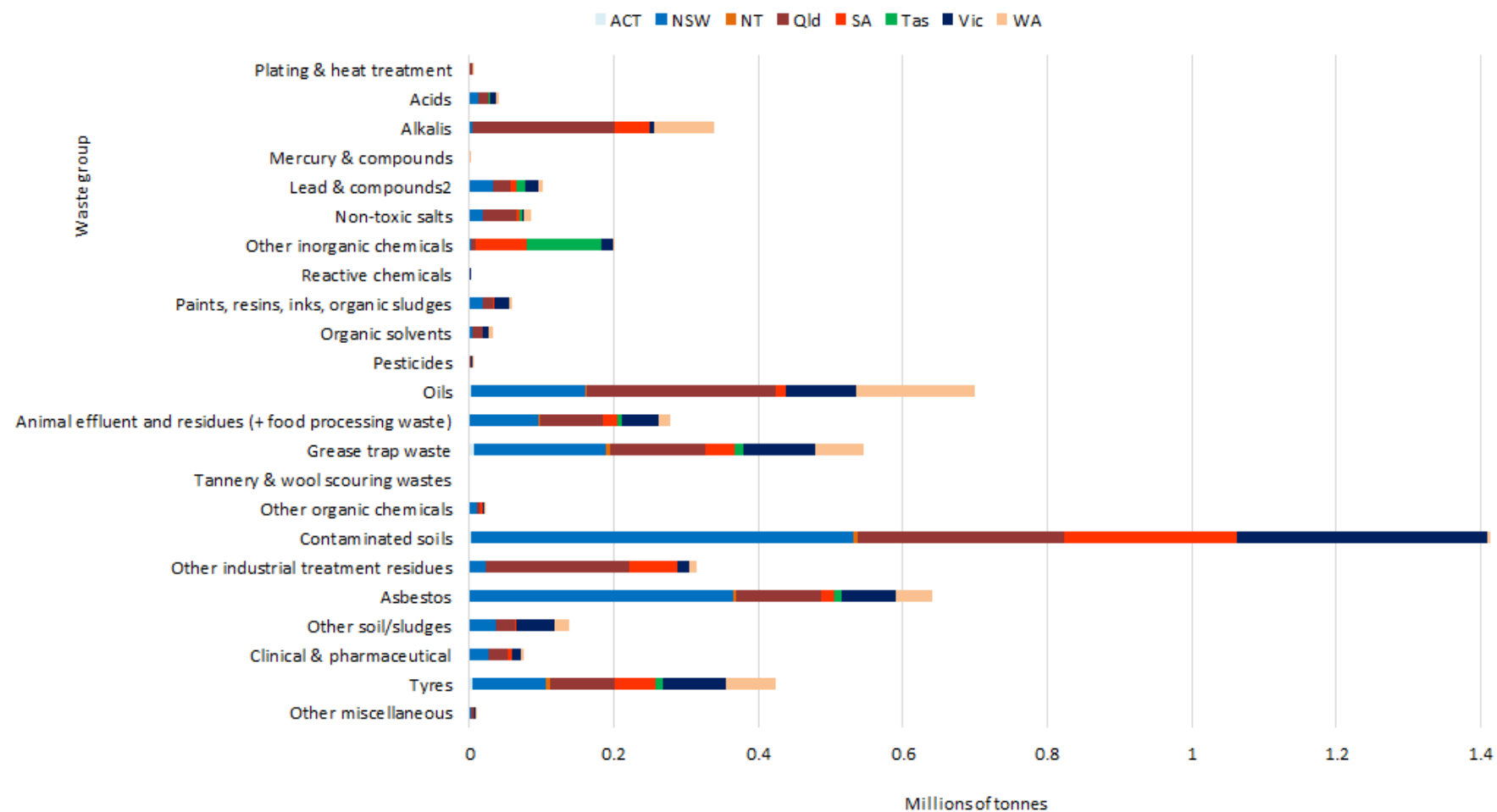
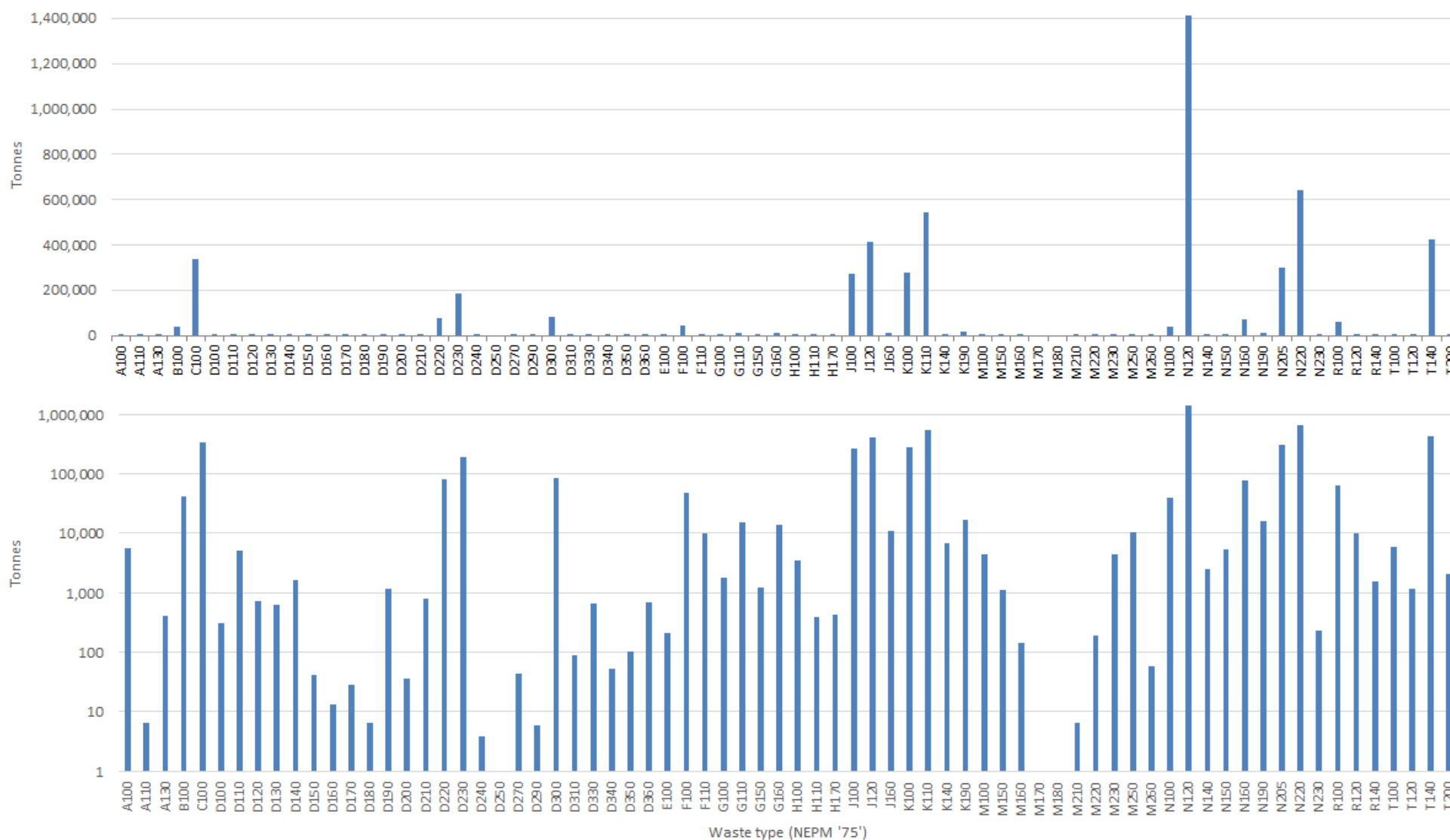


Figure 3: National hazardous waste arisings, 2012-13 (tonnes) – by NEPM '75' waste types (top half of chart: linear display; bottom half: logarithmic display)



Note: Biosolids excluded from N205 data

Table 5: National hazardous waste arisings, 2012-13 (tonnes) – by NEPM headings¹

Code	NEPM '15' wastes ² Description	Waste arising (tonnes)								
		ACT	NSW	NT	Qld	SA	Tas	Vic	WA	National
A	Plating and heat treatment	0	109	0	4,698	102	0	44	1,000	5,953
B	Acids	0	13,258	23	13,616	622	36	9,244	4,009	40,808
C	Alkaline wastes	220	3,968	197	195,544	49,391	1	7,143	82,913	339,377
D	Inorganic chemicals ³	239	52,695	497	76,467	85,163	117,160	38,957	15,376	386,554
E	Reactive chemicals	0	88	0	44	3	0	72	0	207
F	Paints, lacquers, varnish, etc.	171	19,135	80	13,340	2,877	0	20,250	2,175	58,028
G	Organic solvents, solvent residues	68	3,749	9	14,321	543	385	7,590	5,856	32,522
H	Pesticides	15	319	0	2,062	255	0	644	980	4,275
J	Oils, hydrocarbons, emulsions	2,800	157,496	1,431	262,601	13,874	231	96,027	164,702	699,160
K	Putrescible/organic wastes ⁶	5,856	277,956	9,000	216,561	62,841	19,363	149,076	82,409	823,062
M	Organic chemicals	24	10,798	175	4,360	3,669	20	872	695	20,613
N	Solid/sludge wastes ⁴	1,981	955,652	11,300	626,193	324,914	10,650	489,683	86,089	2,506,463
R	Clinical & pharmaceutical	562	26,552	216	25,877	6,503	27	12,378	3,184	75,299
T	Miscellaneous	3,371	105,266	5,685	93,525	57,167	9,986	87,831	70,674	433,505
Totals		15,307	1,627,042	28,614	1,549,209	607,925	157,860	919,811	520,061	5,425,826⁵

Notes:

1. Refer to Appendix A.3 for full NEPM code breakdown
2. 'L Industrial washwaters' NEPM heading is not reported in tracking data
3. Lead; lead compounds waste adjusted from source data
4. Other industrial treatment residues adjusted from source data to remove biosolids
5. Small variance in total due to rounding errors
6. Tannery & wool scouring wastes are excluded from this table due to commercial confidentiality concerns

Figure 4: National hazardous waste arisings, 2012-13 (tonnes) – by NEPM '15' code

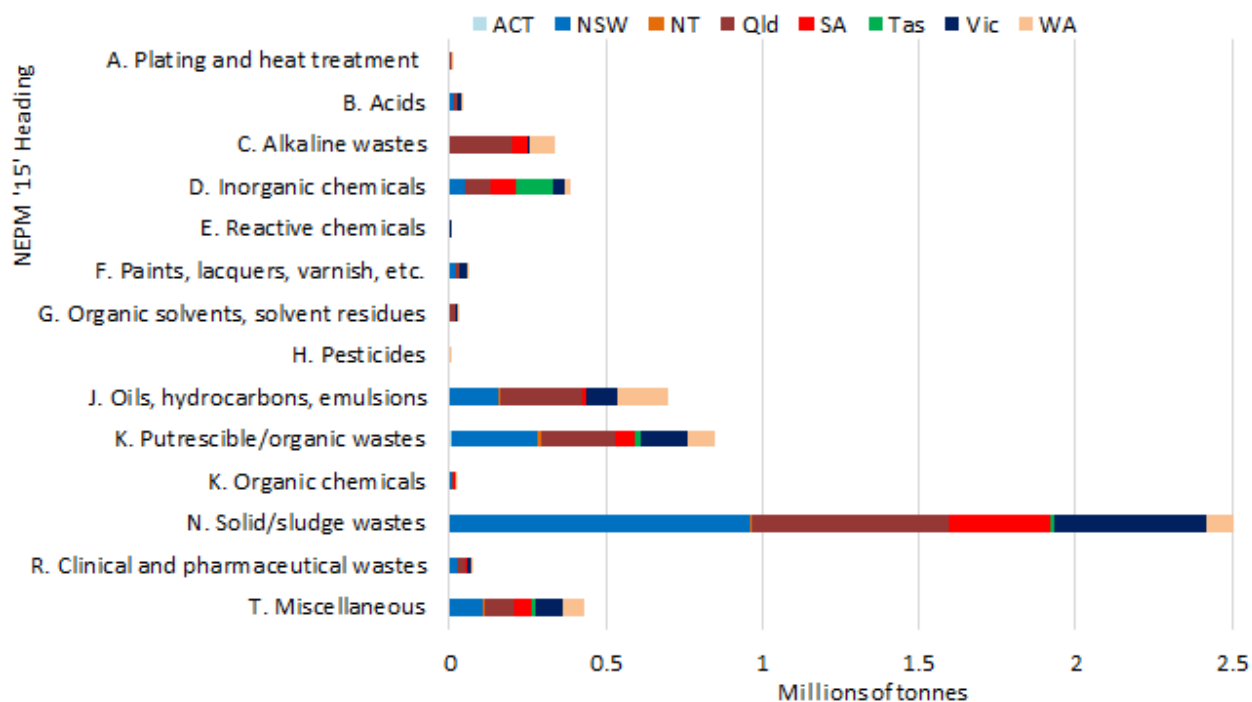


Table 6: National hazardous waste arisings, 2012-13 (%) – by waste groups¹

Waste groups	Waste arising (%)								
	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	% of National total
Plating & heat treatment	0%	2%	0%	79%	2%	0%	1%	17%	0.11%
Acids	0%	32%	0%	33%	2%	0%	23%	10%	0.75%
Alkalis	0%	1%	0%	58%	15%	0%	2%	24%	6.2%
Mercury & compounds	2%	27%	4%	52%	3%	0%	3%	9%	0.01%
Lead & compounds ²	0%	32%	0%	24%	9%	10%	20%	5%	1.9%
Non-toxic salts	0%	20%	0%	56%	5%	4%	3%	11%	1.6%
Other inorganic chemicals	0%	1%	0%	2%	36%	52%	8%	0%	3.7%
Reactive chemicals	0%	43%	0%	21%	1%	0%	35%	0%	0.004%
Paints, resins, inks, organic sludges	0%	33%	0%	23%	5%	0%	35%	4%	1.1%
Organic solvents	0%	12%	0%	44%	2%	1%	23%	18%	0.6%
Pesticides	0%	7%	0%	48%	6%	0%	15%	23%	0.08%
Oils	0%	23%	0%	38%	2%	0%	14%	24%	13%
Animal effluent and residues (+ food processing waste)	0%	34%	1%	31%	8%	2%	18%	6%	5.1%
Grease trap waste	1%	34%	1%	24%	8%	2%	18%	12%	10%
Tannery & wool scouring wastes ⁴									
Other organic chemicals	0%	52%	1%	21%	18%	0%	4%	3%	0.38%
Contaminated soils	0%	37%	0%	20%	17%	0%	25%	0%	26%
Other industrial treatment residues ³	0%	7%	0%	63%	21%	0%	5%	3%	5.8%
Asbestos	0%	57%	1%	18%	3%	2%	12%	8%	12%
Other soil/sludges	0%	27%	0%	19%	1%	0%	37%	16%	2.6%
Clinical & pharmaceutical	1%	35%	0%	34%	9%	0%	16%	4%	1.4%
Tyres	1%	24%	1%	21%	13%	2%	20%	17%	7.8%
Other miscellaneous	1%	30%	2%	37%	4%	0%	21%	6%	0.16%

Notes:

1. Refer to Appendix A.3 for full NEPM code breakdown
2. Lead; lead compounds waste adjusted from source data
3. Other industrial treatment residues adjusted from source data to remove biosolids
4. Tannery & wool scouring wastes are excluded from this table due to commercial confidentiality concerns

3.3 Sources of waste arisings

Source data, in the form of Australia and New Zealand Standard Industry Codes (ANZSIC), was provided for Victorian and South Australian data only. While Victorian data was well-populated with these industry codes, only 38% of South Australia's waste in 2012-13 was allocable to ANZSIC codes. This makes the latter's source data unreliable.

Like South Australia, NSW tracking data has poorly populated ANZSIC codes because, according to the NSW EPA, they are not reliably filled out by certificate users. Consequently their arisings could not be quantitatively analysed for ANZSIC code data, but a qualitative analysis was carried out for each waste group, involving scanning vast numbers of waste transport certificates to ascertain the most prevalent company names, identifying their sectors, and highlighting the most indicatively common sectors represented in arisings data.

Queensland data was different again, in that it contained detailed (but different to ANZSIC) industry code data that consisted of a four-digit alphanumeric identified in Schedule 7 of their regulations (https://www.legislation.qld.gov.au/LEGISLTN/REPEALED/E/EnvProtWaMR00_140521.pdf). Using this reference the top arisings sectors were identified using a semi-quantitative approach, although a full quantitative analysis was out of scope of this project, given the complexity of Queensland data.

Western Australia did not supply any breakdown of waste by source whatsoever in provided data.

Since Tasmania, Northern Territory and the ACT do not have tracking data there no breakdown of their data by source at all.

Due to poor quality and completeness of jurisdictional source data, our approach to providing it was to:

- List the major Victorian sources per waste group, based on ANZSIC code data supplied
- List the major South Australian sources per waste group, based on ANZSIC code data supplied, subject to its coverage quality limitation
- List the major NSW and Qld sources together per waste group, derived semi-quantitatively from detailed investigation of company-level tracking certificate data, and ascribing these companies to an ANZSIC code group
- Collating actual Victorian and South Australian source quantities with semi-quantitative NSW and Qld source data to group together the major sources on a national basis.

Section 4.1 – 4.23s' detailed analysis on a waste group by waste group basis uses this state-based approach to main sources, in tabular form. An example for *C. Alkali waste* is shown below.

Summary source analysis

Industry sources - Vic	Industry sources - SA	Qld and NSW	National summary
<ul style="list-style-type: none"> • Petroleum refining • Metal coating and finishing • Motor vehicle parts manufacturing 	<ul style="list-style-type: none"> • Cement and lime manufacturing 	<ul style="list-style-type: none"> • Oil and gas extraction (including CSG) • Aluminium refining • Cement and lime manufacturing • Metal coating and finishing • Fast food and food manufacturing (cleaning wastes) 	<ul style="list-style-type: none"> • Oil and gas extraction (including CSG) • Aluminium refining • Cement and lime manufacturing • Metal coating and finishing • Motor vehicle parts manufacturing • Fast food and food manufacturing (cleaning wastes)

The only quantitative data of sufficient quality, Victorian data, is detailed in Table 7. It provides ANZSIC code sources of arisings data at the ANZSIC division level. Sub-division level breakdown is also provided, in the underlying spreadsheet, *National data collation v9*, worksheet 'Generators'.

Table 7: 2012-13 Victorian hazardous waste arisings by ANZSIC code (division-level) sources

		Key: Proportion of this waste from this division: >50%																			20% - 50%				0% - 20%			
Waste groups:	A	B	C	Other										K140		Other		Other		Other		All						
				D120	D220	D300	D	E	F	G	H	J	K100	K110	& 190	M	N120	N220	N	R	T							
ANZSIC division	Total tonnes	87	7,664	5,784	27	1,276	422	850	25	10,270	4,537	382	83,755	20,876	89,926	61	510	316,863	56,933	41,093	12,500	1,388						
Agriculture, Forestry and Fishing												4	2	64	88				5	0	0	164						
Mining		112	39	1	20	25	38	2	12	370	1	1,804	12	73		105	28,982	359	250	5	1	32,210						
Manufacturing	22	7,343	5,548	9	1,203	226	481	4	5,641	1,866	35	20,991	11,239	2,183	61	158	3,023	290	12,833	524	229	73,910						
Electricity, Gas, Water & Waste Services	43	80	96	17	19	107	189	14	3,947	1,986	333	51,460	9,352	79,544		169	13,525	324	26,948	10,679	805	199,635						
Construction			0	0	21	1	3	0	70	32		930		72		0	235,103	30,289	276		8	266,805						
Wholesale Trade		0	0		0	0	0	0	9	0		118		680		0	218		16			1,042						
Retail Trade		22	6		11	0	26		64	28	0	2,208	28	531		10	34,488	23,770	20	8	2	61,223						
Accommodation & Food Services		0				0				0		14	8	5,137		0	13		1	8	8	5,189						
Transport, Postal & Warehousing		0	38	0		19	44	1	19	29	1	2,985	168	1,276		22	580	958	387	34	3	6,564						
Information Media & Telecommunications										0		55		1		0	121	12				189						
Financial & Insurance Services																												
Rental, Hiring & Real Estate Services		0								0		67		1								68						
Professional, Scientific & Technical Services	22	72	23	0	0	17	66	1	37	123	2	61				19	220	37	227	545	65	1,537						
Administrative & Support Services											1								0		0	1						
Public Administration & Safety		11	25	0		25	1	0	393	13	1	502		67		5	391	30	46	0	192	1,701						
Education & Training		4	0	1		1	0	0	1	47	0	28	2	85		4	181	210	12	59	73	709						
Health Care & Social Assistance		8	0		0			2	6	20		2	1	150		18	7	656	35	638	2	1,543						
Arts & Recreation Services		0						0		0				9						1		10						
Other Services		12	9	0					70	24	5	2,527	1	30		0	11		37	1	0	2,727						
		655,228																										

3.4 Historical trends in waste arisings

National hazardous waste annual arisings datasets for the last 3 years, excluding biosolids, are compared in Table 8 below. While there is fluctuation evident, overall arisings have increased by 19% over the three years. Detailed trends for each individual waste group, over much longer time series (where data is available) are shown throughout Section 4.

Table 8: National hazardous waste arisings, 2010-11, 2011-12 & 2012-13 (tonnes) – by NEPM headings¹

NEPM '15' wastes ²		Waste arising (tonnes)			
Code	Description	2010-11 ³	2011-12	2012-13	% change 2010-11 to 2012-13
A	Plating and heat treatment	7,917	7,027	5,953	-25%
B	Acids	37,165	47,751	40,808	10%
C	Alkaline wastes	266,759	450,198	339,377	27%
D	Inorganic chemicals	295,893	258,190	386,554	31%
E	Reactive chemicals	1,462	274	207	-86%
F	Paints, lacquers, varnish, etc.	44,441	57,859	58,028	31%
G	Organic solvents, solvent residues	27,985	34,369	32,522	16%
H	Pesticides	2,606	5,436	4,275	64%
J	Oils, hydrocarbons, emulsions	601,848	768,558	699,160	16%
K	Putrescible/organic wastes	779,409	780,331	846,596	9%
M	Organic chemicals	18,553	22,504	20,613	11%
N	Solid/sludge wastes ⁴	2,051,846	2,442,037	2,506,463	22%
R	Clinical and pharmaceutical wastes	59,946	69,872	75,299	26%
T	Miscellaneous	395,585	396,301	433,505	10%
Totals		4,591,417	5,340,040	5,449,360	19%

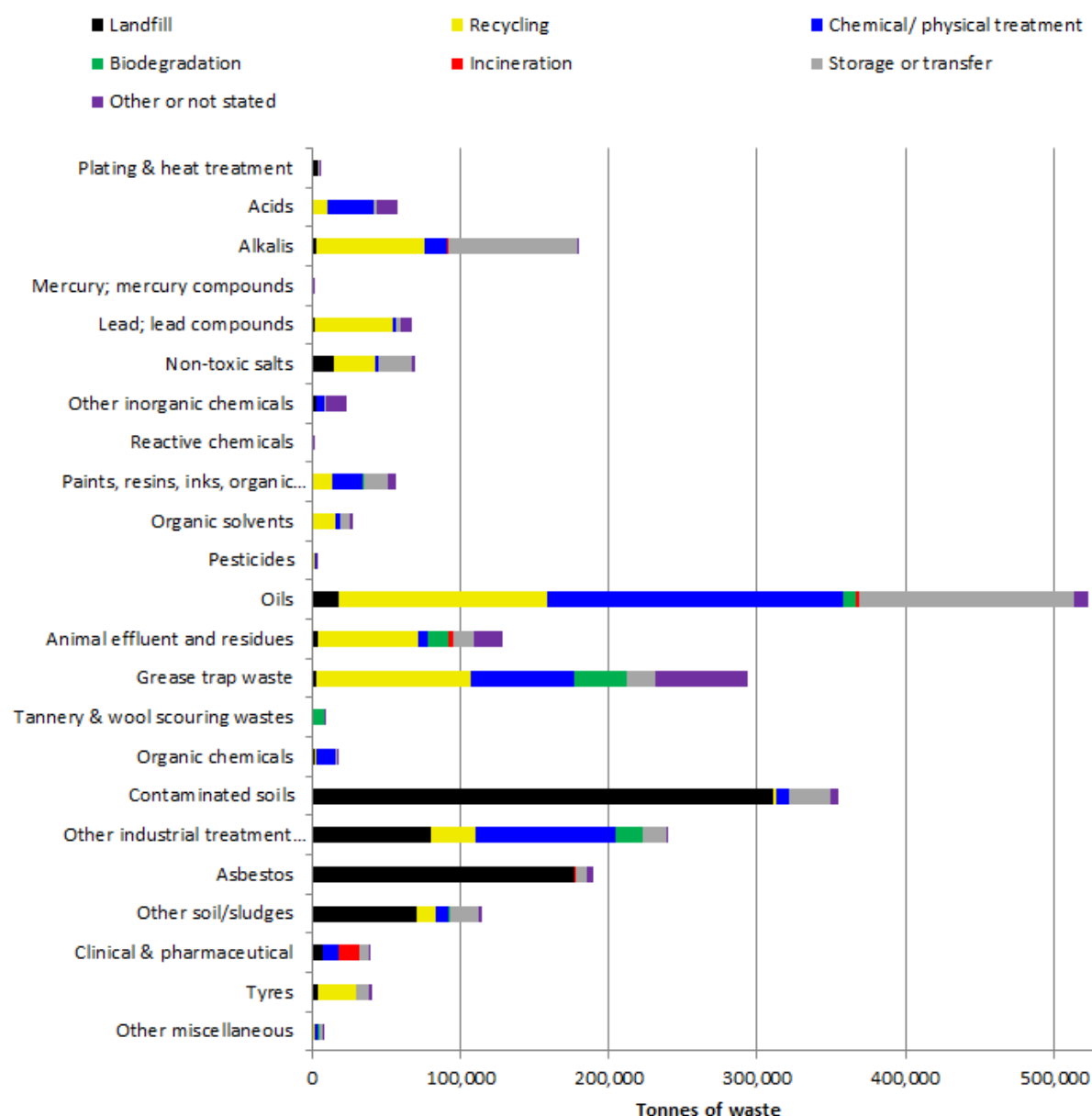
Notes:

1. Refer to Appendix A.3 for full NEPM code breakdown
2. 'L Industrial washwaters' NEPM heading is not reported in tracking data
3. 2010-11 data taken from KMH (2013) <http://www.environment.gov.au/system/files/resources/ca7c7c3b-4061-4253-bea2-2352883c8677/files/hazardous-waste-data-summary.pdf> (excluding biosolids data)
4. All biosolids data excluded

3.5 Fate of hazardous wastes (NSW, Vic, Qld)

The project team analysed jurisdictional tracking system data to determine the ‘treatment types’ (or fates) recorded for each waste group in the tracking system data. Fate data was comprehensively available from NSW, Qld and Vic. The overall tonnage by fate in these jurisdictions was compiled for 2012-13 and is presented in Figure 5 and Table 9. Some manipulation of Qld and Vic data was needed to establish uniform categories based on the NSW system. These fate categories do not align neatly with the fates reported in national waste reporting (waste reuse, recycling, energy recovery and disposal). Overall, the quantity presented represents about half of the total tonnes generated in Australia. The potential for multiple counting within the data should be considered in interpreting the data. For example, waste that is sent to chemical/physical treatment may be landfilled after treatment and the tonnage would be included under both fates in the figure below. From an infrastructure capacity assessment perspective, both the CPT and landfill tonnages are relevant and need to be considered.

Figure 5: The fate of tracked hazardous waste in NSW, Qld and Vic, 2012-13 (tonnes)⁵



⁵ Some figures are not comprehensive due to lack of tracking system data. The ‘tannery and wool scouring wastes’ and ‘asbestos’ data excludes NSW; the ‘contaminated soils’ data excludes NSW and Qld; the ‘other industrial treatment residues’ data excludes Victoria; and the ‘tyres’ data is incomplete in all three jurisdictions. The widely different quantities of the various waste groups means that arisings of ‘reactive chemicals’ are too small to be seen.

Table 9: The fate of tracked hazardous waste in NSW, Qld and Vic, 2012-13 (tonnes)⁵

	Landfill	Recycling	Chemical/ physical treatment	Biodegradation	Incineration	Storage or transfer	Other or not stated
Plating & heat treatment	3,982	54	197	24	42	701	2
Acids	652	10,241	30,324	74	89	1,814	13,993
Alkalies	2,846	72,686	15,269	263	645	87,364	268
Mercury; mercury compounds	93	78	108	5	13	238	30
Lead; lead compounds	2,121	52,348	2,129	68	43	2,605	8,431
Non-toxic salts	14,897	27,298	2,025	218	48	22,847	1,605
Other inorganic chemicals	2,708	635	5,130	173	24	610	13,752
Reactive chemicals	3	5	81	0	0	130	11
Paints, resins, inks, organic sludges	936	12,990	20,350	269	401	16,531	5,377
Organic solvents	52	15,714	3,046	8	146	6,638	1,582
Pesticides	152	2,015	324	0	30	313	199
Oils	18,269	140,320	199,245	8,818	2,037	144,854	10,341
Animal effluent and residues	3,980	67,472	6,699	13,510	3,493	14,216	18,881
Grease trap waste	3,192	103,770	69,723	35,327	54	19,569	62,170
Tannery & wool scouring wastes							
Organic chemicals	1,633	1,021	12,552	15	5	1,425	221
Contaminated soils	311,391	1,475	8,623	210	0	28,131	5,070
Other industrial treatment residues	79,664	30,078	94,492	18,422	334	16,087	236
Asbestos	176,251	151	324	103	563	7,871	3,982
Other soil/sludges	70,785	12,710	8,600	597	169	19,445	2,109
Clinical & pharmaceutical	6,841	200	10,935	83	13,405	7,007	748
Tyres	3,891	25,978	2	2	87	8,051	2,027
Other miscellaneous	517	1,389	2,359	229	69	2,740	118

Tannery and wool scouring data is withheld due to commercial confidentiality concerns

The tracking system data contained no evidence of waste exports (to other countries). Review of reports from the Basel Convention suggest this is not a common pathway for hazardous waste⁶.

Figure 6 and Table 10^{Error! Reference source not found.} present similar data expressed in terms of the percentage of the tonnes of each waste group arising that is sent to each fate category. The fate category 'other or not stated' is removed⁷. The figure also shows the project team's estimates of the likely fate of the six waste groups that are not included in the tracking system data, assuming they are appropriately dealt with as hazardous wastes. These are:

- PFOS, POP-BDEs, HBCD and HCB – allocated to incineration, since the Stockholm Convention requires their 'destruction'
- contaminated biosolids – allocated to landfill
- lithium-ion batteries – allocated to recycling.

⁶ See <http://archive.basel.int/natreporting/questables/dnn-frBody.html>. Australia exported 21kt of hazardous waste in 2010.

⁷ The entry for fate given for most of these tonnages is blank. Most of the remainder appear to be errors.

Figure 6 and Table 10 **Error! Reference source not found.** represent the best available national average for fate, and are used in the analysis detailed in the *Hazardous waste infrastructure needs and capacity assessment* report.

Figure 6: The fate of tracked hazardous waste in NSW, Qld and Vic, 2012-13 (percentages)

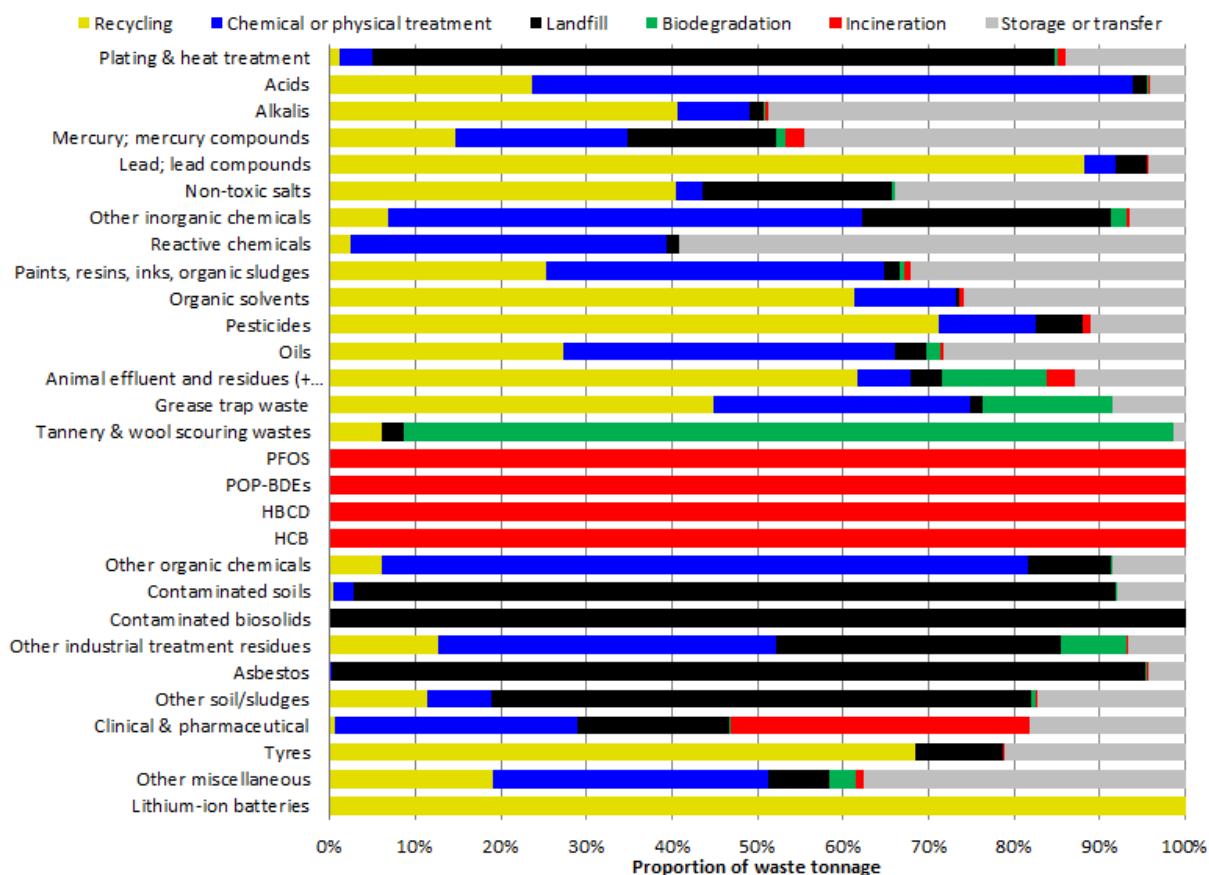


Table 10: The fate of tracked hazardous waste in NSW, Qld and Vic, 2012-13 (percentages)

	Landfill	Recycling	Chemical/ physical treatment	Biodegradation	Incineration	Storage or transfer
Plating & heat treatment	80%	1%	4%	0%	1%	14%
Acids	2%	24%	70%	0%	0%	4%
Alkalis	2%	41%	9%	0%	0%	49%
Mercury; mercury compounds	17%	15%	20%	1%	2%	44%
Lead; lead compounds	4%	88%	4%	0%	0%	4%
Non-toxic salts	22%	41%	3%	0%	0%	34%
Other inorganic chemicals	29%	7%	55%	2%	0%	7%
Reactive chemicals	2%	2%	37%	0%	0%	59%
Paints, resins, inks, organic sludges	2%	25%	40%	1%	1%	32%
Organic solvents	0%	61%	12%	0%	1%	26%
Pesticides	5%	71%	11%	0%	1%	11%
Oils	4%	27%	39%	2%	0%	28%
Animal effluent and residues (+ food processing waste)	4%	62%	6%	12%	3%	13%
Grease trap waste	1%	45%	30%	15%	0%	8%
Tannery & wool scouring wastes	3%	6%	0%	90%	0%	1%
PFOS	0%	0%	0%	0%	100%	0%
POP-BDEs	0%	0%	0%	0%	100%	0%
HBCD	0%	0%	0%	0%	100%	0%
HCB	0%	0%	0%	0%	100%	0%
Other organic chemicals	10%	6%	75%	0%	0%	9%
Contaminated soils	89%	0%	2%	0%	0%	8%
Contaminated biosolids	100%	0%	0%	0%	0%	0%
Other industrial treatment residues	33%	13%	40%	8%	0%	7%
Asbestos	95%	0%	0%	0%	0%	4%
Other soil/sludges	63%	11%	8%	1%	0%	17%
Clinical & pharmaceutical	18%	1%	28%	0%	35%	18%
Tyres	10%	68%	0%	0%	0%	21%
Other miscellaneous	7%	19%	32%	3%	1%	38%
Lithium-ion batteries	0%	100%	0%	0%	0%	0%

The fate proportions for NSW, Qld, and Vic are similarly presented in Figure 7 to Figure 9. Where there is no information about the fate of a waste group it is because the group is not tracked in that state.

Interesting differences are apparent in the ways the management of the various waste groups are recorded. NSW has higher proportions of chemical and physical treatment for several waste groups than both Qld and Vic. In Qld waste groups are often listed as recycled and in Vic they are often listed as recycled or transferred.

These differences could reflect variability how these waste groups are actually managed, but in some cases they may be the result of differences in how jurisdictions classify fates or how users of tracking systems use the classification options. Comparisons of fate proportions between jurisdictions need to be undertaken carefully because inconsistencies could lead to misleading conclusions.

Waste fates are explored further in the *Hazardous waste infrastructure needs and capacity assessment* report.

Figure 7: The fate of tracked hazardous waste in NSW, 2012-13 (percentages)

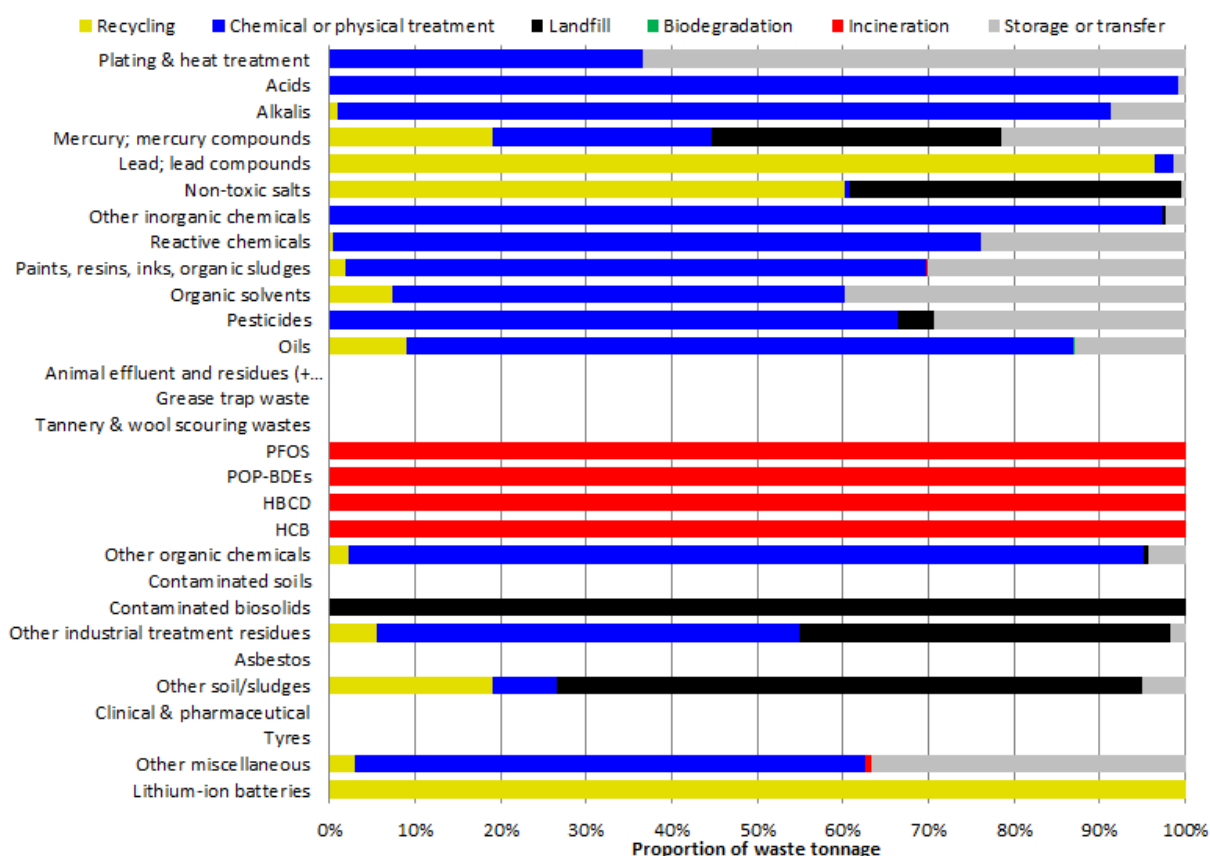


Figure 8: The fate of tracked hazardous waste in Qld, 2012-13 (percentages)

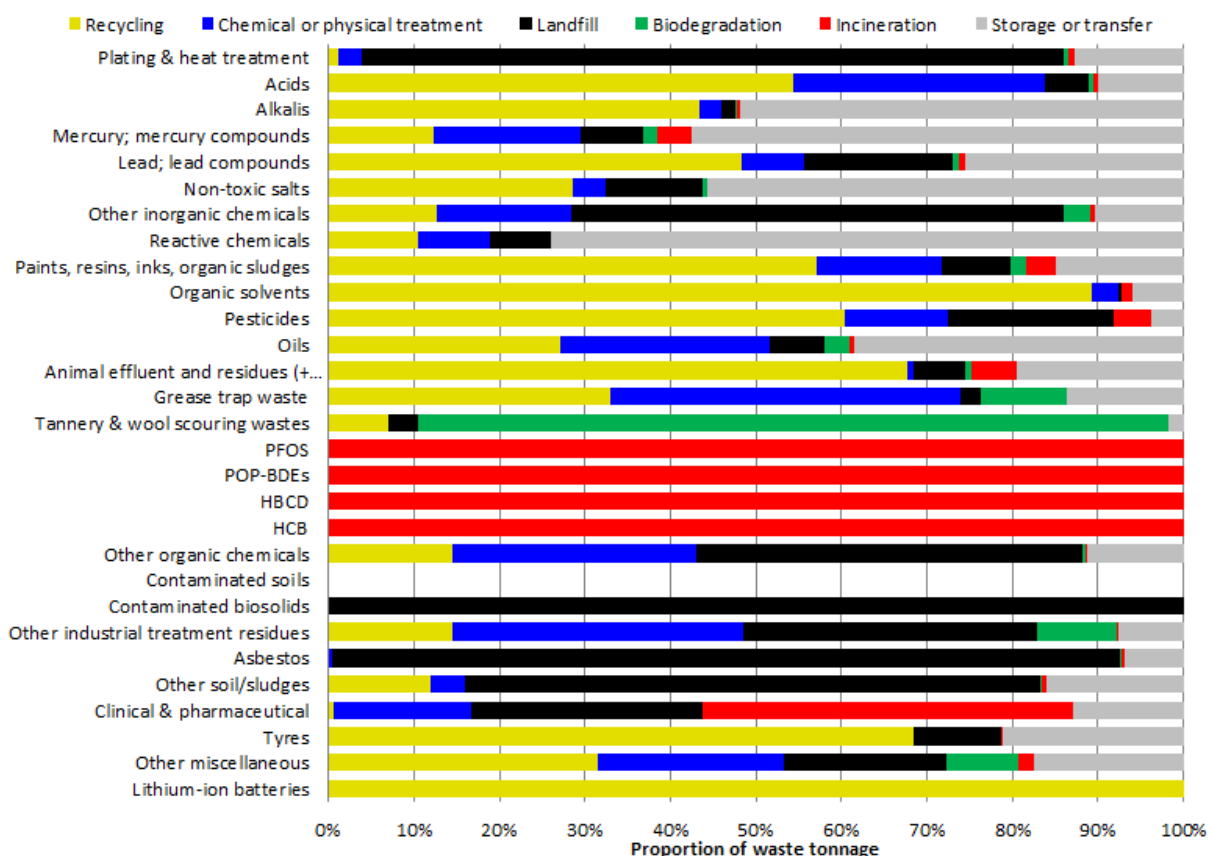
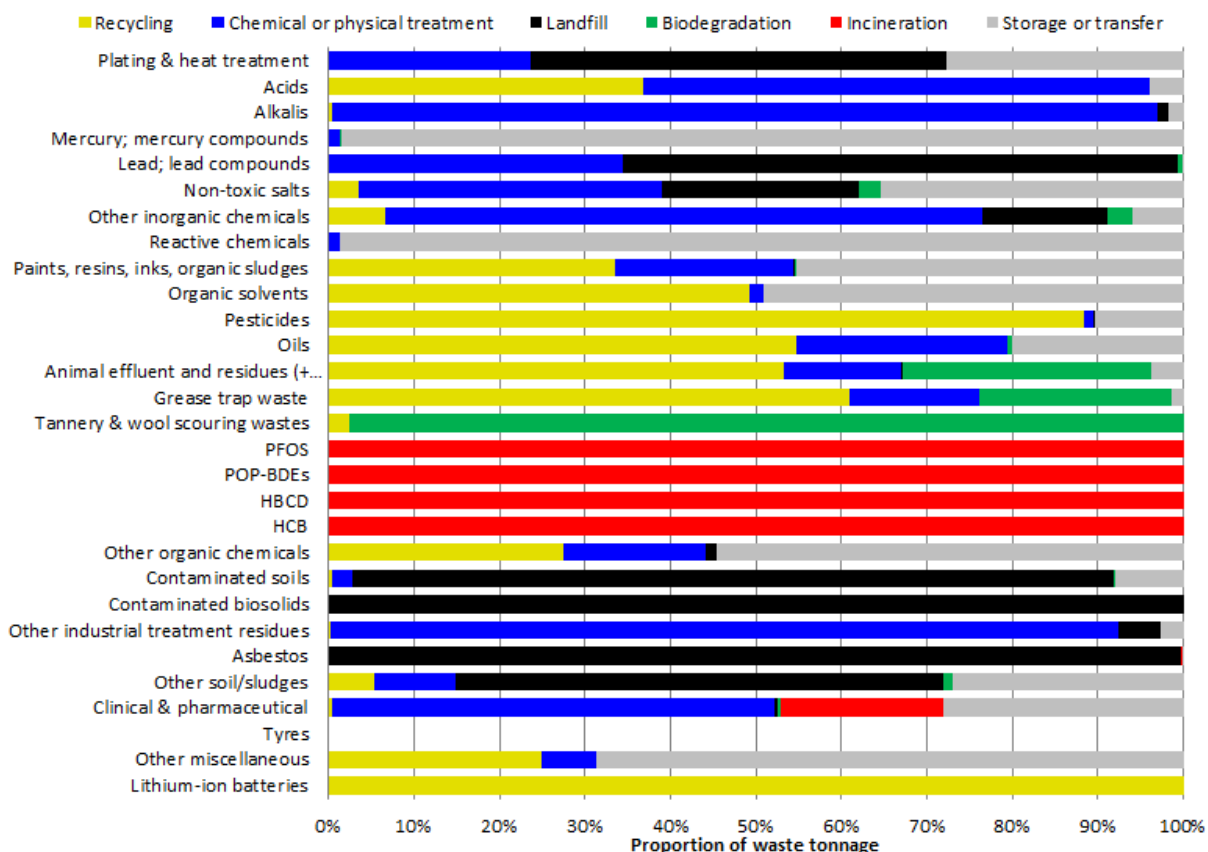


Figure 9: The fate of tracked hazardous waste in Vic, 2012-13 (percentages)



4. Data analysis – by waste group

The section analyses and comments on the data presented in Section 3, and detailed in **Appendix A.2 National hazardous waste data 2012-13 and 2013 – by NEPM code**, for each of the 23 waste groups.

4.1 A. Plating and heat treatment

This group includes:

- *A100 Waste resulting from surface treatment of metals and plastics*: Overspray of coating materials together with excess material removed in cleaning of equipment.
- *A110 Waste from heat treatment and tempering operations containing cyanides*: Molten inorganic salts used to 'case harden' or 'face harden' iron or low-carbon steel or to control temperature in the tempering process.
- *A130 Cyanides (inorganic)*: 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.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none">• Metal coating and finishing• (limited waste in Vic)	<ul style="list-style-type: none">• Metal coating and finishing• (limited waste in SA)	<ul style="list-style-type: none">• Marine fishing• Mining• Petroleum refining• Metal manufacturing• Metal coating and finishing	<ul style="list-style-type: none">• Marine fishing• Mining• Petroleum refining• Metal manufacturing• Metal coating and finishing

Close to 80% of this waste group is generated in Queensland from the following sources:

- Marine fishing; in the context of shipyards and slipways
- Mining; including coal and gold mining
- Petroleum refining
- Metal manufacturing
- Metal coating and finishing; such as electroplaters and galvanisers.

In 2012-13 Western Australia contributed 17% of this waste. Although no source data is available for WA, it is possible, like Queensland, that this contribution is from the mining sector.

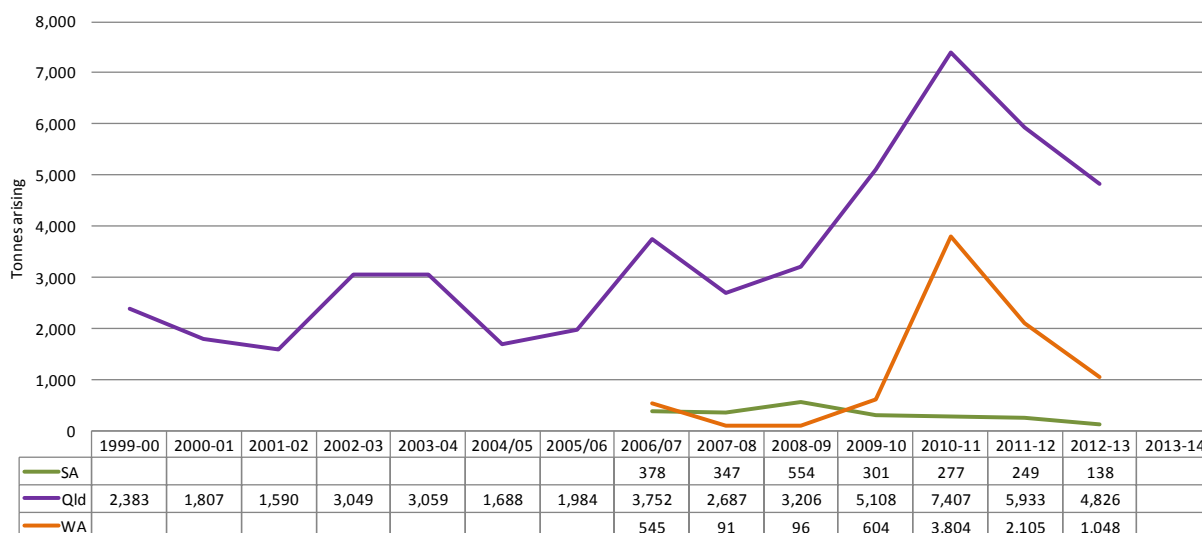
Analysis

This waste group is small by volume in Australia, making up only 0.1% of the national total in 2012-13. It is dominated by *A100 Waste resulting from surface treatment of metals and plastics* and is primarily produced in Queensland.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure overleaf. Viewed across the last decade, Queensland data for this waste group indicates a

strong inclining trend. WA data from 2007-08 to the present is similar. However, in parallel with WA, a sharp declining trend is apparent from a peak of 2010-11. This rise and fall would appear to mirror the rise of the mining boom and its subsequent fall in recent years, although this is a purely speculative observation.

Figure 10: Historical arisings of plating and heat treatment waste



Fate

Fate data suggests that the fate of this waste group is mostly landfill, although the pathway of chemical/physical treatment (including immobilisation) may also be used *en route* to landfill of the residues from treatment. Chromates from surface treatment would be immobilised and disposed at landfill, molten salts from heat treatment would be cooled and disposed of to landfill and cyanide remaining in the plating bath is destroyed by treatment with hypochlorite (or acid) before the liquid is discharged to sewer as trade waste. Remaining metals are precipitated and the resulting sludge may be treated to recover metals or transferred as hazardous waste to landfill.

4.2 B. Acid waste

This group comprises the single NEPM code *B100 Acidic solutions or acids in solid form*. It 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.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none"> Primary metal and metal product manufacturing Metal coating and finishing 	<ul style="list-style-type: none"> Metal coating and finishing 	<ul style="list-style-type: none"> Metal coating and finishing Metal refining Inorganic chemical manufacturing Primary metal & metal product manuf. Petroleum refining Coal mining 	<ul style="list-style-type: none"> Metal coating and finishing Metal refining Primary metal and metal product manufacturing Coal mining

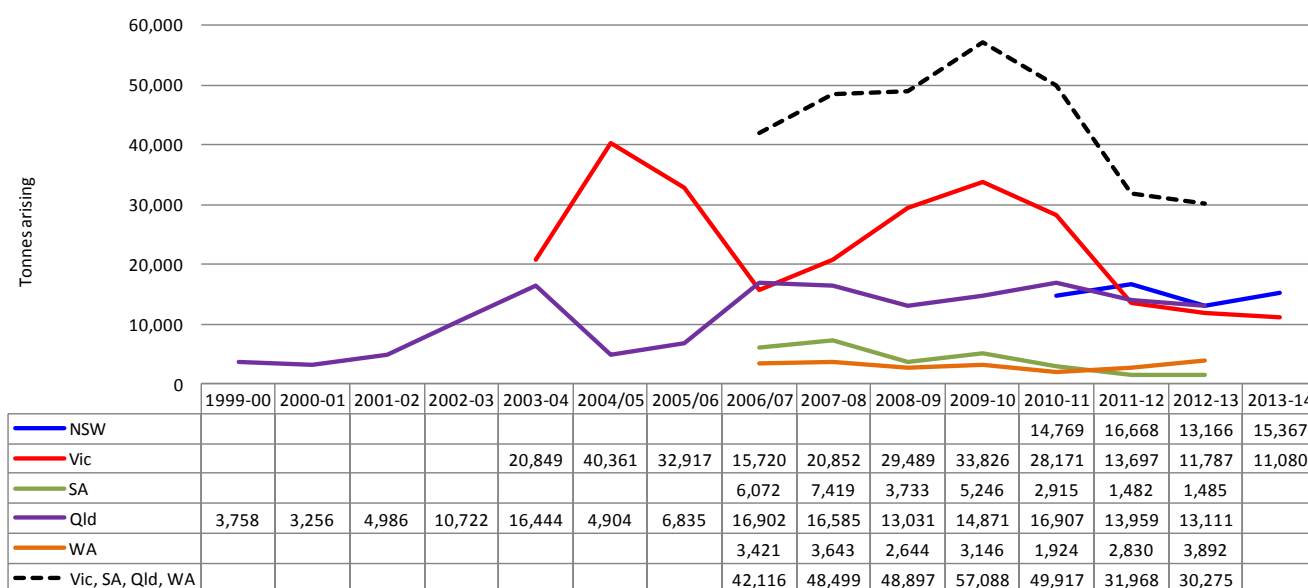
Queensland and NSW, closely followed by Victoria, produced the largest quantities acid wastes in 2012-13. Their main sources are metal coating and finishing (such as electroplaters and galvanisers), metal refining and other metal product manufacturing industries.

Analysis

This waste is relatively small by volume in Australia, making up about 0.75% of the national total in 2012-13.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below. Trends for most states appear reasonably flat over the last decade (where data exists) except for Victoria, which appears to show a marked decrease from 2009-10 to 2011-12, when it seems to have stabilised somewhat. The national trend dotted line overlay below mirrors Victoria's trend. Tracing back to the turn of the current century, Queensland shows a long term increasing trend, characterised by a rise from 1999-00 to mid-decade, followed by relative stability since.

Figure 11: Historical arisings of acids waste



Fate

The fate of this waste group is mostly chemical/ physical treatment, namely to neutralise the acid, although some recycling also occurs. Some liquid wastes are discharged to sewer, after neutralisation, under regulatory agreements.

4.3 C. Alkali waste

This group comprises the single NEPM code *C100 Basic solutions or bases in solid form*.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none"> Petroleum refining Metal coating and finishing Motor vehicle parts manufacturing 	<ul style="list-style-type: none"> Cement and lime manufacturing 	<ul style="list-style-type: none"> Oil and gas extraction (including CSG) Aluminium refining Cement and lime manufacturing Metal coating and finishing Fast food and food manufacturing (cleaning wastes) 	<ul style="list-style-type: none"> Oil and gas extraction (including CSG) Aluminium refining Cement and lime manufacturing Metal coating and finishing Motor vehicle parts manufacturing Fast food and food manufacturing (cleaning wastes)

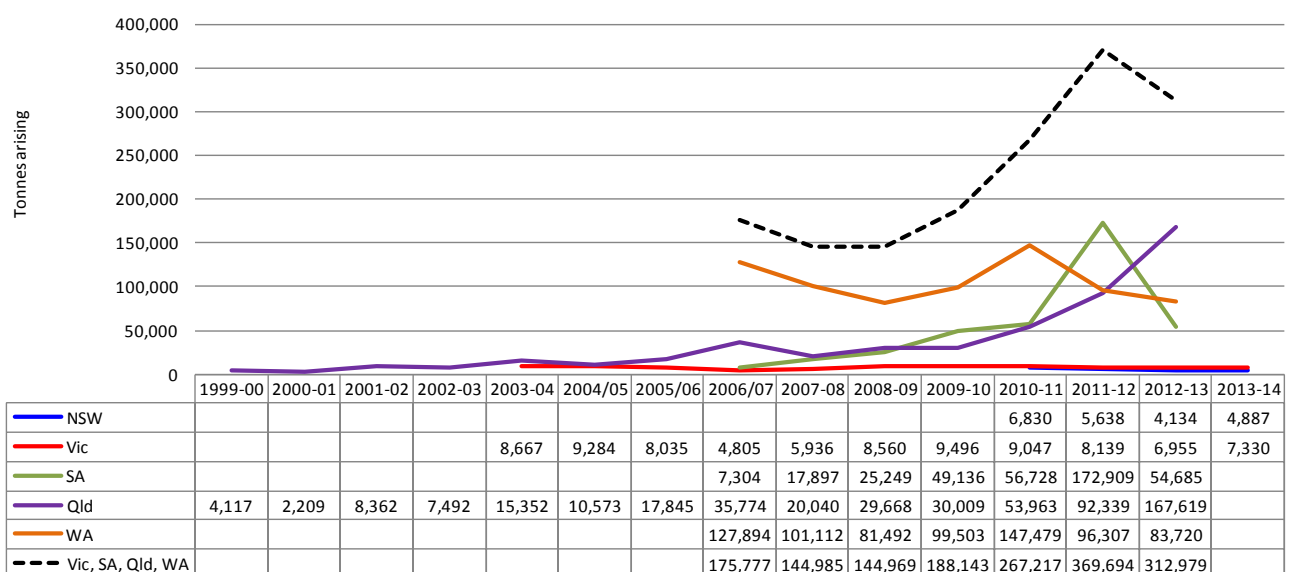
Alkali wastes are produced in significant quantities from coal seam gas (CSG) extraction in Queensland, cement and lime kilns around Australia, aluminium refining and as a surface cleaner/ degreaser in a range of industries such as diverse as metal coating and finishing to fast food.

Analysis

This waste is moderately significant nationally by tonnage, at around 6% of all hazardous waste in 2012-13, with 58% of it arising in Queensland. The volumes are more striking when it is considered that much alkali waste would be expected to bypass tracking systems through onsite neutralisation and discharge as trade waste. WA is the second highest generator with 24% of national tonnages for this waste – this may be due in part to the mining industry, although cement and lime kilns are a possible contributor as they are elsewhere in the country.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below.

Figure 12: Historical arisings of alkalis waste



The national trend from around 2008-09 to present shows a sharp increase, which appears to be strongly influenced by a 3-fold leap in SA waste in 2011-12 compared to 2010-11, and back down to the same level again in 2012-13. This 'hat-shaped' pattern is typical of event based activity, such as a large release from storage. Regardless, the SA figures on a steadily increasing path since mid-2000.

The other factor behind the national trend is an upswing in Queensland tonnages from about 2009-10 onwards which, given its similarity in timing to the more pronounced increase for non-toxic salts (Section 4.5), is likely to be reflective of the rise of the CSG extraction industry in Queensland.

A waste that could nominally be in this category but is not supported by tracking data is 'red mud', which is highly alkaline waste from the Bayer process used in alumina refining (processing of bauxite to aluminium oxide, or alumina), as distinct from aluminium smelting (processing of aluminium oxide to aluminium). Issues related to red mud are discussed as 'missing wastes' in Section 5.

Fate

The largest fate described in annual data for alkali wastes is storage, which supports the theory of a large South Australian storage release occurring in 2012-13. Closely behind that is recycling – alkaline waste may be used in neutralisation processes of acid waste in some instances, rendering a salt waste with reduced overall hazard. Where recycling does not occur, chemical physical treatment (neutralisation, of the waste rather than using the waste as the neutralant) is the next most prevalent management fate.

4.4 D120. Mercury; mercury compounds

This group comprises the single NEPM code *D120 Mercury; mercury compounds*. While volumes are very small, this waste has been singled out due to its inherent hazard, as evidenced by the *Minamata Convention on Mercury*⁸.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none">• Fossil fuel electricity generation• Chemical product manufacturing	<ul style="list-style-type: none">• Petroleum refining	<ul style="list-style-type: none">• Chemical product manufacturing• Fluorescent lamp collection programs• Petroleum refining• Fossil fuel electricity generation• Coal mining• Hospitals• Teaching institutions	<ul style="list-style-type: none">• Chemical product manufacturing• Fluorescent lamp collection programs• Petroleum refining• Fossil fuel electricity generation• Coal Mining;• Hospitals; Teaching institutions

Mercury waste arisings in Australia are dominated by the chemical product manufacturing sector, as well as end-of-life fluorescent lamps that arise from a wide variety of commercial, government and industrial sector organisations. Small quantities also arise from fossil fuel electricity generation, coal

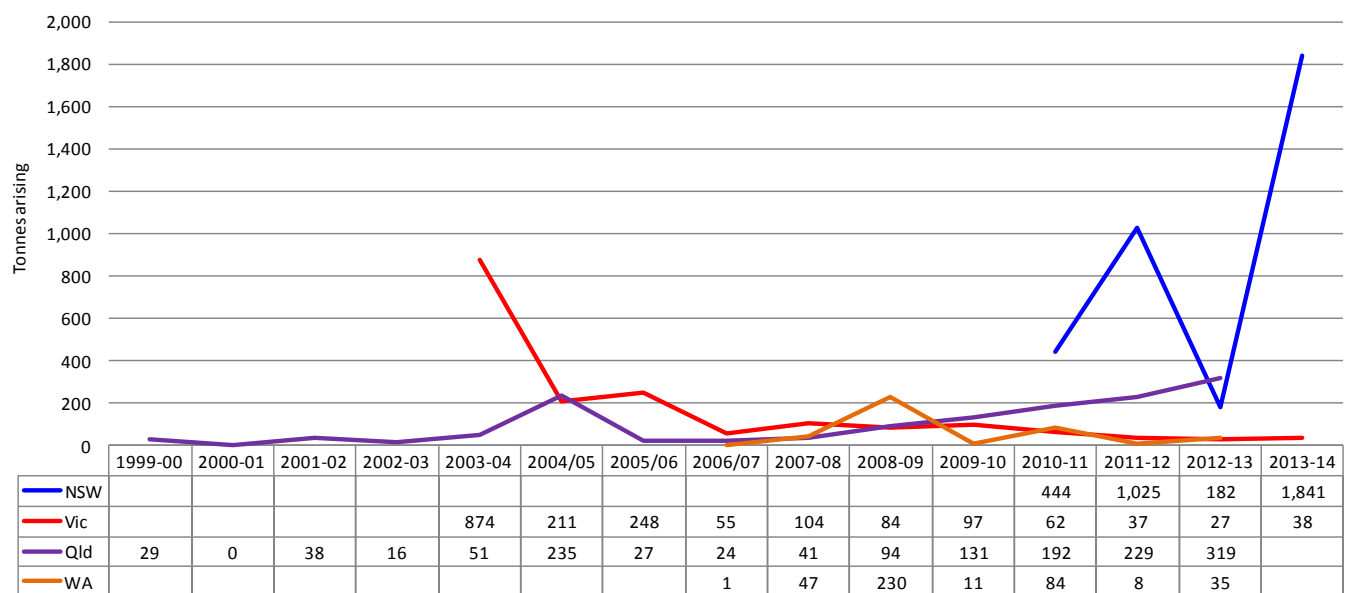
⁸ <http://www.mercuryconvention.org/Convention>

mining and petroleum refining, plus waste mercury containing equipment from hospitals, research and teaching institutions.

Analysis

This waste is very small nationally by tonnage, at around 0.01% of all hazardous waste in 2012-13, with almost 80% of it arising in Queensland (52%) and NSW (27%). However, 2012-13 was a notably low arising year for NSW in the four years of tracking data made available to this project. If 2013-14 NSW data was chosen, all things being equal the NSW proportion would rise to around 70% of national figures for mercury and triple the national proportion of all waste to around 0.03%. This leads to an interesting picture of historical arisings trends, as shown below.

Figure 13: Historical arisings of mercury; mercury compounds waste



While Queensland shows a steady but slow inclining trend over the long term, Victoria demonstrates a countervailing declining trend long term. It is NSW that shows dramatic variation. NSW data in years of very high arisings is dominated by chemical product manufacturing. The zig-zag pattern of rises and falls is indicative of behaviour like large and sporadic releases from onsite storages from these facilities.

Aside from these data 'lumps' from chemical product manufacturing wastes of mercury, it is clear from the data that a large proportion (by number) of waste transport movements tracked for mercury waste deal with end-of-life fluorescent lamps, which contain mercury.

Fate

The largest fate described in 2012-13 data for mercury wastes is storage, which supports the accumulation of small waste quantities as a pathway to arise again to a more permanent fate. After storage, chemical/ physical treatment, landfill and recycling are relatively evenly used. It is possible that treatment/ landfill versus recycling (mercury recovery) is a fate decision made by geographical isolation of the source, which in turn affects cost. Another factor of course is the nature of the waste, which may or may not be amenable to mercury recovery processes. With requirements around the Minamata Convention strengthening in the last two years, there is a possibility that regulatory incentives could push a larger fate proportion towards the recycling/ recovery option for mercury.

In terms of the high NSW data 'spike' years, fate analysis shows this to be due to mercury contaminated demolition waste sent to landfill, in very isolated movements.

4.5 D220. Lead; lead compounds

This group comprises the single NEPM code *D220 Lead; lead compounds*.

Australia has the world's largest deposits of both lead and zinc and as a result, both are mined and used locally and exported⁹.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none"> • Lead acid batteries; • Copper, silver, lead and zinc smelting and refining • Metal mining; • e-waste recycling; • Petroleum refining; • Metals manufacturing 	<ul style="list-style-type: none"> • Fabricated metal product manufacturing • e-waste recycling 	<ul style="list-style-type: none"> • Lead acid batteries • e-waste recycling • metal and coal mining • scrap metal collectors and recyclers 	<ul style="list-style-type: none"> • Lead acid batteries • e-waste recycling • metal and coal mining • scrap metal collectors and recyclers • Copper, silver, lead and zinc smelting and refining

Lead waste arisings in Australia heavily reflect end-of-life lead acid batteries typically bound for recycling/ recovery and (to a lesser extent) glass from e-waste recycling of CRT screens that contains high concentrations of lead (CRT glass). The former originally comes from a broad range of industries, including vehicle intensive ones such as mining and transport-related businesses, but usually via collection programs facilitated by metal and other resource recovery companies. The latter comes from e-waste dismantlers/ recyclers, and may arise through intermediate storage facilities.

There are also smaller more specific arisings of lead waste from smelting and refining of metals, mining and non-e-waste specific scrap metal recyclers.

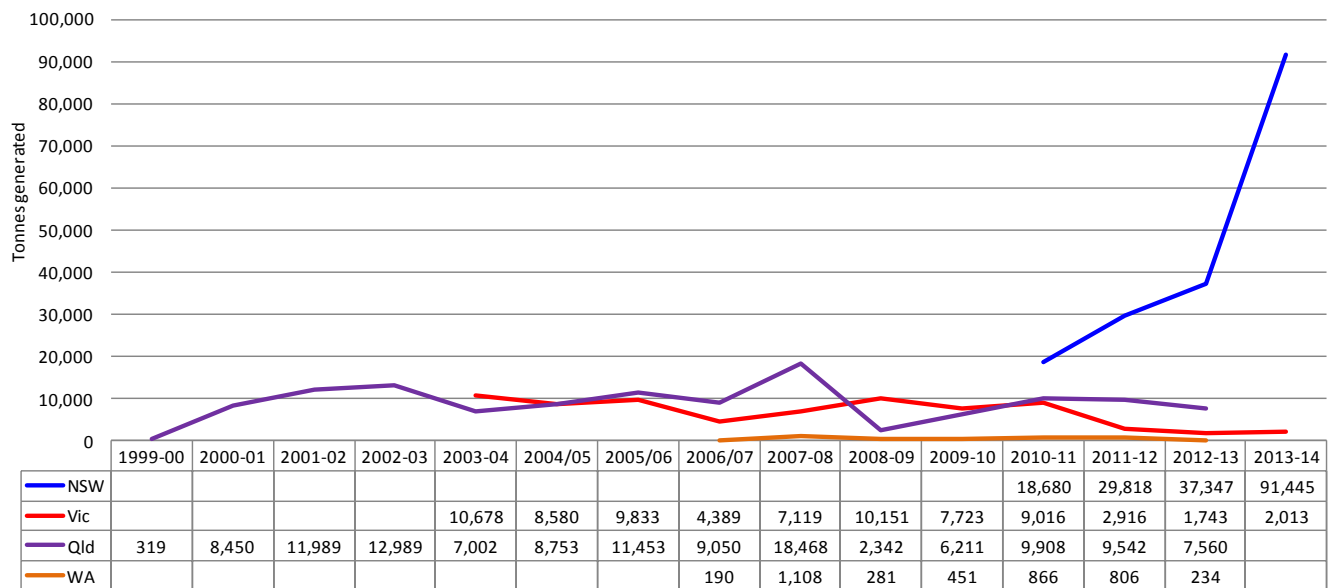
Analysis

In the 2012-13 year, lead waste made up a reasonably significant proportion of national hazardous waste, given the wide spread of waste types, at 1.9% by weight. Almost 80% of this appears to have arisen in SA and NSW, with SA the major apparent generator.

But this does not tell the full story. Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below (excluding South Australia, for reasons discussed below). Lead waste arisings reported to tracking systems were quite stable in 2010-11 and 2011-12 at 30,000 – 40,000 tonnes per year. The graph then shows a change in NSW. Underlying annual data provided by South Australia and Tasmania (for Basel reporting), which does not appear in the trends graph below, also throws up issues that require explanation as do other jurisdictions' data.

⁹ 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>

Figure 14: Historical arisings of lead; lead compounds waste



New South Wales

From 2010-11 to 2013-14, lead waste in NSW shows a 4-fold increase from around 20,000 tonnes to over 90,000 tonnes per annum. This waste is almost entirely made up of lead acid batteries and dwarfs figures from the other states shown. A significant contributor to this was a very steep increase in 2013-14, when around 50,000 tonnes of additional lead waste appear as having arisen in NSW.

Further investigation of the data suggests or confirms errors in the way it has been recorded in waste transport certificates:

- A significant proportion of certificates in 2013-14 (and also in 2012-13) specifically for lead acid batteries are recorded in the NSW tracking system as the producer being from NSW, with a NSW address, when in fact further description in the 'Consignor Name' field indicates that the waste consignment originated from outside of NSW. For example "Company X – various sites VIC" actually describes waste arising in Victoria, transported to NSW for treatment (recycling). This is a legitimate waste movement that appears to be assigned to the wrong arising state, due to incorrect waste certificate data. Follow up with NSW EPA confirmed that this wasn't a 'mistake' per se but rather an advised means of recording where so called 'accredited agents' conduct multiple small waste pick-ups from various sites and 'act' as the producer of the waste.
- Amongst thousands of individual certificate transactions, two stand out as probably incorrect: two single certificates of 22,480 tonnes and 23,500 tonnes respectively, both recorded in the manner above, as if from NSW but actually from WA. Since the next largest single certificate entry in over 1,500 lead acid battery records is 34 tonnes, combined with the physical limitations of what a truck can actually carry, these two are highly likely to be data mistakes. Correct quantities may well be 22,480 and 23,500 kg instead. Accounting for this in 2013-14 data would reduce 91,445 tonnes to 45,511 tonnes.
- A final oddity of the NSW numbers is that in legal terms, spent lead acid battery acid wastes (that are classified as hazardous or industrial waste) destined for reuse in NSW are not required to use a waste transport certificate; i.e. they have a waste tracking exemption¹⁰. Interstate movements, however must still use certificates. In theory, there should be zero lead acid batteries arising in NSW

¹⁰ See <http://www.epa.nsw.gov.au/wasteregulation/lead-acid-battery.htm>

tracking data (for recycling), but there are in fact a number of certificates recorded where arising and fate is legitimately NSW. However, the total of these (obviously NSW) battery arisings is only 1,234 tonnes in 2012-13, which validates the theory that most NSW-generated batteries are absent from tracking due to the exemption.

- Analysis of the 2012-13 data shows 1,686 tonnes of all lead waste arisings identified as from NSW are obviously from NSW, based on perusal of generator facility names. This is only 4.5% of the 37,347 tonnes recorded as tracked in 2012-13. The remainder are imports from other states, destined for NSW-based recycling infrastructure.
- This suggests that there must be many more tonnes of lead acid batteries going to a recycling fate in NSW, from NSW, that are not factored into the underlying data for this project. This would have the effect of countering the reductions that would accrue from any data adjustments made on the basis of dot points one and two, but there is no quantitative basis (in tracking data) available to the authors to estimate non-tracked NSW battery arisings.

Controlled waste NEPM data for interstate movements of lead waste into NSW suggest it contributes 27% to all hazardous waste imports to NSW in 12-13; and 50% in 2010-11.

Western Australia

Western Australian data suggest a very low arising 2012-13 of lead waste (234 tonnes), compared to other states. Also, the obviously WA-generated exports to NSW mentioned above are not featured in the WA tracking system data provided – good in that data is not duplicated; bad in that it should be counted as WA ‘arisings’. Investigation of 2012-13 NSW tracking data suggests 4,463 tonnes was exported from WA for NSW-based fates.

Victoria

Like WA, Victoria’s arisings in 2012-13 of 1,743 tonnes look very low, although quite consistent with 2011-12 and 2013-14 data. Similar to WA, investigation of 2012-13 NSW tracking data suggests 18,377 tonnes was exported from Victoria for NSW-based fates. Like WA, Victorian tracking data does not seem to include exports, confirming no duplication but also a hole in Victorian arisings.

Queensland

Queensland’s tracking data records 2012-13 arisings as 7,560 tonnes, which does not include exports to NSW. However, investigation of 2012-13 NSW tracking data suggests 16,316 tonnes was exported from Queensland for NSW-based fates. Like WA and Victoria, Queensland tracking data does not seem to include exports, confirming no duplication but also a hole in Queensland arisings.

South Australia

South Australian historical trends were excluded from analysis for lead waste, on account of some irregularities in the data supplied, particularly for 2013-14, that could not be further interrogated based on the level of data supplied.

But South Australian tracking data records 2012-13 arisings as 9,259 tonnes, which appears consistent with earlier years’ data. South Australia has previously advised the project team that they cannot differentiate between waste movements generated within the state and generated in SA but exported (from SA) as both sets of data use certificate numbers with the same prefix. This should mean that the South Australian arisings figure is correct.

Investigation of 2012-13 NSW tracking data suggests 7,231 tonnes was exported from South Australia for NSW-based fates. Since this 7,231 is less than the SA supplied figure (9,269 tonnes), it is assumed

that 9,259 tonnes is an accurate estimate of arisings for SA in 2012-13, regardless of its intra or inter-state fate.

Other jurisdictions

Tasmania reports an arisings figure for lead of 10,413 tonnes for 2012-13. Investigation of 2012-13 NSW tracking data suggests only 680 tonnes was exported from Tasmania for NSW-based fates. It is likely that the Tasmania figure, although very high, is correct based on other sources in that state than just batteries.

Arisings figures of 226 tonnes and 410 tonnes respectively for ACT and NT appear reasonable so were not questioned through further data analysis.

Fate

The largest fate described in 2012-13 data for lead is recycling. This is particularly true for NSW, where battery recycling infrastructure capacity has grown significantly in recent years. As a result there has been an increase in interstate transport of batteries into NSW, for recycling. Some landfill still occurs, particularly in geographically constrained areas, and accumulation in storage is common ahead of shipment to interstate fates, as occurs around Australia into NSW recycling infrastructure. Export is also a potential fate for low volumes of lead acid batteries.

Summary

So what is the true story for arisings of lead in Australia? From the analysis above we can conclude with some confidence:

- Apparent 'NSW' arisings are in reality not, in the main, from NSW, due to misleading certificate data and the exemption in place from intrastate tracking
- Yet NSW tracking data for lead is good data per se, because it captures large quantities of other states' arisings that have been imported into NSW for recycling. This data does not appear to be counted in tracking data in WA and Victoria and at least not directly in Queensland, so it has been added to lead waste arisings figures in these states.
- This may point to a broader question of whether other wastes bound for interstate export are captured in some states' estimates of arisings from their tracking systems. By definition, they should be. Conversely they may be captured in the receiving state's system (as is the case in NSW), which could lead to double-counting. Using the lead data interrogation as an example, it seems that the receiving state takes carriage of the tracking data, which makes sense from a regulatory risk management point of view but leaves a hole in the arisings data of the originating state. Rather than leading to double-counting, it is leading to under-counting.
- This analysis significantly improves arisings apparent from Western Australian, Victorian and Queensland tracking data, but leaves open the question of what NSW arisings really are.

Using the approach of adding export tonnages into NSW (revealed by NSW tracking data) to estimates from (non-NSW) state tracking data, for WA, VIC and QLD, and keeping estimates already provided for SA, TAS, ACT and NT, corrected arisings for 2012-13 can be estimated. In addition, using a population surrogate approach, averaging Victorian and Queensland per capita figures, NSW arisings can be estimated for lead in 2012-13, and as a consequence national data. These are shown in Table 11 below.

Table 11: Adjusted 2012-13 arisings of lead from Australian jurisdictions (tonnes)

ACT	NSW	NT	Qld	SA	Tas	Vic	WA	NATIONAL
226	32,085	410	23,876	9,259	10,413	20,120	4,697	101,086

The Australian Government's *Factsheet – Hazardous waste Profile 2010-11*¹¹ estimates lead acid battery arisings in 2010 to be 134,949 tonnes, of which 75% (100,750 tonnes) are estimated to be recycled in Australia. Another Department of the Environment study¹² in 2014 estimated total lead acid battery waste in Australia to be 137,000 tonnes, which agrees well with the factsheet figure. Both of these estimates agree closely with the revised figures from Table 7.

Adjusted 2012-13 arisings of lead waste from Australian jurisdictions (tonnes), based on the correction of observed inequities in jurisdictional approaches to interstate tracking that impacts lead waste in particular (as a highly 'border-crossing' waste), agree well with recent literature estimates and appear to confirm the estimation approach to NSW data as reliable.

4.6 D300. Non-toxic salts

This group comprises the single NEPM code *D300 Non-toxic salts*.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none"> Iron and steel casting Aluminium smelting 	<ul style="list-style-type: none"> Glass product manufacturing 	<ul style="list-style-type: none"> CSG extraction Aluminium smelting Electricity supply Mining Iron and steel casting 	<ul style="list-style-type: none"> CSG extraction Aluminium smelting Electricity supply Mining Iron and steel casting

The vast majority of this waste group comes from the coal seam gas (CSG) extraction industry (as discussed further in Section 5.1), approximately 80% of which is located in Queensland, with the remainder in NSW. The CSG industry is often placed within the industry source heading of *Oil and gas extraction* and D300 waste tracking certificates in Queensland also regularly show 'electricity supply' as a major source which, on close analysis, could be miscoded CSG sourced transactions. This is because resource companies that operate CSG facilities are often also power generators, and these facilities may be close to, and fuelled from, nearby CSG extraction fields.

In NSW in 2012-13, aluminium smelting is a major contributing source, which also includes waste from smelters closed in recent years. However, detailed analysis of tracking data reveals this as likely to be miscoded spent potlining waste sent for recycling (see Section 5.2), which should probably be classified under *D110 Inorganic fluorine compounds excluding calcium fluoride*.

WA also makes a significant contribution to arisings of this waste, although no data is available as to its source. There is no CSG extraction or aluminium smelting in WA, but there is metal mining and alumina refining, the latter commonly dealing with a waste stream called 'red mud' (discussed further in Section

¹¹ <http://www.environment.gov.au/topics/environment-protection/nwp/reporting/hazardous-waste>

¹² Mohr, S., Fyfe, J. and Giurco, D., 2014. A review of data on lead-acid batteries entering Australia and arising as waste. Prepared for the Department of the Environment by the Institute for Sustainable Futures, University of Technology, Sydney.

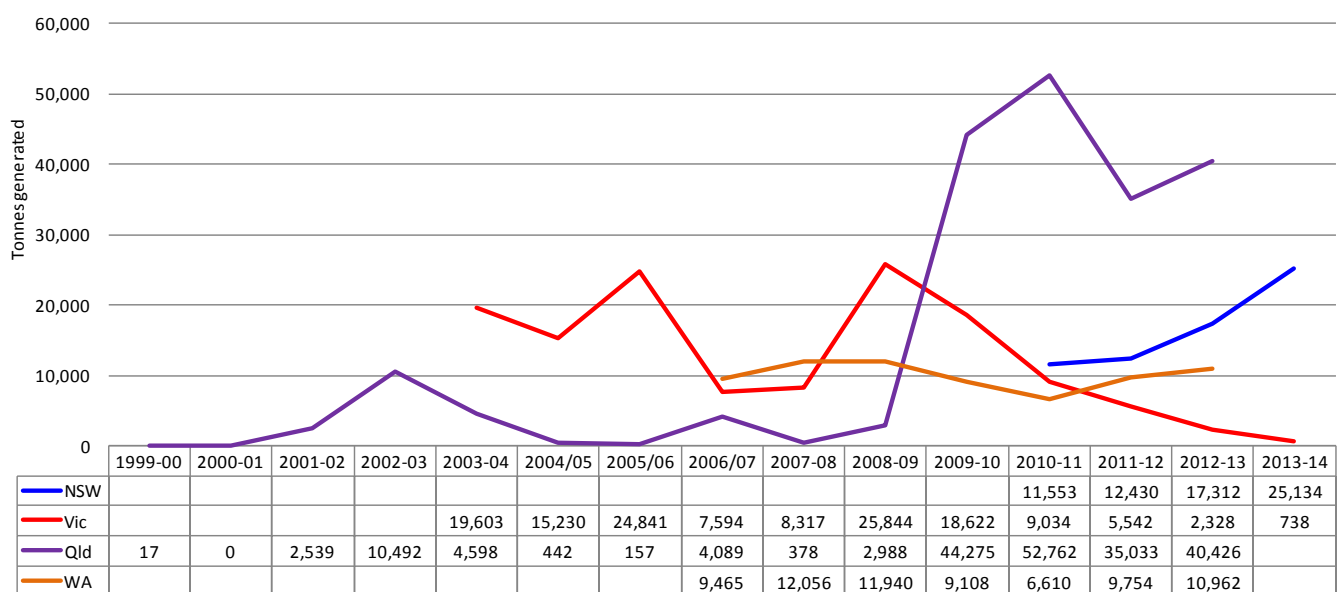
5.2), including recycling processes that may produce alkaline salt wastes. The other strong possibility as a contributing source in WA is cement and lime production.

Analysis

Non-toxic salts makes up about 1.6% of national hazardous waste arisings, making it a relatively prominent waste. The main component of this waste (CSG waste) is discussed at length in Section 5.1, including the likelihood that actual volumes produced and stored on CSG extraction sites vastly outweigh figures reported in tracking data.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below.

Figure 15: Historical arisings of non-toxic salts waste



Rising trends are noted in Queensland and NSW, the main producing states. These appear to mirror the growth in the CSG industry witnessed to date. The jagged and steep nature of the Queensland graph is possibly an indicator of storages and releases, as discussed in Section 5.1.

Fate

The fate of CSG waste is a current conundrum. If the apparently spurious NSW (spent potlining waste) estimates were discounted, which the data show as going to a recycling fate, then the primary fate (for 2012-13 data) of recycling would slip back behind storage, with landfilling not too far behind.

The other issue at play in fate data for CSG waste is that 'recycling' is regularly chosen as a fate description to describe where salts are desalinated offsite (given the resultant reuse of the desalinated water), but a more dubious use of the 'recycling' description is sometimes applied to situations that appear to be evaporation ponds for CSG waters, which would be better described as storage, and perhaps even permanent storage. Ultimate fates for CSG waters can also be ocean discharge (if extraction activities are near the coast), although this does not appear in road transport-based tracking systems.

4.7 Other D. Other inorganic chemicals

This group includes waste and wastes contaminated with: metal carbonyls; inorganic sulphides; perchlorates; chlorates; arsenic¹³, cadmium¹³, beryllium¹³, antimony¹³, thallium¹³, selenium¹³ and tellurium¹³; compounds of copper, cobalt, nickel, vanadium, boron, zinc, barium (excl. barium sulphate), chromium (hexavalent & trivalent), phosphorus (excl. mineral phosphates) & inorganic fluorine (excl. calcium fluoride).

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none"> • Fossil fuel electricity generation; • motor vehicle parts manufacturing; • petroleum refining; • leather tanning, fur dressing and leather product manufacturing; • chemical product manufacturing • metal coating and finishing; • port and water transport terminal operations; • professional, scientific and technical services 	<ul style="list-style-type: none"> • Limited sources in SA 	<ul style="list-style-type: none"> • Similar sources to Vic – no unique dominant industries 	<ul style="list-style-type: none"> • Fossil fuel electricity generation; • motor vehicle parts manufacturing; • petroleum refining; • leather tanning, fur dressing and leather product manufacturing; • chemical product manufacturing • metal coating and finishing; • port and water transport terminal operations; • professional, scientific and technical services

While this group is diverse, by volume around 90% (a substantial 144,834 tonnes) of the waste arising in 2012-13 is contributed by *D230 Zinc compounds*, in Tasmania and South Australia. Source data beyond this is not available for these jurisdictions.

Analysis

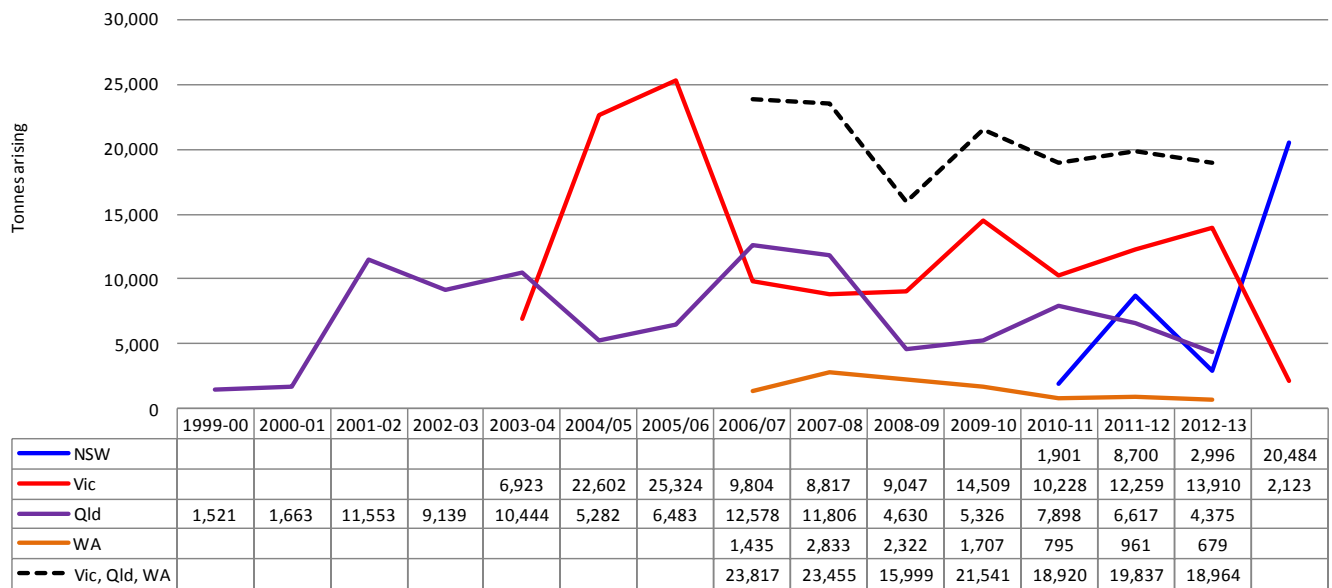
The 'other D' waste group is significant in the broader national context at 3.7% of all hazardous waste, but only on the back of the zinc component, which is 2.6% itself.

Spent potlining (SPL) waste, introduced above but discussed at length in Section 5.2, is a waste of national significance that would be classified in this category, under *D110 Inorganic fluorine compounds excluding calcium fluoride*. The fact that it does not significantly register is due to it being largely an onsite storage issue that does not routinely hit tracking systems or, if it does, may be incorrectly classified (as it is in NSW; as D300).

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure overleaf. These tell little, because of the mix of wastes they represent and, more critically, because Tasmanian and South Australian data are not represented (Tasmania has no trend data and South Australia's has uncertainties in relation to source jurisdiction), which means zinc compounds, the major arising waste, does not show in the chart. (Inclusion of single year data points for these wastes would increase the y-axis scale 5 times greater.)

¹³ Also including compounds containing these elements.

Figure 16: Historical arisings of other inorganic chemical waste



Fate

Fate data for the dominant zinc waste is not available. Fates for the non-zinc component are as varied as the wastes themselves with the 'other or not stated' category dominant, adding nothing of value to our understanding.

Limitations in tracking data from the jurisdictions in which zinc, the major component of this group, arises prevent detailed analysis of fate.

4.8 E. Reactive chemicals

This waste group comprises the single NEPM code: *E100 Waste containing peroxides other than hydrogen peroxide*, although it shares similar strong oxidising properties to *D340 Perchlorates* and *D350 Chlorates*, which were not grouped together in this category to preserve NEPM E reporting alignment and because the contributions from D340 and D350 are similarly small.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none"> Limited sources in Vic (other than waste industry storages) 	<ul style="list-style-type: none"> No sources in SA 	<ul style="list-style-type: none"> Chemical manufacturing Metal product manufacturing Water supply drainage & sewerage Oil and gas extraction Soap and Other Detergent Manufacturing Potato, Corn and Other Crisp Manufacturing 	<ul style="list-style-type: none"> Chemical manufacturing Metal product manufacturing Water supply drainage & sewerage Oil and gas extraction Soap and Other Detergent Manufacturing Potato, Corn and Other Crisp Manufacturing

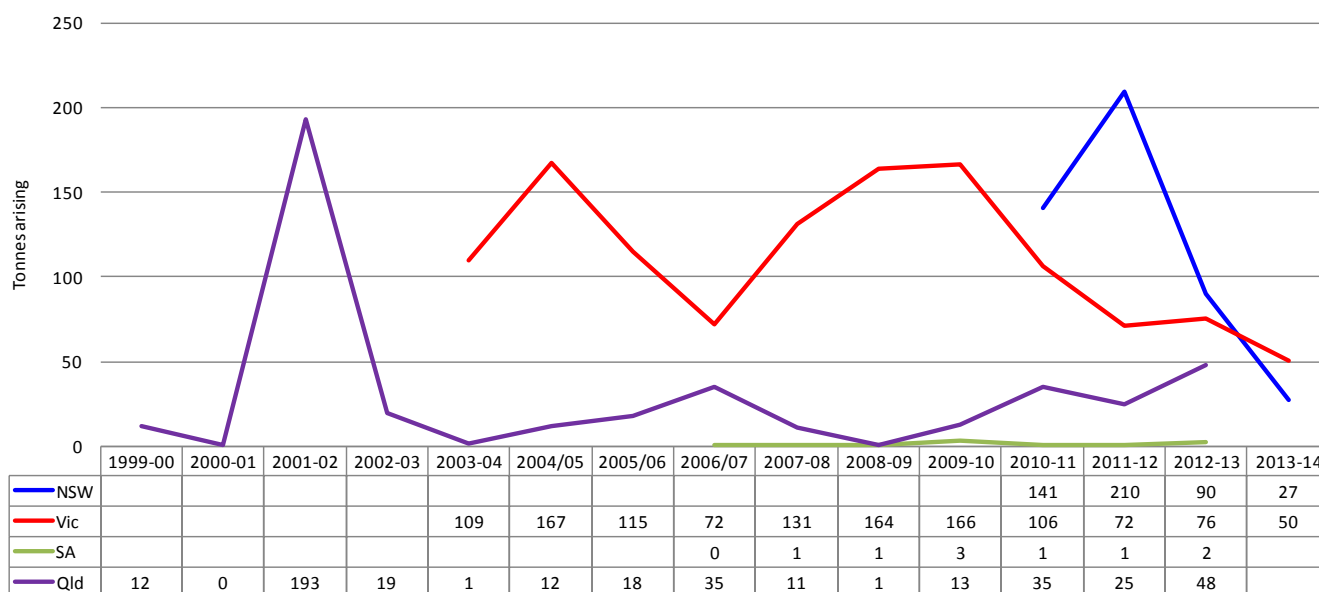
This waste has high inherent hazard due to its potential for oxidation and/ or explosion when in contact with other substances. Strong regulation in Australia is applied to most substances with explosive potential: nitroglycerine for military purposes, cordite for military and recreational ammunition, 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. 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.

Sources are due to small scale specific application wastes with a limited number of waste movements making up total data. Interestingly soap and detergent manufacture and 'crisp' manufacturing (as in potato crisps and related snack foods) appear as sources (however small) of this waste.

Analysis

It is no surprise that this waste contributes only 0.004% of the national tonnage of hazardous waste, with arisings coming from the three largest states. Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below and, due to the limited number of actual waste movements that underpin the numbers, do not reveal a historical trend of any note.

Figure 17: Historical arisings of reactive chemicals waste



Fate

Because of the small tonnages per waste movement, storage (for subsequent accumulation) is the primary fate indicated in tracking data. Beyond that chemical/ physical treatment is indicated, to immobilise of 'fix' the hazard, for later landfill.

4.9 F. Paints, resins, inks, organic sludges

This group includes:

- F100 Waste from the production and use of inks, dyes, pigments, paints, lacquers & varnish
- F110 Waste from the production & use of resins, latex, plasticisers, glues and adhesives.

The former includes polymeric material such as polyacrylates and methacrylates, together with pigments and small quantities of substances like plasticizers and anti-oxidants. The latter includes monomers used in production of polymers, waste products from the production site, or waste generated in or after use of the products.

Sources

Summary source analysis

Vic	SA	Qld and NSW	National summary
<ul style="list-style-type: none"> • Motor vehicle manufacturing • Chemical and chemical product manufacturing • Printing • Machinery and equipment manufacturing • Furniture manufacturing 	<ul style="list-style-type: none"> • Motor vehicle manufacturing 	<ul style="list-style-type: none"> • Paint, ink and resin manufacturing • Chemical and chemical product manufacturing • Printing • Metal product manufacturing • Pulp and paper manufacturing • Aircraft manufacturing 	<ul style="list-style-type: none"> • Motor vehicle manufacturing • Paint ink and resin manufacturing • Chemical and chemical product manufacturing • Printing • Machinery and equipment manufacturing • Metal product manufacturing • Pulp and paper manufacturing • Aircraft manufacturing • Furniture manufacturing

Nationally in 2012-13, wastes from F100 outweigh those from F110 about 5:1. In Victoria and South Australia motor vehicle manufacturing overspray wastes (usage) predominate, while in NSW and Queensland wastes from the manufacturing of these materials are the primary source, as well as small contributors (as material users) in printing, surface coating and manufacturing of aircraft, aircraft components and furniture.

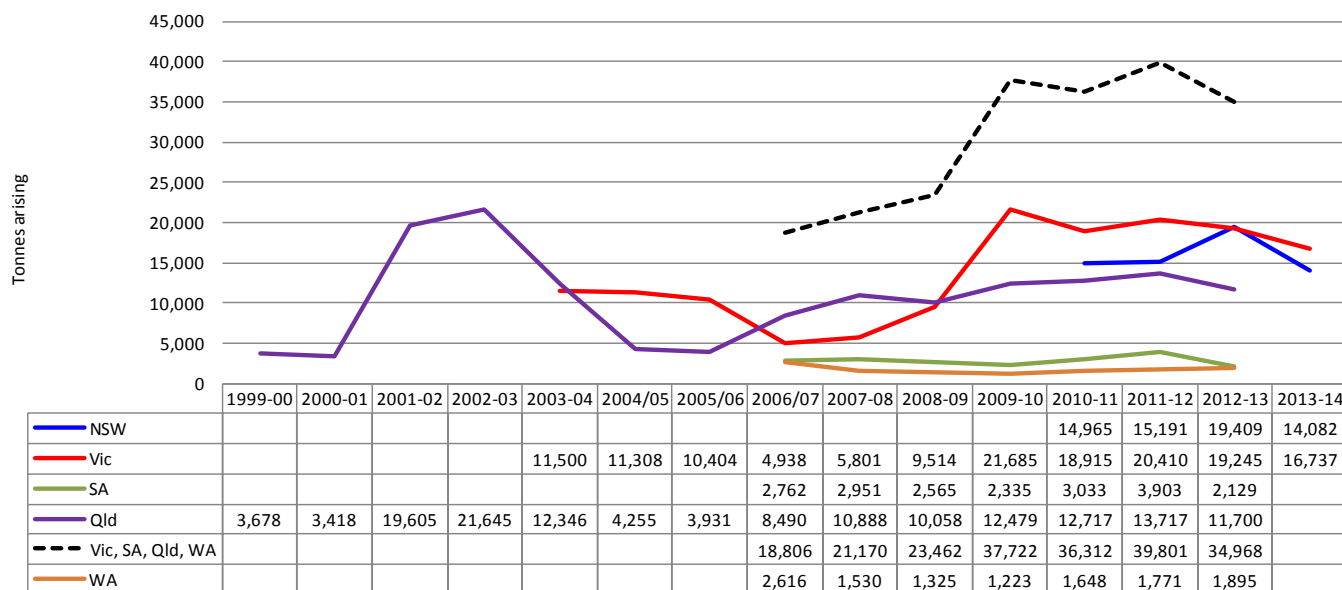
Analysis

These wastes are almost exclusively generated in Victoria (35%), NSW (33%) and Queensland (23%). This waste group is significant enough in volumetric terms, making up just over 1% of Australia's hazardous wastes.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure overleaf.

Anecdotally, this waste should be declining due to decreasing material hazard from the advent of water-based paints and coatings and vegetable oils replacing petroleum products in most printing inks. Decade long datasets in Victoria and Queensland indicate growth from around the mid-2000s onwards, but the last three years of data indicate a steady decline, perhaps due to stagnancy in some industries that use these materials (e.g. car manufacturing) as well as lower hazard surface coating materials finding broader application.

Figure 18: Historical arisings of paints, resins, inks, organic sludge waste



Fate

Although the highest national fate is chemical physical treatment, this waste appears to be dealt with differently in each of the major states, based on the type of infrastructure present. In Victoria and Queensland recycling, which includes energy recovery such as blending into waste-derived fuels, is the primary fate followed by storage (presumably to accumulate for further recycling). In NSW chemical/physical treatment is the major fate by some distance, which is surprising given the calorific value that will be present in some of these wastes.

4.10 G. Organic solvents

This waste group includes:

- G100 ethers
- G110 organic solvents excluding halogenated solvents
- G150 halogenated organic solvents
- G160 waste from the production, formulation and use of organic solvents.

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. They are often distinguished on the basis of halogenation in their chemical structure, with halogenated organic solvents more of a health and environmental concern than non-halogenated organic solvents. As a result, both usage and waste from halogenated organic solvents tend to be declining in favour of non-halogenated alternatives.

Sources

Summary source analysis

Vic	SA	Qld, NSW and WA	National summary
<ul style="list-style-type: none"> Chemical and chemical product manufacturing Oil and gas extraction Printing 	<ul style="list-style-type: none"> Medical and other health care services 	<ul style="list-style-type: none"> Fertiliser manufacturing Agrichemical formulation Chemical and chemical product manufacturing Motor vehicle manufacturing Dry cleaning 	<ul style="list-style-type: none"> Fertiliser manufacturing Agrichemical formulation Chemical and chemical product manufacturing Oil and gas extraction Printing Motor vehicle manufacturing Dry cleaning

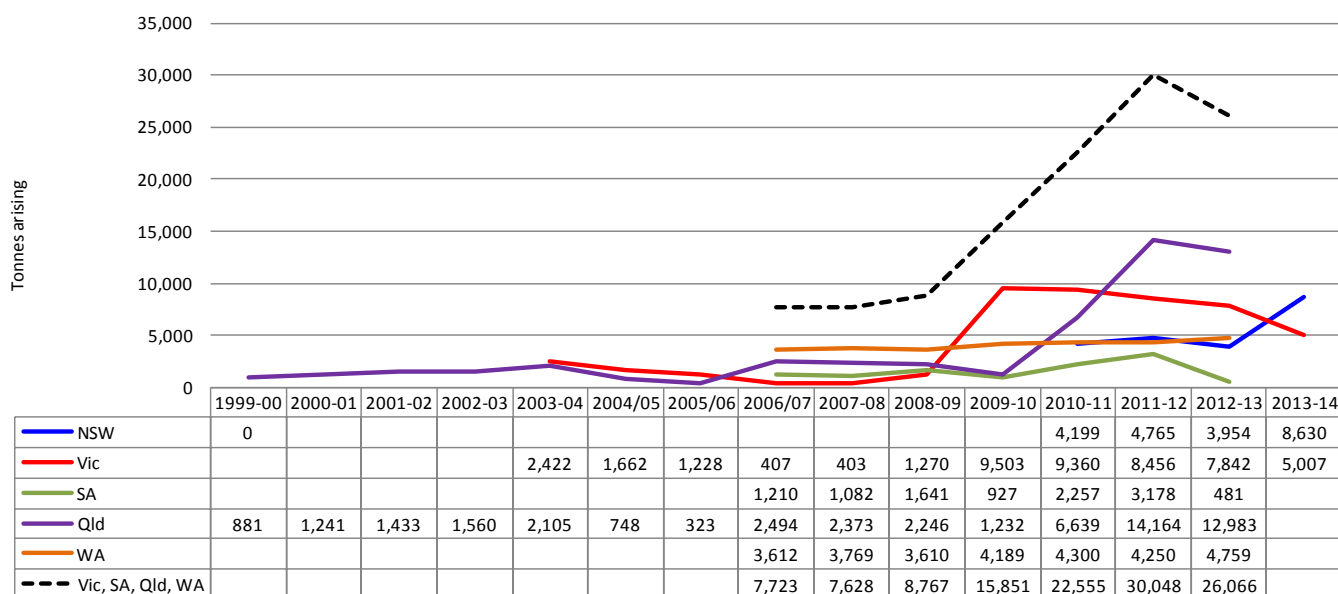
Organic and inorganic chemical manufacturing, fertiliser manufacturing and agrichemical formulation are major sources of these wastes followed by motor vehicle manufacturing, printing and dry cleaning.

Analysis

Solvent wastes make up around 0.6% of the national hazardous waste arising total, and are generated mainly in Queensland (44%) and Victoria (23%). The vast majority of these wastes are non-halogenated.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below. There would appear to be quite a steep inclining national trend in this waste evident around 2009-10 in Victoria and 2010-11 in Queensland. Victoria was shown a slow but steady tailing off since whereas Queensland essentially flattened in the last year for which we have tracking data (2012-13). Waste volumes are typically higher than they were 8-10 years ago.

Figure 19: Historical arisings of organic solvent waste



Fate

Waste solvents are often subject to reclamation, with any residues sent to energy recovery processes such as incineration or hazardous waste landfill. This is borne out in fate data with recycling the major fate, followed by storage and accumulation for later release to final fates. Some chemical/ physical treatment also occurs but landfill is virtually non-existent for this waste group.

4.11 H. Pesticides

This group includes three potentially diverse types of waste:

- *H100: waste from the production, formulation and use of biocides and phytopharmaceuticals*
- *H110: organic phosphorous compounds*
- *H170: waste from manufacture, formulation and use of wood-preserving chemicals.*

H100 is the major pesticide heading (biocide means pesticide) although it also includes the relatively unrelated phytopharmaceuticals, which are plant derived pharmaceutical products such as alkaloids.

H110 includes wastes from organic phosphorus compounds used as lubricants, plasticizers, flame retardants and, most notably, as organophosphate pesticides.

H170 is different again in that it covers wastes from timber preservation which in Australia has historically been dominated by chromated copper arsenate (CCA) treatment. Its overlap in this NEPM category is presumably due to the function of CCA preservation of timber, where the copper acts as a fungicide, the arsenic an insecticide (both types of biocide) and the chromium chemically fixes these to the wood to stabilise them.

Sources

Summary source analysis

Vic	SA	Qld, NSW and WA	National summary
<ul style="list-style-type: none">• Services to agriculture• wood product manufacturing• waste sector	<ul style="list-style-type: none">• No source data identified in SA data	<ul style="list-style-type: none">• Fertiliser manufacturing• Agrichemical formulation/ services to agriculture• Chemical and chemical product manufacturing• Wood product manufacturing	<ul style="list-style-type: none">• Fertiliser manufacturing• Agrichemical formulation/ services to agriculture• Chemical and chemical product manufacturing• Wood product manufacturing• Waste sector

Over 8,000 pesticide and veterinary products have been registered for use in Australian agriculture, horticulture, livestock, forestry, commercial premises, parks, homes and gardens¹⁴. Pesticide wastes can arise due to historical activities where the active ingredients may be mixed or perhaps unknown, due to weathered container labelling. It also arises from manufacturing and formulating of these chemicals, such as agricultural chemical suppliers, wood preserving chemical supply and chemical manufacturing.

¹⁴ 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

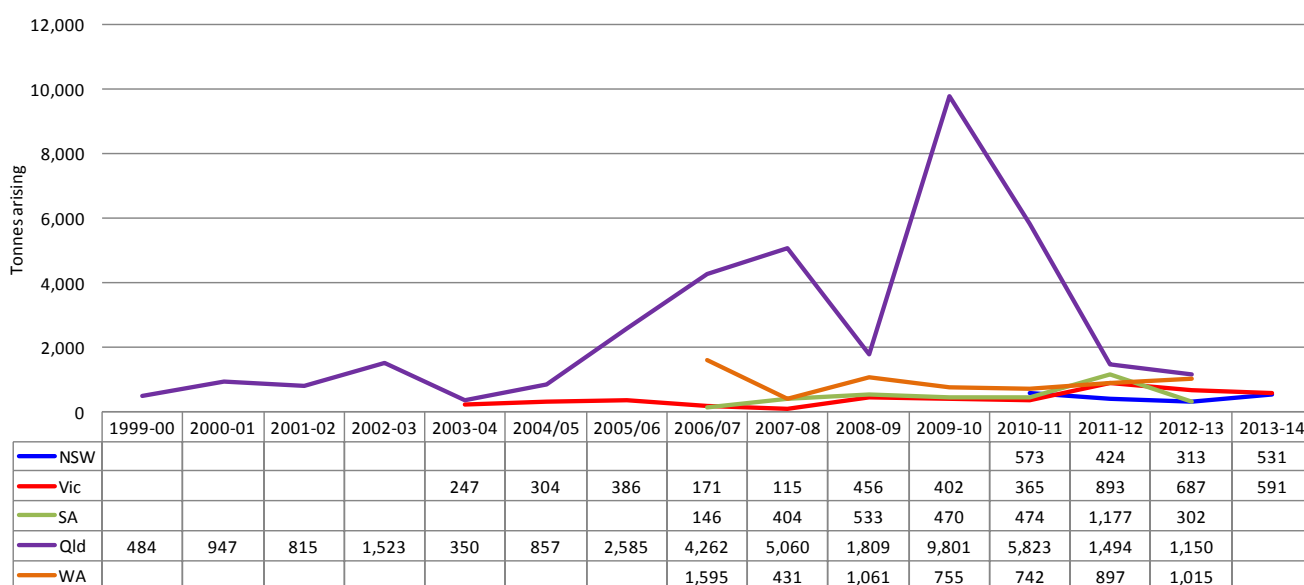
The waste sector is mentioned as a source because this is how household or farm collection program wastes show up in tracking data; the waste sector is the collector rather than the true 'generator', which is individual homes and farms.

Analysis

Tracking data for 2012-13 suggests that about 0.08% of national hazardous waste volumes is pesticides waste, which is primarily recorded as H100, followed by H170 and H110, both at much lower levels. Most of the H100 (pesticides) waste is recorded for Queensland and Victoria, H170 (wood-preservation chemicals) is mostly Queensland and South Australia and around two-thirds of H110 (organophosphorus compounds) waste arisings was recorded in Western Australia.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below.

Figure 20: Historical arisings of pesticide waste



The dominant feature of the graph is Queensland data, particularly with its major peak in 2009-10. The jump from 2008-09 to 2009-10 could be explained by storage releases, but since a sustained rise occurred from 2004-05 through to 2009-10 it may be a reflection of regulatory change, such as the implementation of the requirements for pesticide management technicians in the Pesticide Management Act and Regulations (the latter came into place in 2003).

The other is the possible effect of chemical collection programs like DrumMuster and ChemClear, which have been prevalent throughout Australia in the last 10-15 years. Closer inspection of the Victorian and South Australian data also suggests a rising trend over the period of these collection programs, noting the latter's 2010-11 spike was from wood-preservation chemicals, which may have been a storage release.

Fate

The reported fate for H Pesticides is mostly 'recycling'. On the surface this might seem illogical, since much of the waste is based on highly hazardous chemicals designed to kill various target organisms (not

to mention non-target organisms through misuse). The logical fate is destruction for these chemicals, usually through some form of thermal means.

In reality destruction of the pesticide waste occurs, but the major fate is recycling because the waste is blended into a fuel and burnt for energy recovery in industrial processes. Our broad definition of recycling includes energy recovery because it cannot be logically placed elsewhere in the limited options provided for in the data. For example the category 'incineration' is too narrow, because it does not describe a thermal process that in essence is incineration but the material being incinerated acts as a fuel resource for another manufacturing process, such as the case with fuel substitution in cement kilns.

The other aspect of recycling reported, particularly in Queensland data, is drum recycling by drum reconditioning companies. Pesticide waste is often present in drums and clearly drum reconditioners recycle drums, after cleaning them of their contents, usually presumed to be very small residues. But is the pesticides waste – the drum's contents – recycled?

The treatment of drums and their contents is a confusing area which can lead to mistakes in completion of transport certificates, which results in misleading data. If the drum's contents are significant, then the correct waste type is the one that describes these contents – in this case H group pesticides – and the fate recorded should be what happens to these contents. This is mostly the case in reported data, particularly with fuel substitution as the fate, or storage for accumulation, to be sent to final fate at a later time.

If the drum contents are small (residues) then the waste issue is more focused on the contaminated drums themselves, so the correct classification should be 'N100 Containers and drums that are contaminated with residues of substances referred to in this list', and the correct fate would be recycling. It is not logical or correct to identify the waste by its content (H waste) but the fate by the container it is contained in, which occurs in a significant portion of Queensland H waste tracking data.

4.12 J. Oils

This waste group includes:

- *J100 Waste mineral oils unfit for their original intended use; waste oil/water*
- *J120 hydrocarbons/water mixtures or emulsions*
- *J160 waste tarry residues arising from refining, distillation, and any pyrolytic treatment.*

J100 is dominated by used oil from vehicles, while a small proportion of (mostly Victorian) data also includes the used oil filters themselves. J120 is typically wastewaters that have been contaminated with oils, such as truck and vehicle washwaters, skimmer and interceptor waters, vehicle coolant waters and potentially shipping bilge water. J160 is produced in the refining of petroleum, re-refining of lubricating oils, production of metallurgical coke or town gas by pyrolysis of coal.

J120 makes up 59.5% of this category, J100 39% and J160 1.5% by quantity.

Sources

Summary source analysis

National summary

- Mining
- Manufacturing (various, including food, petroleum & metal coating)
- Transport
- Retail (vehicle servicing shops)
- Waste sector.

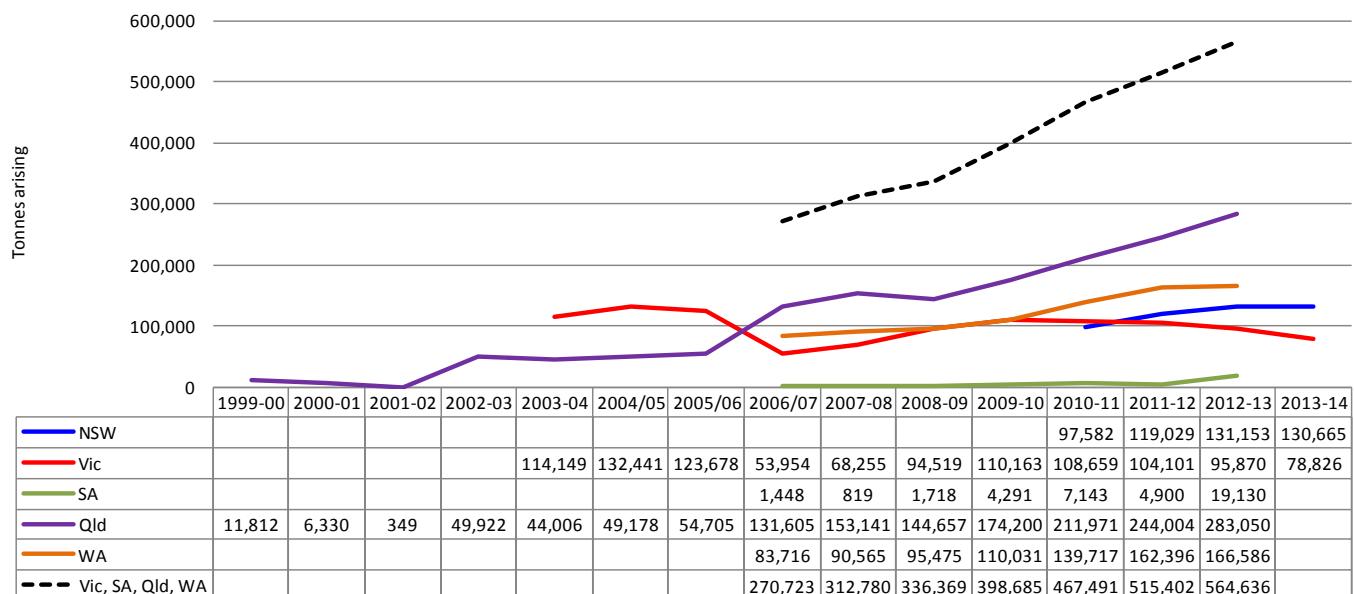
Oily wastes arisings are distributed across industries in jurisdictions quite similarly, with differences being more to do with jurisdictional industrial mix variations, such as the prevalence of mining in WA and Queensland. Mining makes up 30% of recorded sources in Queensland.

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 environmentally sustainable management and re-refining of used oil and its reuse. 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 recyclers. These arrangements provide incentives to increase used oil recycling in the Australian community.

Analysis

Tracking data suggests that about 5% of national hazardous waste volumes is waste oils (J100) and 7% is oily waters (J120). Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below.

Figure 21: Historical arisings of oil waste



In a similar vein to the discussion on lead acid batteries, a complex story is not apparent in the dataset. This is best investigated by looking separately at oils (J100), rather than the group-wide trend graph above.

From tracking data, NSW J100 arisings in 2012-13 were 29,102 tonnes and Victoria's 20,832 tonnes. But 2012-13 Queensland and WA arisings of J100 are 80,014 and 111,118 tonnes respectively. These numbers suggest either something significant is happening in WA and Queensland, or NSW and Victorian data are too low for oils.

New South Wales

Like lead acid batteries, there is an exemption from the use of transport certificates for internal movements of used oil, but only if it is going to a re-refining fate (called reuse in the exemption)¹⁵. By this definition, except where the certificate system is used incorrectly, tracking data should only contain movements of used oil going to non-reuse fates, such as storage and chemical/ physical treatment. Technically, NSW tracking fates do not include reuse as a category, but include recycling, which appears to have been applied to those records that go to re-refining. Detailed analysis of tracking data confirms that 87% of the 29,102 tonnes goes to non-recycling fates. This supports the notion that NSW oils arisings, and in particular, those destined for reuse are largely uncaptured in tracking data, as should be the case.

Data supplied by NSW EPA for Basel reporting in 2012 shows a much different picture: 137Kt (rather than 29Kt). This is likely to be due to the NSW EPA using supplementary data sources to produce this figure. It is noted that the exemption itself requires transporters and treaters to keep detailed individual records of all waste movements that are exempt from the certificate system.

The evidence suggests that NSW J100 data provided in trend analysis under-reports waste oils, possibly by as much as 100kt.

Victoria

Victoria also has a regulatory requirement for used oils (or specifically oil filters, which contain around 30% by weight of oil) that bans them from landfill, and requires their recycling (although the regulatory term used is 'reuse classification'¹⁶). This guideline indicates that transporters can be exempt from use of waste transport certificates.

Like NSW, Victorian tracking data is very low for used oil when compared to Queensland and WA. It is feasible, or even likely, that the waste oil, in many cases having come from used oil filters, is being transported under a transport certificate exemption and therefore not identified by the tracking system. Previous work by the author also identified this suspicion¹⁷.

Exemptions are common in Victoria for Accredited Agents, the name given to licensed transporters who use a 'milk run' style approach to large numbers of small (same waste) pick-ups, such as occurs with motor repair shop used oils/ filters.

Fate

Waste mineral oils can be reclaimed or recovered and recycled for other uses. Waste oils are usually either reused or recycled (re-refined) but may also be used as fuel (deemed by this project to be recycling), composted or sent to some other form of biodegradation. The data for the three states that record it indicates fates split across chemical/ physical treatment (38%), recycling (27%) and storage/

¹⁵ See <http://www.epa.nsw.gov.au/wasteregulation/hydrocarbon-oil.htm>

¹⁶ See <http://www.epa.vic.gov.au/~media/Publications/IWRG423.pdf>

¹⁷ KMH Environmental (2013), for the Department of the Environment. Hazardous Waste Data Summary, accessed on 29 May 2015 from: <http://www.environment.gov.au/protection/national-waste-policy/publications/hazardous-waste-data-assessment>

accumulation (28%), for the broader waste group of J. For the purposes of J100 oils alone, re-refining is likely to be described by both chemical/ physical treatment and recycling. This means that for the purposes of waste oils, recycling (as re-refining) is likely to count for at least 65% (38% + 27%) of the waste's fate, and given that storage can be for later release to re-refining, it may be closer to 75%.

Summary

Quantities of J100 oils reported from all jurisdictions for 2012-13, sourced from tracking data where that is available, totals 245,219 tonnes. The Department of the Environment's independent review of the *Product Stewardship (Oil) Act 2000*, commissioned and prepared by Professor Neil Byron of Aither¹⁸, estimates the total volume of oil collected under the Product Stewardship for Oil Scheme in 2011-12 to be 315,000 tonnes (assuming a simplistic conversion factor of 1 litre = 1 kg). Assuming as much as 75% of all waste oil might go to re-refining, Byron's estimate gives an estimated national arising of J100 of 420,000 tonnes.

Subtracting the national total reported from tracking estimates leaves a gap of 175Kt which, if spread evenly between the two likely low reporting states (and added to their tracking numbers) gives revised estimates of:

- NSW J100 (2012-13) ~ 116Kt (compared to 29,102 tonnes from tracking data)
- VIC J100 (2012-13) ~ 108Kt (compared to 20,832 tonnes from tracking data).

By these estimates the national figure for J100 would become approximately 420,000 tonnes, which is approximately 175,000 tonnes below what tracking data indicates.

It is noted that the 2012-13 tonnages presented in Section 3 of this report is based on a July-Dec 2012 block previously collected from Victorian and NSW EPA's and the Jan-Jun 2013 block assembled by this project team from State-supplied tracking data. The data shows the July-Dec 2012 block from EPA NSW to be much higher (40,343 tonnes compared to 15,184 tonnes for Jan-Jun 2013), which supports the assertion that NSW supported tracking data with other data in providing their portion of the estimate.

4.13 K100. Animal effluent and residues (+ food processing waste)

This waste group is represents the NEPM code *K100 Animal effluent and residues (abattoir effluent, poultry and fish processing wastes)*, plus the wastes unique to Queensland *regulated waste: Liquid food processing waste* and Victoria: *Food and beverage processing wastes, including animal and vegetable oils and derivatives*, both so-called K200. 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.

It is notable that neither NSW nor SA track this waste group.

¹⁸ 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>

Sources

Summary source analysis*

Vic	Qld, WA	National summary
<ul style="list-style-type: none"> Food product manufacturing (meat, poultry and dairy processing) waste sector 	<ul style="list-style-type: none"> Food product manufacturing (meat, poultry and dairy processing) Fruit and vegetable processing (Qld only) waste sector 	<ul style="list-style-type: none"> Food product manufacturing (meat, poultry and dairy processing) waste sector

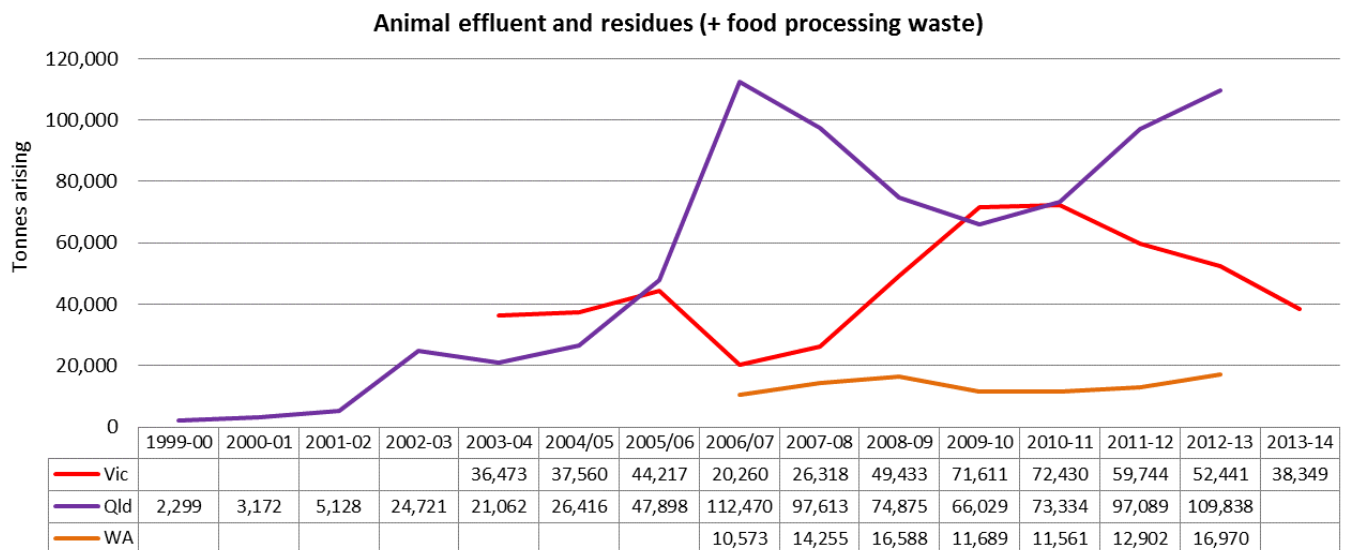
* waste not tracked in NSW or SA

Analysis

This waste group is a significant proportion of all hazardous waste nationally, at over 5%, if population-based estimates are provided for the non-tracking jurisdictions, as has been done in 2012-13 data. This correction was not applied in the ACT, where a significant animal processing industry could not be identified. However, from a hazard perspective, it is likely to pose one of the lowest risks.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure overleaf. Long-term trends in Queensland and Victoria are increasing, although they vary quite wildly. Victoria's waste has reduced quite dramatically since its highs around 2009 to 2011.

Figure 22: Historical arisings of animal effluent and residues (+ food processing waste)



Fate

Sixty-two percent of this waste group is identified in tracking records as going to a 'recycling' fate, with the next highest categories being biodegradation and storage. This waste group highlights the inconsistency in what jurisdictions describe as fate categories, what they mean and how the categories themselves are not sufficiently unique.

In Queensland, almost all of the K100 recycled tonnes are allocated to a heading called 'R3 Recycling/reclamation of organic waste materials which are not used as solvents'. D and R codes, as they

are known, descend from a list in Annex IV of the Basel Convention, used for in Basel export/ import permits. The use of R3 in this case does not make sense – the ‘organic waste’ envisaged by Basel refers to organic chemical waste, such as benzene or any of the Controlled Waste NEPM’s ‘M’ code wastes. Queensland data in this instance has taken the more populist use of ‘organic’ to mean that they are derived from living matter and putrescible (subject to putrefaction or biological decay). This is clearly incorrect, since animal effluent is unlikely to be ‘reclaimed’ and could never be remotely considered to be used as a solvent! Victoria also has a significant proportion of this waste incorrectly recorded as R3.

However, in a strict D and R code context, composting (which would be one of the fates relevant to this waste) does not have a logical R code. ‘R10 Land treatment resulting in benefit to agriculture or ecological improvement’ is likely to best describe biodegradation (on land) which is also certainly occurring.

What is actually occurring for this waste is unclear from the tracking data. But, biodegradative type fates are most likely to prevail; 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, potentially after composting.

4.14 K110. Grease trap waste

K110 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.

Sources

Summary source analysis

National summary

- Food product manufacturing
- Cafes and restaurants
- Supermarkets and grocery stores
- Waste sector (as collectors and aggregators from cafes and restaurants)

Like other K wastes, grease trap is not tracked in NSW or SA.

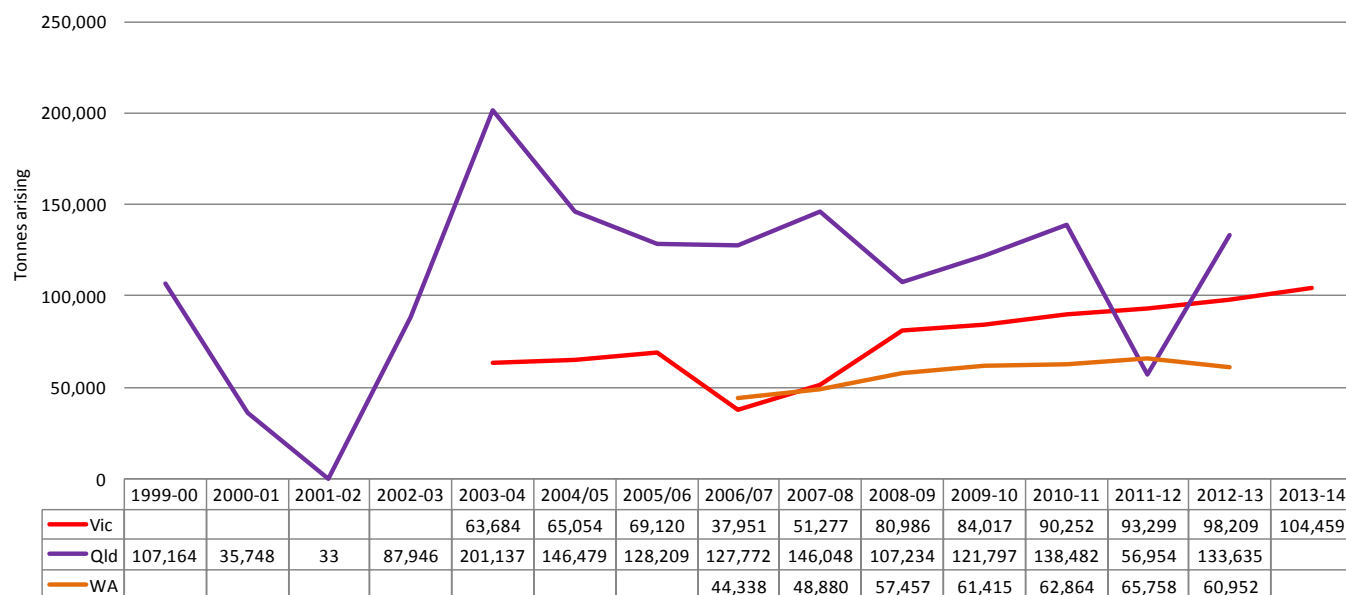
Analysis

This waste group is a significant proportion of all hazardous waste nationally, approximately 10%, if population-based estimates are provided for the non-tracking jurisdictions, as has been done in 2012-13 data. However, from a hazard perspective, it is likely to pose one of the risks at the lower end of the scale. Impacts could include odour and environmental impacts similar to the more viscous and solid petroleum fractions, such as waste mineral oils and waste tarry residues. Primarily, though, large amounts of oil and grease create congealment on the surface of tanks and clog pipes, due to their insolubility in water, as well as hampering effective treatment at wastewater treatment plants. These indirect potential ‘environmental’ impacts, in a related vein to tyres, are the reason some jurisdictions do not view them as ‘hazardous’ waste.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below. Long-term trends in Queensland are declining and in Victoria and WA steadily

increasing. Victoria has a regulatory 'classification for reuse' in place¹⁹ which essentially requires grease trap not to be mixed with other similar wastes to ensure recycling and reuse outcomes, which are mandatory.

Figure 23: Historical arisings of grease trap waste



Fate

Fate data for grease trap waste is only available for Victoria and Queensland. In Victoria recycling is listed as the primary fate, while in Queensland chemical/ physical treatment is the highest, followed closely by recycling. Overall the numbers point to recycling as the predominant fate.

It is likely that assignment of this waste to chemical/ physical treatment is an example of the lack of clarity defining the waste fates applied in tracking data. *The Hazardous waste infrastructure needs and capacity assessment* report defines chemical/ physical treatment as 'processes can include all chemical treatments (e.g. oxidation, reduction, precipitation, neutralisation, etc.) and physical treatments (e.g. sedimentation, filtration, adsorption, immobilisation, etc.).' It is likely that chemical/ physical treatment in the context of grease trap involves separation and clarification techniques at the lower end of the physical treatment scale, and if its outputs are used for further value then it could arguably be defined as recycling.

4.15 K140 & 190. Tannery and wool scouring wastes

Tannery and wool scouring data is withheld due to commercial confidentiality concerns.

4.16 Other M. Other organic chemicals

This waste group includes the broad catch-all of:

- M100 waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated naphthalenes, polychlorinated terphenyls and/or polybrominated biphenyls
- M150 phenols, phenol compounds including chlorophenols

¹⁹ See <http://www.epa.vic.gov.au/~media/Publications/IWRG421.pdf>

- M160 organohalogen compounds
- M160 & M170 polychlorinated dibenzo-furan and polychlorinated dibenzo-p-dioxin, respectively
- M210 cyanides (organic)
- M220 isocyanate compounds
- M230 triethylamine catalysts for setting foundry sands
- M250 surface active agents (surfactants) containing principally organic constituents
- M260 highly odorous organic chemicals (including mercaptans and acrylates).

Sources

Summary source analysis

Vic	SA	Qld, NSW and WA	National summary
<ul style="list-style-type: none"> • Airline industry • Chemical manufacturing • Oil and gas extraction • Various other manufacturing • Electricity supply 	<ul style="list-style-type: none"> • Iron and steel casting 	<ul style="list-style-type: none"> • Airline industry • Chemical manufacturing • Soap and detergent manufacturing • Electricity supply 	<ul style="list-style-type: none"> • Airline industry • Iron and steel casting • Chemical manufacturing • Soap and detergent manufacturing • Various other manufacturing • Electricity supply

Major sources include the airline industry (surfactants), iron and steel casting (triethylamine catalysts), chemical manufacturing (surfactants), electricity supply (PCBs, typically in oils) and a wide range of manufacturing sources for wastes broadly across the group.

Analysis

The 'Other organic chemicals' group collectively make up around 0.4% of the national hazardous waste arising total, and are generated mainly in NSW (52%). Surfactants are the largest national contributor (0.15%), followed by PCBs and triethylamine catalysts at 0.07% each. Surfactants are around 80% of NSW's arisings, with the other 20% coming from PCBs. South Australia contributes almost all of the triethylamine catalyst waste and PCB wastes are shared quite evenly between NSW and Queensland, with Victoria's PCB arisings only about a tenth of either NSW or Queensland's arisings.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure overleaf.

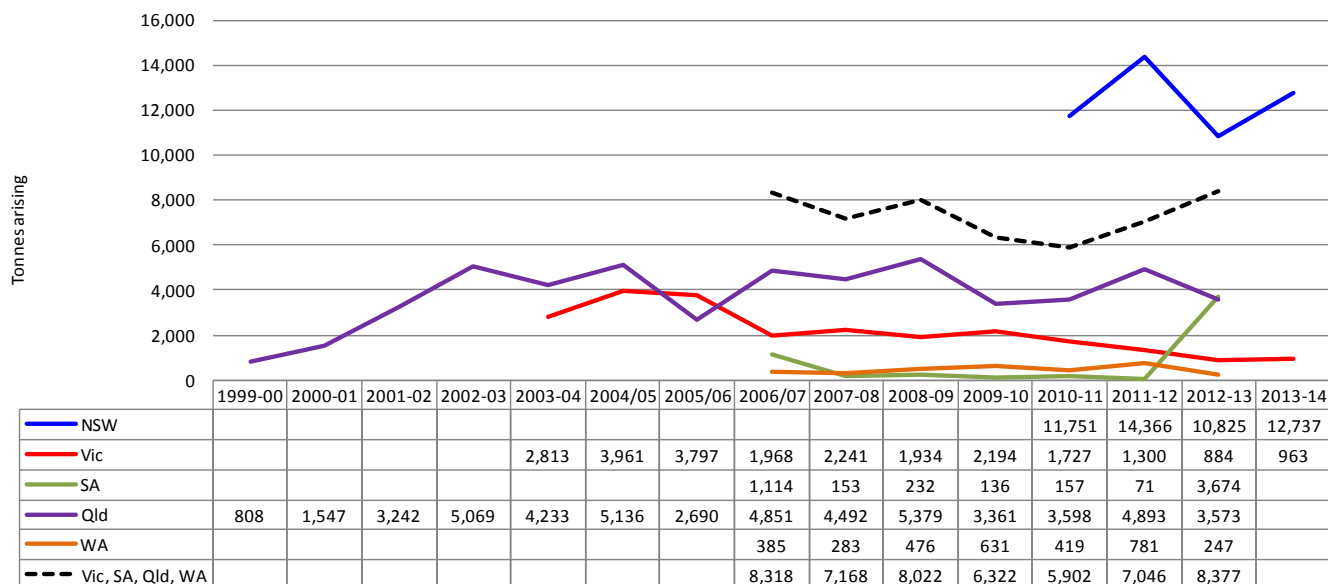
While it is difficult to read too much into the graph, because of the variety of wastes in the group, there is a relatively stable trend for long term arisings. South Australia appears to have had some kind of storage release or other change in arisings behaviour of triethylamine catalyst in 2012-13. Victoria's long-term trend appears to be slow decline, which may reflect significant work in the 1990s and 2000s on removing PCBs from electricity supply infrastructure, plus other work reducing waste from foundry (castings) industries.

Fate

Fate for the waste group is reported as 75% chemical/ physical treatment. For PCBs, which are destroyed almost exclusively by thermal decomposition processes such as plasma arc, this seems out of step. This would appear to be a reflection of the fate types available in the data. While similar to

incineration, PCB destruction facilities are not well captured in the headings available so allocation to chemical/ physical treatment seems to have occurred.

Figure 24: Historical arisings of other organic chemicals waste



4.17 N120. Contaminated soils

This group comprises *N120 Soils contaminated with a controlled waste*. NSW and Queensland do not specifically track contaminated soils, but both were able to report data from landfill records. Queensland is unique in Australia in including acid sulphate soils in this category. These have their own characteristics and particular management problems.

Sources

Summary source analysis

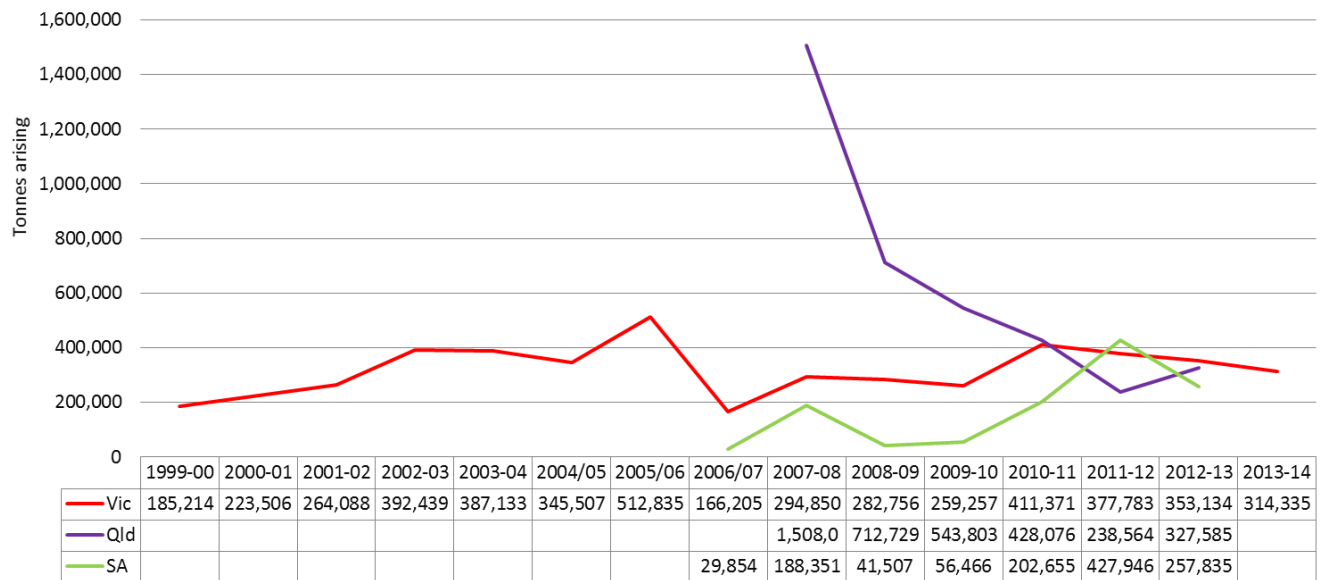
Vic	SA	Qld, NSW and WA	National summary
<ul style="list-style-type: none"> Construction Property development Retail trade Electricity supply Mining 	<ul style="list-style-type: none"> Construction Cement and lime manufacturing 	<ul style="list-style-type: none"> Construction Property development Retail trade Electricity supply Mining 	<ul style="list-style-type: none"> Construction Property development Retail trade Electricity supply Mining

Analysis

Contaminated soils are the largest hazardous waste in national data, making up 26% of the tonnages in 2012-13. NSW is the highest contributor of arisings at 37%, followed by Victoria at 25% and Queensland at 20%. Two other states' data appear unusual – SA is surprisingly high at 17% and WA appears low at only 0.2%, but the latter can be explained due to the regulatory differences outlined on page 58.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below.

Figure 25: Historical arisings of contaminated soils waste



Contaminated soils are a result of construction and development (including demolition) activities that require the excavation of contaminated material. The level of contamination is an historical legacy issue, whereas the quantity produced in any given year fluctuates with the level of development activity in contaminant-prone geographical areas. They are a special case in the assessment of hazardous waste data.

With the exception of asbestos, the drivers for contaminated soil arisings are quite different from virtually all other hazardous waste categories. Other wastes are more directly related to consumption patterns, and therefore reflect current rather than historical activity. Contaminated soil quantities are large and can vary widely from year to year. Caution needs to be exercised in interpreting such data to avoid misleading messages about trends and broader waste producer behaviours.

Trend data analysis, in light of these influences, is difficult to decipher. Victoria's is the only reliable long-term dataset, and has remained relatively consistent over 15 years. Only South Australia also tracks contaminated soils – the remaining jurisdictions have no tracking system or do not track this material.

Queensland data is impossible to decipher without more information. The very large volumes of 2007-08 and 2008-09 may be influenced by large quantities of acid sulfate soils from coastal development activity. Whatever the reason, 2007-08 is an example of wild variation, since 1.5M tonnes is more than the respective national annual totals in 2011-12 and 2012-13, which are inclusive of Queensland and NSW landfill data estimates.

South Australia has had rises and falls typical of the fluctuating influences mentioned above. The 2011-12 tonnage for example (and perhaps the years either side of it) is probably heavily influenced by two major projects in Adelaide – the redevelopment of Adelaide Oval and, more significantly, the new Royal Adelaide Hospital construction on railyards at the west end of Adelaide.

WA's low arising in 2012-13 (3,483 tonnes) can be attributed to the fact that only highly contaminated soil that does not meet the contaminant thresholds for acceptance at Class I (inert), Class II (putrescible) or Class III (putrescible) landfills is considered controlled waste and tracked. Contaminated soil suitable for Class I, II or III landfill is not tracked or included in the data provided for Basel reporting.

Considering it is Australia's highest generated hazardous waste, oversight of contaminated soil data is surprisingly inconsistent and consequently poorly understood.

Fate

Landfill is the dominant fate recorded for contaminated soil throughout Australia, at 89%. The remaining 11% is mostly listed as storage. While the dominance of landfill is not surprising, it would appear that soil remediation facilities do not feature in the data. There are probably two reasons for this:

1. Some remediation technologies are mobile enough to be installed onsite. This means that most of the post-treatment material can be re-emplaced resulting in minimal soil hitting the tracking system.
2. Contaminated soil is made up of a wide variety of contamination levels. Victoria is the only state that distinguishes the soil's level of contamination in tracking data, through the use of a 3-tier hazard classification system. Long-term Victorian data shows that the high and medium level contaminated soil – which is the component of the waste group that would require remediation/ treatment - is typically only 8% of all soils by weight. The massive volume of low level contaminated soil, which goes to landfill, therefore obscures the quantities with remediation fates; fates that under the current clumsy jurisdictional fate categories could be either biodegradation, chemical/ physical treatment or even recycling.

4.18 N205b. Other industrial treatment residues

This category covers the single NEPM code *N205 Residues from industrial waste treatment/disposal operations*. For this project we rebadge this material as *N205b. Other industrial treatment residues* to distinguish it from biosolids, which are not typically reported in jurisdictional tracking systems, and which we characterise as N205a. The way biosolids are considered in this current tranche of projects is described in Section 2.2. Biosolids are only considered hazardous waste in annual data reported to Basel, as a precautionary approach, and coded to N205. In other parts of the project team's current work, only the estimated contaminated portion of biosolids are considered in a hazardous waste context and, to allow separate consideration to other industrial treatment residues. Consequently there is a split in this code:

- N205a: Contaminated biosolids
- N205b: Other industrial treatment residues.

This NEPM group considers N205b, industrial treatment residues, not including any form of biosolids.

Sources

Summary source analysis

Vic	SA	Qld, NSW and WA	National summary
<ul style="list-style-type: none"> • Waste treatment and disposal services • Organic chemical manufacturing • Other manufacturing 	<ul style="list-style-type: none"> • Waste collection, treatment, disposal and remediation services 	<ul style="list-style-type: none"> • Waste treatment and disposal services • Electricity supply • Wastewater treatment plants • Oil and gas extraction (CSG) • Aluminium smelting • Mining • Steel manufacturing • Petroleum refining • Other manufacturing 	<ul style="list-style-type: none"> • Waste treatment and disposal services • Electricity supply • Wastewater treatment plants • Oil and gas extraction (CSG)

Sources of industrial treatment residues in Victoria and South Australia are mostly the waste sector. Queensland data is by far the largest contributor to national arisings with 63% of industrial treatment residues in 2012-13. One-third of Queensland residues appear to be solid residues from the waste industry, one-third again are solid residues from power generation and a further 15% are liquid wastes from Council operations, whether wastewater treatment or landfill is unclear but it is probable that most of it is from the former.

Analysis

This is a significant waste group that makes up almost 6% of all hazardous wastes nationally. It is catch-all in nature, and seems to include a variety of industrial residues. Victorian data identifies the waste form as 'liquid' but the category type as 'solids requiring special handling', which is a little confusing. Queensland's waste, the majority tracked nationally, can be summarised as:

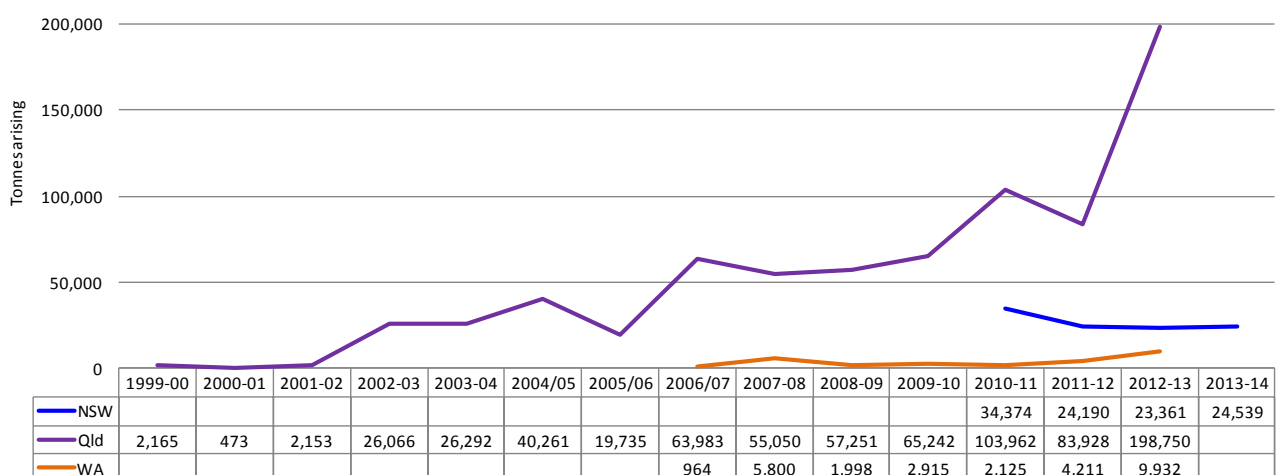
- 34% waste industry solid residues going to landfill
- 33% power generation solid residues going to composting
- 16% Council facility liquid wastes (probably sewage sludge) going to composting
- approximately 10% CSG extraction waste (solid, liquid, sludge) going to storage or landfill
- the rest: various industrial sources.

It would appear that 16% of Queensland's waste is miscoded sewage sludge (Queensland uses a non-NEPM code K130 for this purpose), which creates a small double-counting issue considering that biosolids, the processed version of sewage sludge, is separated out of this dataset (as N205a).

Historical trends in arisings for this waste group, for those states with tracking data, are shown below.

Queensland's 2012-13 arisings are 86% of those shown in the graph, since SA and Victorian data have not been charted due to questions about data reliability. Queensland has clearly spiked dramatically in 2012-13. A single reason for this is not obvious, but miscoded CSG waste (that should be D300) and miscoded K130 sewage sludge may be contributing factors. Perhaps the most significant reason is due to rapid growth in biomass power generation in Queensland, where ash is beneficially reused in composting.²⁰

Figure 26: Historical arisings of other industrial treatment residues



²⁰ WME magazine: http://www.wme.com.au/categories/energy/aug6_07.php

Fate

Fate data for Queensland, NSW and Victoria shows that 40% of this waste goes to chemical physical treatment, 33% to landfill and 13% to recycling. These figures appear to overstate the chemical physical treatment component, which occurs almost exclusively in Victoria and is the main fate in NSW and is apparently 34% in Queensland.

Closer inspection of Queensland tracking data shows a significant number of records that capture biomass power generation ash going to a fate called 'blending or mixing prior to submission to any of the operations in Section A' (Section A is exclusively disposal activities, not recycling or reuse), which is mapped to chemical/ physical treatment. A recent WME article¹³ quotes the General Manager of the facility as saying that "ash is on-sold to one of the mulching people as it's filled with minerals and sterile." This confirms that the treatment type chosen in the tracking system is incorrect, although it is understandable that it was chosen – blending of the ash occurring – but rather than continuing to a disposal fate it is being recycled into a mulch product. Probably the correct category would be 'R11 Uses of residual materials obtained from any of the operations numbered R1-R10', which would map to recycling as the broad fate category. The core issue though, as with other wastes, is the lack of clarity of the fate categories available to tracking system users to choose.

4.19 N220. Asbestos

This waste group captures the single NEPM code of *N220 Asbestos*. Asbestos is the name given to a group of naturally occurring minerals found in rock formations. 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.

Sources

Summary source analysis

National summary

- Construction and demolition (including asbestos removal services)
- Property development
- Hospitals
- Schools
- Defence
- Numerous sectors involved in asbestos removal from their buildings

Jurisdictional tracking systems do not currently differentiate between asbestos-containing building materials asbestos-contaminated soils. Sources of asbestos are construction/ demolition related as well

as any residential, commercial or industrial buildings that are involved in removal of asbestos containing material.

Analysis

Asbestos is a large contributor to national hazardous waste volumes, making up almost 12%. Asbestos is only tracked in Victoria, Queensland and South Australia, but NSW supplied landfill acceptance data as an alternative data source in 2012-13. Asbestos estimates for ACT, NT and Tasmania were done on a per-capita basis by the project team assuming that generation correlates with population.

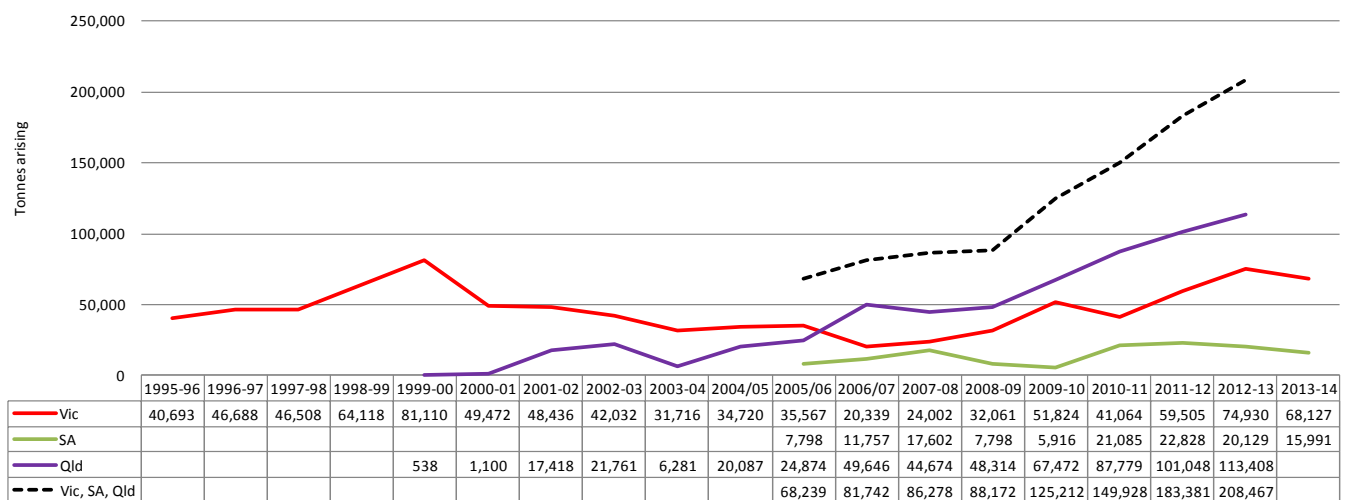
NSW has the highest arisings of asbestos with 57% of national volumes, followed by Queensland with 18% and Victoria with 12%.

Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure overleaf.

Fate

Asbestos waste is disposed of at landfills licensed by environmental regulators to receive asbestos waste. This is reflected in Victorian and Queensland data, with 95% of tracked waste going to landfill and the remainder stored.

Figure 27: Historical arisings of asbestos waste



Asbestos arisings have shown a consistent increasing trend in Queensland and Victoria over the last decade. There is no evidence to suggest the supply of waste asbestos is peaking or slowing and the average 60-year lifespan of buildings suggest increasing quantities in coming years. Combined Victoria, SA and Queensland data between 2005-06 and 2012-13 is consistent with average 17% annual increase.

4.20 Other N. Other soil/sludges

This waste group collects those remaining N group codes including:

- *N100 containers & drums contaminated with residues of substances referred to in the NEPM 15 list*
- *N140 fire debris and fire wash waters*
- *N150 fly ash, excluding fly ash generated from Australian coal fired power stations*

- N160 encapsulated, chemically-fixed, solidified or polymerised wastes in the NEPM 15 list
- N190 filter cake contaminated with residues of substances referred to in the NEPM 15 list
- N230 ceramic-based fibres with physico-chemical characteristics similar to those of asbestos.

Sources

Summary source analysis

Vic	SA	Qld, NSW, WA	National summary
<ul style="list-style-type: none"> • Waste industry • Chemical product manufacturing • Paper & paper product manufacturing • Machinery and equipment manufacturing 	<ul style="list-style-type: none"> • Waste industry • Motor vehicle manufacturing 	<ul style="list-style-type: none"> • Waste industry • Chemical product manufacturing • Metals manufacturing • Petroleum refining • Paper & paper product manufacturing • Hospitals & nursing • Meat industry • Water supply & sewerage 	<ul style="list-style-type: none"> • Waste industry • Chemical product manufacturing • Metals manufacturing • Petroleum refining • Paper & paper product manufacturing

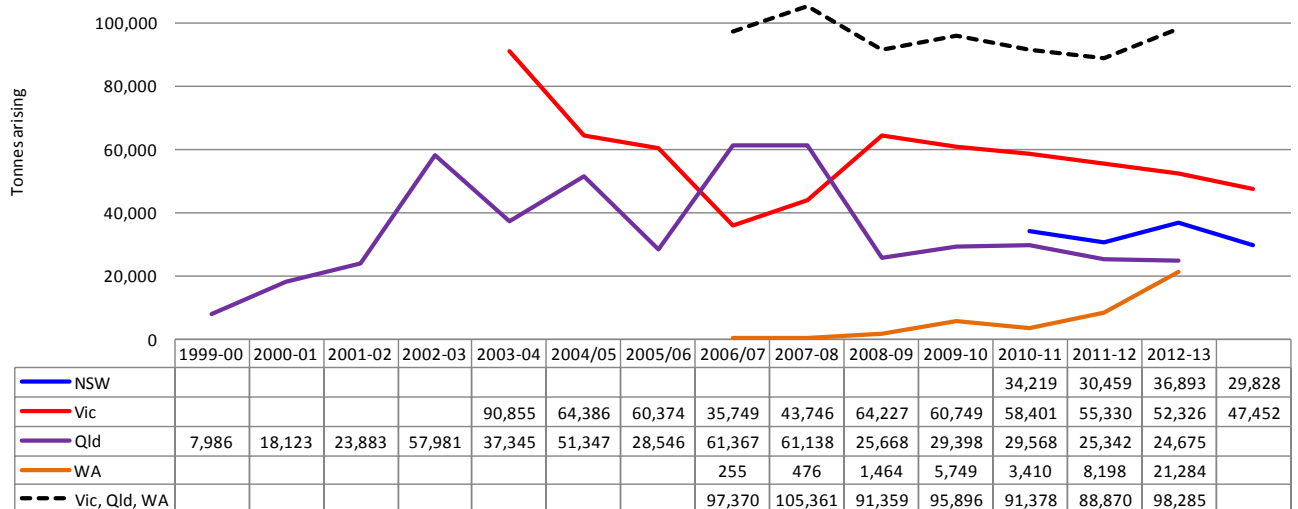
N160 Encapsulated waste is waste that has been treated to reduce its hazard by various chemical/physical treatment facilities in the waste industry. Chemical product and related manufacturing and petroleum refining contribute to drums arisings (N100) and N190 filter cake is a waste from a variety of industrial processes, including chemical product manufacturing, metals manufacturing, paper and paper product manufacturing and machinery and equipment manufacturing.

Analysis

On a national basis, N160 encapsulated waste is the primary contributor of arisings, followed by N100 containers and drums, then N190 filter cake, with the remainder in much lower proportions. The whole group makes a moderate contribution to national figures at 2.1% combined.

Historical trends in arisings for this waste group, for those states with tracking data, are shown below.

Figure 28: Historical arisings of other soil/sludge waste



The main trend evident is in WA data which has increased quite dramatically from about 2007-08 onwards. While we do not have enough information to determine the cause of this, it may be due to a regulatory change around requirements for immobilisation or other forms of treatment, prior to acceptance at landfill.

Victoria shows a steady declining trend over the last five years, which may have its driver in the economics of a rising hazardous waste levy, since immobilisation and encapsulation is a requirement for the highest level of hazardous waste, before it can be accepted at landfill.

Fate

The dominant fate in 2012-13 tracking data for this whole waste group is landfill (63%), which, for N160 waste, logically follows on as the fate subsequent to treatment to ameliorate hazard. The other fates of recycling and chemical/ physical treatment are represented at about 20% in total, and reflect fates more in line with containers and filter cake respectively.

4.21 R. Clinical and pharmaceutical

This waste group is made up of:

- *R100 Clinical and related wastes*
- *R120 Waste pharmaceuticals, drugs and medicines*
- *R140 Waste from the production and preparation of pharmaceutical products.*

Clinical and related wastes are wastes 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.

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.

Lastly, waste from the production and preparation of pharmaceutical products is similar to R120, the key difference is the setting that it is generated – 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.

Sources

National summary

- Hospitals, health care centres and clinics
- Nursing homes and aged care facilities
- Dentists
- Pharmacies

Analysis

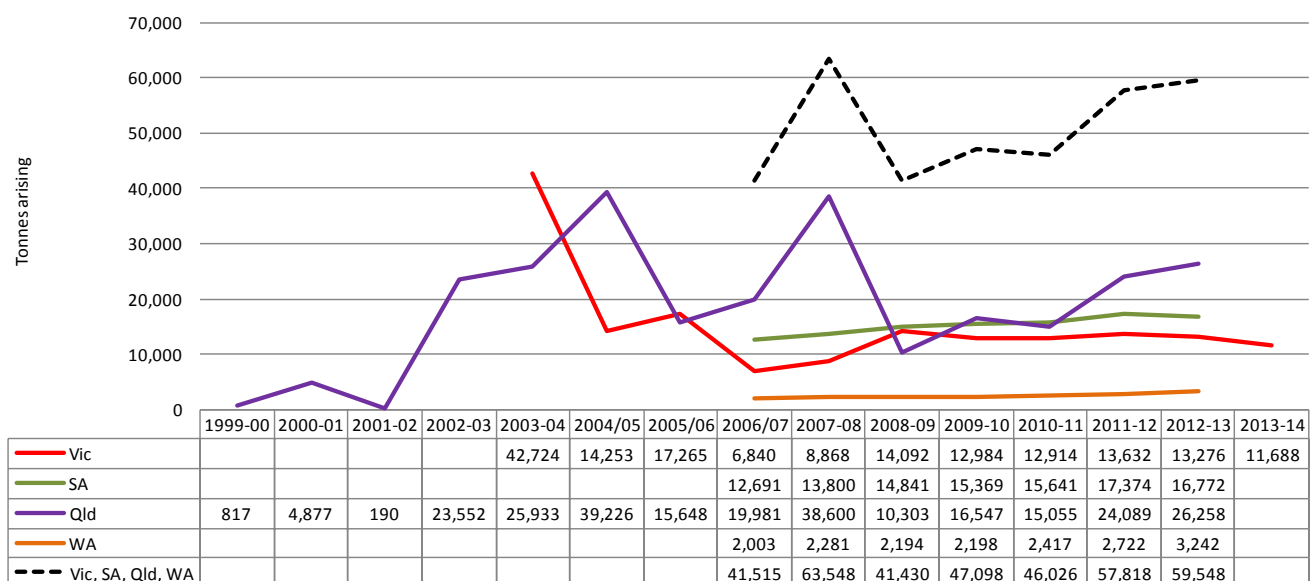
NSW does not track any of the R group wastes. National data reported to Basel for 2013 and for the purposes of 2012-13 arisings in this report, includes estimates of NSW risings derived from per capita comparison with other jurisdictional arisings.

The R Clinical and pharmaceutical waste group made up 1.4% of Australia's hazardous waste in 2012-13, with R100 clinical and related waste making up most of it. Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure below.

There is a general slowly increasing trend evident for most jurisdictions over the last five years, presumably as hospital bed days grow. Historical arisings for both Victoria and WA are lower than their respective populations would indicate. For Victoria this may have been achieved through the results of better hospital waste management planning and waste segregation in the last decade or so – one of the drivers may have been the increasing hazardous waste levy and the high costs of incineration, which is required in Victoria for some clinical waste streams, such as cytotoxics, human tissue and body parts and pharmaceutical waste.

WA tonnages are particularly low in comparison to SA, for example. Since both states provide limited detail in their data the reason for this is unknown.

Figure 29: Historical arisings of clinical and pharmaceutical waste



Fate

For this type of waste the following treatment techniques are routinely carried out in Australia:

- Incineration
- Autoclaving and shredding
- Chemical disinfection and shredding.

Fate data gathered for 2012-13 indicates that 35% of this group is incinerated, 28% undergoes chemical/physical treatment, 18% is stored and, surprisingly, 18% is landfilled. Investigation of the tracking system data reveals that only 0.2% of this waste is landfilled in Victoria while 27% is landfilled in Queensland. Forensic examination of Queensland data reveals this to be mainly due to landfilling of already treated clinical waste, since the generator is a clinical waste treatment company, and small volumes of clinical waste landfilled in isolated community settings on Cape York and the Cook Shire, where alternative facilities probably do not exist. It is possible that these wastes may also have been treated prior to landfill anyway.

4.22 T140. Tyres

This group is the sole NEPM category *T140 Tyres*. 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.

Tyres are only tracked in Queensland and Western Australia and the recorded arisings indicate that they are significantly under-reported in tracking data, when compared with credible recent estimates of arisings produced by Hyder Consulting (2012)²¹. Consequently, in reporting to Basel and the 2012-13 dataset for this report, data from the Hyder report was used to estimate arisings.

Sources

Only Queensland provided source data for tyres. This data indicates the bulk of the waste are produced from tyre and motor vehicle retailing and motor vehicle servicing industries.

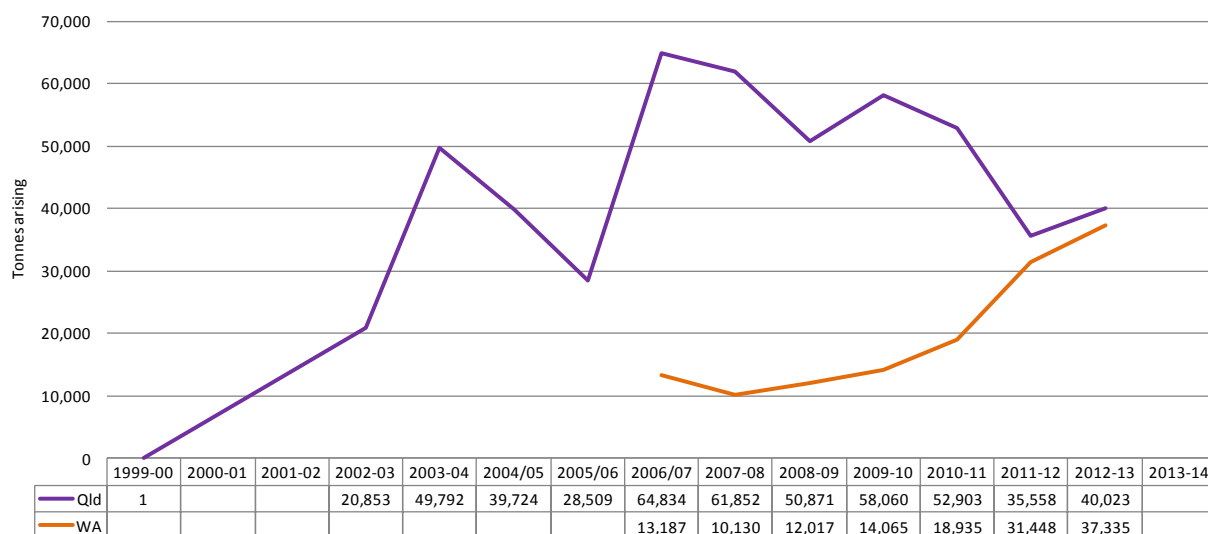
Analysis

Using Hyder Consulting data, tyres are a significant national waste, making up 7.8% of all hazardous wastes.

Since the bulk of jurisdictions do not track them, and the Controlled Waste NEPM does not include them, are tyres a hazardous waste? Tyres per se are not hazardous in the context of traditional human health and environmental impact measures. 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).

Using Queensland and WA data, historical trends in arisings for this waste group are shown in the Figure below. Both datasets exhibit a long-term growth trend, although Queensland's arisings show large peaks and troughs between years. This variability likely to be associated with stockpiling, and releases from such, which is common with tyres.

²¹ Table 2 of Hyder Consulting (2012) *Study into Domestic and International Fate of End-of-Life Tyres*, prepared for COAG, available from: <http://www.scew.gov.au/resource/study-domestic-and-international-fate-end-life-tyres-final-report>

Figure 30: Historical arisings of tyre waste

Fate

Only Queensland fate data exists for tyres, and this is only on tracked quantities, which are significantly lower than the Hyder figures used in national data compilation. This data shows that tyres are mostly recycled or stored, with a small proportion landfilled.

Permanent stockpiling and illegal dumping is a longstanding problem for this waste. These fates do not show up in tracking data. According to recent Victorian data²² the rate of tyre recycling in Australia remains relatively low – 20% of all tyres generated as waste - with 26% exported and 54% unaccounted for and presumed to be either stockpiled or illegally dumped.

In January 2015 The Australian Government announced the formation of Tyre Stewardship Australia (TSA) and the national Tyre Product Stewardship Scheme, to promote the increase in environmentally sustainable collection and recycling processes and to explore and promote new uses for recycled end-of-life tyres.

4.23 Other T. Other miscellaneous

This waste group includes:

- T100 waste chemicals from research and development or teaching activities
- T120 waste from the production & use of photographic chemicals and processing materials
- T200 waste of an explosive nature not subject to other legislation.

This waste group is a collection of relatively unrelated wastes that are produced in small quantities and are made up of mostly T100, with smaller quantities of T200 and T120.

²² EPA Victoria Storage of waste tyres – Regulatory impact statement (RIS) (2014). Publication number 1576.

Sources

Summary source analysis

Vic	SA	Qld, NSW, WA	National summary
<ul style="list-style-type: none"> Waste sector Printing Public administration & other education 	<ul style="list-style-type: none"> Variety of very small source industries 	<ul style="list-style-type: none"> Waste sector Public administration & other education Mining Explosives manufacturing Printing Water supply, sewerage & drainage services 	<ul style="list-style-type: none"> Waste sector Public administration & other education Mining Explosives manufacturing Printing Water supply, sewerage & drainage services

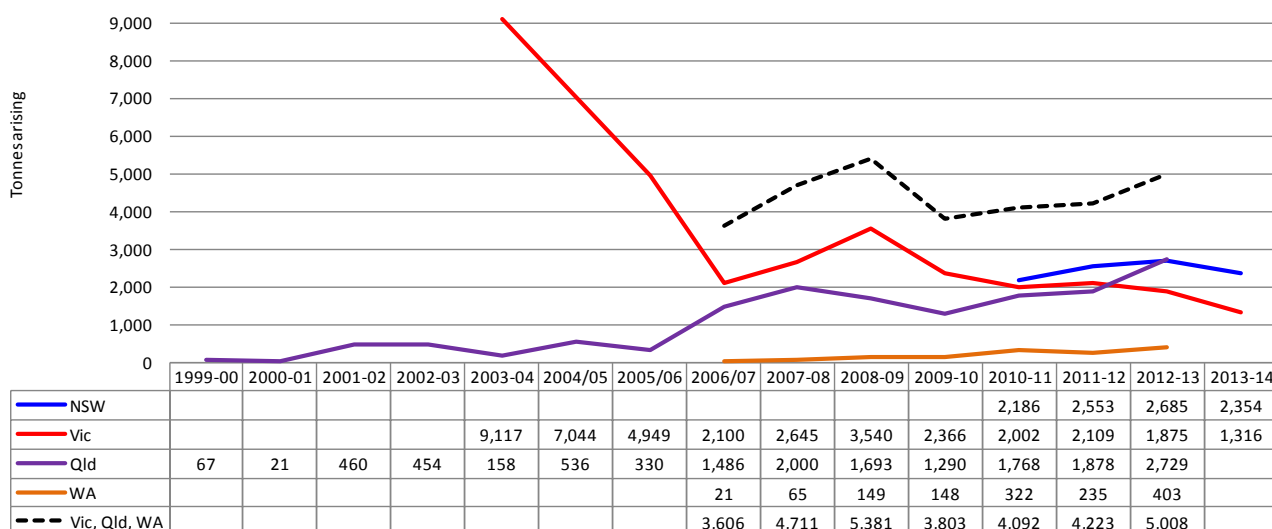
T100 waste is, as the name suggests, contributed by laboratories of teaching or research institutions, but is often a result of numerous mixed load small pick-ups by waste transporters, and recorded in tracking systems as coming from the waste sector. T120 is a specialty waste from the printing industry, but also includes x-ray photography activities such as dentists and other health practitioners, that would fit into the 'public administration' heading above. T200 is produced by the mining industry from the use of mine explosives, but also from manufacturers and suppliers of these explosives.

Analysis

Other T miscellaneous wastes make up 0.2% of all hazardous waste nationally. Historical trends in arisings for this waste group, for those states that record tracking data, are shown in the Figure overleaf.

The most striking trend of all is the steep fall in Victorian data from 2003-04 to 2006-07, then relative stabilisation thereafter. This drop tells the story of waste code T120 and how it was impacted with the rise of digital photography (resulting in the demise of photographic film processing). The approximate timing of 2003 to 2006 correlates with a press release in January 2006, noting Kodak's digital sales had overtaken film sales for the first time²³. Other notable trends are the steady rises in Queensland and WA, which reflect mining industry growth and their use of explosives (T200).

Figure 31: Historical arisings of other miscellaneous waste



²³ <http://www.dpreview.com/articles/6085531672/kodaksales>

Fate

The major fates for these wastes are chemical/ physical treatment and storage, with significant recycling in Victoria and Queensland, which may reflect wastes with recoverable constituents, such as silver in some photographic wastes.

5. Wastes of particular interest

A range of wastes are not neatly captured by waste tracking systems due to issues such as inconsistent classification, large-scale onsite or offsite storage (stockpiling), historical consideration outside of the hazardous waste framework or simply because the waste has only recently started to arise in significant quantities.

Changes in consumer products or technologies can lead to new wastes emerging – e-waste brominated flame retardants (POPs) are a good example; changing lighting technology (mercury filaments) or changing battery technologies are others. Or it could simply be the rise of new industries with inherent waste issues, such as the coal seam gas extraction industry. These can be problem wastes because mature waste treatment processes and infrastructure may not yet have developed to manage them appropriately.

Another type of problem waste is historically known but unresolved; maybe it is a problem that has long been difficult to deal with such as spent potlining waste or the Orica HCB stockpile. Such wastes that are stored onsite could be deemed 'missing' because they are absent from arisings reported via tracking systems or Basel reports.

This section discusses some of these wastes of particular interest and associated issues, as a complement to Section 4's assessment of those wastes better understood by waste regulators.

5.1 Emerging wastes

Coal seam gas 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. CSG in Queensland is usually liquefied to allow easier transport, such as by ship, which means it is also referred to as liquefied natural gas (LNG). The CSG industry is often placed within the ANZSIC category *Oil and gas extraction*.

The CSG extraction process produces a range of wastes, but in volume terms salt wastes are the most prevalent. These wastes are nominally captured in waste tracking systems as *D300 non-toxic salts*, described in Section 4.6.

Water is extracted as part of the CSG mining process because the gas – methane – is in the coal seam and held there at great pressure by water and other sediment layers. To release the gas, the water needs to be pumped out of this coal seam and up to the surface in a process known as 'dewatering'. The water that is pumped out as part of the CSG mining process is very salty and contains a range of petroleum and mineral based chemical compounds, such as heavy metals and hydrocarbons.

Once at the surface, the water is stored in ponds and treated by desalination to enable reuse, to the extent possible. However, this process leaves a salt brine or solid salt waste as a by-product. This salty waste stream may also include hydrocarbons and heavy metals as residual contaminants from the original CSG extraction process.

CSG wastes are interesting as an emerging waste because a) very large tonnages are involved and b) salty waters, brines or solid salts 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

risk of groundwater infiltration, especially given the volumes to be managed. Consequently, landfill design is critical for this form of management to be successful. The enormous volumes also mean that treatment to reduce the salt levels, such as reverse osmosis, are expensive and energy-intensive.

Because of these management difficulties, large quantities of CSG wastes are temporarily stored on site in brine ponds or other temporary structures offsite, awaiting a more definitive management fate. This storage aspect would appear to be borne out in the arisings numbers. Tracking systems indicate a current volume arising of this waste near 100,000 tonnes (i.e. what is being transported and tracked to an offsite pathway or fate). But industry and government estimates of water volumes extracted each year, multiplied by typical salinity of this water, yield a conservative estimate of approximately 21 million tonnes of salt over the next 30 years²⁴ – or (on a flat annual average) 700,000 tonnes per year of waste salt. Some of this volume discrepancy is due to temporary storage onsite, which is not reflected in tracking system data.

For this project and the accompanying projections developed in the *Hazardous Waste Infrastructure Needs and Capacity Assessment Project*, the tracking system figure of approximately 100,000 tonnes has been used. Tracking data alone suggests in the order of 20% annual growth in non-toxic salts recent years, which is also consistent with the accompanying project's projections.

Analysis of data for CSG waste is largely covered by the D300 non-toxic salts data analysis (Section 4.6) and the fate-specific data presentation in Section 3.4, which shows that the fate of this waste is spread between:

- recycling (41%)
- storage or transfer (34%)
- landfill (22%).

Outside of the tracking system, depending on the location of the mining activity, discharge to ocean of salty water is also likely to be a fate for this waste.

Projections of this waste over the next 20 years are provided in the *Hazardous Waste Infrastructure Needs and Capacity Assessment* report (as D300). These foresee annual growth under the 'best' (or most likely) scenario of 10%. On a treatment-difficulty and sheer scale basis, CSG waste is a current and future management problem.

Persistent organic pollutants (POPs) waste

This waste group is captured in tracking systems as *M160 Organo halogen compounds—other than substances referred to in this Table or Table 2*, but is not mentioned elsewhere in this report because only very limited quantities are recorded in tracking systems. While there may some current issues with inaccurate coding, current quantities are inconsequential compared to those possible in future.

Three 'new' potentially hazardous waste streams may emerge over the next five years should the Australian Government determine to ratify the recent listing of a number of new chemicals onto the Stockholm Convention on Persistent Organic Pollutants (POPs).

²⁴ Water Group Advice on EPBC Act Referrals, September 2010. Accessed 21 May 2015 from: https://drive.google.com/folderview?id=0B1FpO85tVgNrZjE0MWEyNjEtN2VmMC00ODAyLWE5YjAtMTRjYTtyZWJjODUz&usp=drive_web&ddrp=1#

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. There is general international agreement that they require global action to reduce their impact on humans and the environment. The new listings of relevance to this project are polybrominated diphenyl ethers (PBDEs, known as POP-BDEs), hexabromocyclododecane (HBCD) and perfluorooctanesulfonic acid (PFOS). Both the POP-BDEs and HBCD are brominated flame retardant chemicals, while PFOS has been used in various mist dispersal and surface coating applications, including (significantly) firefighting foams.

A fourth key waste belongs in this waste group, and while it is potentially 'emerging' in terms of tracked hazardous waste arisings and (more importantly) Australian fate infrastructure, it is actually a legacy problem waste. This is the hexachlorobenzene (HCB) waste stockpile at Orica's Port Botany facility in Sydney. No acceptable management solution – whether destruction or more appropriate storage – has been identified many decades since this material began accumulating in the 1960s.

The common property of this waste group 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 dioxins and furans (M170 and M180), PCB-like compounds (M100) and organochlorine pesticides (H100). The presence of the halogen species is usually the reason for the property of interest – and the reason for the toxicity.

Apart from the scientific consensus around their environmental impacts, POPs wastes are problematic for other reasons:

- They have been historically added at high (percentage) levels in products or 'articles' such as flame retardants in hard plastics and foams. At the end of their useful life, these articles are typically discarded to landfill, although there is substantial recycling of e-waste, which can contain these treated hard plastics. Such end-of-life articles are not currently treated or managed as hazardous waste, particularly since Australian ratification of the Stockholm listing of these chemicals is yet to occur.
- The ubiquitous nature of POPs means that they are not only present in waste articles, but can also present as waste from their broader use and dispersal, such as in landfill leachate, wastewater treatment plant discharge and, most importantly, in sewage sludge, which, after dewatering, is known as biosolids.
- Strong drivers exist for recycling end-of-life articles such as e-waste. However, if hazardous chemicals such as POPs are present in the recycled plastic commodity (recyclate) then the problem of exposure and dispersal is perpetuated through re-entrainment, albeit generally at lower concentrations than in the original product.

Projections of this waste over the next 20 years are provided in the *Hazardous Waste Infrastructure Needs and Capacity Assessment* report. Depending on scenario conditions, such as whether and when Australia ratify the latest Stockholm Convention listings and a raft of other uncertainties, the emergence of POPs waste could change the landscape of hazardous waste management in Australia.

Broadly speaking, the Stockholm Convention requires POP-containing wastes to be destroyed. From a fate perspective, ratification of the new Stockholm POPs could massively increase the demand on infrastructure capacity that already appears to be inadequate for the estimated current generation of polluted firewaters (a PFOS waste stream). It has been long understood that existing Australian infrastructure for halogenated chemical treatment is inadequate for dealing with the Orica HCB waste in technology, scale and cost.

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.

5.2 'Missing' wastes

At the jurisdictional level, hazardous waste management and classification is built around the risks associated with transport. In terms of tracking data, a material is not deemed to be a hazardous waste until it is loaded onto a truck for offsite treatment.

Although transport of a material typically increases the environmental and health risks, especially through inappropriate disposal, clearly the characteristics that cause a material to be hazardous exist regardless. Arguably, there are mechanisms to manage onsite risks posed by a hazardous material, but these relate primarily to workplace health and safety.

A substantial quantity of hazardous waste is generated and managed onsite in industrial settings that is unrecognised in government data. This section explores key examples of problem wastes that are 'missing' from tracking data and routine consideration by governments.

Spent potlining (SPL) waste

Spent potlining (SPL) is a waste material generated from aluminium smelters, of which there are five in Australia. Aluminium smelting is the extraction of aluminium metal from aluminium oxide (also known as alumina). The process takes place in electrolytic cells that are known as pots. The pots are made up of steel shells with two linings, an outer insulating or refractory lining (known as 'second cut' pot liner waste) and an inner carbon lining that acts as the cathode (known as 'first cut' pot liner waste). 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.

The toxic, corrosive and reactive nature of SPL means that particular care must be taken in its handling, transportation and storage. SPL has been recognised a major environmental concern for the industry for decades, but has recovery potential because of its fluoride and energy content.

First cut SPL is similar or slightly higher in fluoride content than second cut SPL but, because it mostly consists of carbon, it absorbs more heavy metals and other substances of concern, which have the potential to leach into the environment. While first cut SPL can be more of a waste management concern than second cut SPL (the USEPA focus more on first cut SPL), both cuts are typically classed as hazardous waste. Data analysed for this project does not distinguish between first and second cuts.

SPL waste is captured in tracking systems as *D110 Inorganic fluorine compounds excluding calcium fluoride*. It is not specifically analysed elsewhere in this report but rather included within the broad group *Other D (other inorganic chemicals)*, which includes many NEPM codes (see Section 4.7). The reason it was not isolated as a waste group is that historically, reported quantities of *D110 Inorganic fluorine compounds excluding calcium fluoride* (to tracking systems) have been sporadic and at low levels, not worthy of a waste group in their own right. This is because suitable treatment infrastructure in Australia is limited and, as a consequence, wastes have been stockpiled onsite or exported for recycling (in Spain or the UK), meaning they do not materially register on tracking systems.

Consultation with industry in the *Hazardous Waste Infrastructure Needs and Capacity Assessment* project indicates that the primary issue with this waste was the scale of the stockpile – industry estimates a stockpile of 900,000 tonnes of this hazardous waste, sufficient to more than half fill the Melbourne Cricket Ground.

Despite some exports and massive onsite storages, a steady stream of local recycling does occur. Alcoa's Australian website states that a significant and growing amount of SPL has been recycled at its Point Henry smelter near Geelong in Victoria:

*"In 2009, 7,449 tonnes of spent pot lining (SPL) were recycled. A by-product of the smelting process, SPL is made of carbon and refractory materials. We engaged a contractor to process SPL at our Point Henry operations to produce mineral products and a fuel that has reduced emissions for the cement industry. An extra 242 tonnes of SPL was recycled in 2009 compared with 2008, which was 1727 tonnes more than in 2007."*²⁵

This recycling quantity does not 'arise' in tracking system data since it is recycled onsite from onsite SPL stores.

Projections of 'Other D' waste group over the next 20 years are provided in the *Hazardous Waste Infrastructure Needs and Capacity Assessment* report. While the low and best scenario assume that stockpiling will continue, the 'high' scenario assumes local processing of the stockpiles commences in three years' time and takes 10 years to exhaust, creating a sustained 10 year spike in arisings.

The storage of large quantities of spent potlining from aluminium smelting should be a social concern, given the decline of this industry. The three current operators able to process this waste report sufficient capacity to process the stockpile over a 10-15 year period. A mismatch between demand and capacity could cause inappropriate treatment or demand for exports. A nationally coordinated negotiation with the industry would be advisable.

Fly ash

Fly ash is a residue generated from combustion comprising fine particles that 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 combustion of coal, the bulk of which arises in power stations. However, this is specifically excluded from the relevant NEPM hazardous waste classification *N150 fly ash, excluding fly ash generated from Australian coal fired power stations*.

Fly ash often contains hazardous materials such as heavy metals at low concentrations, but still typically at levels sufficient to classify it as a hazardous waste, 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.

Fly ash is identified through tracking data as having been produced quite consistently at a rate of 5,000 – 6,000 tonnes per year nationally over the last few years. Incineration, meat processing, cement kilns, coal-fired power stations (despite the waste classification name), non-coal power stations, asphalt plants, iron and steel manufacturing and petroleum refining are identified by this data as the main generating sources. In the context of this report and the broader hazardous waste infrastructure and data projects, N150 is aggregated into *Other N - Other soil/sludges* waste group, because its quantity based on tracking data alone is only 0.07% of national hazardous waste arisings.

²⁵ Alcoa website, accessed on 22/5/15 from: http://www.alcoa.com/australia/en/info_page/environs_waste.asp

However, the quantities of fly ash generated from coal-fired electricity generation in Australia are likely to dwarf this figure by more than three orders of magnitude. Industry estimates of fly ash generation from coal fired power stations in Australia is almost 11 million tonnes²⁶. This exceeds the total amount of all other hazardous waste arisings that make up the national total in this report (7.19 million tonnes), and is almost 10 times the quantity of contaminated soil.

The fate of fly ash is either storage in onsite storage ponds or landfills, offsite hazardous waste landfill, or reuse in concrete, structural fill or road base. The latter has high potential, since fly ash can be used as a partial replacement for the sand, limestone and cement content in concrete. By reducing the need for cement production (a highly energy-intensive process), the reuse of fly ash reduces greenhouse gas emissions. Fly ash also enhances the performance of concrete in regard to workability, shrinkage and durability. In 2013, more than half of Australian generated fly ash was used for a beneficial purpose²⁶.

Clearly, this is a very large quantity to be definitionally 'missing' from national estimates of hazardous waste. Also clearly, this material has both hazardous characteristics and resource-recovery benefits.

Red mud

Red mud is the fine-grained residue left after alumina has been extracted from aluminium containing ores (bauxite) in alumina (aluminium oxide) refining. It is the by-product of the Bayer process, the name of the industrial chemical process for refining bauxite into alumina via digestion with sodium hydroxide (caustic soda).

Bauxite residue material is often described as red mud due to the colour of the original bauxite ore and the iron oxide it contains. Red mud is highly alkaline in pH, salty, and contains heavy metals - sufficient to categorise it as a hazardous waste in most jurisdictional frameworks in Australia.

Red mud is a legacy waste to some extent, because of the very large volumes stored at Australia's six alumina refineries. Many of these stores have been in place for decades; Queensland Alumina's 1,000 hectare residual disposal area at Boyne Island has been in operation since 1967.

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 are typically 75-80% water in their 'wet' state, compared to sewage sludge which is approximately 97% water. Like fly ash, 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.

Biosolids are not a controlled waste under the NEPM and consequently are not tracked in all jurisdictions. However, 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. Other organic pollutants may also be present. Consequently and conservatively, biosolids have been included in Australia's annual hazardous waste reporting to the Basel Convention as a precaution. In the 2012 and 2013 Basel report, biosolids were included under the NEPM category *N205 Residues arising from industrial waste treatment/disposal operations*, along with other wastes that are reported to tracking systems under this category.

²⁶ Ash Development Association of Australia (2014) *Annual membership survey results 2013*, HBM Group Pty Ltd, Woolongong, available from: <http://www.adaa.asn.au/resource-utilisation/ccp-utilisation>

Table 12 separates out reported tonnages of total biosolids in Australia for each of the last three years, in the context of total reported arisings, to give an indication of their relative scale.

Table 12: Total biosolids produced in Australia over the last 3 years

	Time-series (reporting year)		
	2010-11	2011-12	2012-13
Total biosolids (t)	1,350,246*	1,350,246*	1,409,565
Total hazardous waste (including biosolids) (t)	5,941,663**	6,690,286	6,825,391
Biosolids as a percentage of total hazardous waste including biosolids (%)	23%	20%	21%

Source: Australia and New Zealand Biosolids Partnership website: <http://www.biosolids.com.au/bs-australia.php>

* Source data year for both 2010-11 and 2011-12 was the same (2010 biosolids survey)

** Interstate-transported waste (92,092 t) excluded from 2010-11 arisings to be consistent with 2011-12 & 2012-13

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 conservative to classify all biosolids as hazardous waste, it is logical that biosolids containing pollutants at concentrations exceeding the highest classification levels outlined in biosolids guidelines may be deemed to be hazardous waste. Soils or other wastes so contaminated would be regulated as hazardous. Consequently, the hazardous waste group 'contaminated biosolids' was created for this project, with arisings estimates modelled from national (total) biosolids tonnages.

Biosolids mostly fall outside of the tracking process, although some states appear to track movements of sewage sludge (the raw state of biosolids), presumably based on issues such as odour and pathogenicity. The lack of tracking means biosolids are often 'missing' from hazardous waste consideration – their inclusion for Basel reporting purposes is a recent development. They are not typically considered as hazardous waste, or even waste at all by some, but, like fly ash, they can contain contaminants such as heavy metals and even POPs, that would make them a hazardous waste based on NSW or Victorian waste contaminant classification/ categorisation concentrations.

While 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. This appears to be predominantly what occurs, although the authors were not able to obtain publicly available data to provide transparency to this evaluation process. The major exception to this was the two major Victorian treatment plant biosolids stockpiles (for Eastern and Western Treatment Plants respectively), which have excellent detailed analysis data in the public domain.

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.

6. Key messages

Section 4 provides analysis and commentary on individual waste groups. Most of these wastes tell a story, often one that is revealed only through forensic interrogation of the tracking system data. Examination of individual tracking certificates for 'other T' waste, for example, links the steep historical decline in the mid-2000s to the demise of photographic film (and therefore waste) in favour of digital photography.

The process of analysis of arisings, sources and fates for hazardous wastes generated in 2012-13, together with analysis of historical trend data and an evaluation of the status of some other wastes of that are not well-represented by tracking systems, has drawn out the following key messages.

6.1 Overall hazardous waste arisings appear to be increasing

National hazardous waste annual arisings datasets for the last three years, excluding biosolids, total the following respectively:

- 4,591,417 tonnes in 2010-11
- 5,340,040 tonnes in 2011-12
- 5,449,360 tonnes in 2012-13.

While there is fluctuation evident, overall arisings have increased by 19% over these three years.

6.2 New wastes with new challenges are emerging

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.

CSG wastes are interesting as an emerging waste because a) there are very large tonnages involved and b) salty waters, brines or solid salts are a difficult problem for the waste industry, which often relies on landfill. While they are present in significant quantities in arisings numbers, these are probably dwarfed by what is currently in storage, awaiting an acceptable fate option. The rapid growth in CSG wastes would appear to be evident in trend charts for Other D (Inorganic fluorine compounds), D300 (non-toxic salts) and N205b (industrial residues), particularly over the last five or so years.

Three 'new' potentially hazardous waste streams may emerge over the next five years should the Australian Government determine to ratify the recent listing of a number of new chemicals onto the Stockholm Convention on Persistent Organic Pollutants, and a fourth is a long-term legacy issue in Australia. Broadly speaking, the Stockholm Convention requires POP-containing wastes to be destroyed. From a fate perspective, ratification of the new Stockholm POPs could massively increase the demand on infrastructure capacity that already appears to be inadequate for the estimated current generation of polluted firewaters (a PFOS waste stream). It has been long understood that existing Australian infrastructure for halogenated chemical treatment is inadequate for dealing with the Orica HCB waste in technology, scale and cost.

6.3 Interstate waste movements appear to be absent from arisings data

Through the process of interrogation of tracking data, three examples of major arisings anomalies were uncovered in the New South Wales, Victorian and Queensland datasets, for lead acid batteries, waste oils and pesticides respectively. All three wastes have the same characteristic: their respective national markets are dominated by treatment facilities concentrated in a particular state, which gives rise to large one-way movements of interstate waste.

Lead acid batteries

NSW tracking data for lead captures large quantities of other states' arisings that have been imported into NSW for recycling. This data does not appear in tracking data in WA and Victoria. Because lead acid batteries are imported in NSW in large volumes, this means that exporting states' arisings figures, collected from their own tracking systems, are reported at much lower tonnages than they should be.

Waste oils

Similar to lead acid batteries, waste oils destined for recycling in NSW are exempt from using waste transport certificates and this produces other issues relevant to oils, as discussed in Section 6.2 and 6.8. Also like lead acid batteries, Victorian tracking data does not list NSW as a receiving jurisdiction for waste oil but NSW records a small but significant quantity of oils received from Victoria. This would appear to be an example of missing interstate-bound Victorian oils arisings – 'missing' because it is not in Victorian tracking data and as such is not collated into Victorian arisings.

Pesticides

Significant quantities of pesticide waste are transported from Queensland, WA and a lesser extent NSW, into Victoria for use as fuel substitution in thermal plant. Queensland tracking systems have some data that recognises this – 466 tonnes exported to Victoria. But Victoria's tracking data recognises 821 tonnes from Queensland, all supported by defensible certificate data. Which is correct? Given the evidence available, probably the Victorian figure.

In each case the receiving state appears to capture better data on the import than the sending state does on the export. In fact two of these examples show the receiving state collects the only data on the interstate movement.

This may point to a broader question of whether wastes bound for interstate export are captured properly or at all in sending states' estimates of arisings from their tracking systems, which are used to provide their respective Basel reports. It seems that the receiving state takes carriage of the tracking data, which makes sense from a regulatory risk management point of view but leaves a hole in the arisings data of the originating state. This may be occurring because the receiving state has more incentive to record the movement – it not only has legal carriage of the waste should there be a pollution event or accident but also has the responsibility to report all waste received into its jurisdiction, specifically from ever other jurisdiction, in its annual NEPM report.

This represents a systemic weakness in generation data reported to Basel, which appears to either under-report or completely omit waste that is transported interstate. This lack of reporting has most impact in cases where the interstate-sent component of a jurisdiction's total arising is large, such is the case with lead acid batteries

6.4 Regulatory exemptions mask waste arisings

Spent lead acid battery acid wastes destined for reuse and used oil going to a re-refining fate in NSW are two examples of a significant volume waste having a waste tracking exemption. Used oil transporters in Victoria may also apply for an exemption from using transport certificates, and the Victorian data suggest that many do.

These situations, particularly the blanket ones in NSW, create major holes in tracking system data on waste arisings. Sometimes these holes are not obvious; for example NSW oils figures still include about 29,000 tonnes of oil arisings – of which analysis suggests 25,000 tonnes to be legitimately going to non-recycling fates which are not exempt.

Further analysis indicates that between NSW and Victoria, due to their respective exemptions, as much as 175,000 tonnes of waste oil is absent from tracking data. Putting this ‘hole’ into perspective, it would make a very large addition to the reported figure nationally of 271,297 in 2012-13.

6.5 Differences in jurisdictional approaches to hazardous waste management adversely affect data quality

In addition to the regulatory exemptions discussed in 6.3, other jurisdictional differences in approach impact data. Although the general approach to classification and management of hazardous wastes across jurisdictions is relatively consistent, historically evolved differences can make data collection, collation and comparison difficult. This is still leading to pockets of questionable data quality, particularly at a jurisdictional level, such as:

- Key waste streams, such as contaminated soil, asbestos, waste oils, lead acid batteries and grease trap waste are not captured in full or at all in some states due to classification and/or tracking differences.
- Tasmania, the Northern Territory and the ACT have no tracking system, leading to under-reporting of hazardous waste quantities.
- South Australia does not report disposal or treatment information, and Western Australia did not provide such data due to confidentiality reasons, although some data is tracked. This constrains analysis to the waste arisings end of the data.
- South Australia cannot differentiate between waste movements within the state and those exported as both sets of data use certificate numbers with the same prefix.
- Asbestos data is not historically tracked in New South Wales, and Western Australia has no reliable asbestos data.
- Close examination of Victorian tracking data indicates the presence of even more Victorian-specific waste codes than were previously understood. For example it was previously thought that Victoria tracked four codes under the H category (pesticides), one more than in the NEPM. Tracking data shows 10 different H codes have historically been used in Victoria, although the practice appears to have stopped in 2014, due to EPA Victoria’s IT system upgrades.

6.6 Jurisdictional fate categories are inconsistent and inadequate for national analysis

The fate categories applied to enable all three states’ data to be used in this project were:

- recycling

- chemical/ physical treatment
- landfill
- biodegradation
- incineration
- storage or transfer.

This approach, and the way primary data is recorded in these tracking systems, introduces a level of ambiguity that limits the value of the fate assessment. These ambiguities have led to a number of what could be interpreted as odd fates in the reported data:

- Pesticides that go to recycling, but could have been placed in the incineration category.
- Animal and food processing wastes are mostly recorded as recycling, but further analysis suggests the actual fate could be composting, which could either be describes as biodegradation or recycling.
- PCBs are recorded as predominantly chemical/ physical treatment, yet they are destroyed almost exclusively by thermal decomposition processes such as plasma arc. This would appear to be a reflection of the fate types available in the data. While similar to incineration, PCB destruction facilities are not well captured in the headings available so allocation to chemical/ physical treatment seems to have occurred.
- Queensland data reports power station ash going to be blended into a mulch product as chemical/ physical treatment, when recycling would probably be a better choice.
- Grease trap waste in Queensland is recorded as going to chemical/ physical treatment as the highest fate proportion, but if the outputs of what is likely to be relatively basic treatment find another use, then it probably should be recycling.

These inconsistencies are in part to do with the limiting number of high level fates the project team was able to use in data analysis. But some blame also rests with the underlying Basel 'D and R' codes, which are either not very clear or used differently between jurisdictions and users of tracking certificates.

6.7 Significant tracking certificate errors exist in tracking data

Sections 4.1 – 4.23 highlight numerous examples of certificate errors, which can lead to poor data and interpretation outcomes.

For lead waste (lead acid batteries) in the NSW tracking system there were two single certificates of 22,480 tonnes and 23,500 tonnes respectively. Since the next largest single certificate entry in over 1,500 lead acid battery records is 34 tonnes, combined with the physical limitations of what a truck can actually carry, these two are highly likely to be data mistakes. Correct quantities may well be 22,480 and 23,500 kg instead.

For N205b *Other industrial treatment residues*, closer inspection of tracking data suggests that 16% of Queensland's waste is miscoded sewage sludge, which creates a small double-counting issue considering that biosolids, the processed version of sewage sludge, is separated out of this dataset (as N205a).

Queensland N205b data also contains miscoded CSG waste (that should be D300) and over 80% of Queensland's C100 (*Basic solutions or bases in solid form*) data is from the CSG industry which raises a

question of whether this is a different waste altogether than the salty wastes of D300 (non-toxic salts) or whether this is another example of miscoding.

There are many other examples of what appear to be mistakes made by those filling out waste transport certificates, in terms of quantities, waste types, industry source codes and, regularly, the treatment or fate types chosen (as discussed in Finding 6). For these two example wastes in particular, the consequences are many tens of thousands of tonnes in the wrong place, absent or creating falsely high tonnages.

6.8 Large volumes of problem wastes are ‘hidden’ outside of tracking systems

A substantial quantity of hazardous waste is generated and managed onsite in industrial settings and does not appear in waste tracking data. These wastes include spent potlining (SPL) waste, fly ash, red mud and biosolids, all of which have problematic management issues. For example:

- For SPL:
 - It is difficult to handle and treat due to its hazard – one of several issues being its reactivity with water, leading to the production of flammable, toxic and explosive gases.
 - Through consultation with industry in the *Hazardous Waste Infrastructure Needs and Capacity Assessment* project, it became apparent that the primary issue with this waste was the scale of the stockpile - industry estimates stockpiles of 900,000 tonnes of this hazardous waste – sufficient to more than half fill the Melbourne Cricket Ground.
- For biosolids:
 - Biosolids mostly fall outside of the tracking process, which means they are ‘missing’ from hazardous waste consideration. They are not typically considered as hazardous waste, or even waste at all by some, but they can contain contaminants such as heavy metals and even POPs, that would make them a hazardous waste based on NSW or Victorian waste contaminant classification/ categorisation concentrations.
 - 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.

7. Recommendations

Below are recommendations that may assist in addressing some of the key issues identified in Section 6.

Recommendation 1: Interstate transport data should be included in jurisdictional arisings figures used for Basel reporting

A more thorough understanding is required of the treatment of interstate movements of waste by jurisdictions, from a data tracking perspective, to ensure future Basel reports and other national data collations of hazardous waste reflect accurate arisings, regardless of where the arisen waste's fate is located.

Subsequent meetings with jurisdictions to de-brief about the broader set of projects would be an ideal setting to clarify these current arrangements so collection systems can be tailored to fully capture interstate-bound arisings data.

Recommendation 2: The impact of regulatory exemptions on arisings data needs to be better understood

Transport certificate exemptions such as those for lead acid batteries, oils and other wastes in NSW need to be further explored to ascertain their potential to result in under-reported arisings data. This will ensure future Basel reports and other national data collations of hazardous waste reflect accurate arisings and may result in a requirement for further data adjustments to future data collation methods.

Subsequent meetings with jurisdictions to de-brief about the broader set of projects would be an ideal setting to clarify these current arrangements, particularly if other non-tracking data sources are available to jurisdictions.

Recommendation 3: Jurisdictions should work together to improve fate categories and use them consistently

Fate allocations in tracking systems, including the underlying D and R codes, should be a very important topic of shared discussion between current and potential tracking system jurisdictions. The current categories and how they are used in industry is highly inconsistent, ambiguous and unhelpful to everyone concerned. The way this data is currently collected makes sensible use of fate data very difficult.

Revision of fate categories is an important issue that will be raised in subsequent de-brief meetings with jurisdictions.

Recommendation 4: Emerging and 'hidden' wastes management planning is overdue

State and federal governments should critically assess some of the wastes of particular concern raised in this report, to enable future management priorities to be established.

Recommendation 5: Opportunities exist to better manage data

Jurisdictions could obtain great insights from this project and the shared approaches of other jurisdictions that may assist in the way they manage hazardous waste tracking data. This is a primary objective of the next round of this project involving jurisdictional debriefing.

Appendices

A.1 Definition of the projection groups with reference to NEPM codes

'15' code	NEPM 15 description	'75' code	Waste description (NEPM Schedule A, List 1)	Projection groups
A	Plating and heat treatment	A100	Waste resulting from surface treatment of metals and plastics	Plating & heat treatment (A)
		A110	Waste from heat treatment and tempering operations containing cyanides	
		A130	Cyanides (inorganic)	
B	Acids	B100	Acidic solutions or acids in solid form	Acids (B)
C	Alkalis	C100	Basic solutions or bases in solid form	Alkalis (C)
D	Inorganic chemicals	D100	Metal carbonyls	Combined with: 'Other organic chemicals (other D)'
		D110	Inorganic fluorine compounds excluding calcium fluoride	Mercury; mercury compounds (D120)
		D120	Mercury; mercury compounds	
		D130	Arsenic; arsenic compounds	
		D140	Chromium compounds (hexavalent and trivalent)	Combined with: 'Other organic chemicals (other D)'
		D150	Cadmium; cadmium compounds	
		D160	Beryllium; beryllium compounds	
		D170	Antimony; antimony compounds	
		D180	Thallium; thallium compounds	
		D190	Copper compounds	
		D200	Cobalt compounds	
		D210	Nickel compounds	
		D220	Lead; lead compounds	Lead; lead compounds
		D230	Zinc compounds	Combined with: 'Other organic chemicals (other D)'
		D240	Selenium; selenium compounds	
		D250	Tellurium; tellurium compounds	
		D270	Vanadium compounds	
		D290	Barium compounds (excluding barium sulphate)	Non-toxic salts
		D300	Non-toxic salts	
		D310	Boron compounds	Other inorganic chemicals (other D)
		D330	Inorganic sulfides	
		D340	Perchlorates	
		D350	Chlorates	
		D360	Phosphorus compounds excluding mineral phosphates	

'15' code	NEPM 15 description	'75' code	Waste description (NEPM Schedule A, List 1)	Projection groups
E	Reactive chemicals	E100	Waste containing peroxides other than hydrogen peroxide	Reactive chemicals (E)
F	Paints, resins, inks, organic sludges	F100	Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	Paints, resins, inks, organic sludges (F)
		F110	Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	
G	Organic solvents	G100	Ethers	Organic solvents (G)
		G110	Organic solvents excluding halogenated solvents	
		G150	Halogenated organic solvents	
		G160	Waste from the production, formulation and use of organic solvents	
H	Pesticides	H100	Waste from the production, formulation and use of biocides and phytopharmaceuticals	Pesticides (H)
		H110	Organic phosphorous compounds	
		H170	Waste from manufacture, formulation and use of wood-preserving chemicals	
J	Oils	J100	Waste mineral oils unfit for their original intended use	Oils (J)
		J120	Waste oil/water, hydrocarbons/water mixtures or emulsions	
		J160	Waste tarry residues arising from refining, distillation, and any pyrolytic treatment	
K	Putrescible/ organic waste	K100	Animal effluent and residues (abattoir effluent, poultry and fish processing wastes)	Animal effluent and residues (+ food processing waste) (K100)
		K110	Grease trap waste	Grease trap waste (K110)
		K140	Tannery wastes (including leather dust, ash, sludges and flours)	Tannery & wool scouring wastes (K140 & 190)
		K190	Wool scouring wastes	
M	Organic chemicals	M100	Waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated naphthalenes, polychlorinated terphenyls and/or polybrominated biphenyls	Combined with: 'Other organic chemicals (other M)'
		M150	Phenols, phenol compounds including chlorophenols	
		M160	Organo halogen compounds—other than substances referred to in this Table or Table 2	PFOS (M160a)
				POP-BDEs (M160b)
				HBCD (M160c)
				HCB (M160d)
		M170	Polychlorinated dibenzo-furan (any congener)	Other organic chemicals (other M)
		M180	Polychlorinated dibenzo-p-dioxin (any congener)	

'15' code	NEPM 15 description	'75' code	Waste description (NEPM Schedule A, List 1)	Projection groups
		M210	Cyanides (organic)	
		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)	
N	Soil/ sludge	N100	Containers and drums that are contaminated with residues of substances referred to in this list	Combined with: 'Other soil/sludges (other N)'
		N120	Soils contaminated with a controlled waste	Contaminated soils (N120)
		N140	Fire debris and fire wash waters	Combined with: 'Other soil/sludges (other N)'
		N150	Fly ash, excluding fly ash generated from Australian coal fired power stations	
		N160	Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list	
		N190	Filter cake contaminated with residues of substances referred to in this list	Contaminated biosolids (N205a) Other industrial treatment residues (N205b)
		N205	Residues from industrial waste treatment/disposal operations	
		N220	Asbestos	Asbestos (N220)
		N230	Ceramic-based fibres with physico-chemical characteristics similar to those of asbestos	Other soil/sludges (other N)
R	Clinical and pharmaceutical	R100	Clinical and related wastes	Clinical & pharmaceutical (R)
		R120	Waste pharmaceuticals, drugs and medicines	
		R140	Waste from the production and preparation of pharmaceutical products	
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	Combined with: 'Other miscellaneous (other T)'
		T120	Waste from the production, formulation and use of photographic chemicals and processing materials	
		T140	Tyres	Tyres (T140)
		T200	Waste of an explosive nature not subject to other legislation	Other miscellaneous (other T)

A.2 National hazardous waste data 2012-13 and 2013 – by NEPM code

National Environment Protection (Movement of Controlled Waste between States and Territories) Measure				Tonnes generated				
"15" code	NEPM 15 waste description	"75" code	Waste description (NEPM Schedule A, List 1)	Jul-Dec 2012	Jan-Jun 2013	Jul-Dec 2013	2012/13	2013
A	Plating and heat treatment	A100	Waste resulting from surface treatment of metals and plastics	2,871	2,672	2,408	5,543	5,080
		A110	Waste from heat treatment and tempering operations containing cyanides	0	7	7	7	13
		A130	Cyanides (inorganic)	336	67	40	403	108
B	Acids	B100	Acidic solutions or acids in solid form	22,348	18,460	22,004	40,808	40,464
C	Alkalis	C100	Basic solutions or bases in solid form	166,769	172,608	178,403	339,377	351,011
D	Inorganic chemicals	D100	Metal carbonyls	109	190	183	299	373
		D110	Inorganic fluorine compounds excluding calcium fluoride	729	4,396	8,771	5,125	13,167
		D120	Mercury; mercury compounds	385	320	1,871	705	2,191
		D130	Arsenic; arsenic compounds	508	104	95	612	200
		D140	Chromium compounds (hexavalent and trivalent)	963	645	985	1,608	1,630
		D150	Cadmium; cadmium compounds	31	10	21	41	31
		D160	Beryllium; beryllium compounds	8	5	1	13	5
		D170	Antimony; antimony compounds	27	1	3	28	4
		D180	Thallium; thallium compounds	6	0	0	6	0
		D190	Copper compounds	745	439	350	1,184	789
		D200	Cobalt compounds	34	2	3	36	5
		D210	Nickel compounds	254	540	575	794	1,115
		D220	Lead; lead compounds	14,472	64,509	68,665	78,981	133,174
		D230	Zinc compounds	80,116	108,065	103,390	188,181	211,455
		D240	Selenium; selenium compounds	0	4	36	4	40
		D250	Tellurium; tellurium compounds	0	0	0	0	0

National Environment Protection (Movement of Controlled Waste between States and Territories) Measure					Tonnes generated			
"15" code	NEPM 15 waste description	"75" code	Waste description (NEPM Schedule A, List 1)	Jul-Dec 2012	Jan-Jun 2013	Jul-Dec 2013	2012/13	2013
		D270	Vanadium compounds	16	28	28	43	55
		D290	Barium compounds (excluding barium sulphate)	5	1	0	6	1
		D300	Non-toxic salts	41,226	43,987	47,191	85,213	91,178
		D310	Boron compounds	87	2	4	90	6
		D330	Inorganic sulfides	179	486	399	665	886
		D340	Perchlorates	48	5	5	53	10
		D350	Chlorates	102	2	6	104	8
		D360	Phosphorus compounds excluding mineral phosphates	234	470	470	704	940
E	Reactive chemicals	E100	Waste containing peroxides other than hydrogen peroxide	123	84	41	207	125
F	Paints, resins, inks, organic sludges	F100	Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	26,258	21,646	22,464	47,904	44,110
		F110	Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	7,898	2,226	2,566	10,124	4,792
G	Organic solvents	G100	Ethers	913	872	591	1,784	1,463
		G110	Organic solvents excluding halogenated solvents	8,641	6,752	8,090	15,392	14,842
		G150	Halogenated organic solvents	577	661	602	1,238	1,263
		G160	Waste from the production, formulation and use of organic solvents	7,325	6,782	6,948	14,107	13,730
H	Pesticides	H100	Waste from the production, formulation and use of biocides and phytopharmaceuticals	2,181	1,274	1,467	3,455	2,740
		H110	Organic phosphorous compounds	89	297	379	386	676
		H170	Waste from manufacture, formulation and use of wood-preserving chemicals	155	279	290	434	570
J	Oils	J100	Waste mineral oils unfit for their original intended use	148,896	122,401	118,229	271,297	240,630
		J120	Waste oil/water, hydrocarbons/water mixtures or emulsions	204,283	212,460	204,063	416,743	416,523
		J160	Waste tarry residues arising from refining, distillation, and	994	10,126	17,473	11,121	27,599

National Environment Protection (Movement of Controlled Waste between States and Territories) Measure					Tonnes generated			
"15" code	NEPM 15 waste description	"75" code	Waste description (NEPM Schedule A, List 1)	Jul-Dec 2012	Jan-Jun 2013	Jul-Dec 2013	2012/13	2013
			any pyrolytic treatment					
K	Putrescible/ organic waste	K100	Animal effluent and residues (abattoir effluent, poultry and fish processing wastes)	108,685	169,758	172,042	278,443	341,801
		K110	Grease trap waste	268,644	275,975	280,648	544,619	556,623
		K140	Tannery wastes (including leather dust, ash, sludges and flours)	3,395	3,249	3,292	6,643	6,541
		K190	Wool scouring wastes	16,720	171	215	16,891	386
M	Organic chemicals	M100	Waste substances and articles containing or contaminated with polychlorinated biphenyls, polychlorinated naphthalenes, polychlorinated terphenyls and/or polybrominated biphenyls	2,401	2,003	2,139	4,404	4,142
		M150	Phenols, phenol compounds including chlorophenols	540	582	528	1,122	1,110
		M160	Organo halogen compounds—other than substances referred to in this Table or Table 2	135	10	10	144	20
		M170	Polychlorinated dibenzo-furan (any congener)	0	0	0	0	0
		M180	Polychlorinated dibenzo-p-dioxin (any congener)	0	0	0	0	0
		M210	Cyanides (organic)	0	7	5	7	11
		M220	Isocyanate compounds	106	84	47	189	131
		M230	Triethylamine catalysts for setting foundry sands	2,779	1,673	1,696	4,452	3,369
		M250	Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials	5,563	4,676	6,056	10,239	10,732
		M260	Highly odorous organic chemicals (including mercaptans and acrylates)	44	13	27	57	40
N	Soil/ sludge	N100	Containers and drums that are contaminated with residues of substances referred to in this list	20,124	19,707	21,696	39,831	41,402
		N120	Soils contaminated with a controlled waste	707,677	705,698	732,175	1,413,375	1,437,872
		N140	Fire debris and fire wash waters	1,532	1,003	720	2,535	1,723
		N150	Fly ash, excluding fly ash generated from Australian coal	2,882	2,430	2,571	5,312	5,001

National Environment Protection (Movement of Controlled Waste between States and Territories) Measure				Tonnes generated				
"15" code	NEPM 15 waste description	"75" code	Waste description (NEPM Schedule A, List 1)	Jul-Dec 2012	Jan-Jun 2013	Jul-Dec 2013	2012/13	2013
			fired power stations					
		N160	Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list	39,553	35,542	27,360	75,094	62,901
		N190	Filter cake contaminated with residues of substances referred to in this list	7,258	8,598	9,437	15,857	18,036
		N205	Residues from industrial waste treatment/disposal operations	834,790	876,958	885,336	1,711,748	1,762,294
		N220	Asbestos	246,048	394,565	396,127	640,613	790,692
		N230	Ceramic-based fibres with physico-chemical characteristics similar to those of asbestos	44	191	224	235	414
R	Clinical and pharmaceutical	R100	Clinical and related wastes	27,742	36,214	36,000	63,957	72,214
		R120	Waste pharmaceuticals, drugs and medicines	6,920	2,908	2,518	9,828	5,426
		R140	Waste from the production and preparation of pharmaceutical products	886	628	535	1,514	1,163
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	2,809	2,936	2,971	5,746	5,907
		T120	Waste from the production, formulation and use of photographic chemicals and processing materials	699	453	373	1,151	826
		T140	Tyres	221,537	203,014	232,219	424,551	435,233
		T200	Waste of an explosive nature not subject to other legislation	909	1,148	1,151	2,057	2,299
TOTAL				3,271,361	3,554,078	3,637,233	6,825,439	7,191,312

A.3 Basel data

Total amount of hazardous wastes under Art. 1 (1)a (Annex I: Y1-Y45) generated ¹				4,243,238
Total amount of hazardous wastes under Art. 1 (1)b generated ²				7,191,312
Total amount of other wastes (Annex II: Y46 - Y47) ³				13,401,060
Basel Convention		Tonnes generated		2013 total
Code	Waste description (Annex 1)	Jan-Jun	Jul-Dec	
Y1	Clinical wastes from medical care in hospitals, medical centres and clinics	36,214	36,000	72,214
Y2	Wastes from the production and preparation of pharmaceutical products	628	535	1,163
Y3	Waste pharmaceuticals, drugs and medicines	2,908	2,518	5,426
Y4	Wastes from the production..... of biocides and phytopharmaceuticals	1,274	1,467	2,740
Y5	Wastes from the manufacture..... of wood preserving chemicals	279	290	570
Y6	Wastes from the production, formulation and use of organic solvent	6,782	6,948	13,730
Y7	Wastes from heat treatment and tempering operations containing cyanides	7	7	13
Y8	Waste mineral oils unfit for their originally intended use	122,401	118,229	240,630
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsion	212,460	204,063	416,523
Y10	Waste substancescontaining or contaminated with PCBs, PCTs, PBBs	2,003	2,139	4,142
Y11	Waste tarry residues ... from refining, distillation and any pyrolytic treatment	10,126	17,473	27,599
Y12	Wastes from production..... of inks, dyes, pigments, paints, etc.	21,646	22,464	44,110
Y13	Wastes from production.....resins, latex, plasticizers, glues, etc.	2,226	2,566	4,792
Y14	Waste chemical substances arising environment are not known	2,936	2,971	5,907
Y15	Wastes of an explosive nature not subject to other legislation	1,239	1,202	2,441
Y16	Wastes from production, formulation and use of photographic chemicals...	453	373	826
Y17	Wastes resulting from surface treatment of metals and plastics	2,672	2,408	5,080
Y18	Residues arising from industrial waste disposal operations	915,121	915,490	1,830,611

1. Sum of Y-codes Y1 – Y45.

2. Sum of Y-codes Y1 – Y45, plus the 8 additional 'Y+8' codes. This figure is the total 2013 national arising of hazardous waste.

3. Sum of Y-codes Y46 and Y47 (household wastes and incineration residues).

Wastes having as constituents ...				
Y19	Metal carbonyls	190	183	373
Y20	Beryllium; beryllium compounds	5	1	5
Y21	Hexavalent chromium compounds	645	985	1,630
Y22	Copper compounds	439	350	789
Y23	Zinc compounds	108,065	103,390	211,455
Y24	Arsenic; arsenic compounds	104	95	200
Y25	Selenium; selenium compounds	4	36	40
Y26	Cadmium; cadmium compounds	10	21	31
Y27	Antimony; antimony compounds	1	3	4
Y28	Tellurium; tellurium compounds	0	0	0
Y29	Mercury; mercury compounds	320	1,871	2,191
Y30	Thallium; thallium compounds	0	0	0
Y31	Lead; lead compounds	64,509	68,665	133,174
Y32	Inorganic fluorine compounds excluding calcium fluoride	4,396	8,771	13,167
Y33	Inorganic cyanides	67	40	108
Y34	Acidic solutions or acids in solid form	18,460	22,004	40,464
Y35	Basic solutions or bases in solid form	172,608	178,403	351,011
Y36	Asbestos (dust and fibres)	394,565	396,127	790,692
Y37	Organic phosphorus compounds	297	379	676
Y38	Organic cyanides	7	5	11
Y39	Phenols; phenol compounds including chlorophenols	582	528	1,110
Y40	Ethers	872	591	1,463
Y41	Halogenated organic solvents	661	602	1,263
Y42	Organic solvents excluding halogenated solvents	6,752	8,090	14,842
Y43	Any congener of polychlorinated dibenzo-furan	0	0	0
Y44	Any congener of polychlorinated dibenzo-p-dioxin	0	0	0
Y45	Organohalogen compounds other than ... (e.g. Y39, Y41, Y42, Y43, Y44)	10	10	20
Categories of wastes requiring special consideration (Annex II)				
Y46	Wastes collected from households	6,672,104	6,728,956	13,401,060
Y47	Residues arising from the incineration of household wastes	0	0	0

Additional waste categories not included in Y-Codes				
Y+1	Other metal compounds	570	605	1,176
Y+2	Other inorganic chemicals	44,946	48,064	93,010
Y+3	Other organic chemicals	6,446	7,827	14,272
Y+4	Putrescible/ organic waste	449,153	456,197	905,350
Y+5	Waste packages and containers containing Annex 1 substances in concentrations sufficient to exhibit Annex III hazard characteristics	19,707	21,696	41,402
Y+6	Soils contaminated with residues of substances in Basel Y-codes 19-45	705,698	732,175	1,437,872
Y+7	Sludges contaminated with residues of substances in Basel Y-codes 19-45	9,601	10,157	19,759
Y+8	Tyres	203,014	232,219	435,233

Adopted Y-code translations from additional NEPM codes (Basel 'Y+8')

Additional waste categories not included in Y-Codes (Y+8 codes)		NEPM code	NEPM Description
Y+1	Other metal compounds	D200	Cobalt compounds
		D210	Nickel compounds
		D270	Vanadium compounds
		D290	Barium compounds (excluding barium sulphate)
Y+2	Other inorganic chemicals	D300	Non-toxic salts
		D310	Boron compounds
		D330	Inorganic sulfides
		D360	Phosphorus compounds excluding mineral phosphates
Y+3	Other organic chemicals	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)
Y+4	Controlled putrescible/ organic wastes	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
Y+5	Waste packages and containers containing Annex 1 substances in concentrations sufficient to exhibit Annex III hazard characteristics	N100	Containers and drums that are contaminated with residues of substances referred to in this list
Y+6	Soils contaminated with residues of substances in Basel Y-codes 19-45	N120	Soils contaminated with a controlled waste
Y+7	Sludges contaminated with residues of substances in Basel Y-codes 19-45	N140	Fire debris and fire wash waters
		N190	Filter cake contaminated with residues of substances referred to in this list
Y+8	Tyres	T140	Tyres