

Hazardous Waste Data Summary

Final Report

**Department of Sustainability, Environment, Water,
Population and Communities**

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Hazardous Waste Data Summary

Final Report

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Glossary and Abbreviations

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.
C&D	Construction and Demolition (waste)
C&I	Commercial and Industrial (waste)
Companion report	This report—the <i>Hazardous Waste Data Summary</i> —as a companion to the Data Report
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.
Data report	<i>Hazardous Waste Data Assessment</i> , Appendix A to this report
EfW	Energy from Waste
Hazardous waste	<p>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.</p> <p>Hazardous waste means:</p> <ul style="list-style-type: none">(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
Liquid waste	Any waste that:

- (a) has an angle of repose of less than five degrees above horizontal, or
- (b) becomes free-flowing at or below 60 degrees Celsius or when it is transported, or
- (c) is generally not capable of being picked up by a spade or shovel.

MSW	Municipal Solid Waste
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
Non-tracked data	Hazardous waste not collected under the arrangements of a formal tracking system. This may include material with no arrangement for any kind of tracking or measurement as well as material tracked, measured, estimated or otherwise covered by parallel or shadow systems.
Recovery of energy	(from solid waste) is the process of recovering the energy that is embodied in solid wastes. The amount of solid waste recovered by recovery of energy processes is net of any materials recycled and/or disposed.
Recycling	A series of activities by which solid wastes are collected, sorted, processed (including composting), and converted into raw materials to be used in the production of new products.
Resource recovery	The sum of materials sent to recycling and energy recovery facilities minus contaminants/residual wastes sent to disposal. Resource recovery = recycling + recovery of energy.
Reuse	The use of products or materials for the same or a different purpose without reprocessing or remanufacture. These products or materials may also be repaired to extend their use.
Solid waste	Any waste that: <ul style="list-style-type: none"> (a) has an angle of repose of greater than five degrees above horizontal, or (b) does not become free-flowing at or below 60 degrees Celsius or when it is transported, or (c) is generally capable of being picked up by a spade or shovel.
Solid waste disposal	Solid waste that is deposited in a landfill net of recovery of energy.
Tracked data	Hazardous waste collected under the arrangements of a tracking system
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.

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 EfW 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 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 generation	Typically, waste generation = resource recovery (recycling + energy recovery) + disposal. For the purposes of this report however, waste generation means what has been reported by jurisdictional data providers as waste generation.
Waste reuse	The reuse of a product or material that has entered a waste management facility (e.g. the sale of goods from a landfill or transfer station 'tip shop') for the same or a different purpose. These products or materials may also be repaired to extend their use.

1. Introduction

This report—the *Hazardous Waste Data Summary* (the Summary Report)—is a companion report to the *Hazardous Waste Data Assessment* (the Data Report)—a data investigation, assessment and compilation report prepared for the Department of Sustainability, Environment, Water, Population and Communities by KMH Environmental Pty Ltd. The Data Report is Appendix A to this report.

1.1. Purpose of this report

The purpose of this companion report is to provide further interpretation, analysis and, where appropriate, augmentation of the data presented at Appendix A.

Where the Data Report acts as the underpinning data source, the Summary Report acts as a complementary analytical commentary piece which draws out headline messages about hazardous waste generation and management in Australia.

1.2. Scope and limitations

The scope of the Summary Report is to interrogate hazardous waste data collected from jurisdictional tracking systems in Appendix A to identify:

- apparent anomalies
- quality and coverage issues
- possible errors or omissions
- jurisdictional inconsistencies and irregularities with respect to data tracking and classification
- comparative issues that suggest different approaches in different jurisdictions
- pertinent observations that suggest a trend in hazardous waste management.

Having identified the issues, this report aims to extract key themes, messages and overarching meaning, by applying KMH's specialised knowledge in the area of hazardous waste management in Australia.

The assumptions, possible explanations, reasoning and potential conclusions drawn in this report are limited by the extent of available data and collective knowledge of the report's authors and other collaborators. Much of the opinion expressed in the report is based on the authors' experience and knowledge of the hazardous waste industry.

Any interpretative advice based on the analysis and opinions expressed in this report should first be verified with the relevant state or territory hazardous waste management agency before being relied upon as factually correct.

Due to the extensive gaps in treatment/disposal data—for some jurisdictions there is no information available at the destination end—and the potential for double-counting where wastes undergo primary treatment before secondary treatment/disposal, this report focuses primarily on analysis of waste quantities generated, imported and exported.

2. Key messages

The process of data analysis, evaluation and expert review and discussion has drawn out the following key messages regarding hazardous waste reported as generated by jurisdictions across Australia in 2011.

2.1. 2010–11 National hazardous waste generation data

The national totals estimated for hazardous waste generation in Australia in 2010–11 are:

- total hazardous waste generated within state/territory = 6,068,985 tonnes
- total hazardous waste sent across state/territory borders = 92,921 tonnes
- hazardous waste generated from MSW stream = 301,836 tonnes
- therefore total hazardous waste generated in Australia in 2010–11 = **6,463,743 tonnes**.

2.2. Differences in jurisdictional approaches to hazardous waste management adversely impact data quality

There are fundamental differences in the way jurisdictions manage hazardous wastes. Inconsistencies in waste classification, regulation, data collection, waste tracking systems, management priorities and the resourcing of hazardous waste management have a marked effect on data quality.

For the most part the states and territories use the NEPM waste categorisation codes and descriptions. There are, however, several instances where the waste descriptions vary from the NEPM description and this can make it difficult to match corresponding waste types across jurisdictions.

Jurisdictions do not collect hazardous waste data for the sake of annual collation and analysis. Rather they are at various points in their history of managing the risks to human health and the environment posed by hazardous waste, primarily through 'cradle to grave' tracking of road transport movement of these wastes on a consignment by consignment basis, from point of generation to treatment destination. As a consequence of this focus, a jurisdiction's purpose for the data supplied by the waste consignment has essentially been met once the transaction has been successfully and verifiably completed. There is a different perspective between those managing the tracking of waste movements and those looking for strategic messages and information from analysis of the sum of this data.

Although the general approach to classification and management across jurisdictions is very consistent, historically evolved differences make data collection, collation and comparison difficult. These inconsistencies lead to large gaps in data which could, on the surface at least, lead to misleading conclusions about comparative waste management across Australia.

The inability to access detailed data on hazardous waste quantities in Australia, at least in the public domain, contributes to a lack of awareness of these differences, which in turn provides no impetus to improve data quality.

2.3. Major gaps exist in hazardous waste data

As a result of the inconsistent approaches above, significant data gaps exist within state waste tracking systems. The following key data gaps were observed:

- The Australian Capital Territory, Northern Territory and Tasmania do not track intrastate hazardous waste movements, leaving only interstate data available for this study.
- Western Australia and South Australia do not report any disposal or treatment information at all. This constrains analysis to the waste generation 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.
- Key waste streams, such as contaminated soil, asbestos, sewage sludge/biosolids, septic tank pump-out liquid and grease trap waste are not captured in some states due to classification and/or tracking differences.
- Further wastes such as waste oils, batteries and clinical wastes are subject to exemption from tracking in New South Wales and therefore absent from New South Wales tracking data.
- Similarly, exemption systems apply in Victoria and Queensland, generally to reduce regulatory red tape and thus encourage reuse and recycling. These systems usually exempt the requirement for use of waste transport certificates for the particular wastes covered. This could leave significant hazardous waste tonnages uncounted and filling these data gaps can be complicated when such exemptions apply to one-off projects, wastes or operators only.

These gaps in recorded or tracked data must be clearly recognised and a process of normalisation applied to allow a fairer comparison across jurisdictions.

2.4. Contaminated soil should be viewed separately in hazardous waste data analysis

Contaminated soil is a special case in the assessment of hazardous waste data. It is 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.

These drivers are quite different from virtually all other hazardous waste categories, perhaps with the exception of asbestos, which exhibits similar drivers. 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, which overwhelms all other waste data and introduces the potential for misleading messages to be concluded from the data around trends and broader waste producer behaviours.

To provide a picture of hazardous waste without this large, sporadic and unpredictable influence, contaminated soil quantities were excised from the data, to provide a truer comparison between jurisdictions.

2.5. Less populated states appear to generate more hazardous waste per capita than more populous states

After normalisation of key waste types across jurisdictions and the removal of contaminated soils, hazardous waste generation per capita was plotted (see Figure 4).

Western Australia is the largest producer of hazardous waste on a per capita basis followed sequentially by Queensland, South Australia, New South Wales and Victoria.

While the data is subject to a range of uncertainty, factors at play that may influence these per capita findings could be:

- Stronger regulatory approaches around hazardous waste in the larger states (e.g. New South Wales and Victoria).
- Drivers specific to each state, such as the scarcity of hazardous waste landfill space in Victoria—there is only one hazardous waste landfill in that state—giving rise to an imperative to pursue alternative treatment options, such as reuse and recycling.

- Economies of scale in the larger states such as Victoria and New South Wales, which could lead to greater economic drivers for the establishment of hazardous waste reuse and recycling markets, or better onsite resource recovery practices.
- Western Australian data may be influenced to a small degree by the fly in/fly out component of mining sector employees, estimated to be approximately 50,000¹. These workers do not officially reside in Western Australia but contribute through their working presence to waste and, by extension, hazardous waste generation in the state.
- Western Australia, Queensland and to a lesser extent South Australia have a greater share of mine processing facilities, which may contribute disproportionately to categories such as alkaline waste (C) and Inorganics Chemical wastes (D).

Western Australia is notable in that it is the only state where asbestos data could not be identified. The volumes observed in some states suggest it could be a waste that may contribute significantly to the current Western Australia total per capita.

2.6. Review of hazardous waste classifications and definitions could improve future data quality

It may be appropriate to review the Controlled Waste NEPM as a benchmark for hazardous waste classification in Australia, with a view to:

- determining whether new wastes should be added, either as separate codes or explicitly included in existing classifications
- determining whether existing wastes should be removed or better clarified.

Such a review should be undertaken with a clear understanding of the practicalities and implications for waste tracking and licensing regimes.

Waste management options and other key waste terminology should be clearly defined and understood across all jurisdictions, to ensure data can be more comparable. Examples include reuse (in a waste oil context) and whether a clearly definable hazardous waste that is managed onsite should be considered eligible for inclusion in a data compilation project such as this.

2.7. Clinical waste appears to be under-reported in Western Australia

Clinical and related wastes (R100) appear to be under-reported in Western Australia, compared to generation figures observed for other states. It is noted that a controlled waste tracking form is only required in Western Australia when the total vehicle load is 200 kilograms or more, which could account for part of this apparent discrepancy.

There are state-by-state differences in allowable treatment practices and large price differentials for these treatments. In New South Wales for example, clinical wastes are not subject to the formal (intrastate) tracking system, although interstate movements of these wastes are required to be tracked.

¹ WA Today newspaper article: <http://www.watoday.com.au/wa-news/stis-spreading-doctors-forced-out-ama-warning-to-fifo-inquiry-20120417-1x4r5.html>

3. Key issues observed

This section takes an in depth look at hazardous waste data collected for the Data Report (Appendix A), with a view to identifying key issues and discussing the possible causal factors behind these issues.

The entire dataset has been scrutinised, both at the primary waste code level (designated by the alphabetical description) and the underlying alpha-numeric level. Despite this large volume of data, many of the key issues can be identified by focusing on a comparative analysis of the top two or three (alphabetical level) waste codes for each of the jurisdictions.

Table 1 provides a summary of some of the key issues observed in the compiled hazardous waste data, in terms of the major wastes (by quantity) generated by those states where hazardous wastes are tracked. These states, coincidentally, are the five largest by population. The exception is clinical and related waste, which is not high in tonnage in the context of jurisdictional totals, but warrants particular attention as discussed in Section 3.2.

Wastes reported in Table 1 have been broken down to the detailed alphanumeric waste code level, to allow a better understanding of what generation activities may lie behind the reported numbers, and also to provide for more meaningful comparison between jurisdictions. This table is used for much of the comparative discussion of issues in Section 3.1 and 3.2, although observations drawn from other data (such as import/export figures) are also discussed. The latter data, as with all waste generation, import, export and treatment data, was gathered as part of the Data Report at Appendix A.

Table 1 deliberately focuses on tracked data only at a first pass, which highlights high-order inconsistencies, in terms of what is tracked as hazardous waste within jurisdictions. The table highlights:

- waste data known to be missing from tracking systems but still likely to be generated in that jurisdiction (highlighted in yellow)
- values that appear unusually high when compared to other jurisdictions' data (highlighted in green)
- values that appear unusually low when compared to other jurisdictions' data (highlighted in orange).

There are a number of waste codes not reported by some jurisdictions, as evidenced by the dash (-) symbol in many entries in Table 1. The 'dashed' entries highlighted in yellow are known cases where wastes are not officially tracked, such as wastes specifically exempt from tracking in a particular jurisdiction. Actual reported tonnages located in yellow highlighted entries indicates a known data gap, where a small amount of waste has been reported via the tracking system, even though such reporting is not required in that jurisdiction. This is discussed using the contaminated soil example in Section 3.1.2.

Section 3.1.2 attempts to fill these gaps where possible, using other data sources, and presents the results in terms of 'normalised' data in Table 2 (Section 3.1.2).

The other dashes reported in Table 1 are likely to be cases where that particular waste is not generated within a jurisdiction.

Table 1—Major waste generation data observations and discrepancies (tracked data only) in 2010–11

Major waste generated		Major waste producing states (tonnes)				
NEPM waste description	Waste Code	New South Wales	Queensland	Victoria	Western Australia	South Australia
Inorganic chemicals						
Arsenic and arsenic compounds	D130	-	777	13	120	108,752
Lead and lead compounds	D220	17,701	9,480	4,935	817	1,836
Zinc compounds	D230	0.72	514	175	607	147
Non-toxic salts (e.g. sodium chloride, calcium chloride)	D300	11,611	33,626	1,048	6,341	447
Oils, hydrocarbons, emulsions						
Waste oils unfit for their original intended use (lubricating, hydraulic)	J100	64,554	86,404	10,750	72,316	423
Waste oils and water mixtures or emulsions, and hydrocarbon and water mixtures or emulsions	J120	39,369	149,720	57,786	49,737	6,605
Triple interceptor waste and stormwater contaminated with oil or hydrocarbons	J130	-	-	29,008	13,129	-
Putrescible/organic wastes						
Animal effluent and residues (e.g. abattoir wastes, poultry wastes, fish and shellfish wastes)	K100	-	45,780	33,685	8,530	-
Grease trap waste	K110/ K120	-	117,529	89,503	67,534	-
Sewage sludge and residues including nightsoil and septic tank sludge	K130	-	525,802	-	390,356	-
Food and beverage processing wastes, including animal and vegetable oils and derivatives	K200	68	51,341	41,347	45,697	-
Solid/sludge wastes requiring special handling						
Contaminated soils	N119, N120, N121	21,885	2,569	407,596	7,671	219,322
Prescribed waste residues in bags or containers not specified under N100 and N105	N110	-	14	10,783	-	-
Industrial waste treatment plant residues	N205	-	83,345	-	2,971	-
Asbestos	N220	42	100,162	40,964	-	20,101
Clinical and pharmaceutical wastes						
Clinical and related wastes, NOS (biomedical waste)	R100	216	17,744	9,272	2,837	15,067

Legend:

- **Yellow** = Known gaps in tracked data that need to be filled by other estimation methods to allow worthwhile comparison across the waste code
- **Green** = Tonnages that appear unusually high when compared to other jurisdictions' data
- **Orange** = Tonnages that appear unusually low when compared to other jurisdictions' data
- Not reported.

3.1. High-level observations

The following high-level observations focus on trends, inconsistencies and data gaps that are applicable across a number of jurisdictions and/or waste categories. More detailed observations referencing specific waste types and individual points of interest follow in Section 3.2.

Once identified, these observations were then sorted into three distinct types of issue:

1. Data Quality (Q)
2. Data Interpretation (I)
3. Policy (P) Implications.

3.1.1. Data quality (Q) issues

Q1. Waste classification inconsistencies

For the most part the states and territories use the NEPM waste categorisation codes and descriptions. There are, however, several instances where the waste descriptions vary from the NEPM description and this can make it difficult to match corresponding waste types across jurisdictions.

Western Australia, for example, uses its own waste classification system which differs from the NEPM waste category classifications, whereas Queensland appears to have the closest alignment with NEPM categories. Other states such as Victoria make isolated departures in the way that hazardous waste is classified, based on historical reasons.

Q2. Waste tracking inconsistencies

In addition to the classification differences in Q1, the different application of tracking systems for hazardous waste transport from one jurisdiction to the next also leads to major gaps in data. This may be because the particular waste is not actually classified as hazardous in that jurisdiction, or it may be that historical or other management arrangements apply, which make official tracking unnecessary. Lastly, some jurisdictions do not have a hazardous waste tracking system at all, outside of NEPM requirements across borders.

The data shows several clear inconsistencies with regard to the wastes that are tracked by each jurisdiction:

- The Australian Capital Territory, Northern Territory and Tasmania do not have a formal intrastate tracking system. They only record interstate data for controlled (hazardous) wastes in/out according to the NEPM. These jurisdictions therefore underestimate hazardous waste production, because it can be assumed that some hazardous wastes will be dealt with within borders but are not captured by any form of tracking.
- New South Wales is a good example of a jurisdiction that, in the main, tracks hazardous waste in line with the NEPM, but does not include significant waste streams under its tracking system. This is due to a combination of historical reasons and specific waste exemptions from tracking, the latter being used as a regulatory incentive mechanism to encourage reuse and recycling options. These major inconsistencies and/or gaps are dealt with specifically in section 3.1.2.
- Queensland does track most of the NEPM waste codes (as described in Q1) but has both a very large inclusion (sewage sludge and residues including nightsoil and septic tank sludge) and exclusion (contaminated soil), relative to many other states. The consequences of these inconsistencies are described in sections 3.1.2 I2 and 3.1.2 I1 respectively).
- South Australia, Western Australia and to a lesser extent Victoria, also omit key wastes that are included in the NEPM from their respective state tracking systems.

Figure 1 plots all jurisdictions' available tracking system data, noting that the inconsistencies above have the impact of misrepresenting the actual waste generated in each jurisdiction, which has particular consequences when comparing data between jurisdictions.

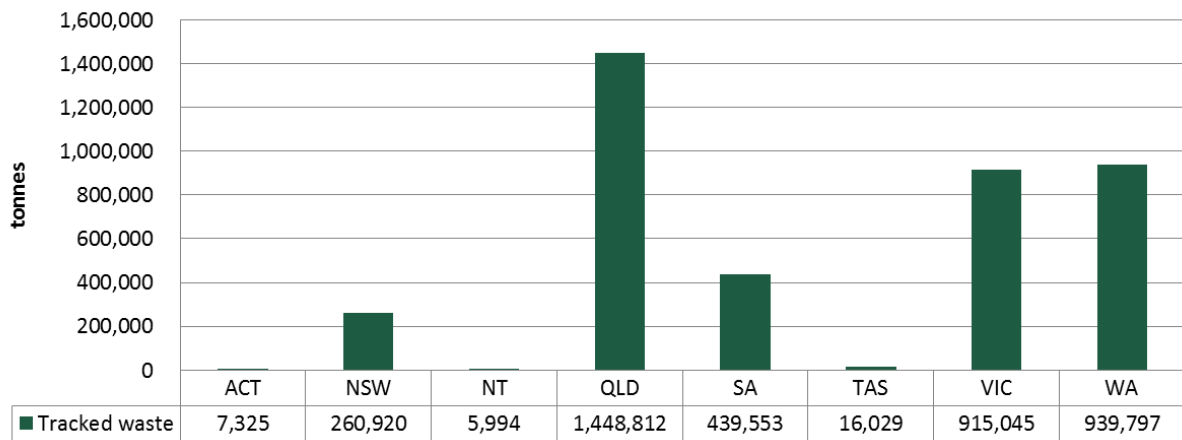


Figure 1 Tracked hazardous waste generated by jurisdictions in 2010–11

Q3. Data gaps

As a result of the inconsistent approaches outlined in Q1 and Q2, significant data gaps exist within jurisdictional waste tracking systems, particularly for disposal and treatment of waste. The following key data gaps were observed:

- As discussed above, the Australian Capital Territory, Northern Territory and Tasmania do not track intrastate hazardous waste movements therefore a significant lack of data exists for these jurisdictions.
- South Australia is not able to report the disposal or treatment route for its hazardous waste. It is not entirely clear why this is the case, although discussion with Environment Protection Authority South Australia indicates that it is a result of disparity in the recording systems employed by individual depots.
- 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.
- Like South Australia, Western Australia does not report any treatment/disposal information.
- Key waste streams, such as contaminated soil, asbestos, sewage sludge/biosolids, septic tank pump-out liquid and grease trap waste are not captured in some states due to classification and/or tracking differences.
- Waste oils, batteries, clinical and other wastes are subject to exemption from tracking in New South Wales and therefore absent from New South Wales data.

Q4. Double counting in treatment and disposal processes

There is a risk of double counting of wastes where either:

- The waste category includes two forms of the same waste material from different stages of a treatment process, for example:
 - sewage sludge and residues (K130) which, by definition, could include both septic tank pump-out liquid taken by truck before the wastewater treatment process and biosolids taken as an output from sewage treatment
 - or
 - transport of a waste to a treatment process to reduce its hazard, and then subsequent transport of the same waste, possibly reduced or increased in volume, in a less hazardous state to another outcome, such as landfill.

- The waste is transported for storage during a particular reporting period and subsequently transported for treatment/disposal during the next reporting period.

It is not possible to identify exactly where double-counting has occurred, more that it is considered to be a possibility due to the way in which waste is tracked and recorded. This is an important reason why the interpretation focus of this report is on the waste generation data.

Q5. Data irregularities (generated waste versus treated waste anomalies)

There are a number of instances where the quantity of waste generated and the quantity of waste exported or disposed/treated differ significantly for a particular waste category. These irregularities are potentially due to errors caused by either double-counting (see Q4. above) or data recording errors.

3.1.2. Data interpretation (I) issues

The quality issues mentioned above have been used to explore how data interpretation across jurisdictions could be improved, through a process of normalisation. This section identifies each issue or key data gap, and attempts to fill these gaps or otherwise address these issues, so a more considered interpretation can be made. Because of the lack of any data outside of interstate movements for the Australian Capital Territory, Northern Territory and Tasmania, these jurisdictions have been removed from the normalisation process.

I1. Contaminated soils

Contaminated soil is an example of a waste with several different classifications and tracking obligations depending on the jurisdiction in which it is generated. This has a large impact on the hazardous waste totals for each jurisdiction as contaminated soils make up a significant proportion of hazardous waste in all jurisdictions.

Tracking data is present for contaminated soils in all states where tracking systems exist. That being said, contaminated soils are not required to be tracked for intrastate movements in New South Wales and Queensland. The very low figures at Table 1 for these states may represent either mistakes in classification or use of transport certification in that particular state beyond legal requirements.

Western Australia is the other State with very low reported tonnages for contaminated soil. While WA does track some types of contaminated soils, this tracking is dependent on the level of and types of contamination. Contaminated soils that meet a Class I, II or III landfill disposal (*as per the WA Landfill Classification and Waste Definitions 1996 document*) are not tracked. This may explain the very low generation figures for WA. However the authors note that soils classified as suitable for Class I, II or III landfill in WA, based on the contaminant threshold values in the aforementioned classification document, would not necessarily be classified as hazardous elsewhere either (for example Victoria), and hence would also not be tracked.

In practice, contaminated soils are primarily tracked as hazardous wastes in Victoria and South Australia.

I2. Sewage/septic sludge

The sewage sludge and residues (including nightsoil and septic tank sludge) waste category could include both septic tank pump-out waste and sludge/biosolids from sewage treatment which may lead to double-counting as described in Q4. Like contaminated soil, this waste can make a massive contribution to hazardous waste in a jurisdiction, but is only tracked as hazardous in two states (Queensland and Western Australia) and therefore presents a large anomaly in data comparison between the jurisdictions.

To further complicate the overall picture (yet simplify the situation within state), Western Australia data separates these categories out as different categories.

I4. Asbestos

Asbestos is not tracked in Western Australia or New South Wales.

Asbestos data volumes can also be somewhat misleading because it can be a discrete material, a minor contaminant in a 'clean' stream (such as from specialised building removal processes), as well as a larger component in mixtures (e.g. mixed demolition wastes that contain asbestos). Where tracking data is available for asbestos, it gives no indication of the level of asbestos in the waste.

15. Other putrescible organics

New South Wales and South Australia do not track grease trap waste (K110/K120) and animal effluent and residues (K100).

16. Filling state versus state data gaps ('normalisation')

In order to more accurately determine the total hazardous waste generated by each jurisdiction it is necessary to fill the data gaps that exist within the tracked waste data. For the purpose of this report this gap filling process is referred to as 'normalisation'.

Normalising the data involves obtaining hazardous waste data from other published sources.

Missing asbestos and contaminated soils data has been 'filled' using estimates quoted in *Waste and Recycling in Australia 2011*².

Where data is not available or does not exist, estimates based on population have been made, if population is a conceivable surrogate for the generation of that waste. For example, in the case of grease trap waste (K110/K120) there is no data available for New South Wales or South Australia as it is neither tracked internally nor recorded in other systems. However it could conceivably be assumed that grease trap, which is largely a retail food industry waste, would be a function of population.

By using an average per capita value for Victoria, Western Australia and Queensland, an estimate of the grease trap waste produced in New South Wales and South Australia has been calculated. Similar estimates have been determined for animal effluent and residues (K100).

Due to several jurisdictions not tracking sewage sludge and residues data, this category has been replaced with biosolids data for each jurisdiction, sourced from the Australian and New Zealand Biosolids Partnership website (<http://www.biosolids.com.au/bs-australia.php>). Because of the dual nature of wastes that could fit under this code (septic tank pump-out waste and post-treatment sludge/biosolids removal), biosolids data is a more reliable method for all jurisdictions than tracking. Consequentially, all data used in the normalisation process for this category has been taken from this source.

This has also eliminated any potential double-counting impacts caused by septic tank sludge and treated sewage sludge both being listed under the same category (refer to I2).

The results of normalising, through the filling of key data gaps, are depicted graphically for the major states at Figure 2 below, and detailed in Table 2 overleaf.

The complete data set for all jurisdictions, after normalisation, is provided at Appendices B and C, which tabulate national waste data by jurisdiction and waste code respectively. Appendix C also incorporates estimates of hazardous waste likely to be present in the municipal solid waste (MSW) stream.

Table 14 of the Data Report at Appendix A shows that the total hazardous waste generated in Australia, derived from interstate and intrastate tracking systems, is 4,097,047 tonnes, with an additional 301,836 tonnes estimated to be present outside of these systems in MSW.

Given the data improvements from normalisation, it is recommended that the data in Appendices B and C should be used over the totals collated in the Data Report, as they are a more robust estimate of national totals of hazardous waste generation. Consequently the national totals for hazardous waste generation in 2010–11 become:

- total hazardous waste generated within state/territory = 6,068,985 tonnes
- total hazardous waste sent across state/territory borders = 92,921 tonnes
- hazardous waste generated from MSW stream = 301,836 tonnes
- Therefore total hazardous waste generated in Australia in 2010–11 = **6,463,743 tonnes.**

² <http://www.environment.gov.au/wastepolicy/publications/waste-recycling2011.html>

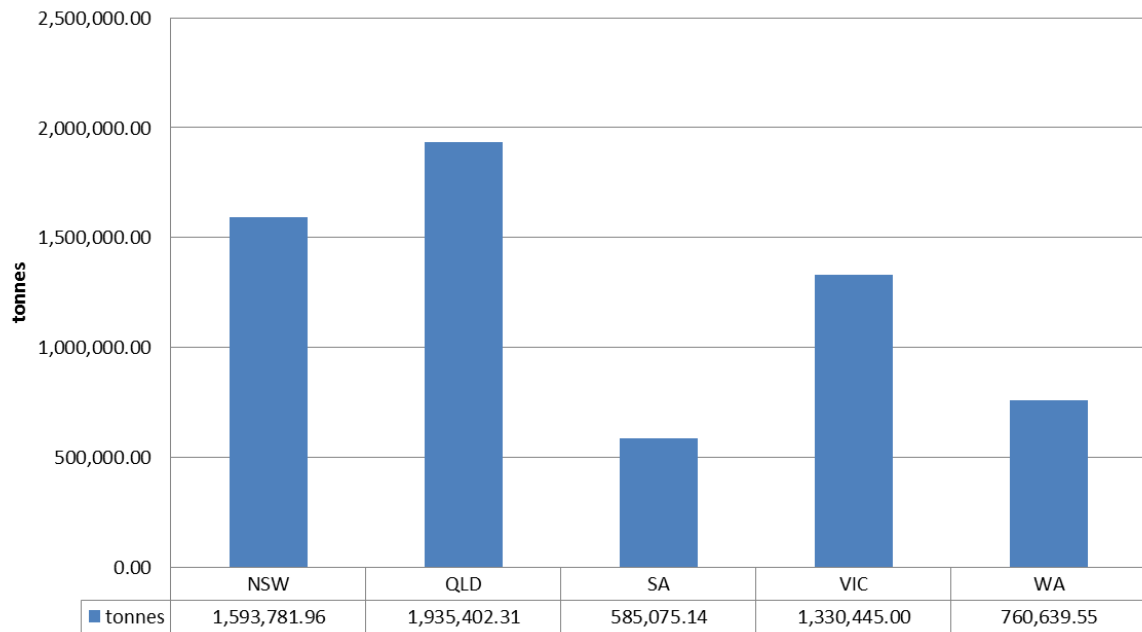


Figure 2—Normalised hazardous waste generated by jurisdiction in 2010–11

Table 2—Major waste generation data observations in 2010–11, after normalisation

Major waste generated		Major waste producing states (tonnes)				
NEPM Waste description	Waste code	New South Wales	Queensland	Victoria	Western Australia	South Australia
Inorganic chemicals						
Arsenic and arsenic compounds	D130	-	777	13	120	108,752
Lead and lead compounds	D220	17,701	9,480	4,935	817	1,836
Zinc compounds	D230	0.72**	514	175	607	147
Non-toxic salts (e.g. sodium chloride, calcium chloride)	D300	11,611	33,626	1,048	6,341	447
Oils, hydrocarbons, emulsions						
Waste oils unfit for their original intended use (lubricating, hydraulic)	J100	64,554	86,404	10,750	72,316	423**
Waste oils and water mixtures or emulsions, and hydrocarbon and water mixtures or emulsions	J120	39,369	149,720	57,786	49,737	6,605**
Triple interceptor waste and stormwater contaminated with oil or hydrocarbons	J130	-	-	29,008	13,129	-
Putrescible/organic wastes						
Animal effluent and residues (e.g. abattoir wastes, poultry wastes, fish and shellfish wastes)	K100	48,058	45,780	33,685	8,530	10,940
Grease trap waste	K110/ K120	172,646	117,529	89,503	67,534	39,301
Sewage sludge and residues including nightsoil and septic tank sludge	K130	375,813	302,261	415,400	302,261	106,222
Food and beverage processing wastes, including animal and vegetable oils and derivatives	K200	68	51,341	41,347	45,697	-
Solid/sludge wastes requiring special handling						
Contaminated soils	N119, N120, N121	371,606	536,338	407,596	7,671**	219,322
Prescribed waste residues in bags or containers not specified under N100 and N105	N110	-	14	10,783	-	-
Industrial waste treatment plant residues	N205	-	83,345	-	2,971	-
Asbestos	N220	434,900	100,162	40,964	-**	20,101
Clinical and pharmaceutical wastes						
Clinical and related wastes, NOS (biomedical waste)	R100	216*	17,744	9,272	2,837	15,067

- **Purple** = Quantities estimated from other sources (as described in Section 3.1.2, I6) used to fill gaps in tracked data
- ** Insufficient information available to fill gap
- Not reported

16. Impact of contaminated soils on waste totals

Contaminated soil is a special case in the assessment of hazardous waste data. It is 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. Influences such as economic climate, industry growth and demographic changes can all impact on the amount of development undertaken.

These drivers are quite different from virtually all other hazardous waste categories, perhaps with the exception of asbestos, which exhibits similar drivers. Other wastes are more directly related to current activities and therefore strategies to tackle their reduction can tap into consumption behaviours, including efficiencies and resource recovery. Conversely, contaminated soil quantities can vary widely from year to year due to factors unrelated to the activity that caused the contamination, which overwhelms all other waste data and introduces the potential for misleading messages to be concluded from the data around trend and broader waste producer behaviours.

To provide a picture of hazardous waste without this large, sporadic and unpredictable influence, contaminated soil quantities have been excised from Figure 2 to provide a truer comparison between jurisdictions. This is depicted in Figure 3 below, which shows the normalised hazardous waste totals for each jurisdiction, contaminated soils excluded.

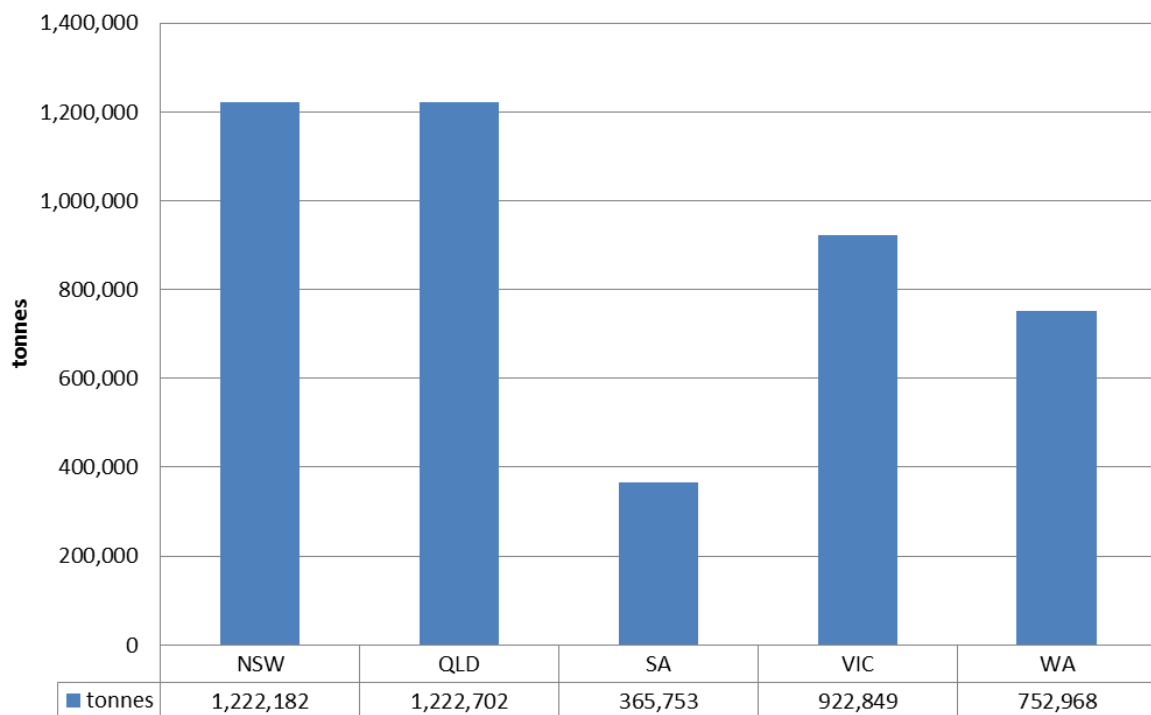


Figure 3—Normalised hazardous waste generated by jurisdiction in 2010–11 (excluding contaminated soils)

17. Per capita comparison

Hazardous waste generated per capita for each jurisdiction, normalised and excluding contaminated soils, is shown in Figure 4. For comparison purposes, Figure 5 shows the same normalised per capita analysis, but with contaminated soils retained.

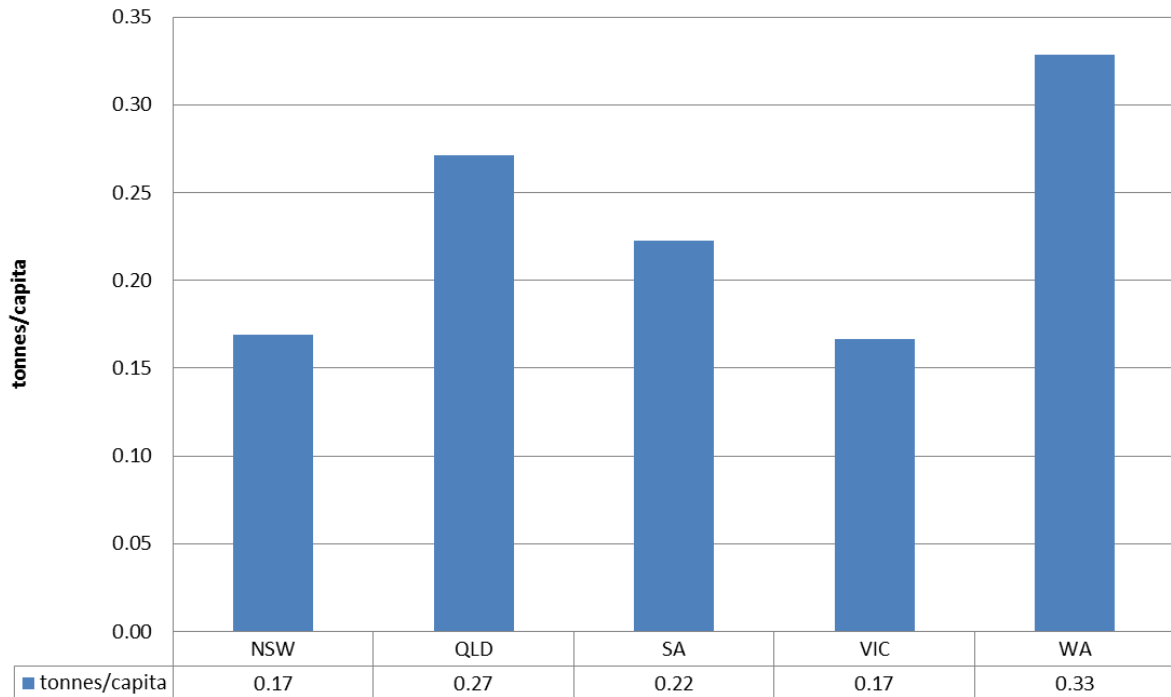


Figure 4—Normalised hazardous waste generation per capita in 2010–11 (excluding contaminated soils)

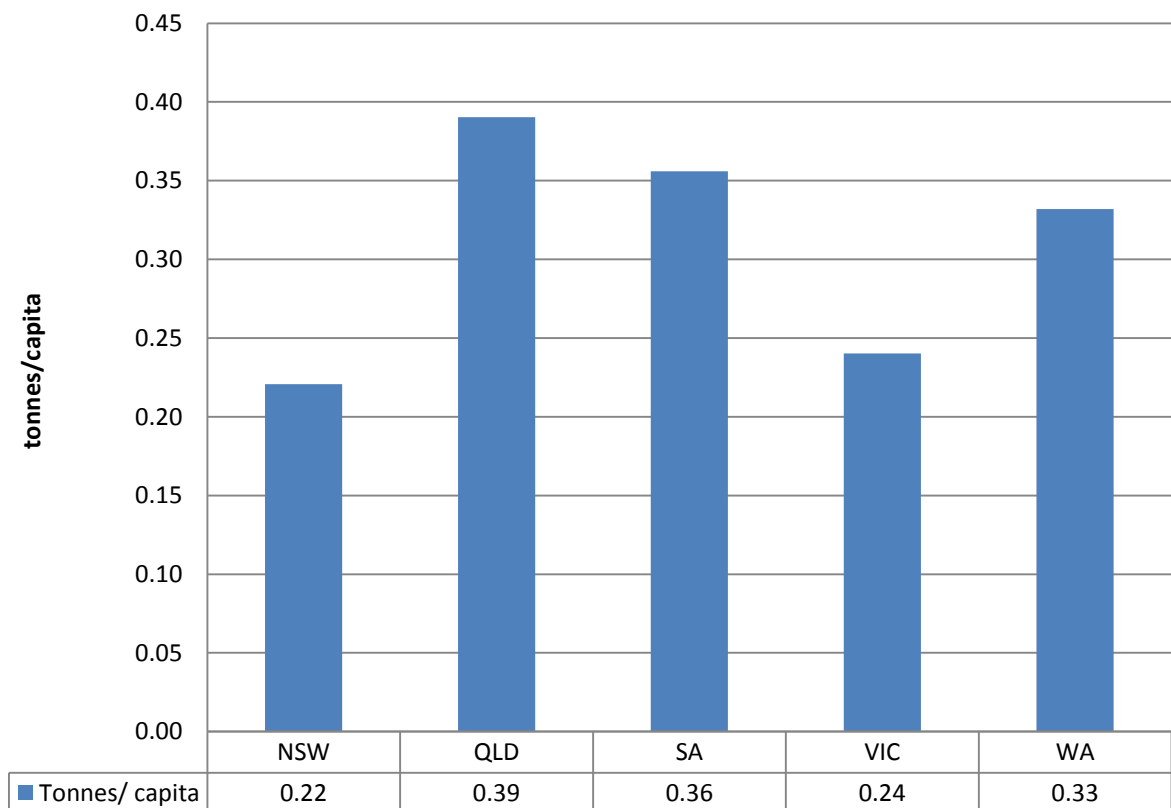


Figure 5—Normalised hazardous waste generation per capita in 2010–11 (including contaminated soils)

With reference to Figure 4, Western Australia is the largest producer of hazardous waste on a per capita basis, followed sequentially by Queensland, South Australia, New South Wales and Victoria. It is interesting to note that this trend differs considerably from that of the total waste generation figures.

While the data is subject to a range of uncertainty, factors that may influence these findings could be:

- Stronger regulatory approaches around hazardous waste in the larger states (e.g. New South Wales and Victoria).
- Drivers specific to each state, such as the scarcity of hazardous waste landfill space in Victoria—there is only one hazardous waste landfill in that state—giving rise to an imperative to pursue alternative treatment options, such as reuse and recycling.
- Economies of scale in the larger states such as Victoria and New South Wales, which could lead to greater economic drivers for the establishment of hazardous waste reuse and recycling markets, or better onsite resource recovery practices.
- Western Australian data may be influenced to a small degree by the fly in/fly out component of mining sector employees, estimated to be approximately 50,000³. These workers do not officially reside in Western Australia but contribute through their working presence to waste and, by extension, hazardous waste generation in the state.
- Western Australia, Queensland and to a lesser extent South Australia have a greater share of mine processing facilities, which may contribute disproportionately to categories such as alkaline waste (C) and Inorganic Chemical wastes (D).
- Western Australia is notable in that it is the only state where asbestos data could not be identified. The volumes observed in some states suggest it could be a waste that may contribute significantly to the current Western Australia total per capita.

Similarly, Western Australia tracking data reports very low tonnages for contaminated soils, compared to the other four states. For example, it is 40% larger by population than South Australia, yet reported 30 times less contaminated soil than South Australia in 2013. This figure may be a perfectly legitimate example of the highly variable factors influencing contaminated soil generation as outlined in Section I6, or it may be grossly under-reported. Either way, this is an illustration of the shortcomings of including contaminated soils in hazardous waste data analysis.

3.1.3. Policy (P) implications

P1. Purpose and use of data by jurisdictions

Data tracking is predominantly driven by the need to meet regulatory requirements around the transport of hazardous wastes. These are in place to manage risks posed by the transport of hazardous wastes and to ensure that the wastes are managed and disposed of in an environmentally acceptable and safe manner. Tracking data provided by jurisdictions for this study is a collation of individual pieces of data collected from a waste transport certificate, which details the quantities and characteristics of a single truck load of waste carried on public roads.

At the broadest level, a jurisdiction's needs for safe and environmentally sound movement of a hazardous waste consignment have been met once the transaction is complete and verified as satisfactorily received by the end treatment operator. Because of this transactional focus, jurisdictions typically do not use this data to for strategic purposes, such as characterising waste management trends and assessing priorities and future waste policy considerations based on underlying data.

P2. Classification anomalies: non-recorded wastes

There are examples where the classification system used by the Controlled Waste NEPM (and within jurisdictional classification approaches) may not include wastes that, in other contexts, could be

³ WA Today newspaper article: <http://www.watoday.com.au/wa-news/stis-spreading-doctors-forced-out-ama-warning-to-fifo-inquiry-20120417-1x4r5.html>

deemed to be hazardous. For example e-waste and compact fluorescent light bulbs (CFL) are waste streams of increasing concern, with some of that concern borne out of the heavy metal (or other chemical) contaminants that exist in these materials. It is an open question as to why a material with a hazard-related concern, such as mercury in CFL or other heavy metals in printed circuit boards, is not managed as a hazardous waste from a transport perspective.

P3. When is a hazardous waste a hazardous waste?

As discussed in P1 above, at the jurisdictional level, hazardous waste management and classification is built around the risks associated its transport. In other words, in terms of tracking data, a hazardous waste is not deemed to be a hazardous waste until it is loaded onto a truck for treatment off-site.

Consequently, this raises an issue regarding the hidden aspect of hazardous waste. Is a waste hazardous because of its inherent characteristics, where it is generated on-site, or is it only hazardous when it is collected by a truck when those inherent characteristics have the potential to cause harm off-site?

Arguably there are mechanisms in place onsite to manage 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 on-site in industrial settings that does not appear in waste tracking data. As an example, fly ash, which typically contains levels of heavy metals that classify it as a hazardous waste, is identified through tracking data as having been produced at a rate of 6,450t across the states of Victoria, New South Wales, Queensland, South Australia and Western Australia in 2011. However, actual quantities of fly ash generated from coal-fired electricity generation in Australia, which are largely managed onsite and therefore not deemed a hazardous waste for the purpose of this study, are likely to dwarf 6,450t by approximately three orders of magnitude.

P4. Definitional questions

This report has previously discussed definitional issues regarding hazardous waste classification, such as whether some materials should be added to the classifications list and whether some existing classifications should be removed or are sufficiently clearly defined. The Victorian data identified in this study highlights a particular issue which opens up the definition of reuse for debate.

Victoria is the only state that has supplied reuse tonnage data, in addition to energy recovery, recycling, storage, treatment and disposal (landfill). Over 7% of all reported hazardous waste in Victoria has undergone reuse, primarily made up of oil, paint, solvent and animal wastes.

Victorian data for the 'J' code oils, hydrocarbons and emulsions, made up mostly of waste oil (J100) and waste oil/water mixtures (J120), is primarily classified as having undergone the reuse management option, with much less reported against the recycling management option. For example, of the 104,795t of J waste generated in Victoria, 31,707t is reported as reused while only 5,502t is reported as recycled.

In the Data Report, *Hazardous Waste Data Assessment* (Appendix A), reuse has been defined as:

The use of products or materials for the same or a different purpose without reprocessing or remanufacture. These products or materials may also be repaired to extend their use.

The question relevant to this Victorian waste oil reuse data is whether the 'cleaning' of the waste oil, to enable it to be fit for its original (or similar) purpose, constitutes reprocessing or should be considered as a kind of refurbishment or repair activity. The former interpretation describes recycling while the latter describes reuse.

A helpful example is a wooden pallet—if the pallet is simply repaired and used again it is deemed to be reused, but if it is disassembled and shredded for the value of its materials, this is considered to be recycling.

It would seem reasonable that the treatment of waste oil to enable it to be used for its original (or similar) purpose would constitute recycling rather than reuse. An examination of what form of processing occurs to the tonnages tracked under the reuse heading would inform the appropriate management option classification.

3.2. Detailed observations

Some more detailed observations focussing on key waste categories and perceived irregularities in waste figures are listed and discussed in the following table, with a view to exploring possible contributing factors. These suggestions are based on the expertise and experience of the authors in the area of hazardous waste and should be viewed as professional opinion only. The suggestion are presented here as a means of generating discussion and further enquiry.

Observation	Potential contributing factors
<p>Waste oil (J100) quantities reported for Victoria appear low (10,750t), compared to Queensland (86,404t), Western Australia (72,316t), and even New South Wales (64,554t), considering that non-hazardous waste oils in New South Wales are exempt from tracking.</p>	<p>The Victorian legislative framework stipulates that used oil filters (J170) are prohibited from landfill and must be reused or recycled, through the value of the metal casing, cardboard filters and used oil. There is also the ability within this framework for transporters to gain an exemption for the use of waste transport certificates for transport of some wastes, where it is destined for reuse or recycling. This exemption approach also applies to various wastes in other jurisdictions.</p> <p>One explanation for the low tonnage reported is that the waste oil, in many cases having come from used oil filters, is being transported under an exemption and therefore not identified by the tracking system.</p>
<p>Asbestos (N220) generation in Victoria (40,964t) is much lower than for other comparable states such as NSW (434,900t—sourced from estimates in <i>Waste and Recycling in Australia 2011</i>).</p>	<p>Asbestos tonnages for New South Wales are difficult to obtain, because this waste is not tracked. The asbestos estimate from <i>Waste and Recycling in Australia 2011</i> was taken from a single waste audit data point and projected for the entire state. This method is likely to have high uncertainties and low accuracy.</p> <p>In addition, there may be instances in Victoria where movements of asbestos are occurring untracked as a result of confusion in the industry between the requirement for waste transport certificates for collections undertaken by commercial contractors versus domestic loads which do not require certificates.</p>
<p>Clinical and related wastes (R100) appear to be under-reported in Western Australia.</p>	<p>Clinical and related wastes (R100) reported by the major states are:</p> <p>Western Australia: 2,837t; South Australia: 15,067t; Queensland: 17,744t; Victoria: 9,272t; and New South Wales: 216t.</p> <p>Noting that this category is exempt from waste tracking in New South Wales, leading to the low figure reported in that state, the Western Australia figure in particular appears to be unusually low. Western Australia data shows that zero tonnes of R100 were exported in 2011.</p> <p>In Western Australia and Victoria, clinical and related</p>

	<p>wastes can only legally be treated using incineration due to the nature of the hazard inherent to this waste category. However in New South Wales, other forms of treatment, such as sterilisation methods, are accepted by environmental regulators. Anecdotal evidence suggests that in New South Wales, some sterilisation services for this waste type can be provided at half the cost or less of incineration.</p> <p>This large economic disparity could make interstate transport of clinical and related wastes followed by interstate treatment competitive against intrastate incineration. However, there is no export data reported from Western Australia for this waste.</p> <p>If clinical waste was imported into NSW from other jurisdictions, the fact that these wastes are exempt from intrastate tracking in New South Wales, but not from interstate tracking under the NEPM, could reasonably have caused confusion over the requirements that apply to wastes entering New South Wales, resulting in non-reporting within the industry.</p>
<p>South Australia imports a significant quantity (19,786t) of zinc compounds (D230). Why?</p>	<p>This is likely to be 'dross' waste from a number of galvanising plants, as there is a zinc smelter at Nyrstar's Port Pirie lead zinc plant. Both primary and secondary zinc materials are used as feedstock in the smelter.</p>
<p>South Australia generates 108,752t of arsenic (D130) waste. This figure seems unreasonably high.</p>	<p>Arsenic is a by-product of the lead/zinc smelting process undertaken at Port Pirie. We believe that such a high figure may be due to an error in reporting, potentially of an order of magnitude.</p>
<p>Why does Victoria import and export a similar amount of inorganic chemicals (category D) (20,858t and 18,010t respectively)?</p>	<p>Looking more closely at the individual waste types within the Category D wastes reveals that the types of waste imported are different to those exported. The two major export wastes are zinc compounds (likely to be destined for South Australia's Port Pirie lead zinc smelter) and non-toxic salts which appear to be destined for New South Wales. In terms of imports, the major waste is lead and lead compounds.</p>
<p>After oils and putrescible wastes, Western Australia's next largest waste generated is 106,000t of alkaline waste (C100). What is this waste?</p>	<p>While easily confirmed by tracking system managers at Western Australia's Department of Environment and Conservation, this is likely to be generated from the alumina refining and smelting processes (e.g. at Kwinana refinery) which use large quantities of caustic.</p>

4. Recommendations

4.1. Detailed review of this report by state and territory agencies

Beyond the collected data itself, this Summary Report contains opinions and interpretation by the authors of observations in the data. These interpretations have not yet been verified or shared with

the providers of the raw data at the jurisdictional level. It is recommended that both Summary Report and the Data Report—the *Hazardous Waste Data Assessment*—be provided for detailed jurisdictional review before any form of publication.

4.2. More detailed investigation to fill key data gaps

This report demonstrates significant gaps in Australian hazardous waste data. The authors have attempted to fill many of these gaps, through other data sources or extrapolation approaches. However many gaps could not be filled. It is recommended that a project be established that focuses solely on approaches to fill these data gaps. Such a project would inform future hazardous waste compilation and the methodology standardisation suggested in 4.7 below.

4.3. Update report with *Waste and Recycling in Australia 2012*

Currently this Summary Report and its companion, the *Hazardous Waste Data Assessment*, rely on *Waste and Recycling in Australia 2011* data, for asbestos and contaminated soil estimates in several jurisdictions. The authors are aware of some limitations in the accuracy of some of this data. It is recommended that as soon as *Waste and Recycling in Australia 2012* data becomes available, this report is updated. If possible, publication of this report should be withheld until this has been completed.

4.4. Classification/policy framework review

It is recommended that consideration be given to review of the Controlled Waste NEPM with a view to harmonising jurisdictional definitional approaches where benefits to do so exist.

4.5. Investigate clinical waste data

It is recommended that further investigation be undertaken into the potential for clinical and other wastes (R100) to be transported across borders without waste transport certificates, particularly between Western Australia and New South Wales.

4.6. Co-operative Commonwealth/state data analysis project opportunities

The wealth of data available to be extracted from waste transport tracking systems suggests there are opportunities to gain further insight from the data. It is recommended that the possibility of Commonwealth/state co-operative projects be explored with a view to analysing hazardous waste data both at the collated and individual transaction level (if appropriate), to assist in informing future waste management policy and priorities.

4.7. Further work on the hazardous component of C&I waste

There is very limited data available in Australia that identifies the amount of hazardous waste present in the otherwise deemed non-hazardous component of C&I waste. In other words, after removing the known and tracked waste from C&I producers, what fraction of the remaining waste volumes contains hazardous wastes? It is recommended that further work be carried out to better fill this data gap.

4.8. Establish a replicable hazardous waste data collection methodology

To assist future compilation of hazardous waste data in Australia, it is recommended that a replicable methodology be further refined and established that captures an acceptable value for effort approach to all of the aspects of data collected in forming a picture of Australian hazardous waste. This includes non-tracked waste and non-hazardous waste stream contributing sources.

Appendix A

Hazardous Waste Data Assessment

Final Report



Appendix B

Revised (Normalised) National 2010–11 Hazardous Waste Data

by Jurisdiction

State/territory	Waste generated (tonnes)		
	Intrastate	Sent interstate	Total from waste movements
Australian Capital Territory	6,345	7,325	13,670
New South Wales	1,641,853	0	1,641,853
Northern Territory	35,300	5994	41,294
Queensland	1,759,040	6505	1,765,545
South Australia	596,015	5201	601,216
Tasmania	35,820	16029	51,849
Victoria	1,330,445	43725	1,374,170
Western Australia	664,168	8142	672,309
Total	6,068,986	92,921	6,161,907

All jurisdictions' tracking data, except for Tasmania's, has been revised in some way, incorporating the following changes:

- Animal effluent and residues (K100)—New South Wales' and South Australia's data gaps filled by population extrapolation from existing jurisdictions' data.
- Grease trap waste (K110/K120)—New South Wales' and South Australia's data gaps filled by population extrapolation from existing jurisdictions' data.
- Sewage sludge and residues (K130)—estimates of biosolids data from the Australian and New Zealand Biosolids Partnership (<http://www.biosolids.com.au/bs-australia.php>) were used for all jurisdictions to replace tracked data.
- Contaminated soils (N119/N120/N121)—data for New South Wales, Queensland, the Australian Capital Territory and the Northern Territory was replaced by estimates from *Waste and Recycling in Australia 2011*. It is noted that while Western Australia's tracked data appears to be very low, there was no change made as no data currently exists to replace it.
- Asbestos (N220)—data for New South Wales, the Australian Capital Territory and the Northern Territory was replaced by estimates from *Waste and Recycling in Australia 2011*. It is noted that there was no data provided by Western Australia's tracking system and no data currently exists to replace it.

Tasmania's interstate export data was deemed to be superior to the alternative data source for contaminated soils and asbestos, *Waste and Recycling in Australia 2011*, so no changes were made.

These changes also apply to data provided at Appendix C.

Appendix C

Revised (Normalised) National 2010–11 Hazardous Waste Data

by Waste Code

Hazardous waste classification		Waste generated (tonnes)					
Code	Waste description	Intrastate	Sent interstate	Total from waste movements	From MSW	Total	% MSW of total
A	Cyanides	7,917	35	7,952	0	7,952	0%
B	Acids	37,165	11,996	49,161	37,073	86,234	43%
C	Alkaline wastes	266,759	849	267,608	1,823	269,431	1%
D	Inorganic chemicals	295,807	35,361	331,168	1,724	332,892	1%
E	Reactive chemicals	1,462	8	1,470	20,820	22,290	93%
F	Paints, lacquers, varnish, resins, inks, dyes, pigments, adhesives	44,441	3,917	48,358	166,535	214,893	77%
G	Organic solvents, solvent residues	27,985	2,309	30,294	454	30,748	1%
H	Pesticides (includes herbicides and insecticides)	2,606	1,294	3,900	5,552	9,452	59%
J	Oils, hydrocarbons, emulsions	601,848	12,041	613,889	49,666	663,555	7%
K	Putrescible/organic wastes	2,129,652	8,695	2,138,347	0	2,138,347	0%
L	Industrial washwaters	88,698	7	88,705	0	88,705	0%
M	Organic chemicals	18,553	1,603	20,156	453	20,609	2%
N	Solid/sludge wastes requiring special handling	2,422,491	13,361	2,435,852	4,101	2,439,953	0%
R	Clinical and pharmaceutical wastes	59,946	909	60,855	2,046	62,901	3%
T	Miscellaneous	63,655	536	64,191	11,590	75,781	15%
Total		6,068,985	92,921	6,161,906	301,837	6,463,743	5%

Putrescible/organic wastes = revised K100/K110/120 and K130, based on population-derived extrapolation and national biosolids data respectively

Solid/sludge wastes requiring special handling = revised N119/N120/N121 and N220 based on *Waste and Recycling in Australia, 2011* estimates