Environment, Climate Change & Water

UPSS Technical Note: Site Validation Reporting

Disclaimer

This technical note has been prepared by the Department of Environment, Climate Change and Water NSW in good faith, exercising all due care and attention. However no representation or warranty, expressed or implied, is made as to the relevance, accuracy, completeness or fitness of this document for any other purpose in respect of a particular user's circumstances. Users of this document should satisfy themselves about its application to their situation and, where necessary, seek expert advice.

Note

This technical note is advisory only. It has been prepared to support some of the requirements and processes outlined in *Guidelines for implementing the Protection of the Environment (Underground Petroleum Storage Systems) Regulation 2008* prepared by the Department of Environment, Climate Change and Water NSW (DECCW 2009). It should be read in conjunction with recognised industry best practice and standards and other technical publications.

The note will be revised from time to time following feedback from stakeholders using it, ensuring its ongoing relevance and reflecting advances in best practice as the result of regulator and industry experience. Comments on it are welcome and should be sent via email to UPSSREG@environment.nsw.gov.au

Published by:

Department of Environment, Climate Change and Water NSW
59 Goulburn Street, Sydney
PO Box A290, Sydney South 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks information and publications requests)
Fax: (02) 9995 5999
TTY: (02) 9211 4723
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

ISBN 978 1 74232 193 6
DECCW 2010/35
January 2010

Contents

1. Introduction 1

2. Site validation reporting requirements 1

3. Validation considerations 2

Data quality objectives
Quality assurance/Quality control (QA/QC)
Soil sampling
Groundwater assessment
Contaminants of concern
In situ decommissioning
Documenting field practices

Appendix I: Validation report checklist 7

Appendix II: Field screening for volatile organic compounds 9

References and further reading 11

1. Introduction

The Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (the 'UPSS Regulation') focuses on a preventative approach to minimise the risk of contamination from leaks at sites with underground petroleum storage systems (UPSS).

Where UPSS are decommissioned, abandoned or removed, clauses 13 and 15 of the UPSS Regulation require preparation of a report validating that the site is suitable for continued use. This report must be submitted to the relevant local authority (usually the council) within 60 days of completion of the validation or any necessary remediation works.

This technical note outlines the matters that should be considered when preparing a validation report that meets the requirements of clauses 13 and 15 of the UPSS Regulation.

2. Site validation reporting requirements

A validation report provides independent verification, using objective and measurable criteria, that a UPSS site is free of unacceptable levels of contamination, all necessary remediation works have been successfully carried out, and the site is suitable for an ongoing or future use.

The validation process assists in developing proactive actions which can minimise the chances of contaminating local water and soil resources and ensure the sustainability of the operation.

The details contained in a validation report will depend on:

- the degree of any contamination originally present
- the type of remediation processes that have been carried out, where applicable
- the ongoing or future land use.

The process of validation must confirm statistically that the remediated site complies with the clean-up criteria set for the site and that contamination will not compromise the ongoing or future use of the site. To meet the requirements of the UPSS Regulation, this must be documented in a report.

A site validation report, as required by the Regulation, must contain:

- a description of the scale and nature of any contamination originally present
- a description of the remedial methods used, including objectives, where applicable
- a statement about the site's ongoing or future use
- a description of the extent of any remaining contamination and how this was assessed
- a site plan delineating the area being validated and any contamination remaining after site works
- a clear conclusion on the suitability of the site for its ongoing or future use.

The validation report must specify the boundaries of the area subject to any detailed investigations. It should be noted that the Regulation defines a 'storage site' as the premises where a UPSS is located and thus the site validation report must provide a conclusion about the suitability of the entire premises.

The area potentially influenced by contamination from a UPSS may range from the immediate vicinity of the system, such as the tank pit only, to the entire site and even areas offsite. As a result, the validation report should consider other potentially contaminating factors beyond the tank pit, such as leaking pipework and workshop activities.

For example, sampling only from the walls and bottom of the tank pit (tank pit validation) is insufficient to identify contamination at a UPSS site as it assumes that:

- where there is contamination of a UPSS, it will be found in the tank pit
- where no contamination is found in the tank pit, the site must be clean.

These assumptions do not take into account preferential pathways where hydrocarbon migrates along conduits of least resistance through an impermeable material, such as cracks and fissures. Pathways may also be created where hydrocarbon contamination acts as a solvent. Therefore samples collected only from the walls and bottom of the tank pit may not necessarily represent the contamination status of a UPSS site.

In addition to demonstrating the site's suitability for use, a site validation report should consider whether environmental receptors, including groundwater and surface water, have been compromised. The potential for contamination migrating offsite must also be considered in the report (DEC 2007).

The site validation report must be provided to the relevant local authority to support future planning decisions about the land uses which are suitable on the site. The person responsible for the UPSS, as nominated in the site's Environment Protection Plan, must ensure the report is submitted appropriately and in a timely fashion.

Appendix I provides a checklist for preparing a site validation report.

3. Validation considerations

The goals of site validation are to show that:

- the objectives of any remedial activities have been met
- any remaining contamination on the site is not having an impact on the environment
- the site is suitable for its ongoing or future use.

Validation should focus on collecting clear evidence to assess whether these goals have been met.

Sampling programs at UPSS sites should identify and delineate the lateral and vertical extent of any contamination and arrive at a scientifically defensible and statistically valid data set which characterises chemical concentrations.

Hydrocarbon contamination should be analysed using discrete samples. Composite sampling is not recommended because of the potential for some hydrocarbon fractions to volatilise, thereby skewing concentrations at individual locations. Refer to *Sampling design guidelines* (EPA 1995) and Australian Standards *AS4482.2–1999: Guide to the investigation and sampling of sites with potentially contaminated soil – Volatile substances* (AS 1999) and *AS4482.1–2005: Guide to the investigation and sampling of sites with potentially contaminated soil – Non-volatile and semi-volatile compounds* (AS 2005) for more information.

Data quality objectives

Validation activities should be informed by the data quality objectives (DQO) process which is used to define the type, quantity and quality of data needed to support a decision relating to the environmental condition of a site. The development of a sampling program with the pre-determined DQO process provides the statistical basis for decision-making. A sampling analysis plan (SAP), which explains the justification for sampling and the practices to be adopted as part of the plan, should include a quality assurance/quality control protocol to ensure sample integrity. See Appendixes IV and V of *Guidelines for the NSW Site Auditor Scheme* (DEC 2006) for more details on the DQO process and quality assurance and control.

The use of a conceptual site model may help characterise the site and support site validation. It can be used to test the outcomes of validation and indicate whether gaps in data exist which may require further investigation and remediation. These models should take into account:

- the nature and extent of contamination found or considered to be likely on site
- remediation goals set for the site
- the type and extent of remedial activities carried out at the site
- adjacent land uses and location of sensitive receptors
- site history, including estimates of the age of any tanks, and underground infrastructure
- site layout, including the location of tanks, lines and services
- local geological and hydrological information
- loss monitoring information, including records and reports
- details of any failures, leaks, spills and incidents onsite
- the results of equipment integrity testing
- documentation of site and workshop practices.

The conceptual site model should be updated as new information is obtained.

For further details on conceptual site models, refer to *UPSS Technical Note: Site sensitivity assessment* (DECCW 2010a).

Quality assurance/Quality control (QA/QC)

Because of the inherent nature of chemicals associated with UPSS (generally liquid, highly mobile and volatile), degradation, volatilisation and transformation may affect a sample's integrity after it is recovered. Preserving the integrity of the sample requires special attention and this should be documented under a chain of custody protocol.

Australian Standard 4482.2–1999 (AS 1999) and *Australian Standard 4482.1–2005* (AS 2005) provide details on appropriate sample collection and preservation methods, health and safety, decontamination of sampling equipment between successive sampling, and quality assurance procedures.

The specific practices below should be followed when sampling UPSS sites:

- maintain sample integrity through correct field techniques and sample preservation
- store samples in a chilled environment
- take duplicate and split (replicate) samples, as required, for QA/QC purposes
- identify appropriate undisturbed sampling locations to reduce the potential for obtaining a non-representative sample
- collect the sample immediately after the excavated surface is exposed to minimise the potential for the sample to degrade or volatilise
- use the correct sampling equipment, sample collection procedures and containers for the type of sample and analysis being conducted
- manage field work to reduce the potential for the loss of volatile chemicals
- sample from discrete locations or soil types and do not obtain the sample over a depth interval greater than 100 millimetres

- correctly record the sample number, seal the sample once it is in the container, and complete the chain of custody form in advance of laboratory analysis
- ensure appropriate storage of samples in transit and deliver them to the laboratory in a timely manner.

Analysis of samples should be completed in accordance with both standard laboratory analysis methodology by laboratories accredited to national standards, such as the National Association of Testing Authorities (NATA), and Schedule B(2) of the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPC 1999).

Further information on QA/QC procedures can be found in Appendixes IV and V of *Guidelines for the NSW Site Auditor Scheme* (DEC 2006).

Soil sampling

Design and assessment of soil sampling at a UPSS site should be undertaken in accordance with the following NSW guidelines:

- *Guidelines for assessing service station sites* (EPA 1994)
- *Sampling design guidelines* (EPA 1995)
- *Guidelines for consultants reporting on contaminated sites* (EPA 1997)
- *Guidelines for the NSW Site Auditor Scheme* (DEC 2006).

All contamination assessments for sites containing UPSS should also be performed in line with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPC 1999) and *Assessment of underground storage systems* (EPHC & NEPC 2003).

It is recommended that waste materials sent offsite for disposal or backfill sourced onsite or imported to the site are characterised using a different frequency and method of soil sampling. For further information, refer to the *Waste classification guidelines* (DECC 2008). Details of the date, location and method of offsite disposal of waste materials should be included in the validation report.

Clear justification for any departures from the guidelines should also be provided and any significant deviations listed.

Groundwater assessment

Groundwater assessment is critical in accurately gauging the potential environmental impacts of UPSS (EPHC & NEPC 2003). Although chemical concentrations of the UPSS contents found in the soil matrix may be low or non-detectable, chemical concentrations within groundwater may frequently exceed drinking water quality standards.

Groundwater assessment must be conducted where soil contamination has been encountered or identified (DEC 2007). Particular attention should also be given to the possibility of residual groundwater contamination at abandoned UPSS sites or those where removal has occurred with inadequate (or no) environmental assessment.

Factors to consider in an assessment include (DEC 2007):

- distance to receptor surface and groundwater
- whether sufficient monitoring wells are onsite and installed correctly to intercept contaminants down-gradient
- if bore logs are available and sufficiently detailed
- the direction of groundwater flow

- whether there are any other potential sources of contamination.

Groundwater monitoring wells should be designed and installed by suitably qualified and experienced persons as required under Part 3 of the UPSS Regulation: see Appendix B in *Guidelines for implementing the Protection of the Environment (Underground Petroleum Storage Systems) Regulation 2008* (DECCW 2009).

The NSW Office of Water may have certain requirements for the licensing and installation of water bores and wells and should be contacted before any wells are installed on a UPSS site.

Contaminants of concern

EPA (1994) recommends a list of contaminants of concern that should be considered when investigating, remediating or validating a UPSS site. These include, as a minimum:

- total petroleum hydrocarbons (TPH) (C_6–C_9, C_{10}–C_{36})
- benzene, toluene, ethyl benzene and xylene (BTEX)
- chlorinated solvents (degreasers)
- polycyclic aromatic hydrocarbons (PAHs) including benzo(a)pyrene
- lead
- the pH of the medium.

Other analytes that should be considered include:

- MTBE and other possible additives, such as ethanol
- select heavy metals, such as cadmium, chromium, zinc, copper, mercury, arsenic and nickel
- phenols.

Where additional contaminants are suspected or identified during preliminary site screening, these should also be included as part of the test suite.

Depending on site history, other possible contaminants (EPHC & NEPC 2003) could include:

- petroleum fuels, lubricating oils and additives, such as organometallic compounds, surfactants, biocides, molybdenate compounds and corrosion inhibitors
- waste oils and cooling liquids of highly variable compositions
- chemicals associated with the fuel manufacturing process, such as catalysts, metals and solvents that may have been used at the site (vanadium, cobalt, molybdenum and platinum)
- other chemicals, including pesticides/herbicides
- asbestos associated with mechanical repairs, including parts cleaning, brake machining and other repairs.

A review of the site history supplemented by field screening may be a useful option to determine if any information on potential contaminants can be gathered while on site.

Appendix II has more information on field screening.

In situ decommissioning

Decommissioning a UPSS in situ by filling with slurry, sand or foam, compromises the full characterisation of the nature and extent of any contamination. For safety reasons, access to tank pits to assess contamination of tank pit sands and pit walls may not be practicable or provide adequate coverage to support a robust technical assessment of contamination. In these cases, complete validation of the site may not be feasible and the resulting validation report must justify why infrastructure was not removed and consider the potential impact of any underground structures left in place.

A report which supports continuing suitability of the site may need to rely on multiple lines of evidence to infer the nature and extent of residual contamination. A discussion of the rationale for the methods of sampling and investigation used and how this supports any assumption that there is no residual contamination below the structure must be included. The report should not rely solely on historical information and should clearly state the limitations of the assessment undertaken. Direct observations to confirm any inferences from a desktop study should be included and the degree of confidence in the information stated. Where sampling is carried out, samples should be taken in the surrounding soils as close to the tank pit as practicable using safe working practices.

The location of infrastructure remaining onsite must be confirmed to the extent practicable and shown on a site plan included in the validation report. Where the exact location of tanks or lines cannot be determined from site drawings, the location of subsurface features may be inferred using other methods. These may include the use of ground-penetrating radar or consideration of the position of surface features, such as vent pipes, fill points, dispensers, monitoring wells and other surface indicators (e.g. cracked pavements).

A statement regarding the assumptions made and limitations of the assessment must be included when documenting site works where UPSS are decommissioned in situ.

UPSS Technical Note: Decommissioning, abandonment and removal of underground petroleum storage systems (DECCW 2010b) has further details on decommissioning UPSS.

Documenting field practices

Field work should be documented by an experienced person using notes written at the time, supplemented by still or video photography to record field observations and activities. The usefulness of this visual evidence may vary due to adverse site conditions such as poor lighting in excavations. Appropriate equipment must used at sites with potentially volatile substances, particularly in confined spaces.

Standardised checklists to record critical aspects of tank pulls (such as in NZME 2003) are recommended to ensure all relevant data has been captured. The records provide evidence to justify decisions made during the site works and allow critical assessment of the appropriateness of the site works undertaken.

Appendix I: Validation report checklist

The following checklist aims to help achieve a uniform approach to validation reporting on UPSS sites and ensure that environmental issues are addressed to DECCW's satisfaction. It has been adapted from Section 3 of the Guidelines for consultants reporting on contaminated sites *(EPA 1997) to assist compliance with clauses 13(2) and 15(2) of the UPSS Regulation.*

Suggested checklist for UPSS site validation reports

☐ **Executive summary**

☐ **Scope of work/site characterisation/site validation/objective**

- ❑ Clear identification of the area being considered (areas just around tank vs entire site vs offsite areas, etc.)
- ❑ Clear statement of type of sampling being considered: groundwater and/or soil
- ❑ Clearly state actions to be undertaken

☐ **Site information and identification**

- ❑ Name, address, lot & DP number, local government area
- ❑ Geographic coordinates
- ❑ Locality map (appendix)
- ❑ Current site plan with scale bar, showing north, local water drainage and other local environmentally significant features

☐ **Company information**

- ❑ Name, ABN, onsite contact person and date(s) onsite
- ❑ Contact information: phone number, postal address
- ❑ Owner's trading name, description of owner (company, operator, third party), current site use, reason for removal/decommissioning

☐ **Contractor information**

- ❑ Company name, ABN, postal address, contact phone number
- ❑ Names of individuals performing works

☐ **Background information (site history)**

- ❑ Summary of site use, zoning, owner history, proposed site use
- ❑ Current and historical details of tank pits on site, including inventory, disposal, incidents
- ❑ Equipment integrity tests and loss monitoring methods and results
- ❑ Summary of adjacent sites' use, zoning, offsite effects, etc.
- ❑ Summary of groundwater usage and monitoring onsite and offsite (if any), including:
  - ❑ Monitoring wells installed onsite? If yes:
    - ❑ Depth to groundwater
    - ❑ Direction of groundwater flow, flow rate
  - ❑ Beneficial reuse (e.g. domestic)

☐ **Site characterisation and observation**

- ❑ Summary of relevant information regarding hydrology, geology, etc. including:
  - ❑ Direction of surface drainage
  - ❑ Distance to surface water features
- ❑ Summary of observations of local sensitive environment
- ❑ Summary of observations of contamination prior to remediation, including:
  - ❑ Location of sources (e.g. tank, oil sump, etc.)

  - ❑ Location of impact
  - ❑ Removal/disposal of contaminated soil and/or contaminated groundwater and/or vegetation

☐ **Remedial action plan**

- ❑ Summary of remedial action plan
- ❑ Summary of remedial activities undertaken (may be different from the remedial action plan and the reasons for any variation must be noted and discussed)

☐ **Sampling and analysis plan and sampling methodology**

- ❑ Sampling, analysis and data quality objectives (DQOs)
- ❑ Rationale
- ❑ Sampling methods
- ❑ Field screening protocols

☐ **Quality assurance and quality control (QA/QC)**

- ❑ Field QA/QC
- ❑ Laboratory QA/QC
- ❑ QA/QC data evaluation

☐ **Basis for assessment criteria**

- ❑ Table listing all selected assessment criteria and references
- ❑ Rationale for, and appropriateness of, the selection of criteria
- ❑ Assumptions and limitations of criteria

☐ **Results**

- ❑ Summary of all results
- ❑ Site plan showing all sampling locations, sample identification numbers and sampling depths
- ❑ Site plan showing the extent of soil and groundwater contamination exceeding selected assessment criteria for each sampling depth

☐ **Validation**

- ❑ Rationale and justification for the validation strategy
- ❑ Details of a statistical analysis of validation results and evaluation against the clean-up criteria
- ❑ Verification of compliance with regulatory requirements including details of the disposal of waste offsite (classification, quantity, disposal location, date)

☐ **Ongoing site monitoring**

- ❑ Requirements (if any), including monitoring parameters and frequency
- ❑ Results of monitoring analyses including all relevant QA/QC reporting requirements
- ❑ Ongoing site/equipment maintenance
- ❑ Details of parties responsible for maintenance and monitoring program

☐ **Conclusions and recommendations**

- ❑ Brief summary of all findings
- ❑ Assumptions used in reaching the conclusions
- ❑ Extent of uncertainties
- ❑ A list summarising the activities and physical changes to the site
- ❑ **A clear statement that the consultant considers the subject site to be suitable for the proposed use or other nominated potential uses**
- ❑ A statement detailing all limitations and constraints on the use of the site (where applicable)
- ❑ Recommendations for further work, if appropriate

Appendix II: Field screening for volatile organic compounds

Field screening tools are useful for gathering information in relation to approximate total volatile organic compounds (VOCs) headspace measurements. Some popular methods include:

- photo ionisation detectors (PIDs) for detecting aromatic compounds
- flame ionisation detectors (FIDs) for detecting aliphatic compounds.

PIDs and FIDs should only be operated by trained personnel. The instruments must be checked and calibrated regularly in accordance with the manufacturer's instructions. Lamp type should be considered prior to gathering data with lamp details recorded. The site assessor should keep training records, instrument maintenance records and calibration records. The site validation report should include this information. Where VOCs are detected using a PID, samples should be collected for chemical analysis.

It should be noted that data from PIDs and FIDs provides non-quantitative information which needs to be supported by laboratory data and interpreted by an appropriately qualified environmental consultant.

Results from field screening tools

The results from field screening tools can assist in decision-making in relation to:

- the location and extent of any excavations to trace contamination or whether to remove additional soil
- a more focused sample collection (number and location) and laboratory analysis
- the need to consider (or implement) any specific health and safety measures, such as potential for a build-up of explosive gases.

The site assessor should also screen ambient air and soils at background locations adjacent to the site. These background screening locations should be fully documented.

Other methods

The method chosen to detect total VOCs should ensure the loss of volatiles is minimised. Some additional alternative methods which may be considered include:

- visual/olfactory detection
- detector tubes
- fibre optic sensors
- colourimetric tests
- turbimetric tests
- immuno-assay tests
- portable infrared detectors
- portable gas chromatography mass spectrometry (GCMS)
- in situ soil gas measurements using direct push technology.

A cost-benefit study of the available methods to measure VOCs will provide the site assessor with the suitable method of analysis.

Limitations

As with most analytical methods, limitations associated with the chosen technique must be noted and taken into consideration. For example, headspace measurements for total VOCs can be affected by a number of factors and should be used in conjunction with other suitable field observation methods, such as visual techniques (where evident).

Some factors which may affect volatilisation of contaminants include:

- soil matrix (variability, disturbance)
- moisture content
- ambient air dilution into headspace
- temperature changes
- time taken to prepare and analyse samples
- an inaccurate or non-existent conceptual site model may contribute to the loss of VOCs due to inappropriate vapour collection procedure.

It should be noted that certain compounds can be masked by other contaminants and so, wherever possible, the constituents present in the sample should be known before analysis so that the correct test procedure can be selected.

References and further reading

Links were current at the time of publication.

References

AS 1999, *AS4482.2–1999: Guide to the investigation and sampling of sites with potentially contaminated soil – Volatile substances*, Standards Australia, Sydney; available at www.standards.org.au

AS 2005, *AS4482.1–2005: Guide to the investigation and sampling of sites with potentially contaminated soil – Non-volatile and semi-volatile compounds*, Standards Australia, Sydney; available at www.standards.org.au

DEC 2006, *Guidelines for the NSW Site Auditor Scheme*, 2nd edition, Department of Environment and Conservation NSW, Sydney; available at www.environment.nsw.gov.au/resources/clm/auditorglines06121.pdf

DEC 2007, *Guidelines for the assessment and management of groundwater contamination*, Department of Environment and Conservation NSW, Sydney; available at www.environment.nsw.gov.au/resources/clm/groundwaterguidelines07144.pdf

DECC 2008, *Waste classification guidelines*, Department of Environment and Climate Change NSW, Sydney; available at www.environment.nsw.gov.au/waste/envguidlns/index.htm

DECCW 2009, *Guidelines for implementing the POEO (Underground Petroleum Storage Systems) Regulation 2008*, Department of Environment, Climate Change and Water NSW, Sydney; available at www.environment.nsw.gov.au/clm/upssguidelines.htm

DECCW 2010a, *UPSS Technical Note: Site sensitivity assessment*, Department of Environment, Climate Change and Water NSW, Sydney; available at www.environment.nsw.gov.au/clm/upssguidelines.htm

DECCW 2010b, *UPSS Technical Note: Decommissioning, abandonment and removal of underground petroleum storage systems*, Department of Environment, Climate Change and Water NSW, Sydney; available at www.environment.nsw.gov.au/clm/upssguidelines.htm

EPA 1994, *Contaminated Sites: Guidelines for assessing service station sites*, NSW Environment Protection Authority, Sydney; available at www.environment.nsw.gov.au/clm/servicestation.htm

EPA 1995, *Contaminated Sites: Sampling design guidelines*, NSW Environment Protection Authority, Sydney

EPA 1997, *Contaminated Sites: Guidelines for consultants reporting on contaminated sites*, NSW Environment Protection Authority, Sydney; available at www.environment.nsw.gov.au/resources/clm/97104consultantsglines.pdf

EPHC & NEPC 2003, *Assessment of Underground Storage Systems: Proceedings of the Fifth National Workshop on the Assessment of Site Contamination*, Environment Protection and Heritage Council & National Environment Protection Council, Adelaide; available at www.ephc.gov.au/sites/default/files/ASC_WkshopPaper__08_TPHs_Cattlin_UGrndStorage_200301.pdf

NEPC 1999, 'Schedule B(2): Guideline on data collection, sample design and reporting' in *National Environment Protection (Assessment of Site Contamination) Measure 1999*, National Environment Protection Council, Canberra; available at www.ephc.gov.au/sites/default/files/ASC_NEPMsch__02_Data_Collection_199912.pdf

NZME 2003, 'Checklist for the removal of petroleum underground storage tanks' in *Contaminated Land Management Guidelines No. 1: Reporting on contaminated sites in New Zealand*, New Zealand Ministry for the Environment, Wellington; available at www.mfe.govt.nz/publications/hazardous/checklist-rem-apr01.html

Further reading

Inclusion of these additional reading sources is designed to assist stakeholders meet DECCW requirements but does not imply DECCW endorsement of them.

AS 2008, *AS4976–2008: Removal and disposal of underground petroleum storage tanks*, Standards Australia, Sydney; available at www.standards.org.au

DECCW 2009, *Planning and development process for sites with underground petroleum storage systems*, Department of Environment, Climate Change and Water NSW, Sydney; available at www.environment.nsw.gov.au/clm/upssguidelines.htm

LWBC 2003, *Minimum construction requirements for water bores in Australia*, 2nd edition, Land and Water Biodiversity Committee, Canberra

NZME 1999, *Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand*, New Zealand Ministry for the Environment, Wellington; available at www.mfe.govt.nz/publications/hazardous/oil-guide-jun99/

NZME 2004, 'Appendix B: Guidance on sample numbers' in *Contaminated Land Management Guidelines No. 5: Site investigation and analysis of soils*, New Zealand Ministry for the Environment, Wellington; available at www.mfe.govt.nz/publications/ser/hazardous/contaminated-land-mgmt-guidelines-no5/html/page9.html

US EPA 1989, *Methods for evaluating the attainment of cleanup standards: Volume 1 – Solids and solid media*, United States Environment Protection Agency, Washington DC; available at www.epa.gov/tio/download/stats/vol1soils.pdf