
This publication was withdrawn on 17 February 2022

We have replaced this guidance with [Review your hydrogeological risk assessment](#) which introduces the need for a 6-yearly review.

HYDROGEOLOGICAL RISK ASSESSMENT FOR LANDFILLS

FOUR YEARLY REVIEW TEMPLATE

Preamble

This template has been produced so as to aid the production of hydrogeological risk assessment (HRA) reviews that are carried out for landfills. It is a generic template and not everything contained within it may be necessary or relevant to the site being assessed. The person carrying out the assessment should therefore use professional judgement as to which parts are relevant and provide sufficient justification to whatever decision is made.

The template is also relevant for the assessment of the reviews. It is recommended that the assessment is carried out with reference to the original HRA and environmental setting and installation design (ESID) report as well as any subsequent ongoing submissions from the operator.

With regards to the original HRA that is being reviewed, it should have been carried out for the whole lifecycle of the landfill. The purpose of this review is to assess whether the original input parameters and assumptions remain valid.

As well as meeting a requirement of the Groundwater Regulations, this is an opportunity for the operator to review their permit requirements with respect to the site design as well as the management and monitoring of leachate, groundwater and surface water. Alterations may need to be accompanied by a permit variation.

It is recommended that the operator and local Environment Agency officers have a meeting to review this template and any site specific issues before the operator embarks on their four yearly review.

It is important that the input parameters used in the original assessments are reviewed using the information that has been gathered as part of the site's monitoring programme. If these inputs are still appropriate and the parameter distributions remain unchanged, it is considered that additional modelling is not required as it would only confirm the original outputs.

If site monitoring suggests that the input parameters have varied since the original HRA, then the extent and significance of the variance should be reviewed in order to determine whether the change in inputs could significantly alter the outcome of the original HRA i.e. whether these variations increase the predicted resultant concentrations to an unacceptable level. If there is considered to be no significant change, then additional quantitative modelling is not required but sufficient technical justification must be provided.

If it is determined that the variation in input parameters could have a significant impact on the outcome of the HRA, then the original models should be re-run with the input parameters appropriately amended. If Landsim has been used as the modelling tool, then the preference is for the most up to date version (currently 2.5) to be used. In addition, the most up to date version of LandSim must be used under the following circumstances;

- When the review is being carried out on landfills where the initial permit application was associated with, or later than, Tranche 3 (May 2004) of the PPC transitional process; and/or

- When the review being carried out is not the first 4 yearly review (i.e. the most up-to-date version of LandSim must be used for the second review after 8 years following permit issue, the third review after 12 years etc).

When carrying out the first 4 yearly reviews for sites where the initial permit application was earlier than Tranche 3, if the last HRA was carried out using an earlier version of LandSim, it is possible to re-run these earlier model versions. Where this is the case, sufficient justification should be given relating to the comparability of the modelling to the results expected if LandSim 2.5 was used. This justification should be based on site-specific circumstances and should include a consideration of the following:

- The spatial and temporal variability of leachate quality considering both non-volatile and volatile species;
- The duration of management control and the conceptualisation of leachate levels before and after the cessation of operational control;
- The simulation of the longevity of both the cap and the engineered containment system; and
- The removal of cation exchange capacity option from the LandSim 2.5 software.

If these specific factors have not been considered then the quantitative risk assessment must be re-run using LandSim 2.5 (or an equivalent model).

If models other than Landsim have been used, the operator will have to demonstrate that it is broadly equivalent to Landsim 2.5, particularly the long term degradation elements.

If it is proposed to change the existing assessment and compliance criteria for leachate, this must be supported by additional quantitative risk assessment modelling.

If it is proposed to change the existing assessment and compliance criteria for groundwater, this may be supported by additional quantitative risk assessment modelling or a site specific justification.

In carrying out HRA reviews for sites that have previously been considered in a simple manner, it is important to assess whether the level of risk posed by the site remains low. If this is not the case, then quantitative modelling, using the most up-to-date version of LandSim (or an equivalent modelling package) should be used.

The template overleaf has been primarily developed for sites that have been quantitatively assessed and so some sections may not be relevant to sites that have been assessed qualitatively. It is therefore the responsibility of the person carrying out the assessment to use professional judgement in order to decide which parts are relevant and to provide sufficient justification to whatever decision is made.

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TABLES

Tables should be used whenever possible and included within the text to which they relate, as they can summarise large volumes of information/data into a manageable format. The numbering and content of the tables presented within this review will alter according to site-specific circumstances and whether additional modelling is undertaken. However, typical examples of table that could be included are presented below

Table 1	The Date and Nature of Any Relevant Improvement Conditions
Table 2	Summary of Conceptual Hydrogeological Model
Table 3	Hydrogeological Risk Assessment Scenarios
Table 4	Relevant Priority Contaminants and EALs
Table 5	Model Parameterisation Table
Table 6	Proposed Leachate, Groundwater and Surface Water Monitoring Schedule
Table 7	Leachate Control and Trigger Levels
Table 8	Groundwater Control and Trigger Levels

APPENDICES

The numbering and content of the appendices presented within this review will alter according to site-specific circumstances and whether additional modelling is undertaken. However, typical examples of appendices that could be included are presented below

Appendix A	Leachate hydrographs
Appendix B	Leachate quality information
Appendix C	Surface water quality information (if applicable)
Appendix D	Groundwater hydrographs
Appendix E	Groundwater quality information

If additional modelling is undertaken

Appendix F	Electronic copies of all models relied upon within the review
Appendix G	Hardcopies of the models and inputs used within the assessment
Appendix H	Results of any sensitivity analysis carried out for the site (unless specified within the text)

DRAWINGS

The numbering and content of the drawings presented within this review will alter according to site-specific circumstances. However, an example of a drawing that could be included is presented below.

Drawing No.1	Conceptual Hydrogeological Site Model and Risk Assessment Scenarios
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Drawing to include:

Site plan, to include:

- Installation boundary
- Cell boundaries
- Monitoring locations, potential receptors, compliance points and pathways
- Groundwater contours

Hydrogeological Cross Section, to include:

- Site details e.g. formation levels, leachate levels, etc
- Geology
- Groundwater levels and flow directions
- The identification of all receptors and pathways

Risk Assessment Scenarios

- If no modelling required – original scenarios presented from Permit Application
- If modelling required – revised scenarios presented

1.0 INTRODUCTION

To include details relating to the following:

- The operator, the landfill being considered and the Environmental Permit reference
- The party (ies) who completed this report.
- The date of the last hydrogeological risk assessment completed for the site and whether this was completed as part of the Permit Application or a subsequent Schedule 4.
- The requirements of the site's Environmental Permit in relation to the HRA Review (timings).
- The date and nature of any relevant Improvement Conditions including whether it was implemented prior to the required date and the status of agreement with the EA.
- The objective of the report, which is to review whether the landfill remains in compliance with the requirements of the Groundwater Regulations, 1998.
- Relevant documents that provide useful cross references to the information provided in the review e.g. annual monitoring reviews.

2.0 REVIEW OF CONCEPTUAL HYDROGEOLOGICAL SITE MODEL

This section presents the conceptual hydrogeological site model that was previously developed for the HRA submitted with the site's original Permit Application and how it has changed (or not) since the completion of the last HRA. This information should be presented in tabular format wherever possible and should reiterate the conceptual model rather than developing it from first principles. This review should include details relating to;

Sources

- Summary details relating to the installation and the development of the landfill since the last HRA. Such details to include:
 1. Any relevant alterations/amendments to the operation (e.g. phasing, restoration, etc), construction (e.g. containment design) or management (e.g. leachate, local/regional groundwater, etc) of the site.
 2. A summary of the previously assumed leachate levels and whether these assumptions are still applicable (i.e. comparison with additional data obtained to date). If appropriate, include external groundwater levels also.
 3. A summary of previously assumed leachate quality (presence of List I and List II Substances) and whether these assumptions are still applicable (i.e. comparison with additional data obtained to date). Assessment of whether Groundwater Regulations, 1998, apply.
 4. An assessment of whether the priority contaminants modelled in the last HRA remain applicable for the HRA review in light of additional data obtained to date.

Pathways

- A summary of all previously assumed relevant pathways including their nature and characteristics (e.g. the purifying powers of soils and sub-soils) and whether these assumptions are still applicable in the light of information gathered since the last HRA. This should include geology, groundwater flow and groundwater quality with particular reference to upstream groundwater quality.

Receptors

- Review of private and licensed abstractions to confirm presence or otherwise of new abstractions.
- For List I and List II Substances, the previously assumed receptor/compliance points for both List I and List II Substances and whether they are still applicable
- An assessment of the appropriate Environmentally Acceptable Levels (EALs), which should consider whether the previously assumed EALs are still relevant or whether new EALs need to be determined (e.g. if background groundwater quality has deteriorated or if new priority contaminants need to be considered).

Summary of key changes (or lack of them) in the conceptual site model since the last HRA/HRA Review was submitted

3.0 HYDROGEOLOGICAL RISK ASSESSMENT

3.1 Numerical Modelling

3.1.1 *Justification for Modelling Approach and Software*

To include details (in tabular format wherever possible) relating to the following:

- Review of the previous risk assessment methodology (e.g. simple or complex) and whether this is still applicable.
- Review of the previously assumed risk assessment scenarios and whether they are still applicable. Such scenarios may relate to different stages of the landfill's lifecycle and how certain inputs (e.g. the potential for degradation of the leachate drainage system, etc) and external forces (e.g. groundwater levels) change with time.
- Review of previously selected model and software and whether it is still applicable for the considered scenarios and hydrogeological conditions.
- The justification for the confidence levels used within any existing stochastic modelling
- The model verification and the suitability of model used to identify and represent receptors and compliance criteria

3.1.2 *Model Parameterisation*

This section should principally contain a table that presents the following:

- All of the input parameters previously used for the last HRA.
- An assessment of whether the previously used parameter distributions are still applicable and, if applicable, the revised distribution (referring to summary tables in Section 2).
- If appropriate, an assessment of whether any change to the input parameters justifies further modelling. This should be done on a parameter by parameter basis (see preamble).

Following the completion of this section, it should be possible to determine whether additional modelling is required or whether the previous modelling is still applicable. In addition, it may be possible to determine whether there is any flexibility in site design as well as the leachate and groundwater trigger levels that are currently specified in the site's Environmental Permit. This may lead to additional modelling being carried out even though there has been no significant change in the site's source-pathway-receptor terms.

3.2 Emissions to Groundwater

The HRA review must establish whether the predicted discharge from the landfill remains in compliance with the requirements of the Groundwater Regulations, 1998 throughout the whole lifecycle of the site.

If Section 3.1 has determined that additional modelling was not required, and that the previous modelling is still applicable, then this section should re-iterate the results of the last HRA. If applicable, this should include appropriate commentary relating to whether subsequent information indicates that the predicted concentrations are too conservative.

If additional modelling has been necessary, then the revised predicted concentrations should be presented.

3.2.1 *List I Substances*

This section should include;

- The predicted concentrations of List I Substances at the point that they enter the groundwater.
- The determination of whether the concentrations are discernible

3.2.2 List II Substances

This section should include;

The assessment of whether the predicted concentrations of List II Substances exceed the relevant EALs at the appropriate compliance points.

3.3 Sensitivity Analysis

If additional modelling is carried out as part of this review, then an analysis of the sensitivity of the predicted concentrations to key inputs should be carried out and presented in this section.

If it has been established that the previous modelling is still applicable, then the sensitivity of the outputs should be suitably reviewed.

3.4 Review of Technical Precautions

This section should review the site's existing essential and technical precautions and determine whether they remain sufficient, so as to ensure compliance with the Groundwater Regulations, 1998, and whether they should be revised in the light of the previous or revised modelling. Such a consideration should include the following;

- Capping
- Lining design
- Leachate drainage systems
- Leachate head control
- Groundwater management
- Leak detection systems

4.0 REQUISITE SURVEILLANCE

Requisite surveillance is a requirement of the Groundwater Regulations, 1998 and this takes the form of leachate and groundwater monitoring. It may also be appropriate to include surface water monitoring.

The HRA Review should be used to re-assess the applicability of the existing monitoring programme and to revise, where appropriate, the assessment and compliance criteria (e.g. control and trigger levels for groundwater quality) that are currently specified in the site's Environmental Permit.

4.1 Leachate, Groundwater and Surface Water Monitoring Schedule

To include details for each medium, presented in tabular format, relating to the following;

- The monitoring objectives and a review of whether they are being met
- Overview of the number and location of monitoring points and whether the points appropriate and serviceable (include a new location plan if appropriate)
- Monitoring measurements
- Monitoring schedules and whether the schedule is consistent with that stated. It may be useful to consider the potential travel times of, say, chloride, from the the landfill to the proposed compliance points when considering the frequency of monitoring.
- Appropriate assessment (control) and compliance (trigger) criteria for leachate levels and groundwater quality. It may be also appropriate to include criteria for surface water and groundwater level control.
- A review of whether the assessments and assessment schedule are reported at appropriate intervals (e.g quarterly/annual reporting). It may also be appropriate to show trends that may suggest future non-compliance..
- A review of whether the existing compliance criteria have been exceeded, the compliance reports sent to the Environment Agency, the action plan agreed and whether the problem has been resolved?

Justification should be provided if the proposed assessment (control) and compliance (trigger) criteria is different from that currently included in the site's Environmental Permit.

5.0 CONCLUSIONS

This section needs to include specific conclusions relating to the compliance of the landfill with the requirements of the Groundwater Regulations and the Landfill Directive. These should relate to:

- The applicability of the Groundwater Regulations, 1998
- The prevention of List I Substances from entering the groundwater
- The limitation of the introduction of List II Substances into groundwater so as to avoid pollution
- Essential and technical precautions
- Requisite Surveillance including the derivation of control and trigger levels for groundwater quality

The conclusions should include proposals relating to the amendment of any existing assessment (control) and compliance (trigger) criteria.