Contamination Management Manual

Annex C
Soil Stockpiles and Reuse of Excavated Material
March 2018
Quick Reference Guide

Why is this an issue for Defence?

**Mandatory requirements**

- The following requirements are mandatory when undertaking project work on or in the vicinity of stockpiles or excavated materials:

- Defence Project Managers demonstrate alignment with the Defence Waste Minimisation Policy and seek opportunities to reuse excess excavated soil on-site, as the preferred waste management option from a cost, sustainability and capability perspective.

- Stockpiling of waste materials is to be used as a short term (or temporary) management measure only (i.e. for a period no greater than 12 months). Project Managers have responsibility for all stockpiles created by their project (regardless of the contamination type, e.g. Per- and Poly-Fluoroalkyl Substances (PFAS) or asbestos). Management of stockpiled material is addressed in the Initial Environmental Reviews (IERs) and business case cost plans, where relevant.

- Contractors are responsible for managing their stockpiles to a suitable end-point (e.g. reuse, treatment and reuse, containment on-site or disposal off-site) and up to the end of the defects liability period. All stockpiles must be managed and tracked in accordance with the project Construction Environmental Management Plan (CEMP)/Stockpile Management Strategy.

- A base level Stockpile Register must be maintained by Service Delivery Division personnel and/or Base Service Contractors to capture the location, origin, composition, approximate volume and stockpile ownership status (responsible party) for all stockpiles that are expected to remain at the Defence base for periods greater than twelve months.

- Prior to construction (e.g. design phase) contractors should consider:
  - Design and construction techniques that reduce and/or eliminate generation of spoil material, for example directional boring versus opening excavation.
– Undertaking sampling, either in-situ (preferred) and/or ex-situ, if there are legacy stockpiles in the construction area, to characterise the soil for potential end use (e.g. reuse or disposal) via a Pre-construction Contamination Assessment (PCA).
– Consult with regional environmental personnel to agree a suitable end-point of excavated material which may include reuse, on-site treatment and reuse and off-site disposal (refer to Section 4.1.2).

• Selection of the chemical parameters for stockpile sampling and characterisation must be informed by historical data and/or site interviews. Review the Garrison Estate Management System Environmental Factor Management – Contaminated Site Register (GEMS EFM – CSR), formerly referred to as Contaminated Sites Register.
• Management of stockpiles must be undertaken in accordance with the project Environmental Clearance Certificate (ECC) and Defence Contamination Directives.
• If a stockpile is to be retained for a duration of greater than 12 months, Site Selection Board approval is required.
• No material can be added to existing stockpiles without the approval of regional environmental personnel.

More information

• Defence PFAS Investigation and Management Program
• Annex K Management of PFAS Contamination [hyperlink]
Table of contents

Quick Reference Guide ........................................................................................................... i
Abbreviations .......................................................................................................................... v
1. Introduction ............................................................................................................................ 1
   1.1 Background ...................................................................................................................... 1
   1.2 Purpose ............................................................................................................................ 1
   1.3 Defence Documentation ................................................................................................. 1
2. Regulatory Overview ............................................................................................................. 3
   2.1 Overview .......................................................................................................................... 3
   2.2 Stockpiles and Reuse of Contaminated Soil ................................................................. 5
   2.3 Sampling and Analysis ................................................................................................. 6
   2.4 Defence Contamination Directives .............................................................................. 6
3. Contamination Risk ................................................................................................................. 7
   3.1 Background ..................................................................................................................... 7
   3.2 Conceptual Site Model .................................................................................................. 7
4. Projects and Contamination Management ............................................................................ 10
   4.1 General .......................................................................................................................... 10
   4.2 Characterisation ............................................................................................................. 11
   4.3 Management ................................................................................................................ 13
   4.4 Pollution Prevention ...................................................................................................... 15
   4.5 Case Studies .................................................................................................................. 15
   4.6 Case Study 1: Re-use or offsite disposal of spoil/waste water from construction works ................................................................................................................. 16
   4.7 Case Study 2: Potential re-use of stockpiled materials onsite .................................... 17
   4.8 Case Study 3: Re-use of PFAS impacted soil ................................................................. 18
5. Data and Reporting ................................................................................................................. 19
   5.1 GEMS EFM – CSR ........................................................................................................ 19
   5.2 Geographic Information Systems ................................................................................ 19
   5.3 Assessment and Record Management ......................................................................... 19
6. References ............................................................................................................................. 21

Figure index

Figure 1-1 Overview of Defence Environmental Documentation and Annex C ......................... 2
Figure 3-1 Contamination Risks associated with Stockpiles and Reusing Contaminated Material ................................................................................................................................. 9
Appendices

Appendix A – Checklist for characterisation of stockpiles
Appendix B – Management and treatment options
Appendix C – Stockpile risks and mitigation measures
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADES</td>
<td>Assistant Director Environment and Sustainability</td>
</tr>
<tr>
<td>AGPS</td>
<td>Australian Government Publishing Service</td>
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<tr>
<td>ANZECC</td>
<td>The Australian and New Zealand Environment Conservation Council</td>
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<td>ARMCANZ</td>
<td>Agriculture and Resource Management Council of Australia and New Zealand</td>
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<td>AS</td>
<td>Australian Standard</td>
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<tr>
<td>ASC NEPM</td>
<td>National Environment Protection (Assessment of Site Contamination) Measure 1999 (Cth) (NEPC 2013)</td>
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<td>ASLP</td>
<td>Australian Standard Leaching Procedure</td>
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<td>CEMP</td>
<td>Construction Environmental Management Plan</td>
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<td>CEPA</td>
<td>Commonwealth Environment Protection Agency</td>
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<td>CoPC</td>
<td>Contaminants of Potential Concern</td>
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<td>CSM</td>
<td>Conceptual Site Model</td>
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<td>CSR</td>
<td>Contaminated Sites Register</td>
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<td>DCD</td>
<td>Defence Contamination Directive</td>
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<td>DEHP</td>
<td>Defence Environment and Heritage Panel</td>
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<td>DEQMS</td>
<td>Defence Estate Quality Management System</td>
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<td>DERP</td>
<td>Defence Environment Remediation Program</td>
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<td>DQO</td>
<td>Data Quality Objective</td>
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<td>DRN</td>
<td>Defence Restricted Network</td>
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<td>ECC</td>
<td>Environmental Clearance Certificate</td>
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<td>EPA</td>
<td>Environmental Protection Agency or Environment Protection Authority</td>
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<td>EPBC Act</td>
<td>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</td>
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<td>FRTR</td>
<td>US Federal Remediation Technologies Roundtable</td>
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<td>GEMS EFM – CSR</td>
<td>Garrison Estate Management System Environmental Factor Management – Contaminated Site Register (formerly referred to as the Contaminated Sites Register)</td>
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<td>GIS</td>
<td>Geographic Information System</td>
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<td>HSE</td>
<td>Health, Safety and Environment</td>
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<td>IERs</td>
<td>Initial Environmental Reviews</td>
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<td>IWRC</td>
<td>Industrial Waste Reduction Centre</td>
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<td>Meaning</td>
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<td>IWRG</td>
<td>Industrial Waste Resource Guidelines</td>
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<td>LOCR</td>
<td>Defence Legal Obligations Compliance Register</td>
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<td>National Association of Testing Authorities</td>
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<td>National Environment Protection Council</td>
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<td>National Environment Protection Measure</td>
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<td>NSIMS</td>
<td>National Spatial Information Management System</td>
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<td>PCA</td>
<td>Pre-construction Contamination Assessment</td>
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<td>PFAS</td>
<td>Per- and Poly-Fluoroalkyl Substances</td>
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<td>PFASIM Branch</td>
<td>PFAS Investigation and Management Branch</td>
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<td>QAQC</td>
<td>Quality Assurance and Quality Control</td>
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<td>RAAF</td>
<td>Royal Australian Air Force</td>
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<tr>
<td>RESO</td>
<td>Regional Environmental Sustainability Officer</td>
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<tr>
<td>SA EPA</td>
<td>South Australia Environment Protection Authority</td>
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<td>SAQP</td>
<td>Sampling and Analysis Quality Plan</td>
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<td>SSB</td>
<td>Site Selection Board</td>
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<td>TCLP</td>
<td>Toxicity Characteristic Leaching Procedure</td>
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<tr>
<td>UCL</td>
<td>Upper Confidence Level</td>
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<tr>
<td>US EPA</td>
<td>United States Environmental Protection Agency</td>
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1. **Introduction**

1.1 **Background**

Project schedule and budget implications associated with the management of new and legacy stockpiles is an on-going issue for Defence. Stockpiling of soil is considered a temporary management measure only and stockpiling of soil for periods greater than twelve months must only occur when other options are exhausted and with Defence approval. If a stockpile is to be retained for a duration of greater than 12 months, Site Selection Board approval is required.

This guidance document focuses on the characterisation and management of stockpiles comprised predominantly of soil (typically generated by construction activity at one location) as opposed to a waste stockpile containing uncontrolled fill/waste from multiple sites – guidance on the management of legacy waste sites (landfills) is provided in Annex D.

In some circumstances, it is necessary to stockpile soil before its contamination status is known and at some Defence sites, potentially contaminated stockpiled soil exists as a result of construction activities that have occurred in areas of legacy contamination.

If potentially contaminated soil is stockpiled, the stockpile should be managed appropriately to reduce risk to human health and the environment. Management options may include reuse, treatment (following characterisation to classify the soils as suitable for reuse) or disposal off-site. Reuse of the soil on site is the preferred option from a cost and sustainability perspective and is aligned with Defence’s Waste Minimisation Policy.

This document is to be used in combination with other contamination management tools, which are discussed further in the Defence Environmental Strategy, Defence Contamination Management Manual prepared by the Directorate of Environmental Remediation Programs (DERP).

1.2 **Purpose**

The purpose of this document is to provide Defence personnel and its contractors with information on how to manage potentially contaminated stockpiled soil.

It covers the following:

- Key issues
- Regulatory requirements and performance standards
- Contamination risk and management
- Contamination management and case studies
- Data and reporting requirements.

1.3 **Defence Documentation**

This document is Annex C to the Defence Contamination Management Manual of the Defence Environmental Strategy. An overview of where this Annex fits into the Manual is presented in Figure 1-1.
Figure 1-1  Overview of Defence Environmental Documentation and Annex C
2. Regulatory Overview

2.1 Overview

Defence and its contractors must operate to comply with all Commonwealth legislation, including the WHS Act, EPBC Act and the NEPM. Reference can be made to the Defence Legal Obligations Compliance Register (LOCR) found on Defence Estate Quality Management System (DEQMS).

Defence may not be subject to State and Territory law in all situations. Whether or not Defence is bound by State and Territory law is a complex issue and legal advice must be obtained to confirm whether a particular State or Territory law is applicable to Defence. Defence contractors must comply with relevant State or Territory laws.

Guidance relating to the assessment of site contamination is outlined in the National Environment Protection Council (NEPC) 1999 (Cth), National Environment Protection (Assessment of Site Contamination) Measure (NEPM) as amended in May 2013.

2.1.1 NEPM

The National Environment Protection (Assessment of Site Contamination) Measures 1999 (Cth) (the ASC NEPM) was made under the National Environment Protection Council Act 1994 (Cth). The ASC NEPM is the national guidance document for the assessment of site contamination in Australia. It is given effect by the National Environment Protection Measures (Implementation) Act 1998 (Cth) for the Commonwealth and individual legislation and guidelines in each State and Territory.

The NEPC agreed to vary the NEPM by approving an amending instrument to the ASC NEPM in 2013.

All assessments of site contamination on the Defence Estate are to be undertaken in accordance with the recommended process and guidance provided in the ASC NEPM.

The purpose of the ASC NEPM is to establish a nationally consistent approach for the assessment of site contamination; to ensure sound environmental management practices by the community, including regulators, site assessors, site contamination consultants, environmental auditors, landowners, developers and industry parties.

The desired outcome of the ASC NEPM is to provide adequate protection of human health and the environment, where contamination has occurred, through the development of an efficient and effective national approach to the assessment of site contamination.

The ASC NEPM and schedules are available for download through the NEPC website. The ASC NEPM Toolbox contains additional information including calculators, spreadsheets and other supporting documents to assist with application of the amended ASC NEPM.

Section 7.5, Schedule B2 of the ASC NEPM presents the methodology for sampling and characterisation of stockpiles.

2.1.2 Commonwealth Work Health and Safety Act 2011

The Work Health and Safety Act 2011 (Cth) (WHS Act) commenced in 2012 and is regulated by Comcare, a Commonwealth Government agency that works in partnership with the Safety, Rehabilitation and Compensation Commission. The WHS Act provides for a nationally consistent framework to protect workers and other persons against harm to their health and safety through the elimination or minimisation of the risks to the extent reasonably practicable.
Under the WHS Act, employers must take all reasonably practicable steps to ensure the health and safety of its employees and those who are at or near a workplace under the employer's control. This means that Defence and its contractors have obligations to protect the health and safety of workers and others operating within the vicinity of contaminated land that is on or near to a workplace under Defence control.

Model Codes of Practice administered by Safe Work Australia provide practical guides to achieve the standards of health, safety and welfare required under the WHS Act.

Any controls outlined in the Defence Work Health and Safety Manual (SafetyMan) must be implemented when managing contaminated materials.

### 2.1.3 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) is the Australian Government’s central piece of environmental legislation.

The EPBC Act provides a legal framework to protect and manage matters of national environmental significance.

The current matters of national environmental significance to which the EPBC Act applies are:

- World heritage properties
- National heritage places
- Wetlands of international importance (often referred to as Ramsar wetlands)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- Actions, in relation to coal seam gas development and large coal mining development that have, will have, or are likely to have a significant impact on a water resource.

Under the EPBC Act, a person must not undertake an action that has, will have, or is likely to have a significant impact on a matter of national environmental significance without approval from the Commonwealth Environment Minister. If an 'action' has the potential to have a 'significant' impact on a 'matter of national environmental significance', the person proposing to undertake that action must refer the proposal to the Commonwealth Environment Minister for determination as to whether the action is a controlled action.

In addition, the EPBC Act confers jurisdiction over actions that have a significant environmental impact on Commonwealth land, or that are carried out by a Commonwealth agency (even if that significant impact is not on one of the listed matters of 'national environmental significance'). A referral to the Commonwealth Environment Minister is required where:

- a proposal has or is likely to have a significant impact on the environment of Commonwealth land; or
- a Defence proposal has or is likely to have a significant impact on the environment, whether or not it is on Commonwealth land or waters.

All matters that may trigger the EPBC Act are to be referred to the Directorate of Environmental Protection and Assessment.

2.1.4 Off-site migration

The Defence Project Manager should obtain professional advice to inform the reporting and management of any contamination that is found to have migrated off-site into a State/Territory jurisdiction. Delineating the nature and extent of the off-site contamination will assist Defence to implement appropriate mitigation measures and to manage any legal implications. A link to the various State and Territory environmental agencies can be found in the Defence Environmental Strategy, Defence Contamination Management Manual. Any interaction with State or Territory environmental regulators must only occur after first consulting the Assistant Director, Environmental and Sustainability (ADES) or DERP.

2.1.5 Defence Legal Obligations Compliance Register

Defence and its contractors must operate to comply with all Commonwealth legislation, including the WHS Act, EPBC Act and the NEPM. In addition, Defence and its contractors should be generally familiar with the legislative and other regulatory requirements associated with the site activities undertaken relevant to the State or Territory in which the site is located. Contractors must comply with State and Territory laws where applicable. Reference can be made to the Defence Legal Obligations Compliance Register (LOCR) found DEQMS.

2.2 Stockpiles and Reuse of Contaminated Soil

Contaminated soil, if not managed appropriately, has the potential to have an impact to human health and the environment. It is best practice to adopt on-site stockpile management, including on-site treatment and reuse and containment, to minimise the ecological footprint and the economic cost of soil management. Reuse of contaminated materials, where such use does not have adverse impacts on human health and the environment, can prove to be highly beneficial from both an environmental and an economic standpoint (IWRC, 2003).

The suitability of stockpiled soil/sediment for reuse as clean fill (or another beneficial use), either onsite or offsite is assessed on the basis of waste soil classification performed by an appropriately qualified environmental consultant.

The Commonwealth Government’s “National Waste Minimisation and Recycling Strategy” sets out a waste management hierarchy (CEPA, 1992) that can be applied to contaminated materials. In order of preference, the options that should be considered are:

- Avoidance
- Reduction
- Reuse
- Recycling
- Treatment
- Disposal

The above is aligned with the Defence Waste Minimisation Policy.
2.3 Sampling and Analysis

The following national guideline documents provide further information on the technical requirements for soil sampling and analysis:

- NEPC (2013). Schedule B2 Guideline on Site Characterisation
- NEPC (2013). Schedule B3 Guideline on Laboratory Analysis of Potentially Contaminated Soils
- AS 4482.1 (2005), Guide to the sampling and investigation of potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds
- AS 4482.2 (2005), Guide to the sampling and investigation of potentially contaminated soil Part 2: Volatile substances
- Safe Work Australia (2016) Model Code of Practice: How to Safely Remove Asbestos

2.4 Defence Contamination Directives

A series of Defence Contamination Directives (DCDs) that include mandatory requirements for management of PFAS contamination, including requirements relating to stockpile management, material reuse and disposal, are available at Defence Contamination Directives.

The Department of Defence, Estate and Infrastructure Group (2017), Application of Defence Contamination Directive (DCD) #8 Amendment 2 outlines the activities that are required when PFAS is encountered during the project lifecycle, including sampling, Environmental Clearance Certificate (ECC), disposal of PFAS contaminated waste and stockpiling.

The PFAS Investigation Management Branch (PFASIM Branch) will continue to update the relevant Directives as further national guidance is developed and becomes available.
3. Contamination Risk

3.1 Background

Day to day activities on Defence sites, such as construction and excavation activities, may result in the creation of soil stockpiles. If the soil is contaminated, it must be managed in a way that minimises the potential for contamination to cause harm to the environment or to impact sensitive receptors on-site and/or off-site.

On-site risk factors associated with stockpiles include:

- Chemical and physical characteristics of the soil stockpiled and length of time materials will be stored
- Location and climate of the site
- Hydrogeology and hydrology including proximity to surface and groundwater
- Management approaches to the stockpiled materials (SA EPA 2017)

Off-site risk factors associated with stockpiles include:

- Proximity to, and sensitivity of, the surrounding environment
- Topography and hydrology elevation of the working level which the stockpile is situated upon and relative to the surrounding environment
- Implementation of appropriate pollution control standards
- Management of traffic in and around the site (SA EPA 2017)

A more detailed description of these above risk factors, and management measures, are presented in Appendix C.

3.2 Conceptual Site Model

3.2.1 Overview

As described in the ASC NEPM, a Conceptual Site Model (CSM) describes the contamination sources, pathways and receptors and the potential linkages between these.

The initial CSM is constructed from the results of a Stage 1 PSI and is the basis for defining where potential source-pathway-receptor linkages may exist, which require further investigation. The CSM must be continually reviewed and updated throughout the assessment process to inform subsequent decisions on whether further investigation or contamination management actions are required.

The CSM should identify complete and potential pathways between known or potential contamination sources and receptors. Where the pathway between a source and a receptor is incomplete, the exposure to chemical substances via that pathway cannot occur, but the potential for that pathway to be completed (for example, by abstraction of groundwater or a change in land use) should be considered in all stages of assessment. The CSM can also be used to consider where management measures would reduce the likelihood of an exposure pathway becoming complete.

The essential elements of a CSM are:

- Known and potential sources of contamination and contaminants of concern including the mechanism(s) of contamination (e.g. ‘top down’ spill or sub-surface release from corroded tank or pipe).
- Potentially affected media (e.g. soil, sediment, groundwater, indoor and ambient air).
3.2.2 Contaminants of Potential Concern

Contaminants of Potential Concern (CoPC) within stockpiles at Defence sites may be broad ranging, as material can be sourced from any part of the site. Due to the composition of stockpiles generally being unknown, a broad analysis of CoPC is generally recommended.

An assessment of the site and stockpiled materials, including site history, will identify which contaminants to analyse to characterise the stockpile; however, this does not preclude the analysis of other contaminants. A broader sampling suite of potential contaminants may be required to characterise the soil if:

- Little is known about the origin of the contaminated material
- The material appears to be mixed with other waste
- The material appears to be comprised of multiple soil types.

It is necessary to determine the CoPC for each site on an individual basis due to the diverse nature of Defence activities and the range of potential historical uses across the Defence Estate. A review of the current and historical use of each site is necessary to determine which contaminants may be present. For example, if a site was historically used as a rifle range, lead would be considered one of the primary CoPC. In general, 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
- Have had manufactured chemicals applied.

It is necessary for Project Managers to identify and assess the risks to human health and environment associated with the potential CoPC, prior to reuse.

For further information on the CoPC associated with particular Defence activities, refer to Table 3-1, Section 3.2 of the Defence Contamination Management Manual of the Defence Environmental Strategy.

3.2.3 Fate and transport

Depending on the solubility and persistence of the contaminants present in the stockpiled materials, contaminants may be mobilised from the stockpiles as a result of leaching and runoff into the immediate and surrounding environment, causing contamination of soil, sediment, surface water and/or groundwater.

3.2.4 Graphical conceptual site model

A visual representation of a CSM relating to stockpiles and reuse of contaminated materials, and the potential contamination sources, pathways and receptors is presented in Figure 3-1.
Figure 3-1 Contamination Risks associated with Stockpiles and Reusing Contaminated Material
4. Projects and Contamination Management

4.1 General

The presence of stockpiles on site may be the result of historical or current activities. In relation to the generation of excess material excavated from site, the following overarching principals apply:

- Don’t excavate/minimise excavation and generation of spoil
- Stockpiling of soil is considered a temporary, i.e. a short term solution of less than 12 months, management measure only
- Stockpiles are the responsibility of the project that created the stockpile and contractors are responsible for managing their stockpiles to a suitable end-point (e.g. reuse, containment on-site or disposal off-site) up to the end of their defects liability period
- Stockpiling must not occur unless there has been consideration of the end-point of the soil (i.e. re-use or disposal), and consultation and agreement with Defence project manager and regional environmental personnel as to this end-point
- Reuse of excess excavated soil on-site is the preferred option from a cost, sustainability and capability perspective and is aligned with the waste management hierarchy set out in the Defence Waste Minimisation Policy.

4.1.1 Pre-construction

Prior to construction, contractors are to:

- Consider design construction techniques that eliminate/reduce generation of spoil material, for example directional boring versus opening excavation. In short – don’t excavate if it’s not necessary
- Undertake Pre-construction Contamination Assessment (PCA) sampling, either in-situ prior to construction (preferred) and/or ex-situ if there are legacy stockpiles in the construction area, to characterise the soil for reuse or disposal.
- Consult and reach agreement with regional environmental personnel regarding the end-point of any excavated material, whether that be re-use or off-site disposal.

Where excavation will be undertaken using hydro-vacuum excavation techniques (e.g. non-destructive digging/hydracav) the contractor must consider the requirements for managing dewatering water/sludge.

4.1.2 Approvals process for on-site stockpile management

Where the soil does not meet the land use thresholds for reuse, has contaminant concentrations above acceptable levels for disposal to an off-site facility and will be stockpiled for periods greater than 12 months (or end of DLP), contractors must consult with the regional Defence personnel to:

- Agree on the location and requirements for stockpiling and document/map the requirements in an Environmental Management Plan and/or Site Management Plan.
- Identify the risks associated with the stockpile and management measures to prevent release of contamination in leachate, surface water run-off, sediment and dust. Pollution prevention measures must be documented in the Environmental Management Plan and may include specifications for a liner system, overhead cover and bunding and prescribed stockpile dimensions.
• Assess and identify potential treatment options to enable reuse or off-site disposal and the funding sources to facilitate treatment.

• Enter the stockpile on the Stockpile Register if treatment options are viable. Where no apparent treatment options exist, and long-term stockpiling is likely, the stockpile must be added to the Garrison Estate Management System Environmental Factor Management – Contaminated Site Register (GEMS EFM – CSR) as a contaminated site.

If a stockpile is to be retained for a duration of greater than 12 months, Site Selection Board (SSB) approval is required. Where a more permanent solution is required for waste materials and treatment or disposal off-site isn’t an option, due to the volume of material or distance and cost for landfill disposal, a SSB process is triggered. The SSB will consider a range of factors such as land constraints and impacts to Defence capability. Any permanent solution (e.g. containment cell) will need to consider suitable siting criteria (e.g. depth to groundwater and sensitive human or ecological receptors) and associated design features such as lining/leachate collection system (suitable for the CoPC) and capping.

4.1.3 Stockpile register

There are two levels of stockpile registers required – project-level and base-level:

• **Project-level** – stockpiles are considered temporary and contractors are responsible for the management/tracking (e.g. location, origin, composition, volume) of stockpiles generated during their projects. All stockpiles must be managed/tracked in accordance with the project Construction Environmental Management Plan (CEMP) – the CEMP must consider the end-point of excavated material which may include reuse, on-site treatment and off-site disposal.

  Where significant volumes of excess soil will be generated (e.g. >1000 m³) a separate Stockpile Management Strategy setting out the sampling/analysis plan for soil characterisation, and identifying the end-point of the soil, should be prepared to supplement the CEMP.

• **Base-level** – A base level Stockpile Register must be maintained by Service Delivery Division personnel and/or Base Service Contractors to capture the location, origin, composition, volume and stockpile ownership status (responsible party) for all stockpiles that will remain at the Defence base for periods greater than 12 months to ensure that all stockpiles are appropriately recorded and to facilitate on-site reuse or treatment and re-use, where appropriate. Composition of the stockpile should be recorded by attaching waste characterisation reports to the register.

4.2 Characterisation

It is important to assess the chemical and physical characteristics of the soil to determine the remediation or management option(s) available. Characterisation of potentially contaminated soil must be conducted by consultancies with proven relevant experience, such as the members of the Defence Environment and Heritage Panel (DEHP).

Selection of the chemical parameters for stockpile sampling and characterisation must be informed by historical data and/or site interviews. Review the GEMS EFM – CSR and liaison with regional Defence environmental personnel must be undertaken as a starting point.

In-situ characterisation of soil, prior to construction, is Defence’s preferred approach on the basis that this practice can eliminate the need for stockpiling and/or reduce the duration that soil stockpiles are present on-site. Where soil has been stockpiled without assessment, or only partially assessed, stockpile sampling will be required.
Accurate characterisation of stockpiled materials according to the nature and concentrations of chemical substances is required to determine the appropriate end-point of the material.

Sampling for chemical characterisation is typically undertaken to achieve three objectives:

- **Waste classification** – a waste classification of the soil to facilitate off-site disposal.
- **Treatment suitability** – information to assist with an assessment of the potential for the soil to be successfully remediated to achieve the desired end-point.
- **Suitability for reuse** – assessment of the soil for reuse following excavation and treatment (if required).

Characterisation is achieved through the collection and analysis of samples. If a soil is to be reused, it is important to consider not only the type and concentrations of contaminants present, but also the potential for these contaminants to leach from the soil - through an assessment of leachability (Section 4.2.2).

### 4.2.1 Stockpiling inspection and sampling

Soil characterisation and classification typically involves three major components:

1. Collecting a representative sample(s) of the soil at an appropriate sampling frequency. Stockpile sampling density must meet the minimum requirements detailed in Section 7.5 Schedule B2 of the ASC NEPM and with consideration to EPA Victoria (2009b) Industrial Waste Resource Guidelines: Soil Sampling (IWRG702).
2. Submitting the samples to an analytical laboratory for a suite of selected CoPC.
3. Comparison of the analytical results to the appropriate State or Territory disposal regulations and environmental/human health criteria, to determine the waste category and whether treatment of the soil is required prior to reuse or offsite disposal.

In accordance with ASC NEPM (2013), the following key tasks must be undertaken:

- Obtain available historical data and undertake site interviews to obtain background information, such as the origin, composition and age, on the stockpile – this will assist in identifying the CoPC for analysis once samples are collected.
- Excavate inspection slots/test-pits into the stockpile noting the items listed in the checklist in Appendix A. These include visual and olfactory indicators of contamination and stockpile homogeneity. Smaller stockpiles can be excavated using a shovel. For larger stockpiles an excavator may be required.
- Undertake sampling at a frequency aligned with Section 7.5, Schedule B2 of the ASC NEPM (Appendix A).
- Composite sampling (combining samples collected from throughout the stockpile) should be considered where inorganic analytes are the CoPC. Composite sampling is not appropriate for assessment of volatile, or semi-volatile organic analytes.

The results of sample analysis will provide detailed information on the nature and level of contaminants present. Results can then be assessed against the relevant land use/waste disposal criteria, either using the highest sample result, or the 95% UCL average value for each individual contaminant.

The EPA Victoria (2009b) guidance document, Industrial Waste Resource Guidelines: Soil Sampling (IWRG702), has guidance on the minimal number of samples for in situ characterisation of soil and stockpile characterisation (based on volume) for reuse and worked examples of 95% UCL (normal distribution and log-normal data).
4.2.2 Assessment of soil leachability

In an environmental context, leaching is the process of transferring chemical constituents from a solid particle to an aqueous solution. The leaching characteristics of soil can be used to select an appropriate landfill for off-site disposal of soil, and also to assess the suitability of soil for reuse (by assessing the potential for soluble contaminants to move through the soil and impact on groundwater).

With regard to the assessment of soil leachability, the following is highlighted:

- Leachability testing must be undertaken in accordance with the Australian Standard Leaching Procedure (ASLP) (AS 4439.2 and 44396.3) or Toxicity Characteristic Leaching Procedure (TCLP) (US EPA method 1311) by a National Association of Testing Authorities (NATA) accredited laboratory.
- When assessing soil for reuse typically a neutral leaching solution (~ pH 6.5 to 7) (e.g. deionised water) is used to simulate the pH of rainwater infiltrating the soil.
- When assessing soil for off-site disposal typically an acidic leaching solution (~pH 2 to 4) is used to simulate the pH of a landfill environment.

4.3 Management

4.3.1 Protecting human health and the environment

Before contaminated materials are reused on a site, it must be demonstrated that the nature of the material is appropriate given the present and proposed future use of the site. In order to determine if a material is appropriate for reuse, it is essential to consider how and where the material will be reused and the risks that are associated with the proposed reuse.

If a contaminated material has been removed from an area off site, this may be because it is considered to have the potential to have a negative impact on human health and/or the environment. If the material is to be reused, the associated negative impact must be removed or at least significantly reduced to an acceptable level.

The impacts associated with a contaminated material can be reduced by:

- Soil treatment prior to reuse of impacted soils to reduce the level of contamination in the material. This is the preferred method.
- Capping, containment or storage (in an engineered facility) of the contaminated material to reduce the risk of exposure to people and/or ecological receptors.

4.3.2 Management options

Sufficient information to inform the most appropriate management option for the material, should be available following soil characterisation and waste classification. Examples of the potential management options for stockpiled materials include:

- Separation
- Segregation
- Disposal off-site
- Management ex situ (storage)
- Reuse of soil on-site
- Management in situ.
Treatment technologies may need to be considered to reduce contaminant concentrations to the levels that are suitable for the desired end-use (e.g. reuse or off-site disposal). Ex-situ treatment technologies include:

- Biological treatment (e.g. biopiles or landfarming)
- Physical/chemical treatment (e.g. soil washing or stabilisation)
- Thermal treatment (e.g. incineration or thermal desorption).

Examples of possible re-use scenarios, assuming the required chemical and geotechnical parameters are achieved, include:

- On-site under roadways/runways
- On-site under capped landscaping
- Off-site as fill material. Although uncommon, where stockpiled material is proposed for use off-site as fill material.

Appendix B contains further information about the management options is presented above.

4.3.3 Asbestos

Under the Work, Health and Safety Act 2011 and regulations, the controllers of premises and/or employers, have a duty to assess workplaces for the presence of asbestos and to document and communicate the condition of that asbestos to employees, contractors and visitors. This includes instances of potential asbestos containing material in stockpiles.

The individual State and Territory regulations require the employer or controller to consult health and safety representatives and employees about asbestos presence, risk assessment and control measures (refer to Section 2 for legislative and regulatory requirements). The Base or Regional Asbestos Management Registers and Management Plans must be referred to when undertaking to manage legacy stockpiles.

Management of a stockpile is the responsibility of the project that created the stockpile regardless of the contaminant(s) within the stockpile. If a stockpile contains asbestos the WHS officer must be consulted, where necessary, but the contractor/consultant engaged by the project are to devise/specify the stockpile end use and management measures.

4.3.4 PFAS

The requirements relating to sampling, stockpiling and off-site disposal of PFAS impacted soil is outlined in the Department of Defence, Estate and Infrastructure Group (2017), Application of Defence Contamination Directive (DCD) #8 Amendment 2.

4.3.5 Property transactions

Adequate provision must be made for the characterisation and disposal/management of existing stockpiles during preparation of Defence property for disposal and leasing or when assessing properties for acquisition by Defence in order to minimise future liabilities. Refer to Annex A – Property Transactions, Redevelopment and Disposal for further information.
4.4 Pollution Prevention

All stockpiles must be managed in a way that minimises the potential for contamination to mobilise into the environment. Some general environmental management measures for the temporary stockpiling of contaminated soil are presented below with further information provided in Appendix C:

- Where possible segregate clean and contaminated excavated soil.
  - All site personnel must be made aware of the importance of keeping materials with different contamination status separate (through signage and site inductions). The status of the stockpile (e.g. clean/contaminated) must be noted in the Construction Environmental Management Plan or Stockpile Management Strategy during projects or in the Stockpile Register for stockpiles older than 12 months.
  - Material of unknown contamination status which is awaiting sampling must be banded and kept separate from other material until it has been sampled and classified
- If contaminated or potentially contaminated material is to be stockpiled, an appropriate impermeable base will be required to prevent leaching of contaminants into the soil/groundwater and to control surface water run-off and signage must be erected
- Any stockpile of contaminated or potentially contaminated material must be identified on a site plan or by labelling on-site with a stake or similar. The stockpile should be identified with its source location, type of material contained in the stockpile, contamination status (e.g. awaiting classification), estimated volume, and the date it was stockpiled
- All stockpiled materials must have a planned end-use and must not be stored at the site indefinitely
- Appropriate sediment and erosion control measures must be implemented on the site
- The site must be secured, and access controlled to prevent additional dumping and non-project personnel entering the site
- The details of all stockpiles that will remain at the Defence base for periods greater than 12 months must be documented in the Stockpile Register.

4.5 Case Studies

The following case studies highlight the contamination risks related to the management of stockpiles and reuse of contaminated materials on Defence land and identify management measures and sources of further information to address these contamination issues. These case studies are hypothetical examples only and are not based on actual events.
4.6 Case Study 1: Re-use or offsite disposal of spoil/waste water from construction works

4.6.1 Scenario

An underground service will be installed in a new 200 m service corridor on an active Royal Australian Air Force (RAAF) Base. Excavation of the trench and service pits will generate 500 m$^3$ of spoil material that may be contaminated; contamination is associated with historical site activities (fuel storage).

The work area is constrained in size meaning spoil material can only be temporarily stockpiled. The groundwater depth is shallow.

4.6.2 Risks

**HSE** – If contaminated material is encountered during excavation, construction workers may be exposed to an unacceptable HSE risk. If stockpiles are not managed correctly an environmental pollution incident, via surface water run-off or dust, could occur.

**Project Delays** – If material is not suitable for reuse by reinstatement back in the excavation or at another location on the RAAF Base then the material will need to be disposed off-site requiring permits and approvals that cause project delays.

4.6.3 Key considerations and management measures

- Is an ECC required?
- Are there any known Contaminated Site Records along the proposed excavation corridor to provide an indication of the type of contamination that may be encountered?
- Can sampling be conducted to characterise the soil/groundwater quality prior to excavation (this will assist in material segregation as not all contamination can be seen)?
- What is the likelihood that dewatering water will be generated and how will it be managed (disposal to stormwater/sewer or treated)?
- Does the RAAF Base have an area for temporary stockpiles? If no, where will the material be stored prior to reinstatement or off-site disposal?
- How will you track the movement of excavated materials from origin to final destination?
- In most states and territories, waste classification is required to categorise the waste for off-site disposal. The legislative requirements for off-site disposal for contaminated soils may differ for each State/Territory.

4.6.4 More information

- Section 7.5 Schedule B2 of the ASC NEPM and EPA Victoria (2009) IWRG702 guidance which present the methodology for sampling and characterisation of stockpiles.
- Defence Regional Environmental Sustainability Officer (RESO)
4.7 Case Study 2: Potential re-use of stockpiled materials onsite

4.7.1 Scenario
An area of a Defence base is being developed as a military vehicle maintenance area. As a part of the development, a series of raised pads are required to be constructed on site. Appropriate stockpiled materials of a sufficient volume to construct the pads have been identified on site; however, the source, composition and age of the stockpiles are unknown.

4.7.2 Risks
HSE – If contaminated material is encountered within the stockpiled materials, construction workers and future site users may be exposed to an unacceptable HSE risk. If the stockpiled material is not characterised correctly and is inappropriately reused, an environmental pollution incident, via groundwater contamination, surface water run-off or dust, could occur.

Project Delays – If the stockpiled material is classified as being contaminated and is subsequently not suitable for reuse on site, then the material will need to be disposed off-site. This process will require permits and approvals that can delay projects.

4.7.3 Key considerations and management measures
- Is an ECC required?
- Are there any known Contaminated Site Records that may have been excavated and stockpiled at the site to provide an indication of the type of contamination that may be encountered?
- Stockpile sampling density must meet the minimum requirements detailed in Section 7.5 Schedule B2 of the ASC NEPM and IWRG702 (EPA Victoria, 2009b).
- Samples must be collected according to AS 4482.1 and AS 4482.2 prior to excavation (this will assist in material segregation as not all contamination can be seen).
- Samples must be chemically characterised through laboratory testing and results compared to appropriate guidelines to determine if the material can be reused on site.
- In most States and Territories waste classification is required to categorise the waste for off-site disposal. The legislative requirements for off-site disposal for contaminated soils may differ for each State/Territory.

4.7.4 More information
- Section 7.5 Schedule B2 of the ASC NEPM and EPA Victoria (2009b) IWRG702 guidance which presents the methodology for sampling and characterisation of stockpiles.
- RESO.
4.8 Case Study 3: Re-use of PFAS impacted soil

4.8.1 Scenario

A new large-scale building is to be constructed at a Defence RAAF Base. During construction, large volumes of spoil material from excavation of a basement carpark will be generated – it is proposed that the spoil is reused at the site or disposed off-site.

In consultation with the RESO, a PCA was scoped and implemented by a suitably qualified person. Low-level PFAS impact was identified in the soil proposed for reuse - soil characterisation included sampling/analysis for totals (mg/kg) and leachability (mg/L) (Section 4.2). PFAS concentrations in the soil met Defence guidance on acceptable levels for commercial land use and the soil’s leaching potential was considered acceptable based on a site-specific CSM.

The soil was reused within the project site under roadways and in landscaped areas - requirements for reuse included setbacks from drainage lines and waterways, maintaining a 0.5 m capping in reuse areas and on-going monitoring of the spoil under a site management plan.

4.8.2 Risks

HSE – If soil proposed for reuse is not appropriately characterised prior to reuse, and then tracked and monitored during placement and reuse (e.g. using a site management plan), construction workers and future site users may be exposed to an unacceptable HSE risk.

There is the potential for HSE risks if impacted soil (PFAS or other) is transported out of the project site to a “clean” part of the Base during construction – meaning that it can’t be managed under a site management plan.

Project Delays – Early engagement with the RESO, and potentially the PFASIM Branch, to identify the process and site-specific requirements around reuse of impacted material to avoid delay projects.

4.8.3 Key considerations and management measures

- As per Section 4.7.3
- Early engagement with the RESO, and if required the PFASIM Branch, to map out the process and site-specific requirements for reuse
- Classification for reuse must consider total (mg/kg), leaching potential (mg/L) of the CoPC and potential source-pathway-receptor linkages through preparation of a site specific CSM.

4.8.4 More information

- Section 7.5 Schedule B2 of the ASC NEPM and EPA Victoria (2009b) IWRG702 guidance, which present the methodology for sampling and characterisation of stockpiles.
5. **Data and Reporting**

5.1 **GEMS EFM – CSR**

Data and reports generated as part of the investigation and assessment of burning grounds must be captured in the GEMS EFM – CSR (formerly referred to as the Contaminated Sites Register).

The GEMS EFM – CSR is the database used to capture environmental information across the Defence estate, and provides access to historical contamination investigation reports for Defence properties. Contaminated site records are geo-referenced and they can be accessed by Defence personnel or contractors with Defence Restricted Network (DRN) Access.

Contractors working on behalf of Defence must forward reports, data and updated Adobe Interactive Forms (for new or existing Contaminated Sites Registers, CSRs) relating to contamination to their Defence point of contact, Project Manager or RESO who will be responsible for uploading the information into the GEMS EFM – CSR.


5.2 **Geographic Information Systems**

All mapping Geographic Information System (GIS) data is required to be provided to Defence in National Spatial Information Management System (NSIMS) metadata format. The Defence [NSIMS metadata tool](hyperlink) is available through an online search and on DEQMS.


5.3 **Assessment and Record Management**

5.3.1 **Stockpile assessment**

A report on the assessment of the contaminated stockpiled materials and the implementation and effectiveness of the management of the materials, including compliance with the adopted guideline criteria, must be prepared at the conclusion of the assessment. The report must address the following:

- Establish the objectives of the assessment.
- Include details of a desktop study and detailed site inspection, including relevant information pertaining to site history and possible sources of stockpile material and potential contamination.
- Develop a CSM (Section 3.2).
- Develop a Sampling and Analysis Quality Plan (SAQP), including Data Quality Objectives (DQOs), appropriate sampling frequency and analytical suite and spatial coverage to ensure that samples are representative of the entire stockpile.
- Detail site activities, including on-site excavation methodologies, stockpiling, importation of fill materials, environmental performance, off-site transportation and final disposal destination.
- Discuss data Quality Assurance and Quality Control (QAQC) procedures, analysis, and interpretation against adopted guideline criteria and relevant waste categories.
- Samples analysed at a NATA accredited laboratory.
- Analytical results are compared to the relevant guideline documents.
The development and maintenance of site management plans and keeping detailed site records is essential. The sampling, analysis, classification, movement, storage and reuse of all contaminated materials must be recorded in project waste and soil tracking during redevelopments and incorporated into the Stockpile Register (Section 4.1.3) for stockpiles that will be retained on site for more than 12 months.

Tracking of contaminated materials in a “cradle to grave” manner is required to minimise future human and environmental exposure to contaminated materials.

5.3.2 Record management

If a stockpile has been deemed chemically inappropriate for offsite disposal, or onsite reuse, it must be added to the GEMS EFM_CSR with the required documentation attached. This documentation would include the sampling results, soil and waste classification, a CRAT risk output and other details as required to facilitate ongoing risk management.
6. References


Safe Work Australia (2016) *Code of Practice: How to Safely Remove Asbestos*

Safe Work Australia (2016) *Code of Practice: How to Manage and Control Asbestos in the Workplace*


Appendices
Appendix A – Checklist for characterisation of stockpiles
### Table A-1 Checklist – Soil Classification and Characterisation

<table>
<thead>
<tr>
<th>Indicators for soil classification &amp; characterisation</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Visual Evidence of Contamination – are there any visual indications of chemical contamination (e.g. surface staining) on or in the soil and has adequate sampling/analysis been undertaken to determine the cause of the visual impact?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>2. Odours – are there any odours emanating from the soil and has adequate sampling/analysis been undertaken to determine the cause of the olfactory impact?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>3. Potentially Contaminating Activities – what type of activity has caused the generation of the soil, and does the activity have the potential to have contaminated the soil?</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
| For example if the soil has been:  
- Generated from the removal of a UST, a vehicle wash down bay or a drain near a mechanical workshop, then there is a high likelihood that the soil is contaminated; whereas  
- Excavated on a Greenfield site, or a site where little historic activity has occurred, then there may be a low probability that the soil is contaminated. | □  | □ |
| 4. Waste Soil from an Unknown Source – is the source of the soil / sediment known? | □  | □ |
| If the source of the soil / sediment is unknown then sampling and analysis of the material is advisable in order to assess the most appropriate option for the material. | □  | □ |
| 5. Waste Classification – has adequate sampling and laboratory analysis been undertaken of the soil to assess the chemical composition, and determine a waste classification of the material? | □  | □ |
| The sampling and analysis requirements, in addition to the categories of waste, vary between the states/territories. | □  | □ |
| 6. Reuse of Material – has adequate sampling and laboratory analysis been undertaken of the soil to assess the chemical composition to determine whether the material is suitable for reuse on or off-site? | □  | □ |
| The land-use criteria (for human health and ecological protection) are provided in the National Environment Protection (Assessment of Contamination) Measure 1999 (Cth), as amended 2013. | □  | □ |
| 7. If ex-situ remediation (i.e. excavation) is proposed, is there the potential for the soil to be Acid Sulfate Soils (ASS)? | □  | □ |
| Has any sampling been undertaken to confirm the absence or presence of ASS? | □  | □ |
| 8. Remediation/Management Parameters – has adequate sampling and laboratory analysis been undertaken to characterise the key chemical and physical parameters of the soil to:  
- Assess whether specific soil remediation methods are appropriate  
- Assess the suitability of the available management options (Monitored Natural Attenuation) | □  | □ |

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2. Visual indications may include surface staining, vegetation dieback, sheen or product floating on surface or groundwater.
3. Visual indications may include surface staining, vegetation dieback, sheen or product floating on surface or groundwater.
7.5.2 Number of samples

Table 4 below provides the minimum number of samples recommended for characterisation of stockpiles up to 200 m\(^3\) comprising similar materials. A greater number of samples may be required when there is a large range in contaminant concentrations or soil types. If only the minimum number of samples is collected and there is a large range in contaminant concentration, then either the maximum concentration should be assumed for disposal purposes or additional samples collected and analysed and the situation re-evaluated. In situ samples taken prior to excavation may be helpful for informing the decision on the number of samples required for adequate characterisation of stockpiles.

<table>
<thead>
<tr>
<th>Stockpile volume, (m(^3))</th>
<th>No. of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;75</td>
<td>3</td>
</tr>
<tr>
<td>75 – &lt;100</td>
<td>4</td>
</tr>
<tr>
<td>100 – &lt;125</td>
<td>5</td>
</tr>
<tr>
<td>125 – &lt;150</td>
<td>6</td>
</tr>
<tr>
<td>150 – &lt;175</td>
<td>7</td>
</tr>
<tr>
<td>175 – &lt;200</td>
<td>8</td>
</tr>
</tbody>
</table>

The recommended sampling frequency (Table 4) applies to the characterisation of homogenous soils suspected of contamination. Lower sampling rates may be derived for soil quantities greater than 200 m\(^3\) by applying statistical analysis. Worked examples of applying 95% \(\text{UCL}_\text{req}\) to characterise stockpiles are included in EPA Victoria (2010).

Jurisdictions may have specific requirements where materials are to be recycled, recovered and reused for beneficial purposes.

**Figure A-1 Extract from ASC NEPM, Stockpile Sampling**
Appendix B – Management and treatment options

Management options

Following the soil characterisation and waste classification of the stockpiled material, there should be enough information to inform the most appropriate management option for the material. Examples of potential management options for stockpiled materials are presented below, as per the Department of Defence Manual for the Management & Remediation of Petroleum Hydrocarbon Contaminated Soil and Sediments (Department of Defence, 2009).

Separation

Once the different types of soil have been classified according to the nature and concentrations of contaminants present, they should be physically separated so far as reasonably practicable. This ensures that the volume of materials recovered as a potentially valuable resource is maximised and the volume that requires further processing, treatment or disposal is minimised.

The methods used to separate more contaminated material from less contaminated materials vary according to the nature of both the material and the contaminant.

Soil, rock and similar materials can generally be simply excavated and stockpiled in discrete areas according to their classification, however other solid materials may require more complex separation techniques:

- Mixed demolition wastes may require mechanical screening or hand-picking to separate out different material types.
- Where materials are stockpiled, it may be prudent to place the materials on a lined surface, to reduce the opportunity for leaching of contaminants to soil or groundwater or sediment movement.

Segregation

Contaminated materials often need to be stored prior to reuse, possibly for only a few hours or perhaps years. During this time it is essential to ensure that the transfer of contaminants between material types and to external receptors (i.e. people and the environment), is kept to a minimum. It may be prudent to place the materials on a lined surface to reduce the opportunity for leaching of contaminants to soil and or groundwater. Similarly, appropriate sediment control measures (e.g. silt mesh) should be implemented.

Stockpiles should be bunded to prevent the runoff of contaminated surface water and sediments and to reduce the opportunity for leaching. Covers should be used on stockpiles to minimise the opportunity for emissions to the atmosphere, surface water runoff and generation and transfer of contaminated dust. The types of materials stored should also be documented within the environmental management system for the site.

Disposal off-site

Depending on the waste characterisation of the stockpiled soil, contaminated material may be disposed of off-site to an appropriately licenced waste disposal facility pre- or post-treatment. If the waste soil requires treatment, the treatment process may occur on-site or off-site at an appropriately licensed premises, pending approvals or other requirements by state authorities (Department of Defence, 2009).
Management ex-situ (storage)

Contaminated soil may be excavated from the stockpile and contained in a dedicated long-term or short-term storage area. This may be on or off-site in a manner consistent with local regulatory requirements. Short-term storage options may be considered if, a) the soil treatment technology selected is unsuccessful, or b) immediate funding to treat the soil is not initially available. Having the available space and resources to ensure waste segregation is achieved is an important consideration when evaluating this endpoint. For example, on site containment cells may be considered as a possible management option. If containment of contaminants on site is deemed to be an option, then the following key considerations would need to be made regarding the containment cell design/specification:

- Site specific conditions (depth and quality of groundwater, permeability of underlying lithology/geology).
- Physical/chemical properties of the waste.
- Containment cell siting, design and construction.

Reuse of soil/sediment on-site

This reuse of stockpiled material assumes that the soil can be treated to a quality that is suitable for reuse in accordance with Defence and state and territory regulatory requirements. Stockpiled soil should be assessed for its suitability to be reused onsite or elsewhere based on an assessment against human health and ecological criteria (e.g. NEPM) and leachability. If treatment of contaminated soil is required, it may occur on-site or off-site at an appropriately licensed premise.

Management in-situ

The management of impacted stockpiled soil without extensive excavation may be undertaken to remove the contaminants. This form of management may be achieved via the a) installation of a containment wall, b) the use of in-situ remedial techniques such as bio-venting, or c) if a risk assessment finds the environmental and human health risks acceptable. Management of residual impacted stockpiled soil may need to be approved by a Environmental (Contaminated Land) Auditor and may require a site-specific management plan (Department of Defence, 2009).

Treatment options

To reduce contamination concentrations in stockpiled soil to levels that are suitable for reuse, or off-site disposal, treatment technologies may need to be considered.

Potential treatment options for stockpiled soil includes:

- Biopiling
- Landfarming
- Soil washing
- Solidification stabilisation
- Incineration
- Thermal desorption.

Selection of the most appropriate treatment technology is based on a number of site-specific factors including:

- Chemical and physical characteristics of the soil
- Degree of technical difficulty, reliability, cost and time associated with the treatment technology
- Operational and long-term management requirements
- Site location and availability of equipment and resources.

Further information with regard to soil remediation and treatment options includes:

- [Management and Remediation of Petroleum Hydrocarbon Contamination Soil and Sediments](https://frtr.gov/matrix2/section3/table3_2.pdf)
Appendix C – Stockpile risks and mitigation measures
<table>
<thead>
<tr>
<th>Risks</th>
<th>Potential impacts</th>
<th>Examples of factors affecting the risks and resulting impacts</th>
<th>Suggested measures</th>
</tr>
</thead>
</table>
| Pollution of surface water and groundwater via leaching or runoff of contaminants and particulates | • Reduced natural resource quality and potential use  
• Site contamination (land, surface water and ground water)  
• Site degradation  
• Reduced ecosystem quality and function | • Soil type and chemical composition (including leachability)  
• Climate  
• Effectiveness of management procedures and practices  
• Engineering controls  
• Topography and proximity to watercourses | • Containment of leachate and diversion and control of stormwater  
• Bunding  
• Low permeability surface  
• Cover/enclosure  
• Stormwater runoff controls such as silt traps and settlement ponds  
• Management plans  
• Suitable site selection and separation distances |
| Dust emissions                                                        | • Adverse impact on amenity  
• Damage to property  
• Human health impacts (e.g. respiratory problems) | • Climatic conditions including exposure to winds  
• Elevation stockpile size  
• Waste type  
• Exposed soils/unsealed roads | • Physical controls (e.g. sprays, covers, compaction, screening, enclosure, windbreaks, binders and road surfacing)  
• Traffic (control frequency and speed)  
• Minimised stockpile height  
• Suitable site selection and separation distances  
• Materials handling, operational procedures and management, e.g. moisture content during handling or cessation of activities in adverse conditions |
| Odour emissions                                                       | • Adverse impacts on amenity  
• Human health impacts (e.g. respiratory problems) if odours are related to vapour | • Soil type and chemical composition  
• Climatic conditions management procedures  
• Land use and compatibility with surrounding land use | • Physical controls (e.g. containment, cover, enclosure, vapour filtration)  
• Suitable site selection and separations distances  
• Effective management and monitoring procedures  
• Maintain aerobic conditions |
| Adverse visual amenity                                               | Interference with the enjoyment of the area and creation of unsightly or offensive conditions. | • Stockpile size  
• Waste type  
• Land use and compatibility with surrounding land use | • Minimise stockpile size  
• Suitable site selection and separation  
• Physical controls (e.g. screening, enclosure) |
## Soil Stockpiles: Risks Associated and Mitigation Measures

<table>
<thead>
<tr>
<th>Risks</th>
<th>Potential impacts</th>
<th>Examples of factors affecting the risks and resulting impacts</th>
<th>Suggested measures</th>
</tr>
</thead>
</table>
| Stockpile instability                      | Stockpile collapse, leading to potential injury and damage to infrastructure.      | • Waste type  
• Topography  
• Climatic conditions  
• Stockpile height  
• Materials management                                                           | • Implement appropriate materials handling procedures  
• Minimise stockpile size                                                             |
| Inadequate platform stability and suitability | • Site contamination  
• Infiltration of leachate into and damage to underlying groundwater aquifers  
• Damage to stockpiled area and infrastructure  
• Potential damage to capping material if storage is on old landfill, leading to increased risk of emissions from leachate and gas generation  
• Ground instability | • Waste type  
• Sub-surface geology and structure below sub-base  
• Sub-base material characteristics (particle size, Atterberg limits, density)  
• Likelihood of sub-base failure e.g. due to faulting, sliding, slumping, caving or climatic impacts  
• Proximity to extraneous sources of ground vibrations including railway lines | • Suitability designed and engineering facility  
• Minimise stockpiling size and overloading  
• Suitable size selection and separation distances |
| Excessive accumulation of material         | • Adverse impact on amenity  
• Increased risk of dust emission and other resulting impacts  
• Expanding capacity of site | • Ineffective or lack of planning and management procedures  
• Speculative stockpiling  
• Lack of materials balance and flow management  
• Acceptance of inappropriate materials | • Pre-planning and consideration in the design arrangement and construction techniques to eliminate and/or reduce generation of spoil material requiring stockpiling  
• Appropriate materials flow calculations, management and procedures  
• Site Management Plans |

### Note: