



**Proposed methodology for  
deriving background level  
concentration when assessing  
potentially contaminated land**

**January 2021**

# Methodology for deriving background level concentration

---

EPA acknowledges Aboriginal people as the First Peoples and Traditional Custodians of the land and water on which we live, work and depend. We pay respect to Aboriginal Elders, past and present.

As Victoria's environmental regulator, we pay respect to how Country has been protected and cared for by Aboriginal people over many tens of thousands of years.

We acknowledge the unique spiritual and cultural significance of land, water and all that is in the environment to Traditional Owners, and recognise their continuing connection to, and aspirations for Country.

Publication 1936 January 2021

Authorised and published by EPA Victoria  
Level 3, 200 Victoria Street, Carlton VIC 3053  
1300 372 842 (1300 EPA VIC)

This publication can be found online at [epa.vic.gov.au/publications](https://epa.vic.gov.au/publications)



If you need interpreter assistance or want this document translated,  
please call 131 450 and advise your preferred language.

# Methodology for deriving background level concentration

---

## Executive summary

The Victorian Government is committed to modernising Environment Protection Authority (EPA) to meet Victoria's environment and human health challenges now and into the future. The amended *Environment Protection Act 2017* is a key part of this modernisation, introducing a preventative duties-based model including a general environmental duty (GED) and specific contaminated land duties. Section 35 of the Act defines contaminated land as being land where a waste or chemical substance is present in concentrations above background levels, and, creates a risk of harm to human health or the environment.

The Act provides that the background level of a waste or chemical substance is either; the background level specified in, or determined in accordance with, Regulations, environment reference standards or a determination made under the Act, or, if no such specification exists, the naturally occurring concentration of the waste or chemical substance in the vicinity of the land. EPA is proposing to make a determination that sets out the manner of deriving the background level of specified naturally occurring chemical substances.

The proposed methodology comprises a set of requirements that must be met to substantiate that specified naturally occurring chemical substances are not present at a concentration above background levels. The three main requirements in the proposed methodology are:

- a literature review and data analysis of local geology and hydrology
- a conceptual site model (CSM)
- a multiple lines of evidence approach.

A literature review of local geology and hydrogeology provides a greater understanding of the chemical substances that may arise during site assessment which are attributed to geological formations. Data analysis review and comparison of potential reference sites sets the basis for understanding whether the chemical substance is naturally occurring or is from widespread anthropogenic non-point source from human activity at the site.

The CSM assists in understanding the complexities of site investigation by outlining the essential elements and data gaps during the assessment phase of work. The CSM incorporates all the findings from the literature review, data analysis and sampling results and describes the ways chemical substances move through the environment (source – pathway – receptor). The CSM provides a basis for the last step which incorporates a multiple lines of evidence approach.

Applying a multiple-lines-of-evidence approach enables a robust and scientifically supportable understanding of the nature and extent of the chemical substance associated with a site. A multiple-lines-of-evidence approach incorporates all available data including the development of the CSM.

The proposed methodology will support an assessment allowing for site-based naturally occurring concentrations to be derived during the assessment of potentially contaminated land. This consultation paper is seeking your views on a series of questions as well as any other feedback you may have about the clarity of terminology related to contaminated land and the proposed methodology for deriving background levels.

# Methodology for deriving background level concentration

---

## Table of contents

<b>1</b>	<b>Glossary of terms</b> .....	<b>5</b>
<b>2</b>	<b>Introduction</b> .....	<b>6</b>
2.1	<i>Who will likely use the proposed methodology when assessing background levels?</i> .....	6
<b>3</b>	<b>What is contaminated land?</b> .....	<b>7</b>
<b>4</b>	<b>Contaminated land framework</b> .....	<b>8</b>
4.1	<i>Contaminated land duties</i> .....	8
4.2	<i>What is not contaminated land?</i> .....	9
<b>5</b>	<b>What is a determination?</b> .....	<b>10</b>
<b>6</b>	<b>Current definition and use of background levels</b> .....	<b>11</b>
6.1	<i>Future definitions of background levels</i> .....	11
<b>7</b>	<b>What about diffuse, ambient or regional contaminants?</b> .....	<b>12</b>
7.1	<i>What about anthropogenic non-point contaminants?</i> .....	12
7.2	<i>What about infilled areas?</i> .....	12
7.3	<i>The National Environment Prevention (Assessment of Site Contamination) Measure approach to ambient background concentrations?</i> .....	12
<b>8</b>	<b>Current approach for assessing background levels</b> .....	<b>14</b>
<b>9</b>	<b>Proposed methodology for deriving background levels</b> .....	<b>15</b>
9.1	<i>Literature review and data analysis</i> .....	15
9.1.1	<i>Literature review</i> .....	15
9.1.2	<i>Sampling and data availability</i> .....	16
9.1.3	<i>Data analysis</i> .....	17
9.1.4	<i>Use of a reference site</i> .....	17
9.2	<i>Conceptual site model</i> .....	18
9.3	<i>Multiple lines of evidence approach</i> .....	18
<b>10</b>	<b>References</b> .....	<b>20</b>

# Methodology for deriving background level concentration

---

## 1 Glossary of terms

<b>Ambient background concentration</b>	Ambient background concentration of a contaminant is the soil concentration in a specified locality that is the sum of the naturally occurring background and the contaminant levels that have been introduced from diffuse or non-point sources by general anthropogenic activity not attributed to industrial, commercial, or agricultural activities, for example, motor vehicle emissions.
<b>Anthropogenic contaminants</b>	Natural and human-made substances present in the environment as a result of human activities.
<b>Background level</b>	Background level, in relation to the land environment, means the level or range of levels of an indicator (measured in geologically similar land containing a measurable level of that indicator), outside the influence of any waste or contaminant.
<b>Diffuse contaminants</b>	Chemical substance that is spread out over a large area, which is not concentrated.
<b>Groundwater</b>	Means any water contained in or occurring in a geological structure or formation or an artificial landfill below the surface of land.
<b>Land</b>	Means any land, whether publicly or privately owned, and includes any buildings or other structures permanently affixed to the land; and includes groundwater.
<b>National Environment Protection (Assessment of Site Contamination) Measure or NEPM (ASC)</b>	Refers to the National Environment Protection (Assessment of Site Contamination) Measure 1999 made under section 14 of the <i>National Environment Protection Council (Victoria) Act 1995</i> and the equivalent legislation of the participating jurisdictions, as in force from time to time.
<b>Non-point sources</b>	Non-point sources are those that cannot be specifically or individually identified as a source of contamination. These may include atmospheric deposition, emissions or industrial areas with a long history of diverse land uses.
<b>Point sources</b>	The term 'point source' means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.
<b>Pollution</b>	Includes any emission, discharge, deposit, disturbance or escape of a solid, liquid or gas, or a combination of a solid, liquid or gas.

## 2 Introduction

Contaminated land is land where the presence of waste or a chemical substance is above background levels and presents a risk of harm to human health or the environment. The potential for contaminated land to have an adverse impact on human health or the environment depends on the type, concentration, location, level of exposure, pathway, fate and behaviour of the substance among other site-specific considerations.

With the exception of sites subject to remedial notices or environmental audits, the nature and extent of contaminated land throughout Victoria is unknown. Contaminated land may not be known, mapped, or easily identified and may be impacting on and contaminating surrounding land.

With the commencement of the amended *Environment Protect Act 2017* expected on 1 July 2021, those in management or control of contaminated land will have a duty to manage contaminated land as well as a duty to notify of contaminated land to the EPA. The duty to manage contaminated land involves the requirement to minimise risks posed by contaminated land and applies to all land that is contaminated. The duty to notify of contaminated land only applies in certain circumstances such as where prescribed in the proposed final Environment Protection Regulations 2020 (the proposed final Regulations).

Section 35 of the Act provides that land is considered to be contaminated land if waste, a chemical substance or a prescribed substance is present on or under the surface of the land, and the waste, chemical substance or prescribed substance:

- (a) is present in a concentration above the background level; and
- (b) creates a risk of harm to human health or the environment.

Background level is defined at section 36 as a waste or chemical substance that is either; 'the background level specified in, or determined in accordance with, Regulations, or an environment reference standard' or determination made under the Act, or, if no such specification exists, 'the naturally occurring concentration of the waste or chemical substance in the vicinity of the land'.

EPA recognises the challenges and uncertainties associated with measuring naturally occurring concentrations in land. Accordingly, EPA is proposing to make a determination that sets out how to derive the background level of specified naturally occurring chemical substances. The proposed methodology will clarify how EPA expects those undertaking assessments of potentially contaminated land to ascertain the background concentrations of the specified chemical substances.

EPA intends to produce future guidance to support implementation of the proposed methodology to ensure that the proposed methodology is clear, understood and applied consistently within the industry.

### 2.1 Who will likely use the proposed methodology when assessing background levels?

It is expected that persons applying the proposed methodology as a part of an assessment of contamination at a site will have the appropriate skills, knowledge and experience, such as environmental contaminated land consultants, EPA-appointed environmental auditors and environmental practitioners.

## 3 What is contaminated land?

Section 35 of the Act defines contaminated land as land where waste, a chemical substance or a prescribed substance is present on or under the surface of the land, and the waste, chemical substance or prescribed substance:

- (a) is present in a concentration above the background level; and
- (b) creates a risk of harm to human health or the environment.

Section 36 of the Act states that the background level of waste, a chemical substance or a prescribed substance in relation to land is:

- (a) the background level specified in, or determined in accordance with, the Regulations or an environmental reference standard in relation to waste, chemical substance or prescribed substance; or
- (b) if the Regulations or an environment reference standard do not specify, or set out how to determine, a background level for the waste, chemical substance or prescribed substance – the naturally occurring concentration of the waste, chemical substance or prescribed substance on or under the surface of land in the vicinity of the land.

EPA is currently working on defining what the scope of contaminated land is and this will be communicated to stakeholders once the paper has been finalised.

# Methodology for deriving background level concentration

## 4 Contaminated land framework

The Act and proposed final Regulations introduce a range of significant changes to environmental protection laws. These include new obligations relating to the risks contaminated land poses to human health and the environment – a duty to manage contamination risks and a duty to notify EPA in certain circumstances.

Figure 1 represents the relationship between knowledge of different states of contamination and the corresponding compliance response that is expected under the key duties. Part 3.5 of the Act sets out the contamination duties.

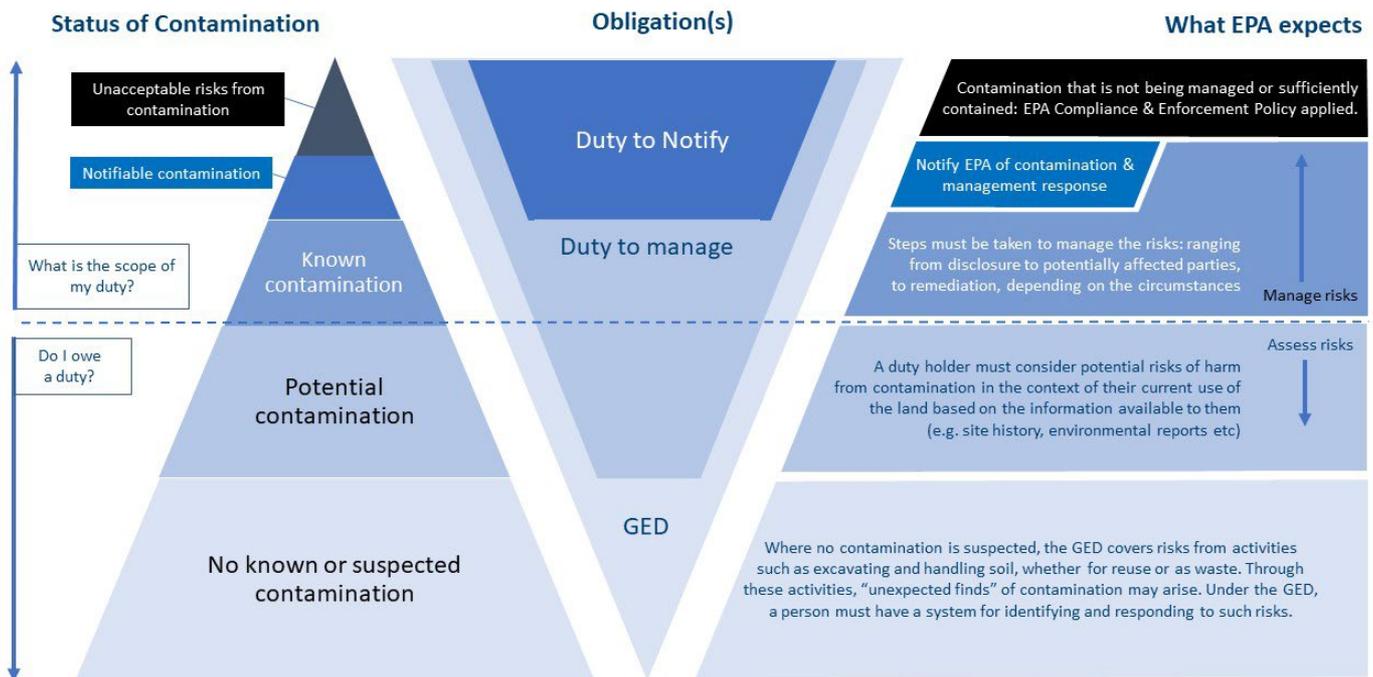


Figure 1: Contaminated land obligations and the knowledge of site contamination

### 4.1 Contaminated land duties

There are three key duties that address contaminated land risks – the general environmental duty (GED), the duty to manage contaminated land and the duty to notify of contaminated land. They sit within a broader risk management and response scheme under the Act.

The GED is at the centre of the Act and applies to all Victorians. The main focus of the GED is to reduce the risk of harm from your activities:

- to human health and the environment
- from pollution or waste.

Where your activities may disturb contaminated land, such that pollution or waste is generated, then the GED will require you to minimise any associated risks of harm.

The duty to manage contaminated land (section 39) requires a person in management or control of land to minimise risks of harm to human health or the environment from the contaminated land or groundwater. Minimising risks of harm in this context means:

# Methodology for deriving background level concentration

---

- identification of any contamination that the person knows or ought reasonably to know of
- investigation and assessment of the contamination
- provision and maintenance of reasonably practicable measures to minimise risks
- provision of adequate information to any person that may be affected by the contamination (including any person who is reasonably expected to become a person in management or control of the contaminated land).

The proposed final Regulations set out circumstances where elevated levels of contaminants may need to be reported to EPA under the duty to notify of contamination (section 40). The duty to notify requires a person in management or control of land to notify EPA if the land has 'notifiable contamination' (which is prescribed in the proposed final Regulations) as soon as practicable after they become aware of the contamination or reasonably ought to have been aware of the contamination. The duty to notify of contamination promotes transparency of information, increases available knowledge for all parties and will improve the management of contaminated land risks – whether directly between parties involved with the land, or by EPA.

The proposed methodology will support a practical and pragmatic means of identifying naturally occurring concentrations that are widespread and common in the environment. However, any such levels derived from the proposed methodology must also be consistent with the objectives and purposes of the Act. If a chemical substance is determined to be at a background level and there is a risk of harm to human health or the environment, then the risk of harm must still be addressed under the GED.

## 4.2 What is not contaminated land?

Section 35(2) of the Act states that land is not contaminated:

- (a) merely because waste, a chemical substance or a prescribed substance is present in a concentration above the background level in water that is on or above the surface of the land; or
- (b) if any prescribed circumstances apply to the land.

## 5 What is a determination?

A determination is a legislative instrument made by the Authority under the proposed final Regulations. Its function is to set out the background level (or the manner of deriving the background level) of waste or a chemical substance in relation to land. A determination can relate to waste or a type of waste, or a chemical substance or a class of chemical substance and be limited to a specific place or premises or class of place or premises. It can also be of specific or general application.

Here, a determination is proposed to assist those undertaking environmental assessments of potential contaminated land to ascertain whether a specified naturally occurring chemical substance measured in a site assessment is present above the specified background level (or if no background level is specified, the naturally occurring concentration). The intention of the proposed determination is to preclude land which has concentrations resulting from natural environmental processes from being defined as, or considered, contaminated land.

## 6 Current definition and use of background levels

While the EP Act 1970 itself does not define background levels when applied to contaminated land, it is defined under the current legislative framework through the State Environment Protection Policies (SEPP).

State Environment Protection Policy (Prevention and Management of Contamination of Land) (SEPP PMCL) defines background level as 'the level or range of levels of an indicator, measured in geologically similar land containing a measurable level of that indicator, outside the influence of any contaminant'. The primary purpose of the concept of background concentrations in SEPP PMCL is to recognise that occasionally natural concentrations of chemicals do not protect beneficial uses of land and allow for EPA to determine that the affected beneficial use does not apply to that land. The background level also sets a benchmark to which concentrations of chemicals 'should be maintained as close as practicable'; that is, duty holders should not contaminate up to the risk-based environmental quality objectives.

State Environment Protection Policy (Waters) (SEPP Waters) defines background levels as 'the level or ranges of levels of an indicator in waters, or in aquatic ecosystems, outside the influence of any waste or contaminant containing a measurable level of that indicator'. The purpose of 'background' in SEPP Waters in relation to groundwater is comparable to its use in SEPP PMCL.

SEPP Waters also includes a definition of ambient levels as 'the level or ranges of levels of an indicator in surface waters or groundwater that includes background levels and levels introduced by waste or contaminants due to general anthropogenic activity from diffuse (non-point) sources'. While including groundwater in this definition, the application of this definition appears to only apply to surface waters within SEPP Waters.

### 6.1 Future definitions of background levels

Section 36 of the Act, defines the background level of a waste or substance as either:

- (a) the background level specified in, or determined in accordance with, the regulations or an environment reference standard in relation to the waste, chemical substance or prescribed substance; or
- (b) if the Regulations or an environment reference standard do not specify, or set out how to determine, a background level for the waste, chemical substance or prescribed substance – the naturally occurring concentration of the waste, chemical substance or prescribed substance on or under the surface of land in the vicinity of the land.

The proposed final environmental reference standard (ERS) defines background level, in relation to the land environment, as the level or range of levels of an indicator (measured in geologically similar land containing a measurable level of that indicator), outside the influence of any waste or contaminant. In relation to groundwater, the background water quality level means the level or range of levels of an indicator in waters or in aquatic ecosystems, outside the influence of any waste or contaminant containing a measurable level of that indicator.

## 7 What about diffuse, ambient or regional contaminants?

The National Environment Protection (Assessment of Site Contamination) Measure (NEPM ASC) defines ambient background concentration of a contaminant as the soil concentration in a specified locality that is the sum of the naturally occurring background and the contaminant levels that have been introduced from diffuse or non-point sources arising from general anthropogenic activity not attributed to industrial, commercial, or agricultural activities, for example, atmospheric deposition to land from motor vehicles.

Diffuse pollution occurs when a chemical substance, which is not concentrated, is spread out over a large area. Examples of diffuse pollution are the use of fertiliser in agriculture and forestry, pesticide use from a wide range of activities, contaminants from roads and paved areas, and atmospheric deposition of contaminants arising from industry.

Regional contaminants refer to a chemical substance that occurs in a regional area due to high mineralisation in the geological strata. An example is the Goldfields regions in North West Victoria, which have been impacted by a long history of mining activities resulting in mine tailings and calcine sands containing high levels of arsenic being distributed throughout the region, as well as naturally occurring arsenic.

The definition of a background level currently includes only the levels of a chemical substance or waste in or on the land in naturally occurring concentrations. On this basis, the proposed method cannot be applied to address concentrations resulting from diffuse, ambient or regional sources. The contaminated land duties apply to anyone in management or control of contaminated land regardless of the source of any anthropogenic contaminants identified.

### 7.1 What about anthropogenic non-point contaminants?

EPA acknowledges that anthropogenic 'non-point source' contamination has impacted the environment as a result of historic global industrialisation to some degree. The current approach is that any anthropogenic contaminants are considered to be above background level and the risk of harm would need to be considered in accordance with the definition of contaminated land under the Act. This is due to the definition of background level currently only including the levels of a chemical substance or waste in or on the land due to naturally occurring concentrations.

### 7.2 What about infilled areas?

In many parts of the Melbourne metropolitan region (and also in some regional areas of Victoria) the historic use of fill material may have occurred at an individual site or across a wider area. Fill tends to be heterogeneous and thus unpredictable in quality. Regardless of the scale of filling, inputs resulting from its presence cannot be regarded as naturally occurring because it has been disturbed by anthropogenic activity.

### 7.3 The National Environment Protection (Assessment of Site Contamination) Measure approach to ambient background concentrations?

The NEPM ASC also provides a definition of background concentrations in Volume 1 as 'the naturally occurring, ambient concentrations of substances in the local area of a site'. Victoria has not incorporated the complete NEPM ASC into law, rather, it incorporates only specific aspects to define the indicators and objectives of the SEPP PMCL. Despite the definition of 'background concentrations' in Volume 1, section 2.5.7 of Schedule B1 the NEPM ASC goes on to state:

## Methodology for deriving background level concentration

---

*The [Ambient Background Concentration] of a contaminant is the soil concentration in a specified locality that is the sum of the naturally occurring background level **and** the contaminant levels that have been introduced from diffuse or non-point sources by general anthropogenic activity not attributed to industrial, commercial, or agricultural activities, for example, motor vehicle emissions. [Emphasis added]*

The NEPM ASC is, and will likely remain, an important guidance tool for assessing contaminated land. The Act definition of 'background levels' is limited to the naturally occurring concentration of the waste or chemical substance on or under the surface of land in the vicinity of the land unless otherwise specified in the regulations, the ERS or a determination, like the proposed methodology in this paper.

There is no current proposal for the ERS to specify background levels, rather the ERS, as currently proposed, is drafted expressly to have regard to any determination made under section 36(a).

## 8 Current approach for assessing background levels

There are many approaches to assessing background levels that are routinely used in contaminated land and groundwater assessments. There is no consistent approach, and some ambiguity exists when applying methods and assessments. The following examples are approaches that are often applied when assessing background levels.

**Desktop review of local, publicly available data** - The common approach for assessing background levels of a chemical substance in soil involves reviewing the geological map for the local area and comparing the data to publicly available environmental audit reports or other environmental assessments the consultant may have access to, such as the Victoria Soil database. This approach can only occur if there are environmental audit reports available either locally or regionally and it often lacks statistical sampling consistency where multiple sources of information, with sometimes contradictory conclusions are brought together in a different context.

Comparing site environmental sampling 'upgradient' data with other data is the standard approach for assessing background levels of a chemical substance in groundwater. Data sampled from the same aquifer or comparing limited statistical analysis of onsite data (where available) is also used. This is a simple approach that can only be achieved if there are environmental audit reports readily available either locally or regionally, and in many cases sufficient data is available to allow robust conclusion, based on professional judgement of the assessor.

# Methodology for deriving background level concentration

## 9 Proposed methodology for deriving background levels

The proposed methodology comprises a set of requirements that must be addressed to confirm that a chemical substance is present at above or below background levels. The proposed requirements would, wherever appropriate, be consistent with the NEPM ASC and draw on standard practices that environmental consultants currently apply when undertaking a site assessment.

Figure 2 represents the three main steps that are required in the proposed methodology to set out where it is reasonable to state that the chemical substance is naturally occurring, and the supporting documentation and results required during the assessment.

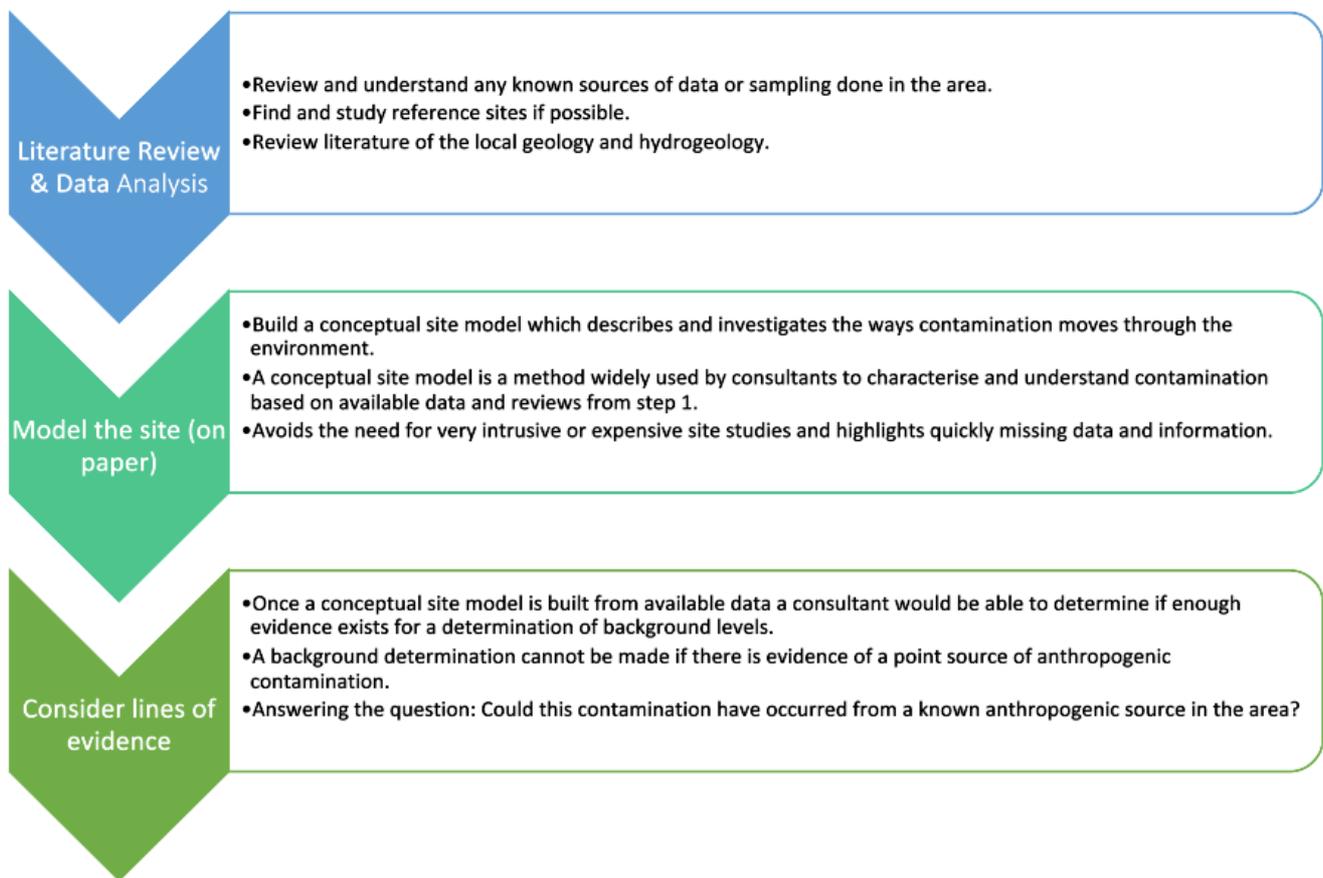


Figure 2: The three main steps required in the proposed methodology

### 9.1 Literature review and data analysis

Undertaking a literature review of the local geology and hydrogeology provides a greater understanding of the chemical components that may arise during site assessment, such as naturally elevated concentrations of nickel within basalt geology in Melbourne. For example, the RMIT background database can be used to review the background soil concentrations and the different geological formations for Melbourne, Geelong and Ballarat.

#### 9.1.1 Literature review

A literature review should include but not be limited to:

# Methodology for deriving background level concentration

---

- current published studies, especially the studies focusing on background concentrations in Victoria
- geological maps
- mineralogy landform – especially when assessing for natural enrichment
- soil types
- nature and extent of historical activities resulting in broadly distributed contamination including potential causes of variability
- geomorphology
- available soil and groundwater data which can build on the understanding of the geology, hydrogeology and contamination that may have arisen from historical land uses or human activity.

## 9.1.2 Sampling and data availability

Robust background analytical data must consider the consistency and comparability in the elements of the background samples with data collected for the site, especially background samples collected specifically for the study and data gathered from published sources. Site and background samples should be collected and analysed in the same way and according to relevant standards and guidance.

Background sites should be located upgradient of the study site and should have the majority of characteristics in common with the study site, especially:

- geology: including sample depth (soil) or hydrogeological unit (groundwater)
- current and former site uses (other than the study site use under consideration).

### **Soil**

The more persistent and immobile substances are of primary interest because of their potential to absorb and accumulate in the soil. The proposed methodology for deriving background levels of chemical substances in soil should consider:

- soil samples to be taken in the same geology which has similar physical, chemical, geological, and biological characteristics/properties
- soil samples to be collected using the same technique across the site and from the same soil strata
- sampling can be carried out on a fixed depth basis (i.e. layer) or according to definite horizon types
- soil strata and lithology would need to be characterised to determine whether there are localised areas of a particular chemical as a result of mineralisation.

When undertaking soil sampling, the appropriate sampling strategy should be based on accurate and reliable site-specific information.

### **Groundwater**

Due to natural spatial and temporal variability, background groundwater samples should ideally be collected at the same time and from the same aquifer/s, using the same sampling technique as the site groundwater samples.

# Methodology for deriving background level concentration

---

In accordance with the NEPM ASC, one upgradient bore is required to be installed and sampled for each aquifer or geological unit of interest to establish the quality of groundwater entering the site.

When assessing groundwater, the following requirements are to be considered:

- Determine which bores were upgradient and were considered to reliably represent groundwater flowing into the site, in a location with a similar level of disturbance or modification.
- Adopt the concentrations in that bore as background.
- Review the data from the reference site/bore and establish the upper limit of a contaminant at the 75th percentile (for parameters that are problematic in high concentrations), or at 25th percentile for parameters that are problematic at low levels.

## 9.1.3 Data analysis

The use of environmental audits/site assessments completed for surrounding sites (where available) is beneficial for the comparison of soil type data and chemical substance concentrations. During the literature review and data analysis a potential reference site may be identified that could be used for collection of samples from a comparable groundwater aquifer or soil stratum.

### **Soil**

Three main factors that can influence the concentration of a chemical in soil are:

- the parent material of the soil (i.e. the underlying geology) – this is considered to be the main controlling factor
- enrichment of soils due to mineralisation in the underlying rocks – it is noted that this may also have an anthropogenic component when the mineralisation is mined
- legacy of urbanisation and industrialisation, which can provide both diffuse and point sources inputs.

Ideally, data should only be adopted from sources that are from the same or similar study area including soil horizon, sampling methodology, spatial distribution, and analytical method. Where insufficient soil data is available to characterise the chemical substance, a soil survey may be required. A soil survey should be undertaken in accordance with the NEPM ASC, and the survey design, sampling depth and frequency should be informed by the literature review.

### **Groundwater**

Groundwater wells should be located as close as possible to, but not in, the area of impact. This can be onsite or offsite and upgradient or cross-gradient. Data from similar, nearby sites can also be used but should be sampled by the same method and from the same aquifer zone as the study site.

## 9.1.4 Use of a reference site

The term 'reference site' is a site that is free from anthropogenic inputs of a particular chemical or waste so far as reasonably practicable. A reference site should:

- be located as close as possible to the site being assessed
- be upgradient of the site to minimise the risk that surface runoff or shallow groundwater flow may have transported contaminated material to the reference site
- not be impacted by local, diffuse or regional inputs with sufficient historical information provided to demonstrate that the background site has not been affected by land uses

# Methodology for deriving background level concentration

---

carried out during the assessment or preferably any other potentially contaminating activity

- be a site with a same parent material of comparable soil type and textural classification.

## **Soil**

It may be appropriate to use a reference site for the collection of soil samples from a comparable soil stratum. If a single, ideal reference site does not exist, it may be necessary to select more than one reference site. Soil samples from reference sites should be collected using the same sampling equipment and technique as those used to collect samples during the site assessment.

## **Groundwater**

The use of reference sites for groundwater should only occur where there is sufficient historical data to characterise water quality. Ideally, reference sites would be in the same aquifer, screened at a comparable depth and located in a comparable hydrogeological setting to that of the parent location.

Truly 'undisturbed' aquifers/waterways are typically absent due to the extent of land clearing, agriculture and urban development that has occurred in the catchments throughout Victoria. In addition, atmospheric deposition can contain appreciable concentrations of elements/compounds derived from a variety of natural and anthropogenic processes. Therefore, the potential presence of contamination from such widespread and diffuse sources suggests that finding a reference site that is completely unimpacted is unlikely.

## **9.2 Conceptual site model**

The purpose of the conceptual site model (CSM) is to provide an overview of what chemical substance is naturally occurring and to be confident in identifying other anthropogenic sources, such as legacy lead deposits on residential properties located on major roads. The CSM will help demonstrate where it is reasonable to conclude that the chemical is naturally occurring.

When developing the CSM for a site, the local setting should be reviewed holistically rather than mainly focusing on the site area. The development of an initial CSM, which is derived from the findings of the preliminary site investigation, forms the basis of further site investigations. The CSM describes the environmental setting, the surrounding land uses, geology and hydrogeology, surface waters, wetlands, tidal regime, seasonal or climatic conditions or any other feature of the environment that may be relevant to the site assessment. The CSM can identify contaminant sources (potential areas of concern and associated contaminants), modes of contaminant movement (migration pathways), the person/ecosystem components/environmental values potentially affected by the contamination (potential receptors) and how exposure may occur (exposure pathways). This environmental setting aids in understanding chemical substance interactions in the environment. The CSM incorporates all the findings from the literature review, data analysis and sampling results, and describes the ways chemical substances move through the environment (source - pathway – receptor).

## **9.3 Multiple lines of evidence approach**

A multiple lines of evidence approach, in accordance with Schedule B2 of the NEPM ASC, is regularly used in the assessment of site contamination. Applying this approach enables a robust and scientifically supportable understanding of the nature and extent of the chemical substance(s) associated with a site. It incorporates all available data including the development of the CSM.

## Methodology for deriving background level concentration

---

The approach to comparing background to site data, to allow for a conclusion on whether site data is present above the background level, can be scaled according to the availability of data (both site and background), and should consider multiple lines of evidence where possible.

For example, when assessing soil, the main lines of evidence are to collect a high density of data across the site, ensure that deeper soil samples away from the fill material interface and point sources are collected and analysed. Where inferring natural soil data is natural background, ensuring that the same analytical schedule has been completed in the overlying fill material at each location. Leachability analysis of natural soil samples is important when inferring data is background, to confirm it is tightly bound to soil matrix and not associated with fill material leaching.

The use of data that may not meet all ideal conceptual requirements, such as data from different time periods across different audit reports, onsite data upgradient or unimpacted by site-related activities, can be used if there is sufficient justification or the lines of evidence support the overall conclusion.

## 10 References

- EPA SA, 2018. *Site contamination guideline: Assessment of background concentrations*. Environment Protection Authority South Australia. Document Ref EPA 838/18. July 2018.
- Mikonnen, H.G., Clarke, B.O., Dasika, R., Wallis, C.J., Reichman, S.M., 2017. *Assessment of ambient background concentrations of elements in soil using combined survey and open-source data*, Science of the Total Environment 580(2017):1410–1420.
- Mikkonen, H. G., 2018a. *Environmental and anthropogenic influences on ambient background concentrations of potentially toxic elements in the soils of Victoria, Australia*. Doctor of Philosophy. RMIT University, Melbourne.
- NEPC, 2013a. *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013). Schedule B5b Guideline on Methodology to Derive Ecological Investigation Levels in Contaminated Soils*. National Environment Protection Council, Canberra, 2013.
- NEPC, 2013b. *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013). Schedule B2 Guideline on Site Characterisation*. National Environment Protection Council, Canberra, 2013.
- Olszowy, H, Torr, P, Imray, P, Smith, P, Hegarty, J & Hastie, G, 1995. *Trace element concentrations in soils from rural and urban areas of Australia*, Contaminated Sites monograph no. 4, South Australian Health Commission, Adelaide, Australia.
- USEPA, 2002. *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*. United States Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540-R-01-003, OSWER 9285.7-41, September 2002.
- WA DER, 2014. *Assessment and management of contaminated sites*, Contaminated sites guidelines. Government of Western Australia, Department of Environment Regulation. December 2014.

