Supporting documentation for draft Guideline for solid waste: criteria for assessment, classification and disposal of waste

Issued September 2009

EPA 658/09: This information sheet provides supporting technical information for the draft publication, Guideline for solid waste: criteria for assessment, classification and disposal of waste*, and should be read in conjunction with this guideline. It describes the process used to derive the revised disposal classifications for waste which includes the corresponding total dry weight and leachable chemical concentration limits.*

Introduction

For many years in South Australia, limits have been set and applied for both the total and leachable concentrations of chemical substances in waste for disposal to landfill. The majority of landfill facilities receiving municipal solid waste, commercial and industrial waste and waste soil would be aware of the application of such limits as it applied to waste soil. Some facilities are also permitted to receive certain industrial wastes containing listed wastes, and have similar limits applied. These permitted limits are stated in the individual licences for such facilities.

As part of the development of the draft Guideline for solid waste: criteria for assessment, classification and disposal of waste (the guideline), the analytes and corresponding limits for the previously classified 'Intermediate' and 'Low Level Contaminated' were reviewed. This document describes the process of that review.

The draft guideline was developed to clarify the application of these criteria for both waste soils and industrial wastes containing listed wastes. It describes the relevant quality assurance and quality controls (QA/QC) needed in the assessment, classification and certification of waste for disposal, and the process and circumstances under which treatment of waste may be required.

Existing limits and nomenclature

In this review, the existing total concentration limits for chemical substances listed for Waste Fill in the *Environment Protection (Fees and Levy) Regulations 1994* will not be revised. The physical and chemical criteria for Waste Fill will remain the same as currently published (Refer Appendix 2 which also lists the source of each chemical criteria).

Waste soil will retain the classification nomenclature for Intermediate Waste Soil and Low Level Contaminated Soil.

Waste soil and other waste streams require differing chemical assessment and classification. To ensure clear differentiation between soils and other wastes, Commercial and Industrial Waste (Listed) will have classifications as either Level 1 or Level 2 Waste.

The limits specified for Level 1 and Level 2 Waste correspond to those for Intermediate Waste Soil and Low Level Contaminated Soil. However, there is an expanded list of chemical substances in the classification table for Commercial and Industrial Waste (Listed).

Table 1 Nomenclature changes for waste disposal criteria

CURRENT		NEW	
Waste type	**Classification**	**Waste type**	**Classification**
Contaminated Soil	Intermediate Landfill Cover	**Waste soil**	Intermediate Waste Soil
	Low Level Contaminated Soil		Low Level Contaminated Soil
Industrial waste	Intermediate Waste	**Commercial and Industrial Waste (Listed)**	Level 1 Waste
	Low Level Contaminated Waste		Level 2 Waste

Process

For the review, the *Environment Protection Authority* (EPA) commissioned an expert peer review panel comprising:

a site contamination auditor who has been accredited under the Victorian *Environment Protection Act 1970*

two environmental engineering consultants

a CSIRO environmental toxicologist

an EPA senior site contamination officer.

This expert panel met several times throughout the project to recommend a process and rational for the setting of criteria.

A desktop review of existing limits was then conducted and a variety of documents and sources reviewed to determine an appropriate rationale for setting criteria for Level 1 Waste/Intermediate Waste Soil and Level 2 Waste/Low Level Contaminated Soil.

Selection of analytes

Other than adding total organochlorine pesticides, the existing set of analytes used for waste soils was retained as the minimum suite required for analysis.

As Commercial and Industrial Waste (Listed) may contain additional substances, the list of analytes required for classifying this waste as Level 1 or Level 2 was expanded. This was done by consulting interstate waste disposal guidelines and national guidance on Scheduled Wastes.

The expanded list for Commercial and Industrial Waste (Listed) can be applied where it is suspected that waste soil contains a contaminant that does not appear in the analyte criteria for waste soil. an expert assessment can be conducted, and justification provided, to determine if that waste soil is suitable for disposal . Where the likely contaminants are unknown or highly variable, then a broad suite analysis must first be conducted.

Setting of criteria

The expert panel recommended that the setting of the total and the leachable criteria would be based on different aspects of the risk they pose. In summary the following rationale was used:

1 Where available, total concentrations criteria were set using national legislation regarding Scheduled Wastes. Health based triggers were considered next, given the industrial setting and exposure of wastes to workers. Interstate criteria or rationale were then used to determine the remaining total dry weight criteria.

   In order to derive the total concentration, other jurisdictions sometimes applied a formula to the likely proportion of a chemical substance that is leachable but which will still meet maximum permissible leachate concentrations (mg/L).

The EPA accepts this as a sound approach and utilised such criteria as a second preference where limits using the first preference in derivation were not available.

2 Leachate criteria would be derived on the basis of environmental risk using existing groundwater protection values.

Total concentration criteria–mg/kg

The following are the considerations used by the EPA when setting disposal criteria, in descending order of preference:

1 The first preference to deriving criteria was related to those limits already set for Scheduled Wastes.

This includes maximum disposal concentrations for organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs).

For example:

The national PCB Management Plan details that:

a <2 mg/kg = PCB free

b 2–50 mg/kg = non-scheduled PCB material. Solids can go to landfill in accordance with recommended guidance notes

c >50 mg/kg = Scheduled PCB material which must not go to landfill without appropriate treatment.

Victorian EPA has a maximum permissible PCB concentration of 50 mg/kg for both TC1 and TC2 classifications[1]; and NSW EPA has a permissible PCB concentration of 50 mg/kg for both General Solid Waste and Restricted Solid Waste classifications[2].The proposed limits for SA Level 1 Waste/Intermediate Waste Soil and Level 2 Waste/Low Level Contaminated Soil have been set in that same manner.

The limits for other Scheduled Wastes which use criteria set in management plans have been applied in this manner. It should be noted that although some individual OCPs have maximum limits set based on existing guidance as outlined below, collectively the total OCPs must not exceed 50 mg/kg.

2 After applying the Scheduled Waste limits, setting the maximum total concentrations of chemical substances in waste was based on the human health risk that they might posed, based on existing investigation triggers

Given the main health risk exposure from the waste would be to landfill workers in an industrial setting, the basis for selection of Level 1 Waste and Intermediate Waste Soil total criteria (mg/kg) is the *National Environment Protection (Site Contamination) Measure Human Health Investigation Level F (Industrial land use)* [NEPM HIL F].

Although not designed for this purpose, the use of these criteria as maxima for an authorised waste disposal site with engineered liners and monitoring is viewed as reasonable and is in line with waste disposal criteria practised interstate.

A misuse of the NEPM would occur if the NEPM was used for clean up criteria or as a limit up to which pollution at an industrial site is permitted (ie through the importation of fill).

3 Service station sites: assessment & remediation–NSW [3]

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1 *Guidelines for Hazard Classification of Solid Prescribed Industrial Wastes, 2005* <epanote2.epa.vic.gov.au/EPA/publications.nsf/2f1c2625731746aa4a256ce90001cbb5/0be2355b52eb2f2aca256e9a001bbae0/$FILE/996.pdf>

2 *Waste Classification Guidelines, Part 1: Classifying Waste*, April 2008 <www.environment.nsw.gov.au/waste/envguidlns/index.htm>

3 *Service station sites: assessment & remediation* <www.environment.nsw.gov.au/clm/servicestation.htm>

Total Petroleum Hydrocarbon (TPH) and BTEX (Benzene, Toluene, Ethylbenzene and Xylene) limits have been sourced from the NSW Service Station guidelines for sensitive landuse. The NSW EPA proposed a multiplication factor of 10 for organic contaminants has been applied to these limits to derive Level 1 Waste total concentration limits to allow for the landfill's industrial setting.

4 Dutch Intervention Levels for Soil Remediation (human and environmental based values)

Where NEPM HIL F values were not available, the *Dutch Intervention Levels for Soil Remediation* was consulted[4]. These values indicate when the functional properties of the soil for humans, plants and animal life are seriously impaired or threatened. They represent the level of contamination above which there is a serious case of soil contamination in a sensitive land use setting. A 'rule of thumb', proposed by NSW EPA in their setting of criteria, is to apply a multiplication factor of 5 for inorganic contaminants and 10 for organic contaminants to the Dutch values, given the level of protection provided in the setting of an engineered landfill.

5 NSW EPA 'General Solid Waste' criteria

The criteria set in NSW for General Solid Waste disposal is equivalent to the EPA's Level 1 Waste/Intermediate Waste Soil. Sources of their criteria can be found by reviewing the NSW document. When the method outlined in option 4 is not used, NSW EPA proposed an alternative approach of applying a factor to the leachate criteria based on likely concentrations of a contaminant that would leach from a substance. This approach has also been applied to EPA leachate criteria, where options 1–3 do not apply.

The approach as advised by NSW EPA is to multiply the leachate value by a multiplication factor of 36. This factor is based on the following:

> Given a given solid waste would leach a proportion of adsorbed of absorbed organic chemicals from within the waste, which can be determined by subjecting the waste to leachate assessment using ASLP[5], a factor can be applied to leachate values to determine total dry weight criteria.

It was acknowledged that values derived by this method are conservative, particularly for those chemicals which are not very soluble in water. This approach was accepted given the potential carcinogenic risks to human health posed by such organic chemicals. The NSW approach and values obtained have been accepted and applied successfully since 1999 when the criteria appeared in *Assessment Classification & Management of Liquid and Non-liquid Wastes*[6]. The EPA sees this as a reasonable and achievable approach in the absence of other criteria.

6 Victorian EPA Guidelines for Hazard Classification of Solid Prescribed Industrial Wastes (2005)

TC1 Values for Industrial Prescribed Waste (and Category C soils) in Victoria are equivalent to SA Level 1 Waste/Intermediate Waste Soil in terms of derivation and the landfill setting. As such these values have been considered where criteria for particular analytes were unavailable elsewhere. However often the approach is already reflected in the above steps and consistent criteria have already been defined. For some analytes Victorian EPA have used Dutch criteria directly or have used a slightly modified NSW leachate factor approach (ie multiply by 40), rather than factors applied to Dutch criteria.

7 Level 2 Waste/Low Level Contaminated Soil criteria limits were then derived by applying a factor, agreed by the expert peer review panel, to Level 1 criteria

It is expected that facilities permitted to receive Level 2 Waste will require more stringent OHS&W practices and procedures to deal with highly contaminated wastes, as well as greater engineering design to control emissions than landfills permitted to receive Level 1 Waste/Intermediate Waste Soil. The expert panel recommended a factor of 4 be applied to Level 1 values in order to set Level 2 total (and leachate) concentration limits.

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4 *Circular on target values and intervention values for soil remediation ANNEX A – Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination,* 4 February 2000

5 *Australian Standard Leaching Procedure* (AS4439.2 and AS4439.3)

6 *Environmental Guideline: Assessment Classification & Management of Liquid and Non-liquid Wastes,* Department of Environment and Conservation, NSW, June 2004.

Leachable concentration criteria–mg/L

The leachable concentration criteria reflect the maximum permissible concentrations of chemical substances in leachate produced from waste as determined by standard laboratory procedures[5]. Leachate can percolate through soil and engineered liners or runoff from waste and therefore pose a potential risk to the environment, particularly groundwater and surface water quality. Therefore it was agreed with the expert panel that the sources of information used to develop criteria for maximum leachable limits should be those sources that have limits based on risk to the environment.

In order to protect waters, criteria that applied to both freshwater ecosystems as well as drinking water were consulted. It was agreed that the most protective value would be selected to reflect the risk that represents the more limiting value. The multiplication factor of 100 as set by the US EPA TCLP[7] (applied to health based drinking water standards) was also recommended by the expert panel to be applied to the environmental criteria in setting the final leachate limit. This factors was to account for the landfill setting with engineered liners and leachate collection systems. A multiplication factor of 4 was then set to reflect the different engineering design and operational standards of landfill permitted to receive Level 1 Waste/Intermediate Waste Soil versus Level 2 Waste/Low Level Contaminated Soil criteria. This is consistent with the approach to set waste disposal leachate criteria in other Australian jurisdictions (eg Victoria and NSW).

The US EPA applied an attenuation factor of 100 to health based values to get the levels for the Toxicity Characteristic rule. These levels were then used in a modelling approach to simulate what happened to waste in a landfill. This model is the Toxicity Characteristic Leaching Procedure (TCLP). The Australian Standard Leaching Procedure (ASLP) is based on the TCLP. Through the use of a subsurface fate and transport model, the US EPA also confirmed the adequacy of this factor for all of their listed constituents[8].

In consultation with members of the EPA Water Quality Branch and in consideration of the approaches to setting criteria interstate and in the USA, criteria were set considering the sources as follows:

1 *The National Water Quality Manager Strategy–Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000* (ANZECC and ARMCANZ[9])

2 *The National Water Quality Manager Strategy Australian Drinking Water Guidelines–6*, 2004 (NHMRC and NRM Ministerial Council[10])

3 The EPA *Environment Protection (Water Quality) Policy*

4 The *National Environment Protection (Assessment of Site Contamination) Measure*, Schedule B1, Table 5-B Groundwater Investigation Levels

5 USEPA final rule for TCLP levels (also reflected for criteria set by NSW and Victoria following the same principle[11]). This includes:

   a USEPA Toxicity Characteristic Rule Finalized, March 1990

   b Table IV-1–TC Constituents and Regulatory Levels Proposed June 13, 1986–Continued, of the Federal Register Vol 55, No 61, Thursday, March 29, 1990.

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7 Toxicity Characteristic Leaching Procedure

8 *Applicability of the Toxicity Characteristic Leaching Procedure to Mineral Processing Wastes, Technical Background Document Supporting the Supplemental Rule Applying Phase IV Land Disposal Restrictions to Newly Identified Mineral Processing Wastes*, Office of Solid Waste, US Environmental Protection Agency, December 1995

9 Australian and New Zealand Environment and Conservation Council; and Agriculture and Resource Management Council of Australia and New Zealand

10 The National Health and Medical Research Council; and Natural Resource Management Ministerial Council

11 Victorian and NSW leachable concentrations are based on Human Health values as sourced from Water Quality criteria or the US EPA TCLP values.

Application of the criteria

Both the total and leachable concentrations for waste soil that exceeds Waste Fill criteria, and all Industrial and Commercial Wastes containing Listed Wastes, must be assessed and the classification determined according to the maximum criteria set out in the guideline.

Where wastes have either higher total concentrations or leachate concentrations that the limits set for Waste Fill or Level 1 Waste/Intermediate Waste Soil, the waste must be assessed according to the next classification up. Where wastes have higher total concentrations than Level 2 but meet the maximum leachate concentrations, any additional site specific OHW&S risks controls will be assessed. Any additional controls need to be proposed by an expert in this area on behalf of the waste producer for EPA's consideration. In any case, the leachate criteria must not be exceeded and will need to be demonstrated as stable by the application of a Multiple Extraction Procedure. Where leachate criteria are exceeded, then treatment where possible or long term storage need to be considered as no direct disposal to landfill will be permitted for these wastes.

Disclaimer

This publication is a guide only and does not necessarily provide adequate information in relation to every situation. This publication seeks to explain your possible obligations in a helpful and accessible way. In doing so, however, some detail may not be captured. It is important, therefore, that you seek information from the EPA itself regarding your possible obligations and, where appropriate, that you seek your own legal advice.

Further information

Legislation

Legislation may be viewed on the Internet at: <www.legislation.com.au>
Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet	Telephone:	13 23 24
Adelaide Service SA Centre	Facsimile:	(08) 8204 1909
108 North Terrace		
Adelaide SA 5000		

For general information please contact:

Environment Protection Authority	Telephone:	(08) 8204 2004
GPO Box 2607	Facsimile:	(08) 8124 4670
Adelaide SA 5001	Freecall (country):	1800 623 445
	Internet:	<www.epa.sa.gov.au>
	Email:	<epainfo@epa.sa.gov.au>

Appendix 1 Notes on sources used for individual chemical substances

Total dry weight chemical substance concentrations (mg/kg)

Substance	Source
Aldrin/dieldrin, Chlordane, DDT (+DDD+DDE), Endrin, Heptachlor, Hexachlorobenzene, Lindane, Isodrin, Hexachlorophene, Hexachlorocyclohexane isomers, Pentachloronitrobenzene (quintozene), Pentachlorophenol, 2,4,5-T (Trichlorophenoxyacetic acid), total PCB, total OCP	As per Scheduled Waste Management Plans or NEPM HILF where additional Scheduled chemicals are specified therein
TPH C_6-C_9, TPH > C9, Benzene, Toluene, Ethylbenzene, Xylenes	NSW Service Station x10 (organic chemical substances)
Chlorobenzene, Chloroform (trichloromethane), 2-Chlorophenol, 1,2-Dichloroethane, Dichloromethane (methylene chloride), Ethylbenzene, Tetrachloroethylene (Tetrachloroethene; Perchlorothylene - PCE), 1,1,1-Trichloroethane, Trichloroethylene	Dutch Intervention Levels x10 (organic chemical substances)
Antimony, Barium, Molybdenum, Selenium, Silver, Styrene (vinyl benzene), Tributyl tin oxide	Dutch Intervention Levels x5 (inorganic chemical substances)
Carbon tetrachloride, Cresol (total), 2,4-D (2,4-dichlorophenoxyacetic acid), Di (2 ethylhexyl) phthalate, 1,2-Dichlorobenzene, 1,4-Dichlorobenzene, 1,1-Dichloroethylene (1,1-Dichloroethene), 1,2-Dichloroethylene (1,2-Dichloroethene), 2,4-Dichlorophenol, 2,4-Dinitrotoluene, EDTA (Ethylene diamene tetra acetic acid), Formaldehyde, Fluoride, Hexachloro-1,3-butadiene, Methyl ethyl ketone, Nitrobenzene, 1,1,1,2-Tetrachloroethane, 1,1,2,2-Tetrachloroethane, Trichlorobenzene (total), 1,1,2-Trichloroethane, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, Vinyl Chloride	NSW factor approach (leachate *36)
All others	NEPM HIL F

Leachate concentrations for chemical substances (mg/L)

Substance	Source
Aldrin + Dieldrin, Antimony, Arsenic, Barium, Benzene, Benzo(a)pyrene, Carbon tetrachloride, Chlorobenzene, 2-Chlorophenol, Di (2 ethylhexyl) phthalate, 1,2-Dichloroethane, 1,1-Dichloroethylene (or 1,1-Dichloroethene), 1,2-Dichloroethylene (1,2-Dichloroethene), Dichloromethane (methylene chloride), Ethylbenzene, EDTA (Ethylene diamene tetra acetic acid), Formaldehyde, Fluoride, Hexachloro-1,3-butadiene, Iodide, Manganese, Molybdenum, Nitrite (as nitrogen), Pentachloronitrobenzene (quintozene), Styrene (vinyl benzene), Tetrachloroethylene (Tetrachloroethene; Perchlorothylene - PCE), Trichlorobenzene (total), Vinyl Chloride	NHMRC Drinking Water*100 (many also WQEPP*100)
Beryllium, Chromium (VI), Hexachlorobenzene, Iron, Phenol and phenolic compounds (total), Polycyclic aromatic hydrocarbons (PAH), Polychlorinated biphenyls (PCB) Total, Selenium, 2,4,5-Trichlorophenol	EPP—lower of Aquatic Ecosystems or Potable (Phenol also as per NEPM GIL Table 5-B, Chromium VI and Selenium also as per ANZECC fresh water)
Boron, Cadmium, Chlordane, Cobalt, Copper, Cyanides (total) – complexed, 2,4-D (2,4-dichlorophenoxyacetic acid), DDT (+DDD+DDE), 1,2-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4-Dichlorophenol, 2,4-Dinitrotoluene, Endrin, Heptachlor, Lead, Lindane, Mercury, Nickel, Nitrate (as nitrogen), Nitrobenzene, Pentachlorophenol, Silver, Tributyl tin oxide, 2,4,5-T (2,4,5-Trichlorophenoxyacetic acid), 2,4,6-Trichlorophenol, Zinc	ANZECC fresh water*100
Toluene, Xylenes (total), Phenol and phenolic compounds (total) (and EPP), Chromium (III)	NEPM GIL*100
Chloroform (trichloromethane), Cresol (total), Cyanides (free) – amenable, Methyl ethyl ketone, 1,1,1,2-Tetrachloroethane, 1,1,2,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, Trichloroethylene	• US EPA, Toxicity Characteristic Rule Finalized, March 1990 • Table IV–1—TC Constituents and Regulatory Levels Proposed June 13, 1986—Continued, of the Federal Register Vol 55, No 61, Thursday, March 29, 1990

Appendix 2 Waste Fill criteria

Waste consisting of clay, concrete, rock, sand, soil or other inert mineralogical matter in pieces not exceeding 100 mm in length and containing chemical substances in concentrations (calculated in a manner determined by the Authority) **less than the concentrations** for those substances set out in Schedule 6, but does not include waste consisting of or containing asbestos or bitumen.

Table 2 Concentrations of chemical substances in waste

Chemical Substance	Concentration (mg/kg of waste)	Source
Aldrin/dieldrin (total)	2	OCPMP
Arsenic	20	ANZECC
Barium	300	NEPM IU EIL
Benzene	1	NSW
Benzo (a) pyrene	1	NEPM HIL A
Beryllium	20	NEPM HIL A
Cadmium	3	NEPM IU EIL
Cobalt	170	ANZECC background
Chlordane	5	OCPMP
Chromium (III)	400	NEPM IU EIL
Chromium (VI)	1	NEPM IU EIL
Copper	60	ANZECC
Cyanides (total)	500	NEPM HIL A
DDT	2	OCPMP
Ethylbenzene	3.1	NSW
Heptachlor	2	OCPMP
Lead	300	NEPM HIL A
Manganese	500	NEPM IU EIL
Mercury	1	NEPM IU EIL
Nickel	60	NEPM IU EIL
Petroleum hydrocarbons TPH C6–C9 (total)	65	NSW
Petroleum hydrocarbons TPH> C9	1,000	NSW
Phenolic compounds (total)	0.5	ANZECC background

Chemical Substance	Concentration (mg/kg of waste)	Source
Polychlorinated biphenyls (PCBs)	2	PCBMP
Polycyclic aromatic hydrocarbons (PAH) (total)	5	ANZECC
Toluene	1.4	Dutch MPC / NSW
Xylene (total)	14	Dutch MPC / NSW
Zinc	200	NEPM IU EIL

ANZECC Guidelines for the Assessment and Management of Contaminated Sites (1992) ('environmental investigation' values unless otherwise stated)

Dutch MPC Dutch Maximum Permissible Concentration

NEPM IU EIL National Environment Protection (Assessment of Site Contamination) Measure 1999

IU EIL Ecologically-based Investigation Level (Interim Urban)

HIL A Health-based Investigation Level A—Residential with garden/accessible soil

NSW NSW EPA Guidelines for assessing service station sites

OCPMP National Organochlorine Pesticide Management Plan
(exempt OCP waste <2
non-scheduled OCP waste >2 and <50
scheduled OCP waste >50)

PCBMP PCB Management Plan
PCB Free <2
non-scheduled PBC waste >2 and <50;
scheduled PCB waste >50