Roadworks - Contaminated Soil Management Procedure

(Including management of coastal acid sulphate soils, i.e. Coode Island silt)

City of Melbourne

April 2023

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1.0 Introduction

The City of Melbourne includes a number of areas where reclamation of low lying land coincided with early industrial activities, such as gasworks, abattoirs and tanneries. Waste products from these industrial activities were frequently used as fill or foundation material during redevelopment works, and thus contaminated soils are likely to be present in these areas of inner urban Melbourne. In fact, there have been several instances in the past where contractors have encountered contaminated soil during road and subsurface service infrastructure repair and maintenance works within the City of Melbourne. Similarly, the City of Melbourne is in an area that contains Coastal Acid Sulfate Soils which occur naturally along many parts of Victoria's coast. When Coastal Acid Sulfate Soils are disturbed they can react with oxygen to produce sulfuric acid. This can result in environmental impacts; including acidification of water and soil, de-oxygenation of water, poor water quality, dissolution of metals from soil and corrosion of concrete and metal structures.

Such incidents have the potential to result in additional costs, work stoppage and/or delays, unexpected additional costs, and potential human exposure to contaminated soil. Excess contaminated soils and/or Coastal Acid Sulfate Soils, which are generated during infrastructure projects, must be managed in accordance with Victorian regulatory requirements.

1.1 Objective

This Procedure aims to achieve the following objectives:

- Summarise the regulatory requirements for managing contaminated soil and Coastal Acid Sulfate Soils in Victoria.
- Provide Council with a Procedure for managing contaminated soil and Coastal Acid Sulfate Soils, which takes into account the nature and scale of works undertaken by the Council and its Contractors.
- Provide a Procedure that supports more efficient management of contaminated soils and Coastal Acid Sulfate Soils, and which is cost effective and can be readily implemented by Council and its Contractors.
- Develop an implementation plan for adoption of the proposed Procedure.

1.2 Scope of the Procedure

This Procedure is intended to cover works by Council within road reserves.

The scope of this Procedure will address soil contamination and Coastal Acid Sulfate Soils, but will not address any other issues that may be associated with Council’s earthworks, such as management, disposal and reuse of other waste material (e.g. solid inert waste, bitumen, concrete), groundwater and surface water contamination, cultural heritage, or fauna and flora impacts.

This Procedure outlines the following:

- Underlying principles (Section 2.0);
- Victorian waste management statutory requirements (Section 3.0);
- Soil management procedures (Section 4.0); and
- Implementation plan (Section 5.0).

2.0 Underlying principles

The Procedure is:

- Based on consideration of the nature and scale, and potential risks associated with Council's infrastructure works;
- Cost effective; and
- Able to be readily implemented by Council and its Contractors.

3.0 Victorian waste management statutory requirements

This section outlines the statutory framework that governs the management of contaminated soils in Victoria.

3.1 Environment Protection Act 1970

The *Environment Protection Act* 1970 (the Act) is the primary legislation in Victoria for the protection of the environment. It considers all aspects of environment (air, water, land, waste and noise). The Act aims to prevent pollution and environmental damage by enabling the establishment of environmental quality objectives and supporting implementation programs. The Act has been amended considerably since its inception in 1970, and incorporates a wide variety of mechanisms, enforcement measures and enables the development of many supporting subordinate instruments.

Principles consistent with the *National Strategy on Ecologically Sustainable Development* and the *Intergovernmental Agreement on the Environment* have been incorporated into the Act to assist with implementation and decision making.

3.2 Industrial Waste Management Policy (Waste Acid Sulfate Soils)

An acid sulfate soil is any soil, sediment, unconsolidated geological material or disturbed consolidated rock mass, which contains metal sulfides exceeding criteria published by the Environment Protection Authority. Waste acid sulfate soils and rock must be managed in accordance with the requirements of the Industrial Waste Management Policy (IWMP) (Waste Acid Sulfate Soils) (WASS) 1999. This policy provides a management framework and specific requirements for the management of acid sulfate soils in an environmentally responsible manner. The IWMP (WASS) requires that off-site disposal or reuse of waste acid sulfate soil may only occur at premises:

- that are licensed to dispose of that type of waste under the Environment Protection Act 1970; or
- where an EMP, prepared in accordance with the Policy, has been approved by the Authority.

The IWMP (WASS) also requires that onsite management of waste acid sulfate soil takes place where best practice environmental management guidelines *(Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils)* are implemented.

3.2.1 Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils

The Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (BPMG) have been produced to guide landowners, developers and planners through an approach to assist them to make decisions about the assessment and management of Coastal Acid Sulfate Soils.

The Coastal Acid Sulfate Soils risk identification process in the BPMG is designed to guide a decision-making process for development or activity proposed on land that has been identified as having the potential to contain Coastal Acid Sulfate Soils.

The BPMG describes the following risk identification and assessment process;

- Stage A: Preliminary Coastal Acid Sulfate Soils hazard assessment.

- Stage B: Detailed site soil sampling program and assessment.
- Stage C: Surface/ground water sampling program and assessment.
- Stage D: Coastal Acid Sulfate Soils hazard assessment.

The impacts of disturbing Coastal Acid Sulfate Soils will vary between sites and the nature of activities. The need to undertake detailed soil sampling an analysis will be dependent on the outcome of the preliminary Coastal Acid Sulfate Soils hazard assessment. The preliminary Coastal Acid Sulfate Soils hazard assessment is intended to take into account if the:

- activity is “High Risk”; and
- activity is to occur in a Coastal Acid Sulfate Soils risk area.

High Risk activities as described in the BPMG have been incorporated into the procedure (Section 4.1). A map, based on publicly available information showing Coastal Acid Sulfate Soils Risk areas in the City of Melbourne has been developed and forms part of the Procedure (APPENDIX A).

3.3 Environment Protection (Industrial Waste Resource) Regulations 2009

Hazardous wastes are sometimes generated as a result of activities such as the manufacturing of motor vehicles, paint and plastics, dry cleaning services, fast food outlets, dental surgeries and hospitals, and the remediation of contaminated land. In the Victorian statutory framework for environment protection, such wastes are referred to as Prescribed Industrial Waste. As these wastes pose a potentially higher risk to people and the environment, they are more closely regulated than other forms of waste.

The *Environment Protection (Industrial Waste Resource) Regulations* 2009 (the Regulations) are intended to manage Prescribed Industrial Waste within a risk-based regulatory system. The primary purpose of introducing this risk-based approach is to enable enhanced reuse and recycling of industrial waste resources in accordance with the waste hierarchy (shown in Figure 1) and to reinforce the safe management of Prescribed Industrial Waste by supporting the treatment of waste to reduce its hazard prior to disposal.

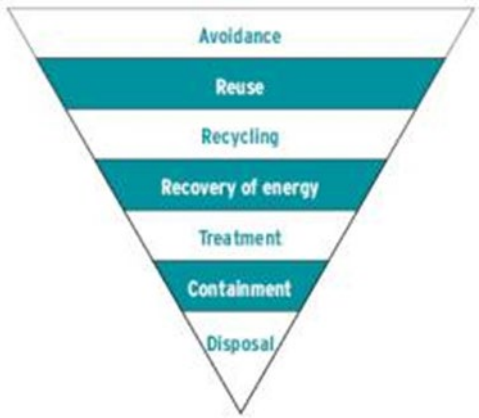

Figure 1: Waste Hierarchy (Sourced from the Victorian Environment Protection Authority, www.epa.vic.gov.au)

Under the framework established by the Regulations, industrial wastes are subject to hazard categorisation. Wastes are categorised on the basis of the potential hazard posed by their chemical composition or physical attributes, and those that are identified as Category A, B or C wastes, are regulated as Prescribed Industrial Waste. Less hazardous waste that falls below the Category C threshold is managed as industrial waste, or as fill material in the case of soils.

The Act and the Regulations place particular requirements on the management of Prescribed Industrial Waste, including:

- Obligations for generators to classify waste;
- Requirements for Prescribed Industrial Waste to be transported in Victorian Environment Protection Authority permitted vehicles;
- Requirement that Prescribed Industrial Waste can be sent only to Environment Protection Authority licenced facilities; and
- Tracking of waste from point of generation to final disposal.

3.3.1 Industrial Waste Resource Guidelines

The Environment Protection Authority *Industrial Waste Resource Guidelines (IWRG)* 2009 provides guidance on compliance with the Regulations for the classification of waste soil.

Where a site has potentially contaminated soil, the soil must be assigned a hazard category of A, B, C or fill material prior to off-site reuse, or disposal.

Environment Protection Authority Guidance states that soils are considered potentially contaminated if they:

- Have been mixed with any wastes;
- Consist of, or partially consist of, soil of unknown origin that has been brought onto a site;
- Arise from sites where former uses include industrial, commercial, mining or agricultural activities; or,
- Have had manufactured chemicals applied.

Due to the widespread use of waste products from industrial activities to infill low lying areas, or as foundation material during redevelopment works, contaminated soils (as a result of mixing with waste) are likely to be present in areas of inner urban Melbourne.

Sampling and classification must be undertaken in accordance with Environment Protection Authority Publications *Soil Sampling* ('IWRG702'[1]) and *Soil Hazard Categorisation and Management* ('IWRG621'[2]).

The initial step in waste characterisation is to conduct a Preliminary Site Investigation (PSI) in accordance with Australian Standard 4482.1[3]. The primary objectives of the PSI are to:

- Assess the potential for the soil to be contaminated; and
- Identify which contaminants require analysis to determine the appropriate hazard category.

Where a PSI identifies that the soil is likely to be contaminated, the Guidelines require the analysis to be for all chemical substances known, and reasonably expected to be present in the waste. In the event that a site history assessment is not undertaken, or not known, and in particular where information indicates a high likelihood that contaminated soil is likely to be present, then a conservative position should be adopted, typically involving testing the broad range of chemicals listed in Table 2 of Environment Protection Authority Publication IWRG621.

Environment Protection Authority Publication IWRG621 also provides threshold values to categorize soil into one of four hazard classes:

- Category A - Highest waste classification. This soil must be treated prior to disposal as there are no landfills licensed to receive Category A waste in Victoria.

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[1] Industrial Waste Resource Guidelines *Soil Sampling,* Document IWRG702, June 2009, prepared under the same Regulations

[2] Industrial Waste Resource Guidelines *Soil Hazard Categorisation and Managemen*t, Document IWRG621, June 2009, prepared under the same Regulations

[3] Australian Standard 4482.1, *Guide to the sampling and investigation of potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds.*

- Category B - This soil can be treated or disposed to landfill.
- Category C - This soil can be treated or disposed to landfill.
- Fill Material - Lowest waste classification. Provided it is safe to do so (based on consideration of the State Environment Protection Policy (Prevention and management of Contamination of Land)) this soil can be reused on other sites or disposed to landfill. Fill material includes rock of naturally occurring materials.

Soil that contains asbestos, or Asbestos Containing Material, but no other chemical contamination is classed as Category C Asbestos Waste to be disposed to a landfill, licensed to accept this waste. Such material must be removed, packaged, transported and disposed of in accordance with Environment Protection Authority and Worksafe Victoria requirements.

3.3.2 Transport and Disposal

Category A, B or C soils and Asbestos Waste are Prescribed Industrial Waste under the *Environment Protection (Industrial Waste Resource) Regulations* 2009. Transport and disposal of Prescribed Industrial Waste is required to be carried out using vehicles permitted by Environment Protection Authority to carry such materials, and must be tracked using Environment Protection Authority Waste Transport Certificates. The transport of waste Coastal Acid Sulfate Soils does not require use of transported certificates or permitted vehicles.

Asbestos from industrial origins (including commercial or trade activities) must be transported and disposed in accordance with the guidelines in Environment Protection Authority Publication IWRG611[4] *Asbestos Transport and Disposal.*

Landfills must be licenced by Environment Protection Authority to receive Prescribed Industrial Waste and asbestos. The landfills will have in place their own processes and procedures to assess the material being received.

3.3.3 Exemptions

A waste transporter, transporting Prescribed Industrial Waste for no fee or reward, where the net load is less than 50 kg or litres is exempted from the requirement to hold a transport permit under section 53A of the Act and the requirements to use transport certificates.

3.4 Asbestos Removal from Soil

Environment Protection Authority and Worksafe Victoria have developed a *Guidance Note – Asbestos Contaminated Soil* (Guidance Note) to assist in understanding statutory obligations regarding assessment of soil contaminated with Asbestos Containing Material. The Guidance Note is intended to clarify measures for removing Asbestos Containing Material from soil prior to disposal of the Asbestos Containing Material and residual soil. The Guidance Note describes;

- Who should inspect asbestos contaminated soil;
- Who can remove asbestos contamination from soil;
- Requirements relating to transportation and disposal of asbestos contaminated soil (see also Section 3.2.2); and,
- Suggested means of documenting assessment outcomes.

The assessment of Asbestos Containing Material contaminated soil and removal of Asbestos Containing Material from soil should be in accordance with this Guidance Note.

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[4] Industrial Waste Resource Guidelines *Asbestos Transport and Disposal*, Document IWRG611.1, July 2009, prepared under the same Regulations

4.0 Soil management procedures

The Procedure is divided into the following three steps and the management procedures to be followed in each step are described in Sections 4.1 to 4.3.

- Step 1 – Project Planning (including Coastal Acid Sulfate Soils screening)
- Step 2 – Excavation
- Step 3 – Disposal

There are a number of different scenarios in each step, and the Council and its Contractors can determine which scenario is applicable for a respective project by following the decision making flow chart provided in Appendix B.

4.1 Step 1 – Project Planning

The decision making process and procedures to be followed in this step are summarised as follows:

- Council proposes an infrastructure project.
- Council assesses the likelihood that Coastal Acid Sulfate Soils will be disturbed during the project.
- Council assesses the project scope of works to determine if soils will be excavated.
- If soils will be excavated during the works, the project design should be assessed to determine if it is possible to reuse soils as part of the works, to prevent the generation of excess soils.
- If excess soils will be generated during the works, then the project should be reassessed to determine if it is possible to modify the project design to prevent or minimise excess soil generation.

Coastal Acid Sulfate Soils Screening

The Coastal Acid Sulfate Soils screening process assesses the likelihood of Coastal Acid Sulfate Soils being present at a site where a project is proposed (i.e. site is within Probable Coastal Acid Sulfate Soils area) and whether Coastal Acid Sulfate Soils will be disturbed (high risk activity).

The screening process involves undertaking a desktop assessment of available information about the project site to determine whether high risk activity is proposed in a probable Coastal Acid Sulfate Soils area.

A Coastal Acid Sulfate Soils risk area is an area where:

- Acid sulfate soils have been previously identified at or near the site (based on Council records);or
- An area identified by mapping (based on map of probable Coastal Acid Sulfate Soils) that has the potential to contain Coastal Acid Sulfate Soils.

APPENDIX A shows a map of probable Coastal Acid Sulfate Soils areas in the City of Melbourne. This map has been developed based on consideration of the:

- Coastal Acid Sulfate Soils GIS data set published by Department of Environment and Primary Industries; and
- Atlas of Australia Acid Sulfate Soils GIS data set published by CSIRO Land & Water.

There are a number steps in the Coastal Acid Sulfate Soils screening process, which are presented in a decision making flow chart provided in Appendix B.

The first step in the Coastal Acid Sulfate Soils screening process is to check for the presence of Coastal Acid Sulfate Soils in the vicinity of the proposed project site by checking: (1) the City of Melbourne records; and (2) the map of Probable Coastal Acid Sulfate Soils.

Where the activity is not in an area of probable Coastal Acid Sulfate Soils, then no further actions regarding Coastal Acid Sulfate Soils need to be undertaken. If records or the map of Probable Coastal Acid Sulfate Soils indicate that the project site is likely to be in an area of probable Coastal Acid Sulfate Soils then the Coastal Acid Sulfate Soils risk associated with the project needs to be further assessed.

The Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils identifies high risk activities as:

- Excavating soil/sediment (> 1000 m3);
- Extracting or lowering groundwater;
- Filling land or stockpiling soil (more than 100 m3 with an average depth of at least 0.5 m) over in situ Potential Acid Sulfate Soils (PASS); these activities can force the underlying ASS above the water table at the margins of the added soil or fill;
- Planting of vegetation (crops or plantation) that may potentially lower the water table; and
- Coastal or inshore dredging.

Where Council is proposing a project that includes any of the high risk activities, the risk should be further assessed if excavations are likely to be more than 600mm below the site ground level (bgl). Where excavations are less than 600 mm bgl, then no further actions regarding Coastal Acid Sulfate Soils needs to be undertaken.

If undertaking a high risk activity and proposed excavation is greater than 600 mm, then Council should engage a consultant with Coastal Acid Sulfate Soils management experience to assess the need to sample and analyse soils for the presence of Coastal Acid Sulfate Soils, to enable offsite disposal or management. If the consultant recommends that soil sampling is not required then no further actions regarding Coastal Acid Sulfate Soils need to be undertaken.

Where the consultant identifies that soil sampling is required, soils should be sampled and analysed for the presence of Coastal Acid Sulfate Soils. Where required, soil sampling and analysis for Coastal Acid Sulfate Soils could be undertaken in conjunction with sampling for potential contamination (see *Soil Sampling, Analysis and Classification*). The Environment Protection Authority Publication, *Acid Sulfate Soil and Rock, Publication number 655.1*, summarises sampling frequencies in relation to off-site disposal of Coastal Acid Sulfate Soils.

If sampling and analysis indicate that Coastal Acid Sulfate Soils is not present then no further actions regarding Coastal Acid Sulfate Soils need to be undertaken.

Where soil sampling indicates that Coastal Acid Sulfate Soils is present:

- Excavated soil must be disposed of at a site approved by Environment Protection Authority; and
- Retained soil must be managed in accordance with the Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils.

Where Council has identified that it is not undertaking a high risk activity, then the possibility of retaining or reusing soils on site will need to be evaluated.

If excavated soils are to retained onsite and the site is connected to a natural water body or wetland (e.g. within 50 m), then retained soil will require management in accordance with Victorian Best Practice Guidelines for Assessing & Managing Coastal Acid Sulfate Soils.

Where soils cannot be retained and the volume of soil is less than 30 m^3, no further actions regarding Coastal Acid Sulfate Soils need to be undertaken. Where the volume of soil is greater[5] than 30 m^3, Council should engage a consultant with Coastal Acid Sulfate Soils management experience to assess the need to sample and analyse soils for the presence of Coastal Acid Sulfate Soils to enable offsite disposal or management.

Council Preliminary Screening Process

Council adopted the following preliminary screening process to determine when sampling and analysis of soils will be undertaken.

- If the generation of excess soils cannot be avoided, Council will assess if macadam (a form of potentially contaminated road base) will be excavated, and if so, Council will arrange for in situ sampling and analysis to classify the excess soils.
- If the generation of excess soils cannot be avoided and excavation is to occur in an area where Council believes that there is the potential for contamination to be encountered (based on Council's knowledge of historical fill use in the area, potentially contaminating historical land uses, or prior analysis of soils) then Council will arrange for in situ sampling and analysis to classify the excess soils.
- Council will then assess the volume of excess soils that will be generated. As outlined below, there are two potential excavation scenarios depending on the volume of soils excavated, and scale of the project:
    - Scenario 1 – Council has determined macadam will not be excavated, works are not in an area where Council believes the potential for contamination exists, excess soil volume is greater than5 30 m3 and project defined as a 'major or minor project'6 by Council; and
    - Scenario 2 - Council has determined macadam will not be excavated, works are not in an area where Council believes the potential for contamination exists and excess soil volume is less than 30 m3.

It is noted that the volume of 30 m^3 is a nominal volume, which has been determined by Council as a practical means of ensuring sampling is undertaken for those projects with the greatest potential to have significant cost impacts associated with excess soil disposal. This volume is subject to Council review to assess if it is appropriate, noting the soil sampling, analysis and classification requirements outlined in Environment Protection Authority Publications *Soil Sampling* (IWRG702). Council will review this trigger volume within 12 months of adopting this Procedure.

If excess soil volume is less than 30 m^3 (and Council has determined that no macadam, or works in a potentially contaminated area are proposed), then visual assessment during excavation will be used to determine the potential for contamination. Where contamination is observed, or suspected, sampling and analysis are required to classify the waste prior to disposal. The field card provided in Appendix C is to be used as a guide on how to undertake a visual and olfactory inspection of excess soils for contamination, or Asbestos Containing Material.

If excess soil volume is greater than 30 m^3, excess soils will be classified based on the results of sampling and analysis.

Soil Sampling, Analysis and Classification

Soil sampling and classification will be undertaken in accordance with Australian Standard 4482.1[7], Environment Protection Authority Publications *Soil Sampling* ('IWRG702'[8]) and *Soil Hazard Categorisation and Management* ('IWRG621'[9]).

The minimum sampling rate to classify *in-situ* or stockpiled soils for offsite disposal is <u>1 sample per 25 m^3 and a minimum of 3 samples.</u> Sampled soils are categorised based on the highest reported concentration. Alternatively, the soils may be categorised based on a statistical assessment, provided that sufficient sample data is available (i.e. 10 samples for a soil volume <2,500 m3).

Full details of the soil sampling requirements are provided in Environment Protection Authority Publication *Soil Sampling* ('IWRG702'), a copy of which is provided in Appendix D.

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[7] Australian Standard AS4482.1-2005, Guide to investigation and sampling of sites with potentially contaminated soil, Part: Non-volatile and semi-volatile compounds, 2005.

[8] Industrial Waste Resource Guidelines Soil Sampling, Document IWRG702, June 2009, prepared under the same Regulations.

[9] Industrial Waste Resource Guidelines Soil Hazard Categorisation and Management, Document IWRG621, June 2009, prepared under the same Regulations.

Council may engage an Environmental Consultant to assist in soil sampling, analysis and classification. The classification methodology should take into account the following details:

- Location of the site from which soils will be excavated;
- Volume of soils to be excavated;
- The presence of domains at the site (a domain is an area or layer of material with same probable soil hazard category); and
- The availability of historical representative soil classification data.

Soil classification data from previous infrastructure projects in the vicinity of the site may be considered *representative* if the soil samples meet the following criteria:

- The samples were collected from the same 'domain' (a domain is an area or layer of material with same probable soil hazard category);
- Samples were collected in accordance with Australian Standard 4482.1;
- There is a sufficient number of samples to classify soils for disposal in accordance with Environment Protection Authority Publication IWRG621.

Council may engage an Environmental Consultant to assess if soil classification data from previous projects would be considered '*representative'*.

Major Projects

Major Projects are those that involve:

- Public tendering of Council works;
- Prominent locations with high use or lack of space for stockpiling of soils;
- Generation of excess soils over 200m3 in volume.

Failure to appropriately manage and classify the excess soils during major projects has the potential to result in significant additional project costs and delays. It is therefore necessary for Council to classify soils prior to commencement of works, as part of the project planning and tender preparation.

When planning major projects, Council will consider the amount of excess soil and its contamination status. Where the quantity and nature of contamination is likely to result in significant additional management and disposal costs, Council will evaluate the feasibility of proceeding with the project.

The process and procedures to be followed for Major Projects are summarised below and the decision making flowchart is provided in Appendix B:

- If no representative soil analytical data is available to classify soils for disposal, Council will arrange for an Environmental Consultant to collect representative soil samples in accordance with the Australian Standard 4482.1 and Environment Protection Authority Publication IWRG702. Samples should be analysed and classified in accordance with Environment Protection Authority Publication 'IWRG621' (copies of which are provided in Appendix D). Where required, soil sampling and analysis for contamination could be undertaken in conjunction with sampling for Coastal Acid Sulfate Soils (see Coastal Acid Sulfate Soils Screening).
- Council will evaluate the potential to collect soil samples for waste classification purposes during other intrusive works (e.g. utility clearance or geotechnical works), as this should save on mobilisation and sampling costs.

- An Environmental Consultant may be required to provide Council with a Waste Classification Report which presents the waste classification and the corresponding soil analytical data. In engaging the Environmental Consultant for this work, Council will require a report that:
    - Confirms that sampling and analysis have been undertaken in accordance with Australian Standard 4482.1 and Environment Protection Authority Publication IWRG702.
    - Confirms that sufficient samples have been taken in accordance with Environment Protection Authority Publication IWRG702 to enable classification of the specific volume of excess soils in accordance with Environment Protection Authority Publication IWRG621.
    - Includes a summary letter confirming the classification of the excess soil is in accordance with Environment Protection Authority Publication IWRG621, which can be made available to the operator of the facility where the excess soil is to be disposed.
- Council will provide the Environmental Consultant with an estimate of the volume of excess soil made during the planning phase, to assist with the design of a suitable sampling program.
- Council will consider the waste classification results and volume estimates during project planning, budgeting and tender documentation preparation. Council will make the Consultant's Report available to contract tenderers.

Minor Projects

Minor Projects are those that do not fall into the major projects category as described above, and therefore carry a lesser risk. It is appropriate for Contractors to manage and classify the excess soils as part of the minor project delivery.

The decision making process and procedures to be followed for Minor Projects are summarised below, and the decision making flowchart is provided in Appendix B:

- If no representative soil analytical data is available to classify soils for disposal, the Contractor should arrange for a an Environmental Consultant to collect representative soil samples in accordance with the Australian Standard 4482.1 and Environment Protection Authority Publication IWRG702. Samples should be analysed and classified in accordance with Environment Protection Authority Publication 'IWRG621'. Where required, soil sampling and analysis for contamination could be undertaken in conjunction with sampling for Coastal Acid Sulfate Soils (see Coastal Acid Sulfate Soils Screening).
- The Contractor should evaluate the potential to collect soil samples for waste classification purposes during other intrusive works (e.g. utility clearance or geotechnical works), as this should save on mobilisation and sampling costs.
- An Environmental Consultant may be required to provide the Contractor with a Waste Classification Report which presents the waste classification and the corresponding soil analytical data. In engaging the Environmental Consultant for this work, the Contractor will require a report that:
    - Confirms that sampling and analysis have been undertaken in accordance with Australian Standard 4482.1 and Environment Protection Authority Publication IWRG702.
    - Confirms that sufficient samples have been taken in accordance with Environment Protection Authority Publication IWRG702 to enable classification of the specific volume of excess soils in accordance with Environment Protection Authority Publication IWRG621.
    - Includes a summary letter confirming the classification of the excess soil is in accordance with Environment Protection Authority Publication IWRG621, which can be made available to the operator of the facility where the excess soil is to be disposed.

Projects < 30m^3

- For projects where the excess soil volume is less than 30 m3 (and Council has determined that no macadam, or works in a potentially contaminated area or probable Coastal Acid Sulfate Soils area are proposed), waste classification of excess soils is to be based on field inspection for evidence of contamination, Coastal Acid Sulfate Soils, or visible Asbestos Containing Material. Soils with evidence of contamination, or suspected of being contaminated or containing Coastal Acid Sulfate Soils, will be sampled and classified prior to disposal. The field card provided in Appendix C is to be used as a guide on how to undertake a visual and olfactory inspection of excess soils for contamination, Coastal Acid Sulfate Soils or Asbestos Containing Material.

4.2 Step 2 - Excavation

The decision making process and procedures to be followed in the excavation step are summarised below, with the decision making flowchart is provided in Appendix B:

Scenario 1

In this scenario, excess soils have been pre-classified prior to commencement of excavation and the procedure includes the following steps:

- The Contractor should consider the waste classification results and, if practical, segregate different domains during excavation works (e.g. asphalt, road base and material of different waste classifications (Category A, Category A, Category C, Coastal Acid Sulfate Soils, Fill Material). Asphalt and road base should be reused or recycled in accordance with the Waste Hierarchy. Solid Inert waste should be disposed to a landfill licensed to accept Solid Inert Waste.
- Oversize material (>100 mm in size), should be screened as far as practicable from soils to enable it to be managed as Fill Material and minimise the volume of soils that require disposal to landfill.
- The Contractor should undertake an inspection of the excess soil for visible Asbestos Containing Material or unexpected contamination or Coastal Acid Sulfate Soils during excavation. The field card provided in Appendix C is to be used as a guide on how to undertake a visual and olfactory inspection of excess soils for contamination, Coastal Acid Sulfate Soils or Asbestos Containing Material.
- If unexpected contamination is encountered, soils with evidence of contamination, Coastal Acid Sulfate Soils or Asbestos Containing Material should be segregated from clean material to the extent practical.
- Contractor should arrange for an Environmental Consultant to collect representative soil samples of this segregated material in accordance with the Australian Standard 4482.1, Environment Protection Authority Publication IWRG702, Environment Protection Authority Publication 655.1 (where Coastal Acid Sulfate Soils is present) and to classify the soil for disposal in accordance with Environment Protection Authority Publication IWRG621 and Environment Protection Authority Publication 655.1.
- The Environmental Consultant should provide the Contractor with a Waste Classification Letter, which presents the waste classification and the corresponding soil analytical data. Prior to disposal or treatment of any soil, the nominated receiver should be contacted to verify that there is sufficient soil quality data for them to accept the classification indicated within the report.
- The procedures for waste transport and disposal are determined by the waste category and are described in the Section 4.3

Scenario 2

In this scenario, the excess soil volume is less than 30 m^3 and therefore pre-classification of soils prior to excavation has not been undertaken. The procedure for this scenario includes the following steps:

- The Contractor should undertake an inspection of the excess soil during excavation for visible Asbestos Containing Material, Coastal Acid Sulfate Soils or contamination. The field card provided in Appendix C

is to be used as a guide on how to undertake a visual and olfactory inspection of excess soils for contamination, Coastal Acid Sulfate Soils or Asbestos Containing Material.

- Soils with no evidence of contamination, Coastal Acid Sulfate Soils or Asbestos Containing Material should be disposed of as Fill Material.
- Soils with evidence of contamination, Coastal Acid Sulfate Soils or Asbestos Containing Material should be segregated to the extent practical from clean material.
- Contractor should arrange for a suitably trained person such as an Environmental Consultant to collect representative soil samples of this segregated material in accordance with the Australian Standard 4482.1, Environment Protection Authority Publication IWRG702 and/or Environment Protection Authority Publication 655.1 (where Coastal Acid Sulfate Soils is present) and to classify the soil for disposal in accordance with Environment Protection Authority Publication IWRG621.
- The Environmental Consultant should provide the Contractor with a Waste Classification Letter which presents the waste classification and the corresponding soil analytical data. Prior to disposal or treatment of any soil, the nominated receiver should be contacted to verify that there is sufficient soil quality data for them to accept the classification indicated within the report.

The procedures for waste transport and disposal are determined by the waste category and are described in the Section 4.3.

4.3 Step 3 – Disposal

The decision making process and procedures for waste transport and disposal are summarised below and the decision making flowchart is provided in Appendix B:

In summary, soil classified as a Prescribed Industrial Waste must be placed in an appropriately permitted vehicle and transported directly to an appropriately licenced facility for disposal or treatment. Each vehicle load of Prescribed Industrial Waste must be accompanied by an Environment Protection Authority Waste Transport Certificate, in accordance the *Environment Protection (Industrial Waste Resource) Regulations* 2009. Soils which do not exceed the Prescribed Industrial Waste thresholds can be disposed of as Fill Material.

Soil classified as waste Coastal Acid Sulfate Soils must be disposed of at a site approved by Environment Protection Authority (EMP or licensed) to accept Coastal Acid Sulfate Soils).

The specific requirements for each waste category are summarised in Table 1 below.

Table 1: Waste – Transport, Storage and Disposal

Excess Soil Category	Description	Transport Requirements	Disposal Requirements
Fill Material, Asbestos Containing Material "free"	Reported concentrations are less than 'contaminant concentrations threshold' for Fill Material and material contains no visible Asbestos Containing Material	Covered vehicle	May be disposed of as Fill Material, no specific regulatory requirements apply.
Waste Coastal Acid Sulfate Soils	Soil, sediment, unconsolidated geological material or disturbed consolidated rock mass containing metal sulfides which exceeds criteria for acid sulfate soils specified in Environment Protection Authority Publication 655.1	Covered Vehicle	Site approved by Environment Protection Authority (EMP or licensed to accept Coastal Acid Sulfate Soils)
Category C Prescribed Industrial Waste (Asbestos Waste)	Reported concentrations are less than 'contaminant concentrations threshold' for Fill Material and material contains visible Asbestos Containing Material	Environment Protection Authority Permitted Vehicle and Asbestos Containing Material to be wrapped in two layers of polythene sheeting, sealed with adhesive tape and labelled with the asbestos warning mark (See Environment Protection Authority guidelines IWRG611)	Landfill licenced for acceptance of industrial Asbestos Containing Material (Prescribed Industrial Waste)[10].
Category C Prescribed Industrial Waste (contaminated soil and Asbestos Containing Material)	Reported concentrations exceed the 'contaminant concentrations threshold' for Fill Material, but are less than the Category C threshold and material contains visible Asbestos Containing Material	Environment Protection Authority Permitted Vehicle and Asbestos Containing Material to be wrapped in two layers of polythene sheeting, sealed with adhesive tape and labelled with the asbestos warning mark (See Environment Protection Authority guidelines IWRG611)	Landfill specifically licenced to accept Category C Prescribed Industrial Waste (including Asbestos Containing Material)[10].

[10] If soil is also classified as Coastal Acid Sulfate Soils then it must be disposed of at a facility approved by Environment Protection Authority (EMP or licensed to accept Coastal Acid Sulfate Soils)

Excess Soil Category	Description	Transport Requirements	Disposal Requirements
Category B Prescribed Industrial Waste (contaminated soil)	Reported concentrations exceed the 'contaminant concentrations threshold' for Cat C, but are less than the Cat B threshold and material contains no visible Asbestos Containing Material.	Environment Protection Authority Permitted Vehicle	Landfill specifically licenced to accept Category B Prescribed Industrial Waste (SITA landfill, Lyndhurst)[10].
Category B Prescribed Industrial Waste (contaminated soil and Asbestos Containing Material)	Reported concentrations exceed the 'contaminant concentrations threshold' for Cat C, but are less than the Cat B threshold and material contains visible Asbestos Containing Material	Environment Protection Authority Permitted Vehicle and Asbestos Containing Material to be wrapped in two layers of polythene sheeting, sealed with adhesive tape and labelled with the asbestos warning mark (See Environment Protection Authority guidelines IWRG611)	Landfill specifically licenced to accept Category B Prescribed Industrial Waste (including Asbestos Containing Material)[10]
Category A Prescribed Industrial Waste (contaminated soil)	Reported concentrations exceed the 'contaminant concentrations threshold' for Cat B but material contains no visible Asbestos Containing Material.	Environment Protection Authority Permitted Vehicle	Treatment facility licenced to treat Category A Prescribed Industrial Waste[11]
Category A Prescribed Industrial Waste (contaminated soil and Asbestos Containing Material)	Reported concentrations exceed 'contaminant concentrations threshold' for Cat B and material contains visible Asbestos Containing Material.	Environment Protection Authority Permitted Vehicle and Asbestos Containing Material to be wrapped in two layers of polythene sheeting, sealed with adhesive tape and labelled with the asbestos warning mark (See Environment Protection Authority guidelines IWRG611)	Treatment facility licenced to treat Category A Prescribed Industrial Waste (including Asbestos Containing Material)[11]

4.3.1 Transport Requirements

All Prescribed Industrial Waste transported to an Environment Protection Authority licenced facility, must be transported in covered vehicles permitted by Environment Protection Authority to transport Prescribed Industrial Waste and be accompanied by Environment Protection Authority Waste Transport Certificates at all times.

4.3.2 Disposal Requirements

There are a number of additional requirements to be considered for each waste category as outlined below:

[11] Treatment facility should be advised if soil is also Coastal Acid Sulfate Soils

Category A Prescribed Industrial Waste

- Facility operator must treat waste to meet disposal specification.
- Facility operator is responsible for ensuring waste meets landfill specification following treatment.

Category B Prescribed Industrial Waste

- Must be disposed of at SITA landfill, Lyndhurst.
- Facility operator is responsible for ensuring waste meets landfill specification.

Category C Prescribed Industrial Waste

- Facility operator is responsible for ensuring waste meets landfill specification.

Waste Coastal Acid Sulfate Soils

- Facility operator is responsible for ensuring waste Coastal Acid Sulfate Soils meets specification.

Fill Material

- May be disposed of as Fill Material, no specific regulatory requirements apply.

4.3.3 Material Tracking

The Contractor should implement a Material Tracking System which tracks all excess soils and Asbestos Containing Material from the point of generation to treatment or disposal, at a licenced facility. The Material Tracking System must include, as a minimum, the following information:

- Volume of excess soil excavated;
- A record of the inspection of the excess soil during excavation for contamination or visible Asbestos Containing Material which includes:
    - Details of any identified contamination;
    - Details of any visual Asbestos Containing Material identified (if no contamination or Asbestos Containing Material is identified this must also be recorded);
    - Waste classification of the soil (if applicable).
- Soil stockpile (and/or storage container) unique identifier.
- Date excess soil was excavated from each location and subsequently transported to a disposal facility;
- Details of the vehicle transporting the soil to a disposal facility;
- Details of the disposal facility;
- Date the excess soil arrived at the disposal facility;
- Copies of Environment Protection Authority Waste Transport Certificates completed by the disposal facility.

The Contractor must collate and retain all documentation relating to the handling, transport, storage and disposal of excess soil and Asbestos Containing Material, including copies of Environment Protection Authority Waste Transport Certificates completed by the disposal facility.

Council should obtain an updated record of the Material Tracking System from the Contractor on a quarterly basis and should periodically audit the Contractor's Material Tracking System and record keeping.

Council should retain copies of the Material Tracking System and Environment Protection Authority waste transport certificates for a minimum of 2 years following the disposal of waste.

5.0 Implementation plan

5.1 Overview

This Procedure document should be implemented by Council's Contractors through the development of a project specific Soil Management Plan which clearly demonstrates how project works will be undertaken in accordance with the procedures outlined in this Procedure.

It is proposed that documented procedures consistent with this Procedure be provided as a 'Tender Document' with Council's 'Requests for Tender' and that the requirement for the development of a Soil Management Plan be included as a clause in Council's Contracts with its Contractors. An outline of the general requirements of the Soil Management Plan is provided in Appendix C.

This Procedure should be implemented internally through the provision of a training course to relevant Council personnel.

5.2 Training

The Council's training course should include, as a minimum, communication of the following items described within this Procedure:

- Background;
- Objectives;
- Scope;
- Victorian Waste Management Statutory Requirements;
- Soil Management Procedures, divided into:
  - Planning, with an emphasis on:
    - Modifying project designs to reduce the volume of excess soils generated;
    - Soil sampling and waste classification requirements; and
    - Implications for project budget and timing.
  - Excavation, with an emphasis on:
    - Field inspection of excess soils for unexpected contamination or Asbestos Containing Material;
  - Disposal, with an emphasis on:
    - Waste transport;
    - Waste Tracking; and
    - Record Keeping.

The Contractor will be responsible for ensuring its personnel and subcontractors receive the appropriate training regarding the requirements of this Procedure, and have the adequate resources and/or materials available to implement these measures. The Contractor's training course should include training in the items listed above. The Contractor is responsible for maintaining an up-to-date Training Register for its personnel.

5.3 Roles and Responsibilities

The following section outlines the roles and responsibilities for personnel involved in the implementation of this Procedure.

5.3.1 Council

Council's responsibilities include:

- Ensure excess soils generated during projects are managed in accordance with relevant Victorian statutory requirements;
- Ensure Contractors undertake project works in accordance with the procedures outlined in this Procedure;
- Providing documented procedures consistent with this Procedure to relevant internal personnel and Contractors involved in the works; and,
- Periodically auditing and monitoring Contractor's compliance with this Procedure, including the inspection of soils for evidence of contamination, Material Tracking System and record keeping.
- Develop and maintain a Register of Known Clean and Contaminated Land.

5.3.2 Contractor Responsibilities

The Contractor's responsibilities include:

- Ensuring works are undertaken in accordance with Victorian statutory requirements;
- Ensuring works comply with the guidance and procedures provided in this Procedure;
- Ensuring all personnel and subcontractors involved in the works have received appropriate training in the requirements of this Procedure;
- Providing feedback as necessary to Council on the implementation of this Procedure;
- Obtaining all necessary certificates, permits and approvals to undertake handling, transport, storage and disposal of Prescribed Industrial Waste and Asbestos Containing Material;
- Implementation of a Material Tracking System which tracks all excess soils and Asbestos Containing Material from the point of generation to either a licenced treatment facility or disposal at a licenced facility;
- Collation and maintenance of all documentation relating to the handling, transport, storage and disposal of excess soil and Asbestos Containing Material for a minimum period of 2 years; and,
- Ensuring appropriate personal protective equipment is used consistent with Council's HSE procedures.

5.3.3 Environmental Consultant (if required)

If an Environmental Consultant is engaged by Council, or its Contractors, its responsibilities include:

- Undertaking preliminary site investigations and soil sampling, assessment and waste classification, as requested; and
- Assisting with liaison with the Council, Contractors, Environment Protection Authority and other key stakeholders, as requested.

5.4 Procedure Auditing and Monitoring

Council will audit and monitor the Contractor's compliance with this Procedure. Table 2 provides a template for the monitoring and auditing program that should be conducted by Council as part of the implementation of the Procedure. Frequency of audit and monitoring programs will be on a project-specific basis.

Table 2: Procedure Monitoring Tasks.

Monitoring Task	**Performance Indicator**	**Meets Performance Indicator** **Yes - ☑ /No -☒ / NA**
Inspect Contractor's Training Register	Training register demonstrates that all project personnel have received Environmental Training relating to the implementation of this Procedure.	☐
Conduct a review of field assessment procedures to assess adequacy of Contactor's procedures for identifying evidence of potential contamination and Asbestos Containing Material.	Contractor adequately assesses and identifies indicators of potential contamination.	☐
Check that soils with evidence of contamination are sampled and subsequently assigned as Category A, B or C Prescribed Industrial Waste, Solid Inert Waste or Fill Material prior to disposal.	Waste classification data available for all potentially contaminated soil. Contractor demonstrates that the sampling rate meets 1 per 25 m^3 and a minimum of 3 samples requirement.	☐
Check the Project's Materials Tracking System to ensure the excavation, transport and disposal of all excess soils & Asbestos Containing Material is tracked.	The volume of soil & Asbestos Containing Material excavated and transported correlates with the volume of soil which is disposed at appropriately licenced facilities.	☐
Check that all excess soil and Asbestos Containing Material are disposed at appropriately licenced facilities.	Environment Protection Authority Waste Transport Certificates demonstrate that all Prescribed Industrial Waste (including Asbestos Containing Material) is disposed at appropriately licenced facilities.	☐
Complaints and Incidents Response Register	All community complaints are recorded, mitigated or managed by the Contractor and recorded in the Complaints and Incidents Response Register.	☐

5.5 Non-Conformance

Any identified non-conformance with the Procedure must be addressed as soon as is practical. The member of staff and/or Contractor responsible for the non-conformance must be notified immediately of the error and provided with guidance on the method of rectification of the problem, if possible.

Contractors are required to keep a Complaints and Incidents Response Register, stating the nature of the non-conformance and the actions implemented to rectify the problem and make this available to Council on request.

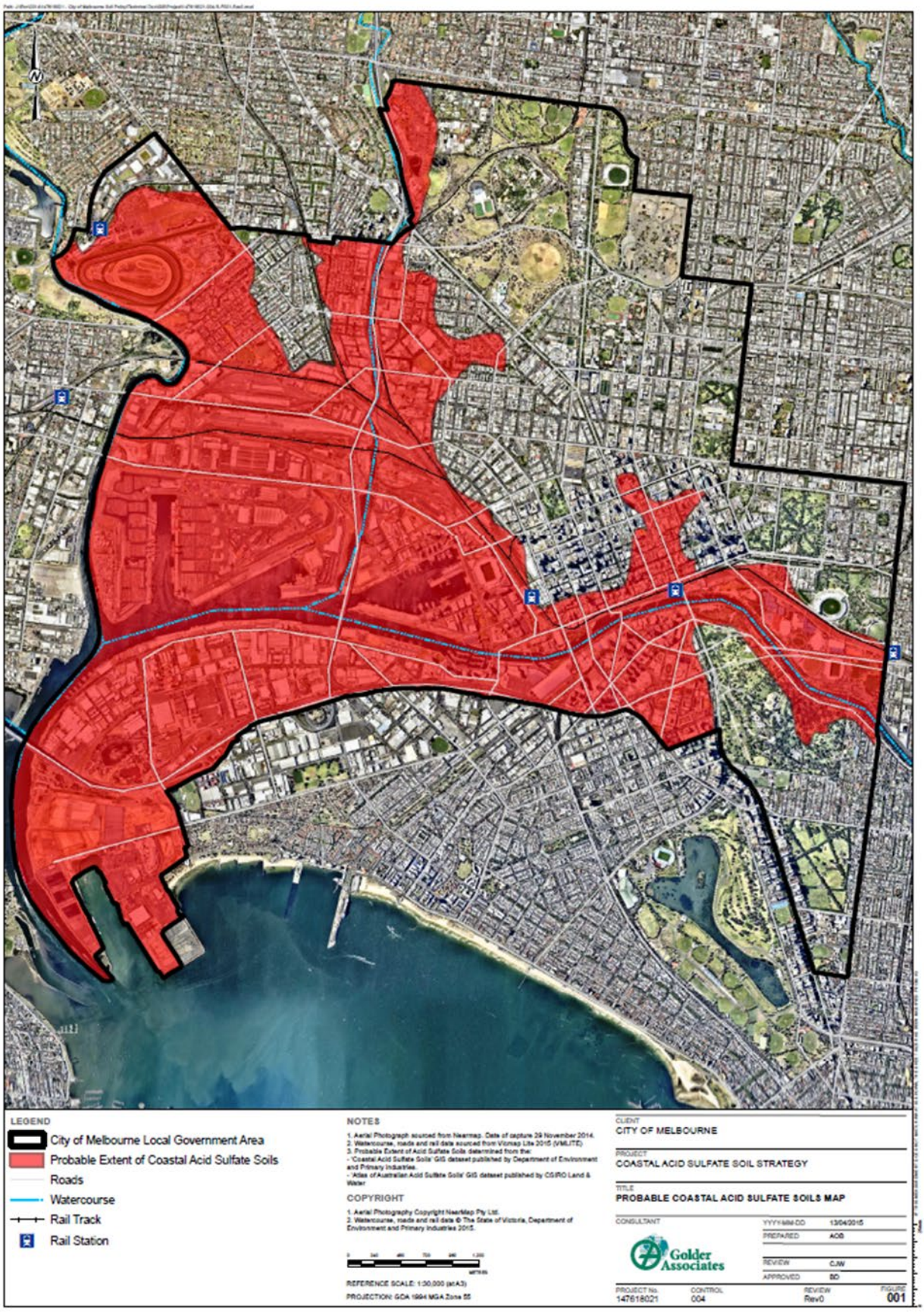
6.0 Procedure review and updates

This version of the Procedure is referenced as EDOCs #8742616. Revisions of the Procedure, if required, will be issued based on changes to the proposed Procedure in response to changes in Victorian Waste Management Statutory requirements or significant logistical changes to the program of works.

7.0 Appendices

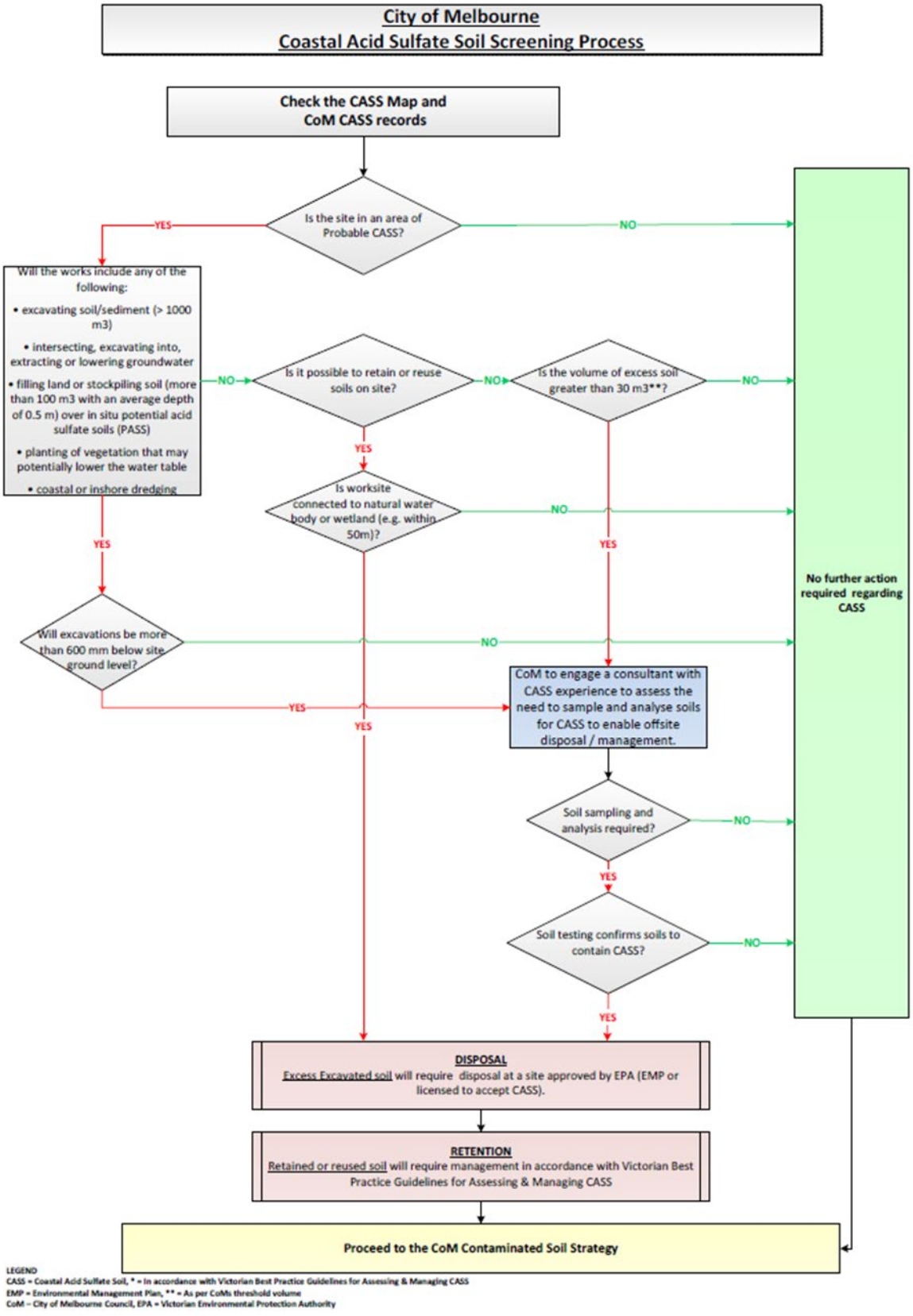
APPENDIX A

Coastal Acid Sulfate Soils Map


N
LEGEND
City of Melbourne Local Government Area
Probable Extent of Coastal Acid Sulfate Soils
Roads
Watercourse
Rail Track
Rail Station
NOTES
1. Aerial Photograph sourced from Nearmap. Date of capture 29 November 2014.
2. Watercourse, roads and rail data sourced from Vicmap Lite 2015 (VMLITE)
3. Probable Extent of Acid Sulfate Soils determined from the:
- 'Coastal Acid Sulfate Soils' GIS dataset published by Department of Environment and Primary Industries.
- 'Atlas of Australian Acid Sulfate Soils' GIS dataset published by CSIRO Land & Water
COPYRIGHT
1. Aerial Photography Copyright NearMap Pty Ltd.
2. Watercourse, roads and rail data © The State of Victoria, Department of Environment and Primary Industries 2015.
REFERENCE SCALE: 1:30,000 (at A3)
PROJECTION: GDA 1994 MGA Zone 55
CLIENT
CITY OF MELBOURNE
PROJECT
COASTAL ACID SULFATE SOIL STRATEGY
TITLE
PROBABLE COASTAL ACID SULFATE SOILS MAP
CONSULTANT
Golder Associates
YYYY/MM/DD 13/04/2015
PREPARED AOB
REVIEW CJW
APPROVED BD
PROJECT No. 147618021
CONTROL 004
REVIEW Rev0
FIGURE 001

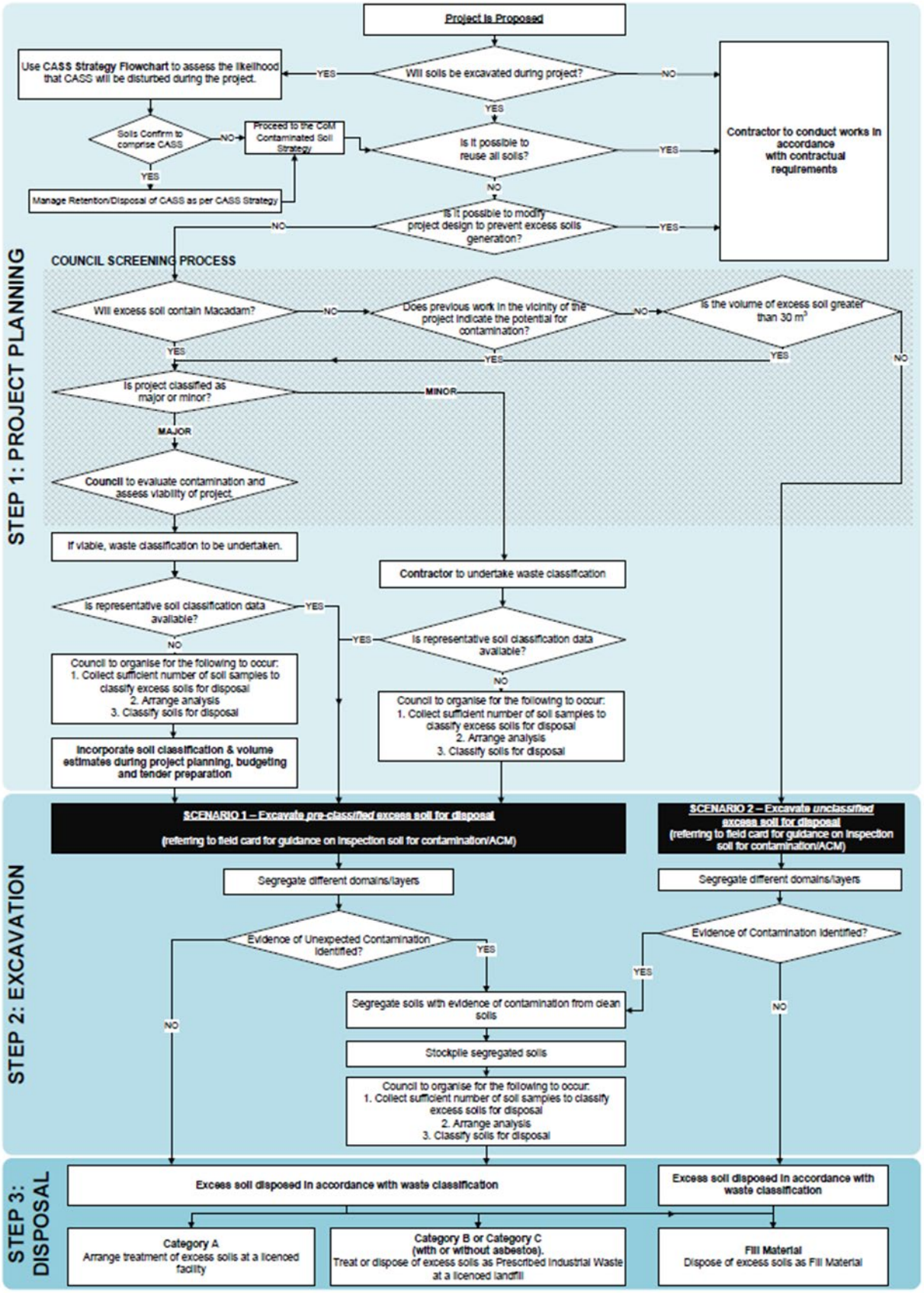
APPENDIX B

Soil Management Procedures & Coastal Acid Sulfate Soils Screening Process


City of Melbourne
Coastal Acid Sulfate Soil Screening Process
Check the CASS Map and CoM CASS records
Is the site in an area of Probable CASS?
YES
NO
Will the works include any of the following:
• excavating soil/sediment (> 1000 m3)
• intersecting, excavating into, extracting or lowering groundwater
• filling land or stockpiling soil (more than 100 m3 with an average depth of 0.5 m) over in situ potential acid sulfate soils (PASS)
• planting of vegetation that may potentially lower the water table
• coastal or inshore dredging
NO
Is it possible to retain or reuse soils on site?
NO
Is the volume of excess soil greater than 30 m3**?
NO
YES
Is worksite connected to natural water body or wetland (e.g. within 50m)?
NO
YES
YES
Will excavations be more than 600 mm below site ground level?
NO
YES
YES
CoM to engage a consultant with CASS experience to assess the need to sample and analyse soils for CASS to enable offsite disposal / management.
Soil sampling and analysis required?
NO
YES
Soil testing confirms soils to contain CASS?
NO
YES
No further action required regarding CASS
DISPOSAL
Excess Excavated soil will require disposal at a site approved by EPA (EMP or licensed to accept CASS).
RETENTION
Retained or reused soil will require management in accordance with Victorian Best Practice Guidelines for Assessing & Managing CASS
Proceed to the CoM Contaminated Soil Strategy
LEGEND
CASS = Coastal Acid Sulfate Soil, * = In accordance with Victorian Best Practice Guidelines for Assessing & Managing CASS
EMP = Environmental Management Plan, ** = As per CoMs threshold volume
CoM = City of Melbourne Council, EPA = Victorian Environmental Protection Authority

City of Melbourne – Roadworks Contaminated Soil Strategy

Soil Management Procedures



APPENDIX C

Soil Inspection – Field Card

APPENDIX C
Soil Inspection - Field Card

Purpose

This field card has been prepared to support the identification of unexpected soil contamination including potential Coastal Acid Sulfate Soils (CASS).

Introduction

All excess soil excavated must be inspected for evidence of contamination including visible Asbestos Containing Material (ACM) prior to transport to a licenced disposal facility.

Soil with evidence of contamination needs further assessed prior to disposal. Procedures for classification and disposal are described in Section 6.2 of the Strategy.

Tables 1 to **4** summarise odour and visible indicators of soil contamination and CASS. Table 4 provides photographic examples of visual indicators of contamination. **These descriptions are to be used as a guide only, and are not a definite list of all visual and odour indicators of contamination.**

Safety note: ***Do not smell soil. Odour indicators might be noticed in the vicinity of the works during excavation.***

Table 3 summarises materials which are considered inert waste. If these materials are present and are oversized (>100 mm in size), they must be screened as far as practicable from soils.

Soils should be inspected for visible ACM by a competent person who has the ability to identify ACM or potential ACM.

Table 1: Odour Indicators of General Soil Contamination

Odour Description
Fuel (Petrol / Diesel / Kerosene)
Tar / burned
Solvent
Sweet
Pool Water
Chemical

Table 2: Odour Indicators of CASS

Odour Description
Rotten Eggs

Table 3: Visual Indicators of General Soil Contamination

Visual Appearance	Description
Discoloured Soils	Soils are discoloured and the colouration does not appear to be natural.
Oily Stained Soils	Soils look oily or liquid oil is seen dripping or pooling in pit. This may be accompanied by a fuel odour.
Ash/Coke/ Slag/Clinker /Asphalt/Tar	Evidence of burning, filling with ash, or broken up road or pavement asphalt

Table 4: Visual Indicators of CASS

Visual Appearance	Description
Shells	Shells with or without yellow staining or coating
Pale Yellow Residues on soils	Jarosite is a pale yellow mineral deposit, which may be found in cracks and root channels in soils.
Rusty staining on soils	Evidence of iron oxide (rust) mottling in recently dug soils.

Table 5: Examples of Inert Waste

Waste Type
Brick
Glass
Metal
Plastic
Wood
Concrete/Cement

APPENDIX C
Soil Inspection - Field Card

Table 6: Photographic Examples of Visual Indicators of Contamination

Visual Appearance	Description	Photographic Examples
Discoloured Soils	Soils are discoloured and the colouration does not appear to be natural.	  
Oily stained Soils	Soils have an oily sheen. Note soils with an oily sheen will often also have a petrol or diesel odour.	 
Ash/Coke/Slag/ Clinker/Bitumen/Tar	There may be layers of ash/coke/slag/bitumen/tar and/or fragments of the materials are visible in the soils.	  

APPENDIX D

Environment Protection Authority Soil Sampling and Waste Classification Guidelines

SOIL SAMPLING

CONTENTS

INTRODUCTION

This guideline provides information relating to the most suitable patterns for sampling and the number of samples to be taken to ensure the appropriate hazard categorisation is applied to soils being moved off-site for reuse, treatment or disposal.

It also details the acceptance requirements for disposal facilities receiving contaminated soils to assist such facilities in meeting EPA licence acceptance criteria.

The following related documents should be used in conjunction with this document:

- Australian Standard 4482.1, *Guide to the sampling and investigation of potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds*. For information on conducting preliminary site investigations and determining if a site is potentially contaminated.
- Australian Standard 4482.2, *Guide to the sampling and investigation of potentially contaminated soil Part 2: Volatile substances*.
- Industrial Waste Resource Guideline (IWRG) *Sampling and analysis of waters, wastewaters, soils and wastes*. Details the protocols that are required for soil sample collection, handling and storage.
- IWRG *Soil hazard categorisation and management*. Details how to categorise waste soils to determine the appropriate management option.

Where a site has any potentially contaminated soil, the soil must be assigned a hazard category of A, B, C or clean fill prior to off-site reuse, or disposal, and this sampling guide should be applied.

Soils are considered **potentially contaminated** if they:

- have been mixed with any wastes

or

- consist of, or partially consist of, soil of unknown origin that has been brought onto a site

or

- arise from sites where former uses include industrial, commercial, mining or agricultural activities

or

- have had manufactured chemicals applied.

EPA requires that any waste soils be managed in accordance with the waste hierarchy of avoidance, reuse, recycling, recovery of energy, treatment, containment and disposal as set out in the *Environment Protection Act 1970*.

SAMPLING GUIDELINES

Preliminary site investigation

Prior to categorising potentially contaminated soil for off-site reuse or disposal, as a minimum, a preliminary site investigation should be conducted in accordance with Australian Standard 4482.1. The soils category should be based on the outcome of the preliminary site investigation and any subsequent information that is collected.

This guidance forms part of the Industrial Waste Resource Guidelines, which offer guidance for wastes and resources regulated under the *Environment Protection (Industrial Waste Resource) Regulations 2009*. Publication IWRG702 – June 2009.

SOIL SAMPLING

For the purpose of categorising the soils, the site should be divided into domains[1] or stockpiles[2] representing similar material types (eg. fill, natural soil or rock), similar contamination, and other site-specific features as indicated by the site history (eg. underground storage tank areas). Note: a domain may be defined as a layer of material at a specific depth, as contamination will often vary with depth, as well as surface location.

How many samples to take

The preliminary site investigation should identify appropriate depth and corresponding soil volume, for soil to be categorised for off-site management using in-situ sampling (prior to disturbance).

Once domains and soil volume(s) have been identified, site assessors should refer to the guidance below to determine the minimum number of samples required.

Figure 1 illustrates the minimum sampling rate for soils being removed from the site.

Minimum sample numbers for soil volumes less than or equal to 200m³

The site assessor should take, at least, the number of samples listed in Table 1 or Table 2 (depending on volume) and, after analysing all samples, determine the hazard category by using the result of the highest contaminant or leachable concentration. For example, if the results of three samples indicate that the sample with the highest concentration is Category B contaminated soil (as defined in IWRG Soil Hazard Categorisation and Management) then the entire volume must be managed as Category B soil.

Alternatively, the site manager may choose to categorise the soil volume (less than 200m³) based on the 95%$UCL_{average}$[3] provided that a sufficient amount of sample data is available.

Table 1: Minimum number of samples for in-situ 200m³ or less (minimum of 3 then 1:25 plus bulking factor of 33%)

Soil volume, m³	No. of samples*
25 or < 25	3
50	3
75	4
100	5
125	7
150	8
175	9
200	10
>200	1:25

Table 2: Minimum number of samples for stockpile 200 m³ or less (minimum of 3 then 1:25)

Soil volume, m³	No. of samples*
25 or <25	3
50	3
75	3
100	4
125	5
150	6
175	7
200	8
>200	1:25

Minimum Sampling Numbers for Soil Volumes Greater that 200m³

Option 1: Samples should be taken at 1 sample per 25m³. Soils can be categorised based on the highest sample result.

Option 2: The sampling rate can be reduced subject to a comparison of the 95%$UCL_{average}$ for the soil.

The appropriate sampling rate when comparing the 95%$UCL_{average}$ will vary depending on the homogeneity of the soil and should be assessed on a case-by-case basis. Table 3 lists the minimum sampling rate for volumes greater than 200m³.

Site assessors should note that these are minimum sampling rates for calculation of the 95%$UCL_{average}$ and are best suited to homogenous soils. Where the site contamination is heterogeneous it may be necessary to take a higher number of samples to enable the calculation of a 95%$UCL_{average}$ that more accurately reflects contaminant levels.

1 Domain: is an area or layer of material on the site with same probable soil hazard category.

2 Stockpile: refers to soils that are ex-situ. Stockpiles need to be prepared from soils of like material. Where an existing stockpile consists of materials that are likely to differ in hazard category, they should be managed as individual stockpiles for the purpose of categorisation.

3 95% UCLaverage is the 95% upper confidence limit of the average concentration of the sampling results.

* Alternatively, a 95% UCLaverage can be used.

* Alternatively, a 95% UCLaverage can be used.

Table 3: Minimum number of samples for soil volumes greater than 200m³ (1:25 or 95%UCL)

Soil volume, m^3	No. of samples at 1:25m^3	Minimum No. of samples 95%UCLaverage[4]
300	12	10
400	16	10
500	20	10
600	24	10
700	28	10
800	32	10
900	36	10
1000	40	10
1500	60	10
2000	80	10
2500	100	10
3000	120	12 (1:250)
4000	160	16 (1:250)
4500	180	18 (1:250)
5000	200	20 (1:250)
>5000	1:25	1:250

Calculation of $95\%UCL_{average}$

The $95\%UCL_{average}$ demonstrates with 95% confidence that the average contaminant concentration of the soil represented by the data set is at or below the concentration stated.

EPA recommends a minimum of ten samples for $95\%UCL_{average}$ calculation. For large soil volumes (i.e. >2500m^3) the minimum sampling rate should not be less than 1 sample per 250m^3.

US EPA has software available called ProUCL that, at the time of writing, was free to download from:

www.epa.gov/nerlesd1/tsc/download.htm

This software enables the user to calculate the $95\%UCL_{average}$ using various methods and to check data normality. The software also calculates confidence limits for non-normal or unknown distributions.

Instructions to download are featured on this website and the ProUCL User's Guide is also avaliable free of charge.

The $95\%UCL_{average}$ only needs to be calculated for contaminants that exceed the relevant threshold in IWRG *Soil Hazard categorisation and management*.

Each domain or stockpile should be categorised separately.

EPA accepts the use of ProUCL to categorise material. To calculate the $95\%UCL_{average}$ manually, see Appendix 2 and Appendix 3 for worked examples.

Non-detect samples need to be included in calculations of $95\%UCL_{average}$. Historically, non-detect values have commonly been substituted with a value of half of the detection limit of the laboratory apparatus. This may be appropriate where the detection limit is insignificant in comparison to the categorisation threshold. However, where detection limits are similar to the categorisation threshold (as may be the case for leachable criteria) assuming a value of half the detection limit may not be appropriate. For more information on handling non-detect values refer to the ProUCL User's Guide, which includes worked examples for using ProUCL to calculate $95\%UCL_{average}$ with non-detects.

Sampling grid and depth of samples

A systematic grid-sampling pattern is recommended for both in-situ and stockpile sampling .

For in-situ categorisation, the sampling depth should correspond to the depth of contamination and the grid of sampling locations should be selected to be representative of the site being sampled (as determined by the site preliminary investigation). This should be based on obtaining sufficient samples to meet the sampling rates outlined above.

For stockpiles, a 3-dimensional systematic grid sampling design should be applied to account for spatial variability. Surface sampling from the stockpile will not be sufficient to categorise its contents and is not appropriate where volatile contaminants are present. Sampling should be uniformly distributed throughout the stockpile, including sampling at depth.

Figure 2 illustrates a three-dimensional systemic grid sampling pattern.

4 Minimum sampling rates specified in Table 3 are to provide a sufficient amount of data to calculate the 95%UCLaverage, and therefore the bulking factor is not included for in-situ soils (>200m3) categorised using a 95%UCLaverage. For soil volumes >200m3, in-situ receivers of the soils should be aware that volumes delivered may be greater than the volume sampled in-situ.

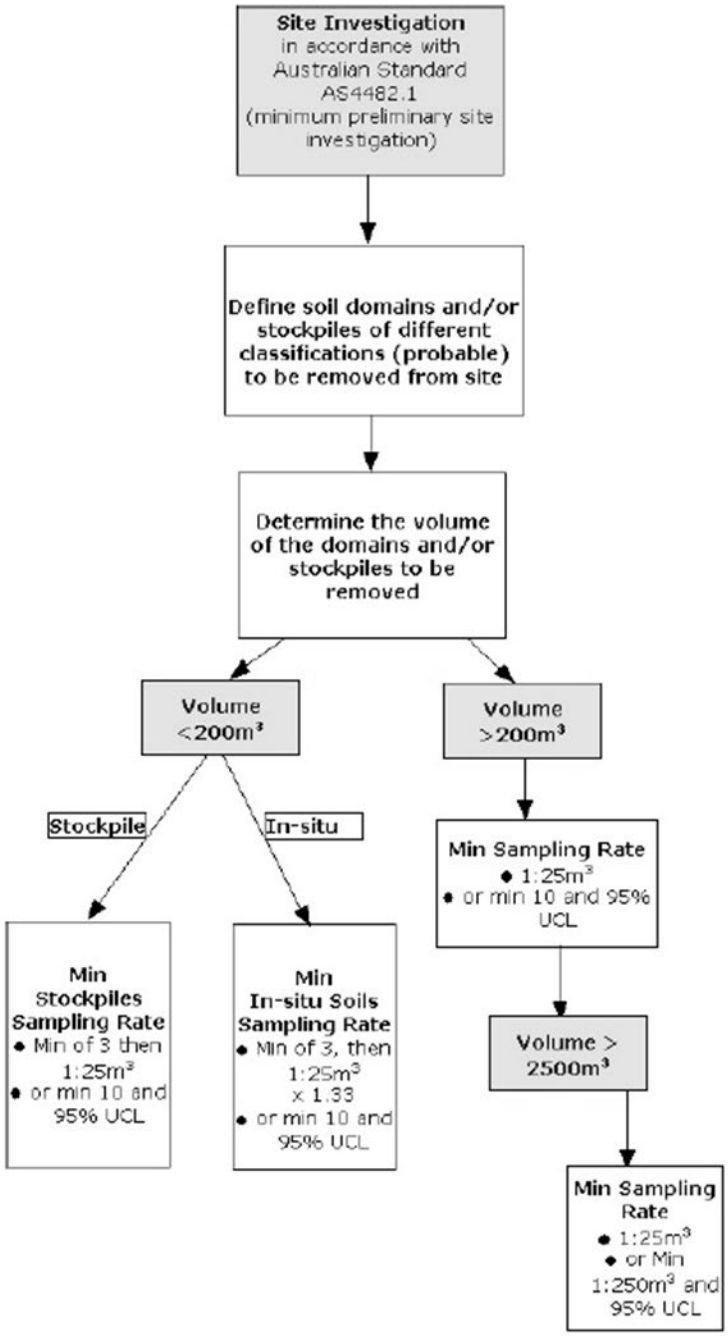


Figure 1: Flow chart for determining the minimum sampling rate for soils being removed from site

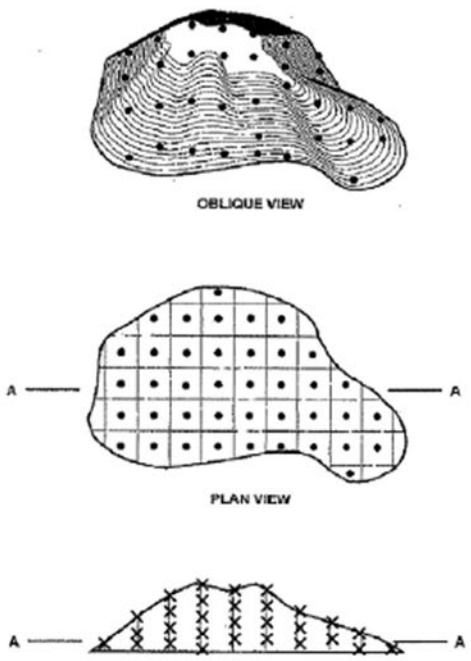


Figure 2: Three-dimensional systemic grid sampling pattern

(Reprinted, with permission from D 6009-96(2006) Standard Guide for Sampling Waste Piles, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be purchased from ASTM International, www.astm.org)

Stockpile sampling techniques

Two documents that provide useful guidance on the techniques for sampling of soils from stockpiles are:

- Australian Standard 1141.3.1 *Methods for sampling and testing aggregates*, Method 3.1: Sampling - Aggregates
- Cement Concrete & Aggregates Australia *Guideline to SAMPLING for the Extractive Industry*, August 2006.

Quality assurance (QA) samples

The Australian Standard 4482.1 provides appropriate guidance for taking QA samples, including blind replicates, split samples and rinsate blanks.

Leachate testing

Categorising wastes in accordance with IWRG *Soil hazard categorisation and management* requires that soils be tested for total concentrations and leachable concentrations.

'Twenty Times Rule': Leachate analysis is not required for Category C soils when the total concentration results are less than 20 times the leachable concentration threshold for each contaminant.

For example, a sample result with total concentration Zinc = 5000mg/kg.

Referring to IWRG *Soil hazard categorisation and management*, the maximum leachable concentration of Zinc (Category C) is 300 mg/kg, therefore 20 times the leachable concentration is 6000mg/kg.

With a total concentration result for Zinc of 5000mg/kg (less than 300 mg/kg times 20), leachable testing is not required for zinc, for this sample.

CATEGORISING SOILS

IWRG *Soil hazard categorisation and management* describes how soil is categorised. The category will determine whether the soil can be reused or disposed of.

Categorisation of the soils can be based on in-situ sampling or stockpile sampling. The values used to determine the hazard category can be either the highest sample result or the 95%$UCL_{average}$ value for each individual contaminant. Sufficient samples must be collected and analysed to meet the minimum number of samples listed above.

The contaminants listed in IWRG *Soil hazard categorisation and management* represent a broad range of common contaminants analysed in contaminated soil. (Note: individual contaminants are listed in the notes section). An assessment of the soil, including site history, will identify which contaminants to analyse to determine the hazard category, but does not preclude the analysis of other contaminants that are not specifically listed. If the waste contains a contaminant that is potentially poisonous (acute), toxic (delayed or chronic) and/or ecotoxic and is not listed, the waste generator must apply to EPA for a determination of the hazard category.

ACCEPTANCE PROTOCOLS FOR RECEIPT OF CATEGORY C OR B CONTAMINATED SOIL

This section outlines requirements for facilities receiving contaminated soil. A facility's EPA licence may include requirements in addition to those listed here.

The facility should have a quality assurance program in place to ensure that the contaminated soils received are consistent with those analysed and documented by the generator.

The following protocols should be followed by generators and facilities licensed to receive contaminated soil:

1. Each vehicle load must be accompanied by an EPA waste transport certificate, in accordance with the *Environment Protection (Industrial Waste Resource) Regulations 2009*.
2. For each domain or stockpile with a different hazard category, the generator of the waste soil should provide to the receiving facility:
    a. a copy of the NATA-accredited laboratory analysis (must be provided)
    b. the number of samples taken
    c. the site assessor's report detailing the hazard category of the waste and how it has been calculated.
3. All information should be sent to the receiving facility and approved before the soils are transported. Appendix 1 details the information that the soil generator should provide to the receiving facility.
4. Receiving facilities must only accept soils, in accordance with their licence, which meet the relevant limits set out in IWRG *Soil hazard categorisation and management*, based on:

    (a) the highest concentration result

    or

    (b) a comparison of the 95%$UCL_{average}$ from the sampling results.
5. The facility operator should conduct a visual inspection of each load at the receiving gate and at the tipping face, to ensure other wastes have not been concealed in the soil.
6. Facilities receiving contaminated soils should implement a sampling program of incoming loads to enable the operator to compare their sampling results with those received from the soil generator. EPA will develop an appropriate sampling program with each landfill through the site's Environmental Improvement Plan.

FURTHER INFORMATION

ASTM International, D 6009-96(2006) *Standard Guide for Sampling Waste Piles*, 2006.

Australian Standard 1141.3.1 Methods for sampling and testing aggregates, Method 3.1: Sampling – Aggregates.

Cement Concrete & Aggregates Australia Guideline to SAMPLING for the Extractive Industry, August 2006.

Environment Protection Authority, New South Wales, *Contaminated Sites – Sampling Design Guidelines*, September 1995.

EPA Victoria, publication IWRG701, June 2009, *Sampling and analysis of waters, wastewaters, soils and wastes*.

EPA South Australia, publication 584/05 Composite soil sampling in site contamination assessment and management (Issued March 2005)

Gilbert RO, 1987, *Statistical Methods for Environmental Pollution Monitoring*, Chapter 13, page 170, Van Nostrand Reinhold.

Standards Australia, 1999, AS 4482.2-1999 *Australian Standard: Guide to the Sampling and Investigation of Potentially Contaminated Soil. Part 2: Volatile Substances*.

Standards Australia, 2005, AS 4482.1-2005, *Australian Standard: Guide to the Sampling and Investigation of Potentially Contaminated Soil. Part 1: Non-volatile and Semi-volatile compounds*.

United States Environmental Protection Agency, *ProUCL Version 4.0 User Guide*, April 2007.

APPENDIX 1: INFORMATION THAT THE SOIL GENERATOR SHOULD PROVIDE TO THE RECEIVING FACILITY. NOTE: ALL NATA ANALYTICAL LABORATORY REPORTS ARE REQUIRED BY THE RECEIVING FACILITY.

Details of soil sampling completed

Volume of soil to be disposed (m^3)	Number of samples taken	How were samples taken	Soil categorised by highest concentration or using $95\%UCL_{average}$	Hazard category of contaminated soil. State whether soils are Category B, or C. Note: It is a criminal offence to dispose category A waste to landfill.
		In-situ ☐ Ex-situ ☐	High conc. ☐ $95\%UCL_{average}$ ☐	

Analytical summary sheet checklist for receiving facility

Contaminant	Soil analytical results		Maximum contaminant concentration allowed by EPA licence (See IWRG *Soil hazard categorisation and management*)		Complies with licence condition? Yes / No	
	Contaminant concentration (total) mg/kg dry weight	Leachable Concentration ASLP (mg/L)	Maximum contaminant concentration (total) mg/kg dry weight	Maximum leachable concentration ASLP (mg/L)		
List of: Contaminants analysed from IWRG *Soil hazard categorisation and management*. If contaminant not tested provide explanation (eg. Site investigation)						
Any additional contaminants listed in licence						
Other contaminants of concern not specifically listed						

APPENDIX 2: WORKED EXAMPLE OF 95% UCL AVERAGE (NORMAL DISTRIBUTION)[5]

Reference: Gilbert, R.O., 1987, *Statistical Methods for Environmental Pollution Monitoring*, Chapter 13, page 170, Van Nostrand Reinhold.

A 250 cubic metre stockpile needs to be removed from site and requires categorisation as fill material or contaminated soil (category A, B or C) according to IWRG *Soil hazard categorisation and management*. The preliminary site investigation demonstrates a contaminant of concern is arsenic.

Solution

1. A stockpile of 250 m^3 requires:
   i. samples to be taken at 1 in 25 m^3 (total of 10 samples) and for the soil to be categorised based on the highest concentration sample result, or
   ii. the soils may be categorised using 95% $UCL_{average}$ as demonstrated below.

The soil site history and visual inspection indicate that the soil is well characterised. The site assessor decides to categorise the soil using a 95% $UCL_{average}$. A minimum of 10 samples needs to be taken and tested for total concentrations and the leachable concentration.

The arsenic concentrations in these 10 samples are:

5, 10, 18, 20, 25, 28, 30, 40, 43, 45 mg/kg

2. Mean = 26.4 mg/kg, Standard deviation (S) = 13.59 mg/kg

The coefficient of variation (CV) = S/Mean = 0.515

CV < 1.2, indicating that the data is normally distributed.

3. Determine the t value from the table in Appendix 4. For 10 samples, with 95% confidence, t (for n-1) = 1.833

4. Determining the 95% $UCL_{average}$ concentration:

Equation 1: $$UCL\ mean = \bar{x} + t_{\alpha, n-1}\frac{S}{\sqrt{n}}$$

Where:

UCL mean = Upper confidence limit of the arithmetic mean concentration of the sampling area at the $1-\alpha$ confidence level.
α = The probability that the 'true' mean concentration of the sampling area might exceed the UCL mean determined by the above equation 6.
n = Number of sample measurements.
$\bar{x}$ = Arithmetic mean of all sample measurements.
$t_{\alpha, n-1}$ = A test statistic (Student's t and a α level of significance and $n-1$ degrees of freedom).
S = Standard deviation of the sample measurements.

UCL *mean* = 26.4 + [(1.833)*((13.59/√10))] = 34.28

Based on the 95% $UCL_{average}$ concentration = 34.28 mg/kg, arsenic, this soil is not suitable for fill material.

5. The leachability of the soils now needs to be determined. The leachable concentration for categorisation can be calculated using the same 95% $UCL_{average}$ methodology discussed above. Note: where the CV is greater than 1.2, the leachate concentration may need to be calculated using the method outlined in Appendix 3. For the purposes of this example the 95% $UCL_{average}$ leachable concentration = 0.5 mg/L.

6. According to IWRG *Soil hazard categorisation and management*, the soil is categorised as Category C contaminated soil.

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5 Normal distribution: is a data set that is normally distributed. To determine if the data is normal, the coefficient of variation (CV) needs to be < 1.2. If the CV is > 1.2 it indicates that the data may be log normal and may need to be calculated using method outlined in Appendix 3.

APPENDIX 3: WORKED EXAMPLE OF 95% UCL AVERAGE FOR LOGNORMAL DATA

Reference: Gilbert RO, 1987.

A site has 5000m³ in-situ soil which needs to be removed from site, and requires categorisation as fill material or contaminated soil (category A, B or C) according to IWRG *Soil hazard categorisation and management*. Preliminary site investigation indicates a contaminant of concern is copper.

Solution:

1. The site history and visual inspection indicate that the soil is well characterised. The site assessor determines that sampling at the minimum rate (1 in 250 m³) should be sufficient to categorise the soil. Twenty soil samples are taken and analysed chemically for copper resulting in the follow results (mg/kg):

   500, 510, 155, 150, 121, 100, 99, 95, 92, 90, 55, 50, 49, 47, 18, 15, 40, 38, 29, 25.

The results indicate the soil contamination is heterogeneous. Therefore, the site assessor should check the adequacy of the domains to ensure that all possible measures, including additional sampling, have been taken to segregate areas of varied contamination.

2. Calculate the CV (as detailed in Appendix 2). The CV = 1.229.
3. The CV > 1.2 indicates the distribution of the soil is lognormal and the 95% $UCL_{average}$ needs to be calculated using Equation 2.

Equation 2: $$UCL\ mean = \exp\left(\overline{y} + 0.5Sy^2 + \frac{S_y H}{\sqrt{n-1}}\right)$$

Where:

UCL mean = Upper confidence limit of the arithmetic mean concentration at the % confidence level.

$\overline{y}$ = Arithmetic mean of the log-transformed sample measurements.

Sy^2 = Variance of the log-transformed sample measurements.

n = Number of sample measurements.

H = A statistical constant. Its value is dependent on the values of S_y and *n*.

exp = Exponential function, i.e. 2.7183 to the power of the value inside the brackets.

4. Logarithmically transform the sample measurements. Let $y_i = \ln x$, where x is the original sample measurement.

Sample result *(x)*	y_i = log of sample result *(x)*
500	6.214608
510	6.234411
155	5.043425
150	5.010635
121	4.795791
100	4.60517
99	4.59512
95	4.553877
92	4.521789
90	4.49981
55	4.007333
50	3.912023
49	3.89182
47	3.850148
18	2.890372
15	2.70805
40	3.688879
38	3.637586
29	3.367296
25	3.218876

5. Compute $\bar{y}$.

$$\bar{y} = \Sigma y_i / n = 4.26$$

6. Compute S_y^2 and S_y.

$$S_y^2 = \Sigma(\bar{y} - y_i)^2 / n-1 = 0.89$$

$$S_y = \sqrt{S_y^2} = 0.95$$

7. Determine the value of H from Appendix 5. For values of S_y and n that are not listed in the tables, use interpolation.

   $H = 2.545$.

8. Compute the % UCL mean from Equation 2 above.

   95% UCL mean concentration = 193 mg/kg, Copper.

9. The leachability of the soils now needs to be determined. The leachable concentration for categorisation can be calculated using the same 95% $UCL_{average}$ methodology discussed above. Note: where the CV is >1.2 the leachate concentration may need to be calculated using the lognormal method outlined above. For the purposes of this example the 95% $UCL_{average}$ leachable concentration = 100 mg/L.

10. The soils are categorised as Category C contaminated soils based on the concentration (total) of 193 mg/kg and the leachable concentration of 100 mg/L.

APPENDIX 4: VALUES OF STUDENT'S T AT $\alpha = 0.05$ (THIS GIVES 95% UCL)

Reference: Gilbert, R.O, 1987.

α	0.05 (95%)	α	0.05 (95%)
Number of Samples		Number of Samples	
1	6.314	16	1.746
2	2.920	17	1.740
3	2.353	18	1.734
4	2.132	19	1.729
5	2.015	20	1.725
6	1.943	21	1.721
7	1.895	22	1.717
8	1.860	23	1.714
9	1.833	24	1.711
10	1.812	25	1.708
11	1.796	26	1.706
12	1.782	27	1.703
13	1.771	28	1.701
14	1.761	29	1.699
15	1.753	30	1.697
		40	1.684
		60	1.671
		120	1.658
		∞	1.645

APPENDIX 5: VALUES OF $H_{1-\alpha} = H_{0.95}$ FOR COMPUTING A ONE-SIDED UPPER 95% CONFIDENCE LIMIT ON A LOGNORMAL MEAN

Reference: Gilbert, R.O., 1987.

S_y	Number of samples (n)								
	5	7	10	12	15	21	31	51	101
0.10	2.035	1.886	1.802	1.775	1.749	1.722	1.701	1.684	1.670
0.20	2.198	1.992	1.881	1.843	1.809	1.771	1.742	1.718	1.697
0.30	2.402	2.125	1.977	1.927	1.882	1.833	1.793	1.761	1.733
0.40	2.651	2.282	2.089	2.026	1.968	1.905	1.856	1.813	1.777
0.50	2.947	2.465	2.220	2.141	2.068	1.989	1.928	1.876	1.830
0.60	3.287	2.673	2.368	2.271	2.181	2.085	2.010	1.946	1.891
0.70	3.662	2.904	2.532	2.414	2.306	2.191	2.102	2.025	1.960
0.80	4.062	3.155	2.710	2.570	2.443	2.307	2.202	2.112	2.035
0.90	4.478	3.420	2.902	2.738	2.589	2.432	2.310	2.206	2.117
1.00	4.905	3.698	3.103	2.915	2.744	2.564	2.423	2.306	2.205
1.25	6.001	4.426	3.639	3.389	3.163	2.923	2.737	2.580	2.447
1.50	7.120	5.184	4.207	3.896	3.612	3.311	3.077	2.881	2.713
1.75	8.250	5.960	4.795	4.422	4.081	3.719	3.437	3.200	2.997
2.00	9.387	6.747	5.396	4.962	4.564	4.141	3.812	3.533	3.295
2.50	11.67	8.339	6.621	6.067	5.557	5.013	4.588	4.228	3.920
3.00	13.97	9.945	7.864	7.191	6.570	5.907	5.388	4.947	4.569
3.50	16.27	11.56	9.118	8.326	7.596	6.815	6.201	5.681	5.233
4.00	18.58	13.18	10.38	9.469	8.630	7.731	7.024	6.424	5.908
4.50	20.88	14.80	11.64	10.62	9.669	8.652	7.854	7.174	6.590
5.00	23.19	16.43	12.91	11.77	10.71	9.579	8.688	7.929	7.277
6.00	27.81	19.68	15.45	14.08	12.81	11.44	10.36	9.449	8.661
7.00	32.43	22.94	18.00	16.39	14.90	13.31	12.05	10.98	10.05
8.00	37.06	26.20	20.55	18.71	17.01	15.18	13.74	12.51	11.45
9.00	41.68	29.46	23.10	21.03	19.11	17.05	15.43	14.05	12.85
10.00	46.31	32.73	25.66	23.35	21.22	18.93	17.13	15.59	14.26

INDUSTRIAL WASTE RESOURCE GUIDELINES

SOIL HAZARD CATEGORISATION AND MANAGEMENT

CONTENTS

INTRODUCTION

Producers of contaminated soil must categorise their waste into one of four categories, Category A, B, C or clean fill.

This guideline applies only to soils (it is not suitable for rubble, concrete and other inert solid waste materials).

WHAT THIS MEANS FOR YOU

If you are a producer or treater of contaminated soils, you will be required to categorise the soil into Category A, B, C or clean fill to determine what management options are available for that material.

WASTE CHARACTERISATION

Waste characterisation involves an assessment of the soil, including site history, to identify which contaminants require analysis to determine the hazard category. The assessment must be for all chemical substances known and reasonably expected to be present in the waste.

If the waste contains a contaminant that is potentially poisonous (acute), toxic (delayed or chronic) and/or ecotoxic and the contaminant is not listed in Table 2, the waste generator must apply to EPA for a determination of hazard category.

Allowable contaminant levels for fill material are also specified in Table 2. EPA does not regulate the use of fill material. However, the Environment Protection Act 1970 places general obligations to prevent adverse impacts on the environment and human health. Where there is potential for adverse impacts from the deposit of fill material, advice should be sought from EPA.

SAMPLING AND ANALYSIS

Soil sampling should be conducted in accordance with the IWRG *Soil sampling*, whilst soil analysis should be performed in accordance with the IWRG *Sampling and analysis of waters, wastewaters, soils and wastes.*

EPA requires that leachability testing be undertaken in accordance with the Australian Standard Leaching Procedure (ASLP) (Australian Standards AS4439.2 and 44396.3) by a NATA accredited laboratory. For contaminated soil going to disposal or re-use, it is necessary to perform ASLP using the acetate buffer solution (pH of 2.9 or pH 5, dependant on the pre-testing step as outline in the Australian Standard).

There is no need to conduct leachability tests in cases where total concentration data indicates that all total concentration results are less than 20 times the relevant Category C leachable concentration upper limits. This reflects the effect of dilution resulting from the use of the Australian Standard Leaching Procedure.

RECOMMENDED METHODS

The recommended methods for contaminated soils are provided in the IWRG *Solid industrial waste sampling*. EPA has no plans to mandate methods for 'totals', but the method that is used must be appropriate to determine the 'total concentration' of the contaminants.

Further information on these methods can be found on the USEPA website Test Methods SW-846 www.epa.gov/epaoswer/hazwaste/test/main.htm and from the National Environment Protection (Assessment of Site Contamination) Measure 1999 Guideline on Laboratory Analysis of Potentially Contaminated Soils www.ephc.gov.au/sites/default/files/ASC_NEPMsch_03_Lab_Analysis_199912.pdf

SPECIFIC CONTAMINANTS

Many laboratories conduct Total Recoverable Hydrocarbon (TRH) analysis and report this for Total Petroleum Hydrocarbon (TPH). A number of people have raised concerns with using TRH result and reporting these as TPH due to the presence of other hydrocarbon substances, not related to petroleum hydrocarbons, that are included in a TRH test. Until

This guidance forms part of the Industrial Waste Resource Guidelines (IWRG), which offer guidance for wastes and resources regulated under the *Environment Protection (Industrial Waste Resource) Regulations 2009* (the Regulations). Publication IWRG621 – June 2009.

there is a routine test developed exclusively for TPH, it may be necessary to discuss with clients what options are available to remove non petroleum based hydrocarbons.

To provide consistency in the approach of summing grouped contaminants and interpreting results that are below the limit of reporting, EPA recommends all positive values for the individual components be summed together.

Soils with a pH value of 4 or less or a pH of 9 or more are considered to be Prescribed Industrial Wastes (PIWs). Table 1 provides further information on pH values that are applicable to Category A.

Results for total concentrations are to be reported on a dry weight basis.

WASTE CATEGORIES

To determine the hazard category, contaminated soil must first be considered and excluded from Category A, then considered and excluded from Category B, before it can be considered as Category C. Figure 1 shows a decision flowchart for classifying waste soils.

Contaminated soils that display any specific hazard characteristic listed in Table 1 are categorised as Category A PIW.

Table 2 contains the threshold limit values (upper limits) for each of the categories, including clean fill. Contaminated soils must be assessed against the total concentration (TC0, TC1 and TC2) and leachable concentration (ASLP1 and ASLP2) thresholds specified in Table 2

Contaminated soils with any contaminant level above the TC2 or ALSP2 thresholds are categorised as Category A. Contaminated soils with any contaminant level greater than TC1, but below TC2, or greater than ASLP1, but below ASLP2 are categorised as Category B. Soils with any contaminant level greater than TC0, but below the TC1 and ALSP1 thresholds are categorised as Category C. Soils with all contaminant levels below the TC0 threshold are categorised as clean fill.

If doubt exists as to which hazard category applies to a soil, seek advice from EPA.

Landfill operators will require analytical results to demonstrate that the contaminated soil meets the relevant criteria set out in their licence.

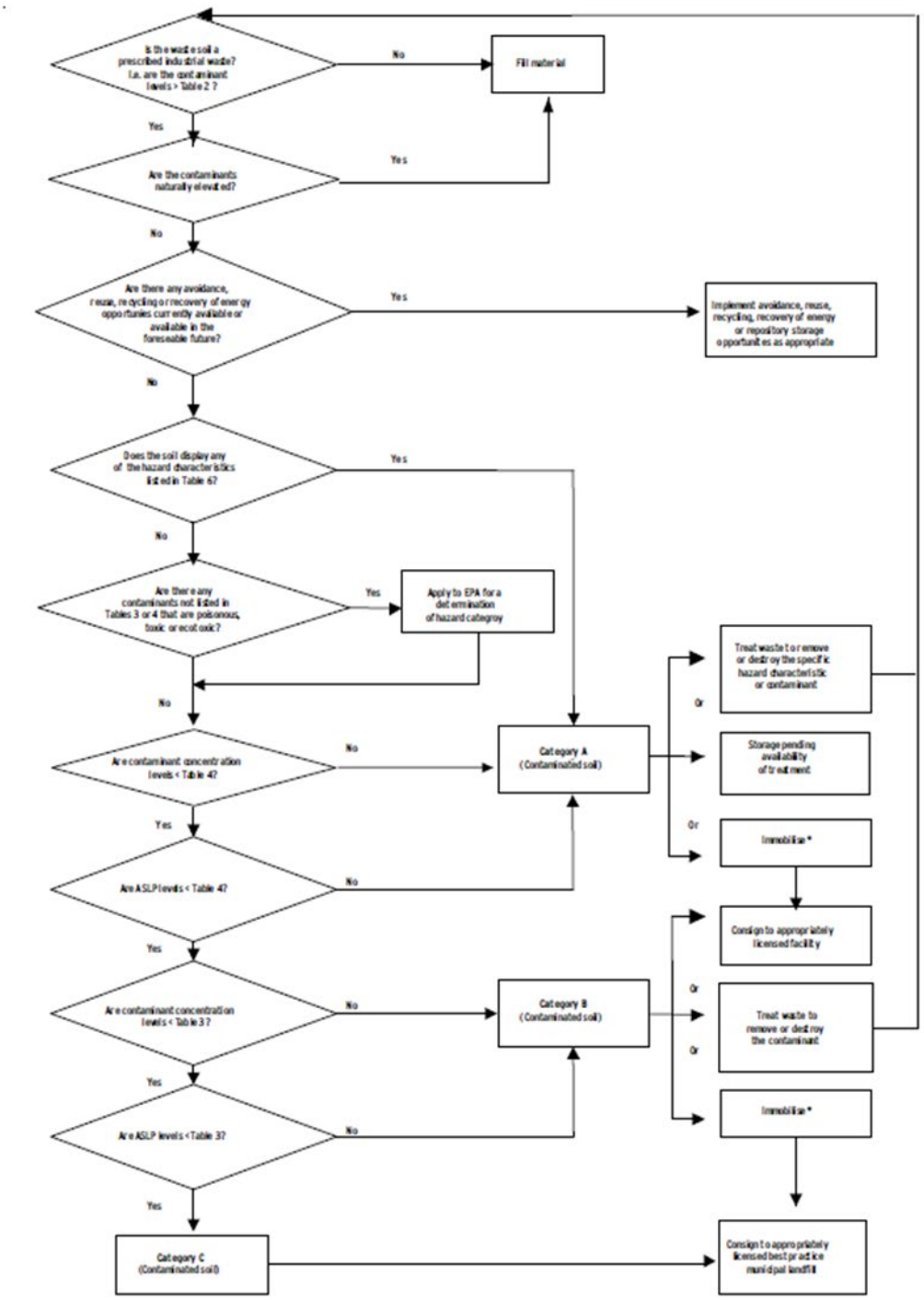

Figure 1: Decision flow chart for waste soil

Table 1: Specific hazard characteristics

Hazard characteristic	Definition1
Explosive wastes	An explosive waste is a solid waste (or mixture of wastes) which is in itself capable, by chemical reaction, of producing gas at such a temperature, pressure and speed, as to cause damage to the surroundings. Note: These are wastes classified as 'Class 1' under the provisions of the Road Transport (Dangerous Goods) Act 1995 and/or classified as 'Goods too dangerous to be transported' under the Australian Dangerous Goods Code.
Flammable2 solid wastes	Waste solids, other than those classified as explosives, which, under conditions encountered in transport or containment, are readily combustible, or may cause or contribute to fire through friction. Note: These are wastes classified as 'Class 4.1' under the provisions of the Road Transport (Dangerous Goods) Act 1995.
Wastes liable to spontaneous combustion	Wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and liable to catch fire. Note: These are wastes classified as 'Class 4.2' under the provisions of the Road Transport (Dangerous Goods) Act 1995.
Wastes which, in contact with water, emit flammable gases	Wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. Note: These are wastes classified as 'Class 4.3' under the provisions of the Road Transport (Dangerous Goods) Act 1995.
Oxidising wastes	Wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other materials. Note: These are wastes classified as 'Class 5.1' under the provisions of the Road Transport (Dangerous Goods) Act 1995.
Organic peroxide wastes	Organic wastes which contain the bivalent-O-O-structure and which are thermally unstable and may undergo exothermic self-accelerating decomposition. Note: These are wastes classified as 'Class 5.2' under the provisions of the Road Transport (Dangerous Goods) Act 1995.
Infectious wastes	Wastes containing viable microorganisms or their toxins which are known or suspected to cause disease in animals or humans. Note: These include clinical and related wastes as prescribed in the Environment Protection (Prescribed Waste) Regulations 1998 and is waste classified as 'Class 6.2' under the provisions of the Road Transport (Dangerous Goods) Act 1995.
Corrosive wastes	Wastes which, by chemical action, will cause severe damage when in contact with living tissue, or in the case of leakage, will materially damage, or even destroy, other goods or the means of transport or containment. They may also cause other hazards. Where corrosivity testing data is not available, pH may be used to determine if the material is Category A. • pH value of 2 or less • pH value of 12.5 or more Note: This includes wastes classified as 'Class 8' under the provisions of the Road Transport (Dangerous Goods) Act 1995.
Wastes that liberate toxic gases in contact with air or water	Wastes which, by liberation with air or water, are liable to give off toxic gases in dangerous quantities. Note: These are wastes liable to give off toxic gases that are classified as 'Class 2.3' under the provisions of the Road Transport (Dangerous Goods) Act 1995.

1 Definitions are adopted from the *Industrial Waste Management Policy (Movement of Controlled Wastes between States and Territories) 2001.*

2 In this document the word 'flammable' has the same meaning as 'inflammable'. Flammable liquid wastes are waste liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc.) which give off flammable vapour at temperatures of not more than 60.5 °C (closed-cup test), or not more than 65.6 °C (open-cup test). Note: The definition of flammable liquid wastes are those wastes classified as 'Class 3' under the provisions of the Road Transport (Dangerous Goods) Act 1995.

Table 2: Soil hazard categorisation thresholds

Category	Fill Material upper limits		Category C upper limits		Category B upper limits		
Contaminant concentration thresholds (dry weight)		TCO	ASLP1[1]	TC1	ASLP2[1]	TC2	
Units		(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	
Inorganic species	Inorganic species		Inorganic species		Inorganic species		
Arsenic		20	0.7	500	2.8	2,000	
Cadmium		3	0.2	100	0.8	400	
Chromium (VI)		1	5	500	20	2,000	
Copper		100	200	5,000	800	20,000	
Lead		300	1	1,500	4	6,000	
Mercury		1	0.1	75	0.4	300	
Molybdenum		40	5	1,000	20	4,000	
Nickel		60	2	3,000	8	12,000	
Tin		50	-	500	-	-	
Selenium		10	1	50	4	200	
Silver		10	10	180	40	720	
Zinc		200	300	35,000	1,200	140,000	
Anions	Anions		Anions		Anions		
Cyanide		50	8	2,500	32	10,000	
Fluoride		450	150	10,000	600	40,000	
Organic species	Organic species		Organic species		Organic species		
Phenols (halogenated)[2]		1	2	10	8	320	
Phenols (non-halogenated)[3]		60	14	560	56	2,200	
Monocyclic aromatic hydrocarbons[4]		7	-	70	-	240	
Benzene		1	0.1	4	0.4	16	
Polycyclic aromatic hydrocarbons[5]		20	-	100	-	400	
Benzo(a)pyrene		1	0.001	5	0.004	20	
C6-C9 petroleum hydrocarbons		100	-	650	-	2,600	
C10-C36 petroleum hydrocarbons		1,000	-	10,000	-	40,000	
Polychlorinated biphenyls[6]		2	see note 6		see note 6		
Chlorinated hydrocarbons[7]		1					
Hexachlorobutadiene			0.07	2.8	0.28	11	
Vinyl chloride			0.03	1.2	0.12	4.8	
Other chlorinated hydrocarbons[8]			-	10	-	50	
Pesticides	Pesticides		Pesticides		Pesticides		
Organochlorine pesticides[9]		1					
Aldrin + dieldrin			0.03	1.2	0.12	4.8	
DDT + DDD + DDE			2	50	-	50	
Chlordane			0.1	4	0.4	16	
Heptachlor			0.03	1.2	0.12	4.8	
Other organochlorine pesticides[10]			-	10	-	50	

FILL MATERIAL | CATEGORY C CONTAMINATED SOIL | CATEGORY B CONTAMINATED SOIL | CATEGORY A CONTAMINATED SOIL

Notes

1. Australian Standard Leaching Procedure (acetate buffer) as specified in Australian Standards 4439.2 and 4439.3.
2. Total sum of 4-chloro-3-methylphenol, 2-chlorophenol, 2,4-dichlorophenol, 2,6-dichlorophenol, pentachlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4,6-tetrachlorophenol, 2,3,5,6-tetrachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol.
3. Total sum of phenol, 2-methylphenol (o-cresol), 3-methylphenol (m-cresol), 4-methylphenol (p-cresol), 2,4-dimethylphenol, 2,4-dinitrophenol, 2-methyl-4,6-dinitrophenol, 2-nitrophenol, 4-nitrophenol, 2-cyclohexyl-4,6-dinitrophenol and dinoseb.
4. Total sum of benzene, toluene, ethyl benzene, xylenes (includes ortho, para and meta xylenes) and styrene.
5. Total sum of naphthalene, acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluorene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene and pyrene.
6. Soil containing polychlorinated biphenyls (PCBs) must be managed in accordance with the *Notifiable Chemical Order for Polychlorinated Biphenyls*. Industrial Waste Guidelines section *Polychlorinated Biphenyls (PCBs)* provides further information.
7. Total sum of carbon tetrachloride, chlorobenzene, chloroform, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, dichloromethane (methylene chloride), 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, tetrachloroethene, vinyl chloride and hexachlorobutadiene.
8. Total sum of carbon tetrachloride, chlorobenzene, chloroform, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, dichloromethane (methylene chloride), 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene and tetrachloroethene.
9. Total sum of aldrin, hexachlorobenzene, alpha BHC, beta BHC, gamma BHC (lindane), delta BHC, chlordane, DDT, DDD, DDE, dieldrin, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, methoxychlor and endosulfan (includes endosulfan I, endosulfan II and endosulfan sulphate).
10. Total sum of hexachlorobenzene(HCB), alpha BHC, beta BHC, gamma BHC (lindane), delta BHC, chlordane, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, methoxychlor and endosulfan (includes endosulfan I, endosulfan II and endosulfan sulphate).

MANAGEMENT OPTIONS

Waste generators must classify contaminated soil by hazard category in order to determine which facility is licensed to accept the soil. If the soil does not meet the acceptance criteria, further treatment or stabilisation will be required.

Category C and Category B Contaminated soil can be accepted at a landfill or facility licensed by EPA to accept such waste.

Category A Contaminated soil will require treatment to reduce or control the hazard before meeting acceptance criteria for disposal at an appropriate EPA-licensed facility.

Table 3: Contaminated soil management options

Category A contaminated soil	• On-site remediation • Off-site remediation • Storage pending availability of treatment	No disposal to landfill. • EPA transport certificates must be used. • Vehicles must hold EPA permit (unless exemption issued).
Category B contaminated soil	• On-site remediation • Off-site remediation • Licensed facility	Disposal to licensed facility. • EPA Transport certificate system must be used. • Vehicles must hold EPA permit (unless exemption issued).
Category C contaminated soil	• On-site remediation • Off-site remediation • Licensed landfill	Disposal to licensed landfill. • EPA Transport certificate system must be used. • Vehicles must hold EPA permit (unless exemption issued).

Generators of contaminated soils may wish to submit a classification application to EPA for approval, where it can be demonstrated that a different category from that outlined above is appropriate for a particular contaminant or group of contaminants in soil. For example, a contaminant that is intrinsically immobilised (without treatment) may display a low hazard because of the very low leachable concentration, despite a relatively high total concentration. Applications will need to provide justification as to why the proposed management will achieve the best environmental outcome. Further analytical testing may also be required. The Industrial Waste Resource Guidelines (IWRG) Classifications - for Disposal provides further information on the requirements for a classification.

FURTHER INFORMATION

- Australian Standard 4439.2 – 1997, *Wastes, sediments and contaminated soils*. Part 2: Preparation of leachates – Zero headspace procedure
- Australian Standard 4439.3 – 1997, *Wastes, sediments and contaminated soils*. Part 3: Preparation of leachates –Bottle leaching procedure
- Australian Standard 4482.1 – 2005, *Guide to sampling and investigation of potentially contaminated soil*. Part 1: Non-volatile and semi-volatile compounds