

Environment, Health and Safety Committee
Note on:
Environmental Risk Assessment

Introduction

This paper summarises some of the basic principles and uses of environmental risk assessment. The information is based mainly on two sources, the Guidelines for Environmental Risk Assessment and Management published by the Department for Environment, Food and Rural Affairs (Defra) and Environmental Risk Assessment – Approaches, Experiences and Information Sources published by the European Environment Agency. Given the wide-ranging nature of environmental risk assessment a large amount of other, more detailed, information and guidance is available for specific situations. Examples of such guidance (non-exhaustive) are given in the reading list, and the reader is directed to these for further information.

What is environmental risk assessment?

In order to understand what is meant by environmental risk assessment it is important to be familiar with the concepts of **hazard** and **risk**. These terms have different meanings and are not interchangeable. The following definitions are used here.

Hazard: is the inherent potential for something to cause harm. Hazards can include substances, machines, energy forms, or the way work is carried out.

Risk: is the likelihood that harm will actually be done by the realisation of the hazard during the work being carried out or by the way something is used. **Risk = Hazard × Exposure**.

In general, the term *environmental* covers the physical surroundings that are common to everybody including air, water, land, plants and wildlife. The definition used in the Environmental Protection Act 1990 is that the environment '... consists of all, or any, of the following media, namely the air, water and land'.

Thus environmental risk assessment covers the risk to all ecosystems, including humans, exposed via, or impacted via, these media. The term environmental risk assessment does not normally cover the risks to individuals or the general public at large from consumer products or from exposure in the work place, where other specific legislation applies.

Stages in carrying out an environmental risk assessment

Environmental risk assessment can be thought of as containing the following key stages¹.

1. **Hazard identification**. This would typically include identification of the property or situation that could lead to harm. This step is sometimes also known as **problem formulation**.

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2. Identification of **consequences** if the **hazard** was to occur. This step is sometimes also known as **hazard identification**.
3. Estimation of the magnitude of the **consequences**. This can include consideration of the spatial and temporal scale of the **consequences** and the time to onset of the **consequences**. When considering chemicals, this step can sometimes be termed **release assessment**.
4. Estimation of the probability of the **consequences**. There are three components to this, the presence of the **hazard**, the probability of the receptors being exposed to the **hazard** and the probability of harm resulting from exposure to the **hazard**. This step can sometimes be called **exposure assessment** or **consequence assessment**.
5. Evaluating the significance of a risk (often termed **risk characterisation** or **risk estimation**) is the product of the likelihood of the hazard being realised and the severity of the consequences.

A concept frequently used in environmental risk assessment is that of the **source – pathway – receptor**. In this model the **pathway** between a hazard **source** (for example a source of contamination) and a **receptor** (for example a particular ecosystem) is investigated. The **pathway** is the linkage by which the **receptor** could come into contact with the **source** (a number of pathways often need to be considered). If no **pathway** exists then no risk exists. If a pathway exists linking the source to the receptor then the **consequences** of this is determined. This approach is used in the assessment of contaminated land, but can be, and is, applied to many other areas. An EHSC note is available on the assessment of contaminated land (see bibliography).

Example Sources	Example Pathways	Example Receptors
<ul style="list-style-type: none"> • Contaminated soils • Contaminated water • Leaking drums • Industrial process releases 	<ul style="list-style-type: none"> • Air • Water • Soil • Food chain 	<ul style="list-style-type: none"> • People • Domestic and commercial property • Infrastructure • Ecosystems • Animals • Plants • Controlled waters

At the end of the risk assessment process, existing controls should be recorded and further measures may need to be considered to reduce or eliminate the risks identified. Detailed consideration of risk management is beyond the scope of this paper but, in general terms, risk management can be achieved by reducing or modifying the **source**, by managing or breaking the **pathway** and/or modifying the **receptor**.

The final stage is the evaluation of the significance of the risk which involves placing it in a context for example with respect environmental standard or other criterion defined in legislation, statutory or good practice guidance.

The amount of effort and detail required in assessing each risk can vary widely, but is generally proportionate to its priority and complexity. Thus environmental risk assessments can be carried out on several levels. An example of a relatively common, simplistic, approach based on a risk ranking matrix is shown below. The meanings of high, medium, low and very low can be determined in various ways, for example using a descriptive or numerical scale, or often based on expert judgement. Once risks have been identified, the matrix allows the relative importance to be easily determined, and the risk can then be prioritised and an appropriate risk management strategy or plan can be implemented. Other relatively simple approaches include the use of assessment sheets whereby the materials and activities are listed, and any potential impacts for the environment are described.

¹ Note: There is a wide range of different terminologies used in this area. However, most of the different terminologies can normally be related to one of these steps.

Probability of receptors being exposed ↑	High	Medium risk	Medium risk	High risk	High Risk
	Medium	Low risk	Medium risk	Medium risk	High Risk
	Low	Low risk	Low risk	Medium risk	Medium risk
	Very low	Very low risk	Low risk	Low risk	Medium risk
		Very low	Low risk	Medium	High
Consequences of hazard being realised →					

In more complex cases, it may be appropriate to use (semi)qualitative risk assessment approaches. Such approaches can define the **pathway** and **consequences** using modelling/estimation techniques that allow the level of exposure of a **receptor**, and the consequences to the **receptor**, to be better determined. In some cases probabilistic models can be used to estimate the actual probability of risk occurring.

Uses of environmental risk assessment

There are a wide range of uses of environmental risk assessment and, although the specific methodology and the responsibility for carrying out the assessment may vary, the core principles and the key stages of the process are fundamentally the same in each case. There is a wide range of legislation that encompasses the principles of environmental risk assessment in relation to chemicals. The European Environment Agency (1999) publication lists some of these but the area is rapidly changing and it is impractical to provide a complete list here. Specific guidance is often available for each piece of legislation. The principles of environmental risk assessment are also applied in a number of other areas, for example flood protection, noise pollution and planning.

Some examples of the use of environmental risk assessment are given below.

- Assessing the impacts of chemicals used at existing sites (for example for the Control of Major Accident Hazards (COMAH) Regulations (1999), Environmental Permitting Regulations (2007) and other similar legislation).
- Assessing the impacts of products generated by individual companies/sites due to their use or transport etc.
- Assessing potential impacts of new developments, new sites or new processes as part of the planning procedure (for example in relation to the Town and Country Planning Regulations (1999) (as amended). This is often known as Environmental Impact Assessment or EIA.
- Assessing the impacts of products, processes or services over their life cycle (life cycle assessment or LCA). An EHSC note on LCA is available (see bibliography).
- Consideration of risks to the environment in a company's environmental management system (EMS) or eco-management and audit scheme (EMAS). Such schemes are based on continual environmental improvement in which risk assessment plays an important part. An EHSC note is available on EMS (see bibliography).
- Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation. Environmental risk assessment is a key component of determining the safe use of chemicals under this legislation.

An EHSC note is available on individual legal and ethical responsibilities for environmental safety (see references).

References

Guidelines for Environmental Risk Assessment and Management. Defra, 2002 (see <http://www.defra.gov.uk/Environment/risk/eramguide/index.htm>).

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EHSC Note on Environmental Management Systems. Environment Health and Safety Committee 2006. (see <http://www.rsc.org/ScienceAndTechnology/Policy/EHSC/EMS.asp>).

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