

**Contaminated Site  
Management Guidelines No. 1**

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**Guidelines for Reporting  
on Contaminated Sites  
in New Zealand**

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## Disclaimer

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Environment Canterbury co-ordinated this project on behalf of the Regional Waste Officers' Forum and the Ministry for the Environment. The Regional Waste Officers' Forum includes representatives of all regional councils and unitary authorities in New Zealand.

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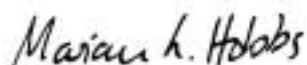
## Foreword

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Day to day management of contaminated sites is an important role of local government. This publication, the first in a series being produced on contaminated sites, is aimed at supporting an effective framework for contaminated site management in New Zealand.

The Contaminated Site Management Guideline No. 1 will provide national consistency in the reporting of contaminated site information, and should improve the quality and completeness of site investigation reports received by regulatory agencies. Its publication will be of particular interest to site owners, environmental consultancies and regulatory agencies, and I encourage its widespread adoption and use by all concerned who work in this area.

The report has been prepared by collaboration between regional councils, unitary authorities and the Ministry for the Environment. I see it as a good example of a local and central government partnership aimed at fostering improved environmental outcomes.



Hon. Marian Hobbs  
**MINISTER FOR THE ENVIRONMENT**

## Preface

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These guidelines are the first in a series of guidance documents that will be published on contaminated site management under the auspices of the Regional Waste Officers' Forum and the Ministry for the Environment. Others, including guidelines for site classification and site assessment, are in preparation.

These guidelines have been adapted for New Zealand from Australian guidelines as a best practice guide for use by all regional councils, territorial and unitary authorities; the adaptation has been made under funding and guidance of Environment Canterbury. An earlier draft of the guidelines was circulated to local government, environmental consultants and key industries. The final document has been revised based on the submissions received.

The purpose of this document is to ensure consistency of reporting on the investigation, assessment and remediation of contaminated sites in New Zealand. This will assist council and authority staff, site auditors, members of the public, and other interested parties in evaluating the effects on the environment such contaminated sites may cause.

These guidelines do not aim to provide guidance to consultants and others in how to investigate contaminated sites, how to assess the effects of contamination and contaminants on the environment, or how to detail appropriate remediation.

Compliance with these guidelines does not in any way authorise any person, including consultants, to access land for the purpose of undertaking investigations other than on land owned or leased by them, without the express permission of the owner or lessee of the land or their rightfully appointed agents.

Compliance with these guidelines does not in any way release any person, including consultants, from additional requirements (including permits required by various legislation) which may be imposed by local authorities. Where documentation required for such additional requirements satisfies part or all of these guidelines, this should be included in reporting and clearly identified as doing so.

Consultants (and their clients) should be aware of the duty to avoid, remedy, or mitigate adverse effects on the environment as specified in s.17 of the Resource Management Act 1991.

While not a statutory instrument, these guidelines and their use will be monitored in each region where they are adopted for use; they will be reviewed and where necessary updated.

## Acknowledgements

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The project was funded by Environment Canterbury, Environment Waikato, Environment Southland, the Taranaki Regional Council, Tasman District Council, and the Wellington Regional Council.

The checklist for reporting on the removal of petroleum underground storage tanks (given in Chapter 4) is based on an original developed by URS (NZ) Ltd, Wellington; permission to use this material is gratefully acknowledged.

Thanks are expressed to all those who reviewed or provided comment on an earlier draft version of these guidelines.

# Executive Summary

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These guidelines are the first of an intended series of documents on contaminated site management to be jointly produced by regional councils, unitary authorities and the Ministry for the Environment. They are adapted from Australian guidelines and are here published by the Ministry for the Environment under the auspices of the Regional Waste Officers' Forum. The guidelines cover reporting practice only and are intended as a best-practice guide for local authorities; they do not show how to conduct investigations, to make assessments, or to suggest remediation.

Five reporting stages are described:

- preliminary site investigation report
- detailed site investigation report
- site remedial action plan
- site validation report
- ongoing monitoring and management plan.

Consultants' reports normally address these stages. Reports may be prepared for sale or purchase agreements, or for permit applications, as well as for documenting contamination and describing clean-up procedures.

Report stages may be presented separately, as is often the case with complex sites, or they can be combined. Notwithstanding, each report must contain all the necessary information to enable a full review.

The document presents a detailed checklist covering these five reporting stages. The checklist will help achieve a uniform approach to reporting on contaminated sites and ensure that local authorities receive the information they need to address the relevant environmental issues.

Because the main checklist is not appropriate for reports prepared following the removal of petroleum underground storage tanks, a separate checklist on this topic is given.

An extended list of references is provided, showing information available from selected sources in New Zealand, Australia and the United States.

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# 1 Introduction

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This is the first of an intended series of documents on contaminated site management to be produced by regional councils, unitary authorities and the Ministry for the Environment.

Their purpose is to ensure that reports prepared by consultants and others on the investigation, assessment, remediation and any subsequent monitoring of any contaminated land contain sufficient and appropriate information to enable efficient review and appropriate action by regulators, site auditors, members of the public and other interested parties. In Chapters 2 and 3, these guidelines outline the minimum requirement of contents for reports related to contaminated land. Chapter 4 lists guidelines for dealing with underground petroleum storage tanks. Adoption and use of these guidelines should result in enhanced environmental awareness of the issues at contaminated sites and promote outcomes in accord with the principles of the Resource Management Act 1991 (RMA).

Other or additional reporting requirements may apply in certain cases. Where land is subject to specific planning, building or zoning requirements related to the actual or likely presence of hazardous contaminants, additional information may be requested; consult the appropriate planning authority for details. Also get in touch with the relevant authority when a site<sup>1</sup> is subject to:

- an investigation by the authority
- an enforcement action by the authority
- a resource consent application, or
- where the site has previously been granted a resource consent(s).

Reports and reporting related to contaminated sites may be used by local authorities or the Ministry for the Environment to monitor environmental impacts associated with contaminated sites, their management, and relevant policy.

There are already New Zealand guidelines on the investigation, assessment, remediation, and monitoring for some types of land uses, specifically, gasworks, petroleum hydrocarbon contaminated sites, and timber treatment sites. These are available from the Ministry for the Environment, and are listed on the Ministry's website: <http://www.mfe.govt.nz/issues/contam.htm>.

A number of contaminant types and land use activities are not yet addressed in guidelines, nor are a number of associated issues, such as representativeness of sampling, assessing natural attenuation, requisite auditing procedures, competency of personnel involved in site investigations, audit, and monitoring. A list of New Zealand and international reference documents (Chapter 5) has been compiled that may provide assistance in these matters when reporting on contaminated sites.

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<sup>1</sup> For the purposes of this document, "site" means an area of land, as defined by a legal description or part of a legal description, which is under investigation.

## 2 Investigating and Reporting

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Contaminated site management can be broadly classified into the following reporting stages, which track the site investigation process from inception to remediation or long term management:

- preliminary site inspection report (PSI)
- detailed site investigation report (SIR)
- site remedial action plan (RAP)
- site validation report (SVR)
- ongoing monitoring and management plan (MMP).

Consultants' reports normally address these stages. Reports may be prepared to satisfy the requirements of sale and purchase agreements, permit applications or for other purposes in addition to the documenting of the investigation and clean-up procedures considered and adopted.

Report stages may be presented separately, and usually are where large and complex sites are being considered, or they can be combined. However, each report produced must stand alone and have enough information to be clearly and readily understood by the appropriate persons reviewing them.

If there is already information prepared on a site, and that information is still available, a summary of that information should suffice in subsequent reports. If there is already a relevant report about a site (e.g., at a local authority on an identified file), who holds this file and its location should be disclosed in the report.

Where the report(s) being prepared will be used towards a resource consent, the appropriate additional information required by s.88 and the Fourth Schedule of the RMA may be included in the report or attached to it. Note that some local authorities require permit application information to be presented on specified forms.

The following five stages may contribute to a report. Chapter 3 provides a detailed checklist of what should be included, as a minimum, for each stage. Note particularly the single-page summary checklist, which should be the first page of your report. The summary checklist will serve as a quick guide to the contents and completeness of the report. Note also that not all stages may be necessary for a report, although any exclusion should be clearly justified in the report.

## **2.1 Stage 1 – Preliminary site inspection report (PSI)**

The purpose of the preliminary site inspection report is to present the site history. It should:

- Identify any known local information providing baseline information on soil and groundwater quality near the site.
- List in order all past and present activities at the site which involved the storage, production, use, treatment or disposal of materials which could contaminate the site.
- Identify the types of materials which could contaminate the site and where such contamination could have occurred.
- Describe the current site condition, and the contents and results of any known previous assessments.
- Cite any records from relevant authorities detailing site condition, including the data and results of any Rapid Hazard Assessments undertaken.
- Identify the likelihood of contamination.
- Make a preliminary assessment of that site contamination based on the qualitative and quantitative information available.
- Assess the need for further investigation at the site, specifically with reference to the current and/or proposed land uses and/or the potential environmental impact.

The site history is fundamental to the preliminary assessment; and may be used to assess the likelihood of the site having become contaminated. It is important to review and assess all relevant information about the site, including information obtained during a site inspection. If a complete site history clearly demonstrates that site activities have been non-contaminating, there may be no need for further investigation or sampling.

However, if contaminating activities have or may have occurred, or if the site history is incomplete, it may be necessary to undertake a preliminary sampling and analysis programme. The results of such an investigation should be included in the PSI as part of the basis upon which to assess the need for a further, more detailed, site investigation.

## **2.2 Stage 2 – Detailed site investigation report (SIR)**

This should give comprehensive information on:

- issues raised in the preliminary inspection
- the type, extent and level of contamination anticipated
- the nature of samples collected and the sampling procedures followed, including quality assurance/quality control (QA/QC) requirements
- the analyses undertaken, methodologies used and laboratory QA/QC procedures.

The site investigation report should also assess:

- the actual extent and concentrations of contaminants in all appropriate media at the site

- any likely dispersal in air, surface water, groundwater, soil and dust from the detected contaminants
- where applicable, the location and magnitude of any on-site or off-site impacts on soil, water, sediment and biota
- any potential effects of contaminants on public health, the environment and structures
- the adequacy and completeness of all information that is used in decisions on remedial options
- if clean-up, management, or ongoing monitoring is intended at the site.

There are computer tools that can help assess risk to human health and ecology. Where these are used, describe them in the SIR (including what they are designed to do) and detail what data was used, what scenarios were examined and the underlying algorithms. Sufficient information should be provided so that the report reviewer is able to replicate the risk assessments.

If the results of the detailed site investigation indicate that the site poses unacceptable risks to human health or the environment – on-site or off-site, and under either the present or proposed land use – then a remedial action plan needs to be prepared and implemented.

Note that all areas of interest to the local authority, the consultant or their client(s) may not lie within the property boundary. In this case, the boundaries of interest (i.e., the area of contamination) should be clearly defined. Any investigation should extend to such a point as to clearly bound the contamination related to the source(s) or site in question. If contamination extraneous to the site being investigated is found, the appropriate local authority should be advised. This can be done either via the SIR or, if immediate adverse effects are detected or anticipated, as soon as practicable.

### **2.3 Stage 3 – Site remedial action plan (RAP)**

Once the site has been identified as requiring remediation or management, prepare the remedial action plan:

- Set remediation or management goals that ensure that the site and any relevant additional land contaminated by site activities will be suitable for its current or proposed land use and will pose no unacceptable risk to human health or the environment, either on-site or off-site.
- Document in detail all risk-reducing procedures and plans to be implemented to achieve an acceptable level of risk for the current or proposed site land use.
- Establish a recording mechanism to ensure activities proceed as detailed in the RAP.
- Establish the environmental safeguards required to complete the remediation in an environmentally acceptable manner.
- Identify and include proof of the necessary approvals, permits or licenses required by regulatory authorities to undertake remediation.

Where site-specific clean-up levels are to be developed by applying proprietary risk assessment methods, the consultant must consult the relevant regional council or unitary authority to discuss appropriate procedures.

Where generic or guideline clean-up levels (such as those in the industry-based guidelines published by the Ministry for the Environment) are to be applied, the assumptions on which those guidelines are based must be shown to apply to the site and surrounding conditions under investigation. Local background conditions should be verified within the RAP.

Make systematic and clear records of remedial work undertaken, ensuring amongst other things that dates, quantities and sampling, excavation and disposal locations will be recorded. Such data and any management or regulatory decisions made during or following the remedial process will be required for reporting stages 4 or 5 (or both).

## **2.4 Stage 4 – Site validation report (SVR)**

After remedial or management action, the conditions at the site must be assessed to validate achievement of the objectives stated in the RAP. A site validation report detailing the application of the RAP, any variances from the proposed plan, and the results of validation is required.

This will vary according to:

- the degree of contamination originally present and the remediation goals set for the site
- the type and extent of remedial processes that have been carried out
- the current or proposed land use.

Validation must confirm statistically that the remediated site complies with the clean-up criteria set for the site in the RAP. For further guidance on statistical sampling and confirmation, we recommend that consultants see the New South Wales Environment Protection Authority's *Contaminated Sites Sampling Design Guidelines* (1995). The United States Environmental Protection Agency's *Methods for Evaluating the Attainment of Cleanup Standards* (1989) is also useful.

A number of computer tools can also assist with sample planning and assessment of statistics related to sampling. As in the SIR, the report should give details of the programme and give enough information to let the reviewer replicate the assessment.

The SVR must assess the results of the post-remediation testing against the clean-up criteria stated in the RAP. Where targets have not been achieved, state the reasons and list additional site work proposed to achieve the specified RAP objectives. If any contingency plans were detailed in earlier reports, they should have been implemented before the SVR is submitted.

The SVR should also include, where possible, information confirming that all of the requirements of regional council, unitary and territorial authority or other planning authority licenses or permits have been met. In particular, include documentary evidence that any disposal of contaminated material off-site has been done or will be done in

accordance with the RAP, the requirements of the disposal site, and of the relevant local authority.

## **2.5 Stage 5 – Ongoing monitoring and management plan (MMP)**

The requirements for an ongoing monitoring and management plan for the site should be assessed where:

- full clean-up is not possible
- monitored natural attenuation is selected as the preferred remedial option
- on-site containment of contamination is proposed.

Where remedial goals are achieved in accordance with the RAP, as confirmed by the SVR, there may still be a requirement to provide an ongoing monitoring and management plan. In accordance with s.15 of the RMA, this may be required as supporting information for an application for a discharge permit, if this is required to authorise contaminants which remain on-site or off-site. In this case the appropriate requirements of s.88 and the Fourth Schedule of the RMA should also be included. Contact the relevant regional council or unitary authority to confirm the requirements in each area.

A monitoring programme should detail the proposed monitoring strategy, what will be monitored, the location and frequency of monitoring (as well as where and how often), and the reporting requirements (format, content and frequency). It should also state the proposed period for reviewing the monitoring and management plan.

Reporting of the results of monitoring fall outside the scope of these guidelines. Where ongoing monitoring or site management is required to be reported as a condition of a resource consent, the reporting requirements will be in accordance with those set down by the consent. It would be anticipated that the requirements proposed in the MMP would form the basis for proposing conditions of any ongoing reporting under a resource consent. Where monitoring or management is governed by a non-statutory instrument, any additional requirements will be as stated in that controlling mechanism.

## 3 Checklist of Reporting Requirements

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The following checklist is provided to help achieve a uniform approach to reporting on contaminated sites and to ensure that the environmental issues of relevance to the regional council or unitary authority are being addressed to their satisfaction. The aim is not to require identical reporting from consultants, but to ensure the comprehensiveness of information provided. The headings given in the checklist may be used for report section headings.

If a report has to deviate from the checklist, reasons for this should be clearly stated. Include in the main text of the report all information needed to satisfy any guideline criteria that are applied to the site. If some conclusions need to be supported by large or unwieldy amounts of detail, such detail can be included as a separate appendix to the report, but be sure to mention in the main text that the appendix exists.

### 3.1 Summary checklist

Always include the summary checklist as the first page of your report. It provides the reader with a succinct overview of the full report, the type of information included in each section, and the degree of completeness of the information given.

The main checklist and the summary page both use the abbreviations set out in Section 3.2.

### 3.2 How to use the checklist

The checklist links with the stages 1 through 5 of reporting, already discussed in Chapter 2. The aim has been to provide a logical and sequential list ensuring each section of a report covers the required data. The listings are indicative and not directive; include additional relevant topics and headings where site details or contaminant issues warrant.

The first column lists report headings to be included and principal subjects to be covered under each heading. The other columns refer to the principal reporting stages of contaminated site studies:

PSI	preliminary site inspection report
SIR	detailed site investigation report
RAP	site remedial action plan
SVR	site validation report
MMP	ongoing monitoring and management plan

## Summary Contaminated Sites Report Checklist

Indicate the reports contained in this document	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Report section(s) and information to be presented	PSI	SIR	RAP	SVR	MMP
Executive summary	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>
Scope of work	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>
Site identification	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>
Site history	R <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>
Site condition and surrounding environment	R <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>
Geology and hydrology	A <input type="checkbox"/>	R <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>
Sampling and analysis plan and sampling methodology	A <input type="checkbox"/>	R <input type="checkbox"/>	X	R <input type="checkbox"/>	R <input type="checkbox"/>
Field quality assurance and quality control (QA/QC)	N <input type="checkbox"/>	R <input type="checkbox"/>	X	R <input type="checkbox"/>	S <input type="checkbox"/>
Laboratory QA/QC	N <input type="checkbox"/>	R <input type="checkbox"/>	X	R <input type="checkbox"/>	X
QA/QC data evaluation	N <input type="checkbox"/>	R <input type="checkbox"/>	X	R <input type="checkbox"/>	X
Basis for assessment criteria	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>
Results	A <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	S <input type="checkbox"/>
Site characterisation	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>
Remedial actions	X	X	R <input type="checkbox"/>	S <input type="checkbox"/>	S <input type="checkbox"/>
Validation	X	X	X	R <input type="checkbox"/>	S <input type="checkbox"/>
Ongoing site monitoring	X	X	X	N <input type="checkbox"/>	R <input type="checkbox"/>
Conclusions and recommendations	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>	R <input type="checkbox"/>

The following abbreviations indicate the information requirements:

- R the corresponding heading and details are required
- A readily available information should be included
- S a summary of this section's details will be adequate if detailed information has been included in an available, referenced report
- N include only if no further site investigation is to be undertaken
- X not applicable and may be omitted.

### Minimum information requirements for each of the five stages

Report section(s) and information to be included	PSI	SIR	RAP	SVR	MMP
<b>Executive summary</b> <ul style="list-style-type: none"> <li>• Background</li> <li>• Objectives of the investigation stage(s) being reported</li> <li>• Scope of work to be, or which has been, undertaken</li> <li>• Summary of conclusions and recommendations</li> </ul>	R	R	R	R	R
<b>Scope of work</b> <ul style="list-style-type: none"> <li>• A clear statement of the scope of work to be, or which has been, undertaken</li> </ul>	R	R	R	R	R
<b>Site identification</b> <ul style="list-style-type: none"> <li>• Street number, street name, suburb and town/city</li> <li>• Legal description with lot, deposited plan and certificate of title number(s)</li> <li>• Geographic co-ordinates as per NZMS 260 when dealing with a small part of a larger site</li> <li>• Current site plan with scale bar showing north direction, local water drainage and other locally significant features on-site and immediately off-site. The plan should also show historic location of structures that may have affected the distribution of contamination, e.g., buildings, underground storage tanks, treatment baths, etc</li> <li>• Locality map</li> </ul>	R	R	R	R	R

Report section(s) and information to be included	PSI	SIR	RAP	SVR	MMP
<p><b>Site history</b></p> <ul style="list-style-type: none"> <li>• Chronological list of site ownership and uses (including where possible the relevant ANZECC or ANZSIC codes for those uses) indicating information gaps, unoccupied periods, and if relevant, proposed uses</li> <li>• An outline of those contaminants commonly associated with each land use based on ANZSIC (1993) codes and AS4482.1/2 (1997 and 1999) and/or from site-specific information</li> <li>• Zoning – previous, present and if relevant, proposed, with summary of reasons for changes to zoning which have occurred</li> <li>• Details of relevant building and related permits, licenses, resource consents, approvals and trade waste agreements with records of compliance</li> <li>• Local usage of ground and surface water resources including presence, rate and location of abstractions (current and historical)</li> <li>• Site layout plans showing present and past industrial processes</li> <li>• Sewer and services plans identifying active and abandoned services</li> <li>• Historical uses of adjacent land</li> <li>• Relevant complaint history</li> <li>• Local knowledge of site by staff and residents – present and former</li> <li>• Summary of literature relating to the site including newspaper articles</li> <li>• Review of aerial and site photography with date and location (including direction of photography) indicated on site maps</li> <li>• Description of manufacturing processes</li> <li>• Inventory of materials and waste products associated with site use and their on-site storage and/or disposal locations</li> <li>• Details and locations of current and former underground and aboveground storage tanks with details of integrity testing</li> <li>• Product spill and loss history</li> <li>• Recorded discharges to land, water and air (authorised and unauthorised)</li> <li>• On-site and off-site disposal locations</li> <li>• Contaminant source areas and pathways on-site and off-site</li> <li>• Integrity assessment (assessment of the accuracy of the information)</li> </ul>	R	S	S	S	S

<b>Report section(s) and information to be included</b>	<b>PSI</b>	<b>SIR</b>	<b>RAP</b>	<b>SVR</b>	<b>MMP</b>
<p><b>Site condition and surrounding environment</b></p> <ul style="list-style-type: none"> <li>• Topography, means of measurement and site map</li> <li>• Condition of buildings and roadways</li> <li>• Presence of drums, wastes and fill materials</li> <li>• Odours</li> <li>• Visual or quantified details of surface water quality</li> <li>• Flood potential described or mapped</li> <li>• Conditions at site boundary such as type and condition of fencing, soil stability, erosion, and storm water discharge</li> <li>• Visible signs of contamination such as identifiable waste products, discoloration or staining of soil, bare soil patches – on-site and at site boundary</li> <li>• Visible signs of plant stress</li> <li>• Details of any relevant local sensitive environment – rivers, lakes, creeks, wetlands, local habitat areas, endangered flora and fauna</li> </ul>	<b>R</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
<p><b>Geology and hydrology</b></p> <ul style="list-style-type: none"> <li>• Background groundwater and surface water quality</li> <li>• Summary of local meteorology</li> <li>• Detailed map and description of location, design and construction of on-site wells, boreholes and pits</li> <li>• Site borehole logs/test pit logs showing stratigraphy using a recognised classification system and depth to groundwater table</li> <li>• Reported range of water table depths below ground surface</li> <li>• Description and location of springs and wells in the vicinity</li> <li>• Location, depth and extent of imported and locally derived fill</li> <li>• Direction(s) and rate of groundwater flow including, where applicable, groundwater levels surveyed to a common datum</li> <li>• Direction(s) of surface water run-off and identification of ponding areas</li> <li>• Preferential flow paths (surface and groundwater)</li> </ul>	<b>A</b>	<b>R</b>	<b>S</b>	<b>S</b>	<b>S</b>

Report section(s) and information to be included	PSI	SIR	RAP	SVR	MMP
<p><b>Sampling and analysis plan and sampling methodology</b></p> <ul style="list-style-type: none"> <li>• Sampling and analysis data quality objectives (DQOs)</li> <li>• Rationale for the selection of: <ul style="list-style-type: none"> <li>– sampling pattern, locations and depths (as shown on site maps)</li> <li>– sampling density including estimated size of the residual hotspots that may remain undetected and statistical confidence in estimate</li> <li>– which samples are/were submitted for analysis and which samples were not analysed</li> <li>– the analytes for each sample and the analytical methods used</li> </ul> </li> <li>• Detailed description of the sampling methods including: <ul style="list-style-type: none"> <li>– sampling devices and equipment type</li> <li>– sampling containers and the type of seal used</li> <li>– sample preservation methods and reference to recognised protocols e.g., APHA (1988) or US EPA SW846 (1992)</li> <li>– sample handling procedures</li> <li>– equipment decontamination procedures</li> </ul> </li> <li>• Detailed description of any field screening protocols, methods, equipment and their calibration</li> </ul>	A	R	X	R	R
<p><b>Field quality assurance and quality control (QA/QC)</b></p> <ul style="list-style-type: none"> <li>• Details of sampling team identifying unique initials for each member</li> <li>• Statement of intended duplicate and blank frequency</li> <li>• Records for each sample collected including; date, time and location, samplers initials, duplicate/blank location and type, analyses to be performed, site observations and weather conditions</li> <li>• Chain of custody identifying for each sample; sampler, nature of the sample, collection date, analyses to be performed, sample preservation method, departure time from site, dispatch courier used</li> <li>• Background sample, field blank, trip blank, and rinsate sample results and laboratory prepared trip spike results for volatile analytes</li> <li>• Decontamination procedures carried out between sampling events</li> <li>• Sample splitting techniques and field instrument calibrations (where used)</li> </ul>	N	R	X	R	S

Report section(s) and information to be included	PSI	SIR	RAP	SVR	MMP
<b>Laboratory QA/QC</b> <ul style="list-style-type: none"> <li>Signed laboratory receipt of signed chain of custody form identifying date/time of receipt and identity of samples included in shipment</li> <li>Record of holding times where not consistent with method specifications</li> <li>Analytical methods used by laboratory and laboratory accreditation for analytical methods used</li> <li>Inter-laboratory comparisons for analytical methods used (where available)</li> <li>Description of spikes and surrogates used with percent recoveries</li> <li>Instrument, method detection and practical quantification limits</li> <li>Standard solution, reference sample and check sample (including daily) results</li> <li>Laboratory duplicate, blank and standard results</li> </ul>	N	R	X	R	X
<b>QA/QC data evaluation</b> <ul style="list-style-type: none"> <li>Evaluation of all field and laboratory QA/QC information listed above against the stated DQOs including a discussion of: <ul style="list-style-type: none"> <li>documentation and data completeness</li> <li>data representativeness</li> <li>precision and accuracy for both sampling and analysis for each analyte in each environmental matrix informing data users of the reliability, unreliability or qualitative value of the data</li> </ul> </li> <li>Data comparability checks, which should include, for example, bias assessment, which may arise from various sources, including: <ul style="list-style-type: none"> <li>collection and analysis of samples by different personnel</li> <li>collection and analysis by same personnel using same methods but at different times (including seasonal for long running projects)</li> <li>use of different sampling or analytical methodologies from those stipulated in guideline documents</li> <li>spatial and temporal changes (because of environmental dynamics)</li> </ul> </li> <li>Relative percent differences for inter- and intra-laboratory duplicates</li> </ul>	N	R	X	R	X
<b>Basis for assessment criteria</b> <ul style="list-style-type: none"> <li>Table listing all selected assessment criteria with references</li> <li>Rationale for and appropriateness of the selection of the criteria chosen</li> <li>Assumptions and limitations of criteria used</li> </ul>	R	R	R	R	R

<b>Report section(s) and information to be included</b>	<b>PSI</b>	<b>SIR</b>	<b>RAP</b>	<b>SVR</b>	<b>MMP</b>
<p><b>Results</b></p> <ul style="list-style-type: none"> <li>• Summary of previous results (where applicable)</li> <li>• Site plan(s) showing all samples and sampling locations, giving sample identification numbers and sample depth</li> <li>• Summary of all results in tabular form: <ul style="list-style-type: none"> <li>– identifying essential details such as sample identification numbers and sample depth</li> <li>– showing comparison with relevant assessment criteria</li> <li>– highlighting every result exceeding the assessment criteria</li> </ul> </li> <li>• A summary table of results containing the following statistics: minimum, maximum, arithmetic average and 95% upper confidence limit on the arithmetic average for each analyte</li> <li>• Site plan showing the extent of soil and/or groundwater contamination exceeding the relevant assessment criteria for medium, location and sample depth</li> </ul>	<b>A</b>	<b>R</b>	<b>R</b>	<b>R</b>	<b>S</b>
<p><b>Site characterisation</b></p> <ul style="list-style-type: none"> <li>• Assessment of the type of all environmental contamination, particularly in soil and groundwater</li> <li>• Assessment of the extent of soil and groundwater contamination, including identifiable off-site contamination which may cause environmental effects</li> <li>• Assessment of potential for chemical degradation or interaction products</li> <li>• Assessment of possible exposure routes and risk to exposed populations (human and ecological risk)</li> </ul>	<b>R</b>	<b>R</b>	<b>R</b>	<b>R</b>	<b>R</b>

Report section(s) and information to be included	PSI	SIR	RAP	SVR	MMP
<p><b>Remedial actions</b></p> <ul style="list-style-type: none"> <li>• Remediation goal(s)</li> <li>• Discussion of the remedial options available, including the status quo, identifying the means of risk reduction proposed in each</li> <li>• Rationale for selection of recommended remedial option</li> <li>• Discussion of the extent of remediation required to achieve remedial goal(s)</li> <li>• Identification of regulatory requirements such as permits, licenses and approvals</li> <li>• Pre-remediation site management plan (e.g., fencing, warning signs, stormwater diversion, etc)</li> <li>• Names and phone numbers of appropriate personnel to contact during remediation</li> <li>• Operational remediation site management plan including (where applicable): <ul style="list-style-type: none"> <li>– community relations</li> <li>– stormwater and soil management</li> <li>– noise and odour control</li> <li>– dust control (including wheel wash)</li> <li>– contingency plans to respond to site incidents to obviate potential effects on surrounding environment and community</li> <li>– proposed long-term site management</li> <li>– occupational safety and health issues and measures</li> </ul> </li> <li>• Remediation schedule including proposed hours of operation</li> <li>• Proposed testing to validate site during and on completion of the remedial activities</li> <li>• Contingency plan if remedial strategy fails to reach the remediation goals</li> <li>• Staged progress reporting (for long running projects)</li> </ul>	X	X	R	S	S
<p><b>Validation</b></p> <ul style="list-style-type: none"> <li>• Rationale and justification for the validation strategy including: <ul style="list-style-type: none"> <li>– clean-up criteria selected</li> <li>– statistically based decision-making methodology</li> <li>– validation sampling and analysis plan</li> </ul> </li> <li>• Details of statistical analysis of validation results and evaluation against the clean-up criteria</li> <li>• Verification of compliance with regulatory requirements set by all relevant local authorities</li> </ul>	X	X	X	R	S

<b>Report section(s) and information to be included</b>	<b>PSI</b>	<b>SIR</b>	<b>RAP</b>	<b>SVR</b>	<b>MMP</b>
<p><b>Ongoing site monitoring</b></p> <ul style="list-style-type: none"> <li>Proposed ongoing site monitoring requirements (if any) including monitoring locations, parameters and frequency</li> <li>Results of monitoring analyses including all relevant QA/QC requirements stated above</li> <li>Ongoing site or plant maintenance (e.g., containment cap integrity, etc) or contingency plans</li> <li>Details of those responsible for the maintenance/ monitoring programme(s)</li> </ul>	<b>X</b>	<b>X</b>	<b>X</b>	<b>N</b>	<b>R</b>
<p><b>Conclusions and recommendations</b></p> <ul style="list-style-type: none"> <li>Brief summary of all relevant findings</li> <li>Assumptions used in making conclusions</li> <li>Extent of uncertainties in the results</li> <li>Where remedial action has been taken, a list summarising the activities and the physical changes to the site</li> <li>A clear statement that the consultant considers the site to be suitable for the current and where applicable the proposed use</li> <li>A statement detailing all limitations and constraints on the use of the site (where applicable)</li> <li>Recommendations for further work, if appropriate</li> </ul>	<b>R</b>	<b>R</b>	<b>R</b>	<b>R</b>	<b>R</b>

## 4 Petroleum Underground Storage Tanks

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The reporting requirements outlined in Chapter 3 are not necessarily appropriate for reports prepared following the removal of petroleum underground storage tanks (USTs). Therefore, this chapter gives a checklist to be completed following the removal of USTs. The checklist has been amended from an original developed by URS (NZ) Ltd, Wellington.

The purpose of the checklist is to ensure consistent and thorough reporting on the removal of USTs in New Zealand, and is for works and investigations generally in accordance with the following nationally accepted documents:

- *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*, Ministry for the Environment, 1999
- *Code of Practice for the Design, Installation, and Operation of Underground Petroleum Storage Systems*, Department of Labour, 1992.

The checklist provides the minimum information required to be provided to regional councils or unitary authorities when USTs are removed or replaced for Tier 1 investigations. If hydrocarbon impact on groundwater is detected and/or where soil remaining on-site exceeds appropriate Tier 1 soil acceptance criteria, a Tier 2 investigation should be undertaken in accordance with Ministry for the Environment's *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand* (1999) and should be reported in accordance with this guideline.

This checklist is also available electronically at <http://www.ecan.govt.nz> and <http://www.mfe.govt.nz/issues/contam.htm>.

It is not appropriate for this checklist to be used in place of a full site investigation should there be, or have been, other activities or land uses on the site that could cause contamination. This checklist is only intended to be used following the decommissioning of an underground storage tank(s) and associated systems, i.e., lines, bowsers, fill points, etc. Where there are other potential sources of contamination, a full investigation, in accordance with Chapters 2 and 3 of these guidelines, should be undertaken.

# Petroleum Underground Storage Tank Removal Report Form

## Checklist

<input type="checkbox"/> Company information <input type="checkbox"/> Site information <input type="checkbox"/> Contaminant information <input type="checkbox"/> Interpretation	<input type="checkbox"/> Site plan and locality diagram <input type="checkbox"/> Bore/pit logs <input type="checkbox"/> Analytical result sheets/chain of custody <input type="checkbox"/> Photographs
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## Company information

Oil company name:			
Company representative/agent:			
Date(s) on-site:			
Ownership:	<input type="checkbox"/> Company	<input type="checkbox"/> Operator	<input type="checkbox"/> Third party
Owners details (trading name and postal address):			
Current site use:	<input type="checkbox"/> Service station <input type="checkbox"/> Truckstop	<input type="checkbox"/> Workshop <input type="checkbox"/> Other (describe)	<input type="checkbox"/> Commercial
Reason for removal:	<input type="checkbox"/> Replacement <input type="checkbox"/> Transfer	<input type="checkbox"/> Partial removal <input type="checkbox"/> Other	<input type="checkbox"/> Complete

## Site information

Name:			
Address:			
Legal description:			
City/district council area:			
City/district council zoning	Site:		
	Adjacent:		
Dangerous goods officer responsible:			
DGI notified on:		DGI on-site at ( <i>date/time</i> ):	
Number of tankpits:		Number of tanks removed:	

## Removed/replaced tank information

Tank/ pit ID	Capacity (litres)	Contents (product)	Remove/ replace	Age (yr)	Material	Holed (y/n)	Condition	Pit construction/ condition

Site environment				
Neighbouring land uses <i>(indicate on site plan)</i>	North	<input type="checkbox"/> Industrial/commercial	<input type="checkbox"/> Residential	<input type="checkbox"/> Agricultural
	South	<input type="checkbox"/> Industrial/commercial	<input type="checkbox"/> Residential	<input type="checkbox"/> Agricultural
	East	<input type="checkbox"/> Industrial/commercial	<input type="checkbox"/> Residential	<input type="checkbox"/> Agricultural
	West	<input type="checkbox"/> Industrial/commercial	<input type="checkbox"/> Residential	<input type="checkbox"/> Agricultural
Topography:		<input type="checkbox"/> Sloping	<input type="checkbox"/> Gently sloping	<input type="checkbox"/> Flat
Surface covering <i>(show on plan)</i> :		<input type="checkbox"/> Unsealed	<input type="checkbox"/> Mixed seal/gravel	<input type="checkbox"/> Sealed
Surface drainage/runoff <i>(show on plan)</i> :		<input type="checkbox"/> Drains	<input type="checkbox"/> Soakholes	<input type="checkbox"/> Interceptor
Underground services <i>(show on plan)</i> :		<input type="checkbox"/> Present	<input type="checkbox"/> Distant	<input type="checkbox"/> Absent
Could services affect migration?		<input type="checkbox"/> Yes (to what extent?)		<input type="checkbox"/> No
Nearest surface water body:		<input type="checkbox"/> > 100 metres	<input type="checkbox"/> < 100 metres <i>(show on plan)</i>	
Surface water use:		<input type="checkbox"/> Recreation	<input type="checkbox"/> Drinking	<input type="checkbox"/> Irrigation
		<input type="checkbox"/> Aquaculture	<input type="checkbox"/> Industry	<input type="checkbox"/> Shipping
		<input type="checkbox"/> Not utilised	<input type="checkbox"/> Not known	
Site soil type log <i>(lithology if known)</i> : Include anomalous or unusual soil characteristics	Depth (m)	Description (e.g., brown silty clay)		
Was groundwater encountered?	<input type="checkbox"/> No	<input type="checkbox"/> Yes	Depth (m bgl)	
Was sheen or free product visible?	<input type="checkbox"/> No	<input type="checkbox"/> Yes	If yes, describe and reference photo	
Have on-site wells been sampled?	<input type="checkbox"/> No	<input type="checkbox"/> Yes		
Checked for separate phase?	<input type="checkbox"/> No	<input type="checkbox"/> Yes		
Off-site wells (check with Regional Council):				
Well number	Distance from site	Direction from site	Depth (m)	Use
Local groundwater flow direction <i>(if more than one aquifer comment on each aquifer individually)</i> :				

Contaminant information								
Hydrocarbon impact assessment								
Location	Visual inspection		PID reading		Samples taken		Evidence of contamination (staining, odour, etc)	Justification for why no samples taken if there was evidence of contamination
	Yes	No	Yes	No	Yes	No		
Tank pit walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Pit bedding material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Under pumps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Dispensing lines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remote fills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Fill lines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Vent lines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Other (services etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Surface soils (show on plan)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Vegetation/soil removal							
Site & near-site vegetation condition:					<input type="checkbox"/> Good	<input type="checkbox"/> Poor	
Was impacted soil/bedding removed from site?					<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, how much, where on the site did it come from, and where was it disposed?							
Sampling (locations shown on plan) (ensure sample numbers are same as those represented on site plan)							
Sample	Date sampled	Location	Depth (m)	Soil type	Odour?		Remaining/removed
					Yes	No	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	

Interpretation				
Current site use:	<input type="checkbox"/> Petroleum use	<input type="checkbox"/> Industrial/commercial	<input type="checkbox"/> Residential	<input type="checkbox"/> Agricultural
Future site use:	<input type="checkbox"/> Petroleum use	<input type="checkbox"/> Industrial/commercial	<input type="checkbox"/> Residential	<input type="checkbox"/> Agricultural
Adjoining land use:	<input type="checkbox"/> Petroleum use	<input type="checkbox"/> Industrial/commercial	<input type="checkbox"/> Residential	<input type="checkbox"/> Agricultural
Groundwater use:	<input type="checkbox"/> Potable	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Stock	<input type="checkbox"/> Not used <input type="checkbox"/> Not known
Soil type:	<input type="checkbox"/> SAND, sandy loams, silty sands	<input type="checkbox"/> PUMICE		
<i>*Considered for groundwater inhalation risk only</i>	<input type="checkbox"/> SANDY SILT, silt, silty loam, clay sand	<input type="checkbox"/> GRAVELS*		
	<input type="checkbox"/> SILTY CLAY, clay loam, sandy clay	<input type="checkbox"/> FRACTURED BASALT*		
	<input type="checkbox"/> CLAY	<input type="checkbox"/> PEAT/ORGANIC SOIL		
Depth to contamination:	<input type="checkbox"/> < 1 metre	<input type="checkbox"/> 1–4 metres	<input type="checkbox"/> > 4 metres	
Depth to groundwater:	<input type="checkbox"/> 2 metres	<input type="checkbox"/> 4 metres	<input type="checkbox"/> 8 metres	<input type="checkbox"/> Unknown

Human health exposure pathways			
	Pathway	Complete	Incomplete
Current site use <input type="checkbox"/> Petroleum use <input type="checkbox"/> Industrial/commercial <input type="checkbox"/> Residential <input type="checkbox"/> Agricultural	Soil ingestion	<input type="checkbox"/>	<input type="checkbox"/>
	Dermal absorption	<input type="checkbox"/>	<input type="checkbox"/>
	Maintenance/excavation worker	<input type="checkbox"/>	<input type="checkbox"/>
	Inhalation of vapour from soil	<input type="checkbox"/>	<input type="checkbox"/>
	Inhalation of vapour from water	<input type="checkbox"/>	<input type="checkbox"/>
	Groundwater usage	<input type="checkbox"/>	<input type="checkbox"/>
	Produce ingestion	<input type="checkbox"/>	<input type="checkbox"/>
Future site use <input type="checkbox"/> Petroleum use <input type="checkbox"/> Industrial/commercial <input type="checkbox"/> Residential <input type="checkbox"/> Agricultural	Soil ingestion	<input type="checkbox"/>	<input type="checkbox"/>
	Dermal absorption	<input type="checkbox"/>	<input type="checkbox"/>
	Maintenance/excavation worker	<input type="checkbox"/>	<input type="checkbox"/>
	Inhalation of vapour from soil	<input type="checkbox"/>	<input type="checkbox"/>
	Inhalation of vapour from water	<input type="checkbox"/>	<input type="checkbox"/>
	Groundwater usage	<input type="checkbox"/>	<input type="checkbox"/>
	Produce ingestion	<input type="checkbox"/>	<input type="checkbox"/>
Adjoining site use <input type="checkbox"/> Petroleum use <input type="checkbox"/> Industrial/commercial <input type="checkbox"/> Residential <input type="checkbox"/> Agricultural	Soil ingestion	<input type="checkbox"/>	<input type="checkbox"/>
	Dermal absorption	<input type="checkbox"/>	<input type="checkbox"/>
	Maintenance/excavation worker	<input type="checkbox"/>	<input type="checkbox"/>
	Inhalation of vapour from soil	<input type="checkbox"/>	<input type="checkbox"/>
	Inhalation of vapour from water	<input type="checkbox"/>	<input type="checkbox"/>
	Groundwater usage	<input type="checkbox"/>	<input type="checkbox"/>
	Produce ingestion	<input type="checkbox"/>	<input type="checkbox"/>

Ecological risk assessment				
	Significantly impacted	Limited impact	Not impacted	
Ecological receptors:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Describe all likely receptors:				
Aesthetic issues				
	Significantly impacted	Limited impact	Not impacted	Description of impact ( <i>if applicable</i> )
Odour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Soil structure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Visual	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vegetation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Comments				
Report prepared by:				
Authorised by:		Date:		

## 5 Additional Information

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The following reference documents contain information that may assist in reporting on contaminated sites.

### 5.1 New Zealand

- Auckland Regional Council (1999). *Trace Element Concentrations in Soils and Soil Amendments of the Auckland Region*.
- Centre for Advanced Engineering, University of Canterbury (2000). *Landfill Guidelines: Towards Sustainable Waste Management in New Zealand*.
- Ministry for the Environment (1997). *Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand*.
- Ministry for the Environment (1998). *Ambient Concentrations of Selected Organochlorines in Soils*.
- Ministry for the Environment (1999). *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand*.
- Ministry of Health (1995). *Drinking-water Standards for New Zealand*.
- Ministry of Health/Ministry for the Environment (1997). *Health and Environmental Guidelines for Selected Timber Treatment Chemicals*.
- Occupational Safety and Health, Department of Labour (1992). *Code of Practice for the Design, Installation and Operation of Underground Petroleum Storage Systems*.
- Occupational Safety and Health, Department of Labour (1994). *Health and Safety Guidelines on the Cleanup of Contaminated Sites*.
- Occupational Safety and Health, Department of Labour (1995). *Code of Practice for the Transportation and Disposal of Petroleum Storage Tanks and Related Wastes*.
- Occupational Safety and Health, Department of Labour (1995). *Code of Practice for the Design, Installation and Operation of Underground Petroleum Storage Systems – Supplement 1: Management of Existing Underground Petroleum Storage Systems*.
- Percival HJ, Webb TH, Speir TW (1996). *Assessment of Background Concentrations of Selected Determinands in Canterbury Soils*. Landcare Research Contract Report LC9596/133 prepared for Canterbury Regional Council.

### 5.2 Australia (New South Wales)

- NSW Agriculture and CMPS&F Consultants (1996). *Guidelines for the Assessment and Cleanup of Cattle Tick Dip Sites for Residential Purposes*.
- NSW Department of Water Resources (1992). *A Practical Guide for Groundwater Sampling*.
- NSW DUAP/Environment Protection Authority (1995). *Contaminated Land: Department of Urban Affairs and Planning*.

- NSW Environment Protection Authority (1994). *Contaminated Sites: Guidelines for Assessing Service Station Sites*.
- NSW Environment Protection Authority (1995). *Assessment of Orchard and Market Garden Contamination: Contaminated Sites Discussion Paper*.
- NSW Environment Protection Authority (1995). *Contaminated Sites: Guidelines for the Vertical Mixing of Soil on Broad-acre Agricultural Land*.
- NSW Environment Protection Authority (1995). *Contaminated Sites: Sampling Design Guidelines*.
- NSW Environment Protection Authority (1995). *Technical Report: Provisional Water Quality Investigations Manual – Preferred Methods for Sampling and Analysis*.
- NSW Environment Protection Authority (1997). *Bananalands Contaminant Distribution Studies*.
- NSW Environment Protection Authority (1997). *Guidelines for Assessing Banana Plantation Sites*.
- NSW Environment Protection Authority (1999). *Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report*.

### **5.3 Australian and New Zealand Environment and Conservation Council (ANZECC)**

- ANZECC (1992). *Australian Water Quality Guidelines for Fresh and Marine Waters*.
- ANZECC/NHMRC (National Health and Medical Research Council) (1992). *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*.
- ARMCANZ/ANZECC (1995). *Guidelines for Groundwater Protection in Australia*.
- ARMCANZ/ANZECC (2001). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
- NHMRC/ARMCANZ (Agricultural and Resources Management Council of Australia and New Zealand) (1996). *Guidelines for Drinking Water Quality in Australia*.

### **5.4 National Environment Protection Council**

- NEPC (1999). *National Environment Protection Council (Assessment of Site Contamination) Measure including schedules:*
- Schedule B(1) *Guideline on Investigation Levels for Soil and Groundwater*
  - Schedule B(2) *Guideline on Data Collection, Sample Design and Reporting*
  - Schedule B(3) *Guideline on Laboratory Analysis of Potentially Contaminated Soils*
  - Schedule B(4) *Guideline on Health Risk Assessment Methodology*
  - Schedule B(5) *Guideline on Ecological Risk Assessment*
  - Schedule B(6) *Guideline on Risk Based Assessment of Groundwater Contamination*
  - Schedule B(7A) *Guideline on Health-Based Investigation Levels*

- Schedule B(7B) *Guidelines on Exposure Scenarios and Exposure Settings*
- Schedule B(8) *Guideline on Community Consultation and Risk Communication*
- Schedule B(9) *Guideline on Protection of Health and the Environment During the Assessment of Site Contamination*
- Schedule B(10) *Guideline on Competencies and Acceptance of Environmental Auditors and Related Professionals.*

## **5.5 South Australian Health Commission, Adelaide (National Environmental Health Forum)**

- Imray P, Langley A (1996). *Health Based Soil Investigation Levels*, Soil Series No. 1.
- Lock WH (1996). *Composite Sampling*, Soil Series No. 3.
- Taylor R, Langley A (1996). *Exposure Scenarios and Exposure Settings*, Soil Series No. 2.

## **5.6 South Australian Health Commission, Adelaide (contaminated sites monographs)**

- Edwards J, Van Alphen M, Langley A (1994). *Identification and Assessment of Contaminated Land – Improving Site History Appraisal*, Contaminated Sites Series No. 3.
- El-Saadi O, Langley A (eds) (1991). *The Health Risk Assessment and Management of Contaminated Sites: Workshop Proceedings of the National Workshop on the Health Risk, Assessment and Management of Contaminated Sites.*
- Langley A, Markey B, Hill H (eds) (1996). *The Health Risk Assessment and Management of Contaminated Sites: Proceedings of the Third National Workshop on the Health Risk, Assessment and Management of Contaminated Sites*, Contaminated Sites Series No. 5.
- Langley A, Van Alphen M (eds) (1993). *The Health Risk Assessment and Management of Contaminated Sites: Proceedings of the Second National Workshop on the Health Risk, Assessment and Management of Contaminated Sites*, Contaminated Sites Series No. 2.
- Olszowy H, Torr P, Imray P (1995). *Trace Element Concentrations in Soils from Rural and Urban Areas of Australia*, Contaminated Sites Series No. 4.

## **5.7 US Environmental Protection Agency**

- US Environmental Protection Agency (1987). *Data Quality Objectives for Remedial Responses*, US EPA 540/G-87/003.
- US Environmental Protection Agency (1988). *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, OSWER Directive 9355.3-0.
- US Environmental Protection Agency (1989). *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media*, US EPA 230/02-89-042.

- US Environmental Protection Agency (1989). *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)*.
- US Environmental Protection Agency (1991). *Summary Report on Issues in Ecological Risk Assessment*.
- US Environmental Protection Agency (1992). *Guidance for Data Useability in Risk Assessment (Parts A and B)* PB92-963356.
- US Environmental Protection Agency (1992). *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods, 3rd Edition, SW-846*.
- US Environmental Protection Agency (1994). *Guidance for the Data Quality Objectives Process*, US EPA QA/G-4, EPA/600/R-96/055.
- US Environmental Protection Agency (1997). *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites: OWSER Directive 9200.4-17*, Office of Solid Waste and Emergency Response.

## **5.8 Other references**

- American Public Health Association, American Water Works Association and Water Environment Federation (1998). *Standard Methods for the Examination of Water and Wastewater* (20th edition).
- American Society for Testing and Materials (1998). *Standard Guide for Remediation of Ground Water by Natural Attenuation at Petroleum Release Sites*.
- Australian Bureau of Statistics (1993). *Australia New Zealand Standard Industrial Codes*.
- Brisbane Bureau of Emergency Services (1992). *Guidelines for the Assessment of Contaminated Land in Queensland*.
- Standards Australia (1997). *Guide to the Sampling and Analysis of Potentially Contaminated Soil – Non-volatile and Semi-volatile Compounds*, AS4482.1.
- Standards Australia (1999). *Guide to the Sampling and Analysis of Potentially Contaminated Soil – Volatile Substances*, AS4482.2.