Methods of Environmental Impact Assessment
Third edition

Edited by Peter Morris and Riki Therivel

Routledge
F Taylor & Francis
Croup LONDON
AND NEW YORK

1 Introduction

Riki Therivel and Peter Morris

1.1 El A and the aims of the book

This book aims to improve practice of environmental impact assessment (EIA) by providing information about how ElAs are, and should be, carried out. Although it focuses on the UK context in its discussion of policies and standards, the principles it discusses apply universally, as do many of the assessment methods it describes. This introductory chapter (a) summarises the current status of EIA, and the legislative background in the UK and EU, (b) explains the book's structure, and (c) considers some trends in EIA methods.

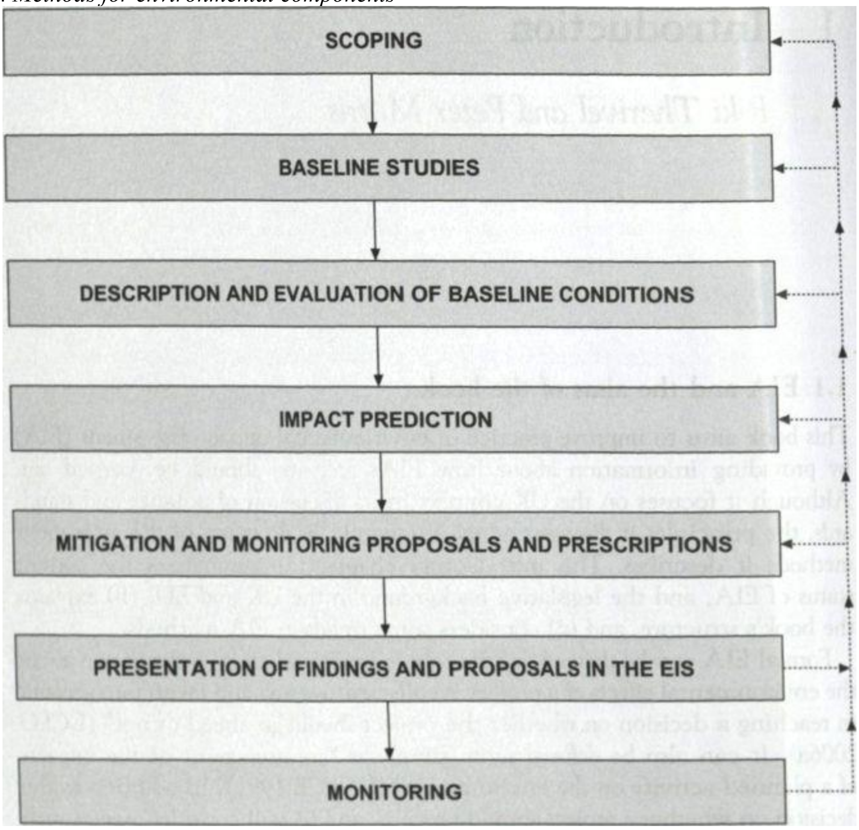
Formal EIA can be defined as "the whole process whereby information about the environmental effects of a project is collected, assessed and taken into account in reaching a decision on whether the project should go ahead or not" (DCLG 2006a). It can also be defined more simply as "an assessment of the impacts of a planned activity on the environment" (UNECE 1991). In addition to the decision on whether a project should proceed, an EIA will consider aspects such as *project options/alternatives* and mitigation measures that should be implemented if the development is allowed. The findings of an EIA are presented in a document called an Environmental Statement or (as in this book) *Environmental Impact Statement* (EIS). The overall EIA process is explained and discussed in this book's "sister volume", *Introduction to Environmental Impact Assessment* (Glasson *et al.* 2005).

ElAs involve individual assessments of aspects of the environment (e.g. population, landscape, heritage, air, climate, soil, water, fauna, flora) likely to be significantly affected by a proposed project. This book focuses on assessment methods (practical techniques) used in the part of the EIA process concerned with analysing a development's impacts on these *environmental components*.

1.2 The EIA process 1.2.1

Introduction

The main EIA procedures that will be followed in the assessment of any environmental component are summarised in Figure 1.1. The figure assumes that the



► Primary pathway 1• Feedback loops

The model illustrates the stepwise nature of EIA, but also the requirement for continuous reappraisal and adjustment (as indicated by the feedback loops).

Figure 1.1 Procedures in the assessment of an environmental component for an EIA.

developer has conducted feasibility studies, and that screening has already been carried out - and these assumptions are made in the chapters. Screening is discussed in Glasson *et al.* (2005).

1.2.2 Scoping *and* baseline studies

Scoping is an essential first step in the assessment of a component. The main aims are:

---

1 to identify at an early stage (when the project design is relatively amenable to modification) what key receptors, impacts and project alternatives

to consider, what methodologies to use, and whom to consult. UK government policy also advocates an appraisal-led design process, and various documents (e.g. MAFF 2000) provide guidance on identifying the preferred option from an environmental perspective;
- to ensure that resources and time are focused on important impacts and receptors;
- to establish early communication between the developer, consultants, statutory consultees and other interest groups who can provide advice and information;
- to warn the developer of any constraints which may pose problems if not discovered until later in the E1A process.

The scoping exercise should provide a ground plan for subsequent steps by making a preliminary assessment of:

- the project's potential impacts on component receptors, estimated from the project description (including its size, construction requirements, operational features and secondary developments such as access roads) and the nature of components and receptors;
- the impact area/zone within which impacts are likely occur, estimated from the impact types and the nature of the surrounding area and environmental components, e.g. impacts on air or water may occur at considerable distances from the project site;
- possible mitigation measures;
- the need and potential for monitoring;
- the methods and levels of study needed to obtain reliable baseline information that can be used to evaluate the baseline conditions, make accurate impact predictions, and formulate adequate mitigation measures and monitoring procedures. The selection of methods should involve consideration of:
    - the impact and receptor variables on which the studies will focus, and the accuracy and precision needed for each;
    - the most appropriate methods for collecting, analysing and presenting information;
    - the resource requirements and timing considerations, especially for field surveys;
    - constraints such as the time and resources available.

Some commonly used aids in E1A are outlined in Table 1.1. Two of these, checklists and scorecards, are useful scoping tools, particularly for tasks such as identifying key impacts and receptors, and selecting appropriate consultees and interest groups. The findings of the scoping exercise should be documented in a scoping report that is made available to the developer, participating consultants and consultees. However, lack of detailed information at the scoping stage means that scoping estimates and decisions should be reassessed in the light of baseline information gained as the EIA progresses.

Table 1.1 Commonly used aids in El A

Method	*Attributes*
Checklists	Useful, especially in scoping, for identifying key impacts and ensuring that they are not overlooked. Can include information such as data requirements, study options, questions to be answered, and statutory thresholds - but are not generally suitable for detailed analysis.
	Can have various uses, e.g. (a) to identify impacts and cause- effect links between impact sources (plotted along one axis) and impacts (plotted along the other axis); (b) to link features such as magnitude and extent (e.g. localised or extensive, short or long term); and (c) to derive estimated impact significances from assessed receptor values and impact magnitudes (e.g. see Table 11.8).
Scorecards	Provide a simple, transparent method for comparing and ranking “subjects" such as receptors or impact factors. Scores for several criteria can be assigned to each subject; and various scales can be used, although summation is only possible if the same scale applies to all criteria (Table 1.2). The method can be used for assessing the relative importance of “subjects” in various contexts including scoping (e.g. identifying key receptors), impact prediction, project options appraisal, and integration of component assessments. However: (a) it does not assist in determining if criteria overlap/ interact or should be given different weightings; and (b) unless based on quantitative data, the scores are subjective, and expens with differing viewpoints may assign different scores for a given criterion.
Flowcharts and networks	Can beuseful for identifying cause-effect links/pathways: between impact sources; between sources and impacts; and between primary and secondary impacts. However, they cannot quantify the magnitudes of impacts or of their effects.
Mathematical/ statistical models	Are based on mathematical or statistical functions which are applied to calculate deterministic or probabilistic quantitative values from numerical input data. They range from simple formulae to sophisticated models that incorporate many variables. They need adequate/reliable data, can be expensive, and may not be suitable for “off the peg” use.
Maps	Are often essential. They can indicate features such as impact areas/zones, and locations and extents of receptor sites and/or features within these. Overlay maps can combine and integrate two or three “layers", e.g. for different impacts and/or environmental components or receptors.
CIS (Chapter 14)	Can be very valuable (a) as a sophisticated mapping tool that can relate a number of different variables by spatially referencing (overlaying) datasets, and (b) in conjunction with an external tool (such as an expert system or simulation model) as a means c4 analysing quantitative data and modelling outcomes.

Table 1.2 A hypothetical scorecard to compare and rank four subjects in relathci to four criteria assessed by means of different scales

	Criterion 1 (% scale)	*Criterion 2 (1-10 scale)*	Criterion 3 (0-5 *scale)*	Criterion 4 (+/- *scale)*	Sum *(if applicable)*	*Rank (if possible)*
Subject 1	15	5	**5**	+		2
Subject 2	40	3	2	0		3
Subject 3	**60**		4	++		1
Subject 4	10	4	1	-		4

Baseline studies form the backbone of component assevsments. It is only when they provide sound information on the socio-economic or environmental systems in the impact area that valid impact predictions can be made, and effective mitigation and monitoring programmes formulated.

The distinction between baseline studies and scoping is not clear cut because (a) consultation should be ongoing, and (b) scoping includes gathering information, much of which is effectively baseline material that can at least form the starting point for more detailed studies. In both stages, it is usually possible to compile some of the required information, by means of a desk study. A thorough search should be made because (a) gathering existing information is generally less expensive and time-consuming than obtaining new data, and (b) it is pointless to undertake new work that merely duplicates information that already exists. However

- Scoping will usually require brief site visits (e.g. for reconnai.vsancc or to confirm features identified on maps) - perhaps including walkover surveys. Such initial visits are best undertaken by several members of the EIA and design team, so that relationships between components can be identified.
- In most cases, existing baseline data will be inadequate or out of date, and it will be necessary to obtain new information by some form of field survey

The description and evaluation of baseline conditions should include:

- a clear presentation of methods and results;
- indications of limitations and uncertainties, e.g. in relation to data accuracy and completeness;

- an assessment of the value of key receptors and their sensitivity to impacts.

1.2.3 Impact prediction

Impact prediction is fundamental to EIA, and the likely impacts of a project should be considered for all environmental components. In order to predict the impacts of a development it is also necessary to consider changes in the baseline conditions that may occur in its absence (a) pnor to its initiation, which can be several years after production of the EIS, and (b) during its projected lifetime. These can be assessed in relation to the current baseline conditions and information on past, present and predicted conditions and trends. Most of the relevant information will have to be sought through the desk study although comparison of field survey data with previous data can help to elucidate recent trends. Box 7.1 gives sources of historical information.

According to the E1A legislation (§1.3) impact prediction should include assessment of

- Direct/primary impacts - that are a direct result of a development.
- Indirect/secondary impacts - that may be "knock on" effects of (and in the same location as) direct impacts, but are often produced in other locations and/or as a result of a complex pathway.
- Cumulative impacts - that accrue over time and space from a number of developments or activities, and to which a new project may contribute. In "*appropriate assessment*" (under the Habitats Directive), these are called "in combination" impacts.

An additional possibility is impact interactions - between different impacts of a project, or between these and impacts of other projects - that result in one or more additional impacts, e.g. (A + B) —» C. For instance, the interaction of population and air pollution may cause health effects.

All impacts may be: positive (beneficial) or negative (adverse); short-, medium-, or long-term; reversible or irreversible; and permanent or temporary. Ideally, impact prediction requires:

- a good understanding of the nature of the proposed project, including project design, construction activities and timing;
- knowledge of the outcomes of similar projects and EIAs, including the effectiveness of mitigation measures;
- knowledge of past, existing or approved projects which may cause interactive or cumulative impacts with the project being assessed;
- predictions of the project's impacts on other environmental components that may interact with that under study;
- adequate information about the relevant receptors, and knowledge of how these may respond to environmental changes/disturbances.

Methods of impact prediction vary both between and within E1A components. For example, the assessment of impact magnitude (severity) may be qualitative or quantitative. Qualitative assessments usually employ ratings such as neutral, slight, *moderate, large* - applied to both negative and positive impacts. They are typically used where quantitative assessments are difficult or impossible, for instance in landscape, archaeological and ecological assessment. Quantitative assessments involve the measurement or calculation of numerical values, e.g. of the level of a pollutant in relation to a statutory threshold value.

Standard techniques that can be used to aid impact prediction in assessments of most environmental components are reviewed in Glasson *et al.* (2005) and briefly summarised in Table 1.1.

It is also important to assess impact significance, which is the “product" of an impact’s magnitude and the value, sensitivity/fragility and recoverability of the relevant receptor(s). It therefore requires an evaluation of these receptor attributes - which should have been carried out in the baseline evaluation.

Impact prediction is often poorly addressed, perhaps because it is the most difficult step in EIA. Direct impacts are usually relatively easy to identify, but accurate prediction of indirect and *cumulative impacts* can be much more problematic. Guidance on assessing these (and impact interactions) is provided in CEAA (1999) and EC (1999).

Whatever methods are employed, impact prediction is not an exact science. There are bound to be uncertainties (that can sometimes be expressed as ranges) which should be clearly stated in the EIS.

1.2.4 *Mitigation*

Mitigation measures aim to avoid, minimise, remedy or compensate (in that sequence) for the predicted adverse impacts of the project. They can include:

- selection of alternative production techniques, and/or locations or alignments (of linear projects);
- modification of the methods and timing of construction;
- modification of design features, including site boundaries and features, c.g. landscaping;
- minimisation of operational impacts (e.g. pollution and waste);
- specific measures, perhaps outside the development site, to minimise particular impacts;
- measures to compensate for losses, e.g. of amenity or habitat features.

Much of the environmental damage caused by developments occurs during the construction phase, and a problem is that construction is usually contracted to a construction company who will not have participated in the EIA process, and over whom the developer may have little control (Wathem 1999). Consequently, there is a need to provide a Construction Environmental Management Flan, ideally as part of an overall project Environmental Management Plan (see §1.5). In addition, because project specifications frequently change between publication of the EIS and the start or completion of construction (often for unforeseeable reasons) developers sometimes employ site environmental managers to ensure

(a) that such modifications take account of environmental considerations. anJ
(b) that construction phase mitigation measures are earned out.

Different mitigation measures will be needed in relation to specific impacts on different environmental components and receptors. The EIS should provide detailed prescriptions for proposed measures for each impact, indicate how they would actually be put in place, and propose how they might be modified if unforeseen post-project impacts arise. A primary consideration is the likely significance of post-mitigation residual impacts, and care is needed to ensure that a mitigation measure does not generate new impacts, perhaps on receptors in other environmental components.

Best practice dictates that the *precautionary principle* (advocated in EU and UK environmental policy) should be applied, i.e. that mitigation should be based on the possibility of a significant impact even though there may not be conclusive evidence that it will occur. Similarly, on the basis of the EU principles that preventive action is preferable to remedial measures, and that environmental damage should be rectified at source (see §1.3) the best mitigation measures should involve modifications to the project rather than containment or repair at receptor sites, or compensatory measures such as habitat creation - which should normally be considered only as a last resort (see §11.8.4).

In addition to mitigation, government guidelines suggest that opportunities for environmental enhancement (improvement of current environmental conditions and features) should be sought in EIA. For instance, this is one of the duties of the Environment Agency, especially in relation to coastal and flood defences (Defra 2005).

1.2.5 *Presentation* of findings and *proposals in the ElS*

The information presented in the E1S must be clear and, at least in the nontechnical summary, should be in a form that can be understood by “nonexperts” without compromising its integrity. It should also be “transparent”, e.g. in relation to limitations and uncertainties. Presentation methods vary between components, but can include the use of maps, graphs/charts, tables and photographs.

The EIS must be an integrated document, and this will necessitate assessing the component in relation to others, e.g. to evaluate its relative importance, and ensure that potential conflicts of interest have been addressed (see §1.5).

1.2.6 Monitoring

Monitoring can be defined as the continuous assessment of environmental or socio-economic variables by the systematic collection of specific data in space and time. It can be strictly continuous, e.g. using recording instruments, but more commonly involves periodic repeat data collection, usually by the same or similar methods as in baseline surveys. Monitoring in EIA can include

- Baseline monitoring - which may be carried out over seasons or years to quantify ranges of natural variation and/or directions and rates of change, that are relevant to impact prediction and mitigation. This can avoid the frequent criticism that baseline studies are only “snapshots" in time. However, time constraints in EIA usually preclude lengthy survey programmes, and assessments of long-term trends normally have to rely on existing data.

- Compliance monitoring - which aims to check that specific conditions and standards are met, e.g. in relation to emissions of pollutants.
- Impact and mitigation monitoring - which aims to compare predicted and actual (residual) impacts, and hence to determine the effectiveness of mitigation measures.

Unless otherwise specified, “monitoring" in E1A normally refers to impact and mitigation monitoring, which is also sometimes called auditing. There is often considerable uncertainty associated with impacts and mitigation measures, and it is responsible best practice to undertake monitoring during both the construction and post-development phases of a project. Monitoring is essential to leam from both successes and failures. For example:

- It is the only mechanism for comparing predicted and actual impacts, and hence of checking whether mitigation measures have been put in place, testing their effectiveness, and evaluating the efficiency of the project management programme;
- If mitigation measures are amenable to modification, it should still be possible to reduce residual impacts identified during monitoring (feedback kxip in Figure 1.1);
- It can provide information about responses of particular receptors to impacts;
- It is the only means of EIA/EIS evaluation and of identifying mistakes that may be rectified in future EIAs. For example, it will provide information that can be used to assess the adequacy of survey and predictive methods, and how they may be improved. Thus, a principal aim of monitoring should be to contribute to a cumulative database that can facilitate the improvement of future EIAs (Clark 1996).

Three requirements are essential for successful monitoring: (a) baseline data that are good enough to detect residual impacts; (b) funding to carry out the monitoring survey work; and (c) sufficient contingency funds to enable modifications to mitigation measures to be made, or faults to be rectified, if necessary.

Monitoring is not strictly part of the EIA process, is not statutory in the UK. and can be expensive. Consequently, in spite of government guidance that it should be undertaken (e.g. Defra 2005) lack of monitoring is a senous deficiency in current EIA practice (SNH 2005).

1.3 The current status of EIA

Since the first EIA system was established in the USA in 1970, EIA systems have been set up worldwide and have become a powerful environmental safeguard in the project planning process. In Europe, EU Direcmes 85/337/EEC, 97/11/EC and 2003/35/EC (EC 1985, 1997, 2003) set the legal hasts for individual member states’ EIA regulations. More than 300 EISs are currently prepared annually in the UK alone.

In response to the Government's sustainable development agenda, most Regional Assemblies have established regional sustainable development frameworks, which some are now converting into "integrated regional frameworks". These have been used as a basis for the sustainability appraisal of Regional Spatial Strategies and Regional Economic Strategies, and in many cases have been the starting point for local authorities' sustainability appraisal frameworks. These RSSs are starting to influence the next round of local development planning, the Local Development Frameworks, and inter authority planning documents, such as regional waste management plans. These will, when complete, provide direct tests against which developments are assessed. Many authorities have also developed "Agenda 21" checklists, sustainable design guidance, sustainability checklists, Supplementary Planning Guidance on sustainability etc. These aim to both inform developers of the authority's thoughts on best practice and/or minimum standards that should apply; and provide the authority with a clear set of principles or standards against which to test planning applications.

16.3 Sustainable development and El A

It is clear, therefore, that Government intends the development industry to improve the design and layout of developments along sustainable lines; and that a developer submitting a planning application will need to demonstrate they have integrated sustainability into the development, and have a mechanism for clearly demonstrating this. Can EIA assist in implementing sustainable development and does sustainability have a place in EIA?

EIA has traditionally not included a test for sustainable development, and the UK EIA regulations do not mention sustainability (Geneletti 2001). However, elements of EIA go beyond the narrow confines of "pure" environmental issues to cover wider sustainability issues (e.g. Wahaab 2004). Some authors believe that sustainability is a principal aim of EIA (Glasson *et al.* 2005, Petts 1999, Sadler 1996), and that EIA is a key mechanism for promoting sustainable development (Geneletti 2001). EIA acts throughout the project development process to improve the environmental performance of development projects and it can, if used correctly, help to drive social and economic issues in the same way. However, although EIA has improved the environmental performance of developments to date, it has been less successful at meeting wider sustainability goals (Caldwell 1993).

Some commentators (e.g. Lawrence 1997) have called for sustainability to be formally integrated into EIA regulations. Certainly EIA is sufficiently flexible and robust to be able to include additional elements within the assessment framework while still meeting legislative requirements. Many EIAs currently consider social and economic issues either directly in the ES or as complementary volumes, for instance on social impact assessment, health impact assessment, economic and social inclusion, and employment studies (e.g. retail analyses). Other commentators, instead, are concerned that broadening out EIA to also include social and economic parameters could water down the original purpose of EIA, which was to prevent significant environmental degradation. Table 16.1 summarises the two sides' arguments.

Table 16.1 Arguments for and against broadening out EIA to cover the full range *cd* sustainability issues

Arguments m *favour of integration*	*Arguments against integration*
Improves coherence and efficiency; reduces duplication of reports.	Given that time and resources are limited for any assessment, there will necessarily be a loss of depth in consideration of the environment t*i* social and economic objectives and criteria are considered simultaneously.
Separating social, economic and environmental issues into assessment ghettoes can make it harder to integrate environmental issues in decisionmaking, as they come to be seen as a special interest subject which constrains other aspirations. Environmental, social and economic "pillars" become "warring houses".	EIA was prompted by concerns that environmental consequences of decisions were being given insufficient weight compared to social and economic ones. If the point of EIA is to redress this balance, then expanding it to include social and economic parameters would be unnecessary and self-defeating.
Helps to identify win-win-win solutions that integrate all three.	Removes questions of an essentially political nature from the realm of democratically accountable decision-making and presents them as reconcilable by technical and rational methodologies or procedures.
The environment matters because it affects human well-being. The apparently ecocentric idea of "environmental protection" always comes back to anthropocentric judgements about what matters for human quality of life. There is no list of environmental imperatives that can be "read off" purely from science without the intervention of any normative judgements about what matters to humankind.	Increases the risk that environmental concerns continue to be marginalised under a rhetoric of "sustainability"; keeping environmental arguments separate allows a clear environmental case to be made and environmental constraints to be clearly stated.
Allows better identification and documentation of indirect and synergistic effects which result from linkages between environmental, social and economic impacts which otherwise might be overlooked in separate, more specialised assessments.	Carrying out the assessment in aggregate allows trade-offs between individual aspects or components to be hidden. A deterioration in qualm of life for some social groups mav not become apparent, and potentially unsustainable environmental effects may go undetected.
Avoids developing purely environmental options which preclude, or minimise, opportunities in economic or social development.	
Allows a more integrated assessment against the criteria which will be used in the future to assess the value of projects.	

Source: Adapted from Momson-Saunders and Thenvel (2005).