Soil Remediation Circular 2009

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1. Introduction

This chapter covers the reasons for drafting this circular in 2006 and for amending it in 2008. An explanation is also provided of the subject, the status and the scope of the circular and the period it will remain in force. Furthermore, an overview is included of new and rescinded legislation concerned with the subject of the circular.

1.1 Background

The legislation to amend the Soil Protection Act[1] entered into force on 1 January 2006. This legislative amendment implements the policy intentions formulated in 2002 in the government's position on modernising policy on soil remediation[2]. Following this, in late December 2003, a Policy Letter on the next step in modernising the soil policy was sent to the Second Chamber[3]; it set out the policy intentions that have had an impact on the aforementioned legislative amendment.

The first phase of the Soil Quality Decree, which regulates the use of soil and dredging sludge in surface water,[4] entered into force on 1 January 2008. The second phase of the Soil Quality Decree, which regulates the use of soil and dredging sludge on land and the use of building materials on or in the soil and in surface water, will enter into force on 1 July 2008.
This circular focuses on the form given to the remediation criterion used to determine whether urgent remediation is necessary. The environmental protection remediation criterion (hereinafter referred to as the remediation criterion) is included in the amended text of section 37 of the Soil Protection Act. The circular also discusses the details of the remediation objective, as included in the amended text of section 38 of the Soil Protection Act. In working out the remediation objective an attempt was made to harmonise it with the Soil Quality Decree.

The decision to produce a circular was taken in 2006 with the aim of providing clarity quickly about the implementation of the two articles. As a result of two years' practical experience with this circular, plus the wish to harmonise it with the new Soil Quality Decree and the cessation of the application of the Circular on target values and intervention values for soil remediation as of 1 October 2008, the amendments to this circular from 2006 enter into force on 1 October 2008. The amendment of the Circular has changed the intervention values for soil remediation.

Some undesirable situations since 1 October 2008, namely additional cases of serious soil contamination, are a consequence of the amendment in the standardisation. The main problem concerns the stricter soil intervention value for the drins sum value, which has led to a massive increase in the number of ‘cases of serious contamination’ as defined in the Soil Protection Act. The soil intervention values for drins (sum), DDE and DDT have been reconsidered as a consequence of these undesirable effects. The Circular was amended in 2009 to reflect this. The soil intervention value for barium, the assessment of lead-related risks to human health, and the assessment of urgency on the basis of ecological risks (step 2) also have been amended partially. A more extensive amendment of the assessment of urgency on the basis of ecological risks (step 2) is foreseen in 2009.

The law gives the jurisdiction to draw up general regulations for both the remediation criterion and the remediation objective. Practical experience with this circular will be the basis for drawing up those regulations.

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[1] Bulletin of Acts and Decrees 2005, 680
[2] Second Chamber, 2001-2002, 28 199, no.1
[3] Second Chamber, 2003-2004, 28 199, no. 13
[4] Bulletin of Acts and Decrees 2007, 469

1.2 Status and scope of the circular and the period it will remain in force

This circular has the character of directives, which is to say that, with a view to exercising caution in decision-making, the competent authority must take into account the provisions contained in this circular.

The directives relate to historical cases of soil contamination (a duty of care has applied since 1987) but do not concern water bottoms. This is connected with a change in remediation management for water bottoms. Whereas the rules of the Soil Protection Act previously formed a reason for the remediation of water bottoms, the European Water Framework Directive is now more of a determining factor for setting quality requirements for water bottoms. The Minister of Transport, Public Works and Water Management, in cooperation with the Minister of Housing, Spatial Planning and the Environment, has therefore produced a separate circular[5].

The directives on asbestos have been given their own individual interpretation because asbestos has specific properties that differ from those of other substances. Moreover, the directives on asbestos are the only ones that are also concerned with water bottoms. The directives on asbestos are included as annex 3 to this circular.

1.3 Rescission of earlier regulations

Upon entering into force, this circular replaces the Circular on the Assessment and Coordination of the Soil Protection Act Remediation Regulations (Government Gazette 1998, no. 242) and the Circular on Determining the Remediation Deadline (Government Gazette 1997, no. 47), the Soil Remediation Circular 2006 and the Soil Remediation Circular 2006, as amended on 1 October 2008.
The Location-specific Conditions Decree and Regulations applied from October 2002 to give shape to the possibility of departing from the objective of section 38. The Decree and Regulations were rescinded with the amendment of section 38 as of 1 January 2006.

The Soil Usage Values[6] will be rescinded with the entry into force on 1 July 2008 of the second part of the Soil Quality Decree, which is concerned with the use of soil and dredging sludge on land. The Background Values and Maximum Values that replace the Soil Usage Values as post-remediation values are included in the Soil Quality Decree. An explanation of the Maximum Values is provided in the Soil Quality Regulations[7].

The Circular on target values and intervention values for soil remediation is rescinded by the entry into force of the amended Soil Remediation Circular 2006 on 1 October 2008 and the Soil Quality Decree on 1July 2008. The groundwater target values and the revised intervention values for soil and groundwater are provided in annex 1 to this circular. Soil target values are therefore only still published in the NOBO report[8]. The aforementioned report explains the underpinning of the soil standards. The groundwater target values continue to play a role in the soil remediation policy and are therefore included in annex 1 to this circular. The intervention values have been revised on the basis of recent scientific data. The NOBO report discusses this in detail. The intervention value for asbestos announced in the Policy Letter on asbestos[9] is also included in Annex 1. The indicative levels for serious contamination are also included in annex 1.

Annex 5 provides an overview of existing regulations as of 1 April 2009 and indicates which regulations have been rescinded.

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[5] Circular on the remediation of water bottoms 2008, Government Gazette 2007, no. 245
[6] Published in the annex to the Location-specific Conditions Regulations, 2002
[7] Soil Quality Regulations, Government Gazette 2007, no. 247
[8] NOBO: report on standardisation and soil quality assessment. Underpinning and policy-based choices for the soil standards in 2005, 2006, and 2007 (Ministry of Housing, Spatial Planning and the Environment, 2008)
[9] Second Chamber, 2004, 28 663 and 28 199, no. 15

The competent authority is charged with determining how to handle situations which have already been surveyed or which are currently in a survey phase, before this Circular came into force. Frequently asked questions and answers dealing with this matter can be found on the SenterNovem/Bodem+ website (www.bodemplus.nl, FAQ section on Soil Remediation Circular).

2. Case of serious contamination: section 29 of Soil Protection Act

This chapter indicates when a case of serious contamination is deemed to exist and what the consequences are. It also examines situations in which contamination exists but does not constitute a case of serious contamination.

2.1 Case of serious contamination

A case of serious contamination is deemed to exist if the average concentration measured of at least one substance in a soil volume of at least 25 m^3 in the case of soil contamination, or a pore-saturated soil volume of at least 100 m^3 in the case of groundwater contamination, is higher than the intervention value. There may be a case of serious contamination in some cases even though the intervention value has not been exceeded. Annex 2 describes susceptible situations of this kind in step 1 of the remediation criterion. A case of serious contamination may also exist in cases of contamination with substances for which no intervention value has been derived. In specific situations the competent authority can enter in consultation with the National Institute for Public Health and the Environment (RIVM).

The ‘Environmental Protection Soil Remediation Criterion, Asbestos Protocol’, which is included as annex 3 to this circular, regulates when a case of soil contamination with asbestos is deemed to constitute a case of serious contamination. In cases of soil contamination with asbestos, the volume criterion is not applicable for determining the seriousness of the contamination.

Determining whether remediation is required urgently and the objective of remediation are discussed in the next chapter.

2.2 Not a case of serious contamination

If a location's soil is contaminated but it is not a case of serious contamination, there is no need to determine whether remediation is an urgent matter. Improving soil quality cannot be prescribed on the grounds of the rules for soil remediation. If a local authority has determined the quality level for a given area on the basis of the Soil Quality Decree, it may encourage that quality level to be taken as the starting point during development activities, for example. This may also be made compulsory if soil has to be used. However, it is not so in cases of serious soil contamination that an obligation may be imposed to make the soil cleaner on the grounds of soil regulations. This is because no risk or potential risk exists that would justify any such obligation.

3. Urgent remediation: section 37 of the Soil Protection Act

This chapter discusses the criteria that form the basis for determining whether a case of serious contamination requires urgent remediation. The consequences are also indicated for the urgent remediation and non-urgent remediation obligation.

3.1 Urgent remediation

If a case of serious contamination is determined, a potential risk exists that requires a form of remediation or management. Section 37 of the Soil Protection Act is concerned with determining whether the risk is such that urgent remediation is required owing to the present or future use of the soil.

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Risks are directly related to the use of the soil and therefore to its function. If the soils use within the scope of its existing or future function involves unacceptable risks, taking measures as soon as possible is of paramount importance. The primary aim of the measures is to tackle the emerging risks properly. Therefore, it does not mean that the entire case requires urgent remediation. This marks a major change in respect of the former section 37 of the Soil Protection Act, which formed the basis for determining the urgency of remediation with a view to tackling the entire case in a single operation. The former section 37 of the Soil Protection Act was concerned with prioritising the approach to contamination, whereas section 37 of the Soil Protection Act is now primarily concerned with removing the risks in a timely manner. The reason for this is that it has specifically been decided to allow a flexible approach to be taken, which takes into account the situation/financial circumstances of the party obliged to carry out remediation operations. This is further discussed in section 5.3.

It should be clear from the 'severity and urgency' decision which part of the case of serious contamination presents unacceptable risks and requires speedy remediation (see section 5.2). If the risks are concerned with future use, measures have to be taken to deal with the risks adequately before any such use takes place. The decision also indicates the control measures that have to be taken at the location of the part of the case of serious contamination that does not present unacceptable risks.

The risks that could be a reason for urgent remediation are divided into: a) risks for humans, b) risks for the ecosystem and c) risks of the contamination spreading to the surrounding area.

re a) A case of unacceptable risks for humans is deemed to exist if the location's present or intended use results in a situation in which:

- chronic adverse impacts on health may occur;
- acute adverse impacts on health may occur.

If the existence of soil contamination in the current use of the soil presents a demonstrable nuisance for humans (e.g. skin irritation and smells), it likewise requires urgent remediation.

re b) A case of unacceptable risks for the ecosystem is deemed to exist if the location's present or intended use means that:

- biodiversity may be harmed (protection of species);
- recycling functions may be disturbed (protection of processes);
- bioaccumulation and biomagnification could occur.

ad c) A case of unacceptable risks of the contamination spreading to the surrounding area is deemed to exist in the following situations:

- the ecosystem or the soil's use by humans is jeopardised by contamination spreading through the groundwater and thereby presenting a nuisance to susceptible objects;
- an uncontrollable situation exists, i.e., if:
  - there is a layer of floating groundwater contamination which could be moved by activities and processes in the soil, which would result in the contamination spreading;
  - there is a layer of sinking groundwater contamination which could be moved by activities and processes in the soil, which would result in the contamination spreading;
  - spreading contamination has resulted in major groundwater contamination and the contamination continues to spread.

Annex 2 describes the remediation criterion method used to determine whether unacceptable risks exist for humans, for the ecosystem or of the contamination spreading. The remediation criterion method of working for asbestos is described in annex 3.

3.2 Non-urgent remediation

If it is determined on the grounds of section 37 of the Soil Protection Act that non-urgent remediation is required, no period for completing remediation applies. Control measures, possibly for the long term, may be imposed, if monitoring the spread of groundwater contamination is advisable, for example. This means that remediation of the case of serious contamination usually takes place if new developments, such as construction activities or the redevelopment of a location or area, give cause. In the case of construction activities on or in seriously contaminated soil that reduce or displace the contamination, a report to the competent authority is compulsory pursuant to section 28 of the Soil Protection Act. A remediation plan must be drawn up before executing the intended actions.
Since 1 January 2006, planning permission must be withheld if it concerns a location that involves a case of serious contamination. If the competent authority has decreed that a situation requiring urgent remediation does not exist, the withdrawal ceases to apply (section 52, subsection a, of the Housing Act).

3.3 Remediation deadline

Any unacceptable risks that exist must be removed as soon as possible. Until remediation has finally removed the risks, unacceptable risks can be limited by taking timely safety measures. Determining the exact causes of the risks and the necessary measures to remove them may take a considerable time. Therefore, the following guideline applies as an indication of the period that should be adopted within which remediation should start: within 4 years of the date on which the ‘severity and urgency’ decision was issued.
The competent authority pursuant to the Soil Protection Act sets the exact remediation deadline and matches it to the conditions that location-specific circumstances involve.

4. Remediation objective: section 38 of the Soil Protection Act

This chapter discusses the determination of the remediation objective for the approach taken to individual cases of serious contamination.

4.1 General

Section 38 of the Soil Protection Act describes the remediation objective. As of 1 January 2006, this means that function-based and cost-effective remediation may be based on the statutory remediation objective.

4.2 Objective

Soil remediation operations must be carried out so that the soil is at least made suitable for the function designated to it after remediation, whereby the risk for humans, plants or animals as a result of exposure to the contamination must be minimised. As far as possible, remediation must minimise the risks of the contamination spreading to the surrounding area. Moreover, remediation is carried out in a way that as far as possible reduces the necessity of taking follow-up measures and imposing restrictions on use after remediation. Here ‘as far as possible’ means that the costs must be commensurate with the effects of remediation.
If follow-up measures are necessary to maintain and check the results of remediation, they must be sufficient to ensure that the contamination remaining after remediation will not result in a reduction in the quality of the soil that is achieved after remediation (section 39, subsection d of the Soil Protection Act).
It must be clear from reasons set out in the remediation plan whether the aforementioned requirements will be met.

Topsoil contamination
The Soil Usage Values for the remediation of immobile contaminants in topsoil were included in the Location-specific Conditions Regulations as post-remediation values. These values likewise determine the quality of any topsoil to be used. These quality requirements cease to apply with the Soil Quality Decree's entry into force. Within the scope of the Soil Quality Decree, local authorities must opt for a generic or area-specific policy. The competent authority pursuant to the Soil Protection Act, which is not the local authority in every situation, adopts the Background Values and Maximum Values used in the generic policy for the soil class function for housing and industry as post-remediation values. If a local authority has opted for an area-specific policy, it is recommended that the competent authority pursuant to the Soil Protection Act should adopt the established Local Maximum Values as the post-remediation values to be adopted. The main rule is therefore that the post-remediation values for the topsoil must be in line with the generic or area-specific values determined on the basis of the Soil Quality Decree. This does not detract from the fact that the competent authority pursuant to the Soil Protection Act has its own obligation to present its reasons when determining the remediation objective and that, in the circumstances of the case concerned, a different objective from that relating to the reasons remains possible. The reason may also be concerned with area-specific circumstances, as applied in the extensive contamination in the Kempen area.

Mobile contamination in the topsoil and subsoil
A contamination situation is said to be mobile if groundwater could spread the contamination to the extent that it could possibly present risks for humans, plants or animals. The distinction in the approach to remediation between the contamination's source and plume is important. The source of a mobile contamination situation is often in the topsoil, whereas plume refers to the groundwater contamination in the subsoil.

The remediation of mobile contamination situations in the topsoil and subsoil must result in the soil and groundwater being of the required quality to make the intended use of the topsoil and subsoil possible, and minimisation of the spread of residual contamination and of the follow-up measures it requires. This can be deemed to be a stable, environmentally acceptable end result. The competent authority pursuant to the Soil Protection Act has the option of adopting an area-specific quality objective for the soil and groundwater.

Various remediation solutions are conceivable for tackling spread contamination. The remediation objective will always be achieved if the contamination (source and plume) is completely removed from the soil. However, in practice complete removal is not always feasible or advisable, for example when the source is unreachable (deep or underneath buildings) or when the environmental benefits do not justify the damage and costs of measures. Choosing the best remediation variant requires an assessment process.

4.3 Aspects of assessing remediation variants
Especially in the case of mobile contamination, determining the remediation variant involves an assessment process in which various aspects play a role in addition to the required results and costs of remediation. On the one hand, this involves aspects that can be viewed as either advantages or disadvantages of remediation. Disadvantages include the duration of remediation, follow-up measures, certainty about achieving the intended remediation results, and the impact on other environmental media. Advantages include the reduced risk, restoration of the options for use, plume behaviour, the volume removed, reduced liability. Besides these generic aspects, advantages and disadvantages may also relate to regional or local aspects for which the competent authority concerned has established a policy.
The competent authority assesses whether the proposed method of remediation is ultimately the most cost-effective and states in the decision on the remediation plan whether agreement to the remediation plan is possible.

The final report on the relaunch project ('doorstart A-5')[10] includes a description of the assessment process. The ROSA ('Robuust Saneringsvarianten Afwegen')[11] guidelines for decision-making when dealing with mobile soil contaminants provide practical instruments for selecting a remediation variant for groundwater in the subsoil and for solving problems in the selection process. The aforementioned relaunch project ('doorstart A-5') referred to an order of preferences in the assessment of remediation variants in which the complete removal of contaminants was seen as the reference variant. As the statutory remediation objective has been amended, this variant no longer serves as a statutorily prescribed reference variant but may, of course, still be adopted as the starting point. When stating the reasons for the optimum remediation chosen, the starting point is the current statutory remediation objective and the resulting requirements. The remediation of mobile contamination situations must not take longer than 30 years, if a long period is required for the selected remediation variant. The reasons for the choice of remediation variant must be stated, along with an assessment of the advantages and disadvantages. It should also be taken into account that remediation operations that can be completed within a few years are preferable, as long-term remediation requires long-term inspection and reporting and the outcome is, nevertheless, often uncertain. An extremely long period of up to 30 years requires additional substantiation based on the expectation that it would result in quality improvements that could not otherwise be achieved.

5 Soil remediation process

This chapter discusses the process of determining the urgency and the achievement of the remediation objective. It starts with a detailed examination of the risk assessment steps. The competent authority pursuant to the Soil Protection Act determines on the basis of the risk assessment whether there is an urgent need for remediation. The results of the detailed survey and the risk assessment are recorded in the 'severity and urgency' decision. An indication is also provided of which aspects can be included in the 'severity and urgency' decision. The chapter concludes with a discussion of the various possibilities for the approach taken to remediation: as a single operation, in phases or partial remediation.

5.1 Risk assessment step-by-step plan

When soil contamination is suspected, locations are at some point surveyed to determine whether a case of serious contamination exists. The urgency of remediation has to be determined in cases of serious contamination. This is done on the basis of a risk assessment (see section 3.1). The risks are initially determined using a standard risk assessment. This is a technical translation of the starting points of the remediation criterion. A generic model is used for this in which calculations for various points can be changed in line with the prevailing circumstances. As it is suitable for application in the field, this system can be used for any location in the Netherlands, barring water bottoms. The assessment is generic and errs on the safe side. The starting point is that the standard risk assessment suffices in most cases.
However, in more complex situations, a more extensive risk assessment may be conducted which takes into account location-specific circumstances. A more detailed and differentiated impression of the risks can be obtained with a location-specific risk assessment, as it focuses on the location and measurements can be used instead of calculations. Once a location-specific assessment has been made decision-making must be based on it.

The risk assessment is carried out in the three steps explained below. Steps 1 and 2 must always be carried out. Step 3 is not compulsory but may be carried out if deemed necessary by the

[10] The final report on the relaunch project ('doorstart A-5') of 2 July 2001: Assessment process for the approach taken to mobile contaminants in the subsoil; Project description and national remediation ladder.
[11] ROSA, (Robuust Saneringsvarianten Afwegen) Handreiking voor het maken van keuzes en afspraken bij mobiele verontreinigingen (Guidelines for decision-making when dealing with mobile soil contaminants), September 2005

initiator or competent authority pursuant to the Soil Protection Act. Figure 1 shows the steps of risk assessment, remediation and management. The three risk assessment steps are explained in annex 2.

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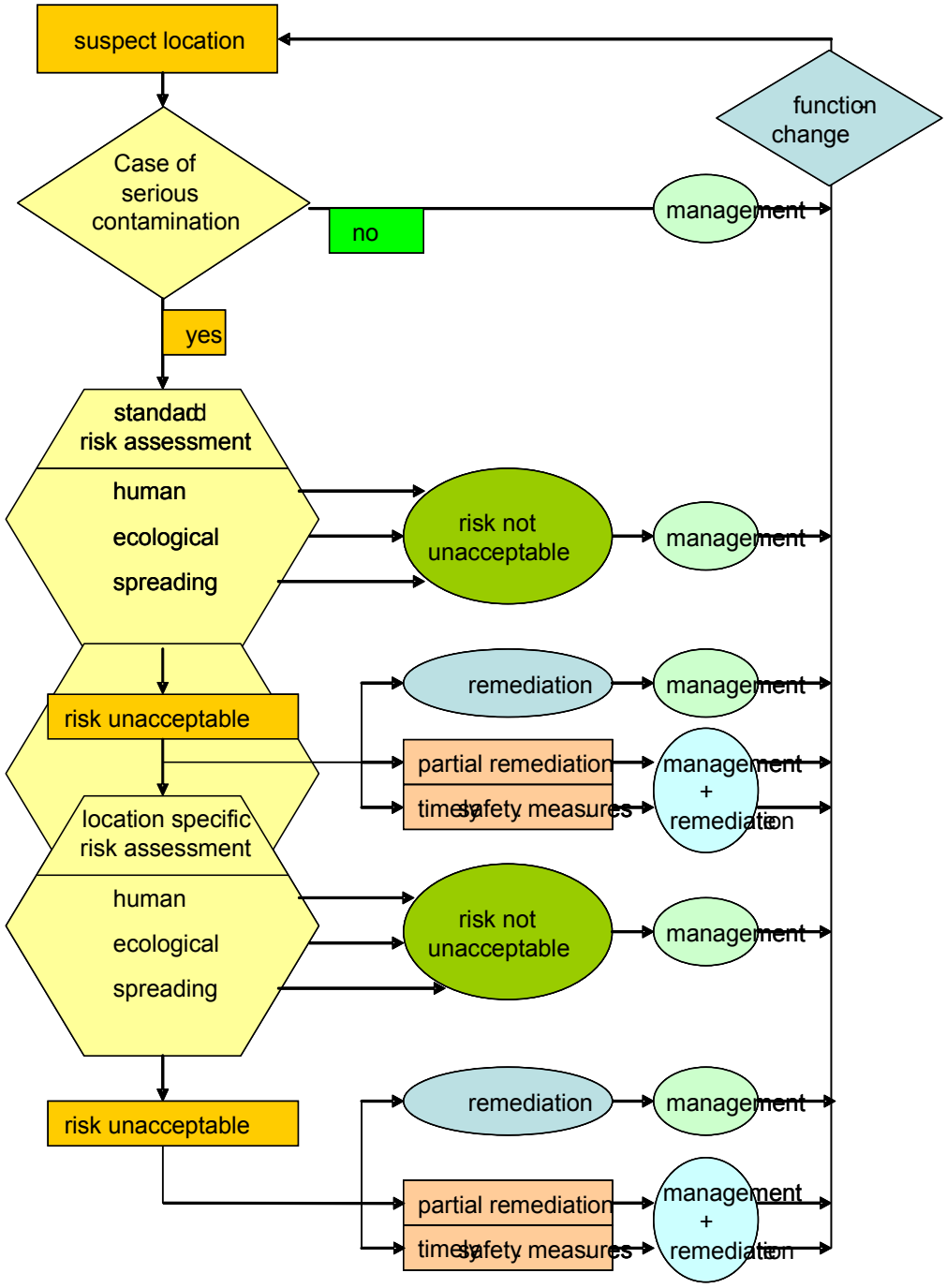

Figure 1: Diagram of soil remediation process

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Step 1: determining a case of serious contamination
The purpose of step 1 is to determine whether there is a case of serious contamination at the location. This is determined on the basis of a detailed survey.

Step 1 may lead to the following results:

- Not a case of serious contamination

If there is not a case of serious contamination, there is no need to determine whether unacceptable risks exist as a result of the contamination.

- Case of serious contamination → step 2: standard risk assessment

The following step is always carried out if there is a case of serious contamination: a standard risk assessment is conducted (step 2).

Step 2: standard risk assessment
The purpose of step 2 is to determine whether unacceptable risks exist for the case of serious contamination or any part of it.

A standard risk assessment method is used to determine whether any risks are involved in the present and future use of the location that would have an unacceptable impact on humans, the ecosystem or from the point of view of the contamination spreading. Future use is determined by the initiator but it must be in keeping with the scope provided by the land use plan. The risk assessment method is generic and parameters erring on the safe side have been chosen. The risk assessment is conducted as part of the detailed survey referred to in step 1.

Step 2 may lead to the following results:

- Unacceptable risk

If it emerges from the standard risk assessment that the existing soil contamination poses no unacceptable risks in the location's present or future use, remediation need not be carried out urgently. However, a register of the limitations of the case of serious contamination is required. Moreover, the competent authority pursuant to the Soil Protection Act has discretion to determine whether management of any description is necessary.

- Risk unacceptable → remediation required urgently

If it emerges from the standard risk assessment that parts of the existing soil contamination pose an unacceptable risk in the location's present or future use, the parts of the case of serious contamination concerned will require remediation urgently. Section 5.3 indicates the measures that may be taken.

- Risk unacceptable → step 3: location-specific risk assessment

Given the possibility of an overestimation of the risks in the methods used in step 2, if it emerges from the standard risk assessment that all or part of the existing contamination poses unacceptable risks in the location's present or future use, there may be grounds for expecting a more specific risk assessment for the case of serious contamination concerned to lead to a different conclusion. The initiator may therefore opt to perform a location-specific risk assessment (step 3) after the standard risk assessment. The competent authority pursuant to the Soil Protection Act may also call for a location-specific assessment to be carried out, if it deems such an assessment necessary for decision-making.

Step 3: location-specific risk assessment
The purpose of step 3 is to determine for the case of serious contamination, or the relevant part of the case, whether performing a location-specific survey would lead to a different conclusion from that based on the result of the standard risk assessment in step 2 ('risk unacceptable') or whether it would confirm and further substantiate the result obtained in step 2. The result obtained in step 3 may also lead to better dimensioning of the remediation measures.

Step 3 may produce the following results:

- Unacceptable risk

If it emerges from the location-specific risk assessment that the existing soil contamination poses no unacceptable risks in the location's present or future use, remediation need not be carried out urgently. However, a register of the limitations of the case of serious contamination is required. Moreover, the competent authority pursuant to the Soil Protection Act has discretion to determine whether management of any description is necessary.

- Risk unacceptable → remediation required urgently

If the location-specific risk assessment leads to the same conclusion as the standard risk assessment in step 2, it confirms that all or part of the existing soil contamination poses unacceptable risks in the location's present or future use. The parts of the case of serious contamination concerned will require remediation urgently. Section 5.3 indicates the measures that may be taken.

5.2 'Severity and urgency' decision

The 'severity and urgency' decision may cover the following matters, if the location's present or intended use involves unacceptable risks:

- the level of contamination and size of the part of the case of serious contamination that has been investigated;
- the register of limitations concerning the case of serious contamination;
- the unacceptable risks that exist for the present or intended use;
- the part of the contamination that causes unacceptable risks;
- when the remediation/remediation phases must start;
- when the remediation plans must be submitted;
- which temporary safety measures have to be taken and when a report must be produced on their implementation;
- the control measures that have to be taken to protect the soil in the part of the case of serious contamination for which it has been established that no unacceptable risks exists and when a report has to be produced on their implementation. The following are examples of the above:
  - monitoring measures and the associated reporting obligations;
  - measures to prevent the contamination from spreading;
  - limitations on use;
- the relevant changes in use that have to be reported to the competent authority pursuant to the Soil Protection Act.

The 'severity and urgency' decision may cover the following matters, if the location's present or intended use does not involve unacceptable risks:

- the level of contamination and size of the part of the case of serious contamination that has been investigated;
- the confirmation that the present or intended use does not involve any unacceptable risks;
- the register of limitations concerning the case of serious contamination;
- the control measures that have to be taken to protect the soil and when a report has to be produced on their implementation. The following are examples of the above:
  - monitoring measures and the associated reporting obligations;

- measures to prevent the contamination from spreading;
- limitations on use;

- the relevant changes in use that have to be reported to the competent authority pursuant to the Soil Protection Act.

The 'severity and urgency' decision cannot be in the form of a 'pro forma urgency' decision. A standard risk assessment that can be used as a basis for determining whether urgent remediation is required has to be made for each case of serious contamination.

5.3 Remediation in phases, management and partial remediation

The starting point for soil remediation is that it will be carried out for all cases of serious contamination. The remediation criterion prescribes urgent remediation of at least the part of the case of serious contamination that results in unacceptable risks. If the situation gives cause, control measures may also be imposed for the remaining part of the case of serious contamination. The approach will differ per case. Legislation offers various options in aid of taking a flexible approach: phased remediation, partial remediation and temporary safety measures. The aim is obviously to achieve the required end result as soon as possible for the entire case. The preferred choice in relatively minor cases requiring urgent remediation is remediation of the entire case as a single operation. Until unacceptable risks have finally been removed by remediation they can be limited by taking timely safety measures.

Phased remediation

Section 38, subsection 3, of the Soil Protection Act permits remediation to be carried out in phases. Phased remediation is often more appropriate for the dynamics of the location for relatively large or complex cases. The remediation plan then indicates how remediation will be carried out in phases for the entire case. In addition, outlines and schedules are worked out for the various remediation phases; along with a budget for the entire remediation process and any follow-up activities are described. Following the decision to accept the remediation plan, a detailed description of the measures is submitted and checked against the decision. Phased remediation is especially suitable if it is largely known what developments will take place at a location and that they will take place in different periods.
The competent authority pursuant to the Soil Protection Act clearly shows in the reasons for the decision how the circumstances of the case will be taken into account and the plans that the initiator has for a location.

Partial remediation

Article 40 of the Soil Protection Act permits partial remediation, provided this is not precluded by the importance of soil protection. The importance of soil protection may especially play a role in situations in which the contamination could spread through groundwater. Phased remediation is more appropriate in such situations. The difference with phased remediation is that a remediation plan is not drawn up for the entire case of serious contamination but for part of it. The detailed survey need not map out the entire site. In that case, the 'severity and urgency' decision is based on the part of the case of serious contamination that has been surveyed.
Henceforth partial remediation should be seen as a complete form of remediation. Compulsory urgent remediation is linked to unacceptable risks, whereas long-term management of the existing contamination is permitted for cases in which there are no unacceptable risks.

The most recent legislative amendment considerably increased the possibilities for partial remediation, with a view to increasing flexibility in the execution of remediation operations and thereby enabling remediation to be appropriate for the required activities. When determining the best approach, the competent authority must take into account the importance of soil protection. On the one hand, scope has to be provided for carrying out a tailored survey and remediation operations quickly, while on the other hand, the speed must not result in a failure to identify risks. If there are any shortcomings in this information because the contamination in the case concerned has not yet been delineated, the possibility of carrying out partial remediation

operations soon can be considered on the basis of a limited survey, on condition that a detailed survey must be carried out to obtain further information on the case as a whole.

Partial remediation can be carried out for the surveyed part of the case of serious contamination that involves unacceptable risks and is covered by the ‘severity and urgency’ decision.

Partial remediation may also be carried out if there are no unacceptable risks but remediation is in aid of the location's required development. In the case of partial remediation in connection with a development plan, the detailed survey will often be limited to the part of the site where the buildings will be located.

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Annex 1: Groundwater target values, Soil remediation intervention values, Indicative levels for serious contamination, soil type correction and measurement regulations.

Table 1 of this annex shows groundwater target values and intervention values for soil and groundwater. Table 2 shows indicative levels for serious contamination and, if available, groundwater target values. The table is preceded by an explanation of the indicative levels for serious contamination. The annex concludes with formulas for soil type correction and instructions on using them.

Groundwater target values and soil remediation intervention values

Groundwater target values provide an indication of the benchmark for environmental quality in the long term, assuming that there are Negligible Risks for the ecosystem. The figures for groundwater target values are shown exactly as stated in the Circular for Soil Remediation Target and Intervention Values (2000). The target values were taken from the Integrated Environmental Quality Standards project (known as INS) and were published in December 1997 (Ministry of Housing, Spatial Planning and the Environment, Integrated Environmental Quality Standards for soil, water and air, 1997). Barring a few exceptions, the INS target values have been adopted. The INS target values are underpinned by a risk analysis wherever possible and apply to individual substances. A distinction is made for metals between deep and shallow groundwater. This is because deep and shallow groundwater contains different background concentrations. An arbitrary limit of 10 metres has been adopted. Note that this limit is indicative. A different limit may be adopted if information is available which indicates that another limit is more plausible for the site to be assessed. For example, information might be available about the boundary between the phreatic groundwater and the first aquifer.

- For shallow groundwater (< 10 metres) the environmental quality objectives for soil and water (MILBOWA) values have been adopted as target values. These are based on background concentrations and serve as a guide.
- The target values proposed in INS have been adopted for deep groundwater (> 10 metres). This means that the target value comprises the background concentration which is naturally present (BC) plus the Negligible Addition (NA). The background concentrations included in the INS are provided as a guide.

In both cases the stated background concentration should be viewed as a guide. Any information available on the local background concentration can be used as a target value together with the Negligible Addition (NA). More information on background concentrations of metals in different areas in the Netherlands can be found in RIVM report, number 711701 017.

The soil remediation intervention values indicate when the functional properties of the soil for humans, plants and animals is seriously impaired or threatened. They are representative of the level of contamination above which a serious case of soil contamination is deemed to exist. Soil intervention values for the first tranche of substances have been evaluated. New proposals have been made for intervention values and these are included in table 7.1 of RIVM report 711701023 (Feb 2001). The new proposed intervention values for a number of substances in the first tranche have been adjusted on the basis of policy-related considerations. The amended standards are described in the NOBO report: Ministry of Housing, Spatial Planning and the Environment, 2008, in print: NOBO: Normstelling en bodemkwaliteitsbeoordeling (report on standardisation and soil quality assessment). Underpinning and policy-based choices for the soil standards in 2005, 2006, and 2007. The soil intervention values for other tranches have not been evaluated and are the same as those included in the Circular for Soil Remediation Target and Intervention Values (2000). The soil intervention values apply to dry soil. Water bottom intervention values have been drawn up separately in the Soil Quality Regulations (Government Gazette 20 December 2007, no. 247) and in the Circular on the remediation of water bottoms 2008 (Government Gazette 2007, no. 245). The groundwater intervention values have been taken unrevised from the Circular for Soil Remediation Target and Intervention Values (2000).

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Table 1 Groundwater target values and soil and groundwater intervention values[9]

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[7] shallow (< 10 m –gl) (µg/l)	National background concentration groundwater (BC) deep (> 10 m –gl) (µg/l)	Target value groundwater[7] (incl. BC) deep (> 10 m –gl) (µg/l)	Intervention values soil (mg/kg d.s.)	groundwater (µg/l)
1 Metals					
Antimony	-	0.09	0.15	22	20
Arsenic	10	7	7.2	76	60
Barium	50	200	200	[8]	625
Cadmium	0.4	0.06	0.06	13	6
Chromium	1	2.4	2.5	-	30
Chromium III	-	-	-	180	-
Chromium VI	-	-	-	78	-
Cobalt	20	0.6	0.7	190	100
Copper	15	1.3	1.3	190	75
Mercury	0.05	-	0.01	-	0.3
Mercury (inorganic)	-	-	-	36	-
Mercury (organic)	-	-	-	4	-
Lead	15	1.6	1.7	530	75
Molybdenum	5	0.7	3.6	190	300
Nickel	15	2.1	2.1	100	75
Zinc	65	24	24	720	800

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[7] (µg/l)	Intervention values soil (mg/kg d.s.)	groundwater (µg/l)
2. Other inorganic substances			
Chloride (mg Cl/l)	100 mg/l	-	-
Cyanide (free)	5	20	1,500
Cyanide (complex)	10	50	1,500
Thiocyanate	-	20	1,500
3. Aromatic compounds			
Benzene	0.2	1.1	30
Ethylbenzene	4	110	150
Toluene	7	32	1,000
Xylenes (sum)[1]	0.2	17	70
Styrene (vinylbenzene)	6	86	300
Phenol	0.2	14	2,000
Cresols (sum)[1]	0.2	13	200

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Table 1 (continued) Target values for groundwater and intervention values for soil and groundwater

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[7] (µg/l)	Intervention values soil (mg/kg d.s.)	groundwater (µg/l)
4. Polycyclic Aromatic Hydrocarbons (PAHs)[5]			
Naphthalene	0.01	-	70
Phenanthrene	0.003*	-	5
Anthracene	0.0007*	-	5
Fluoranthene	0.003	-	1
Chrysene	0.003*	-	0.2
Benzo(a)anthracene	0.0001*	-	0.5
Benzo(a)pyrene	0.0005*	-	0.05
Benzo(k)fluoranthene	0.0004*	-	0.05
Indeno(1,2,3cd)pyrene	0.0004*	-	0.05
Benzo(ghi)perylene	0.0003	-	0.05
PAHs (total) (sum 10)[1]	-	40	-
5. Chlorinated hydrocarbons			
a. (volatile) hydrocarbons			
Monochloroethene (Vinylchloride)[2]	0.01	0.1	5
Dichloromethane	0.01	3.9	1,000
1,1-dichloroethane	7	15	900
1,2-dichloroethane	7	6.4	400
1,1-dichloroethene[2]	0.01	0.3	10
1,2-dichloroethene (sum)[1]	0.01	1	20
Dichloropropanes (sum)[1]	0.8	2	80
Trichloromethane (chloroform)	6	5.6	400
1,1,1-trichloroethane	0.01	15	300
1,1,2-trichloroethane	0.01	10	130
Trichloroethene (Tri)	24	2.5	500
Tetrachloromethane (Tetra)	0.01	0.7	10
Tetrachloroethene (Per)	0.01	8.8	40
b. chlorobenzenes[5]			
Monochlorobenzene	7	15	180
Dichlorobenzenes (sum)[1]	3	19	50
Trichlorobenzenes (sum)[1]	0.01	11	10
Tetrachlorobenzenes (sum)[1]	0.01	2.2	2.5
Pentachlorobenzenes	0.003	6.7	1
Hexachlorobenzene	0.00009*	2.0	0.5
c. chlorophenols[5]			
Monochlorophenols (sum)[1]	0.3	5.4	100
Dichlorophenols (sum)[1]	0.2	22	30
Trichlorophenols (sum)[1]	0.03*	22	10
Tetrachlorophenols (sum)[1]	0.01*	21	10
Pentachlorophenol	0.04*	12	3
d. polychlorobiphenyls (PCBs)			
PCBs (sum 7)[1]	0.01*	1	0.01

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Table 1 (continued) Target values for groundwater and intervention values for soil and groundwater

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[7] (µg/l)	Intervention values soil (mg/kg d.s.)	groundwater (µg/l)
e. Other chlorinated hydrocarbons			
Monochloroanilines (sum)[1]	-	50	30
Dioxin (sum I-TEQ)[1]	-	0.00018	N/A[6]
Chloronaphthalene (sum)[1]	-	23	6
6. Pesticides			
a. organochlorine pesticides			
Chlorodane (sum)[1]	0.02 ng/l*	4	0.2
DDT (sum)[1]	-	1.7	-
DDE (sum)[1]	-	2.3	-
DDD (sum)[1]	-	34	-
DDT/DDE/DDD (sum)[1]	0.004 ng/l*	-	0.01
Aldrin	0.009 ng/l*	0.32	-
Dieldrin	0.1 ng/l*	-	-
Endrin	0.04 ng/l*	-	-
Drins (sum)[1]	-	4	0.1
α-endosulphan	0.2 ng/l*	4	5
α-HCH	33 ng/l	17	-
β-HCH	8 ng/l	1.6	-
γ-HCH (lindane)	9 ng/	1.2	-
HCH-compounds (sum)[1]	0.05	-	1
Heptachlor	0.005 ng/l*	4	0.3
Heptachlor epoxide (sum)[1]	0.005 ng/l*	4	3
b. organophosphorous pesticides			
-			
c. organotin pesticides			
Organotin compounds (sum)[1]	0.05* – 16 ng/l	2.5	0.7
d. chlorophenoxy-acetic acid herbicides			
MCPA	0.02	4	50
e. other pesticides			
Atrazine	29 ng/l	0.71	150
Carbaryl	2 ng/l*	0.45	50
Carbofuran[2]	9 ng/l	0.017	100

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Table 1 (continued) Target values for groundwater and intervention values for soil and groundwater

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[7] (µg/l)	Intervention values soil (mg/kg d.s.)	groundwater (µg/l)
7. Other substances			
Asbestos[3]	-	100	-
Cyclohexanone	0.5	150	15,000
Dimethyl phthalate	-	82	-
Diethyl phthalate	-	53	-
Di-isobutyl phthalate	-	17	-
Dibutyl phthalate	-	36	-
Butyl benzyl phthalate	-	48	-
Dihexyl phthalate	-	220	-
Di(2-ethylhexyl)phthalate	-	60	-
Phthalates (sum)[1]	0.5	-	5
Mineral oil[4]	50	5,000	600
Pyridine	0.5	11	30
Tetrahydrofuran	0.5	7	300
Tetrahydrothiophene	0.5	8.8	5,000
Tribromomethane (bromoform)	-	75	630

* Numeric value below the detection level/no lower detection limit or measurement method available.

1 See annex N of the Soil Quality Regulations (Ministry of Housing, Spatial Planning and the Environment 2007) for the composition of the aggregate parameters. The results below the required reporting limit AS3000 are multiplied by 0.7 when calculating a sum value for the individual components. If all individual values as part of the calculated value have a result below the required reporting limit AS3000, the assessor may assume that the soil or groundwater quality complies with the target value. If there are one or more measured contents (without < sign) for one or more individual components, then the calculated value has to be checked against the applicable standard value. This rule also applies if the measured contents are lower than the required reporting limit. The check result obtained on the basis of a calculated sum value, whereby one or more individual components have been defined as 0.7 times the reporting limit, is not binding. The assessor is free to conclude that the sample in question is not as contaminated as the check result shows, provided he supplies good reasons for such a conclusion. This is for instance the standard approach if a PAH measurement in the groundwater reveals only naphthalene in a slightly increased concentration, and if the other PAHs have a value below the required reporting limit AS3000. Relatively high contents will then be calculated for the other PAHs (by multiplying by 0.7), of which it can be substantiated that such levels will not be present in the groundwater in view of the immobility of the relevant substances.

2 The Intervention value for soil in respect of these substances equals or is lower than the limit of quantification (intralaboratory reproducibility). The risks must be examined in greater detail if the substance is detected. The groundwater must also be surveyed if vinyl chloride or 1,1-dichloroethene is detected in the soil.

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[3] Weighted standard (concentration of serpentine + 10 x concentration of amphibole asbestos)

[4] 'Mineral oil' is defined in the analysis standard. Where the contamination is composed of mixtures (e.g. petrol or domestic heating oil), the concentration of aromatic and/or polycyclic aromatic hydrocarbons must be determined in addition to the alkane concentration. This aggregate parameter has been adopted for practical reasons. Further toxicological and chemical differentiation is under study.

[5] In the case of groundwater, effects of PAHs, chlorobenzenes and chlorophenols are indirectly additive and are expressed as a fraction of the individual intervention value (i.e. 0.5 of the intervention value of substance A has the same effect as 0.5 of the intervention value of substance B). This means that an addition formula must be used to determine whether an intervention value has been exceeded. The intervention value for the sum of a group of substances is exceeded if $\Sigma(C_i/I_i) > 1$, where C_i = measured concentration of a substance in the group of substances in question and I_i = intervention value for the substance concerned in the group.

[6] There is an indicative level for serious contamination

[7] The Groundwater target values for a number of substances are lower than the required reporting limit in AS3000. This means that these Target values are more stringent than the level at which reliable (routine) measurements can be made. The laboratories must at least comply with the required reporting limit in AS3000. Providing the analytical method complies with AS3000, a more stringent reporting limit is also permitted. If the assessment measurement result is < reporting limit AS3000, the assessor may assume that groundwater quality complies with the Target value. If the laboratory reports a measured content (without a < sign), this concentration has to be checked against the target values, even if this concentration is lower than the required reporting limit AS3000.

[8] The barium standard has been repealed because the intervention value for barium proved to be lower than the concentration naturally occurring in the soil. In the case of increased barium concentrations compared to the natural background due to an anthropogenic source, this concentration can be assessed on the basis of the former intervention value for barium of 920 mg/kg d.s. This former intervention value is substantiated in the same manner as the intervention values for most of the other metals, and for barium it includes a natural background concentration of 190 mg/kg d.s.

[9] If the laboratory reports a value below an increased reporting limit (i.e. higher than the reporting limit AS3000), the increased reporting limit concerned must be multiplied by 0.7. The value obtained in this manner is then checked against the applicable standard value. Such an increase in the reporting limit may occur when analysing a seriously contaminated sample or a sample with a non-standard composition. The check results obtained in this manner are not binding. The assessor is free to conclude that the sample cannot be assessed properly, provided he supplies good reasons for such a conclusion.

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Indicative levels for serious contamination

Indicative levels for serious contamination are provided for the substances in table 2. This concerns intervention values derived for substances in the second, third and fourth tranches. Instead of an intervention value, an indicative level for serious contamination is indicated on the basis of two reasons:

1. No standardised measurement and analysis regulations are available or expected in the near future.
2. The ecotoxicological underpinning of the intervention values does not exist or is minimal and, in the latter case, the ecotoxicological impacts are apparently more critical than the human toxicological effects.
   The ecotoxicological underpinning must fulfil the following criteria:
   a. at least four units of toxicity data must be available for at least two taxonomic groups;
   b. all the data for metals must relate to the soil compartment;
   c. in the case of organic substances, no more than two data units may be derived from data on the water compartment via equilibrium partitioning;
   d. at least two data units must be available for individual species.

   In the event of one or more of these criteria not being met and if ecotoxicological impacts are more critical than human toxicological impacts, it is sufficient to set an indicative level for serious contamination.

The indicative levels have a greater degree of uncertainty than the intervention levels. The status of the indicative levels is therefore not equivalent to the status of the intervention levels. Levels above or below the indicative levels do not therefore affect the competent authority's decisions on the seriousness of the contamination. The competent authority should therefore take other considerations into account, besides the indicative levels, when deciding whether there is a case of serious contamination. Examples include:

- Decide on the basis of other substances whether there is a case of serious contamination and the urgency of remediation. Frequently several substances occur simultaneously in contaminated sites. If intervention values have been set for other substances, these substances can be used as a basis for determining whether there is a case of serious contamination and the urgency of remediation. In a case of this kind, an estimate of the risk for substances for which only indicative levels are provided is less relevant. However, it is important to estimate the risk for substances for which only an indicative level is stated, if there is no case of serious contamination or remediation being urgent for other substances.
- An ad hoc determination of the actual risks. Other site-bound factors besides toxicological criteria play a role in determining the actual risks for ascertaining the urgency of remediation. These include exposure possibilities, the use of the site or the surface areas of the contamination. These factors can frequently be readily determined, which enables a reasonable estimate of the actual risks to be made, in spite of uncertainty about the indicative levels. It is advisable here to use bio-assays, since this solves the problem of the uncertainties in the ecotoxicological underpinning as well as the uncertainties arising as a result of the absence of standardised measurement and analysis regulations.
- Additional investigation of the risks that the substance involves. Additional toxicity experiments can be conducted to make a more accurate estimate of the risks that the substance involves.

The indicative levels for serious contamination have not been evaluated and remain unchanged compared to the levels set out in the Circular on target values and intervention values for soil remediation (2000) (*Circulaire streefwaarden en interventiewaarden bodemsanering*). Some former intervention values have been changed into indicative levels for serious contamination. This is explained in the NOBO report ‘Standardisation and soil quality assessment: substantiation and policy decisions for soil standards in 2005, 2006 and 2007’ (Ministry of Housing, Spatial Planning and the Environment, 2008). The indicative levels for serious MTBE contamination of groundwater have been changed to comply with the value stated in the ‘Circular on the duty of

care with regard to MTBE and ETBE contaminations under the Soil Protection Act' (Government Gazette, 18 December 2008, no. 2139).

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Table 2 Groundwater target values and indicative levels for serious contamination[6]

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater shallow[4] (< 10m -mv) (µg/l)	deep[4] (>10 m -mv) (µg/l)	Indicative level for serious contamination soil (mg/kg d.s.)	groundwater (µg/l)
1 Metals				
Beryllium	-	0.05*	30	15
Selenium	-	0.07	100	160
Tellurium	-	-	600	70
Thallium	-	2*	15	7
Tin	-	2.2*	900	50
Vanadium	-	1.2	250	70
Silver	-	-	15	40

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[4] (µg/l)	Indicative level for serious contamination soil (mg/kg d.s.)	groundwater (µg/l)
3. Aromatic compounds			
Dodecylbenzene	-	1,000	0.02
Aromatic solvents[1]	-	200	150
Dihydroxybenzenes (sum)[3]	-	8	-
Catechol (o-dihydroxybenzene)	0.2	-	1,250
Resorcinol (m-dihydroxybenzene)	0.2	-	600
Hydroquinone (p-dihydroxybenzene)	0.2	-	800
5. Chlorinated hydrocarbons			
Dichloroanilines	-	50	100
Trichloroanilines	-	10	10
Tetrachloroanilines	-	30	10
Pentachloroanilines	-	10	1
4-chloromethylphenols	-	15	350
Dioxin (sum I-TEQ)[2]	-	N/A[5]	0.001 ng/l
6. Pesticides			
Azinphos-methyl	0.1 ng/l *	2	2
Maneb	0.05 ng/l*	22	0.1

Table 2 (continued) Groundwater target values and indicative levels for serious contamination

Concentrations in soil are shown for standard soil (10% organic matter and 25% clay)

Substance	Target value groundwater[4] (µg/l)	Indicative level for serious contamination soil (mg/kg d.s.)	groundwater (µg/l)
7. Other compounds			
Acrylonitril	0.08	0.1	5
Butanol	-	30	5,600
1.2 butyl acetate	-	200	6,300
Ethylacetate	-	75	15,000
Diethylene glycol	-	270	13,000
Ethylene glycol	-	100	5,500
Formaldehyde	-	0.1	50
Isopropanol	-	220	31,000
Methanol	-	30	24,000
Methylethylketone	-	35	6,000
Methyl-tert-buthyl ether (MTBE)	-	100	9,400

* Numeric value below the detection level/no lower detection limit or measurement method available

1 Aromatic solvents are defined as a standard mixture of substances referred to as 'C9-aromatic naphtha', as defined by the International Research and Development Corporation: o-xylene 3.2%, i-isopropylbenzene 2.74%, n-propylbenzene 3.97%, 1-methyl-4-ethylbenzene 7.05%, 1-methyl-3-ethylbenzene 15.1%, 1-methyl-2-ethylbenzene 5.44%, 1,3,5-trimethylbenzene 8.37%, 1,2,4-trimethylbenzene 40.5%, 1,2,3-trimetylbenzene 6.18% and > alkylbenzenes 6.19%.

2 See annex N of the Soil Quality Regulations (Ministry of Housing, Spatial Planning and the Environment, 2007) for the composition of the aggregate parameters. The results below the required reporting limit AS3000 are multiplied by 0.7 when calculating a sum value for the individual components. If all individual values as part of the calculated value have a result below the required reporting limit AS3000, the assessor may assume that soil or groundwater quality complies with the target value. If there are one or more measured concentrations (without a < sign) for one or more individual components, then the calculated value must be checked against the applicable standard value. This rule also applies if the measured contents are lower than the required reporting limit. The check result obtained on the basis of a calculated sum value whereby one or more individual components have been defined as 0.7 times the reporting limit, is not binding. The assessor is free to conclude that the sample in question is not as contaminated as the check result shows, provided he supplies good reasons for such a conclusion.

3 Dihydroxybenzenes (sum) means: the sum of catechol, resorcinol and hydroquinone.

4 The groundwater target values for a number of substances are lower than the required reporting limit in AS3000. This means that these target values are more stringent than the level at which reliable (routine) measurements can be made. The laboratories must at least comply with the required reporting limit in AS3000. Providing the analytical method complies with AS3000, a more stringent reporting limit is also permitted. If the assessment measurement result is < reporting limit AS3000, the assessor may assume that groundwater quality complies with the target value. If the laboratory reports a measured concentration (without a < sign), this concentration must be checked against

the target values, even if this concentration is lower than the required reporting limit AS3000.

5 There is an intervention value for soil.

6 If the laboratory reports a value lower than an increased reporting limit (i.e. higher than the reporting limit AS3000), the increased reporting limit concerned must be multiplied by 0.7. The value obtained in this manner is then checked against the applicable standard value. Such an increased reporting limit can occur when analysing a seriously contaminated sample or a sample with a non-standard composition. The checking results obtained in this manner are not binding. The assessor is free to conclude that the sample cannot be assessed properly, provided he supplies good reasons for such a conclusion.

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Soil type correction

When assessing soil quality the values in the table for standard soil are converted to values that apply to the actual soil being assessed on the basis of the measured organic matter and clay. The converted values can then be compared with the measured concentrations in the soil.

Metals
The following soil type correction formula can be used for the conversion for metals:

$(IW)_b = (IW)_{sb} \times [\{A + (B \times \%\ clay) + (C \times \%\ organic\ matter)\} / \{A + (Bx25) + (C \times 10)\}]$

In which:

$(IW)_b$	= intervention value for the soil being assessed
$(IW)_{sb}$	= intervention value for standard soil
%clay	= measured percentage clay in the soil being assessed. A clay content of 2% is assumed for soil with a measured clay content below 2%.
% organic matter	= percentage organic matter measured in the soil being assessed. An organic matter content of 2% is measured for soil with a measured organic matter content below 2%.
A, B, C	= substance-dependent constants for metals (see below)

Substance-dependent constant for metals:

Substance	A	B	C
Arsenic	15	0.4	0.4
Barium	30	5	0
Beryllium	8	0.9	0
Cadmium	0.4	0.007	0.021
Chromium	50	2	0
Cobalt	2	0.28	0
Copper	15	0.6	0.6
Mercury	0.2	0.0034	0.0017
Lead	50	1	1
Nickel	10	1	0
Tin	4	0.6	0
Vanadium	12	1.2	0
Zinc	50	3	1.5

Organic compounds

The intervention values and indicative levels for serious contamination for organic compounds depend on the organic matter content. The following soil type correction formula can be used for the conversion for organic compounds, with the exception of PAHs:

$(IW)_b = (IW)_{sb} \times (\%\ \text{organic matter} / 10)$

In which:

$(IW)_b$	= intervention value for the soil being assessed
$(IW)_{sb}$	= intervention value for standard soil
% organic matter	= measured percentage organic matter in the soil being assessed. For soils with a measured organic matter content exceeding 30% or below 2%, a figure of 30% or 2% is adopted respectively.

PAHs

In the case of the PAHs intervention value, no soil type correction is used for soils with an organic matter content of up to 10% or exceeding 30%. An intervention value of 40 mg/kg d.s. is used for soils with an organic matter content of up to 10%, and a figure of 120 mg/kg d.s. is used for soils with an organic matter content of 30% or higher. The following soil type correction formula can be used for an organic matter content between 10% and 30%:

$(IW)_b = 40 \times (\%\ \text{organic matter}/10)$

In which:

$(IW)_b$	= intervention value for the soil being assessed
% organic matter	= measured percentage organic matter in the soil being assessed.

Measurement regulations

Details of the analytical methods to be used are included in Annex L, relating to section 1.1 (version 30 November 2007) of the Soil Quality Regulations. Government Gazette, 20 December 2007, no. 247, page 67.

ANNEX 2: Remediation Criterion: Determining the risk for humans, for the ecosystem or of spreading

1. General

This annex describes the remediation criterion method used to determine whether unacceptable risks exist for humans, for the ecosystem or of the contamination spreading in the groundwater. Particular risks can be used as a basis for determining whether remediation is required urgently. A computer model called Sanscrit is used to help determine the risks. The first version of Sanscrit (2006) was based on the Remediation Urgency System (SUS), version 2.3, April 2005. The changes in the present circular have also been implemented in the model calculations used in Sanscrit. No further discussion of the computer model is provided in this circular.

2. Starting points

Urgent remediation is required unless the risk assessment demonstrates that this is not the case.

The remediation criterion method of working applies to:

- a case of serious contamination
- historical contamination. Section 13 of the Soil Protection Act (duty of care) applies to cases of contamination that came about after 1987;
- present or intended use;
- soil and groundwater. A separate system has been developed for contaminated water bottoms;
- all substances for which an intervention value has been derived, with the exception of asbestos.

As asbestos has specific chemical and physical properties that differ from those of other substances, the Environmental Protection Soil Remediation Criterion, Asbestos Protocol, has been developed separately for asbestos and also applies to water bottoms (see annex 3 of this circular). The asbestos protocol is likewise composed of three steps but the system for executing steps 2 and 3 differs from that for other substances (see section 3 below). In cases of soil contamination with asbestos it is not always possible to make a statement about the risks on the basis of the results of step 2. In such cases step 3 has to be carried out and the results are used as a basis for making a statement about the risks.

3. Stepwise system

The three steps of the remediation criterion are discussed below. The main text of the circular shows the procedure for progressing through the steps. The discussion of steps 2 and 3 also includes separate discussions of the assessment of the risks for humans, the ecosystem and of the contamination spreading.

Step 1: Determining a case of serious contamination

In the first step, the detailed survey is used as the basis for determining whether there is a case of serious contamination. A case of serious contamination is deemed to exist if the average concentration measured of at least one substance in a soil volume of at least 25 m^3 in the case of soil contamination, or a pore-saturated soil volume of at least 100 m^3 in the case of groundwater contamination, is higher than the intervention value.

In a few specific situations there may be a case of serious contamination even if the concentrations are below the intervention values. This applies to what are termed susceptible land use functions:

- vegetable garden/allotment,
- places where there are volatile compounds in the groundwater in combination with high groundwater levels and/or unsaturated soil underneath buildings.

A case of serious contamination with asbestos is deemed to exist at any location with asbestos concentrations that exceed the intervention value (100 mg/kg d.s. (weighted)), regardless of the volume. The asbestos protocol included as annex 3 must be used as a basis for determining whether there are any unacceptable risks as a result of soil contamination with asbestos.

Step 2: Standard risk assessment
The second step is a generic model calculation called Sanscrit. The model calculation can be based on the results of the detailed survey. A distinction is made between risks for humans, the ecosystem and of the contamination spreading. As the model calculations are generic, model parameters erring on the safe side have been chosen.

Step 3: Location-specific risk assessment
Step three consists of making additional measurements and/or additional model calculations. Concentration figures calculated using the model can be replaced in the model calculations by the figures for concentrations measured at the location. This makes the third step more location-specific.
Measures or addition model calculations need not be made for every component of the generic model calculation. The additional measurements and/or model calculations can focus on critical exposure routes or parts of them.

The shape given to steps 2 and 3 is discussed below for determining unacceptable risks for humans, the ecosystem and of the contamination spreading.

4. Risks for humans

4.1 General
A case of unacceptable risks for humans is deemed to exist if the location's present or intended use results in a situation in which:
- chronic adverse impacts on health may occur;
- acute adverse impacts on health may occur.

Chronic impacts occur at lower concentrations than those that lead to acute impacts. Focusing the risk assessment on chronic impacts means that it automatically covers acute impacts.
As acute exposure to hydrocyanic gas, for example, can be fatal, the Maximum Acceptable Toxic Concentration (MATC) in air was derived taking into account acute fatal exposure.

If the existence of soil contamination in the current use of the soil presents a demonstrable nuisance (e.g. skin irritation and smells), it is deemed to be an unacceptable situation which likewise requires urgent remediation.

4.2 Step 2: Standard risk assessment
The risks for humans are determined using the CSOIL exposure model included in Sanscrit. The model distinguishes between seven exposure scenarios which are used to describe the location's use and the associated risks on the basis of a model.

The model-based calculated exposure figure (lifelong average in mg/kg body weight per day) is checked against the Maximum Permissible Risk level (MPR) for oral and dermal exposure. In the case of inhalational exposure, the calculated concentrations in air are checked against the Maximum Acceptable Toxic Concentration (MATC) in air. The following two results are possible for this:
- exposure ≤ MPR (oral + dermal) and MATC (inhalational) = no unacceptable risk;
- exposure > MPR (oral + dermal) and/or MATC (inhalational) = unacceptable risk.

The MPR and MATC values are shown in table A of this annex 2.

The model-based calculated exposure figure is only checked against MPR during childhood years for lead because lead has been shown to be more critical in this period vis-à-vis its impact during adulthood. In step 2, a factor of 0.74 is used for the human relative bioavailability of lead. Further details on this are provided in the NOBO report: Ministry of Housing, Spatial Planning and the Environment, 2008, in print: NOBO: Normstelling en bodemkwaliteitsbeoordeling (report on

standardisation and soil quality assessment). Underpinning and policy-based choices for the soil standards in 2005, 2006, and 2007.

A case of nuisance is deemed to exist if skin irritation occurs as a result of skin contact with the pure product and/or if there is a smell because the odour threshold has been exceeded. A list of odour thresholds is provided in table A at the end of this annex 2.

4.3 Step 3: Location-specific assessment

Step 3 can be carried out if it is concluded on the basis of the generic model calculation that there are unacceptable risks but there is a suspicion that no such risks actually exist. Such a situation could arise because the model parameters have been set too conservatively vis-à-vis the actual situation.
If step 3 has been carried out, the competent authority must base its conclusion regarding urgency on the results of step 3.

Additional measurements may be made in contact media to complete step 3. This is concerned with determining the concentrations of contaminants in:

- soil air, indoor and outdoor air;
- crops from the vegetable garden;
- drinking water (from plastic pipes passing through the contamination);
- water from a private source that is used for consumption;
- house dust.

The bioavailability of substances in the soil can also be determined. This means that the size of the fraction of a substance in the soil is measured that can actually be taken up by the body. This is particularly important for contamination with lead because human risks are the determining factor in that case. In step 3, it is possible to choose to decrease the human relative bioavailability factor to 0.4. This lower factor applies to urban made-grounds with historical lead contamination, soils with an organic matter content of at least 20% and historical lead contamination, and similar soils of which it can be demonstrated that the lead contamination is associated with low human bioavailability. The factor 0.4 constitutes a temporary recommendation pending investigation. In step 3, the competent authority may also take into account limited crop consumption from one's own garden, issue limitations on use (i.e. advise against consumption of crops from one's own garden), or base its calculations on the actual take-up of lead by means of crops from vegetable gardens on the basis of crop measurements.

There are still no validated measurement methods or established guidelines that have to be used for making the measurements in step 3. RIVM has developed two measurement methods[12] that can be used in support of the location-specific risk assessment in step 3. At this time, no recommendation can be issued regarding a suitable method for measuring the human relative bioavailability factor of lead.
However, it is up to the initiator and competent authority to reach agreement about the suitability of the method to be used. Subject to stating the reasons, the competent authority may reject the method submitted by the initiator. When assessing any such methods, the competent authority may be assisted by Bodem+, if possible. Depending on the method used, Bodem+ can advise the competent authority or refer it to other knowledge organisations.

Processes may be described in different ways in step 3 (state of the art) and bioavailability may actually be taken into account or complete or partial model results may be replaced by measurement results. However, no changes may ever be made to critical exposure levels (MPR

[12] Human health risks due to consumption of vegetables from contaminated sites, RIVM report 711701040/2007
Richtlijn voor luchtmetingen voor de risicobeoordeling van bodemverontreiniging (Guidance on air quality measurements for assessing risks of contaminated soil), RIVM report 711701048/2007

or MATC) or the parameters that describe the normal population. This is because they are set to protect individuals, taking into account susceptible people under susceptible conditions.

The calculated oral and dermal exposure rate is checked against the current MPR. The measured indoor and outdoor air concentrations are checked against the current MATC.
The following two results are possible for this:

- exposure ≤ MPR (oral + dermal) and MATC (inhalational) = no unacceptable risk;
- exposure > MPR (oral + dermal) and/or MATC (inhalational) = unacceptable risk.

5. Risks for the ecosystem

5.1 General

A case of unacceptable risks for the ecosystem is deemed to exist if the location's present or intended use means that:

- biodiversity may be harmed (protection of species);
- recycling functions may be disturbed (protection of processes);
- bioaccumulation and biomagnification could occur.

The establishment of the soil remediation intervention values is based on human and ecological risk limits, whereby the lowest risk limit determines how high the intervention value is, unless it was not possible to determine either of the two with sufficient reliability. The ecological risk limits are lower for heavy metals than the limits for humans and are therefore determining for the intervention value (with the exception of antimony). The same applies for PAHs.
The ecological risk limit for other types of organic matter is also usually lower than that for humans and is therefore determining for the intervention value. Ecological risk limits for mineral oil and cyanides have not yet been determined. Policy considerations have also played a role in determining the intervention value for some substances (copper and zinc). Further details on this are provided in the NOBO report.

5.2 Step 2: Standard risk assessment

Ecosystems are unique and complex. Generic relationships between the impacts referred to in the preceding section and figure-based standards for soil quality are therefore relatively uncertain. Nevertheless, a generic framework can offer protection for most ecosystems, in spite of the uncertainties. Adding more location-specific details can reduce uncertainties. As it is impractical to make a location-specific evaluation of the ecological risk for every site, it was decided that the main features of the generic system should be adopted in step 2, as included in the most recent version of Sanscrit, supplemented with a module for estimating the generic risk posed by the mixture of contaminants. In this system, in which ecology has a high value (nature conservation areas, etc.), unacceptable risks for the ecosystem are much more likely to occur than in the case of contamination of the same extent in areas where ecological function are deemed to be less important (industrial sites, infrastructure, etc.).

In a case of land contamination that is entirely or largely in the top 0.5 m of uncovered soil, a combination of area type, surface area and toxic pressure (TP) determines whether there are unacceptable ecological risks and therefore the urgency of remediation (table 1). In specific cases of deep-rooted crops, a departure from 0.5 metre as the soil thickness is permitted, provided the reasons are stated.

The assessment in step 2 is actually based on the level of contamination, the size of the uncovered contaminated area and the area type.

Table 1 Flow chart for ecological underpinning of the decision on the urgency of remediation. Depending on the area type, remediation of a case of contamination need not be carried out urgently if the horizontal size of the uncovered soil contamination is smaller than the indicated surface area in a contour for Toxic Pressure. Both contours have to be assessed.

area type[B]	surface area of uncovered soil contamination ($TP^A > 0.2$)	surface area of uncovered soil contamination ($TP^A > 0.5$)
• nature conservation areas including areas in the network of protection areas (EHS)[C]	50 m^2	50 m^2
• agriculture • residential with garden • vegetable gardens/allotments • green areas with ecological values	5,000 m^2	50 m^2
• other green area • built-up area • industry • infrastructure	0.5 km^2	5,000 m^2

A TP is the acute Toxic Pressure of the mixture of contaminant substances in a (mixed) sample obtained from the site. The contours for TP = 0.2 and TP = 0.5 are used for the standard assessment in the remediation criterion. The TP is calculated on the basis of the total concentrations of substances in soil samples. All concentrations are corrected for standard soil. The backgrounds for the TP calculation are published in an RIVM report (Rutgers et al., 2008, 711701072).

B The division into area types is related to the 'ecological value' of areas and adjusted for the soil-use categories defined by the NOBO working group (NOBO report). If a location can be divided into several types, the most susceptible type must be chosen.

c EHS = network of protected areas (Ecologische hoofdstructuur)

5.3 Step 3: Location-specific risk assessment

Step 3 can be carried out if it is concluded on the basis of the generic assessment that there are unacceptable risks but there is a suspicion that no such risks actually exist. If step 3 has been carried out, the competent authority must base its conclusion regarding urgency on the results of step 3.

Determining the actual ecological impacts at a location entails conducting an ecological study of how the soil contamination at the location affects the impacts referred to in section 1. The aforementioned study involves more location-specific characteristics and a specific technique is used which reduces uncertainties.
A TRIAD can be carried out in aid of this. A TRIAD comprises three parts:

1. Chemicals: determine which substances are present in the soil in increased concentrations and what the combined effect is on the ecosystem on the basis of the toxic properties of the substances. Methodically, this part is linked precisely to step 2 of the remediation criterion in the assessment of ecological risks.
2. Potential toxicity: this involves using bioassays to measure the toxic effects of the substances present in the soil. This is used to determine whether contaminants in soil samples from the location affect organisms or processes under standardised laboratory conditions.
3. Field surveys: this entails determining whether the condition of the ecosystem observable in the field can be related to potential effects of the soil contamination there. This implicitly takes into account the effect of a combination of substances and the bioavailability of substances in the field. The impact of the contaminants on the

ecosystem can be determined by means of a comparison with a good reference location or the expected picture of the ecosystem at the location.

There are still no validated measurement methods or established guidelines for making the measurements in step 3. However, the building blocks for determining ecological risks are sufficiently developed to enable them to be used. There is sufficient consensus on how the results from various parts of a TRIAD assessment can be used as underpinning for a decision on the urgency of remediation. RIVM and other knowledge institutions are currently developing guidelines[13].
It is therefore up to the initiator and competent authority to make agreements on the method to be used. Subject to stating the reasons, the competent authority may reject the method submitted by the initiator. When assessing any such methods, the competent authority may be assisted by Bodem+, if possible. Depending on the method used, Bodem+ can advise the competent authority or refer it to other knowledge organisations.

6. Risks of the contamination spreading to the surrounding area

6.1 General

A case of unacceptable risks of the contamination spreading to the surrounding area is deemed to exist in the following situations:

- the ecosystem or the soil's use by humans is jeopardised;
- an uncontrollable situation exists, i.e., if:
  - there is a layer of floating groundwater contamination which could be moved by activities and processes in the soil, which would result in the contamination spreading;
  - there is a layer of sinking groundwater contamination which could be moved by activities and processes in the soil, which would result in the contamination spreading;
  - spreading contamination has resulted in major groundwater contamination and the contamination continues to spread.

6.2 Step 2: Standard risk assessment

6.2.1 Use of the soil is under threat

Use of the soil is jeopardised in cases of unacceptable environmental nuisance. Regardless of the extent, nuisance caused by contamination spreading through groundwater is especially important in relation to susceptible objects. A case of unacceptable environmental nuisance is deemed to exist if a susceptible object is enclosed by the intervention value contour in the groundwater or will come within the contour within a few years. The spread within a few years is determined by adopting a distance of 100 metres vis-à-vis the present intervention value contour.

The following susceptible objects are recognised:

- Water catchment areas designated for abstracting water for human consumption within the scope of the Water Framework Directive;
- soil volumes, surface water/ water bottoms that come within or form part of: shellfish waters, water for salmon and cypriniformes, bathing water and Natura2000 areas (which form part of the ‘protected areas’ designated as such for the implementation of the Water Framework Directive; see also the Circular on the remediation of water bottoms)
- soil volumes assigned a special quality in the present or future situation, such as ecologically valuable areas, strategic drinking water reserves or, for example, the soil below residential districts. Local and provincial authorities may give soil volumes of this kind the susceptible objects status;

[13] Handreiking TRIADE: Locatiespecifiek ecologisch onderzoek in stap drie van het Saneringscriterium ('Guideline TRIAD, site-specific ecological risk assessment the Remediation Criterion), RIVM report 711701068/2007.

- areas with seepage.

6.2.2 Unmanageable situation

A situation is deemed to be unmanageable in the following situations, which means that the contamination in the soil is increasing or could increase:

- **Layer of floating groundwater contamination**
  If there is a layer of floating groundwater contamination[14] (regardless of the total extent of groundwater contamination), it is assumed that it could move through the soil, thereby creating an unmanageable situation. Examples include:
  - the extent of the case of contamination increases over time because contamination spreads through the floating layer;
  - the floating layer spreads across the plot boundary;
  - pure product appears at ground level or in surface water;
  - the floating layer may suddenly cover a much larger area if underground obstacles are removed.

- **Layer of sinking groundwater contamination**
  If there is a layer of sinking groundwater contamination[15] (regardless of the total extent of groundwater contamination), it is assumed that it could move through the soil, thereby creating an unmanageable situation. For example, intervention may cause a layer of sinking groundwater contamination to sink to a deeper level, penetrate an aquifer and cause groundwater contamination there.
  A sinking layer of groundwater contamination can arise relatively quickly. If a sinking layer is present, it is often kept in place for years by capillary forces. If the situation is changed, by driving piles or sheet piling into the ground for example, the sinking layer may be vertically displaced. Within the soil's zone of use (the part of the subsoil humans use for activities such as pile driving, laying metro tubes, cold/heat storage), the existence of a sinking layer is deemed to constitute an unmanageable situation.

- **Spreading**
  An unmanageable situation resulting from contamination spreading through groundwater is deemed to exist if the soil volume that is enclosed by the intervention value contour in the groundwater exceeds 6,000 m^3. The assumption here is that the contamination will always spread, if it was caused in the past (before 1987) and has meanwhile developed into groundwater contamination with a volume exceeding 6,000 m^3. On the other hand groundwater contamination that has had an intervention value contour of less than 6,000 m^3 soil volume for at least twenty years will only spread to a limited degree. Groundwater contamination of this kind does not require urgent remediation, as long as no other risks are present.

  The extent of contamination can be determined relatively easily and can be worked out from the actual situation in the soil, namely from the substance concentrations detected in the groundwater at various points at the location.

6.3 Step 3: Location-specific assessment

[14] According to the Land Restoration and Management Guidelines (Richtlijn Herstel en Beheer Landbodem) (http://www.bodemrichtlijn.nl) a floating layer of groundwater contamination is a layer of poorly soluble contaminant(s) in the form of a product with a density lower than water and which consequently floats on groundwater.

[15] According to the Land Restoration and Management Guidelines (Richtlijn Herstel en Beheer Landbodem) (http://www.bodemrichtlijn.nl) a sinking layer of groundwater contamination is a layer of poorly soluble contaminant(s) with a density higher than water. Vertical transport of these substances tends be rapid through readily permeable soil layers, after which they flow horizontally across a less permeable layer.

Step 3 can be carried out if it is concluded on the basis of the generic assessment in step 2 that there are unacceptable risks but there is a suspicion that no such risks actually exist. If step 3 has been carried out, the competent authority must base its conclusion regarding urgency on the results of step 3. There are still no validated measurement methods or established guidelines for determining the spread of contamination. It is therefore up to the initiator and competent authority to make agreements on the method to be used. Subject to stating the reasons, the competent authority may reject the method submitted by the initiator. When assessing any such methods, the competent authority may be assisted by Bodem+, if possible. Depending on the method used, Bodem+ can advise the competent authority or refer it to other knowledge organisations.

6.3.1 Use of the soil is under threat

Susceptible objects
In step 3, if a susceptible object is present in the soil volume enclosed by the intervention value contour in the groundwater and within a radius of 100 metres around it, the initiator can use a calibrated model to calculate the spread of contamination (on the basis of several rounds of hydraulic head calculations) to demonstrate that the contamination is not spreading or is spreading to such a limited degree that susceptible objects will not be threatened within the next few years. Decomposition parameters and sorption can also be taken into account on the basis of measurement results. A long-term (at least five years) series of monitoring results can also be used to demonstrate that the susceptible object is not under threat.

The initiator can also demonstrate in step 3 that the susceptible object will not be subject to any unacceptable environmental nuisance. In that case, measurements and calculations must demonstrate that:

- the quality of a given soil volume or surface water/water bottom will not deteriorate;
- the quality of the groundwater abstracted for human consumption will not be adversely affected to the extent that water treatment will have to be increased;
- groundwater seepage will not lead to unacceptable risks;
- groundwater abstraction will not be adversely affected, i.e. no additional measures will be required on account of the presence of soil contamination.

The contamination spread calculations must be conducted for the substance expected to have the largest spread and to reach the object first. This will usually be the most mobile substance (lowest retardation factor) that has already spread most. However, a situation may arise in which one substance has been spreading for a considerable time and the groundwater becomes contaminated by another much more mobile substance at a later stage. In that case, a choice supported by reasons will have to be made for one of the substances or calculations will have to be made for the two (or more) substances.

No further calculations need to be made if the contamination cannot reach an aquifer that is in contact with objects requiring protection. However, this will have to be properly explained.

6.3.2 Unmanageable situation

Layer of floating groundwater contamination
It is assumed in the standard risk assessment that any floating layer of contamination in the groundwater will be able to spread independently and that it therefore creates an unmanageable situation. However, its spread will largely be determined by the soil's permeability (main flow paths, etc.), obstructions in the soil and the viscosity of the liquid that forms the floating layer. Therefore, cases may occur in which the floating layer is immobile. The unmanageable situation is determined by the location of the floating layer. For example, an unmanageable situation will not be deemed to exist if the floating layer is isolated in the middle of the plot, very deep and far from surface water or if the flow of the floating layer is not affected by removable objects in the subsoil. In step 3 the initiator can determine whether and to what extent the presence of a floating layer of contamination in the groundwater could result in unmanageable situations.
This can be done using a long-term (at least five years) series of monitoring results demonstrating that the floating layer of groundwater contamination has not spread further over a long period. Additional investigations may also be conducted into the physical properties (e.g. viscosity) of the pure product or into the soil's permeability, possibly in combination with a multi-phase flow model, or a description of the situation in the subsoil that affects the displacement of the floating layer.

Layer of sinking groundwater contamination
If there is a sinking layer of groundwater contamination, it will be assumed in the standard risk assessment that an unmanageable situation exists. If the initiator can demonstrate that there is no sinking layer of groundwater contamination in the soil's zone of use or that the depth of the zone of use chosen in step 2 does not apply to the case concerned, an unmanageable situation will no longer be deemed to exist. The initiator may also demonstrate that an unmanageable situation does not exist, for example by demonstrating that the volume of the sinking layer is so small that any further spreading to the aquifer would be negligible and that the likelihood of the contamination spreading therefore no longer exists. Additional investigations may also be conducted into the physical properties (e.g. viscosity) of the pure product or into the soil's permeability, possibly in combination with a multi-phase flow model, or a description of the situation in the subsoil that affects the displacement of the sinking layer.

Spreading
In step 3 the initiator may demonstrate that, even though the soil volume containing groundwater contaminated with one or more substances in concentrations exceeding the intervention value is larger than 6,000 m^3, the additional soil volume that will become contaminated annually with groundwater containing one or more substances in concentrations exceeding the intervention values will be no larger than 1,000 m^3. This can be demonstrated using calculations or measurements. The criterion of 1,000 m^3 extra per year is the same as the difference between categories II and III on the basis of the volume score in the now rescinded Circular on Determining the Remediation Deadline. Urgent remediation is not required in situations involving extra volumes of less than 1,000 m^3 per year. Control measures are taken (see main text of section 5.1), while waiting for remediation to commence. The control measures and associated reporting obligations are stipulated in the ‘severity and urgency’ decision. The nature and intensity of the control measures depend on various factors: the regional or local policy on groundwater contamination, the contamination situation and the extent to which the contamination spreads, the soil properties, the nature of the area where contamination is located and the dynamics in the use of the soil and the resulting consequences.

Because the plumes contaminated with one or more substances in concentrations exceeding the intervention value in a soil volume larger than 6,000 m^3 pose the greatest risk for the groundwater reservoir in the Netherlands, a trend reversal is required to reduce the spread of the contamination over time. European developments play a role in this.

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Requirements are set for the quality of water and groundwater pursuant to the Water Framework Directive and the underlying Groundwater Directive[16]. The general import of this is that good chemical conditions in groundwater must be achieved by no later than 2015. The Groundwater Directive requires a trend reversal if the quality requirement is not met. The measures to be taken will be described in the river basin management plans, which have to be submitted in 2009. Further requirements on managing groundwater contamination may be set on the basis of the aforementioned plans. Examples of possible measures within the scope of any such management include the prevention of new contamination as well as monitoring and possibly intervening in existing contamination situations. Given the regional character of the river basin management plans, it would be inadvisable to prescribe precise control measures in this circular for particular situations.

[16] Directive 2006/118/EC of the European Parliament and Council of Europe of 12 December 2006 on the protection of groundwater against pollution and deterioration.

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Table A Overview of MPR and MATC values and odour thresholds

Overview of MPR values, MATC values and odour thresholds for substances for which an intervention value has been derived, if available.

MPR_{human} = maximum permissible risk (MPR) for humans, in µg per kg body weight per day. For non-carcinogenic substances it corresponds to the "Tolerable Daily Intake (TDI)". For carcinogenic substances it is based on an additional likelihood of tumour incidence of 1 in 10,000 for lifetime exposure (CR_{oral}).
Table 4.1 of RIVM report 711701023 (February 2001) shows the MPR values, which were revised in 1999/2000.

MATC = Maximum Acceptable Toxic Concentration (MATC) in air, in µg per m^3 air.
For non-carcinogenic substances it is the “Tolerable Concentration in Air (TCA)”. For carcinogenic substances it is based on an additional likelihood of tumour incidence of 1 in 10,000 for lifetime exposure (CR_{inhal}). The MATC values of the first tranche of substances are stated in a guide to the urgency of soil remediation: ‘Urgentie van bodemsanering: de handleiding (Koolenbrander, 1995) / Urgency of soil remediation: the user’s guide’. The MATC values of the second and third tranche of substances are stated in 'Proposal for intervention values for soil clean-up: 'Second series of chemicals', Van den Berg et al., 1994 and 'Calculation of human-toxicological serious soil contamination concentrations and proposals for intervention values for clean-up of soil and groundwater: Third series of compounds', Kreule et al., 1995. The MATC values of the fourth tranche of substances are stated in 'Maximum Permissible Risk Levels for Human Intake of Soil Contaminants: Fourth Series of Compounds', Janssen, et al.,1998.
Table 4.1 of RIVM report 711701023 (February 2001) shows the MATC values, which were revised in 1999/2000.

Odour threshold = The odour threshold of a gaseous substance is the lowest concentration of the substance in air that is still detectable by humans.

An odour panel composed of several people is used to determine the odour threshold for a substance. They are given various dilutions of the substance to smell and say each time whether they can detect the odour. The odour threshold is the concentration at which half of the panel is still able to distinguish the odour from odourless air.
Odour thresholds are not exact values; people are not all equally sensitive to a given odour. Different odour thresholds are therefore found for the same substance in references.

The odour threshold is expressed in µg/m^3, ppm or ppb.

The term odour threshold is closely related to the term odour unit: the odour threshold is by definition equal to one odour unit (OU) per m^3. The median is taken as representative for the purposes of the criterion.

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Substance	MPR_{human} (µg/kg/d)	MATC (µg/m^3)	Odour threshold[1] (µg/m^3) median	lowest
I Metals				
Antimony	0.9	-	-	-
Arsenic	1.0	1.0	-	-
Barium (soluble)	20	-	-	-
Barium (insoluble)	-	1.0	-	-
Cadmium	0.5	-	-	-
Chromium III (soluble)	5	-	-	-
Chromium III (insoluble + metallic)	5,000	60	-	-
Chromium VI	5	0.0025	-	-
Cobalt	1.4	0.5	-	-
Copper	140	1.0	-	-
Mercury (organic)	0.1	-	-	-
Mercury (inorganic)	2.0	-	-	-
Mercury (metallic)	-	0.2	-	-
Lead	3.6	-	-	-
Molybdenum	10	12	-	-
Nickel	50	0.05	-	-
Zinc	500	-	-	-
II Inorganic compounds				
Cyanides (free) (hydrogen cyanide)	50	25	2,000	900
Cyanides (complex)	800	-	-	-
Thiocyanate	11	-	-	-
III Aromatic compounds				
Benzene	3.3	20	80,000	5,000
Ethylbenzene	100	770	90,000	9,000
Phenol	40	20	700	20
Cresols (sum)[2]	50	170	-	-
Toluene	223	400	20,000	600
Xylenes (sum)[2]	150	870	8,000	400
Catechol (o-dihydroxybenzene)	40	-	-	-
Resorcinol (m-dihydroxybenzene)	20	-	-	-
Hydroquinone (p-dihydroxybenzene)	25	-	-	-
Styrene (vinylbenzene)	120	900	3,000	70

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Substance	MPR_{human} (µg/kg/d)	MATC (µg/m^3)	Odour threshold[1] (µg/m^3) median	lowest
IV Polycyclic Aromatic Hydrocarbons (PAHs)				
PAH (sum 10)[2]	-	-	-	-
Naphthalene	40	-	800	50
Antracene	40	-	-	-
Phenanthrene	40	-	-	-
Fluoranthene	50	-	-	-
Benzo(a)anthracene	5.0	-	-	-
Chrysene	50	-	-	-
Benzo(a)pyrene	0.5	-	-	-
Benzo(ghi)perylene	30	-	-	-
Benzo(k)fluoranthene	5.0	-	-	-
Indeno(1,2,3cd)pyrene	5.0	-	-	-
V Chlorinated hydrocarbons: volatile chlorinated hydrocarbons				
Vinyl chloride	0.6	3.6	40,000	30,000
Dichloromethane	60	3,000	300,000	5,000
1,1-dichloroethane	80	370	600,000	200,000
1,2-dichloroethane	14	48	100,000	20,000
1,1-dichloroethene	3	14	-	-
1,2-dichloroethene(cis)	6.0	30	-	-
1,2-dichloroethene(trans)	17	60	-	-
Dichloropropane (1,2)	70	12	10,000	1,000
Dichloropropane (1,3)	50	12	10,000	1,000
Trichloromethane (chloroform)	30	100	700,000	300,000
1,1,1-trichloroethane	80	380	900,000	90,000
1,1,2-trichloroethane	4	17	-	-
Trichloroethene (tri)	50	200	50,000	1,000
Tetrachloromethane (tetra)	4.0	60	1,000,000	300,000
Tetrachloroethene (per)	16	250	100,000	10,000
VI Chlorinated hydrocarbons: chlorobenzenes				
Chlorobenzenes (sum)[2]	-	-	7,000	400
Monochlorobenzene	200	500	-	-
1,2 dichlorobenzene	430	600	-	-
1,4 dichlorobenzene	100	670	-	-
Trichlorobenzenes (indiv)	8.0	50	-	-
Tetrachlorobenzenes (sum)[2]	0.5	600	-	-
Pentachlorobenzene	0.5	600	-	-
Hexachlorobenzene	0.16	0.75	-	-
VII Chlorinated hydrocarbons: chlorophenols				
Chlorophenols (sum)[2]	-	-	400	20
Monochlorophenols (sum)[2]	3	-	-	-
Dichlorophenols (sum)[2]	3	-	-	-
Trichlorophenols (sum)[2]	3	-	-	-
Tetrachlorophenols (sum)[2]	3	-	-	-
Pentachlorophenol	3	-	-	-

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Substance	MPR_{human} (µg/kg/d)	MATC (µg/m^3)	Odour threshold[1] (µg/m^3) median	lowest
VIII Other chlorinated hydrocarbons				
Chloronaphthalene (sum)[2]	80	1	-	-
Monochloroanilines (sum)[2]	0.9	4	-	-
PCBs (sum) [2]	0.01	0.5	-	-
Trichlorobiphenyl (2,5,2')	0.09	-	-	-
Hexachlorobiphenyl (2.2',4.4',5.5')	0.09	-	-	-
EOX	-	-	-	-
Dioxins (sum I-TEQ)[2]	0.000002			
IX Pesticides				
DDT/DDE/DDD (sum) [2]	0.5	-	-	-
DDT (sum)[2]	20	-	-	-
DDE (sum)[2]	20	-	-	-
Aldrin,dieldrin,endrin (sum)[2]	0.1	-	-	-
Aldrin	0.1	0.35	-	-
Dieldrin	0.1	0.35	-	-
Endrin	0.2	0.7	-	-
HCH(sum) [2]	1	0.25	-	-
a-HCH	1.0	0.25	-	-
b-HCH	0.02	0.25	-	-
c-HCH	0.04	0.14	-	-
d-HCH	-	-	-	-
Atrazine	5.0	-	-	-
Carbaryl	3.0	10	-	-
Carbofuran	2.0	-	-	-
Chlordane (sum)[2]	0.5	0.02	-	-
Endosulfan	6	-	-	-
Heptachlor	0.3	0.5	-	-
Heptachloroepoxide (sum)[2]	0.4	0.5	-	-
Maneb	50	18	-	-
MCPA	1.5	7	-	-
Organotin compounds (sum)[2]	0.4	-	-	-
Tributyltin	0.4	0.02	-	-
Triphenyltin	0.4	-	-	-
X Other organic compounds				
Cyclohexanone	4,600	136	10,000	500
Butyl benzyl phthalate	500	-	-	-
Di(2-ethylhexyl)phthalate	25	-	-	-
Phthalates (sum) [2]	4.0	-	-	-
Mineral oil [3]	-	-	-	-
Pyridine	1	120	900	9
Tetrahydrofuran	10	35	20,000	300
Tetrahydrothiophene	180	650	3	3
Tribromomethane	20	100	-	-

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[1] This table provides an overview of odour thresholds for volatile substances/groups of substances that are often found in cases of soil contamination. The odour thresholds were taken from the following sources:
Ruth, J.H. Odor thresholds and irritation levels of several chemical substances; a review. Am. Ind. Hyg. Assoc. J., 47, A 142-151, 1986. HSDB (Hazardous Substance Data Base), National Library of medicine, Bethesda, Maryland, USA, 2001.
AIHA (American Industrial Hygiene Association). Odor thresholds for chemicals with established occupational health standards. Akron, OH: AIHA, 1989.
Devos, M., F. Patte, J. Rouault, P. Laffort and L.J. van Gemert. Standardized human olfactory thresholds. New York: Oxford University Press, 1990.
Because values stated in references for odour thresholds sometimes differ considerably, the overview shows both the lowest and median values reported. The median value has to be used for checking the indoor air concentration against the odour threshold.

[2] See annex N of the Soil Quality Regulations (Ministry of Housing, Spatial Planning and the Environment 2007) for the composition of the aggregate parameters

[3] 'Mineral oil' is defined in the analysis standard. Where the contamination is composed of mixtures (e.g. petrol or domestic heating oil), the concentration of aromatic and/or polycyclic aromatic hydrocarbons must be determined in addition to the alkane concentration. This aggregate parameter has been adopted for practical reasons. Further toxicological and chemical disaggregation is under study.

\- No MPR, MATC, or odour threshold available

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Annex 3: Environmental Protection Soil Remediation Criterion, Asbestos Protocol

Contents

1. Introduction

1.1 Background

The background to drafting the Environmental Protection Soil Remediation Criterion, Asbestos Protocol, is the new soil policy defined in the Policy Letter on Soil (Second Chamber, 24 December 2003, 28 663 and 28 199, no. 13) and the new policy on asbestos in the soil, as defined in the Policy Letter on asbestos in water bottom sediment, soil and rubble/rubble granulate (Second Chamber, 3 March 2004, 28 663 and 28 199, no.15). The aforementioned policy letters state that a new 'environmental protection remediation criterion' for soil, including for asbestos, will be developed. The environmental protection remediation criterion for soil is a scientifically underpinned system for determining the risks associated with soil contamination for a given use of the soil on a location- and area-specific basis. The protocol adds asbestos requirements to the environmental protection remediation criterion for soil. The asbestos protocol appeared in 2004 as a separate publication but has now been included as an annex to the Soil Contamination Circular 2009.

1.2 Objective

Soil management and risks are matched to each other in the new soil policy. The Environmental Protection Soil Remediation Criterion, Asbestos Protocol, hereinafter referred to as the "asbestos protocol" can be used as a basis for determining whether unacceptable risks exist as a result of a case of soil contamination with asbestos. Pursuant to the Policy Letter on Soil, the system described in this protocol leads to a statement 'no unacceptable risks', or 'unacceptable risks' (as explained in detail in section 2.3).

2. Delineation

2.1 Starting points and preconditions

The following starting points apply to the application of the “asbestos protocol”:

- The protocol only concerns water bottom sediment, soil and dredging sludge.
- The protocol only applies in cases of soil contamination with asbestos, when asbestos is present at a concentration exceeding the intervention value of 100 mg/kg d.s. weighted (concentration of serpentine + 10 x concentration of amphibole). It is pointed out that a case of ‘contamination’ is only deemed to exist in the case of asbestos in a water bottom, soil and dredging sludge if the intervention value has been exceeded.
- The protocol only applies to historical cases of asbestos contamination (which were caused before 1993) in water bottom sediment, soil and dredging sludge that do not have to undergo remediation on the basis of the duty of care.
- The protocol is concerned with the present and future situation.

2.2 Restriction to human risks

The chemical and physical properties of asbestos mean that hazardous exposure only results from inhaling asbestos fibres. The contamination does not spread through groundwater because asbestos fibres do not dissolve in groundwater. Impacts on the soil ecosystem are not expected to be relevant. Therefore, in cases of soil contamination with asbestos, there is no risk of the contamination spreading or of ecological risks but there is a risk to humans.

2.3 Relationship to new soil policy

A distinction is made between two categories of risks.

No unacceptable risks

If there are no unacceptable risks, a register of limitations in respect of the soil contamination will suffice for the present or future arrangements at the site. The location, level and extent of the soil contamination must also be accurately registered in the municipal register of limitations. The competent authority may also prescribe control measures to prevent exposure to the contamination. The location-specific risks must be reassessed if arrangements change at the location.

Unacceptable risks

Besides a register of limitations, in cases involving unacceptable risks urgent remediation measures must be taken at the part of the location where there are unacceptable risks as a result of soil contamination. The competent authority must make a ‘severity and urgency’ decision within the stipulated period. Remediation must commence within four years of the decision being issued. The competent authority will determine the exact remediation commencement date on the basis of the location-specific situation.

3. Risk assessment scheme

3.1 Basic information and coordination

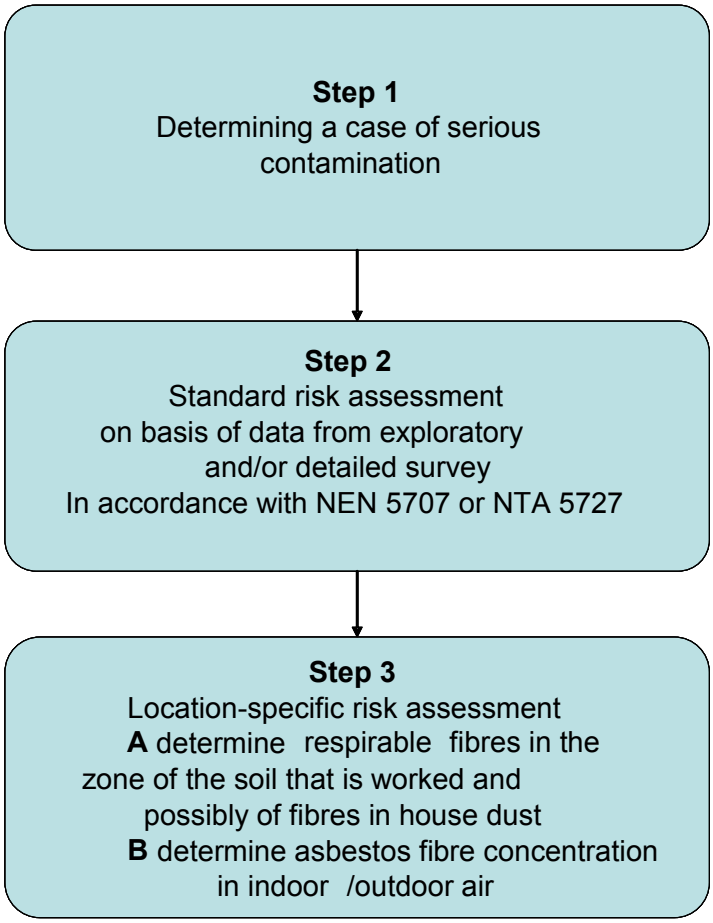
The “asbestos protocol” is based on the system developed by RIVM and TNO for the risk assessment of soil contamination with asbestos (RIVM report 711701034/2003 “Beoordeling van de risico’s van bodemverontreiniging met asbest”). Coordination has also taken place with the soil policy and standardisation working group BONS, and the working group concerned with Asbestos in water bottom sediment, soil and rubble/rubble granulate. The protocol was also drafted taking into account the TCB's recommendations on the new asbestos policy (reference: TCB S56 (2003)).

3.2 Individual steps

The protocol comprises the three steps shown in flow chart 1. The risk assessment for the other substances is likewise composed of three steps but progress to the next step is based on different criteria.

Step 1 covers the determination of whether there is a case of serious contamination at the location. This can be determined on the basis of the results of an exploratory or more detailed survey (see explanatory text box on NEN 5707 and NTA 5727).
Step 2 covers the standard risk assessment. This step can be executed on the basis of the results of an exploratory or more detailed survey (see explanatory text box on NEN 5707 and NTA 5727).
Step 3 covers the location-specific risk assessment. This primarily involves making additional measurements of the weighted concentration of respirable fibres in the soil zone that is worked and possibly of the concentration of fibres in house dust. This sub-step was developed to avoid having to make unnecessary expensive measurements of the concentration of asbestos fibres in indoor/outdoor air. Secondarily, if necessary, it involves measuring the concentration of asbestos fibre in indoor and/or outdoor air.
The next chapter discusses the protocol's individual steps in detail.

Flow chart 1: "Asbestos Protocol" steps



The protocol's system is organised so that progress through the subsequent steps can be discontinued once a conclusion has been reached on which of the two risk categories apply to the site. Depending on the category, either registration is required, possibly supplemented with control measures, or remediation measures must be carried out urgently. The competent authority determines which management and/or remediation measures must be taken. Examples of control measures include a periodic inspection of the current situation at the location, such as an inspection of the thickness of the contamination topsoil, the presence of buildings, paving, vegetation and limitations on the location's use.

Dutch standard NEN 5707 (Bodem – Inspectie, monsterneming en analyses van asbest in bodem en partijen grond (Soil - Investigation, sampling and analysis of asbestos in soil), May 2003) describes a method for the determination of the asbestos concentration in water bottom sediment and in batches of soil. The standard describes three survey phases: preliminary study, exploratory survey and detailed survey. The preliminary study is intended as an aid in drafting a survey hypothesis on the nature and spatial distribution of asbestos in the soil, based on collected (historical) information on the location. The exploratory survey is intended to verify the hypothesis drafted in the preliminary study. The detailed survey is intended to determine the average concentration of asbestos per spatial unit (SU = 1,000 m^2) and, secondly, to provide a detailed determination of the extent of contamination. The method prescribed for asbestos analyses is also described in NEN 5707.

The asbestos concentration in the water bottom and dredging sludge is determined in accordance with the protocol Nederlandse Technische Afspraak (NTA) 5727 – Monsterneming van asbest in waterbodem en baggerspecie (Soil - Sampling and analysis of asbestos in sediment and dredged sludge). The protocol can be obtained from the Netherlands Standardisation Institute NEN.

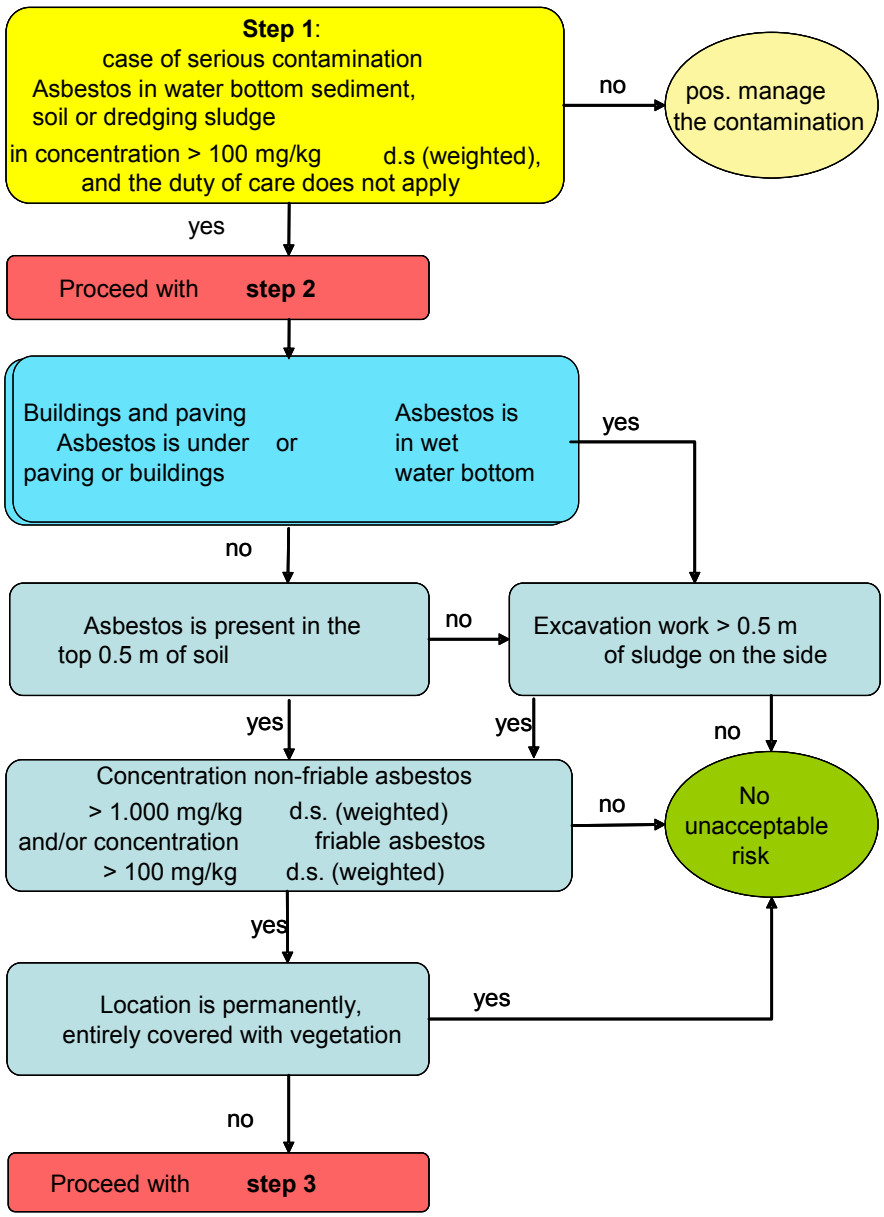
4. Further details of individual steps

4.1 Step 1 Determining a case of serious contamination

In the first step, the exploratory survey and/or the detailed survey are used as the basis for determining whether there is a case of serious contamination. A case of serious contamination with asbestos in the soil is deemed to exist if the average concentration in a spatial unit is higher than the intervention value of 100 mg/kg d.s. (weighted). The average weighted asbestos concentration must be determined in accordance with NEN 5707 or NTA 5727. It is pointed out that the volume criterion for a case of soil contamination with asbestos is not applicable for determining the seriousness of the contamination.

4.2 Step 2 Standard risk assessment

Flow chart 2: Steps 1 and 2



A brief explanation is provided below of a few parts of the standard risk assessment.

This protocol recognises the permanently wet water bottom as the type in use. This refers to the water bottom that is permanently underwater. This does not therefore include periodically dry water bottoms, such as floodplains.

Unacceptable risks will not be deemed to exist if the soil contamination is deeper than 0.5 m below ground level and no excavation work down to the asbestos-containing layer (deeper than 0.5 m) is carried out at the location. Unacceptable risks will not be deemed to exist if asbestos is present in the permanently wet water bottom and it is not placed on the sides along with the dredging sludge.

The asbestos concentration in water bottom sediment, soil or dredging sludge is known from the results of the exploratory survey and/or detailed survey. The analyses must be conducted in accordance with Dutch standard NEN 5707. The aforementioned standard stipulates that besides distinguishing between amphibole asbestos and serpentine asbestos, the report on the conducted analyses must also make a distinction between non-friable and friable asbestos. This distinction is made by comparing the material found with reference material that has a known friability. It is known from measurements in the field that no asbestos in excess of the quantification level is found in the air in cases of soil contamination with only non-friable asbestos in concentrations of less than 1,000 mg/kg d.s. (weighted). It is therefore not necessary to make further measurements, if the concentration of non-friable asbestos is less than 1,000 mg/kg d.s. (weighted).

If a location is permanently and completely covered with vegetation, it is not worked or entered and no substances can be blown around.

4.3 Step 3 Location-specific risk assessment

Step 3 comprises two sub-steps:

- step 3A: determine concentration of respirable fibres in the soil and in house dust (see
- flow chart 3);
- step 3B: determine the concentration of asbestos fibres in indoor and outdoor air. (see flow chart 4).

The concentration of respirable fibres in the soil zone that is worked is measured in step 3A. Respirable fibres are fibres that can be inhaled and reach the lungs. These are fibres with a diameter of less than 3 µm and a length of less than 200 µm. In the second instance, further measurements may be made of the concentration of fibres that are present as a result of secondary contamination in house dust. Secondary contamination occurs because asbestos from soil contamination adheres to clothing or footwear and is carried indoors. Once indoors the asbestos falls from the clothing or footwear and remains there. Step 3A is carried out to enable the expected emission of respirable asbestos fibres from the soil into outdoor air or from indoor dust into the outdoor air to be estimated. This estimate is independent of the actual situation in the location's use and the environmental factors. Indoor and outdoor air measurements are only made in step 3B if there are sufficient reasons for doing so.

Determining the concentration of respirable fibres in the zone of the soil that is worked

If a location being assessed reaches step 3A, the concentration of respirable fibres in the zone of the soil that is worked is always determined. The thickness of the zone depends on the soil use and must be explained. Working the soil also includes entering and driving on the location. A minimum depth of 2 metres is adopted for the zone that is worked.

The method for determining the respirable fibres in the zone worked is described in NEN 5707. Section 1 of chapter 10 describes how the soil sample is made up and dried. Section 4 of chapter 10 describes the method for determining the respirable fraction. By way of departure from NEN 5707, the total dried sample must be passed through a sieve with a screen mesh size of 4 mm and a sub-sample made up of 20 portions. The reason for this is that the screening process is intended to free as many fibres as possible, to ensure that a realistic ‘worst case’ scenario can be determined for the respirable fraction

The text box below explains the adopted risk limit for respirable fibres.

The risk limit of 10 mg/kg d.s. (weighted) for respirable asbestos fibres in the soil appears to contradict the intervention value of 100 mg/kg d.s. (weighted). In theory, there is a possibility of a case of contamination with respirable asbestos fibres in excess of 10 mg/kg d.s. but with a total asbestos concentration that is nevertheless below the intervention value. However, research conducted by the Netherlands Organisation for Applied Scientific Research (TNO) over the past ten years showed that even the respirable fibre percentage of the ‘loosest’ most friable asbestos (practically unbonded asbestos) will never exceed 5-10% (see RIVM report 711701034/2003). This means that for an asbestos concentration in the soil of 100 mg/kg d.s. the respirable fibre concentration will never exceed 5 – 10 mg/kg d.s.

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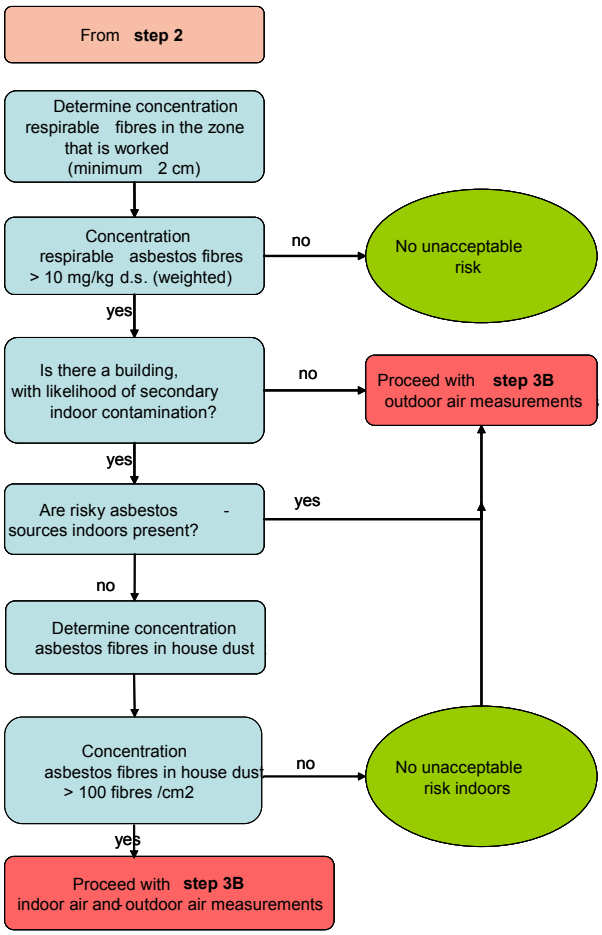
Flow chart 3: components of step 3A



Determine concentration of asbestos fibres in house dust

If the possibility of secondary contamination in a building cannot be excluded, the concentration of asbestos fibres in indoor house dust must be determined within the scope of this protocol in accordance with Dutch standard NEN 2991: 2005 “Lucht - risicobeoordeling in en rondom gebouwen of constructies waarin asbesthoudende materialen zijn verwerkt/Air - Risk assessment in and around buildings or building constructions which contain asbestos materials” (see explanation in text box on next page).

All asbestos-containing structures are taken into account rather than just respirable fibres. This is because it is assumed that the high level of indoor activity will split respirable fibre structures in due course. The concentration of ‘sedimented’ asbestos fibres (in fibres/cm^2) is determined on the basis of NEN 2991.

This determination should not be made within the scope of the “asbestos protocol” if unprotected, friable asbestos-containing materials are present and a risk of fibre emission consequently exists. In that case, it is not possible to determine whether fibres are from soil contamination or asbestos-containing materials indoors.

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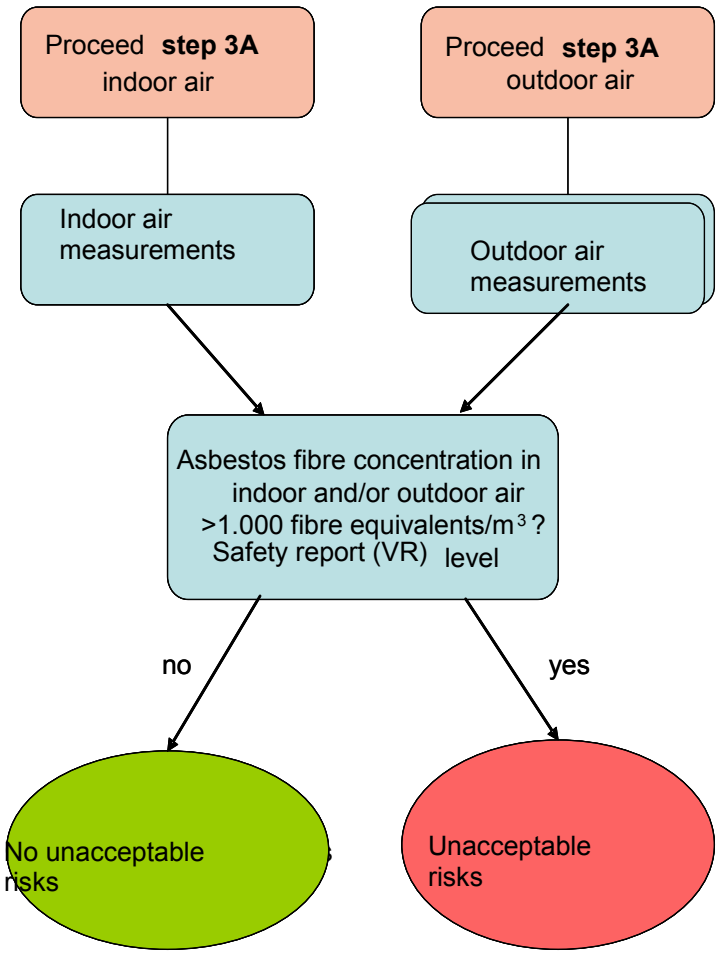
NEN 2991: 2005:
Lucht - Risicobeoordeling in en rondom gebouwen of constructies waarin asbesthoudende materialen zijn verwerkt/Air - Risk assessment in and around buildings or building constructions which contain asbestos materials.
The standard describes how to assess on the basis of a visual inspection whether sources of asbestos that pose a risk are present. The inspection must be supplemented in certain cases by measurements of the asbestos concentration in indoor air. The measurement method used is described in the standard.

Determining concentration of asbestos fibre in indoor and outdoor air
Step 3B describes how the concentration of asbestos fibres (in fibre equivalents/m^3) in indoor and outdoor air must be determined. Flow chart 4 provides an overview of this step.

Flow chart 4: components of step 3B



The system developed by RIVM and TNO for the risk assessment of soil contamination with asbestos (RIVM report 711701034/2003 “Beoordeling van de risico’s van bodemverontreiniging met asbest”) includes a description of a method for determining the concentration of asbestos fibres in outdoor air.

The concentration of asbestos fibres in indoor air is determined in accordance with Dutch standard NEN 2991: 2005 “Lucht - risicobeoordeling in en rondom gebouwen of constructies waarin asbesthoudende materialen zijn verwerkt/Air - Risk assessment in and around buildings or building constructions which contain asbestos materials”.

5. Conclusions and consequences

On the basis of the Environmental Protection Soil Remediation Criterion, Asbestos Protocol, which only applies in cases of soil contamination with asbestos in water bottom sediment, soil and dredging sludge when asbestos is present in a concentration exceeding the intervention value of 100 mg/kg d.s. (weighted), the location-specific risks are divided into two categories: 'no unacceptable risks' and 'unacceptable risks'.

The location comes in the ‘no unacceptable risks’ category if, given the location's present use, there is no likelihood of fibre emission because it is impossible to come into contact with asbestos-containing soil contamination or, if, given the soil's present use, the possibility of contact with asbestos-containing soil contamination cannot be excluded but data obtained from experience supplemented with measurements made in the field have shown that airborne asbestos concentrations exceeding the Negligible Risk Level never occur in such situations. This means that a register of limitations has to be compiled. The competent authority may prescribe control measures in addition to registration. The content of the control measures is determined by the competent authority. The location-specific risks must be reassessed if the arrangements at the location or its use change.

The location is given the ‘unacceptable risks’ category if measurements in indoor or outdoor air show that the Negligible Risk Level is being exceeded. Urgent remediation measures must be taken at the part of the location where there are unacceptable risks as a result of soil contamination with asbestos. Within the scope of this, ‘urgent’ means that remediation should start within 4 years of the date on which the ‘severity and urgency’ decision was issued.

The competent authority provides details in a ‘severity and urgency’ decision of what the consequences of risk assessment in accordance with this "asbestos protocol" are. Section 5.2 of Soil Remediation Circular 2009, includes points for attention regarding the content of any such decision.

Annex 4 Remediation objective: interpretation of topsoil quality requirements

1. General

A distinction is usually made between two types of contamination situations in the approach to remediation. This concerns contamination situations present in the topsoil as well as mobile contamination situations in which the contaminants concerned may be present in both the topsoil and subsoil. The nature of the contaminants in combination with the soil structure and composition determines whether a mobile or immobile contamination situation is deemed to exist. The rules and provisions of the Location-specific Conditions Regulations have been included in this circular without amendment. In the literal sense, the content of the Regulations in section 2 of this annex has been slightly altered.

2 Interpretation of topsoil quality requirements

2.1 Determining the function of the soil

The quality requirement for the topsoil depends on the function of the soil. Seven soil functions are recognised (of which three have sub-functions) for which generic protection levels for sustainable suitability have been worked out.
The 7 functions of the soil are:

a. residential with garden;
b. Places where children play
   i with an average ecological value;
   ii with low ecological value;
c. Vegetable gardens and allotments
   i involving considerable crop consumption (large vegetable gardens)
   ii involving average crop consumption (smaller vegetable gardens)
d. Agriculture;
e. Nature conservation;
f. Green areas with ecological values;
g. Other green area, development, infrastructure and industry
   i not entirely paved or almost entirely paved
   ii entirely or almost entirely paved

Risk scenarios have been worked out for each of the 7 soil functions (including subfunctions) on the basis of:

- amount of human contact with the soil: considerable or little contact;
- amount of crop consumption: none, limited, average, considerable;
- protection of agricultural production: exists or does not exist;
- protection of ecology generic: little, average, high;
- protection of ecology taking into account biomagnification: little, average, high.

The 7 functions of the soil have ultimately been clustered into three soil function classes. A generic standard has been worked out for each soil function class for sustainable suitability on the basis of the most susceptible scenario in the soil function class. The classification of soil functions into soil function classes is shown in table 1. The name of the generic standard for sustainable suitability is also shown. The most susceptible function was determining for establishing the level of the standard.

Table 1 Classification into soil function classes and name of soil standard

Soil standard derived for sustainable suitability	Soil functions that form a single soil function class
Background Values	Agriculture Nature conservation Vegetable gardens/allotments
Maximum Housing Value	Residential with garden; Places where children play Green areas with ecological values
Maximum Industrial Value	Other green area, development, infrastructure and industry

The underpinning for these standards is described in the report: Ken uw (water)bodemkwaliteit, de risico's inzichtelijk/Know the quality of your soil or aquatic sediment, (SenterNovem 1 September 2007, 3BODM0704).
The Soil Quality Regulations indicate the values for the various standards per substance.

2.2 Possible remediation measures

Remediation of soil contamination situations can be carried out using the following measures:
a. excavating the contaminated soil;
b. removing the contaminants from the soil or groundwater;
c. using techniques that result in decomposition/transformation or chemical conversion into non-hazardous end products;
d. isolating the contamination situation by laying topsoil or another durable covering layer.

Laying topsoil suffices in many cases. Laying topsoil is the standard approach for the soil functions 'residential with garden', 'places where children play', 'green areas with ecological values', and 'other green area'.
The contamination situation is automatically isolated where there is paving or development, as is usually the case for the soil functions 'development, infrastructure and industry'. In such cases the isolation is formed by the covering layer of concrete, asphalt, steel-reinforced concrete paving slabs or large areas of contiguous paving with clinkers and flagstones. Exposure risks can be sufficiently reduced if constructions of this kind are durable and contiguous.
No standard approach has been worked out for the soil functions 'nature conservation', 'agriculture' and 'vegetable gardens and allotments'. If remediation is required, the necessary remediation measures will be determined per case.

2.3 Topsoil thickness requirements

If the remediation measure involves laying topsoil, the following requirements apply to the topsoil:
a. the topsoil has a standard thickness of one metre;
b. depending on the depth of roots, a greater depth varying from 1 to 1.5 metres may be required in gardens;
c. depending on the depth of roots, the thickness may vary from 0.5-1.5 metres for other plant-covered sites;
d. at the competent authority's discretion, a topsoil thickness other than the standard thickness is possible under certain conditions, such as a high groundwater level;

An indicator layer is generally laid below the topsoil and is intended to provide a warning of contamination below the indicator layer.

2.4 Post-remediation objective and quality requirements for topsoil and backfill soil

Within the scope of the Soil Quality Decree, local authorities must opt for a generic or area-specific policy. The competent authority pursuant to the Soil Protection Act adopts the Background Values and Maximum Values used in the generic policy for the class of housing and industry as post-remediation values and as a quality requirement for topsoil and backfill soil. If the local authority has opted for an area-specific policy, it is recommended that the competent authority should adopt the established Local Maximum Values as the post-remediation values and quality requirements to be adopted for backfill soil and topsoil. The competent authority

pursuant to the Soil Protection Act has the option of departing from this and using area-specific post-remediation values.

If there are reasons for remediation and the soil quality in the contact zone does not meet the value for the soil function class, the party carrying out remediation may restore the soil quality by excavating soil until the remaining soil meets the required soil quality value. The starting point is that the applicable post-remediation values in the case of a generic policy are the Background Values and Maximum Values for housing and industry and, in the case of an area-specific policy, the Local Maximum Values. The party carrying out the remediation may also lay topsoil that meets the applicable quality requirement.
The intended use will not be impeded by the contamination at the location, provided the applicable quality requirement is met. Therefore, enquiries at the local authorities will always be required to determine the soil function class of the area that requires remediation or whether local Maximum Values exist for the area concerned.

ANNEX 5

Overview of Soil Protection Act regulations on soil remediation as of 1 April 2009

Legislation

Legislation of 15 September 2005 to amend the Soil Protection Act (transfer of tasks of Service Centrum Grond (Centre for Soil)), Bulletin of Acts and Decrees 2005, 482

Legislation of 15 December 2005 concerning amendments to the Wet bodembescherming/Soil Protection Act and a few other Acts in connection with changes in the policy on soil remediation, Bulletin of Acts and Decrees 2005, 680 and as amended Bulletin of Acts and Decrees 2007, 115, Bulletin of Acts and Decrees 2007, 152 and Bulletin of Acts and Decrees 2007, 349

Wet inrichting landelijk gebied (investeringsbudget)/Rural Areas (Investment Budget) Act, Bulletin of Acts and Decrees 2006, 666

Decrees and ministerial regulations

Besluit overige niet-meldingplichtige gevallen bodemsanering/Other non-notifiable soil remediation cases, decree of 29 November 1994, most recently amended on 23 July 2000, Bulletin of Acts and Decrees 2000, 331

Besluit verplicht bodemonderzoek bedrijfsterreinen/Industrial Sites Compulsory Soil Survey Decree, decree of 25 September 1993, Bulletin of Acts and Decrees 1993, 602, most recently amended on 7 June 2005, Bulletin of Acts and Decrees 2005, 302

Besluit aanwijzing bevoegdgezaggemeenten Wet bodembescherming/Soil Protection Act Appointment of Competent Authority Municipalities Decree, decree of 12 December 2000, most recently amended on 8 September 2004, Bulletin of Acts and Decrees 2004, 477

Besluit financiële bepalingen bodemsanering/Soil Remediation Financial Provisions Decree (incl. subsidy scheme for industrial sites), Bulletin of Acts and Decrees 2005, 681, most recently amended (draagkrachtregeling/ability to pay scheme) Bulletin of Acts and Decrees 2006, 637
Regeling financiële bepalingen bodemsanering/Soil Remediation Financial Provisions Regulations, 2005, Government Gazette 2005, 250 most recently amended Government Gazette 2007, 91

Besluit uniforme saneringen (BUS)/Uniform Remediation Decree, Bulletin of Acts and Decrees 2006, 54
Regeling uniforme saneringen/Uniform Remediation Decision, Government Gazette 2006, 29, most recently amended Government Gazette 2008, 167

Besluit bodemkwaliteit/Soil Quality Decree, Bulletin of Acts and Decrees 2007, 469
Regeling bodemkwaliteit/Soil Quality Provisions, Government Gazette 2007, 247, most recently amended Government Gazette, 2008, 249

Regeling beperkingenregistratie Wet bodembescherming/Soil Protection Act Register of Limitations Regulations, Government Gazette 2007, 120

Regeling beoordeling reinigbaarheid grond, 2006/Assessment of Soil Treatment Regulations, Government Gazette 2006, 145

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Regeling inrichting landelijk gebied (investeringsbudget)/Rural Areas (Investment Budget) Regulations, Government Gazette 2006, 249 (rectification Government Gazette 2007, 8)

Mandate/delegation decrees

Besluit mandaat, volmacht en machtiging SenterNovem Bodem+/Mandate, Power of Attorney and Authorisation of SenterNovem Bodem+ Decree, Government Gazette 2004, 243

Besluit mandaat en machtiging SenterNovem Bodem+ (Overgangsrecht)/Mandate and Authorisation of SenterNovem Bodem+ Decree (transitory law), Government Gazette 2005, 32

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