European Commission,
DGVII Transport

Manual on Strategic Environmental Assessment of Transport Infrastructure Plans

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Preface

Strategic environmental assessment (SEA) provides information about the environmental consequences of decisions about policies, plans and programmes. It is increasingly being applied to transport infrastructure plans. Good SEAs:

- prevent unnecessary environmental complications and delays at the project level (the level at which environmental impact assessment (EIA) is applied);
- consider environmentally friendly alternatives that are no longer feasible at the project level, and prevent expensive mitigation measures;
- reduce public resistance to transport infrastructure projects, and raise environmental awareness in the transport sector.

In short, SEA makes transport more sustainable. At the European Union level, its importance was recognised at the 1998 meeting of heads of governments (the Cardiff Summit). The European Union strives to integrate environmental considerations into its own policy making and the European Commission has stated, in its 1992 White Paper on a Common Transport Policy, that it will apply SEA for infrastructure plans. At its session in Berlin on 21-22 April 1997, the European Council of Ministers of Transport formally endorsed the principles of SEA.

The European Parliament and Council have, in Article 8 of the guidelines on development of the Trans-European Transport Networks, requested that SEA methodologies be developed. This Manual has been prepared at the request of the European Commission, in response to that requirement.

The Manual is intended to be a user-friendly guide offering practical recommendations for authorities and other interested parties that are involved in carrying out SEA. It describes the main issues in SEA and gives practical suggestions. It is based on best international practice and research and provides references to the literature for further details. It is the European Commission's intention to keep this Manual up to date, and to extend it where appropriate.

Guide to the user

This Manual is structured as follows.

Contents	Table of contents, tables of boxes, figures and tables, acronyms and glossary.
Executive summary	The executive summary is intended for readers who wish to gain an overview of the main items covered in the Manual and of its recommendations.
Introduction	This section introduces SEA and explains the distinction between SEA and environmental impact assessment. It describes the political and practical reasons for undertaking SEAs. It also sets out the purpose and coverage of the Manual.
Part 1: The principles of SEA for transport infrastructure plans	Part 1 is mainly intended for users who are not acquainted with the principles of SEA or of transport planning. It identifies the steps in the SEA process, which are further elaborated in Part 2. It describes the links between SEA and transport planning and the co-ordination of the planning process as a whole. It discusses the tiering of different decisions and the issues which are generally considered at different levels of planning and decision-making. It also describes the management of the SEA process and how to maximise its benefits.
Part 2: Steps in the SEA Process	Part 2 describes the steps in the SEA process in detail, focusing on its application to transport infrastructure planning. It is intended for users who have relatively little experience with environmental assessment at the strategic level. There are chapters on determining which plans need an SEA (screening), which environmental imapacts should be assessed (scoping), how reports should be drafted and reviewed, how the SEA process can be integrated into planning and decision-making, and how the implementation and effects of transport infrastructure

plans can be monitored. There is also a chapter on consultation of agencies and public participation.

Part 3: Assessment of global, regional and local impacts

Part 3 is intended for those who prepare impact forecasts. It is intended to help less experienced users, or those who are interested in practice in other countries. It describes methods of forecasting the impact of transport infrastructure plans on traffic flows and on the environment, and identifies ways to optimise the environmental consequences of plans.

References

References to publications, internet sites and national guidance are provided, as well as an index of terms in this Manual.

Appendices

Appendices include lists of contributing experts, of SEAs used as illustrations in the Manual, and of examples of national infrastructure planning and SEA frameworks.

Every chapter ends with a section on further reading.

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Acronyms

AE	Acid Equivalent
EIA	environmental impact assessment
EU	European Union
GIS	geographic information system (s)
HSR	high speed rail
MCA	multi-criteria analysis
NGO	non-governmental organisation
SEA	strategic environmental assessment
TEN	Trans-European Network
VOC	volatile organic compounds

Glossary

accessibility	time and cost needed for passengers and freight to move from origins to destinations, and general quality of the transport connection
agency	a governmental organisation
alternatives	a range of strategic options which can best achieve the transport infrastructure plan's objective (s) at the lowest cost and/or greatest benefit to the environment and sustainability, or which achieves the best balance between conflicting objectives (for example: demand reduction, alternative locations, different types of development which can achieve the same objective)
biodiversity	the variety of life on earth; biodiversity can be described in terms of genes, species and ecosystems: sustainable development depends on understanding, protecting and maintaining the world's many interactive ecosystems
corridor	the area between two urban centres, airports, ports or other fixed poles of traffic attraction (e.g. border crossings), between which traffic flows occur
decision-maker	the body or persons responsible for deciding whether an infrastructure plan should proceed: normally a function of government
environmental impact assessment	a procedure for identifying the environmental effects of development projects; as a result of Directive 85/337/EEC (and 97/11/EEC), this is now a legislative procedure to be applied to the assessment of the environmental effects of certain public and private projects which are likely to have significant effects on the environment
geographical information system	computerised database of geographical information which provides a platform for its management, analysis and illustration: by allowing information databases to be associated with real geographical information, GIS provide powerful analytical tools
guidance	official or frequently used documents explaining how transport infrastructure plans or policies should be interpreted
indicator	forecastable quantitative variable, usually with target value representing an objective, which symbolises environmental or other impacts of transport infrastructure plans (including ordinal scales: e.g. low, medium, high)

induced traffic	traffic generated by the availability of new transport infrastructure
mitigation	action taken to prevent, avoid or minimise the actual or potential adverse impacts of a policy, plan, programme or project: it may involve abandoning or modifying a proposal, relocating it, changing the focus from new development to improved performance of existing facilities, etc.
mode	a form of transport (such as road, rail, air, inland water shipping, marine shipping, pipeline, bicycle)
monitoring	a combination of observation and measurement for the performance of a plan and its compliance with environmental policy and legislation against a set of predetermined indicators, criteria or policy objectives
multimodal (plan)	a transport infrastructure plan which considers more than one mode of transport
network	a number of interconnected uni-modal or multi-modal links
node	a location where two transport corridors are connected to one another, enabling transfer from one corridor to the other
objectives	political statements about the desired effects of a plan (or other action)
plan	a purposeful, forward-looking strategy or design, often with co-ordinated priorities, options and measures, that elaborates and implements policy
pole	a fixed location which generates or attracts traffic, either as origin or as destination (e.g. urban centres, industrial areas) or because it is a fixed point where traffic flows need to pass (e.g. a port, border crossing); poles are natural delimitators of corridors which are considered in a transport infrastructure plan
policy	a general course of action or proposed overall direction that a government is, or will be, pursuing and which guides ongoing decision-making
project	construction, modification and/or operation of transport infrastructure or other physical works; a project level decision is a consent decision by competent authorities that a project will be constructed
scenario	an interrelated sequence of events in the future, which may or may not be influenced by an infrastructure plan which is submitted to an SEA

scoping	deciding which issues should be considered in an SEA
screening	deciding whether an infrastructure plan requires an SEA
spatial economic development	the economic developments in different parts of an area and their interlinkages
strategic environmental assessment	a systematic process for evaluating the environmental consequences of proposed policy, plan or programme initiatives in order to ensure that they are fully included and appropriately addressed at the earliest possible stage of decision-making in the same way as with economic and social considerations
target	a specific goal or objective expressed in quantitative terms: can be either physical of financial
tiering	distinguishing different transport infrastructure plans or other policies, plans or programmes which are prepared consecutively, and which influence one another
traffic flows	passengers and freight moving from origins to destinations, and characteristics such as transport mode, speed, time of the day, number of vehicles
transport infrastructure development	making changes to the transport infrastructure network
transport infrastructure plan	a plan, or programme, proposing changes to the transport infrastructure network and setting a framework for more detailed project decisions

Source: derived from European Commission, 1998a, Sadler and Verheem, 1996 and other sources.

Executive summary

PART 1: THE PRINCIPLES OF SEA FOR TRANSPORT INFRASTRUCTURE PLANS

The SEA process

1. SEA should follow a number of **principles**:

   - SEA should be applied, at the earliest stage, to all transport infrastructure plans that may have environmental consequences.
   - The initiator of a proposed transport infrastructure plan should be responsible for the preparation of an SEA report.
   - The SEA report should be reviewed by environmental authorities and other interested parties and by the public.
   - The competent authority should take the SEA report into account in making decisions about the proposed transport infrastructure plan.
   - Consultation and participation are integral to the SEA process.

2. The **structure of the SEA process** should depend on the planning procedure to which the SEA is linked. The following steps should be followed:

   - **Screening** (to determine whether an SEA is necessary)
   - **Scoping** (to determine the issues to be included in the SEA)
   - **Impact assessment** (to assess the impacts of a proposed infrastructure plan in comparison with the baseline situation and to analyse uncertainties)
   - **Review** (to ensure that all the relevant impacts have been properly assessed)

- **Integration into planning and decision-making** (to ensure that the SEA is fully taken into account in making the decision about the plan)

- **Implementation and monitoring** (to ensure that there is a mechanism for correcting unacceptable aspects of implementation)

- **Consultation and participation** of environmental authorities, other agencies and the public or non-governmental organisations should take place throughout the process, including review of the SEA report.

3. The steps of the SEA process listed above are similar to those of project-level environmental impact assessment. In this Manual SEA is presented as a formal process but many of the examples used are drawn from less formal evaluations of environmental effects.

Tiering and linkage to planning

4. Environmental assessments (i.e. SEAs and/or EIAs) of different levels of transport infrastructure planning should be **tiered**. The most appropriate way of tiering depends on the system of planning and decision-making.

5. The following levels of planning and decision-making should be distinguished:

- **network level**, to determine whether and how the nodes in a transport network in a jurisdiction and its neighbours should be connected to each other by infrastructure for any mode of transport, i.e. 'multi-modal' planning;

- **corridor level**, to determine the best way to connect two traffic attraction nodes to each other with any mode of transport infrastructure;

- **project level,** to determine the detailed location and design of the proposed infrastructure.

6. The planning and decision-making system should allow for **multi-modal plans** and alternatives at network level and at corridor level, since different modes can function as environmentally friendly alternatives.

7. Where possible, the SEA of **transport infrastructure plans should be combined with that of transport policy options** at network (jurisdiction) level. The SEA may be extended to the multi-modal network as a whole. This opens up options such as encouragement of public transport, development of planning and assessment guidance, etc.

8. An assessment of a transport infrastructure plan at **network level** should include the following components:

   - assessment of the existing multi-modal transport network and expected future changes using established environmental objectives and standards;

   - identification of alternative courses of action to improve the expected future situation, including transport infrastructure proposals;

   - forecasting the impacts of the alternatives on the environment.

9. Modal **alternatives** at network level should be developed sufficiently to permit assessment of the plan as a whole. This implies that decisions about particular corridors within the network should be postponed until planning, assessment and decision-making at corridor level is undertaken.

10. At **corridor level**, the assessment should be limited to any issues that influence the decision about the corridor as a whole: which of the main alternatives should be chosen, and under which environmental conditions? This implies that, for example, details about the route of linear infrastructure are only relevant if they could influence the decision on the corridor. The assessment of impacts that can be sufficiently mitigated at project level should be postponed until the project-level EIA is undertaken.

11. When approving a network-level or corridor-level plan, which provides **irreversible consent** for transport infrastructure development, there should be sufficient confidence that unacceptable environmental impacts will not occur when the project is further developed and implemented.

Managing the SEA process

12. Following screening, the SEA process should be carefully planned by:

    - setting **clear targets** for the SEA report;
    - setting up an **interdisciplinary team**;
    - ensuring good **collaboration** exists between the planning and environmental authorities;
    - enabling effective **feedback** to be made
    - providing sufficient **time and resources** to carry out public participation.
    - ensuring that the results of the evaluation are taken into consideration in the **final decision**;

13. At the start of the SEA process, a plan should be prepared to ensure effective communication with other agencies and with the public.

PART 2: STEPS IN THE SEA PROCESS

Screening

14. An SEA should be undertaken for a transport infrastructure plan at network or corridor level unless it can be shown that it will have no significant environmental impacts.

15. Transport infrastructure plans should be screened to determine the need for SEA as **early as possible**, i.e. before the planning process.

16. The screening phase should be used by the agencies involved to **agree about** the **SEA procedure** and the linkages with the planning process.

Scoping

17. Scoping should help to ensure that the issues dealt with in the SEA process are confined to those **relevant** to the decision being taken, and thus to the decision-makers.

18. The following groups of **environmental impacts** should be included in the SEA: resource depletion/waste, climate change, acidification, local air pollution, photochemical smog, impact on biodiversity, visual and other impacts on landscape, noise/tranquillity, land take/proximity, impacts on water, and accidents. Direct, indirect, secondary, cumulative and synergistic impacts should be included in the SEA.

19. Scoping may also involve the following **steps**:

    - describing the type of plan decision the initiator envisages;
    - consulting external parties, including the public, on the issues to be assessed;
    - publishing a decision about the scope of the SEA, including the environmental indicators to be employed.

20. **Environmental objectives** and targets should be based on transport and environmental policy. Additional environmental objectives and targets should, if necessary, be defined during the scoping phase, e.g. on the basis of consultation.

21. **Indicators** should be selected to reflect objectives and to distinguish between the different types of **alternatives** that are to be considered:

    - construction methods, design and detailed alignment;
    - alternative indicative routing, or siting in the case of nodal infrastructure;

- alternative modes and measures to influence traffic flows.

Impact assessment

22. Impact assessment relies on reliable and readily available **baseline data**, which should be gathered as early as possible to give an indication of possible significant impacts. Ideally, databases should be set up and managed outside the framework of particular SEAs, in order to be ready for use as soon as an SEA process starts.

23. The impact **forecasting method** should depend on the selected environmental indicators and on the type and level of detail of the alternatives to be compared. Often, the forecasting method used at the network level may be less quantitative and more general than at the corridor level.

24. Transport infrastructure design capacity alternatives and modal alternatives in general may be assessed using **scenario development** with a sufficiently long time horizon. These scenarios include the effects of plan alternatives on future traffic flows and spatial development, and their environmental impacts. These impacts should be compared with those anticipated to arise from the 'do-nothing scenario'.

25. Some **uncertainty** can be reduced by learning from previous experience with SEA, and by being sensitive to the issues on the political agenda. Unavoidable remaining uncertainty in an SEA can be dealt with in several ways, of which the most important are:

    - **sensitivity analysis** using 'extreme' scenarios developed to represent the views of optimists and pessimists (these should include the 'worst case' scenario);

    - **developing alternatives** on the basis of different sets of evaluation criteria (indicators and targets) representing the perspectives of different affected groups;

    - preparing an **environmental action and monitoring plan** to monitor **implementation** of the transport infrastructure plan,

ensuring sufficient control of environmental impacts, including the ability to take remedial measures.

26. The **SEA report** should be intelligible to decision-makers. It should include the following information: (i) executive summary, (ii) decision-making framework, (iii) environmental baseline, (iv) objectives of the plan, (v) summary of the plan, (vi) analysis of alternatives, (vii) description of the environmental impacts anticipated, (viii) environmental protection measures, (ix) report of consultation and participation (x) analysis of uncertainty, and (xi) environmental action and monitoring plan.

Review

27. The review of SEA reports provides an invaluable check on their quality. The findings of the review should be considered by the decision-making authority (or, where appropriate, by an independent body) and should influence both the decision and the conditions imposed.

28. Action-specific scoping guidelines provide a valuable checklist for review. These should be used in conjunction with general review guidelines and may lead to the provision of further information. Review should involve the participation of the environmental authorities, and other relevant parties, and the public. The outcome of the SEA report review should be made public.

Integration into planning and decision-making

29. The proposed transport infrastructure plan may be developed in several iterations. During each iteration, the previous draft plan is improved on the basis of an integrative assessment of all its impacts (not just its environmental impacts). Such an **overall evaluation** is a statement, including value judgements about the options considered, their impacts, and recommendations for further iterations. The evaluation method needs to be credible to decision-makers, as a result, for example, of involving external agencies.

30. The results of the SEA process should be used as inputs to the planning process before the final proposal is presented to the decision-makers. The planning process is obviously not only influenced by the SEA, but also by other assessments such as transport and financial, socio-economic, and spatial assessments.

31. At the start of the planning and assessment process, the linkages between parameters and indicators in different assessments should be clarified. The assessment horizon and scenario assumptions should be co-ordinated. The latter include, in particular, future population changes and economic development, but also fiscal, economic, spatial and environmental policies.

32. The impacts of the proposed plan should be compared with those of **alternatives**; including the do-nothing alternative and distinctively different plans (e.g. different modes and routes, traffic management alternatives or 'environmental' perspectives).

33. Alternatives may be evaluated using:

    - **multi-criteria analysis**, aggregating the separate indicators by making use of the assumed preferences of decision-makers;

    - **monetary valuation** of some of the impacts, expressing these in general economic cost-benefit analysis terms.

34. If potentially environmentally friendly options are rejected in the decision-making process, a justification should be given in a **record of decision** that should also set down environmental protection requirements to be used during decision-making by lower tiers of government.

Implementation and monitoring

35. Sufficient attention should be given to the implementation and monitoring of the transport infrastructure plan. An **environmental action and monitoring plan** should be proposed in the SEA report which should include:

- setting up an implementation and monitoring **framework** for the strategic competent authority to monitor plan implementation, with reference both to its objectives and to its environmental impacts;

- giving **environmental planning guidance**, indicating which decisions at lower tiers require an SEA or an EIA, or how screening and scoping could take place;

- defining appropriate **corrective actions** to reduce unanticipated adverse impacts.

36. Monitoring should be organised at **network level** so that actions which are likely to have effects on the whole network, such as amending emission standards, decommissioning infrastructure or constructing new infrastructure, can be taken.

Consultation and participation

37. Communication with affected groups should take place throughout the SEA process. Relevant environmental authorities, other agencies and affected public groups or their representatives should be identified at the outset. There should be a particular emphasis on consultation and participation during the **scoping phase**, and in the **review** of the SEA report.

38. It is important that public input should be acknowledged. Thus, any suggestions made about the scope of the SEA should be responded to. Similarly, comments on the SEA report and how they were taken into account should be set down in the record of decision on the proposal.

PART 3: ASSESSMENT OF GLOBAL, REGIONAL AND LOCAL IMPACTS

39. In the assessment and forecasting of environmental impacts, a distinction should be drawn between impacts on traffic flows, and environmental impacts at global, regional and local scales. The impacts within each of these groups can be assessed with similar

methods, and they can be influenced or abated by similar types of changes to transport infrastructure plans.

Traffic forecasts

40. Transport indicators should be estimated which are relevant for environmental, spatial, social and economic assessments. Two classes of indicators are crucial:

- **traffic flows**, which directly influence the use of resources and emissions;
- **accessibility**, which induces spatial development and therefore indirectly the demand for transport and hence traffic flows.

41. **Simple traffic models** at different geographical scales, including the network and the corridor, need to be constructed if none are available. These models should be used when changes to the network are proposed and SEAs are undertaken.

42. In addition, or as an alternative to models, **expert judgement** may be employed. A useful first approximation of the effect of new infrastructure on traffic flows is to assume a fixed travel time budget. Scenario analysis generally provides sufficient information to choose among strategic transport infrastructure options.

Global and regional impacts

43. Large-scale impacts include global impacts (the depletion of sources of energy and of other natural resources and climate change) and regional impacts (acidification and photochemical smog). They depend directly upon traffic flows. The most useful indicators are:

- **energy use**;
- **atmospheric emissions** (mainly greenhouse gases, NO_x, SO_2 and VOC).

Large-scale impacts depend largely on spatial, technological and economic policies, and on modal and logistical concepts, rather than on the routing and design of transport infrastructure.

44. The emissions of these air pollutants can have large-scale effects on, inter alia, health and biodiversity. These effects should be assessed in SEAs for transport infrastructure plans by making use of **general emission targets** for these pollutants at the national scale. Targets developed for the transport sector should be employed as an evaluation framework in SEAs for transport infrastructure plans.

45. **Models** for energy use and the emission of gases can be based on specific emissions by vehicle type. In SEA, it is generally appropriate to use the simpler models, because they are sufficiently reliable to compare the impacts of different strategic transport options. They should preferably take account of:

    - **energy use and emissions per vehicle-kilometre** for all types of transport;

    - sensitivity to **average speed**, to allow for the impacts of congestion.

Local impacts

46. Local environmental impacts mainly depend on the location and the design of the transport infrastructure. These include localised air pollution, noise, land take, water pollution, impacts on biodiversity at local scale and visual and other effects on the landscape.

47. The focus of the local impact assessment should be on **deciding between infrastructure options and alternative plans**. This implies that useful indicators are:

    - the **cumulative** magnitude of local impacts for each alternative infrastructure plan (e.g. total land take in protected areas);

- **exceptional local impacts** which are especially significant and which could influence decision-making at this level (e.g. the crossing of an exceptionally valuable and vulnerable area).

48. The level of detail and quantification of such indicators, again, depends on the decision to be made:

    - At the more strategic levels (typically network decisions), **land take** in, and **proximity** to, 'valuable and vulnerable' areas may be used as a general indicator for local impact risks. These areas should be defined and identified as part of the national environmental and spatial policy for use, inter alia, in SEAs;

    - For less strategic, more concrete decisions (typically at corridor level), it will be necessary to develop **broadbrush (indicative) routes** for the infrastructure, in order to better quantify the impacts. No definitive consent should be given if there is insufficient certainty that local impacts can be mitigated to an acceptable level.

49. Broadbrush routes can be developed using the following steps: (i) identifying a range of possible routes, (ii) assessing the baseline in the area concerned, (iii) defining one or more sets of assessment criteria for route optimisation, resulting in vulnerability maps, (iv) developing a broadbrush alternative route to satisfy each of these sets of criteria.

50. The route optimisation process should apply criteria such as cumulative land take / proximity to vulnerable areas, cumulative numbers of people or vulnerable areas affected by air or noise pollution, and avoidance or mitigation of exceptional impacts. **Forecasting methods** consist of mapping techniques, including GIS, and expert judgement. For certain impacts, such as noise, simplified dispersion models can be used.

INTRODUCTION

In the Introduction:

- What is SEA?
- Why SEA?
- Purpose of the Manual

1 Introduction

Read this chapter to get an overview of what this Manual is about.

1.1 What is SEA?

The aim of SEA and the difference from EIA.

Systematic environmental evaluation

Strategic environmental assessment (SEA) is a systematic process for evaluating the environmental consequences of policies, plans and programmes that form the planning framework for projects at the earliest stage of decision-making. SEA has been developed as a tool similar to environmental impact assessment (EIA), which is widely accepted as an indispensable means of providing invaluable environmental information as an input to decisions about whether or not to approve development projects, such as the construction of transport infrastructure.

SEA versus EIA

The main difference between SEA and EIA is the type of decision to which they are linked. EIA is associated with project decisions; normally the final decisions before construction work is started. These are detailed decisions, mainly about the location and design of the project and about measures to mitigate, rather than prevent, environmental impacts. Feasible alternatives at project stage are often limited to minor variants (e.g. the precise alignment of a motorway).

SEA, on the other hand, is associated with strategic decisions. At this level, for example, different routes and transport modes and demand management may still be feasible alternatives. SEA of transport infrastructure plans therefore influences the location of transport infrastructure projects and, consequently, the environmental impacts evaluated in the project EIA.

The art of successful SEA is to undertake a meaningful, but quick, evaluation without the unnecessary expenditure of time and money on overly detailed assessment. The purpose of SEA is to take better account of environmental issues and to make the decision process more transparent by means of consultation and participation.

The nature and principles of SEA are in many ways similar to those of EIA. Like EIA, SEA is a process. However, there is a broad range of views about the nature of SEA. Thus, SEA may be a formal process with a series of stages, similar to those in the EIA process, or it may be any means of considering the environmental impacts of policies, plans and programmes. In this Manual SEA is presented as a formal process but many of the examples are drawn from less formal evaluations of environmental effects.

The difference between project issues and strategic issues has significant consequences for the practical methods used in SEA. These often differ from EIA methods, particularly with regard to impact forecasting and to the improvement of environmental performance.

Strategic EIA

Indeed, in some countries, strategic alternatives are sometimes also considered at the EIA level. International terminology and legislation is not uniform on this point. In this Manual, such EIAs are referred to as SEAs. For example, if major changes of location or expensive mitigation measures (such as tunnels) are still possible, an environmental assessment is considered to be an SEA, even if in national legislation it is designated as an EIA. Throughout this Manual guidance is given which should be useful in project level EIA as well as in SEA.

1.2 Why SEA of transport infrastructure plans?

Political and practical reasons for undertaking SEAs.

1.2.1 Making transport sustainable

Transport infrastructure plans

A transport infrastructure plan is a formal proposal for the development of the transport infrastructure network or a part of it, by a competent body. The planning process is the (sometimes formalised) preparation of a transport infrastructure plan proposal to be presented to the decision-making body. In many countries, SEA has already been utilised for certain transport infrastructure plans with considerable success, as the many examples given in the Manual demonstrate.

Box 1. The EU legal and policy framework

EIA and draft SEA Directives. According to the EU Directive on EIA (Directive 85/337EEC) (European Commission, 1985). EIAs for most infrastructure development projects need to be made before the authorities can give consent to proceed with the project. The most important requirements of the EIA Directive (as amended by Directive 97/11/EC) (European Commission, 1997c) are:

- a statement of environmental impacts should be prepared prior to decision-making. The statement should, inter alia, include a description of mitigation measures and of any alternatives that the project developer has investigated;
- it should take account of the results of inter-agency consultation and public participation;
- the decision has to be justified on the basis of the statement.

In 1997, a proposal for a Directive on the environmental assessment of the effects of certain plans and programmes on the environment (SEA Directive) was published (European Commission, 1997d). This includes plans or programmes which form a framework for making consent decisions about transport infrastructure projects. Article 2 specifically includes plans and programmes for transport corridors, port facilities and airports. The proposed SEA Directive sets out procedural requirements which are similar to those of the EIA Directive. In particular, an environmental statement describing the significant environmental effects of implementing the plan or programme, alternatives, and mitigation measures must be prepared.

White and Green Papers. The White Paper on the Common Transport Policy (European Commission, 1992c) stated that the European Commission would develop SEA as an integrated part of decision making on transport infrastructure plans. Both the White Paper and the progress report on the Fifth Environmental Action Programme (European Commission, 1995b) state that the European Commission, with the support of the Member States, should develop and apply a clear set of criteria and methods for the SEA of plans and programmes. These should address the impact of transport infrastructure and the indirect impacts in terms of newly generated traffic and local and regional development pressures associated with increased accessibility. This, in turn, requires the elaboration of a consistent system assessment approach that is based on comparable and therefore harmonised input and output data.

The European Commission (1995a) has published a Green Paper (discussion document) on 'Towards Fair and Efficient Pricing in Transport'. The objective of this paper is to launch a discussion on how pricing instruments can contribute to solving the most important transport problems (congestion, accidents, air pollution and noise) with which the Union is currently faced. The paper aims to ensure that the true costs of transport are borne more fairly by those who generate them. The paper analyses the general problem of transport externalities, and suggests policy instruments that can be applied to curb those externalities. The problems, the cost estimates and policy options of congestion, accidents, air pollution and noise are discussed in detail. These proposals have been further elaborated in the White Paper on Fair Payment for Infrastructure Use (European Commission, 1998c).

Environmental standards. The EU has passed legislation to reduce the environmental impacts from transport infrastructure and traffic. This includes, for example, standards concerning the quality of fuels, vehicle noise and air emissions and procedures to prevent spills at sea. There are also standards relating to the quality of air and water.

These standards, many of which have to be implemented through national legislation, should be used as criteria when infrastructure projects are developed. At the strategic level, it should be verified that project planning practice takes sufficient account of these standards. Improving project development procedures is also relevant when transport infrastructure plans are made, because they reduce the environmental impacts of new transport infrastructure.

(Continued next page)

Need for sustainable development

The need for sustainable development is now generally accepted. For example, the Treaty of Amsterdam confirms sustainable development as an objective of the European Union (EU) and requires that environmental protection be integrated into all EU policies 'in particular with a view to promoting sustainable development' (Article 3c).

Commitment to SEA

European Union legislation and policies relevant to the SEA of transport infrastructure plans are summarised in Box 1. In addition, it should be noted that:

- The European Conference of Ministers of Transport in Vienna in 1997 committed member countries to implement SEA.
- In May 1998, at the first meeting of the parties to the Espoo Convention on EIA in a Transboundary Context, which encourages the application of environmental assessment to policies, plans and programmes, the need for SEA was re-emphasised.
- At its meeting in Cardiff on 15 and 16 June 1998, the European Council endorsed the principle that major policy proposals by the Commission should be accompanied by its appraisal of their environmental impact. It noted the Commission's efforts to integrate environmental concerns in all Community policies and the need to evaluate this in individual decisions.

1.2.2 The benefits of SEA

Considering impacts

SEA can help to make development in the transport sector more sustainable by considering the environmental impacts of:

- strategic alternatives which are largely pre-empted or foreclosed when decisions are made at project level, such as other transport modes or significantly different routes;
- groups of transport projects, for which common amelioration measures may be appropriate, such as a general policy to stimulate public transport, or a different spatial policy;

(Box 1 continued)

Fifth Environmental Action Programme. At the European level, the Fifth Environmental Action Programme (European Commission, 1992b) gives guidance on the environmental side-effects of transport infrastructure development. It identifies the most significant environmental effects of transport as air emissions, noise and land use.

Other environmental themes in the Fifth Environmental Action Programme which may be relevant in transport infrastructure planning are climate change, acidification, air quality, protection of nature and biodiversity, management of water resources, the urban environment and coastal zones, waste management and management of risks and accidents.

Birds and Habitats and Directives. The Community legislative framework for protecting Europe's wildlife and habitats is essentially made up of Council Directive 79/409/EEC on the protection of wild birds ('Birds Directive') (European Commission, 1979) and Directive 93/43/EEC on the conservation of natural habitats and of wild fauna and flora ('Habitats Directive') (European Commission, 1992a). At the centre of EU policy on nature conservation is the creation of an ecological network, across the EU, of areas protected under the provisions of these two directives, Natura 2000.

The Habitats Directive requires the assessment of plans and projects which constitute a risk to the designated areas. This also includes the investigation of feasible alternatives, mitigation and compensation measures, which is an extra obligation in preparing SEAs of transport infrastructure plans affecting Natura 2000 areas.

Structural Funds. Regulation 2081/93, Articles 8, 9 and 11a require that regional development plans submitted under Objectives 1, 2 and 5b must include an assessment of their impact on the environment. A new Commission proposal for a general regulation on structural funds also proposes a form of SEA. Article 40 on 'Ex ante evaluation' states that "an ex ante evaluation of the environmental situation of the region concerned and of the arrangements to integrate the environmental dimension in the assistance and to ensure compliance with the Community rules on the environment. The ex ante evaluation shall include (inter alia) an environmental evaluation of the expected strategy" (European Commission, 1998b).

International agreements. Undertaking SEA fits into the context of environmental agreements which have been subscribed to, or endorsed by the EU, such as the United Nations Conventions on Climate Change and Biodiversity (UN, 1992a, 1992b). Another example is the Convention on Environmental Assessment in a Transboundary Context, agreed at Espoo (Finland) (UN, 1991). This is formulated to ensure that an environmental impact assessment is undertaken prior to a decision to authorise or undertake an activity that is likely to cause a significant adverse transboundary impact. The Convention stipulates international co-operation in assessing environmental impacts and, as a minimum requirement, that EIA should be undertaken at the project level for the proposed activity. It also states that, to the extent appropriate, the principles of environmental impact assessment should be applied to policies, plans and programmes.

Trans-European Transport Network. The Community Guidelines for the Development of the Trans-European Transport Network require Member States to undertake project EIA (European Commission, 1996a). Article 8 requires the Commission to develop appropriate methods both of analysis for strategically evaluating the environmental impact of the whole network and of corridor analysis.

More information about the EU framework for SEA can be found in, for example, Barass and Madhavan, 1996.

Box 2. Problems with EIA in the absence of SEA

Oslo and Malmö railway. A new railway was under construction along the Swedish west coast (the link between Oslo and Malmö). Construction work was stopped for at least three years due to environmental problems arising from a tunnel. Extremely difficult soft rock necessitated the use of certain chemicals to stop ground water seepage into the tunnel. These chemicals (used in large quantities) caused contamination of the groundwater, which resulted in serious illness of both workers and cattle. Despite the type of geology being known from the outset, it was not taken up as a potential difficulty at strategic level. If it had been, a different strategic decision would have been taken: a different route could have been selected where these problems did not occur. In this case the transport planners assumed wrongly that technical solutions would be found to all environmental problems at the project level (Eriksson, 1998).

Egnatia Motorway in Greece. One section of the Egnatia Motorway in Greece, a priority project of the Trans-European Transport Network, was planned to cross the habitat of the brown bear. This area is protected by international legislation (the European Habitats Directive). Following an EIA and an appeal by a non-governmental organisation, the supreme court of Greece cancelled the authorisation of the project and demanded the development of an alternative route (Dom, forthcoming).

- groups of small-scale transport activities which do not require an EIA, such as making fuller use of the existing transport network.

Other benefits

SEA not only enhances sustainable development, but it also:

- raises environmental awareness in the transport sector;
- may increase the environmental justification of proposals at the project level, resulting in speedier and cheaper project decision-making;
- encourages a learning process, creating support for the criteria used in transport infrastructure planning and hence for future environmental decisions.

If SEA is not employed:

- it may not be possible to mitigate the environmental impacts sufficiently at project level;
- unsustainable development may result;
- decision-making at project level may be delayed.

Examples of cases where undertaking an SEA could have prevented serious problems at the project level are presented in Box 2.

1.3 Purpose of the Manual

Background, intentions and coverage of this Manual.

TEN Guidelines

The European Parliament and Council have adopted Community guidelines for the development of the Trans-European Transport Network (TEN) (European Commission, 1996a). The TEN Guidelines identify potential transport infrastructure developments and Article 8 requires the Commission to develop SEA methodologies both for the whole network and for corridors.

This Manual contributes to meeting this requirement by providing an overview of available methods for SEA. It is based on both practice and on the results of research projects on SEA. Other contributions to

meeting the TEN guidelines include the preparation of a pilot SEA for the whole TEN by the Commission and the European Environment Agency, and, a number of pilot assessments of TEN corridors conducted by the Member States in co-operation with the Commission.

The purpose of this Manual is to provide methodological advice on the SEA of transport infrastructure plans. It is intended to be a user-friendly guidebook offering practical recommendations for authorities and other interested parties that are involved in carrying out an assessment. These could, for example, be environmental and transport authorities, interest groups and SEA managers.

Coverage

This Manual is intended to cover both network and corridor analysis. Network analysis refers to the assessment of the overall Trans-European Transport Network and to assessments of national and regional network schemes. Corridor analysis refers to more detailed assessments of individual transport corridors, potentially involving modal options (roads, railways, inland waterways, pipelines, ports and airports.).

The Manual deals only with the SEA of transport infrastructure plans: the SEA of closely related transport policy (and associated environmental, economic, fiscal and social policy) is not described. However, suggestions about policies to reduce the effects of traffic on new and existing infrastructure are made.

The Manual concentrates on the development of inter-city, rather than urban, transport infrastructure. It gives examples of, and methodological suggestions for, SEA. Wherever possible these are based on cases that are known to have actually contributed to infrastructure planning. The Manual discusses both the SEA process and the writing of the SEA report and the integration of environmental objectives into decision-making by using SEA.

Link with other assessments

It should be remembered that transport infrastructure plans not only have consequences for the environment, but also for employment and income, accessibility of travel destinations, safety, land use, and spatial patterns and relationships. In order to attain sustainable development, these effects also need to be assessed. The different assessments contribute to the same planning and decision-making

process. In particular 'accessibility', i.e. the time and cost to access certain locations, is receiving increasing attention as an indicator for socio-economic effects.

Many of the suggestions made in this Manual are equally applicable to other types of assessments. It is more likely that different assessments will be integrated and co-ordinated at strategic levels of decision-making rather than at project level. This Manual therefore discusses the co-ordination of different assessments and their overall integration into the planning process and into decision-making.

Flexibility

The practice of SEA is closely related to national systems of decision-making. Each country has its own system for transport infrastructure planning, and for integrating environmental factors with transport infrastructure plans. Many countries are in the process of revising their decision-making and assessment systems (see Appendix 3). Since these approaches to national decision-making are so variable, it is not possible in this Manual to give a universal step-by-step approach to SEA of transport infrastructure plans. However, this Manual is designed to be applied within all national frameworks, whether or not there exist explicit national transport and environmental policies.

Many national governments have issued guidance on environmental assessment for transport infrastructure planning. This may vary from, for example, generic guidance on the design of noise barriers to definitions of sensitive and protected areas. Some examples are included in Section 15.3 and in Appendix 3. Numerous European governments are undertaking SEA activities and examples from practice are used as illustrations in boxes throughout this Manual. The sources of these examples are listed in Appendix 2.

1.4 Further Reading

- European Commission, 1995c. *Strategic Environmental Assessment Legislation and Procedures in the Community*. Directorate-General XI, European Commission, Brussels.

(This report provides an overview of the status of SEA legislation and procedures within Member States and presents case studies of a land

use plan (United Kingdom), a forestry plan (Spain) and a transport plan (Germany).)

- European Commission, 1996b. *Environmental Impact Assessment: a Study on Costs and Benefits*. Directorate General XI, Brussels.

(This study includes SEA as well as EIA. It concludes that SEA is already in widespread use throughout the European Community, and that many different forms of assessment are termed SEA. It found that increases in costs attributable to SEA were marginal. Studies of transport infrastructure EIAs showed that some environmental constraints could have been avoided if alternative routes and alignments had been considered at the policy formation stage.)

- European Commission, 1997b. *Case Studies on Strategic Environmental Assessment.* Directorate-General XI, European Commission, Brussels.

(This report presents an overview of 18 SEA case studies drawn from nine EU Member States and Slovenia. Four of these relate to transport policies, plans or programmes.)

- European Commission, 1998a. *A Handbook on Environmental Assessment of Regional Development Plans and EU Structural Fund Programmes.* Directorate-General XI, Brussels.

(This handbook sets out an approach to meeting EU requirements for the environmental assessment of regional development plans and programmes in the context of the Structural Funds. It deals with other sectors as well as transport.)

- National Road Administration, 1998. *Gothenburg – Jönköping Transport Corridor: Environmental Impact of Strategic Choice*. NRA, Borlänge.

(The first pilot assessment of a TEN corridor to be published is intended to develop methods for the SEA of transport infrastructure plans. It involves seven combinations of road and rail development options and includes economic and road safety analyses.)

- Sadler, B. and Verheem, R., 1996. *Strategic Environmental Assessment: Status, Challenges and Future Directions*. Report 53, Ministry of Housing, Spatial Planning and the Environment, The Hague.

(This report compares SEA trends, issues and directions in selected countries and international organisations. It describes the state of the art of the SEA process in practice.)

PART 1: THE PRINCIPLES OF SEA FOR TRANSPORT INFRASTRUCTURE PLANS

In Part 1:

- The SEA process, the steps of which are further elaborated in Part 2.
- Tiering and linkage to planning: how issues in SEA depend on the issues in the transport infrastructure plan.
- Managing the SEA process: increasing efficiency, quality and public support.

2 The SEA process

Read this chapter to gain an overview of the steps in the SEA process, which form the chapters in Part 2. Skip this chapter if you already have a background in EIA and SEA.

2.1 The nature and principles of SEA

How SEA works: procedure; principles; and structure.

Procedure

Ideally, the SEA process should be directly linked to the preparation of a transport infrastructure plan, assessing not only the proposed plan, but also feasible alternatives which may be environmentally preferable. The SEA process may be a legally formalised procedure, or an ad-hoc procedure. If there are no legal procedures, it should be carried out through informal co-operation between transport authorities and environmental authorities.

Principles

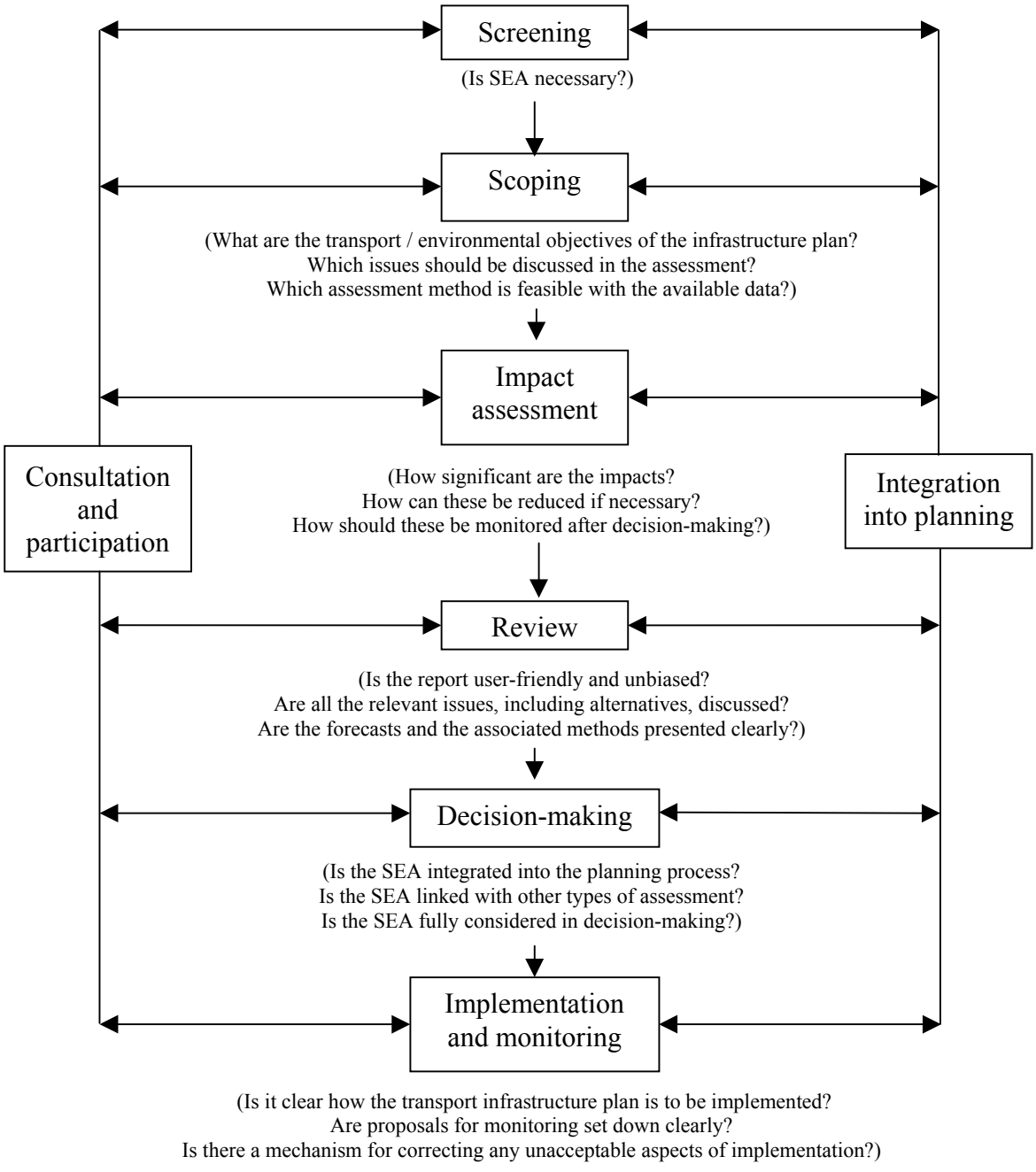
The objectives of the SEA process can be achieved if it follows accepted SEA principles:

- SEA should be applied, **at the earliest stage,** to all transport infrastructure plans that may have environmental consequences. Planners should preferably start a dialogue with environmental experts as soon as it is decided that a new transport infrastructure plan (or major change of an existing plan) is to be prepared.

- The **plan initiator is responsible** for the preparation of an SEA report for the transport infrastructure plan and should seek collaboration with the environmental authorities. The initiator is best positioned to reduce impacts while achieving the plan objectives. He should collaborate with environmental authorities, who are aware of environmental objectives and sensitivities.

- The SEA report should be reviewed by environmental and other interested parties and by the public. The **review** should establish that the SEA report describes the impacts of the proposed plan, as well as possible alternatives and the reasons for their rejection.

Figure 1. Steps in the SEA process



Source: adapted from Department of the Environment, 1991 and
United Nations Economic Commission for Europe, 1992.

- The SEA report should be presented to the decision-makers at the same time as (or as part of) the proposed transport infrastructure plan. The competent authority should take the SEA report into account in **decision-making**. When the competent authority makes its decision about a proposed transport infrastructure plan, it should make explicit reference to the SEA report, justifying its decision if it is unable to adopt some of the SEA report recommendations.

- SEAs should involve both technical forecasting activity and **frequent consultation** (both as a formal step in the procedure and informally) of environmental authorities, other agencies and interested groups. The public should participate in the SEA process. Interested and affected groups should be aware of the steps involved in an SEA process and of the opportunities for **participation** available. The results of the SEA process should be understandable to these groups.

Structure

- The **structure** of an SEA process (the precise steps taken) depends on the planning procedure to which the SEA is linked. The structure of the SEA process, as an instrument for informed decision-making, should therefore be flexible. Indeed, as mentioned in Section 1.1, the term SEA is sometimes applied to the informal consideration of the environmental impacts of policies, plans and programmes.

2.2 Steps in the SEA process

The main stages of the SEA process.

When a transport authority starts the preparation of a transport infrastructure plan, a decision must be made as to whether an SEA is necessary. This is the 'screening decision', the first step of the SEA process, which must be taken very early in the planning process. The further steps leading to the submission of an SEA report and a transport infrastructure proposal (and beyond) may depend on the national system of SEA and of infrastructure planning. However, the steps indicated in Figure 1 are applicable in most transport infrastructure planning contexts.

The following observations can be made about the SEA process illustrated:

- **Environmental objectives** for the transport infrastructure plan should be specified within the SEA process. This normally forms part of the scoping phase.

- **Integration** of the SEA's findings into planning, and c**onsultation and participation** of environmental authorities, other public and private organisations and groups and the public, should occur throughout the SEA process, as illustrated in Figure 1.

- The scoping phase and assessment phase need **baseline information** about the initial state of the environment and about foreseeable development. This information may be gathered from existing sources. If necessary additional baseline data may be gathered.

- It should be remembered that Figure 1 presents a schematic description of the steps in the SEA process. In any SEA, each of these steps will be necessary but may be less explicit or occur in a different order. Steps may be repeated several times, and there may be repeated iterations of earlier steps as further environmental, and non-environmental, information becomes available.

2.3 Further reading

- European Commission, 1995c. *Strategic Environmental Assessment Legislation and Procedures in the Community*. Directorate-General XI, European Commission, Brussels.

(This report presents an overview of SEA legislation and procedures in the European Union and contains three case studies.)

- European Commission, 1998a. *A Handbook on Environmental Assessment of Regional Development Plans and EU Structural Fund Programmes.* Directorate-General XI, Brussels.

(This handbook sets out an approach to meeting EU requirements for the environmental assessment of regional development plans and

programmes in the context of the Structural Funds. Deals with other sectors as well as transport.)

- European Council of Ministers if Transport, 1994. *Environmental Impact Assessment of Roads*. ECMT, Organisation for Economic Co-operation and Development, Paris.

(This publication makes an international comparison of legal requirements and practices of EIA and SEA with respect to road infrastructure. It presents indicators, assessment methods and examples. The recommendations were endorsed by 35 ministers of transport)

- Organisation for Economic Co-operation and Development, 1998. *Strategic Environmental Assessment in the Transport Sector*. OECD, Paris.

(This publication, arising from a European Conference of Ministers of Transport, seeks to contribute to the development of effective procedures for incorporating adequate environmental assessments into all strategic transport sector decisions. It defines the concept of SEA, clarifies the link with EIA and outlines the existing procedures and practice in different countries around the world. An overview is given of the recent development of SEA in the transport sector and of the SEA research of the European Commission. The report formulates recommendations on policy and research, and sets up proposals for priority action.)

- Sadler, B., 1996. *Environmental Assessment in a Changing World: Final Report of the International Study of the Effectiveness of Environmental Assessment.* Canadian Environmental Assessment Agency, Hull, Quebec.

(One chapter of this report presents a detailed review of current SEA approaches and practices in several countries and international organisations. Good practice guidance on the application of SEA is given.)

- Sadler, B. and Verheem, R., 1996. *Strategic Environmental Assessment: Status, Challenges and Future Directions*. Report 53, Ministry of Housing, Spatial Planning and the Environment, The Hague.

(This report compares SEA trends, issues and directions in selected countries and international organisations. It describes the state of the art of the SEA process in practice.)

- Thérivel, R. and Partidário, M. R., 1996. *The Practice of Environmental Assessment*. Earthscan, London.

(This book is a collection of case descriptions by different authors in several sectors, and in several countries, including Germany, the Netherlands, the United Kingdom and Sweden (and the TEN). Thérivel and Partidário add general chapters on SEA regulations and on lessons from practice.)

3 Tiering and linkage to planning

Read this chapter to learn how the issues in SEAs depend on the issues in transport infrastructure plans. Skip this chapter if you already have a background in transport planning.

3.1 Planning levels

Levels of decision-making about transport infrastructure planning.

Transport infrastructure decisions may be divided into the following main planning levels:

- **network** decisions mainly determine transport infrastructure capacity between several urban centres and poles (the nodes, which form points of departure, destination and transhipment). In formalised decision-making systems transport plans are normally made for the whole network in a jurisdiction;

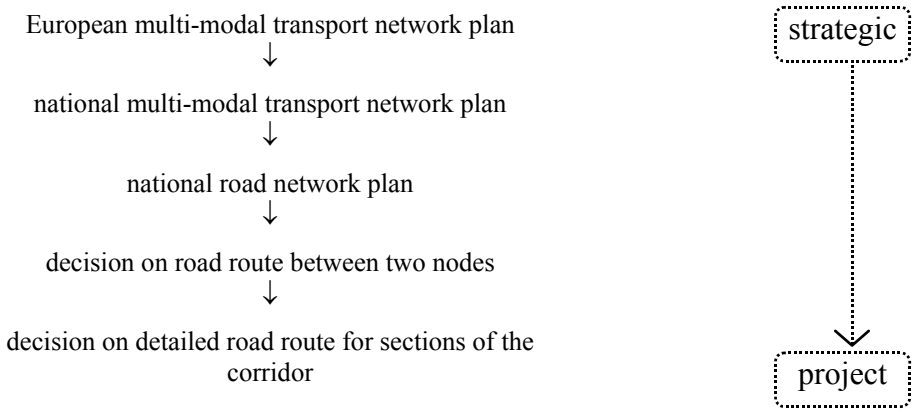
- **corridor** decisions determine the need for developing transport infrastructure capacity, and the appropriate modes and routes, between two urban centres or other major traffic generation poles. The corridor may consist of more than one transport mode;

- **project** decisions consider the detailed location and design of, and mitigation measures for, individual transport infrastructure projects. The environmental effects of these decisions are assessed in (project) environmental impact assessment (EIA).

The three main decision-making levels are an idealised representation of the different types of transport infrastructure plans. Depending on previous decision-making and the competence and intentions of the initiator, the following variations may occur:

- infrastructure plans at network or corridor level may consider only one transport mode (road, rail, inland waterway, marine, air or pipeline) or several (multi-modal);

Figure 2. An example of decision-making in transport infrastructure planning



- infrastructure plans may be limited to a geographic scale (European - international - national - regional - local) and there may be functional interactions with decisions made earlier at different scales;

- infrastructure plans may either be binding or advisory (leaving some issues and options open for (re)consideration in future decision-making). This factor, in particular, is country-dependent.

3.2 Tiering of successive levels

How the different levels of transport infrastructure planning relate to each other.

Tiering

The formal decision-making system in every country is determined by the legal system: i.e. by the responsibilities of administrative bodies and democratically chosen bodies, and by legal procedures that lead to particular types of formal decision. Different formal decisions may be linked to each other (i.e. influence each other in a explicit or in an implicit way), in which case they are said to be tiered.

Most attention is paid to vertical tiering within the transport sector: i.e. phased decision-making about transport infrastructure projects. This is shown in Figure 2. Each of the first four formal decisions shown in Figure 2 can be linked to an SEA process, though the content of these SEAs will vary in order to avoid duplication. The final, project, decision can then be linked to an EIA designed to minimise environmental impacts, rather than to approve or reject the project.

A planning process

Each tier of decision-making is the result of a separate planning process. Because SEA should start at the earliest stage, each planning process should be linked to the SEA process from its inception. The result of a planning/SEA process is a proposed plan and an associated SEA report. The proposal becomes a plan when it is formally approved (formal decision-making) and gains legal status.

Each planning process is itself phased: intermediate plan proposals are assessed and improved; and intermediate (informal) decisions are made. If the planning / SEA process for a particular tier of decision-making follows a legal procedure, some of the intermediate stages and

Box 3. Assessment of transport infrastructure plans in The Netherlands

In The Netherlands, the Cabinet has proposed a number of large infrastructure projects which are crucial for the long term development of the national economy, and has asked for an assessment of the package (Central Planning Bureau, 1998; Geerlings et al., 1998). The assessment included economic growth, environment, mobility and spatial development aspects. The core indicators applied were: employment, regional disparity of income, CO_2-emissions, noise, efficient use of infrastructure capacity, multi-functional land use, and impact on the national network of habitats. In the assessment, alternative 'packages' of projects were compared with one another. Given the large degree of synergy between the projects in each package, they had to be considered together (**'portfolio approach'**). Alternative packages included developing The Netherlands as:

- a 'transport country' (investing more in transport infrastructure),
- a 'high tech country' (investing more in education),
- a 'factor 4 country' reducing the use of environmental resources by a unit of transport by 75% (investing among other things in environmental clean-up), or
- a 'leisure country' investing mainly in spatial quality in rural and urban areas.

reports may have a formal status. It should be remembered that the variation in formal decision-making systems is very large. In one country the number of formal, tiered transport sector decisions that eventually lead to an infrastructure project may be large. In other countries, strategic decisions may not be subject to formal decision-making systems at all. Many layers of strategic decisions are then sometimes made informally, as part of a single planning / SEA process.

Other assessments

In order to be sustainable, transport infrastructure plans should not only account for environmental impacts, but also for many other types of impacts (e.g. economic assessment, etc). These assessments should all be linked to the planning process, in the same way as the environmental assessment. The scope for duplication and methodological inconsistency is considerable and the number of assessments should therefore be kept low by combining different assessments. The following main types of assessment, apart from SEA, may be distinguished, and it may be assumed that other assessments can be accommodated within one or more of these categories:

- **transport and financial assessment**: an assessment of the beneficial macro-economic impacts that the initiator expects to achieve by developing these plans (e.g. financial benefits from reductions in travel time by easing congestion, and reductions in transport costs and in accidents), compared with the financial cost of the investment;

- **socio-economic assessment**: an assessment of the impact on the accessibility of locations to the general public, and the social and economic consequences of this;

- **spatial impact assessment**: an assessment of the consistency of the proposed transport infrastructure plan with existing spatial (land use) plans, and/or an assessment of the induced secondary development and of the general impacts on spatial development.

An example of this type of sustainability assessment, undertaken in the Netherlands, is given in Box 3.

3.3 Implications of tiering of issues

How the issues considered at different levels of transport infrastructure planning relate to each other.

Because of the variations in planning systems, the issues considered in decision-making may also vary. In turn, feasible alternatives and associated environmental impacts that can be influenced by decision-making may also vary. At any level of planning, the following options may be available to reduce environmental impacts:

- the transport capacity and traffic in different corridors,
- the relationships between different corridors and different modes,
- the transport mode (road, rail, air, water, pipeline),
- the location and its sensitivity,
- the design, construction methods and measures to mitigate adverse impacts for individual transport infrastructure projects.

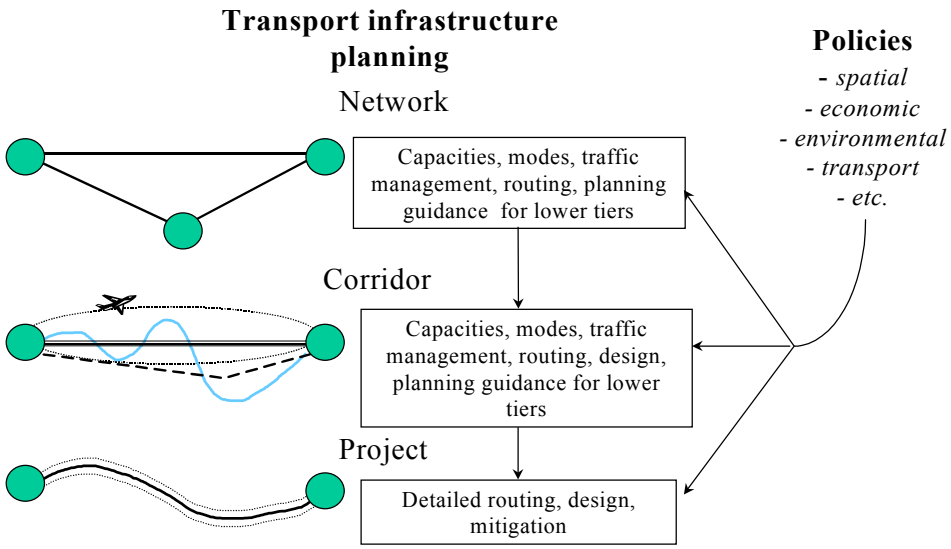
No universal tiering order

The issues considered in an SEA depend on the issues about which the associated transport infrastructure plan proposes solutions. This is determined by the planning and decision-making system: the tiers of infrastructure planning are often determined by country-specific procedures. Moreover, area-specific problems in the transport sector may require a particular tiering of decision-making. Thus, there is no universal tiering order in infrastructure planning or its environmental assessment.

However, it is generally true that:

- in higher tier assessments, the types of alternatives considered are more 'strategic' than in lower-tier decision-making (e.g. determination of the necessary infrastructure capacity is more strategic than design of noise barriers);
- SEAs at higher tier levels apply more broadbrush methods, whilst SEAs and EIAs at lower tier levels apply more detailed and complex methods;

Figure 3. Tiering of transport infrastructure planning



Box 4. Policies to encourage the use of environmentally friendly transport modes

Many governments, and the European Commission, have adopted policies to encourage the use of environmentally friendly modes of transport. The instruments for achieving a change in modal split differ. One instrument is to link transport and spatial policy (e.g. by placing housing and industrial locations near railway stations). One example is Germany, which has set out its policy in a guidance document 'Guidelines for regional planning' (Ministry for Regional Planning, Building and Urban Development, 1993), which includes environmental guidelines.

- at higher tier levels, the emphasis is on global (large-scale) impacts, such as climate change, whilst lower tier levels focus more on local (small-scale) impacts, such as noise.

3.4 Typical issues at different tiering levels

Issues that are typically considered at network, corridor and project level.

Figure 3 presents a general representation of the tiering of transport infrastructure plans and of the issues addressed at each level.

Policies

Policies in various sectors influence both transport infrastructure planning and the general impacts of transport on existing and planned infrastructure (see Box 4). These policies should themselves be subject to SEA wherever possible. Transport policies should take into account general environmental and sustainability objectives for the transport sector which will partly be attained by infrastructure planning.

Networks

Transport infrastructure plans at network level often determine the corridors in which extension of the transport infrastructure is necessary, and they often also determine which mode is to be employed (there may be only one option). The initiator (for example, a road administration) may not have competence with respect to other transport modes, in which case multi-modal issues are probably considered at higher tiers. If not, modal plans can be integrated, because different modes can offer environmentally friendly alternatives. Typical issues at the network level are:

- In which corridors does further development have the highest priority?
- Which corridors are functionally linked, and should be considered together?
- Which corridors have environmental risks that need special attention?
- What political provisions are necessary in relation to infrastructure proposals?

Box 5. Federal Transport Infrastructure Plan 1992, Germany

In Germany, decisions about infrastructure are tiered in the following sequence: Federal Transport Infrastructure Plan, determination of alignment, and project:

Tier	Content	Legal status	Decision level	Environmental assessment
Federal Transport Infrastructure Plan	Determination of demand (need) for federal traffic routes	Government programme	Federal government	Ecological risk analysis
Determination of alignment/regional planning procedure (Linienbestim-mung/ Raum-ordnungsver-fahren)	Determination of general route for a single project	Internal administrative procedure	Ministry of Transport Länder administration	Environmental impact assessment (according to EIA act)
Plan approval / plan determination	Final determination for a single project including mitigation measures	Administrative procedure following a weighing procedure	Federal railway authority, Lländer administration	Environmental impact assessment (according to EIA act)

The Federal Transport Infrastructure Plan determines the priority of a large number of proposed projects. Low ranking projects are rejected. The environmental consequences of proposed infrastructures are among the ranking criteria. The projects with the highest priority subsequently 'enter' the second tier (indicative alignment). At the project level, detailed alignment and mitigation are considered. At each level, an environmental assessment is carried out, with increasingly detailed information and decreasing potential for alternatives.

Among the criteria for allocation to the highest priority is: 'the ecological assessment must show, within the large-scale framework of federal traffic infrastructure planning, that careful co-ordination in the subsequent planning stages will provide an ecologically acceptable and relatively conflict-free alignment, where any inconvenience may possibly be compensated'. If this is not the case, the project is downgraded or may even be dispensed with. In some cases, projects were further pursued even though there were considerable environmental problems. For these projects, special ecological planning commitments for the subsequent tiers of planning were laid down.

NB: See Appendix 2 for sources of SEAs used as illustrations in this Manual.

Box 6. High Speed Railway, Milan-Bologna, Italy

The route selection of the Italian High Speed Railway from Milan to Bologna was determined by the requirements of the national transportation plan (network level). This means that the route was planned to be placed side-by-side with the existing highway. The building permit had to be obtained from the local administrations, who can influence decisions on almost any part of a new infrastructure project, including route selection. During the SEA procedure at corridor level, major route changes were made to more than one-third of the total length of the request of the local authorities. As a result, around 140 km of the line remained alongside the existing highway or railway, while approximately 40 km of the line around the town of Modena was located well away from existing infrastructure.

Corridors

Decisions at corridor level typically involve consideration of alternative transport modes (if they are not foreclosed by plans at network level) and the major routes. Mostly, essential decisions about corridors are made at network level, as was the case for the Federal Transport Infrastructure Programme 1992 in Germany (Box 5). In such cases, alternatives which are rejected at the network level are not normally considered again at the corridor level. The corridor assessment may then be limited to determining the indicative route of the proposed infrastructure, as in the case of the Milan-Bologna High Speed Railway (Box 6). Typical issues at corridor level are:

- Can objectives be met by demand management or redistributing traffic?
- Would it be sufficient to upgrade existing infrastructure, or is a new route unavoidable?
- Broadly, what routing options are available? Are there ways to avoid sensitive sites (e.g. with tunnels)?
- Are there specific options which encourage the use of environmentally friendly modes in the corridor?
- Can the environmental conditions which may have been set at previous tiers be met? Can remaining impacts be mitigated, e.g. by habitat compensation?

In many countries, EIAs at project level also consider alternative modes and major routes for the corridor as a whole. The corridor tier and the project tier are then combined. However, in the ideal case, the alternatives assessed at corridor level (and therefore the impacts assessed) depend on decisions made at network level.

Guidance

As mentioned in Section 15.3, many countries have prepared guidance for environmental assessment. Such guidance may significantly influence the environmental impact of transport infrastructure development. Transport infrastructure plans at network and corridor level may include guidance with respect to decisions still to be made at lower tiers.

The level of environmental alternatives

In SEAs, it is frequently suggested that transport alternatives which are likely to be environmentally preferable should be considered. The

Box 7. Environmental appraisal of Trunk Road Programme, England

In the English environmental appraisal of the Trunk Road Programme, the evaluation of road schemes was intended to be tiered in three steps. At the first stage studies were prepared at corridor level on advantages, disadvantages and constraints from the economic, environmental, engineering and traffic aspects. The route options were identified and evaluated at the second stage. The studies prepared at this stage were used for public consultation. Decisions were made on the preferred option after the second stage. During the last stage design studies and an environmental assessment were prepared on the selected option. At the end of the third stage the apparently final decision was made by the (then) Secretaries of State for the Environment and for Transport. In fact, following a change of Government, further consultation and participation and the preparation of a set of appraisal summary tables, a smaller set of priority schemes was approved.

planning level for considering such environmental alternatives depends on the level of the consequences of these alternatives. SEAs should assess corridors together if they serve the same traffic to a significant extent.

There may be a functional relationship (a dependence or synergy) between corridors, ports and airports. For example, environmentally friendly modes may only be feasible if they are located in different (connected) corridors. These issues should be considered at the network level.

Generally, however, choices made in most corridors and modes are not strongly dependent upon each other from the traffic viewpoint. This was, for example, shown in the case of the German Federal Transport Infrastructure Plan (1992) (see Box 5). Decisions about the need for new infrastructure and about assessments were therefore undertaken on a connection-by-connection basis. Another example is the English Trunk Road Programme (Box 7). In such cases, proposals for extension of corridors are often made by governments at lower scales ('bottom-up': in the German case, the Bundesländer) but actual decisions and financing for long distance infrastructure are made at the higher scale ('top down').

3.5 Further reading

- European Commission, 1997e. *The EU Compendium of Spatial Planning Systems and Policies*. Regional Development Studies 28, Directorate-General XVI, Brussels.

(This report gives an overview of national spatial planning systems and their context.)

- Nooteboom (forthcoming). *Environmental Assessment of Strategic Decisions and Project Decisions: Links and Benefits*. Ministry of Housing, Spatial Planning and the Environment, The Hague, with financial support of the European Commission, Directorate-General XI.

(This report gives an analysis of the literature on, and practice of, links between the application of SEA at the policy, plan or programme

level, and EIA for projects. It is based on 13 case studies in various Member States.)

- See also 'national guidance on SEA and EIA in transport infrastructure planning' (Section 15.3).

- International Society of City and Regional Planners, 1992. *The International Manual of Planning Practice*. ISOCARP, The Hague, 2nd edition.

(This manual gives a detailed account of national planning legislation and practice at local level.)

- Nijkamp, P. and Blaas, E., 1994. *Impact Assessment and Evaluation in Transport Planning*. Kluwer, The Hague.

(This book is an academic work on the process of transportation planning. It describes methods for the analysis of transport and environmental problems that give results suitable for communicating to affected groups. The emphasis is on the link between transport planning, regional development and spatial-economic policy.)

4 Managing the SEA process

Read this chapter to discover ways to improve the management of the SEA process, enhancing its quality and efficiency, and the support for the resulting plan.

4.1 Why SEA process management?

Benefits of SEA process management.

Management of the SEA process is of crucial importance to its success, given:

- the multitude of involved actors. These should include:
  - ⇒ the initiator of the plan (the transport authority)
  - ⇒ the environmental authority
  - ⇒ other departments having an interest in transport infrastructure (e.g. housing, public health, safety)
  - ⇒ the decision-maker who has the competence to approve the final transport infrastructure plan (e.g. Parliament)
  - ⇒ non-governmental organisations (NGOs) and the general public.
- the complex nature of the alternatives and issues considered.
- linkage to planning and other assessments.
- the need for co-ordination and feed-back to avoid unecessary delays.

It is, in fact, the overall planning and assessment process which has to be managed. Done well, considerable time and quality gains are possible.

Transboundary assessments

A special case is the co-ordination of SEAs (and EIAs) for transport infrastructure which crosses borders. In these cases, the Espoo

Table 1. A procedure for managing the SEA process

Step	Phase	Possible report	Primary actors	Consultations
Scoping	initial phase of SEA and transport infrastructure plan development	inception note	initiator	
	consultation and participation	scoping document	initiator, competent authority	other agencies, NGOs, public
Assessment	initial planning and impact assessment phase	SEA report and transport infrastructure plan	initiator	
	consultations	report of comments	initiator, competent authority	other agencies, NGOs, public
	final planning and impact assessment phase	SEA report and final transport infrastructure plan	initiator	

Table 2. Content of possible SEA procedure documents

Inception note	Description of the type of decision which the initiator intends to make (What is it about? What problems should it solve?). The inception note is intended to inform the discussion during consultation and participation. The initiator may express his preliminary views about the issues to be covered in the SEA.
Scoping document	Decision about the scope of the assessment: the environmental objectives the transport infrastructure plan should try to address, and infrastructure options to be assessed. This is the opportunity to justify the exclusion of less significant issues from the scope of the SEA.
SEA report	Statement about the environmental effects of the proposed transport infrastructure plan that is submitted for decision-making.
Review report	Evaluation of the SEA report (Does it respond to the issues raised in the scoping document?).

Convention is applicable. However, the plans on both sides of the border have to be compatible with each other and it is desirable to co-ordinate the planning and assessment processes. There are some cases where this has occurred (e.g. the High Speed Rail Netherlands - Belgium (European Commission, 1997b)).

4.2 Phasing

Structuring the process over time.

Each of the steps of the SEA process (e.g. scoping, impact assessment and review) should be divided into phases with clear tasks, roles and responsibilities. At the end of each phase, intermediate decisions should be made to accept or reject the outcome and to determine the work that still has to be done.

If SEA legislation exists, the law will probably prescribe an SEA procedure. Otherwise, an ad-hoc procedure should be set up with the agreement of the decision-maker. This should involve informal co-operation between the transport authorities and the environmental authorities.

Agreeing a procedure

Transparency is greatly enhanced by agreeing a clear procedure at the start of the SEA process. This procedure may specify (i) the initial problem description for strategy development, (ii) the objectives of the SEA process, (iii) the sequential steps of the procedure (i.e. documents and decision points), (iv) the time frame, (v) provisions for consultation and participation, (vi) the actors and their roles.

By way of an example, one procedure is presented in Table 1. Such procedures at the strategic level may be integrated with other assessments into a general assessment and decision-making procedure (e.g. as the German Federal Transport Infrastructure Programme – Box 5). Particular environmental requirements in the procedure are then limited to the actions assessed and the impacts and alternatives taken into account.

The reports which may be produced during this procedure could have the contents shown in Table 2. The size of these documents depends on the complexity of the decision-making problem (i.e. the number of

Box 8. Linkage of the assessment step in SEA with planning: the German Federal Transport Infrastructure Plan

Phases of Federal Transport Infrastructure Plan	**Actors**
Forecast of traffic demand	Ministry of Transport
Examination of the traffic network Recommendations for infrastructure projects	Länder, Railroads, Deputies, Ministry of Traffic
'Macro-economic' evaluation (including ecological risk assessment)	Ministry of Transport
Priority rating considering financial planning Draft Federal Transport Infrastructure Plan	Ministry of Transport

environmentally relevant issues) and the degree of openness and transparency. For example, in the case of the German Federal Infrastructure Plan (1992) (Box 5), about 30 background publications describing the environmental impacts of traffic at the national level were used.

The most complex step is the assessment itself. This step may be elaborated in more detail, as the example in Box 8 shows.

4.3 Flexibility

Ensuring that the SEA process is not too rigidly defined.

The SEA process should respond appropriately to the various inputs from consultation and participation. Also, the interaction between the transport planning team and the environment team may give unexpected outcomes. The SEA procedure should therefore be flexible with respect to its phasing and organisation. Flexibility can be enhanced in a number of ways:

- anticipating possible outcomes from consultation and public participation;
- communicating frequently, and at an early stage, with interested agencies and groups; listening to signals and clearly explaining the SEA process;
- making short-term or framework contracts with consultants to respond to uncertain outcomes.

4.4 Applying management tools

Other tools for SEA process management.

The initiator may appoint an SEA process manager, who is in charge during the whole SEA process.

The following management tools are particularly helpful in the assessment step:

- setting **clear targets** for the SEA report and its intermediate drafts;

- setting up an **inter-disciplinary team** of experts (e.g. ecologists, traffic modellers, socio-economic experts, landscape planners, etc.);

- ensuring good **collaboration** exists between the planning and environmental authorities.

- enabling effective **feedback** to be made between assessment results and the planning process, for example by:

  ⇒ drawing up organisation charts;

  ⇒ preparing internal draft plans and assessments which are circulated among those taking part in the planning and assessment work;

  ⇒ stationing planners and environmental experts in the same location;

  ⇒ applying team-building techniques;

- providing sufficient **time and resources** to open up the assessment and planning phase by encouraging external parties and the public to comment on the drafts;

- ensuring that the results of the evaluation are taken into consideration in the **final decision**.

Even in countries where co-ordination between different government departments is not institutionalised, there are many advantages in setting up informal collaborations between departments in carrying out an SEA. This is particularly true in countries where environment ministries are not as influential as in, say, The Netherlands.

Managing public participation is described in Chapter 11 and co-ordination with planning and other assessments in Chapter 9.

4.5 Further reading

- European Commission, 1993. *Manual on Project Cycle Management, Integrated Approach and Logical Framework*. Directorate-General VIII, Brussels.

(This manual is intended for use in the design and management of development aid projects. The methods and tools proposed, however, are applicable to wider management of complex projects.)

- United Nations Economic Commission for Europe, 1996. *Current Policies, Strategies and Aspects of Environmental Impact Assessment in a Transboundary Context*. Environmental Series 6, UNECE, Geneva.

(This report describes 1995 practice with respect to the implementation of transboundary environmental assessment, covers legal and administrative aspects and discusses bilateral and multilateral co-operation issues.)

PART 2: STEPS IN THE SEA PROCESS

In Part 2:

- Every step of the SEA process, as indicated in the Figure 1:

  ⇒ Screening

  ⇒ Scoping

  ⇒ Impact assessment

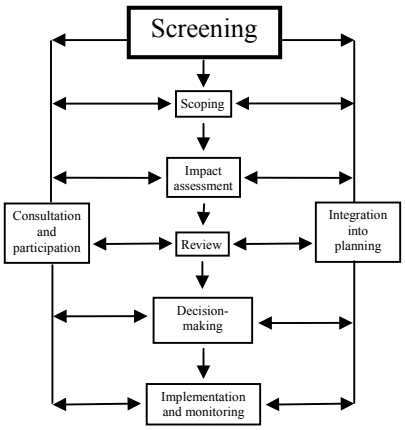
  ⇒ Review

  ⇒ Integration into planning and decision-making

  ⇒ Implementation and monitoring

  ⇒ Consultation and participation

5 Screening



Read this chapter to learn how to decide which transport infrastructure plans require an SEA.

5.1 Which infrastructure plans require an SEA?

Plans requiring mandatory SEA, SEA for plans involving infrastructure projects requiring EIA, and plans not requiring SEA.

If a transport authority intends to propose a transport infrastructure plan, undertaking an SEA may be mandatory. The screening activity is then, as in EIA, limited to verifying whether the infrastructure plan is of a type that legally requires an SEA.

However, it may also be useful to undertake an SEA in other situations. In general, the issue is whether or not the transport infrastructure plan is likely to have significant environmental impacts that can be reduced by undertaking an SEA. This is likely to be the case for many transport infrastructure plans, as most long-distance infrastructure projects require an EIA.

Thus, transport infrastructure plans may require an SEA if:

- they set a framework for further decisions about projects which require an EIA according to national legislation, based on the EU Directive as amended (Table 3);

Table 3. The screening provisions of the amended EIA Directive relevant to transport infrastructure

Annex 1 includes the types of projects which require an EIA. The following categories may be considered in transport infrastructure plans:

7.(a) Construction of lines for long-distance railway traffic and of airports with a basic runway length of 2100 m or more;

(b) Construction of motorways and express roads;

(c) Construction of a new road of four or more lanes, or realignment and/or widening of an existing road of two lanes or less so as to provide four or more lanes, where such new road, or realigned and/or widened section of road would be 10 km or more in a continuous length.

9. (a) Inland waterways and ports for inland/waterways traffic which permit the passage of vessels of over 1350 tonnes.

(b) Trading ports, piers for loading and unloading connected to land and outside ports (excluding ferry piers) which can take vessels of over 1350 tonnes.

16. Pipelines for the transport of gas, oil or chemical with a diameters of more than 800 mm and a length of more than 40 km.

Annex II includes the following projects for which EIAs should be prepared where Member States consider that their characteristics so require:

10. Infrastructure projects:

(c) Construction of railways and intermodal transshipment facilities, and of intermodal terminals (projects not included in Annex 1);

(d) Construction of airfields (projects not included in Annex I);

(e) Construction of roads, harbours and port installations, including fishing harbours (projects not included in Annex I);

(f) Inland waterway construction not included in Annex I, canalization works;

(h) Tramways, elevated and underground railways, suspended lines or similar lines of a particular type, used exclusively or mainly for passenger transport;

(i) Oil and gas pipeline installations (projects not included in Annex I);

(j) Installations of long-distance aqueducts.

NB: Location of likely impacts is dealt with in Part 3.

Source: European Commission, 1997c.

Box 9. Screening in the German Unity Programme

For the German Unity programme criteria for the consideration of environmental effects had been developed co-operatively by the Ministry of Transport and the Ministry of Environment and an agreement has been signed. The environmental considerations have been detailed within supplementary guidance. Both Ministries agreed on additional environmental requirements for a specific project to be inserted in the later licensing procedures.

Source: Bundesministerium für Verkehr, 1992

- they have significant impacts on societal activities which have environmental impacts (e.g. influence on traffic flows, traffic conditions or changes in modal split, with likely effects on energy use and emissions).

Where an SEA is not to be carried out, the initiator should demonstrate, as a result of screening, that the transport infrastructure plan will have no significant environmental impacts.

5.2 How to screen?

Early notification, agreeing procedures and screening criteria.

Normally, the transport authority initiates the development of a transport infrastructure plan, and the competent or environmental authority screens the initiative. Since SEAs should start at the earliest stage of the planning process, the competent and environment authorities should be notified as **early as possible**.

If a transport infrastructure plan is submitted to an SEA procedure, this could be limited to certain decisions made in the plan. For example, in the case of the Federal Transport Infrastructure Plan in Germany (Box 5), additional ecological risk assessments were conducted only for road corridors with a length of more than 10 km (110 roads out of over 1000 road projects), and for all new railroads and inland waterways.

If no mandatory SEA procedure exists, screening can also be used to **agree about the SEA procedure**. To enhance transparency, this should be agreed with, or communicated to, the parties involved, including the public.

Many transport departments initiate several transport infrastructure plans every year. It may be practical to make a programme of initiatives to be subject to an SEA. The programme could clarify the objectives of transport planning, and ensure that environmental objectives are integrated with transport objectives at the appropriate level of decision-making. Unfortunately, such cases are still rare, but one example is an agreement between transport and environmental authorities in Germany (Box 9).

It is possible to organise screening as a permanent activity co-operatively between the transport department and the environmental authority. A committee may be set up which annually reviews the infrastructure plans that are to be prepared and decides which of these will need an SEA as happens, for example, in The Netherlands. There, a committee of all ministries, under the presidency of the most senior civil servant of the Ministry of Foreign Affairs, meets every year to decide which pieces of legislation scheduled for decision-making are to be submitted to an 'environmental test'.

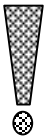
Screening criteria can be found in the 'Guidance on Screening' (European Commission, 1996d). Other indications may be given in state of the environment reports and vulnerability maps, and may arise from consultations.

5.3 The time dimension

Lengthy timescale of transport infrastructure planning and irreversibility of many infrastructure decisions.

Making a series of tiered decisions, from highly strategic to project level, based on thorough assessments, can take many years. Planning periods of more than 20 years have elapsed (although in many countries decision-making and assessment procedures have recently been revised, in order to prevent delays and increase quality). This means that current projects are influenced by strategic decisions taken years ago, when SEA was not practised. Strategic alternatives to these projects might therefore be preferable from an environmental point of view. If this is so, previous transport infrastructure plans or policies may need to be revised.

However, reconsidering strategic alternatives in SEAs takes time. Many transport problems are so urgent that there is no time to wait for the outcome of such an SEA before making decisions at lower levels.



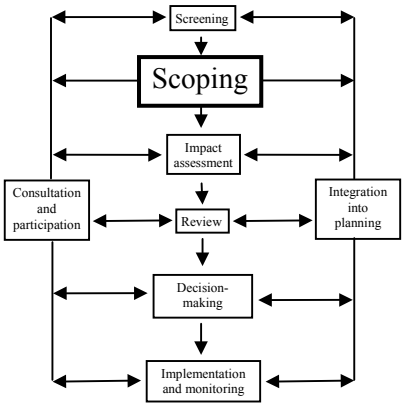
Strategic decisions made in the past, whether binding or not, are difficult to reverse, even if their impacts are significant. Early identification of projects with a significant risk of unacceptable impacts is therefore crucial so that plans can be amended in time.

5.4 Further reading

- European Commission, 1996d. *Guidance on Screening*. Directorate-General XI, Brussels.

(This publication considers the screening phase in the environmental impact assessment of projects. It identifies, among other things, project, location and impact factors determining the need for EIA. Suitably adapted, it can be used at the SEA level.)

6 Scoping



Read this chapter if you need to determine the issues to be covered, and the methods to be used, in an SEA

6.1 What is scoping?

Determination of what the SEA should cover and preparation of the scoping document.

In the scoping phase, decisions are made about the information that the SEA report should provide. In this way the SEA should be concentrated on impacts that appear to be relevant (and alternatives to prevent these).

Scoping document

The scoping decision may be laid down in a scoping document (see Box 10, 11), indicating:

- **environmental objectives and indicators** to be accounted for in the SEA;
- **environmental impacts** to be considered;
- **alternatives** to be elaborated and assessed;
- links with the scope of assessments at **other tiers**;
- the **approach** to the assessment (e.g. data availability, baseline studies and surveys, forecasting methods, significance criteria,

Box 10. Scoping decisions in the SEA of the HSR Zuid, The Netherlands

The HSR Zuid is a major new high speed railway from Amsterdam to Antwerp. Decisions on the Dutch territory were, *inter alia,* made at the tiers of the Spatial Planning Key Decision (PKB) and the Route Decision (TB).

The EIA legislation required that an SEA were undertaken for the PKB decision. The EIA procedure was formally linked to the PKB-procedure. Anticipating that (voluntary) EIA at the subsequent Route Decision tier would be undertaken, the PKB decision did not specify a precise alignment, leaving some uncertainty about the environmental impacts.

In The Netherlands the EIA Decree prescribes that a scoping decision must be made by the competent authority. Both tiers were included in the same scoping decision, but the issues that could be postponed to the second tier were determined later. The scoping decision for the SEA at the PKB level dated from 1987. It did not refer to the Route Decision tier. The scope included the following main items:

- whether further rail capacity between The Netherlands and Belgium was necessary;
- what mode was most appropriate (e.g. conventional rail, high speed rail, or a completely different mode);
- where the HSR would be aligned;
- large-scale environmental impacts caused by effects on the existing rail network, the modal split and car and air transport effects on socio-economic spatial relationships;
- local impacts of alternative alignments for the HSR connection.

The PKB and the SEA dealt with the *whether* question. It compared two scenarios (part, or not part, of the European HSR Network), and it analysed transport alternatives varying from 'do nothing' via 'high speed trains on conventional railways' to 'the construction of an HSR (via different alignments) in the Netherlands'. The environmental impacts were assessed for each of the various alignments. This included the horizontal alignment (with a corridor width) and, where necessary to assess the impact of the whole route, the vertical alignment.

To assess many of the large-scale impacts, the SEA made use of the information provided some time earlier in the international SEA for the Paris, Cologne, Brussels, Amsterdam and London network (1989). This included a generic comparison of the impacts of the HSR with the conventional modes of long distance transport, i.e. road traffic, conventional rail and aviation. The international SEA made overall estimates, amongst which were emissions of carbon dioxide, energy consumption, noise nuisance and traffic safety.

Box 11. Scoping the SEA of the European High Speed Rail Network

When assessing the environmental impacts of the European HSR Network, only traffic which was in competition with the network was considered. Therefore the study was restricted to long distance transport of passengers. Local travel or freight transport were ruled out of the scope of the SEA. For this reason some limitations were introduced. The modes of passenger transport considered were road, air and rail. The network, and the length to be studied, was selected and restricted. For rail transport 9,800 km of new lines, 14,400 km of upgraded old lines, and 25,000 km of the interregional existing rail network, including the existing 430 km French TGV line, were considered. For road transport, the network of roads parallel to the HSR lines was selected, with a total length of 31,450 km. For air transport 83 airports with regular intra-European commercial flights were taken into account in the calculations. Estimated impacts for each transport mode were limited to local impacts (land take and rural landscape), primary energy consumption, air pollution, noise pollution and safety.

aggregation criteria, consultations, presentation of results, participation);

- **justification** for leaving any issues out of the SEA that were proposed during the scoping process (for example, in public hearings). For example, an impact may not be relevant if it can not be influenced by the transport infrastructure plan.

6.2 Why scoping?

Advantages of scoping and importance of consultation.

The general benefits of an early scoping phase are:

- It helps ensure that the environmental information used for decision-making provides a comprehensive picture of all the effects of the project, including issues that are of particular concern to affected groups and other interested parties.

- It helps ensure that attention is focused on the issues that are of most importance for decision-making, avoiding the collection and presentation of unnecessary information and the unproductive use of resources.

- It can help in effective management and resourcing of the SEA by encouraging early planning of the activities required to produce the environmental information.

- It can encourage the initiator and others to consider possible alternatives and measures that might reduce the impact of the project.

Enhancing support

Because scoping involves consultation with outside bodies, it can provide a useful method of establishing contact with other agencies and authorities, interest groups, local communities and the general public. By involving these groups, scoping can increase the acceptability and credibility of the SEA and the decision-making process and reduce the risk of opposition emerging late in the day, causing delay and costs.

Table 4. Environmental impacts of infrastructure plans

Environmental theme	Main cause in the transport sector[1]	Main affected group or amenity
Climate change	fossil energy use by vehicles	people in most areas of the world
Acidification	use of combustion motors in vehicles	agriculture and biodiversity at long distances from the transport infrastructure
Local air pollution	use of combustion motors in vehicles	health of people living and working near transport infrastructure
Photochemical smog	use of combustion motors in vehicles	health of people living and working at long distances from infrastructure, losses of farming crops
Impact on biodiversity	presence of infrastructure and vehicle movements (disturbance, pollution)	many, but can be identified[2]
Impact on visual landscape	presence of infrastructure and vehicle movements	residents and tourists
Severance (fragmentation)	presence and use of infrastructure	people living and working near the infrastructure, biodiversity
Noise	vehicle movements	people near the infrastructure
Land take (valuable sites and objects)	presence of infrastructure	farmers, tourists, residents, biodiversity, cultural objects,
Impacts on water	presence of infratructure and vehicle movements	biodiversity
Impacts on soil quality	presence and use of infrastructure	impairment of use of the soil, otherwise impacts on health
Accidents	vehicle movements	travellers and people near the infrastructure

[1] Causes exclude the secondary effects from changes in spatial patterns of land use caused by improved accessibility.

[2] In the UK, for example, transport directly and indirectly affects 11 key areas and 9 key habitats, 20 species and 25 habitats are directly affected by transport (Royal Society for the Protection of Birds, 1996).

Source: based on European Commission, 1992b, European Conference of Ministers of Transport, 1998 and other sources.

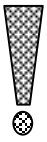
6.3 Which impacts may be relevant in the SEA?

Types of impacts to be covered in an SEA report.

Potentially relevant impacts may be broadly divided into the categories in Table 4. These impacts are basically the same as those that are often studied in infrastructure EIAs. They can therefore be identified with the aid of EIA scoping checklists, such as the European Commission's (1996c) 'Guidance on Scoping'.

Impacts can be relevant if:

- they are mentioned in environmental legislation and policy (such as the Fifth Environmental Action Programme);
- they are considered relevant by the groups that are consulted in the scoping phase;
- they can be influenced by the infrastructure plan. (The impacts selected during scoping must be sensitive to feasible variations in the proposed infrastructure plan. Appropriate indicators therefore depend on the assessment level. For example, energy use may not be an issue in a routing decision, whereas it may be in a modal decision.)



The impacts arising from transport infrastructure plans may be direct, secondary, indirect, cumulative or synergistic, as indicated in Table 5. Many of these impacts should be included in the scope of an SEA because they cannot be assessed at lower tiers.

6.4 How to scope?

Activities involved in scoping: description of objectives, indicators and targets.

The scoping exercise should:

- determine the area of search;
- identify which data are available;

Table 5. Categories of impacts in SEA

EIA is often limited to the direct environmental impacts of a single project. This includes, for example, land take and noise nuisance. In practice direct impacts may not be the most important. Other types of impact may also be caused which should be considered in SEA.

- *Direct* impacts are the impacts of projects and the plans and programmes which determine the project. Transport infrastructure may cause air pollution, which again affects public health. Some impacts are only noticeable a long period after project implementation.
- *Secondary* impacts (sometimes called *induced* impacts) are the environmental impacts of induced developments, such as induced traffic or housing and economic development which is attracted by transport infrastructure. For example, the changes in traffic flows on smaller roads caused by building a highway may be environmentally significant. Again, extending an airport may attract road traffic and therefore road capacity must be increased.
- *Indirect* impacts, e.g. a noise barrier may create adverse visual effects.
- *Cumulative* impacts arise from the combined effect of a number of proposed projects. For example, an individual road infrastructure project may not seriously increase the national emission of carbon dioxide, but a programme of many road projects may.
- *Synergistic* impacts are a special type of cumulative impact where the impacts of several projects exceed the sum of their individual impacts. For instance, several projects that encroach on a wildlife site only minimally may, together, affect the site to an extent where it can no longer support certain species.

Source: based on Sadler and Verheem, 1996, Thérivel and Partidario, 1996 and other sources.

- identify the surveys which would be required to fill data gaps and the cost-effectiveness of these.

The scoping stage of the SEA process may involve the following activities:

- describing the type of plan the initiator envisages and its objectives;
- consulting external parties, including the public, on the issues to be assessed;
- publishing a decision about the scope of the SEA, and selecting indicators (if possible with target values) that serve as evaluation criteria for the transport infrastructure plan.

The setting of the initiator's objectives and the defining of indicators and targets are described below. Consultation and public participation, as more general activities, are described in Chapter 11.

6.4.1 Description of the transport infrastructure plan objectives

Transport infrastructure plans may have the following types of objectives:

- to prevent traffic bottlenecks that are expected to emerge;
- to ameliorate access to inappropriate spatial-economic development by providing (better) infrastructure links;
- to (better) connect peripheral regions to the centre;
- to improve traffic safety;
- to reduce or prevent adverse environmental impacts.

Determining feasible options

The initiator's objectives, duties and responsibilities determine much of the SEA and planning process. They determine not only the type of transport infrastructure plan (e.g. network or corridor), but also the range of feasible options for the transport infrastructure plan that can be taken into consideration.

Box 12. German pilot study on the assessment of existing networks

In 1993, in the German state of North-Rhine Westphalia, an environmental assessment of the existing road network of part of the state was undertaken, covering 657 kilometres of roads in a densely populated area. The objective was to identify environmental bottlenecks and propose solutions. There was no *a priori* connection with an infrastructure plan, but the study led to infrastructure proposals with an environmental objective. Some results of the study were:

- by optimising the traffic system, a total decommissioning[1] of some roads is possible; this is mainly true for trunk roads (Bundesstrassen) but not for motorways (Autobahnen);
- decommissioning roads with high traffic flows is possible only when well-situated alternatives are available. Otherwise detours leading to additional environmental effects will occur.
- some bottlenecks can be removed by new infrastructure in less sensitive locations.

Source: Arbeitsgemeinschaft Planungsgruppe Ökologie and Umwelt / Ingenieurgemeinschaft Stolz, 1993. Quoted in Wagner and Kleinschmidt, 1995. (Decommissioning and reducing road capacity has also been discussed in publications by Cairns et al. (1998a,b).)

The initial problem description represents the initiator's viewpoint. New objectives should be added after consultation, and specified in the scoping decision so that the plan can be assessed against these. (It is difficult to include new objectives during the assessment step itself.)

It is often useful if the initiator explains the background to the plan objectives at the start of the scoping process. This may prevent requests to consider options which are not feasible. Preferably, the objectives should be justified on the basis of transport policy, environmental policy, standards, and spatial plans.

A sound description of objectives is also important to reduce the risk that these (implicitly) reject feasible options that are environmentally preferable. For example, the initiator may formulate an objective as 'to construct a new road connection between A and B, minimising environmental impacts'; this objective implicitly rejects the option of widening existing roads.

An example of the environmental objective of an SEA of an existing road network is shown in Box 12.

6.4.2 Defining environmental objectives, indicators and targets

For every selected impact, objectives, indicators and (where possible) targets should be chosen. These can serve as a reference framework in the impact assessment:

- an objective is an expression of the desirable state or development of an impact (for example, the greenhouse effect should be prevented);
- an indicator is a measurable (and forecastable) quantity, representing objectives (for example, the emission of greenhouse gases);
- a target is the value that an indicator should ideally take (for example, a reduction of emissions of carbon dioxide by 20%).

Political targets

If there is a lack of politically agreed environmental objectives and targets, these may be defined in the scoping phase, e.g. on the basis of consultation. However, there is a risk that this step will cause delay if

Box 13. Selected objectives for the environmental impacts of transport in Finland

1. Greenhouse gas emissions will be kept at the level of the year 1990
2. Emissions of nitrogen oxides from transport will decrease by 30% compared to the level of the year 1980
3. The emission of volatile organic compounds from transport will decrease by 50% compared to the level of the year 1988
4. Transport will not cause the air quality guidelines to be exceeded
5. Noise problems will be significantly mitigated through noise abatement in areas where the guidelines for noise are clearly exceeded
6. The rate of reclamation of scrap vehicles and scrap batteries will be at least 95% and the rate of reclamation of used tyres and catalytic converters will be over 90%. The hazardous waste associated with traffic will be properly treated
7. The construction, management and maintenance of transport systems will not increase the risk of the contamination of ground water, lakes, seas and rivers. The environmental risks of transporting hazardous waste will be further reduced
8. Transport systems will support denser community structure in built-up areas
9. Sensitive areas will be protected and the use of the most valuable areas with regard to nature, landscape and cultural history will be avoided in the planning and implementation of transport projects
10. Internationally approved practices in environmental management will be followed in the traffic sector

Source: Ministry of Transport and Communications, 1995

Box 14. Objectives used for the German Federal Transport Infrastructure Plan and its ecological risk analysis

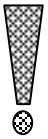
'Structural Goals'[1]	**'Performance Goals'**
Reduction of transportation costs	Reduction of vehicle standing and operating costs
Reduction of travel times	Reduction of travel times; shortening of routes
Improvement of safety	Reduction of injuries and material losses by accidents
Improvement of spatial structure	Improvement of accessibility, improvement of job supply in weak areas
Improvement of environment	Reduction of noise, air pollution and separation effects of traffic
Conservation of nature and landscape	Less consumption of land; avoidance of water pollution as well as dangers to flora and fauna
Promotion of other benefits outside the traffic system	Improvement of the value of natural areas for recreation; use of inland waterways for water supply.

external parties are asked to agree on targets. It is therefore recommended that an environmental policy for the transport sector be adopted, giving such targets. These can, for example, include targets for energy use, for the number of people suffering noise nuisance, or for compensation of the loss of ecosystems (e.g. 'no net effect' principle). Many countries have defined some form of environmental policy for the transport sector. (See also Chapters 13 and 14.)

Finnish transport and environmental policy targets are presented in Box 13. The indicators employed for considering alternatives to the French national motorway network were:

- contribution to the greenhouse effect;
- fragmentation of wildlife areas;
- fragmentation of tranquil areas.

An example of targets specified for a particular infrastructure plan and SEA is presented in Box 14 (it should be noted that non-environmental targets are included, as the environment is only one of several planning criteria).



Impacts receive different priority in different situations and countries, and issues depend on feasible alternatives. Decision-making systems for determining feasible alternatives are not internationally standardised. It is therefore not possible to give general recommendations about appropriate indicators for network or corridor level SEAs. The alternatives considered at project, corridor and network level vary from country to country, and between transport infrastructure plans (see Section 9.2).

It is possible, however, to identify indicators that may be used to compare certain types of alternatives. The main distinction is between:

- alternative construction methods, design and detailed alignment (normally assessed at project level);
- alternative indicative routing, or siting in the case of nodal infrastructure (normally assessed at corridor level);

Table 6. Indicators for comparing alternatives

Impact	Types of alternatives for which the indicator is sensitive		
	Construction methods, design, detailed alignment	**Indicative routing or siting**	**Modal alternatives and traffic flows**
Resource depletion/waste	resource intensity	- resource intensity - energy use (if modes are compared)	- resource intensity - energy use
Climate change	not sensitive to project adjustments	(in cases where significant differences in route length arise) - emission of CO_2 - vehicle kilometres	- emission of CO_2 - vehicle kilometres by vehicle type - modal share in passenger kilometres and tonne-kilometres - congestion - fuel consumption
Acidification	not sensitive to project adjustments	(in cases where significant differences in route length arise) - emission of NO_x and SO_2 - vehicle kilometres	- emission of SO_2 and NO_x - modal share in passenger kilometres and tonne-kilometres - vehicle kilometres by vehicle type - congestion
Local air pollution	exposure of the population to above standard pollutant concentrations	exposure of the population to pollutant concentrations above accepted standards	- emission of pollutants - likelihood that a large number of people will be affected - congestion
Photochemical smog	not sensitive to project adjustments	(in cases where significant differences in route length arise) emission of NO_x	- modal share in passenger kilometres and tonne-kilometres - vehicle kilometres - emission of NO_x and hydrocarbons
Biodiversity	land take and fragmentation of ecologically sensitive sites	land take and fragmentation of ecologically sensitive areas	- length of infrastructure - land take and fragmentation of ecologically sensitive areas - distance from ecologically sensitive sites - risk of affecting key species populations
Landscape	land take, visual and other impacts on character of valued landscape areas	land take, visual and other impacts on character of valued landscape areas	land take, visual and other impacts on character of valued landscape areas
Noise / tranquillity	exposure of the population to above standard noise level	- exposure of the population to levels above accepted standards - area affected by noise above a certain level	- vehicle type and speed - vehicle kilometres - likelihood that a large number of people or tranquil areas will be affected
Land take / proximity	land take in, or in proximity to, different categories of land (including heritage areas)	- land take in different categories of land - distance from sensitive sites	total land take per category
Impacts on water	distance from sensitive sites	distance from sensitive sites	distance from sensitive sites
Accidents	number of accidents or casualties	number of accidents or casualties	number of accidents or casualties

- alternative modes and measures to influence traffic flows (assessed at corridor level or network level).

Table 6 shows indicators appropriate for comparing these three types of alternatives. Information about indicators proposed in France, where indicators at network and corridor level have been distinguished, can be found in SETRA, 1995 and BCEOM, 1997.

6.5 Further reading

- European Commission, 1996c. *Guidance on Scoping*. Directorate-General XI, Brussels.

(The aim of this publication is to provide guidance to developers and competent authorities on scoping at the EIA level. It can also be adapted for use at the SEA level.)

- European Environment Agency, 1995. *The Environment in the European Union 1995*. EEA, Copenhagen.

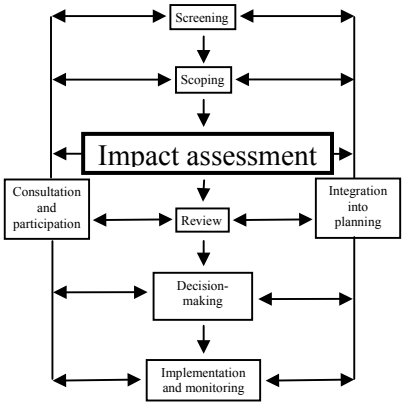
(This report contains a three yearly outlook on the state of the environment in Europe, including an analysis of driving forces (transport is identified as one of the main sources of environmental pressure).)

- European Environment Agency, 1998a. *Europe's Environment: The Second Assessment*. EEA, Copenhagen.

(This report gives an overview of the environmental situation in all countries of Europe, including an analysis of pressures and driving forces (which include transport).)

- Information about the state of the environment and environmental policy can be obtained from the national environmental ministry in any member state.

7 Impact Assessment



Read this chapter to find out about general methods for the analysis of environmental impacts of plan options. Information about developing and evaluating plans can be found in chapter 9.

7.1 Compilation of a database

Determination of study area, setting up of a database and obtaining information.

SEA relies on data for the description of the environmental baseline and foreseeable changes to it. These include, for example, data about land use, population, and ecosystems. The baseline data should, as far as possible, be adequately documented and of known quality, and updated at regular intervals in accordance with reliable procedures.

These data are needed to assess the vulnerability of the area to environmental impacts. Data availability may impose constraints on the methods and scope of the SEA. However, developing new databases in the framework of a single SEA process may cause delay. Those undertaking SEA should:

- make use of available data at a reasonable cost, acknowledging lack of data and using methods adapted accordingly;
- if this approach is expected to leave too much uncertainty in the impact assessment, gather additional baseline data as far as cost and time allow (and start as early as possible);

Table 7. Factors determining the study area for an SEA

The area where significant induced development can be foreseen	Any new infrastructure capacity will cause induced development: traffic, economic and spatial. An initial analysis may determine the area where significant effects may be expected. This depends on the scope of the SEA (alternatives and impacts).
The area where significant environmental impacts can be foreseen	Features of the study area which could be affected must be described in the SEA. Not all impacts extend to the same distance from the infrastructure, however. For impacts which extend far but gradually diminish to negligible levels as the distance becomes greater, some threshold of significance may be determined. The actual study area may then only be determined during SEA preparation (after a more detailed assessment of the affected areas).
The area of the initiator's jurisdiction	It is not useful to develop alternatives in adjoining areas, unless the SEA is prepared in co-operation with the relevant transport authorities. (Such co-operation is desirable if infrastructure development in both jurisdictions is functionally interrelated.)

- where appropriate data are not available, or cannot be obtained in time, employ simpler methods to avoid delay (see Part 3);

- make recommendations to statistics agencies regarding the optimisation of existing databases, or setting-up new regular monitoring systems, that will provide baseline data for future SEAs.

A useful SEA is always possible

Practice has demonstrated that even in the absence of extensive baseline data sets, useful SEAs (relying mainly on expert judgement) can be undertaken. Thus, even if the urgency of transport infrastructure plans does not allow time for extra data gathering, there is no reason why an SEA should not be undertaken.

Determining the study area

The boundaries of the study area for an SEA, and thus the data requirements, are determined by a number of factors, as shown in Table 7. The area may vary according to the impact assessed. For example, in the SEA for the German Federal Transport Infrastructure Programme (1992), the study area for local impacts was limited to zones around the proposed infrastructure, whilst air pollution problems were assessed for the whole country.

Chapter 14 describes a number of geographic information system databases, including EU databases such as GISCO and CORINAIR.

7.2 Impact forecasting

Scenario development and types of forecasting methods.

The environmental impacts of transport infrastructure plans last a long time. Most of the impacts are irreversible, and many reach their greatest magnitude after a long time, when the affected areas become more populated, the economy grows, and transport demand increases. Often, it may be many years, sometimes decades, before the construction works envisaged in a plan commence. In the meantime, the area may become more vulnerable to environmental impacts.

Scenario development

At the strategic level, the most common approach to impact forecasting is therefore the use of scenarios. In this approach, anticipated developments in a ‘do nothing’ reference scenario (without the transport infrastructure plan) are compared with a

Box 15. Examples of scenario development

A common element in many transport infrastructure SEAs is the use of scenarios for assessing the possible development of traffic flows and the related energy use and emissions. Such scenarios generally make assumptions about underlying factors such as economic, political and population development. 'Baseline' economic scenarios are often available which are used for different types of assessments. The technological development and tools to influence traffic flows on available infrastructure may also be part of such scenarios. Examples where scenarios have been applied, are:

- **Examples of backcasting.** Environmentally sustainable transport, a study by the OECD where a 'business as usual' scenario was compared with an alternative policy scenario that would achieve an environmentally sustainable transport system before a fixed point in time (e.g. 2030) (this scenario building activity is referred to as 'backcasting'). This scenario was more for policy assessment than for the assessment of transport infrastructure plans. Backcasting was also applied in the pilot SEA for the Danube Corridor.
- In the French study on **Intermodal proposals for the A7-A9 route** a railway scenario, a road scenario and a zero scenario were developed for the evaluation of air pollution. The zero scenario, in which no specific measures were undertaken, was used as a reference scenario to compare the emission of air pollutants.
- The study of the **European HSR network** compared and evaluated the environmental effects of the situation in year 1988 with the alternatives in the year 2010. Three scenarios were considered. The 2010 Reference scenario (2010 REF) referred to the situation when new HSR lines were not constructed. Only the currently operational French TGV Sud-Est and the conventional modes of transport were considered. The 2010 High Speed Train scenario (2010 HSR) assumed that the construction of the HSR network was completed according to the plans, and was operational in 2010. Since the operation of the HSR was expected to induce extra traffic, the 2010 Forced Mobility scenario (2010 FM) was set up. This scenario used the same higher mobility level as the 2010 HSR scenario, but considered the same conventional transport modes as 2010 REF.
- Four scenarios were formulated for the **Nordic Triangle in Finland** for both passenger transport and for goods for the year 2010: (i) 'Max', implementing all the Nordic Triangle development projects for the different modes of transport, (ii) 'Track', a railway-centred scenario, focusing on implementing railway development projects, (iii) 'Road', a road-centred scenario, focusing on implementing highway development projects, (iv) Min', not implementing any Nordic Triangle development projects, except those commenced in 1996. The scenarios were formulated to be as different as possible from each other in order to be able to identify significant factors.
- In the **Dutch National Environmental Outlook 3** (1994) scenarios were prepared for general traffic development and emissions at national scale. This was linked to the SEA of the **Transport Structure Plan 2** (National Institute of Public Health and Environmental Protection (RIVM), 1994).

Box 16. Forecasts of vehicle fuel consumption for seven alternative road / rail combinations in the Gothenburg – Jönköping Transport Corridor, Sweden

	Fuel consumption (Million litres / year)	**Change %**
Reference	3 100	
Alternative 1	3 070	-0.97%
Alternative 2	3 100	0.00%
Alternative 3	3 070	-0.97%
Alternative 4	3 100	0.00%
Alternative 5	3 070	-0.97%
Alternative 6	3 100	0.00%
Alternative 7	3 070	-0.97%

scenario showing developments after implementation of the transport infrastructure plan (see examples in Box 15). The difference between the two scenarios shows the impacts of the transport infrastructure plan.

In the reference (or baseline, or 'business as usual') scenario, assumptions are made about:

- the general development of the study area (e.g. population, economy, land use, ecosystems);
- development of transport in the study area;
- technological development (e.g. future car emissions);
- the impact on these developments of present and future transport policies (e.g. the development of fuel taxes, parking policy) and of spatial policy (e.g. protection of nature conservation areas).

Sometimes, no significant baseline developments are foreseen, or they are totally unpredictable. Under such circumstances, the present situation may be used as the reference situation, as long as this choice is explained.

To estimate the impact of the transport infrastructure plan, by comparison with the reference scenario, assumptions and forecasts are necessary about:

- the means by which the transport infrastructure plan is to be implemented (modes, routes, design, environmental management, etc.);
- the impact of the plan on traffic flows;
- environmental impacts arising from the presence and use of the proposed infrastructure in the future.

Factors determining forecasting methods

The impact may be forecast in quantitative terms, on an ordinal scale (e.g. greatest, next greatest, third greatest, etc.) or using a qualitative description. As an example, Box 16 shows the effects on road traffic fuel consumption for seven alternatives within a Swedish transport corridor.

A multi-modal assessment of a transport network to determine infrastructure needs will inevitably be more indicative than selecting a route in one corridor (although both may use the same types of environmental indicators). The level of information therefore depends on the alternative transport infrastructure plans to be compared, and the level of information in other assessments into which the SEA will be integrated (e.g. transport assessment). Other factors determining the choice of methods are the availability of data, time, manpower and money. Methods that have been applied in other SEAs may be more acceptable to decision-makers than new methods.

Forecasting methods

Methods are described in Part 3 of this Manual. All these methods involve forecasting the value that indicators will take, or assessing the risk that indicators will take unacceptable values. They make use of experience with EIA at the project level. Sometimes EIA forecasting methods are extended or applied in a broadbrush manner.

Some important general forecasting methods, which can be used in combination, are:

- **expert judgement**; this is often used to determine the risk that environmental objectives and targets may not be achievable. This method is especially useful for building consensus among interested agencies and professional groups (e.g. the Delphi approach involving the iteration of views to achieve consensus can be used);

- **workshops;** interested groups, including members of the public, can meet at workshops to discuss and mutually agree on impact forecasts. Methods to facilitate the discussions can be used, as described in Chapter 11;

- **modelling;** computer models can be used to forecast quantitative impacts on traffic flows, emissions and the dispersion of pollution in the environment.

- **vulnerability mapping** (sometimes referred to as 'constraints mapping' if certain areas are protected); involves assessing the vulnerability of areas and indicating sensitivity on maps. These maps are then employed to determine the impacts of alternative transport infrastructure plans. They are frequently computerised

Box 17. Vulnerability mapping of Intermodal Proposals for the A7-A9 Route, France

The SEA of the French 'Intermodal Proposals for the A7-A9 Route' surveyed the environmental difficulties, such as identified geological problems, topography, meteorology, water catchments, national parks, important wine, fruit and vegetable areas of origin, urban areas, etc. with the help of a 1:200,000 scale map in bands of 10-20 km. These constraints were classified into very strong, strong and mild levels for all the cross links. Based on the classification a constraint summary map was prepared which indicated the areas where the environmental difficulties were concentrated.

Table 8. Some types of uncertainty in SEA

Sources of uncertainty	**Examples**
Lack of reliable baseline data needed to assess the sensitivity of the environment to certain pressures	- Number of people who will in the future live in the study area. - Local ecosystems
Lack of monitoring data about the impacts of previous decisions with respect to infrastructure	- Long-term impacts of noise or low concentrations of air pollutants on public health - The benefit of noise reduction measures on noise levels
Lack of available forecasting methods which are widely accepted politically	No standard for the combination of railway noise with road noise in the same area
Scoping may give insufficient guidance to decide how certain impacts should be valued	- All impacts seem equally important - Is it more acceptable to disturb ecosystem type A or type B?
Lack of clear objectives for the quality of the environment	Noise levels in unpolluted areas
Lack of clear objectives about the desirable contribution of the transport sector to solving problems which are also influenced by other activities	- Targets for the reduction of emission of CO_2 - Avoiding development in sensitive areas

(e.g. using a geographic information system). An example of vulnerability mapping is described in Box 17.

- **proximity analysis**; assessing the potential proximity of proposed transport infrastructure to certain sensitive areas as a risk factor.

7.3 Analysis of uncertainty

Types of uncertainty and ways of dealing with it.

In SEA, there may be many sources of uncertainty, as indicated in Table 8. These can broadly be divided into:

- Uncertainty in the prediction of impact magnitudes, caused by incomplete baseline information, lack of knowledge, variations in the baseline scenario, imperfect forecasting models and unclear lower level decision making.

- Uncertainty in the evaluation of impact significance, caused by the need to make subjective intermediate planning decisions about the development of a limited number of alternatives in each cycle of the planning and assessment process (as described in Chapter 9).

Some of these problems may be temporary, since SEA is a learning process. The lessons of a particular SEA may be used to initiate the development of environmental policy, monitoring systems and assessment methods in the transport sector, enabling better SEAs to be undertaken in the future. SEA may also be employed to learn about the preferences of politicians. (Indeed, one of the benefits of SEA is that it raises the awareness of those involved - Section 1.2.2.)

Intrinsic uncertainties

On the other hand, SEAs are intrinsically uncertain, because the assessments have to be based on strategic proposals which are not as clearly elaborated as project proposals. Important decisions are postponed to lower tiers of decision-making, and are therefore still uncertain.

The 'art' of SEA is to limit the elaboration of the transport infrastructure plan and its assessment to what is absolutely necessary for the decision to be made. If there is a lack of data, methods or time, it is possible to provide a qualitative assessment and to describe

Table 9. Methods for dealing with uncertainty

Sensitivity analysis	In sensitivity analysis, assumptions made in the assessment are varied within a range of likely values. The environmental impact of transport infrastructure development depends on many factors which are still unknown, such as population and economic development. The assessment needs at least one scenario for these factors to enable assessment of the most likely impacts. Extreme (but still plausible in the appropriate political conditions) scenarios may be used to show the possible variation in outcomes between optimistic and pessimistic scenarios.
Alternative plans for differing perspectives	Different sets of evaluation criteria may be applied to generate alternatives plans, representing the views of different affected groups
Controlling implementation	Uncertainty about the implementation of the plan may be controlled by preparing an environmental action and monitoring plan, to check its implementation and to correct this where needed. This depends on the powers of the decision-maker with respect to actions at lower levels of government. In the case of centralised funding, for example, contractual conditions may be applied to the implementation of the plan.
Worst case approach	Uncertainty may not be as serious as it seems. For example, it may be possible to decide that new infrastructure is necessary even if its route is still undecided. The local impacts are still uncertain, but an assessment may demonstrate that in the worst case the impact would still be acceptable. (This is a special case of sensitivity analysis and scenario building.)

Box 18. Sensitivity analysis in the Slovakian Main North-South Corridor Study

The Slovakian Main North-South Corridor Study considers two transport scenarios, and compares them with the no action scenario. Scenario A refers to the situation in which long distance heavy vehicles and dangerous goods are guided around the region, while regional rail and other public transport are promoted. Scenario B represents the opposite situation in which long distance heavy vehicles and dangerous goods are guided through the region and public transport is not improved. Both scenarios are set up for evaluation purposes. In reality, a combination of elements of scenarios A and B is more feasible than either scenario.

comparable examples from the past, or from other countries. In the case of interactions with other sectors, the relevance of any uncertainty in decisions in these sectors may be described.

The level of detail and quantification of impact descriptions should be sufficient to minimise the risk that the proposal will have to be reversed at lower tiers of decision -making. It may be helpful to assess the likelihood that certain issues will meet resistance in the later planning stages (for example, because impacts are more significant than the SEA indicated).

Dealing with uncertainty

Methods available to deal with uncertainty include sensitivity analysis, alternative plans for differing perspectives, controlling implementation and the worst case approach (see Table 9).

More generally, 'decision analysis' has developed as a science of decision-making in the presence of uncertainty. It:

- provides a consistent method for structuring and clarifying decision-making problems;
- is applicable in cases where: specific impacts are either significant or insignificant; the likelihood of significance can be estimated; and the decision-maker is prepared to be influenced by this likelihood;

Many software packages for decision-analysis are available (see Section 7.5).

An example of sensitivity analysis is given in Box 15. The 2010 Forced Mobility scenario for the European High Speed Rail network did not refer to a realistic future situation, but it helped in evaluating the environmental effects of the 2010 HSR scenario. Another example of this approach to uncertainty is shown in Box 18.

7.4 The SEA report

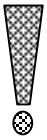
Content of the SEA report and the need for intelligibility.

The function of an SEA report is similar to that of an EIA report: to inform decision-makers about the environmental impact of the

Table 10. Contents of an SEA report for a transport infrastructure plan

Executive summary	Brief technical account of the main findings of the SEA.
The decision-making framework	Description of the higher tiers of decision-making, such as spatial, transport or environmental policies, plans and programmes. This section should also summarise the scoping decision.
Environmental baseline	A description of the study area and any foreseeable developments, and the current and foreseeable environmental situation using the indicators employed in the SEA.
Objectives of the plan	Summary of the transport objectives, and description of the environmental objectives, including their legal and political basis. Translation of objectives into indicators and targets which form the environmental criteria for plan assessment and development.
Summary of the proposed plan	Summary of the proposed transport infrastructure plan, indicating in more detail the elements which are relevant for the environment. It is useful to include maps, graphs, etc.
Analysis of alternatives	Overview of alternatives and options which have been assessed including the alternatives that were identified in the scoping phase. If alternatives are rejected, the reason for rejection should be included.
Environmental impacts	Description of the magnitude and significance of impacts, using the selected indicators. Impacts may be assessed quantitatively or qualitatively. It is useful to illustrate with maps, graphs, photographs. If comprehensive assessment is not possible, typical examples of situations that will occur can be described.
Environmental protection measures	Description of actions that are proposed with the aim of reducing environmental impacts. These may include, for example, (i) a strategy for mitigating impacts at lower levels of decision-making, (ii) weighting methods in lower-level SEA and EIA, (iii) screening guidance for lower levels, and (iv) identification of sensitive areas that should be avoided.
Report of consultation and participation	Report on the steps taken in the assessment phase in order to base the planning criteria on input from agencies and affected groups. Discussion of the way external views were accounted for.
Analysis of uncertainty	Information which, if available, could have contributed to a better comparison of alternatives.
Environmental action and monitoring plan	A plan for monitoring plan implementation (including subsequent decision-making at lower levels of government) and environmental impacts.

proposals, and to assess alternative actions which are potentially better for the environment. To perform this function, the SEA report has to be **intelligible** to the decision-makers. Details of the analysis should also be included for expert review (possibly in an appendix). Sometimes, the SEA report (or a summary of it) is included in the proposed transport infrastructure plan.



The items listed in Table 10 frequently appear in SEA reports.

The content of the SEA report for the German Federal Transport Infrastructure Plan is presented in Box 19. This plan is, in effect, a set of decisions about whether to authorise a large number of projects which still need further design.

7.5 Further reading

- Asian Development Bank, 1996. *Economic Evaluation of Environmental Impacts: A Workbook*. ADB, Manila.

(This user-friendly workbook is intended to help readers to estimate the economic values of environmental impacts so that they can be incorporated in decision-making. The target user is a non-specialist in environmental economics, having some economic understanding.)

- Nijkamp, P. & Blaas, E., 1994. *Assessment and Evaluation of Transport Planning*. Kluwer, The Hague.

(This is an academic work on the process of transportation planning. It presents methods for the analysis of transport and environmental problems that give results suitable for communicating to affected groups. It describes, in particular, methods of multi-criteria analysis.)

- European information centres on environmental topics are part of a network co-ordinated by the European Environment Agency (EEA). For transport, the following topic centres are the most relevant:

  ⇒ The European Topic Centre on Air Quality (ETC/AQ), which was established in 1994 by the European Environment Agency (EEA) supports the EEA in Copenhagen (DK) tasks relating to air quality by maintaining and improving monitoring,

Box 19. Environmental information in the German Federal Transport Infrastructure Plan

In the German Federal Transport Infrastructure Plan (1992), information about new projects was collected in dossiers containing the following information:

- Description of the project
- Evaluation of the project
  - 'Macro-economic' and traffic evaluation (benefit-cost-ratio)
  - Town planning assessment
  - Additional criteria
  - Priority rating of the Ministry of Traffic with a short explanation
- Detailed description of the 'macro-economic' and traffic evaluation
- Verbal description of the environmental risk
- Explanation of the town planning assessment
- Explanation of additional criteria
- Comments (for / against)
- Coloured maps of the planning area for:
  - Sensitivity of landscape
  - Sensitivity of biotopes
  - Sensitivity of water areas
  - Sensitivity of soil/ground
  - Map of areas of conflict (overlay of preceding maps)

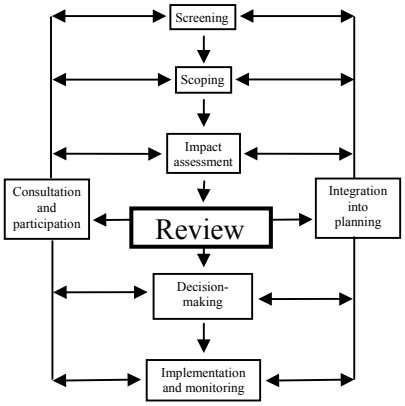
modelling and information systems, and providing air quality assessments. The lead institute is the Dutch National Institute of Public Health and the Environment (RIVM). AIRBASE, the European Air Quality Information System, contains 'meta' information on air quality monitoring networks and stations and raw air quality data for a selection of stations and a number of components. It can be accessed through the World Wide Web at http://www.etcaq.rivm.nl/airbase/index.html.

⇒ The European Topic Centre on Air Emissions (ETC/AE) lead agency is Umweltbundesamt (UBA), Berlin, Germany (http://www.etc-al.eionet.eu.int/). Data about air emissions can be found in CORINAIR, a study of emissions of air pollutants from different sources in Europe: (http://www.aeat.co.uk/netcen/corinair/corinair.html).

⇒ ETC Land Cover - Environmental Satellite Data Centre MDC, Internet http://www.mdc.kiruna.se/etc/index.htm

⇒ ETC Nature Conservation - Muséum National d'Histoire Naturelle MNHN, Paris, France, homepage http://www.mnhn.fr/ctn/. The Centre is in the process of establishing a European Nature Information System (EUNIS); more information can be found on the homepage or at the ETC/NC Core Team, 57 rue Cuvier, F-75005 Paris. (See also Section 15.2 ‘Useful sites on the Internet’.)

8 Review



Read this chapter to learn how to review the SEA to assess its quality with respect to criteria defined at the scoping stage of the SEA process.

8.1 Why review?

Importance of affected party and consultee review of SEA reports.

The review of SEA reports provides an invaluable check on their quality, especially where such checks have not been applied earlier in the SEA process. It is at the review stage that the environmental authorities, other bodies with environmental responsibilities and expertise, and the public, are able to comment on the SEA report and the action it describes.

The existence of SEA report review should ensure that, at the very least, the following questions are fully answered:

- Does the SEA report address the issues raised in the scoping report?
- Is the SEA report user-friendly and unbiased?
- Does the non-technical summary fairly reflect the full SEA report?
- Are all the relevant issues, including alternatives, discussed?
- Are the forecasts and the associated methods presented clearly?

Box 20. Review of the Italian HSR Milan-Bologna SEA report

The SEA of the Italian High Speed Railway Milan-Bolgona was reviewed and evaluated by the EIA Commission of the Ministry of Environment. The Commission approved the SEA with the condition that certain requirements would be included in the detailed project design. These were specific requirements derived from the SEA report. They included noise barriers, measures to mitigate or compensate ecological impacts, as well as project issues, such as route selection, viaducts, hydraulics, construction sites, monitoring, project costs and construction management.

Table 11. Review criteria for presentation of information in an SEA report

No.	Criterion	Relevant Yes / No	Judgement (C / A / I)[1]	Comment
8.4	Has information and analysis been offered to support all conclusions drawn?			
8.5	Has information and analysis been presented so as to be comprehensible to the non-specialist, using maps, tables and graphical material as appropriate?			
8.6	Are all the important data and results discussed in an integrated fashion within the information?			
8.8	Has superfluous information (i.e. information not needed for the decision) been avoided?			
8.9	Have prominence and emphasis been given to severe adverse impacts, to substantial environmental benefits, and to controversial issues?			
8.10	Is the information objective?			

Source: European Commission, 1994a.

- Have the public and the consultees been involved in the SEA process?

The review should lead to the imposition of conditions on the implementation of the plan where it is established that environmental problems will arise (see Box 20).

8.2 How to review?

Use of review criteria, other methods and SEA report review results.

In order to ensure objectivity in the review of the SEA report, a number of methods may be employed. These include the use of review criteria, the use of SEA report review consultants, the setting up of an independent review body, the publication of the results of the review and the involvement of consultees and the public. Wherever possible, skilled professionals should be used in the review process, whether within the decision-making / environment authorities, within the independent review body (if it exists), within the review consultancy (if engaged), or within consultee groups, including public interest groups.

Criteria

The existence of criteria can provide a useful focus for the review of SEA reports. Action-specific scoping guidelines, where they are prepared, provide a valuable checklist for review. In The Netherlands, for example, the EIA Commission formally sets guidelines for SEAs following scoping, and later reviews the quality of the SEA report, checking that the guidelines have been followed.

Several sets of criteria intended for use in the review of environmental assessment reports have been published. These should be used in conjunction with scoping guidelines. Detailed guidance can be found in the 'EIA Review Checklist' (European Commission, 1994a). This provides a set of criteria which can be adapted to be as applicable to SEA reports as they are to EIA reports. Table 11 shows some of these criteria.

Where the treatment of a particular SEA task is adjudged to be clearly inadequate, further information may be requested. This provides a significant check on the preparation of inadequate SEA reports by

proponents. In some cases, a final SEA report may be produced which takes into account the various comments made on the draft SEA report.

The appointment of an independent panel selected from acknowledged experts in the field to review SEA reports has two advantages. First, it should provide a means of reducing bias in the competent authority's decision on the action. Second, it should ensure that the quality of SEA reports increases over time, since its opinions should be both public and influential.

Using the results

It is important that all those bodies and individuals involved in commenting on the SEA report be given a copy of the report and be allowed time to respond. Their comments should, of course, be considered by the competent decision-making authority before any decision on the action is made. (Where the body preparing the transport infrastructure plan is also the competent authority, the comments should be considered by an independent body - for example the environment authority.) The comments should influence both the decision and the conditions imposed.

The outcome of the SEA report review should be made public. In addition, the various comments arising from reviews of the SEA report by consultees and by the public should be placed in the public domain (e.g. by publishing a report or by allowing access to the decision-making authority's SEA file).

8.3 Further reading

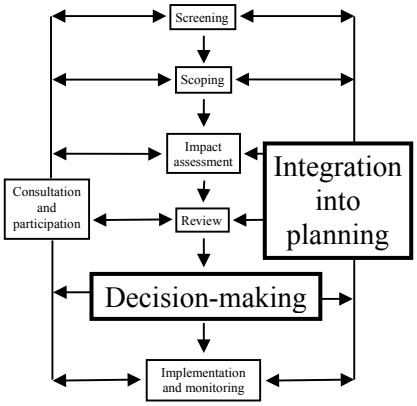
- European Commission, 1994a. *EIA Review Checklist*. Directorate-General XI, Brussels.

(This is an easy-to-use guide which contains a comprehensive set of review criteria. It is adaptable to apply to SEA reports as well as EIA reports.)

- Lee, N. and Colley, R., 1992. *Reviewing the Quality of Environmental Statements*. Occasional Paper 24, Department of Planning and Landscape, University of Manchester, 2nd edition.

(This publication contains review criteria which enable a judgement to be made about the overall quality of the SEA report. The criteria were designed for EIA reports, but can be adapted to be used for SEA reports.)

9 Integration into planning and decision-making



Integration happens throughout the SEA process and leads to a decision based on a comprehensive assessment. Read this chapter if you are interested in ways of ensuring that decision-makers consider fully the findings of the SEA report.

9.1 Developing the proposed transport infrastructure plan

Iterative approach to transport infrastructure planning.

Integration of environmental impacts into decision-making occurs at many stages of the planning process. It should take place every time an informal decision is made about which plan options are to be developed further and which options are to be rejected. These intermediate decisions are incorporated in the final proposed transport infrastructure plan, which is submitted for formal decision-making. In order for decision-makers to make their choice, the results of the SEA need to be integrated with the results of the other assessments (see Section 3.2).

Iterative planning

Transport infrastructure plans are often developed as follows:

- defining criteria (indicators and target values) for the development of the transport infrastructure plan. Among these, environmental criteria are based on the objectives and targets that were developed in the SEA scoping phase (Section 6.4);
- making drafts of the infrastructure plan;

- assessing the environmental (and other) impacts with respect to the criteria defined (evaluation);
- exploring options and amending the infrastructure plan to make it perform better with respect to the criteria;
- assessing the improved draft plan.

These steps may be repeated several times in an iterative process before the final proposed transport infrastructure plan is submitted for decision-making. Decision-makers then have the option to reject, to approve, or to amend the proposed plan.

There may be many options that improve the environmental (and other) performance of the plan. To present a full justification of the final plan proposal, an explanation of why certain options were selected, and why others were rejected, should be included in the SEA report.

9.2 Developing alternatives

Importance of consideration of alternatives in transport infrastructure plans.

As mentioned above, many options are proposed and rejected while the transport infrastructure plan is being developed. However, if the proposed infrastructure plan is not approved by the decision-makers, a different plan (e.g. emphasising a different mode) must be developed and assessed. To prevent delay, several alternative plans may be developed at the same time.

Alternatives at network level

At network level, the alternatives may be defined as alternative policies or strategies for the development of corridor proposals, such as:

- to give a framework for environmentally friendly decision-making at lower tiers (e.g. rules for the design of mitigation measures; adopting the principle of 'no net effect');

Box 21. Lessons learned in the SEA of the Finnish Nordic Triangle

This SEA concerned a multi-modal transport corridor. Formulated alternatives represented the extremes of possible investment policy. When the effect on transport was studied, the alternatives were analysed according to different transport growth scenarios, such as only developing rail alternatives.

Many groups and experts were consulted several times during the process about the alternatives to be considered. There was fierce discussion about the formulation of alternatives, for example concerning:

- assumptions to be made about developments that influence demand for transport, but that cannot be influenced by infrastructure plans (such as development of the Russian economy);
- different objectives for which alternatives should be developed and the significance of impacts;
- the contents of the scenarios under development.

An important lesson learned was that development of the plan and its alternatives is a central issue in the SEA process. The appropriate alternatives depend crucially on the perspectives of the different affected groups. For example:

- parties in favour of large road and harbour investments demanded more 'realistic' alternatives;
- regional planners and employees' organisations felt that the plan should deal with the actual realisation of investments;
- conservation groups proposed that environmental goals should be the main basis for the development of alternatives

Developing the plan (or several alternatives) is therefore a central theme in the management of SEA processes, which have to account for all affected interests, not just environmental interests. Therefore, the SEA process, planning and other assessment processes should be co-ordinated.

Alternative scenarios in multi-modal corridors or networks are useful to assess the secondary impacts on land use in large-scale planning situations; secondary impacts are often more significant than primary impacts, in terms of socio-economic and economic effects.

Formulation of alternatives must be conducted openly. In cases where there is no clear consensus on the right formulation of the planning problem, it is necessary to examine the different views concerned.

- to give a framework for environmentally friendly use of infrastructure (e.g. good housekeeping to reduce emissions from ships).

Alternatives at network and corridor level

At network or at corridor level, groups of interrelated corridors and nodes can be assessed, including:

- continuation of the existing situation, i.e. the no-action (do nothing or zero) option;
- reduction of traffic flows or encouragement of environmentally friendly modes of transport.

Alternatives at corridor level

At corridor level, different route alternatives may be developed. (This may be necessary because there is often a dilemma between, for example, crossing a densely populated area (and conflicting with social objectives), or a more ecologically sensitive area (and conflicting with ecological objectives).)

Plan alternatives are most useful if they are realistic. They should be feasible, and the decision-maker should preferably have the power to approve them. The selected alternative should have support from the administrations that will be responsible for the implementation of the transport infrastructure plan.

In the case of the German Federal Transport Infrastructure Programme 1992 and the English Trunk Road Programme, alternative infrastructure provision was considered on a corridor-by-corridor basis. In other cases, such as the Dutch Transport Structure Plan 2 and the Finnish Nordic Triangle, alternative policies (e.g. for environmental management) were considered, rather than alternative *infrastructure* plans. Box 21 presents some of the lessons learned from the consideration of policy alternatives in the Finnish Nordic Triangle.

At corridor level, there is much more experience of plan alternatives. Examples are mentioned throughout this Manual.

Box 22. Integration of transport and land use planning: the UK example

In the United Kingdom, guidance on the integration of transport and land use planning is available in Planning Policy Guidance Note 13: Transport (PPG13) (Departments of the Environment and Transport, 1994). PPG13 aims to ensure that local authorities carry out their land use policies and transport programmes in ways which help to:

- reduce growth in the length and number of motorised journeys;
- encourage alternative means of travel which have less environmental impact; and hence
- reduce reliance on the private car.

PPG13 advises local authorities to encourage the location of new development in places where there are reasonable alternatives to the car. Those developments which are major travel generators should locate in existing centres which are highly accessible by a choice of means of transport. In order to secure desired improvements in air quality and other environmental impacts, these locational policies need to be supported by complementary measures to ensure that reduced need to travel by car is translated into actual changes in travel behaviour. Unless effective complementary measures are in place, increasing the density of development in urban areas is unlikely to have a significant impact on traffic levels and could worsen congestion and air quality.

To help local authorities and others implement PPG13, the former Departments of the Environment and Transport (1995) published PPG13: A Guide to Better Practice. This gives advice on how to develop integrated land use and transport policies which give appropriate weight to the objectives of environmental improvement and economic growth.

The UK Government has published a white paper on transport and a consultative document on a proposal to integrate more closely the regional land use planning system with the planning of trunk roads. By placing greater emphasis on regional and local views on the impact of a new road, and allowing the consideration of alternatives, such as public transport, the proposals could lead to earlier agreement on schemes and ultimately to quicker construction.

Source: Dom, forthcoming.

9.3 Co-ordination with planning and with other assessments

Importance of considering environmental with transport and financial, socio-economic and spatial assessments.

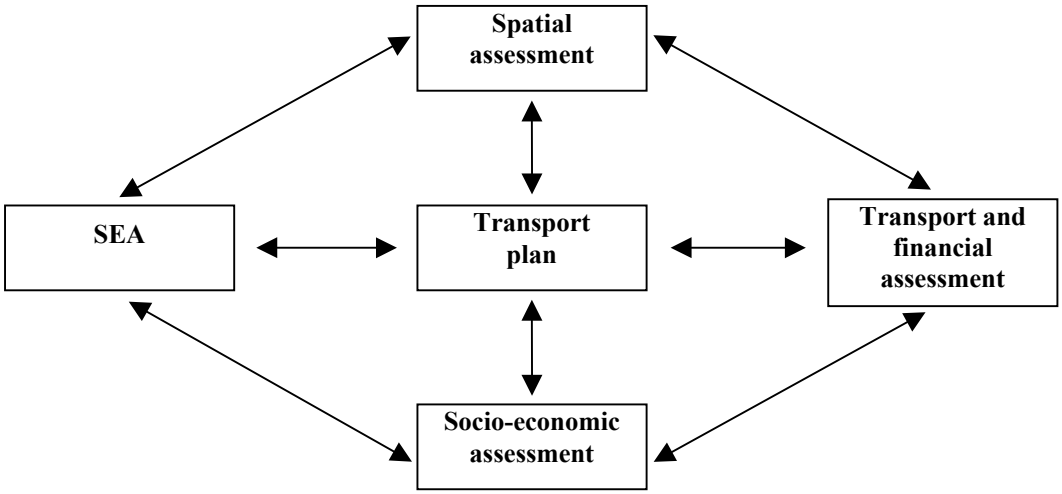
As stated in Section 3.2, the SEA process should not only be linked to the planning process, but also to, for example, transport (mainly macro-economic) and financial, socio-economic, and spatial assessments. Lessons can be learned, for example, from experience in England (see Box 22). These links can be improved by:

- combining the steps of assessments and intermediate plans and decisions;
- co-ordinating and combining general features of the assessments, such as background scenarios, baseline data, public participation, and study horizon;
- setting up an 'umbrella' organisation, with a general task manager who has the power to make intermediate planning decisions; defining the roles, tasks and responsibilities of the different assessment teams;
- preparing a common communication plan for flows of information between the different assessment teams.

Strong, balanced linkages between assessments and planning increase the influence of assessments on planning and subsequent decision-making and reduce overlap and inconsistencies between assessments.

The management of the planning and assessment process, and of the lines of communication (and co-operation) between teams, depends on the functional linkages between different aspects of assessment. It is useful to develop a clear framework for these linkages at the start of the process.

Figure 4. Linkage between the transport planning process and associated assessments



9.4 A general assessment framework for decision-making

Desirability of assessing all types of transport infrastructure plan impacts.

Transport infrastructure planning influences the general development of a country and the distribution of development within the country. A general assessment framework for evaluating all the impacts of transport infrastructure plans, taking account of the causal inter-linkages between different types of impact is needed. Such a framework, which is applicable whenever modal options and transport capacity options are compared at network or at corridor level, is proposed in Figure 4.

It can be seen that each of the different assessments feed into each other, as well as into the transport plan. There is a need for communication and co-operation in undertaking the various assessments.

Linkages between different assessments

The linkages between the different assessments include the following:

- An infrastructure plan influences traffic flows, which can be subject to a transport assessment using '**accessibility**' as the main indicator. This is the effort (mainly time and cost) involved in passenger and freight access to travel destinations. The impact forecasting models for accessibility, and the precise indicators to be used, may be different for freight and passenger transport. However, it is always possible to make useful forecasts (see Chapter 12).

- Improved accessibility influences the extent to which the needs and desires of people are met. This can be assessed in a socio-economic assessment. (Frequently, accessibility may itself be applied as a social impact indicator.)

- Increased accessibility of locations influences the extent of spatial development (i.e. the development of land for, mainly, housing and employment). These are important secondary effects, which 'feed back' to transport flows. Secondary effects should always be

assessed, if only by means of educated guesswork (European Commission, 1996e; Vickerman, 1991).

- A change in traffic flows has direct environmental implications, such as climate change, acidification, local air pollution and photochemical smog.

- The construction of infrastructure that is envisaged in the transport infrastructure plan has direct environmental impacts, such as impact on local biodiversity, visual effects, severance, land take and noise.

- Secondary spatial development that is induced by the infrastructure plan has direct environmental impacts, which are often more important than the direct environmental impacts of the infrastructure plan.

- Improved accessibility also has economic effects. These can often be expressed in terms of growth in Gross Domestic Product. However, for certain locations the impacts may be adverse.

Time horizon

The **time horizon** of all assessments, the points in the future to which forecasts relate, should be co-ordinated. A horizon commonly used in transport studies is about 15 years. However, given the long time span of secondary effects, a horizon of 30 years is appropriate in SEA.

Common reference scenario

Obviously, the nature of general development (disregarding transport infrastructure planning) taking place over such a long period is uncertain. It is therefore necessary to make assumptions about a common reference scenario for the long-term development of population, economy, technology, etc.

9.5 Impact evaluation

Approaches to evaluation in the SEA process.

Evaluation is not only an activity undertaken by decision-makers in making their decision on the basis of the final transport infrastructure plan proposal and the SEA report, but it is also a recurring step in the planning and assessment phase. The SEA report describes the evaluation methods which were applied when the plan was prepared.

Box 23. Illustrations of evaluation methods

In the **Czech SEA of the North-South Highway Corridor** the variants were evaluated by expert judgement according to following ecological and technical aspects.

- nature and ecosystems;
- landscape and scenery;
- natural and/or landscape vulnerability;
- difficulty of technical design within the existing route;
- difficulty of technical design within a new route.

An ordinal scale was applied to classify the impact between 1-very small and 5-very large. The evaluation was presented in impact matrices.

The French case study on **Intermodal proposals for the A7-A9 route** evaluates measures to avoid the future expected saturation of the A7 and A9 motorways with respect to traffic levels, socio-economic effects and environmental impacts.

The evaluation with regard to traffic levels was conducted by calculating the effectiveness of all the measures considered for diverting traffic from the A7 and A9 motorways. The ineffective options were rejected, and only the most effective measures were evaluated with regard to socio-economic and environmental aspects.

Three kind of environmental evaluation were conducted:

1. Summary comparison between the impacts of the 'rail motorway' (high capacity trains carrying heavy road vehicles) and a new motorway included the comparison of the total area of land required and the severance effect, as well as analysis to express in financial terms the benefits of the rail motorway:

- For water protection: benefit was estimated by the cost of a motorway with almost complete water protection;
- For air pollution: benefit was calculated by the quantity of diesel fuel saved as a result of the European "Ecotax", which was a proposal at that time;
- Cost: construction of the rail motorway.

2. The environmental difficulties of different routes were surveyed, classified and transferred into a constraint summary map to classify motorway cross links in terms of difficulty of construction.

3. The third environmental evaluation compared the air pollution arising from the railway scenario and the road scenario with a reference scenario. The indicator of air pollution was expressed in % compared to the emission of the zero scenario. For the calculation emissions of CO, CO_2, HC, NO_x, SO_2 and particulates were aggregated according the toxicity factor of each pollutant.

In an environmental appraisal of the **Trunk Road Programme in England** a new approach was adopted which took account of five main criteria: environmental impact; safety; economy; accessibility; and integration. An important element of this new approach was the development of an appraisal summary table (AST). This is a one page summary of the main economic, environmental and social impacts of a trunk road scheme.

The purpose of the AST is to make the appraisal process more transparent and to provide decision-makers with a clear, consistent and reliable basis on which to determine whether trunk road schemes should proceed.

The five main criteria are divided into a number of sub-criteria, reflecting the wide range of impacts arising from schemes:

Criteria	**Sub-criteria**
Environmental impact[1]:	noise; local air quality; landscape; biodiversity; heritage; water.
Safety	none.
Economy:	journey times and vehicle operating costs; journey time reliability; scheme costs; regeneration.
Accessibility:	access to public transport; community severance; pedestrians and others.
Integration:	none.

[1] Environmental impact also includes data on additional CO_2 emissions.

For each of these, the impacts of a road scheme are expressed qualitatively, quantitatively and as a summary assessment.

ASTs were completed for a short-list of 67 schemes and were used to prioritise the 37 targeted schemes which emerged

These evaluation methods therefore have to be transparent and understandable, in order to generate support. Examples are shown in Box 23.

Simple evaluation methods

The following relatively simple evaluation methods are generally applied in combination:

- textual descriptions; explaining the significance of the impact, often by reference to objectives and targets.
- impact matrices; summarising the impact by type for each of the alternatives considered;
- graphical illustrations and maps;
- presentation of the consensus or disagreement arising from consultation, inter-agency and public workshops.

These evaluations often identify or build areas of consensus. If consensus is difficult to reach, and if quantifiable results are available, multi-criteria analysis and monetary evaluation methods can be used.

Box 24 presents the contributions to achieving environmental goals of various alternative road / rail combinations in the Gothenburg-Jönköping Transport Corridor.

Multi-criteria analysis

Multi-criteria analysis (MCA) makes use of aggregation criteria based on the revealed preferences of decision-makers or other groups. It is often used in transport infrastructure route selection, increasingly in combination with geographic information systems. MCA provides both a tool for communication between all actors involved and an analytical technique for examining (implicitly or explicitly) the implications of trade-offs. It is applied by:

- setting up an impact score matrix, containing estimates of outcomes for all criteria, measured using appropriate dimensions (e.g. levels of air pollution), for each alternative;
- using an *a priori* specified set of judgement criteria to quantify the impact score matrix, obtaining a ranking of alternatives.

Box 24. Contributions of seven alternatives in the Gothenburg-JönköpingTransport Corridor, Sweden, to environmental goals

Environmental Goal	Alternative							
	Reference	**1**	**2**	**3**	**4**	**5**	**6**	**7**
- constitute part of the environmentally-adapted transport system.	**0**	++	0	++	--	-	---	--
- be designed in harmony with the natural and cultural landscape of the region and strengthen its cultural and historic value.	**0**	---	0	---	--	---	---	---
- improve the preconditions for an increase in the biological diversity within the region.	**(-)**	--	0	--	--	---	---	---
- contribute towards a reduction in the local and regional impact of pollution on lakes, watercourses and wetlands.	**(-)**	(-)	(-)	(-)	-	(-)	-	(-)
- participate in producing clean air and less noise disturbance in built up areas.	**(-)**	-	(-)	(-)	(-)	-	(-)	-
- contribute towards greater road safety.	**(-)**	+	0	+	-	(+)	-	(+)
- help to make sure that the national and regional goals for the emission of substances that affect the climate are met.	**(-)**	+	(-)	+	(-)	+	(-)	+

--- very large negative contribution
-- large negative contribution
- small negative contribution
(-) very small negative contribution
0 no or insignificant contribution
(+) very small positive contribution
+ small positive contribution
++ large positive contribution
+++ very large positive contribution

Source: abridged from National Road Administration, 1998.

Box 25. A German study on the use of shadow prices in network SEA

In a German study, a procedure for planning an environmentally sustainable transport system was developed and applied in a case study of Baden-Württenberg. The important features of this approach are:

- The starting point for the procedure is a set of politically defined environmental goals. Transport policy scenarios, including infrastructure, are designed and evaluated, until one of these scenarios achieves stated goals and generates economically optimal results.
- A methodology for a multi-modal and network-wide assessment of the environmental and economic impacts of transport systems has been developed.
- A bridge is built between network level assessments and project orientated cost-benefit analysis by deriving 'shadow prices' from the design of a sustainable transport system which can be used for an economic evaluation of projects. Shadow prices reflect the economic costs of reaching environmental goals and can be combined with direct monetary evaluations.

Source: IWW et al., 1998.

There are various procedures for specifying and applying weights, ranging from the simple to the complicated.

To demonstrate the strengths and weaknesses of alternative options an MCA could:

- play a role in identifying the relative merits of the alternative options against a range of strategic objectives;
- consider alternative options from different perspectives (e.g. an economic versus an ecological viewpoint);
- play a role in vulnerability mapping analysis and optimisation of routes;
- test the robustness of the results by varying the weights of different impacts (see Section 7.3).

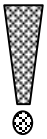
Monetary methods

Monetary evaluation methods express impacts in terms of money. Although much studied, these methods are rarely used at the strategic level because of methodological difficulties (there are different political views about the usefulness of cost-benefit analysis and other methods).

This field is still developing. In France new legislation is under preparation, obliging road developers to compensate landowners for decreases in the price of real estate caused by the environmental impacts of nearby infrastructure. In Finland, monetisation is usually undertaken at project level. An approach to monetary evaluation at network level is proposed in Germany (see Box 25).

The SEA report, and its draft versions, should form part of the general assessment documentation. This documentation should explain the trading-off of different impacts and the rejection of alternative plan options.

Record of decision



The final decision about the plan will be based on the general assessment documentation, but it will also incorporate political considerations. In order to ensure that environmental considerations are not ignored during decision-making it is useful if a **record of decision** is prepared. This should contain a full justification of the reasons for taking decisions where environmental factors have to be

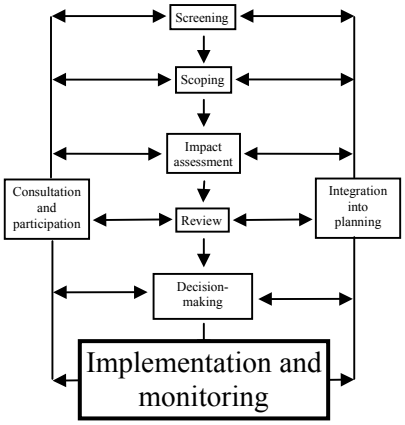
balanced against other factors. It should also set down environmental protection requirements to be used during decision-making by lower levels of government.

9.6 Further reading

- European Commission, 1996e. *Methodologies for Transport Impact Assessment.* Transport Research Series, Office for Official Publications of the European Communities, Luxembourg.

(This book gives an extensive introduction to the indicators used in transport impact assessment, and to forecasting methods, including practical examples.)

10 Implementation and monitoring



The SEA process should be linked with plan implementation, to ensure that its effects are monitored and to enforce and adjust the decision where necessary. Read this chapter to discover how this can be done.

10.1 Linkage with further planning and construction

Using an environmental action and monitoring plan to ensure that the plan's environmental protection provisions are implemented.

After a transport infrastructure plan has been formally approved, it is normally implemented. It forms a framework for further (lower tier) planning and decision-making, and eventually for projects. The impacts that these projects will have can be influenced by the original transport infrastructure plan. It can do so not only by choosing strategic alternatives for the transport infrastructure, but also by ensuring that, during implementation, environmental impacts are accounted for in an appropriate manner.

Environmental action and monitoring plan

This involves the formulation of an environmental action and monitoring plan. This should be developed during the SEA process and included in the SEA report (see Section 7.4). The environmental action and monitoring plan should make explicit reference to all the environmentally significant objectives of the transport infrastructure plan. Decision-makers should adopt the environmental action and monitoring plan as a condition of transport infrastructure plan approval, to reduce the uncertainties that exist at the time of approval. It can do so by:

- checking the implementation of the transport infrastructure plan and indicating where the plan needs to be adjusted;

- ensuring appropriate corrective action will be taken in the case of unexpected impacts or aberrations;

- allowing the 'strategic' decision-makers the opportunity to verify whether lower-tier plans, prepared and approved at other levels of administration, comply with the environmental action and monitoring plan.

Monitoring should also result in improved SEA practice, as the lessons learned from an SEA are fed back into other SEAs.

Environmental action and monitoring plans may determine, for example:

- SEA / EIA screening criteria for decisions at lower tiers. For example, the SEA for the High Speed Rail connection between The Netherlands and Belgium was considered to give insufficient guidance for further planning. Accordingly, the decision-makers required that an EIA be undertaken for the detailed design stage (which would not normally be necessary);

- guidance for scoping at lower tiers, including the weights that certain impacts should have in plan development, and how mitigation should be ensured. For example, the SEA for the High Speed Rail connection between The Netherlands and Belgium included a method specific to this rail line for taking account of visual and ecological effects during design. This method became part of the approved transport infrastructure plan.

- how the administrations responsible for implementation report to the higher tier administration about the implementation of the environmental action and monitoring plan;

- how the impacts during and after construction works are monitored and reported, the role of consultees and the public, and the actions which should be taken if the impacts are different from those forecast in the SEA report. The indicators chosen should be those already being monitored but, where necessary, additional, easily monitored, indicators may need to be selected. These should be

Box 26. Monitoring and implementation of the Italian HSR, Milan-Bologna

In the case of the Italian High Speed Railway, Milan-Bologna, the EIA Commission of the Ministry of the Environment evaluated the SEA prepared at the basic engineering level. The evaluation stated that environmental monitoring was mandatory during implementation. Environmental monitoring both in the construction and operation phases was very useful in negotiations with local authorities to obtain building permits. The local authorities considered monitoring as a guarantee of avoiding damage to the environment. Municipalities showed a more positive attitude when they knew that the environmental impacts were going to be monitored, and that there would be a bank-guaranteed fund to pay for corrective measures if they proved necessary.

Box 27. Network-wide monitoring in The Netherlands

In The Netherlands, the Transport Structure Plan 2 has an associated yearly monitoring programme, which is used to feed back into the policy process (adjusting the TSP-2). The following indicators are monitored at national level:

'Liveability'
- emissions by traffic
- noise nuisance
- number of casualties (dead / wounded / hospitalised)
- severance
- shipping accidents

'Mainport' strategy (rel. to major international transport ports (e.g. Port of Rotterdam)
- air passengers and freight, modal split to and from international airports

Competitive transport
- freight traffic market shares (road, inland shipping, marine, ports)

Selective accessibility in a sustainable society
- frequency of congestion
- support for the Transport Structure Plan 2 and awareness of its targets

Reduction of growth and distribution of road traffic
- municipalities with an active parking policy
- occupancy rate of personal cars
- kilometres of bicycle tracks
- passenger-kilometres by public transport
- lorry-kilometres
- inter-modal traffic

Freight transport
- volume of rail freight transport, volume of inland shipping, volume of short-distance sea container traffic

Individual mobility
- traffic management
- relative travel times by private car and by public transport
- trains with delays
- profitability of city and regional bus transport

Quantitative policy targets are set for these indicators, based on a general assessment (including an environmental assessment). If the targets are reached too slowly, the policies are adjusted. This results in continuous improvement of policy in relation to transport, which also has repercussions for infrastructure planning. On the other hand, transport infrastructure planning itself is driven more by discussions about irreversible impacts than by the impacts which can be abated by adjusting transport and environmental policy.

Source: Ministry of Transport, Public Works and Waterways, 1997.

meaningful and appropriate for the level of decision-making involved (national or local). An example from the High Speed Railway, Milan – Bologna is presented in Box 26.

Some of these actions may also be part of lower-tier environmental action and monitoring plans, if they are not already included at this level.

10.2 Monitoring construction and operation

Corrective measures for improving monitored environmental impacts.

After construction of the transport infrastructure, many impacts become irreversible (unless the infrastructure is removed); i.e. those impacts which are caused by the physical presence of the infrastructure. After construction, however, pressures on the environment that are caused by traffic can still be influenced to some extent (see Part 3).

Appropriate corrective action following the construction phase may, for example, be:

- action specific to the planned infrastructure connections: speeds, mitigation measures such as noise barriers, and traffic management. (The need for such action can be identified in the SEAs for the connections.);

- action related to more general transport policy, environmental policy (emission standards), spatial policy, or fiscal policy, which affects the whole infrastructure network, including the existing connections.

In order to identify the most appropriate corrective action, monitoring of the effects following construction should therefore be part of a **network-wide monitoring** programme, and corrective action should generally be developed at network scale rather than at the connection level. In this way, for example, it is possible to set priorities between different 'black spot' location solutions by, for example, construction of new infrastructure, or decommissioning of existing infrastructure. An example of network-wide monitoring in The Netherlands is shown in Box 27.

The *ex post* monitoring of the construction of motorways is increasingly undertaken in, for example, France and Portugal. In the case of the A39 motorway in France, the zero-situation, and many socio-economic, ecological and landscape impacts, were assessed following the opening of the motorway (Société de Autoroutes Paris-Rhin-Rhône, 1995).

10.3 Further reading

- Arts, J. and Nooteboom, S. G., forthcoming. Monitoring and auditing. In: Petts, J. (ed.) *Handbook of Environmental Impact Assessment*. Blackwell, Oxford.

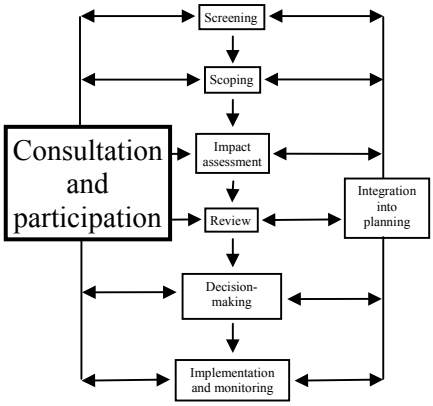
(Gives an overview of current methodology and legislation concerning EIA and SEA monitoring and follow-up. Highlights different types of monitoring, the links between the environmental assessment process before and after formal decision-making, and relates the instruments of EIA and SEA to other instruments of environmental policy, such as *ex ante* and *ex post* evaluation, environmental permitting and environmental auditing.)

- European Conference of Ministers of Transport, 1997. *CO_2 Emissions from Transport*. ECMT, Organisation for Economic Co-operation and Development, Paris.

(Presents the results of an in-depth survey of CO_2 emissions from transport in member and associate member countries. It includes effects on CO_2 emissions from the transport sector, disaggregated to subsector level, of transport policy actions either in effect or planned to limit CO_2 emissions. The study examines the requirements of a monitoring system and current data sources.)

- The European Environment Agency in Copenhagen regularly publishes integrated environmental assessments which include chapters about the environmental pressures caused by the transport sector.

11 Consultation and participation



Read this chapter to gain advice on communication with external groups and the public.

11.1 Why consultation and participation?

Why consultation of affected groups and the public is essential in SEA.

The aim of SEA in strategic transport infrastructure planning is to take early account of the environment. This can only be achieved if the views of affected groups are fully taken into consideration at the various stages of the SEA process. The aims of consultation and participation in SEA are to:

Aims

- enhance transparency in decision-making, by providing information;
- obtain useful information about potential environmental impacts and their mitigation;
- increase support for the final proposal, for example by involving external groups in the planning process;
- avoid controversy, confrontation and delay later in the decision-making process due to public opposition;

- prevent the development of environmentally unacceptable transport infrastructure.

Concerned groups

The following government and public groups should be consulted and invited to participate in an SEA:

- governments:
  - ⇒ the competent authority;
  - ⇒ national, regional and local authorities and organisations responsible for environmental protection, nature conservation, heritage, landscape protection, land use (spatial) planning and pollution control;
  - ⇒ sectoral governmental organisations which may be affected, such as agriculture, energy, fisheries, forestry;
  - ⇒ international agencies, e.g. those responsible for the designation of areas of international importance;
  - ⇒ governments and organisations in adjoining countries.
- the public:
  - ⇒ local community representatives, landowners and residents' groups;
  - ⇒ groups representing users of the environment (e.g. farmers) and research institutes;
  - ⇒ employers' and employees' organisations;
  - ⇒ environmental non-governmental organisations;
  - ⇒ users of transport infrastructure;
  - ⇒ the public in adjoining countries.

11.2 How to undertake consultation and participation?

Methods of consultation of affected groups and the public.

Table 12. Suggestions for public participation in corridor studies

Do:	Do not:
indicate the boundaries of plan development	create any un-fulfillable expectations
only start the planning/assessment process if the outcome is genuinely open	apply interactive planning to achieve a hidden agenda
involve all relevant parties in the process	allow interference in the agreed process
include explicit evaluation steps in the process	allow governments to represent affected groups
keep to the agreed time schedule	start the process without careful preparation
keep all input to the process authentic	mix different steps in the process
show involved parties their input on paper	limit communication to a presentation of the evaluation results
detach people from their fixed patterns of thinking	always use well-known solutions
communicate in understandable terms in a way that appeals to individuals	gather large anonymous groups

Consultation and public participation should take place throughout the SEA process. It is often focused on the scoping phase, when the issues for the SEA are selected and (especially) on the review phase, when reactions to the SEA report can be given. Sometimes there may exist an inter-agency group, which comments on drafts at each phase, supplemented by wider participation on fewer occasions.

Inter-agency

Agency consultation usually involves the circulation of draft documents, bilateral meetings, round-table meetings and informal discussions. Despite agencies' technical competence within their own fields, to elicit full responses it is helpful to make documents as user-friendly as possible and to make the contribution sought absolutely clear.

Wider participation

The main types of public consultation and participation are:

- Informing affected groups:
  - ⇒ printed materials (brochures, displays and exhibits, direct mail);
  - ⇒ use of the media (newspapers, news conferences, newspapers, radio and TV);
  - ⇒ public information sessions (open houses, site visits, field offices);
  - ⇒ use of the Internet (web site describing the SEA).
- Listening to the opinions of the public:
  - ⇒ surveys (interviews with key people, polls and questionnaires);
  - ⇒ large meetings (public meetings, public hearings, conferences).
- Direct participation of the public (or agencies):
  - ⇒ small meetings (public seminars, focus groups);
  - ⇒ advisory groups (e.g. task forces);
  - ⇒ problem solving techniques (e.g. brainstorming, simulation games);

Box 28. Public participation in the Italian HSR Milan-Bologna corridor study

The experience of the Italian Milan-Bologna High Speed Railway shows that public participation is useful at strategic level. Public participation at corridor level, following careful preparation, created agreement on the project and speeded up the approval process for the railway.

Local authorities were aware of the great economic importance of the project at the national level, but were worried that it would have little advantage for the region. They were also concerned about the loss of property values and possible restrictions to land use. During the public meetings a Not In My Backyard (NIMBY) syndrome emerged, and local groups were organised against the new line.

Consultation had started with local authorities involved in the building permit procedure, as well as with the public. The local authorities were under pressure from the population, but also from the agricultural organisations. Several environmental studies were prepared with different purposes, such as studies for all the 50 or more rivers the line crosses to find solutions satisfying nature preservation targets and guaranteeing safety requirements, detailed studies of the construction phase and comparative studies of the alternative route studies.

The study of the alternative routes for part of the line around the town of Modena was undertaken in close co-operation with the municipalities. The municipalities involved set up a commission of experts to analyse the routes by weighting and rating several criteria. Comparative studies were developed to discuss the advantages and disadvantages of each alternative with administrators and local communities. In parallel to this work, an extensive information campaign was conducted through discussion with people, presentation to associations and debate at the municipal council. Each alternative was presented at public meetings, where special attention was paid to clear communication and to restricting discussion to the important issues only. In the public meeting simplified thematic maps, visual simulation drawings, diagrams, histograms and carefully selected environmental indicators were used. These helped to maintain public concentration on the comparison exercise and to avoid NIMBY attitudes during the public meetings. The route selection for the high speed railway involved the whole city and the local newspaper reported daily.

Environmental studies proved to be very helpful during the negotiations to obtain the building permits from municipalities. First, they helped to overcome initial opposition due to their communicative approach. Local administrators preferred to discuss environmental studies rather than technical reports using difficult terminology, complex maps and technical drawings. Technical solutions were also presented within a wider framework, which included transportation, urban planning, land use development and environmental preservation issues. Some of the environmental studies included accurate land use and site analysis, especially where the proposed railway was close to urban area. Second, environmental studies were used to find solutions, when different requirements were in conflict, such as between nature preservation and safety requirements. Conflict between the different authorities could have stopped the permitting procedure.

⇒ consensus building techniques (e.g. Delphi process, arbitration).

Communication plan

It is useful to prepare an external communication plan at the start of an SEA process, as is commonly done, for example, in The Netherlands. Such a plan should define the stages, objectives and methods of, and responsibilities for, communication throughout the SEA process. It should include the preparation of a record of decision including how public and agency inputs to the SEA were taken into account.

It is often difficult to involve large groups that are affected by strategic decisions, in particular when specific locations have not yet been selected. In such cases, non-governmental organisations (NGOs) may represent the public. Groups that operate at the appropriate geographical level should be consulted. For example, in network plans at the national level, national NGOs should be involved. However, if plans that are relevant to identifiable regional or local areas are made at national level, groups in these areas should also be consulted.

Some suggestions about methods of communicating with the public are presented in Table 12. There have been some notable public participation exercises in SEA. That for the Milan-Bologna High Speed Railway is described in Box 28 and the nationwide involvement of the public in the extension of the Port of Rotterdam is evaluated in Box 29.

It is important that public input should be acknowledged. Thus, any suggestions made about the scope of the SEA should be responded to. Similarly, comments on the SEA report, and how they are taken into account, should be set down in a record of decision on the proposal.

11.3 Further reading

- Centre for Environmental Management and Planning, 1995. *Public Participation in EIA: a Review of Experience in Europe and the UK*. CEMP, University of Aberdeen.

(This report examines the formal and informal opportunities for public participation in EIA. The strengths and weaknesses of different approaches to public participation are discussed from the perspectives

Box 29. Public participation in determining the need for an extension to the port of Rotterdam, The Netherlands

In 1996, a decision was made to construct a new freight rail line from the Port of Rotterdam to the German hinterland (Betuweroute). The SEA for this line was heavily criticised because, whilst the environmental impacts were assessed in sufficient detail for that level of decision-making, the economic necessity of the line was never properly demonstrated.

At the same time, the Rotterdam port authorities initiated decision-making about an extension of the reclaimed port area Maasvlakte. To prevent the mistake that was made with respect to the Betuweroute, a national discussion was organised in The Netherlands to determine the need for an extension of the Port of Rotterdam. Decision-making was initiated by a proposal developed by the port authorities. During a time span of one year, public discussions were organised throughout the whole country about the desirability of an increase of freight transport and the locations where this could take place. The result was the following decision by the Cabinet:

- that extension of port capacity, considering the benefits and the environmental impacts of such anextension, was necessary;
- that certain Dutch ports were excluded as potential locations. However, Rotterdam could not be designated as the only feasible option. Antwerp was one of the alternatives to be studied;
- that the possibility of making more efficient use of the existing port area should be studied.

The cabinet decision served as input for a new SEA, in which a number of strategic alternatives could now be excluded from the analysis.

The discussion' of need followed an approach that had been proposed by the Scientific Council on Government Policy (1994) in advice to the government about the planning of large projects. These discussions were to lead to an 'inception decision' for a corridor SEA.

The discussion of need followed a so-called open planning process, where the participants (the general public and organised groups) generate planning proposals and evaluation criteria. The most important techniques used for participation were large and small meetings, telephone and written questionnaires, provision of information brochures and Internet discussions.

This ‘need and necessity’ discussion was evaluated by a high-level committee, which concluded that the open planning process had been only partly successful and could have been improved in many ways. It identified particular weaknesses in the organisation of the process as a whole, in the development of the objectives and in the sequential rejection of alternatives.

of the various stakeholders in the EIA process. Six case studies are presented and analysed to indicate how the real and perceived barriers to public participation can be overcome.)

- Environmental Resources Management, 1995. *Manual on Public Participation*. European Bank for Reconstruction and Development, London.

(This publication presents an overview and description of methods and techniques for public participation.)

- Friend, J. and Hickling, A., 1997. *Planning under Pressure: the Strategic Choice Approach*. Butterworth-Heinemann, Oxford, 2nd edition.

(This book covers the fundamentals of the strategic choice approach which is applied to make progress in strategic decision-making in meetings and workshops; the various analytical methods used; the skills involved in applying them in practice; the practicalities of organizing and managing interactive strategic choice workshops; the role of software; the management of extensive participatory projects; and the wider developmental challenge.)

- Rosenhead, J. (ed.), 1989. *Rational Analysis for a Problematic World*. John Wiley, Chichester.

(This book presents six interactive approaches to the structuring of strategic problems.)

- United Nations Economic Commission for Europe, 1996. *Current Policies, Strategies and Aspects of Environmental Impact Assessment in a Transboundary Context*. UNECE, Environmental Series 6, Geneva.

(This report discusses 1995 practice with respect to the implementation of transboundary assessment, including public involvement.)

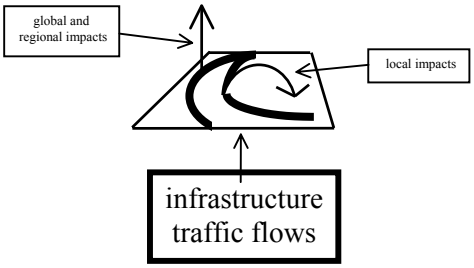
PART 3: ASSESSMENT OF GLOBAL, REGIONAL AND LOCAL IMPACTS

In Part 3:

- Traffic forecasts /impacts on traffic induced by infrastructure (Traffic flows, accessibility).
- Global and regional environmental impacts (Resource depletion, climate change, acidification, smog, mainly caused by infrastructure traffic flows).
- Local impacts (Local air pollution, noise, land take, impacts on water resources, impacts on biodiversity, visual / landscape impacts, largely caused by the construction and location of transport infrastructure).

(See Figure 5, opposite page 73)

12 Traffic forecasts



This chapter explains how changes in traffic flows influence the environment in several ways. It is intended for users who have little knowledge of forecasting traffic flows.

12.1 Indicators

Measures of traffic flows and accessibility .

It has been demonstrated that major roads in Europe induce very significant traffic growth (European Commission, 1996f). In particular, long-distance road infrastructure tends to induce urban development, a phenomenon that is observed in most parts of the EU. This is why it is desirable that transport infrastructure planning should be integrated with spatial planning (as, for example, in the European Spatial Development Perspective, 1997).

Indicators used in traffic forecasting include:

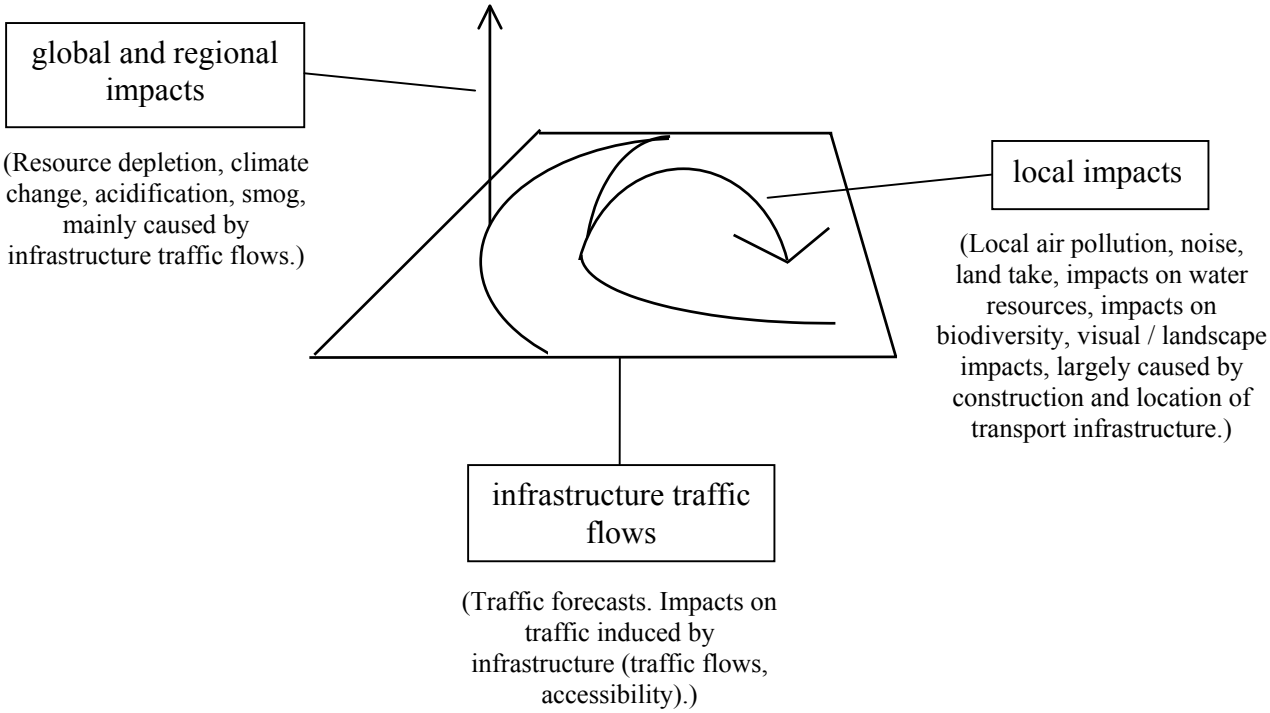
Traffic flows

Traffic flows, which directly influence the use of resources and emissions. The following characteristics of traffic flows are the main inputs for the environmental assessment of infrastructure proposals:

- passengers and freight transport by mode and route (in passenger-kilometres, tonne-kilometres or vehicle-kilometres);
- numbers of vehicles (by time of the day) passing particular locations in the multi-modal network (including the existing network, where traffic volumes may either increase or decrease).

Traffic flows are needed as an input to resource use and emission forecasts. The indicators can distinguish between vehicle types with

Figure 5. Types of impacts arising from new transport infrastructure



In the assessment and forecasting of environmental impacts, a distinction should be drawn between impacts on traffic flows, and environmental impacts at global, regional and local scales. The impacts within each of these groups can be assessed with similar methods, and they can be influenced or abated by similar types of changes to transport infrastructure plans.

Box 30. Speed levels and occupancy rates applied in the European High Speed Rail Network SEA

	speed levels [km/h]		average occupancy rate
	1988	**2010**	
motorway traffic[1]	100	90	1.7 passengers/car
classic rail[2]	160	160-200 [3]	35%
HSR	270	270-300 [3]	60%
aviation	400-800	400-800	60%

[1] average speeds
[2] maximum speeds
[3] depending on the ratio

different environmental impacts (e.g. fuel type), and traffic conditions such as average speed to determine fuel use and emissions per kilometre of road, rail and air transport (both are higher at both high speeds and congested low speeds).

Box 30 shows the average speeds and occupancy rates assumed for various forms of transport in the European HSR Network SEA. These are important parameters in forecasting environmental impacts. Traffic conditions can be significantly influenced by transport infrastructure, for example, where bottlenecks causing congestion are removed. In the case of air transport, the number and time of take-offs is relevant to assess noise nuisance.

Accessibility

Accessibility, the time and cost required to reach travel destinations, has socio-economic impacts (see Chapters 3 and 9). It induces spatial development and therefore indirectly affects the demand for transport and hence traffic flows in the longer term. The impact of infrastructure development on accessibility can be expressed in terms of indicators such as travel speeds and congestion rates. Recently, new methods have been developed for estimating the effects of transport infrastructure plans on accessibility. These are closely related to the socio-economic value and spatial impacts of improved accessibility (Rietveld and Bruinsma, 1998).

Time horizons

Examples of traffic indicators used in recent French and Finnish SEAs are shown in Box 31. These indicators should be forecast with a sufficiently distant time horizon. Infrastructure plans, in particular at network level, are likely to be implemented over a period exceeding 10 years. Traffic scenario time horizons commonly used are between 10 and 50 years.

12.2 Forecasting

Use of models and expert judgement to forecast traffic flows and secondary impacts.

Long-term forecasts of traffic flows and accessibility should ideally be based on models (see Figure 6). However, traffic modelling and forecasting are complex tasks, which often take place over a period of years and, if started from scratch, may be difficult to complete in the

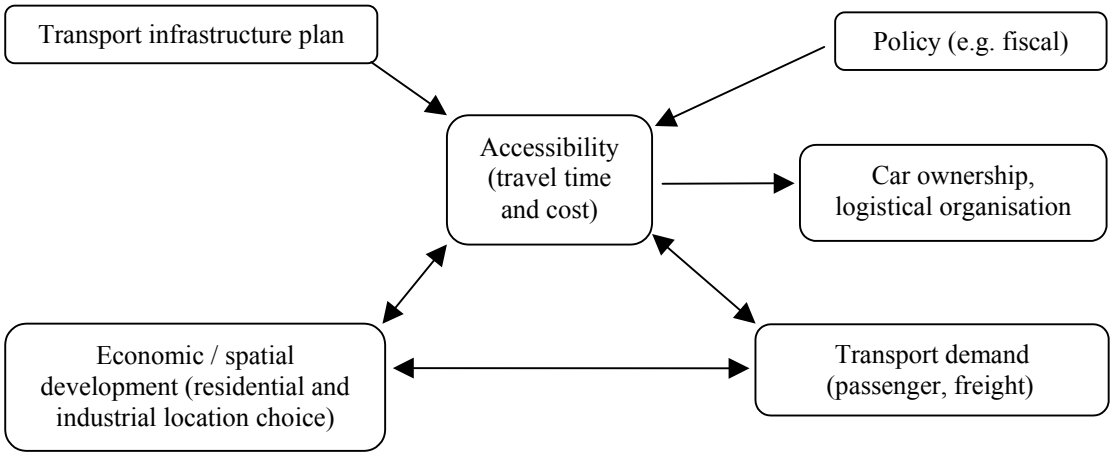
Box 31. Traffic indicators in French and Finnish SEAs

The indicator of traffic level in the French study on '**Intermodal proposals for the A7-A9 route**' is the number of vehicles per day on the A7 Motorway. The study evaluated the effectiveness of the proposed measures to divert traffic from certain roads. An indicator of effectiveness of a measure is defined as the ratio between the number of diverted passenger car units (p.c.u.) kilometres in a given year and the cost of the measure. Other indicators were also applied, such as: the number of days of congestion, the number of days of congestion, also specified for the period of summer holidays. More recently, in France the following indicators are applied: the percentage of heavy goods in total traffic on each route (to assess changes in routes or modal split for this traffic), the distribution over day and night (which is necessary for assessment of noise impacts).

The SEA of the **Nordic Triangle** used the following traffic indicators:

- Indicator for rail traffic: no of journeys per year,
- Indicators for goods traffic: tonnes of good transported per year, tonne-mileage (= journey x
- weight of the cargo), traffic performance (e.g. kilometres per road vehicle, train or vessel);
- Indicator for air traffic: no. of journeys per year.

Figure 6. Causal linkages in long-term transport models



Most traffic forecasting models have the following components:

- *a component which forecasts the demand for transport generated by the transport infrastructure plan and by other factors, such as economic and spatial development policy, car ownership, logistical organisation.*
- *a component which forecasts the allocation of this demand over the available (or proposed) modes and routes. There is currently a lack of such models, especially those that link with the traffic indirectly caused by transport infrastructure – induced land use changes. Such models tend to be complex and to require considerable input of data from various sources. These topics are the subject of research funded by the European Commission (forthcoming) and a new generation of network level transport models is beginning to evolve.*

For SEA purposes, however, simplified models with relatively few data requirements and complex manipulations will suffice to assess global and regional, and local, impacts

time-scale of an SEA process. Ideally, the models should be sensitive to the effects of general policies designed to influence traffic flows (e.g. ecotaxes, vehicle taxes, encouragement of public transport).

In forecasting the effects on transport in the framework of an SEA, it is necessary to:

- **Apply available models** since, in a single SEA, there is insufficient time to develop new models. In many parts of Europe, models are in place at local and regional scale, and in some countries also at national scale. There are also European scale models (European Commission, forthcoming).

- **If necessary, construct simple models.** If transport models are not available, construct models which are as simple as possible within the time span of the SEA. The following basic approach generally provides useful information to choose between strategic infrastructure options:

  ⇒ assume a fixed travel time budget for commuters, or a fixed financial budget for industries;

  ⇒ assume improvement of the level of service to estimate the (longer) travel distances for people and goods;

  ⇒ make indicative scenarios for site selection for industrial and urban development;

  ⇒ compare the results with the expected development *without* changes to the network (or with alternative changes).

- **Apply expert judgement.** In addition to models, expert judgement should be employed, e.g. through the use of workshops with participating experts in economics, transport and geography.

- **Continuously improve models.** Outside the framework of a single SEA, continuously improve the available models for application in future SEAs. The development of permanently managed traffic models and their associated data needs is an issue of prime importance in the development of SEA for transport infrastructure plans. Existing models should be kept up to date in

terms of the existing transport flows, political scenario assumptions and changes to the multi-modal network.

Long-term models

For scenarios beyond 20 years, assumptions about technological and political developments dominate the uncertainties in transport scenarios. Different, more general, models (linked to spatial and economic development scenarios) are useful in these circumstances. For example, in The Netherlands, a personal computer simulation model, the Scenario Explorer, has been developed for long term (15 to 60 years) nationwide travel demand and supply forecasting (Verroen and van Maanen, undated). The model facilitates experimentation with alternative policies (including pricing) and with perceptions about causalities within the traffic and transportation system, taking account of empirical relationships.

Secondary impacts

New transport infrastructure influences the long-term development of settlement patterns of people and economic activities. These again influence traffic flows, and therefore should be accounted for in transport models. Induced regional development itself, of course, also has environmental impacts. These are secondary effects of the transport infrastructure plan. Transport models can therefore also provide input to secondary impact assessments. Such models should be developed because secondary environmental impacts can be more significant than primary environmental impacts.

12.3 Further reading

- European Commission, 1996f. *Overview and Evaluation of Methodologies for the Forecasting of Induced Traffic on New Transport Infrastructure.* Directorate-General XI, Brussels.

(This study provides an overview of methods for forecasting traffic induced by the construction of new transport infrastructure.)

- European Ministers of Spatial Planning, 1997. *The European Spatial Development Perspective*. Ministry of Housing, Spatial Planning and the Environment, The Hague.

(Currently being further developed, this draft document describes the European dimension of spatial planning, and the importance of the

links between spatial planning and transport planning. It includes proposals for action at the European level. It is available at: http://www.inforegio.org/dg16_en.htm.)

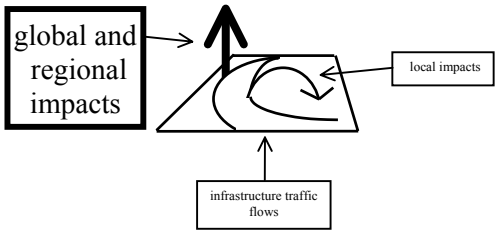
- Rietveld, P. and Bruinsma, F.R., 1998. *Is transport Infrastructure Effective: Transport Infrastructure and Accessibility Impacts on the Space Economy*. Springer Verlag, Berlin.

(This book gives an overview of current methods of assessing spatial and economic impacts of infrastructure. Accessibility is applied as a bridge concept. The book is intended for a wide group of readers, not only those who have a strong background in statistics or modelling. It presents examples from several European countries).

- Standing Advisory Committee on Trunk Road Assessment, 1994. *Trunk Roads and the Generation of Traffic*. HMSO, London.

(This report provides theoretical and empirical evidence about induced traffic. It furthermore argues that neglecting induced traffic contributes to an overestimation of benefits.)

13 Global and regional impacts



Read this chapter to learn about assessing and abating large-scale impacts. (Biodiversity, which is affected locally but may have global significance, is discussed in Chapter 14.) The emission of air pollutants from vehicles is the basis of most of these impacts, and is described first.

13.1 Emission of air pollutants

Main air pollutants emitted by transport and the importance of setting emission targets.

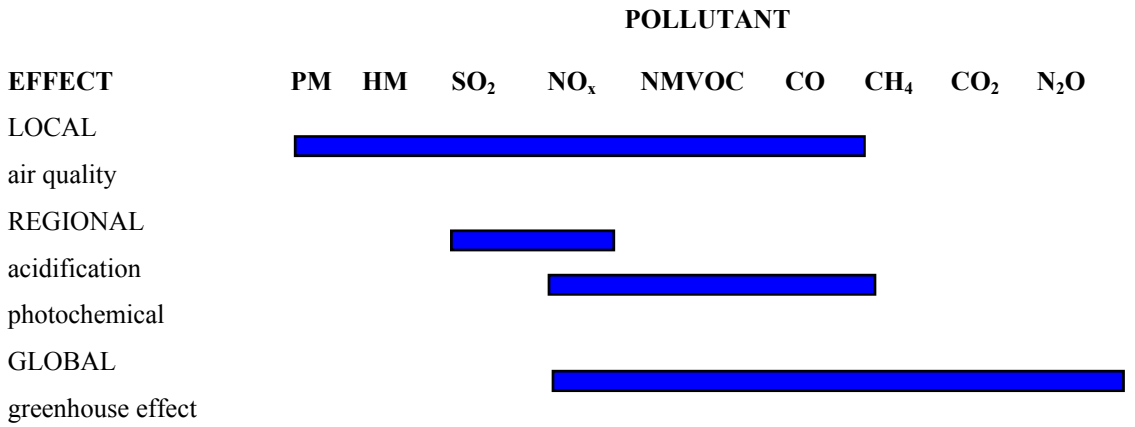
Air pollutants emitted during fuel combustion include: suspended particulate matter (PM), heavy metals (HM), sulphur oxides (SO_x), nitrogen oxides (NO_x), 'non-methane' volatile organic compounds (NMVOCs), carbon monoxide (CO), methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O). The environmental impacts of these pollutants, at different spatial scales, are indicated in Table 13.

The emissions of these air pollutants have large-scale effects on, inter alia, health and biodiversity. (Local impacts of emissions to the atmosphere, close to transport infrastructure, are discussed in Chapter 14.) Such effects are also caused by emissions in other sectors (e.g. industry and heating).

Emission targets

Therefore, in an SEA for a transport infrastructure plan, it is appropriate to make use of existing political targets for the reduction of emissions (perhaps based on calculations of critical pollutant loads). Normally, such emission targets should be defined by bodies such as transport ministries. These should sub-divide the targets to the networks and corridors under their responsibility. If this is not done as part of a transport-environmental policy, such targets have to be derived from environmental policy in the framework of SEAs.

Table 13. The main effects of air pollutants related to spatial scale



Source: European Commission, forthcoming.

Table 14. European Union objectives and targets for air emissions

CO_2	Objective: no exceeding of the earth's natural absorption capacities of CO_2 emissions Target for 2000: stabilisation of CO_2 emissions at 1990 level (progressive emission reduction until 2005 and 2010), later changed into (Kyoto): reduction of 8% of all greenhouse gases from 1990 levels by 2008 - 2012
NO_x	Objective: no exceeding of critical loads and thresholds Target for 2000: reduction of 30% from 1990 level.
SO_2	Objective: no exceeding of critical loads and thresholds Target for 2000: reduction of 35% from 1985 level
VOC	Target for 2000: reduction of 30% from 1990 level.

Source: European Environment Agency, 1998.

In that case, SEAs should assume a reasonable portion of the total target to be reached by the transport infrastructure plan that is being developed for these networks and corridors. If no national targets exist, targets at the European level may be used. (EU objectives and targets are indicated in Table 14.)

The resulting targets at network or corridor level can be used as an evaluation framework in the SEA.

13.2 Large-scale transport impacts

The large-scale impacts of transport: natural resource depletion, climate change, acidification and smog.

13.2.1 Natural resource depletion

World-wide, the transport sector accounts for more than 60% of oil products used. Road vehicles account for more than 80% of this, most of the remainder being used by air transport (Organisation for Economic Co-operation and Development, Environment Directorate, 1996). Resource depletion is recognised as a significant aspect with regard to sustainability of transportation. While there have been improvements in the fuel efficiency of vehicles, their effect has been out-weighed by the increasing demand for transport.

Present-day transportation systems also require a remarkable array of inputs: concrete, sand and steel for infrastructure, plastics and ferrous and non-ferrous metals for vehicles. These materials are often scarce, and their extraction and production causes environmental impacts. In addition, in the decommissioning of infrastructure and vehicles, considerable waste streams are generated, including non-renewable, non-recyclable and environmentally harmful materials.

13.2.2 Climate change

The global climate is strongly influenced by changes in the atmospheric concentrations of a number of gases that trap heat radiated from the earth's surface (the 'greenhouse effect'). Water vapour and carbon dioxide (CO_2) in the atmosphere give rise to a natural greenhouse effect, which is enhanced by emissions caused by

human activities. Other important greenhouse gases are methane (CH_4), nitrous oxide (N_2O), and halogenated compounds such as the chloro-fluoro-carbons (CFCs). Over about the past hundred years, human activities have led to increases in the concentrations of greenhouse gases and other pollutants in the atmosphere, causing the enhanced greenhouse effect or 'global warming'. Climate change is now widely recognised as a threat to the world's environment

Carbon dioxide has been singled out as the most important transport induced greenhouse gas having a direct impact on global warming. Since 1980, the contribution of road transport to the total emission of greenhouse gases due to fossil fuel combustion in the EU has increased from about 10% to nearly 20%. In Kyoto, in December 1997, the European Union committed itself to reduce all greenhouse gases by 8% from 1990 levels by 2008 (Table 14).

13.2.3 Acidification

Acid deposition originates largely from emissions of gaseous pollutants of which sulphur dioxide (SO_2) and nitrogen oxides (NO_x) are the most important. The effects include defoliation, eutrophication, damage to agricultural crops, and damage to limestone and marble buildings and monuments and to stained glass windows. Some of the SO_2 and NO_x emissions originate from diesel and petrol driven vehicles, ships and aircraft.

Acidification is a transboundary problem which calls for a combination of national and international initiatives. EU emission reduction targets with regard to acidification are mentioned in Table 14.

13.2.4 Photochemical smog

Photochemical smog occurs over a large part of Europe every year. Photochemical smog is chemically formed from a number of gases that are present in the troposphere. The main precursors are nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs), methane (CH_4) and carbon monoxide (CO). Many human activities give rise to these pollutants, including fossil-fuel combustion, mainly from transport.

Table 15. Indicators for global and regional impacts

Impact	Possible indicators
Biodiversity	(see Chapter 14)
Depletion of fossil energy	- energy use (megajoules) - fuel use (litres, tonnes)
Depletion of other natural resources	- material intensity (tonnes of material used by a unit of transport capacity
Climate change	- fuel use or energy use (litres, tonnes, megajoules) - emissions of CO_2 (emitted CO_2 per passenger kilometre) - emissions of N_2O and CH_4
Acidification	- fuel use or energy use (litres, tonnes, megajoules) - emissions of NO_x and SO_2 - critical pollutant loads.
Photochemical smog	- fuel use or energy use (litres, tonnes, megajoules) - emission of NO_x and VOC - regional climate, presence of hills

Sunlight acting on these pollutants results in the formation of a range of compounds known as photochemical oxidants, the most important of which is ozone (O_3). The main consequences of exposure to ozone are respiratory difficulties in sensitive humans and damage to vegetation and ecosystems. The EU targets for NO_x and VOC emissions are shown in Table 14.

13.3 Indicators and forecasts

Forecasting indicators for large-scale impacts based on changes in traffic flows and technology.

Possible indicators for global and regional impacts are summarised in Table 15. The location of the infrastructure within a corridor normally has no significant impact on these indicators.

13.3.1 Natural resource depletion and pollutant emissions

Energy is used and pollutants are emitted during (i) the construction of infrastructure and vehicles, (ii) the use of infrastructure by vehicles, and (iii) in the decommissioning of vehicles and infrastructure. Because transport infrastructure has a long lifetime, vehicular use is by far the most important emitter.

Fuel use

Any infrastructure plan that reduces fuel use is beneficial for energy depletion, climate change, acidification and photochemical smog. Fuel use is therefore an appropriate indicator for most global and regional impacts. In the SEA of the European High Speed Rail Network comparison of the energy consumption of different modes of transport was based on primary energy consumption, which included vehicular energy consumption and the energy required for fuel production. The latter took into account the efficiency of electricity production for electric-powered rail transport, as well as the energy losses during the refining of road and air transport fuel.

Factors behind fuel use and emissions

Fuel use and pollutant emissions depend on:

- the amount of transport (passengers-kilometres and tonne-kilometres);

Box 32. Assumptions about long term emission factors

The horizon in infrastructure SEA may often be between 10 and 50 years. In such a long period, traffic emissions and energy can be greatly influenced by various economic, policy and social factors, and by technological, logistical and legal developments. When scenarios are prepared for the environmental impact of transport infrastructure plans, it is therefore essential to make assumptions about such developments which in themselves cannot be influenced by the transport infrastructure plan. Such assumptions can, for example, for example, involve corridors of possible developments that have political credibility. Many of these crucial factors are influenced by policy and legislation at EU level, such as:

- fiscal measures (e.g. ecotax on fuel, encouraging environmentally friendly vehicles)
- agreements about European spatial planning
- road pricing policy
- emission and fuel use regulations
- emission from plants generating power used in rail transport (European Commission, forthcoming).

Such scenario-assumptions could be co-ordinated at EU-level (e.g. high and low-traffic scenarios; a scenario which continues historical trends in technological progress, etc.).

- the mode of transport (road, rail, air, inland waterway, marine, pipeline);
- the kilometres of vehicle movements for each passenger-kilometre or ton-kilometre (load factors);
- traffic conditions such as average speed;
- fuel use and pollutants emitted per vehicle-kilometre (for particular types of vehicle at a given speed, emissions to the air are roughly proportional to fuel use).

Each of these factors has to be assessed in order to make scenarios for fuel use and pollutant emissions. However, fuel consumption and emissions cannot be influenced by infrastructure plans except to a very limited extent or indirectly. When alternative infrastructure plans are compared, many of these factors can safely be assumed to have constant values and to make no difference in the comparison of plan options.

Technological development

As the technological development of vehicles and transport advances, and standards for vehicle fuel consumption become more restrictive, the composition of the vehicle stock changes accordingly. Box 32 discusses the importance of making long-term scenario assumptions in this area.

The use of environmentally friendly vehicles and fuel types may also develop under the influence of market forces (such as the transition in Central and Eastern Europe) and of government interventions (such as fiscal measures, e.g. taxes on vehicles and fuels).

For example, the SEA of the European HSR Network assumes for its forecasts of vehicle energy consumption and air pollution that the best technologies available during SEA preparation will be generally introduced by 2010. This includes 3-way catalytic systems in all cars.

Resource intensity

Resource intensity is the amount of a scarce or polluting non-fossil fuel resource material that is used to produce a fixed amount of 'transport' (e.g. the amount of steel required for a kilometre of railway). Different modes may be compared by calculating the amount of resource used for each passenger-kilometre or tonne - kilometre.

Box 33. European HSR Network SEA 'acid equivalent' and 'CO-equivalent' emissions

The SEA of the European High Speed Rail Network estimated the emissions of air polluting compounds by adding the emissions generated from operation and from fuel production and distribution. Emissions from power stations were taken into account for electric rail transport. For road and air transport emissions from refineries and refuelling were also considered. Emissions were given in absolute terms (in million tonnes) and in relative terms (in g/passenger km). SO_2 and NO_x emission figures were converted into acid equivalent (in million tonnes AE, and in g AE/passenger km). CO, PM, NOx, SO_2 and HC emissions were expressed in 'CO equivalent' (in million tonnes CO-equivalent, and in g CO-equivalent/passenger km) by calculation using toxicity factors.

Figure 7. Emissions of 'acid equivalent' in the SEA of the European HSR Network

1988 is the base year; for 2010 three scenarios have been developed: Reference (REF), Construction of the European High Speed Rail Network (HST) and Forced Mobility (FM).

The resource intensity of transport infrastructure building can be assessed by calculating the use of materials during the lifetime of transport infrastructure. This can be based on current practice and trends. General environmental policy may provide ways to evaluate the significance of the use of certain materials (World Resources Institute et al., 1997).

The Italian SEA of the Milan-Bologna High Speed Railway used the route length, the volume of material brought in from quarries (fill) and the volume of material excavated during construction (cut) as indicators for the evaluation of route alternatives.

Resource intensity is seldom used in SEA practice for transport infrastructure plans, because it is assumed that this can be sufficiently mitigated at the project level. National guidance may provide suggestions for minimising resource intensity.

13.3.2 Emission of greenhouse gases

Carbon dioxide is the most important transport generated gas contributing to climate change. Gross emissions of CO_2 can be estimated on the basis of the use of fuel, specified for each fuel type (or electricity). This relationship is for large-scale transport infrastructure, not significantly affected by changes in speed or clean technology.

The role of two other greenhouse gases, N_2O and CH_4, presently making a small contribution to climate change, may increase in the future. Emissions of greenhouse gases can be used as approximate indicators of the damage caused by them.

13.3.3 Emissions of SO_2 and NO_x

Emissions of SO_2 and NO_x can, at the strategic level, be used as approximations for the damage done by acidification. These emissions are significantly affected by speed and technology. To estimate the aggregated acidifying effects of NO_x and SO_2, a conversion of emissions into acidifying factors can be considered. This was done in the SEA of the European HSR Network (Box 33). Figure 7 shows the total acid equivalent (AE) emissions for various scenarios for the HSR

Network. Such emissions can be used to determine whether nationally identified critical loads are likely to be exceeded.

Emissions of NO_x can serve at the same time as an indicator for photochemical smog, because it is one of the main transport-induced precursors of ozone, the most harmful pollutant in photochemical smog.

13.3.4 Emissions of VOCs

VOCs are another important precursor of ozone. Because changes in vehicle technology may affect the ratio between emitted NO_x and VOCs, it may be used as an additional indicator of photochemical smog.

13.4 Improving environmental performance

Making transport infrastructure plans better for the global and regional environment.

Building new transport infrastructure generally reduces travel time and cost, and therefore the traffic increases. Passenger transport is more sensitive to reductions in travel time, and freight transport is more sensitive to reductions in travel cost. Infrastructure plans can therefore:

- affect the relative time and cost of different transport modes, to give environmentally friendly modes an advantage;
- include provisions for faster and more comfortable ways of interchanging between modes of transport, e.g. ‘park and ride’, ‘transferia’, cycling provision;
- contain measures to influence average speed and driving behaviour, such as:

  ⇒ signalling systems to prevent congestion;

  ⇒ traffic control systems to calm traffic;

  ⇒ road pricing to encourage alternative modes;

Table 16. Other instruments for improving the environmental performance of transport

- Command and control:
  - ⇒ fuel quality and vehicle fuel consumption and emissions
  - ⇒ speed reduction measures
  - ⇒ regular check-up of vehicles
- Economic instruments to encourage environmentally friendly modes:
  - ⇒ subsidising public transport
- Economic instruments to discourage transport, particularly environmentally unfriendly modes:
  - ⇒ increase taxes on new cars and on second hand cars
  - ⇒ increase taxes on fuels
- Economic instruments to encourage environmentally friendly vehicles
  - ⇒ make the level of taxes and subsidies dependent on the vehicle fuel consumption and emissions, e.g. their weight
  - ⇒ subsidising cars with catalytic converters or cruise control
  - ⇒ differentiating taxes on fuel types, e.g. a relatively low tax on LPG
- Restrictive parking policy in urban centres
- Stimulate high load-factors
  - ⇒ car-pooling

Table 17. Reducing emissions by co-ordination with spatial planning

Spatial planning can significantly contribute to the reduction of transport emissions. Options are:

- to promote land for housing, work and recreation in locations capable of being well served by rail or other public transport;
- to avoid sporadic housing, working and recreational development and the development of small settlements;
- to stimulate higher-density residential developments near public transport centres or alongside corridors well served by public transport and close to local facilities;
- to concentrate employment and other activities attracting significant number of trips and avoid major developments in locations not well served by public transport;
- to locate origins and frequent destinations close to each other:
  - ⇒ home-work
  - ⇒ home-shopping
  - ⇒ home-recreation
  - ⇒ supply manufacturer-main manufacturer
  - ⇒ producer-consumer

⇒ assignment of infrastructure, or parts of it (e.g. motorway lanes) to target groups, such as buses or long distance transport rather than local urban transport;

- include provisions to decommission or to reduce the construction of new infrastructure, keeping the capacity low, to induce less traffic.

However, the most effective instruments for influencing transport emissions are outside the scope of infrastructure plans. For example, in countries such as Germany it is official policy to transfer the transport of goods from roads to railways, where feasible. Some of the instruments that can be used to achieve such a transfer are mentioned in Table 16.

Transport emissions can also be reduced by co-ordination with spatial planning, as shown in Table 17 (see also European Commission, 1997d). For example, the Dutch Transport Structure Plan (1992) included the following spatial policies which were used as assumptions for traffic modelling and decisions about transport infrastructure development:

- general criteria for selection of housing and industrial locations;
- 'accessibility profiles' for industrial areas, determining the number of parking places.

Later, these criteria were further elaborated in the national spatial plan.

13.5 Further reading

- Dietz, F. J., Volleberg, H. R. J., and de Vries, J.L., 1995. *Environment, Incentives and the Common Market*. Kluwer, The Hague.

(Chapter 6 describes the pricing instruments for transport policy. This chapter discusses the alternatives and problems facing the EU in formulating a transport policy in which environmental problems are internalised by fiscal instruments.)

- European Commission, 1996e. *Methodologies for Transport Impact Assessment*. Transport Research Series, Office for Official Publications of the European Communities, Luxemburg.

(This report contains a great deal of information about indicators and impact forecasting.)

- European Conference of Ministers of Transport, 1997. *CO_2 Emissions from Transport.* ECMT, Organisation for Economic Co-operation and Development, Paris.

(The European Conference of Ministers of Transport (ECMT) has conducted an in-depth survey of its members to assess what governments are actually doing to meet their commitments on climate change. This report presents the results of this survey, focuses on how the European motor industry is responding to this concern, and examines improvements in fuel consumption and CO_2 emissions from new cars.)

- European Environment Agency, 1998. *Europe's Environment. The Second Assessment.* EEA, Copenhagen.

(This report provides a detailed, authoritative, and well illustrated account of the European situation in relation to the main environmental issues.)

- Faiz, A., Weaver, C. S. and Walsh, M., 1996. *Air Pollution from Motor Vehicles: Standards and Technologies for Controlling Emissions*. World Bank, Washington, DC.

(This book presents a state-of-the-art review of vehicle emission standards and regulations and provides a synthesis of world-wide experience, including European standards.)

- Organisation for Economic Co-operation and Development, 1996. *Policies and Measures for Common Action, Sustainable Transport Policies: CO_2 Emissions from Road Vehicles.* OECD, Paris.

(This report provides an analysis of several types of measure to mitigate road vehicle CO_2

emissions. Measures are analysed whose primary objective is to reduce the energy use of cars and light vehicles such as corporate average fuel economy standards and voluntary agreements with manufacturers to achieve fuel efficiency improvements. It explores the potential for common action in the area of fuel taxation such as vehicle tax reform. It also suggests government action to encourage or implement a wide range of innovative technical and behavioural measures.)

- Smith, S. and Vos, H. B., 1997. *Evaluating Economic Instruments for Environmental Policy*. Organisation for Economic Co-operation and Development, Paris.

(This report describes methods for the *ex ante* evaluation (similar to policy or legislation SEA) of economic instruments such as CO_2-taxes.)

- World Resources Institute, Wuppertal Institute, Netherlands Ministry of Housing, Spatial Planning and the Environment, National Institute for Environmental Studies of Japan, 1997. *Resource Flows: the Material Basis of Industrial Economies*. World Resources Institute, Washington, DC.

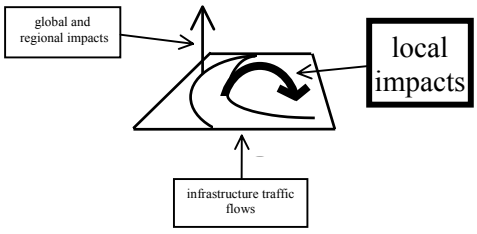
(This report describes methods of, directions in, and the preliminary results of, national resources accounting. The indicators employed can be used in environmental assessment.)

- The European Monitoring and Evaluation Programme (EMEP), set up under the 1979 UN-ECE Geneva Convention on Long Range Transboundary Air Pollution (LRTAP), is the main source of information and data on deposition, concentrations long-range transport and transboundary transfers of air pollutants, including acid pollutants.

- Emission factors depend on the composition of the vehicle fleet and fuel composition. These develop quickly in time due to legislation and technical improvements. Relevant information

about emission factors is available from specialised research institutes (European Commission, forthcoming).

14 Local impacts



Read this chapter to learn about the environmental impacts occurring at relatively short distances from transport infrastructure, which mainly depend on the location and the design of the infrastructure.

14.1 Local transport impacts

Local air pollution, noise, land take, impacts on water resources, impacts on biodiversity and visual / landscape impacts.

14.1.1 Local air pollution

As indicated in Table 13, several air pollutants can cause specific local problems if they occur at high concentrations. Substances that potentially have impacts on human health, flora and fauna include CO, volatile organic compounds (VOCs), SO_2, NO_2, and particulate matter. At very short distances, heavy metals (e.g. lead and cadmium) may also be significant. Pollutant concentrations exceeding ambient air quality standards are normally only measured directly adjacent to roads and airports. Local air quality can play a role in transport infrastructure SEA if standards are likely to be exceeded in residential areas close to new infrastructure.

14.1.2 Noise

Transport is the major source of noise. Noise exposure has adverse impacts on human health, and the perceived quality of life (e.g. noise can seriously interfere with talking and with sleep). Nuisance arising form noise exposure depends almost as much on attitudes and opinions as it does on noise levels.

Table 18. European Union objectives and targets for local impacts

Noise	Objective: no person should be exposed to noise levels which endanger health and quality of life. Targets (for 2000): in terms of night-time noise exposure levels in L_{eq} (i) levels over 85 dBA must not occur, (ii) exposure to levels of 65 dBA+ should be phased out; (iii) exposure to levels between 55-65 dB(A) should not increase; (iv) exposure to levels less than 55 dB(A) should not increase.
Groundwater	Objectives: 1. to maintain the quality of uncontaminated groundwater 2. to prevent further contamination of contaminated groundwater 3. to restore contaminated groundwater to a quality required for drinking water purposes Target: to prevent all pollution from point sources and to reduce pollution from diffuse sources according to best environmental practice and best available technology.
Surface water:	Objective: to maintain a high standard of ecological quality with a biodiversity corresponding as much as possible to the unperturbed state of a given water body. Target: quality improvement towards better ecological quality and safeguarding of existing high quality.
Marine water:	Objective: reduction of discharges of all substances, which due to their toxic persistence or cumulative impact could negatively affect the environment, to levels which are not harmful to a high standard of ecological quality of all surface waters. Target: objectives and actions similar to the North Sea Conference targets applied to other sensitive sea areas of the EU.
Biodiversity:	Objectives: 1. maintenance of European biodiversity through sustainable land management 2. creation of a coherent European ecological network (Natura 2000) of habitats protected under the Birds Directive (79 / 409/ EEC) and the Habitats Directive (92 / 43 / EEC)

Source: European Commission, 1992b.

According to scientific studies of the effects of noise on human health, the outdoor level of noise should not exceed a daytime level (L_{eq}) of 65 dB(A). However, about 113 million people in Europe (17% of the population) are exposed to environmental noise levels above 65 dB(A). Of these, about 9.7 million people live in areas exposed to 'unacceptable' transport noise levels (above a level of 75 dB(A)).

An objective of the 5th Environmental Action Plan (see Table 18) is that no person should be exposed to noise levels that endanger health. Most countries, however, have specified standards for ambient noise levels in settlements. In some countries, 'tranquil areas' are assigned where environmental noise levels are still very low, and where noisy developments should be prevented.

14.1.3 Land take

Transport infrastructure consumes land directly and indirectly:

- direct land take by the infrastructure and associated safety lanes, embankments, dug-outs, service buildings, rail stations, etc.;
- indirect land take by induced spatial development.

Land is not uniform in character. A hectare of land has a different value in urban areas compared with rural areas. Similarly, there will be differences in the quality of agricultural land in rural areas. Most countries have developed systems for designating protected or valuable areas and historical objects and monuments. An objective of transport infrastructure planning is usually to avoid these areas where possible.

14.1.4 Impact on water resources

Transport, in particular the transport of dangerous goods and chemicals, poses a risk of contamination of drinking water resources and wetland areas. Other wastes generated by transport include:

- rainwater runoff from roads containing pollutants such as hydrocarbons and heavy metals;

- de-icing salt and other chemicals used on roads, airport runways and aircraft;
- copper worn off the power lines above railways;
- effluent from ships.

Table 18 identifies the objectives for water resources contained in the 5th Environmental Action Plan.

14.1.5 Impacts on biodiversity

Biodiversity, the richness of species, ecosystems and habitats, has become an important issue in all countries, with the growing realisation that 'biodiversity is the very foundation of human existence' (see the EU biodiversity objectives in Table 18).

The development of transport infrastructure has a number of potential effects on biodiversity:

- **Direct damage** to the integrity of important nature conservation sites (such as the Natura 2000 network) through the inappropriate siting of roads, railways, ports, airports and associated facilities which destroy or damage habitats and species;
- **Fragmentation** of habitats, thereby reducing species diversity and opening the way for the influx of other species. Roads also act as ecological barriers to the movement and genetic interchange between populations, especially vertebrates;
- **Disturbance** of habitats and species due to noise and light which may depress populations and reproduction in some fauna, and from run-off from road surfaces and runways to which salt and other de-icing chemicals have been applied.

Shipping

Shipping is often viewed as more environmentally sustainable than road and air transport, particularly because of its lower energy consumption per tonne kilometre and the reduction of pressure on land based transport systems and urban areas it confers. The environmental impacts of increases in shipping can, however, be negative, resulting in:

- increases in port facilities with irreversible changes in ecologically sensitive coastal zones;
- increases in waste oil dumping or oil and chemical accidents;
- disturbance from high-speed ships on vulnerable coasts and riverbanks.

Objectives and targets

To meet EU biodiversity objectives (Table 18), strategic objectives with respect to the impact of transport infrastructure plans on local biodiversity should include:

- to avoid development in protected habitats. All EU member countries have such areas and networks, for example, those established under the Birds Directive (79 / 409 / EEC) and the Habitats Directive (92 / 43 / EEC);
- to avoid development in, or close to, unprotected but valuable and sensitive habitats (e.g. important bird areas);
- to avoid fragmentation of wildlife migration routes, e.g. by avoiding migration zones, or by mitigating the barrier effect by providing a tunnel or 'ecoduct' for wildlife;
- to adopt the 'no net effect' principle, providing full compensation for lost biodiversity values where loss is unavoidable.

14.1.6 Visual / landscape impacts

The visual appearance of linear transport infrastructure (both the infrastructure itself and the traffic it carries) can have a major visual impact on the existing landscape. Highways and (high speed) railways must have gentle, not sharp, curves, and often need long, high and visually dominant bridges, cuttings, embankments, etc., where rivers, mountains, valleys or other infrastructure have to be crossed. Therefore, sensitive visual (cultural and natural) elements and patterns, which are important at the small scale, cannot always be avoided and are easily damaged or fragmented.

Valuable and visually sensitive landscapes, culturally interesting elements and patterns and natural areas are inventoried and protected

Table 19. Indicators for risks of local impacts (network and corridor level)

Impacts	Indicators
Local air quality	- proximity of high emissions to settlements - number of affected residents
Noise	- proximity to settlements in relation to typical noise levels caused by a transport mode - proximity to tranquil zones in relation to typical noise levels caused by a transport mode - number of affected residents - number of people exposed to noise above standard levels - affected tranquil zones and other areas sensitive for noise
Land take	- direct take of different categories of land (including protected areas) - indirect take of different categories of land
Water resources	- risk of significant emission of pollutants to sensitive water resources (including accidents)
Biodiversity	- proximity to valuable habitat (including protected areas and IBAs) (risk of off-site disturbance and secondary development in the valuable area) - risk of loss and fragmentation of valuable habitat - the same indicators, but with a more precise description of the affected ecosystems and their value, and effects specified for different ecosystems and species
Landscape	- fragmentation of sensitive elements, patterns and landscapes - direct damage to visually important elements and patterns

Table 20. Amended EIA Directive definition of environmentally sensitive (vulnerable and valuable) areas

The environmental sensitivity of geographical areas likely to be affected by projects must be considered, having regard, in particular, to:

- the existing land use,
- the relative abundance, quality and regenerative capacity of natural resources in the area,
- the absorption capacity of the natural environment, paying particular attention to the following areas:
  - (a) wetlands;
  - (b) coastal zones;
  - (c) mountain and forest areas;
  - (d) nature reserves and parks;
  - (e) areas classified or protected under Member States' legislation; special areas designated by Member States pursuant to Directive 79 / 409 / EEC and 92 / 43 / EEC;
  - (f) areas in which the environmental quality standards laid down in Community legislation have already been exceeded;
  - (g) densely populated areas;
  - (h) landscapes of historical, cultural or archaeological significance.

Source: European Commission, 1997c.

in many national and regional areas with the aim of avoiding their destruction or fragmentation. When this is not possible, visual measures can be taken to accommodate the transport infrastructure into the landscape (e.g. by tunnelling) or to compensate the damage (e.g. by restoring the effects of earlier, less-sensitive, infrastructure provision).

14.2 Indicators and forecasts

Identification of relevant local impact indicators, steps in developing broadbrush alternatives and forecasting indicators used in comparing broadbrush alternatives.

Indicators used for local impacts are shown in Table 19. Forecasts are, among other things, based on the sensitivity of the local environment and the application of mitigation measures.

14.2.1 Local impact indicators

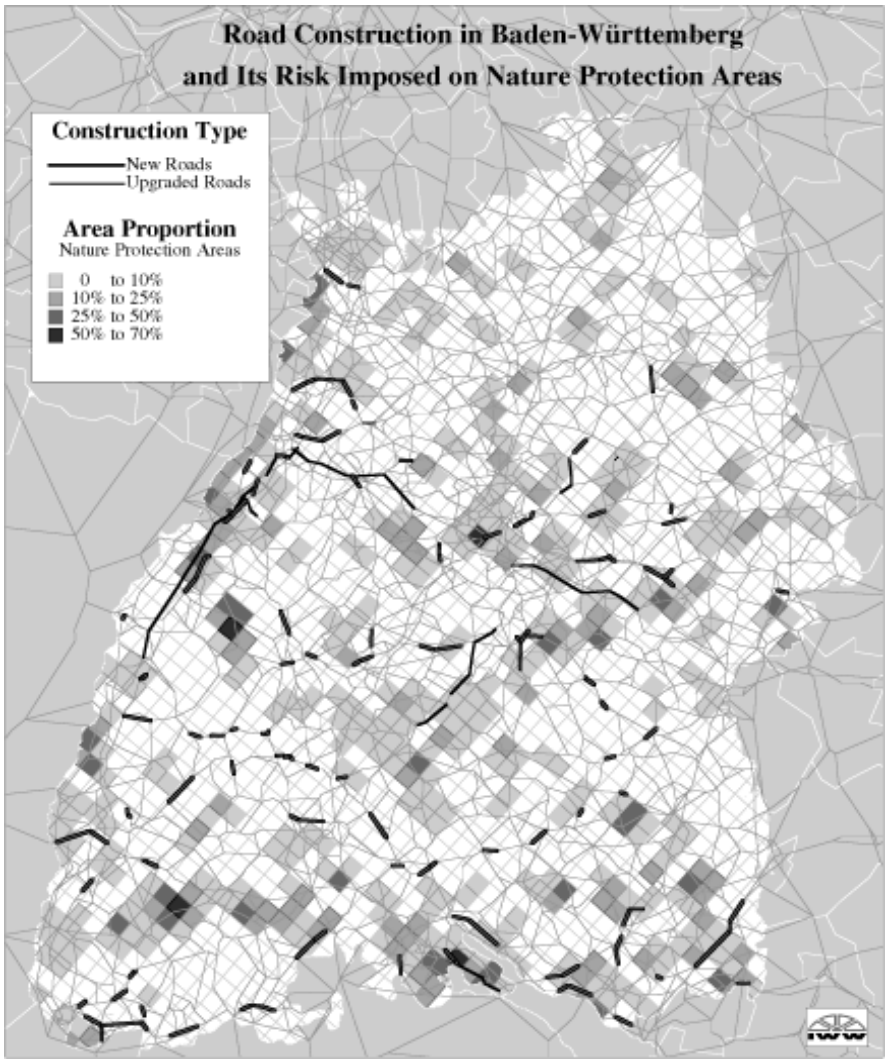
The focus of the local impact assessment at network and corridor level should be **deciding between infrastructure options and alternative plans**. This implies that local impacts will be relevant to decision-making at the strategic level in two ways:

- the **cumulative** magnitude of all local impacts for each alternative infrastructure plan (e.g. total land take in protected areas, average proximity to sensitive areas); these indicators can often be forecast on the basis of computerised geographic information systems (GISs).

- **exceptional local impacts** which are especially significant and which could influence decision-making at this level (e.g. the crossing of an exceptional habitat). These impacts can be assessed on the basis of expert judgement.

The indicators in Table 19 may be relevant at network level or at corridor level, depending on whether they are influenced by the decisions made at that level, and on whether they are politically important enough to influence decision-making. (The level of

Figure 8. Road construction and proximity to nature protection areas, Baden-Württemberg



Box 34. Ecological risk assessment: German Federal Transport Infrastructure Plan

The German Federal Transport Infrastructure Plan, 1992, consists of about 1,600 road construction projects. Ecological vulnerability studies were carried out for all newly constructed sections within the railway networks and for new waterways. For road construction projects, an additional 'ecological risk analysis' was carried out for new projects with a length of more than 10 km. This was the case for 110 projects. Ecological risk analysis is also being considered for an additional 500 large-scale construction projects.

The relatively large scale of the Plan did not allow sufficiently precise assessment methods to determine the ecological effects and possible mitigation measures to be used. It was thus not possible to decide on the environmental compatibility or incompatibility of projects. In the case of risk of complex environmental problems, for which no promising remedial measures were foreseen, the projects were downgraded to a lower priority class or were even abandoned.

The ecological risk analysis comprises information on the land cover and the risk of conflict with ecological protection areas or other areas of special concern. Ecological risk analysis in road construction projects makes it possible to take ecological aspects into consideration at the planning phase of federal traffic infrastructure planning. Only generally available databases covering the whole of the federal territory were used as an information basis; no project-related data surveys were conducted.

The basis of the assessment was a route with a corridor of some hundred metres allowing for alignment optimisation in the next decision-making tiers. The assessment indicators were the lengths of fragmentation and the number of areas possibly affected. The outcomes were summarised in a schematic evaluation matrix and on a map.

information depends on whether it could influence decision-making, as explained in Chapter 7.)

Seeking the right level of information

The level of information can be gradually improved. Examples are shown in Figure 8 and Box 34. Two approaches are:

- **Apply proximity as a measure for local environmental risk.** In some transport infrastructure plans, only decisions about (new) connections and modes are made (i.e. no routes are yet determined). In these cases, the likely proximity of the new infrastructure to sensitive areas may be used as an indicator of local environmental risk. Sensitive (vulnerable and valuable) areas are often defined nationally or regionally but the European Commission (1997c) has provided a convenient definition for screening (see Chapter 5) and other purposes (Table 20).

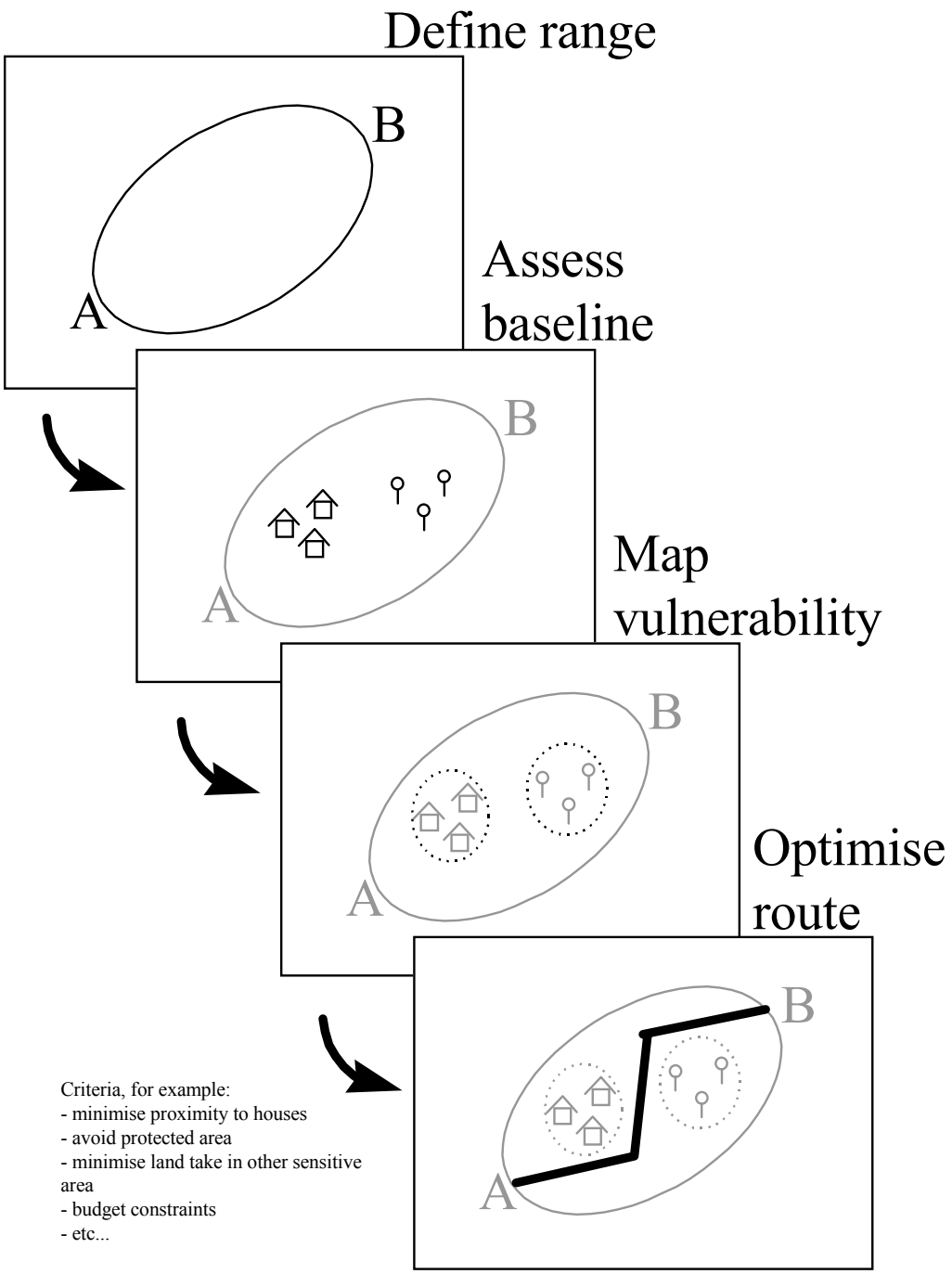
  The European Environment Agency (1998b), in the Pilot SEA of the TENs, used the proximity to sensitive areas approach. The infrastructure is assumed to follow a straight line, or a wide strip, from A to B. Proximity to sensitive zones serves as a 'red flag', indicating that large cumulative or exceptional impacts are likely, and that further decisions should be based on more detailed assessments. It is less suitable for developing routes or comparing alternatives.

- **Develop indicative routes**. If a 'red flag' analysis is not sufficient to make a choice between alternative transport infrastructure plans, indicative routes should be determined. A group of transport and environmental experts can quickly develop feasible indicative route alternatives, taking account of obvious environmental (and other) bottlenecks. They may envisage mitigation measures which could be introduced at reasonable cost. Such assessments may quantify cumulative local impact indicators, and they may identify exceptional local impacts.

Difference between network and corridor level

The guidance given above can be used at network and at corridor level. Infrastructure proposals at corridor level are more developed than at network level, but full detail is only reached at the project (EIA) level. Both at network and corridor level, indicative decisions about modes, routes and designs can be made. Essentially the same forecasting techniques can be used at all levels, but at corridor level

Figure 9. Developing broadbrush routes



Result: - route alternative (optimal for one set of criteria)
- estimate of cumulative and exceptional local impacts

with more reliability than at network level. In any single SEA, the analysis should be sufficiently detailed to give confidence that more thorough assessment would not give unexpected results that could lead to a different decision.

On the other hand, whilst it is only at project (EIA) level that final consent is given to irreversible construction works, strategic decisions are more difficult to reverse if they are fully considered. The more developed an infrastructure proposal is, the more confidence is needed that it is the best option, and the more detail is required in the assessment.

The crucial condition is that no definitive consent is given to developments that might result in unacceptable impacts that cannot be mitigated. If environmental risks are identified, the transport infrastructure plan should include conditions and guidance on how to deal with them in further decision-making.

14.2.2 Developing broadbrush transport infrastructure alternatives

If a 'red flag' analysis is insufficient, indicative alternatives should be developed.

For each corridor and feasible alternative mode, the following steps should be taken (see also Figure 9 and Land Water Milieutechnologie, forthcoming).

- **Identify a range of possible routes.** It is essential that as much information about the possible range of alternative routes is available, without delaying the planning process more than necessary.

- **Assess the baseline.** When the possible locations are known, the baseline (the existing situation and any developments that are not influenced by the infrastructure plan) can be assessed. The first source of information about the value of particular areas is formally approved policy. This may, for example, include nature conservation policy, recreation policy, environmental policy and spatial policy. Preferably, this should be aggregated at an appropriate geographical scale, and indicated on thematic maps. Other areas of value can be assessed by making use of

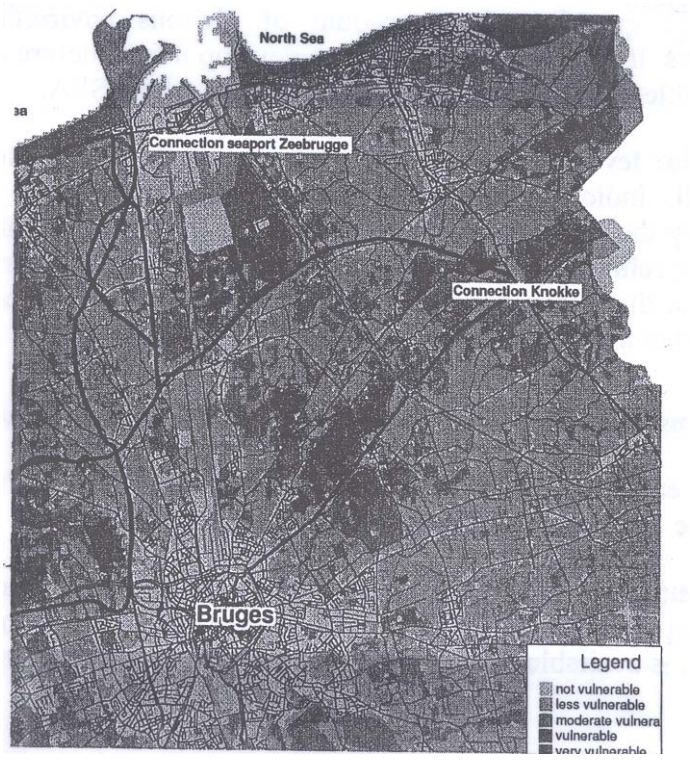
Box 35. Vulnerability mapping and the use of GIS in Flanders, Belgium

In Flanders, Belgium, two pilot projects have been undertaken in which vulnerability mapping was used: (1) the routing decision for a new highway between Jabbeke and Knokke and (2) the routing decision for a new highway between Wetteren and Geraardsbergen. In these two projects vulnerability maps were made for specific impacts (e.g. disturbance of wildlife) and for impact groups (biodiversity). 'Thematic' routes were developed using these vulnerability maps: the most ecologically friendly alternative, the most landscape friendly alternative and an alternative most favourable for human aspects. GIS played a very significant role in the Belgium case. A specific GIS model was developed which enabled simple and user-friendly operations such as weighted summation, sensitivity analysis, varying weights, considering different perspectives, etc. For example, the impact of a new business park on the route alternatives or the effect of a different weighting set could be considered in a few seconds. Consequently, the use of GIS allowed iterative planning and route alternatives could be optimised.

The pilot studies were undertaken in the context of long-term (political) discussions with regard to route alternatives. When the routes identified during these decisions were compared with the results of the pilot studies, no significant differences were revealed. However, vulnerability mapping, supported by GIS, proved to be much faster and provided much more insight into the process. An important additional advantage is that the GIS database and modelling can easily be used in the follow up of the process: e.g. in subsequent project EIA or in public hearing meetings.

Figure 10. Fauna and flora vulnerability map Knokke - Jabbeke (Flanders)

The vulnerability of flora and fauna is indicated as shades, integrating vulnerability for biotope loss (40%), fauna barrier impact (20%), noise disturbance (20%), desiccation (10%) and eutrophication (10%).



geographical information available at research institutes and interest groups (see Section 14.4).

- **Map vulnerable areas.** The range of possible transport infrastructure locations can be narrowed down by defining which types of land use should be avoided by the route. These are categories of land that are sensitive to severance, land take, noise, etc. The simplest method is to distinguish the most valuable areas from other areas. A more complex method (multi-criteria analysis) is illustrated in Box 35 and Figure 10. In both cases, this results in a 'vulnerability map'. The vulnerability map is then overlaid with possible infrastructure routes and designs, including the areas on both sides of the infrastructure where sensitive habitat or settlements could be at risk (different indicators of risk are described in Section 14.2.3). If there are different views about the weight that certain impacts should have, different sets of criteria can be developed (resulting in different vulnerability maps). The classical dilemma is the choice between crossing a rural area, affecting biodiversity, and crossing an urban area, affecting residents. Such dilemmas cannot normally be solved in a technical analysis: they are essentially political. In an SEA, different alternatives have to be developed, minimising impacts from both perspectives. The choice is then made by the decision-makers, on the basis of the SEA report and other factors.

- **Reduce the impact by route optimisation.** If different sets of assessment criteria are applied, different alternative routes can be generated. This can be done by using GIS, which can automatically generate, assess and optimise alternatives, and by hand. (For the reliability of the assessment, the quality of the vulnerability map is more important than 'fitting' the route in it.) The sensitivity of areas to certain impacts obviously depends on the mitigating measures (such as noise barriers and badger pipes) which will be taken. At the strategic level, these may be known if there is an agreed approach to the design of mitigation measures. If there are 'bottlenecks' along routes that are otherwise relatively less vulnerable, mitigation measures can be proposed at the strategic level, especially if they permit discrimination between routes. Generally, such measures, e.g. tunnels, may be expensive if they are an issue at strategic level. (Such issues should, preferably, have already been identified at the scoping phase.)

14.2.3 Forecasting local impact indicators

A number of indicators that are used at the strategic level for the development of alternative infrastructure plans, and mutually comparing the resulting alternatives with each other and with the baseline development, are described hereafter. Exceptional impacts, which are unique to one alternative infrastructure plan, cannot be quantified in the same way as cumulative impacts. They should be described in words, by experts, indicating the possibilities for mitigation.

Land take and proximity

At the strategic level, the surface area directly used by, or in close proximity to, transport infrastructure can easily be estimated. However, it would be better if the indicator could also account for the *value* of the land that is taken, accounting for:

- habitats;
- archaeological sites;
- cultural and historical sites;
- agriculture;
- recreational areas;
- living areas.

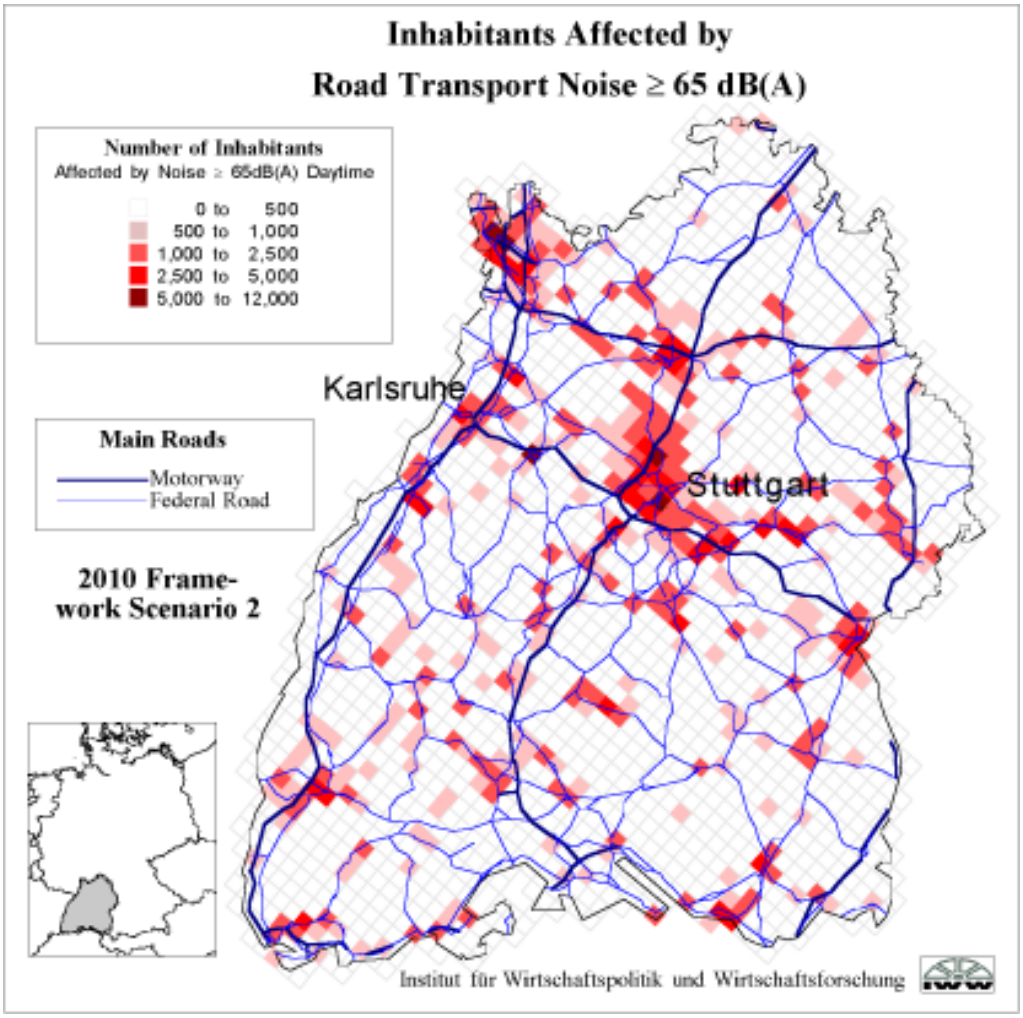
If the baseline data exist in GIS, these categories can be distinguished. However, in particular close to urban areas, the long-term development of land use can be uncertain, and care should be taken in developing a baseline scenario for land use.

Major infrastructure also attracts secondary development and the land area this takes may be larger than the direct land take. This secondary land take should therefore be assessed as well, to the extent such development are foreseeable (see Sections 9.4 and 12.2).

Ambient air quality

The likelihood of settlements being affected by significant air pollution can be identified by comparing emissions of air pollutants (Chapter 13) from the transport infrastructure with the proximity of settlements.

Figure 11. Inhabitants affected by road transport noise, Baden-Württemberg



Box 36. Modelling of noise disturbance: pilot study Baden- Württemberg,Germany

In the context of a German research project on the enhancement of federal infrastructure planning, an SEA model has been developed which was tested on the base of data for the German state of Baden-Württemberg. This model is an advancement of a model that has been previously applied in the development of the transport master plan for this state (Verkehrsministerium Baden-Württemberg, 1995).

The modelling of noise disturbance on the network level is based on screening models. In a first step the reference noise levels along roads and railway tracks were predicted by means of standardised models taken from noise abatement legislation. The noise exposure of the population by road traffic was then calculated by applying typical housing structures to urban and rural road types (see Figure 11). In the case of railway noise the population living within corridors with noise levels above 65 dB (A) was calculated based on population densities in defined grid squares. In total, in 1992 about 10% of the population in Baden-Württemberg was exposed to road transport noise and about 1.7% to rail transport noise above 65 dB (A). In a scenario for 2010, which aims at sustainability, the exposure can be decreased to 7% for road and to slightly less than 1.7% for railway noise.

It is unlikely that local air pollution will be an issue in choices between alternatives in transport infrastructure plans. Any potential excedences of ambient air quality standards and guidelines can usually be mitigated at the project level (e.g. by designing to take maximum effect of dispersion, planting). The impacts of lower concentrations and of odour (e.g. around airports) are normally not considered to be important enough to influence strategic decision-making. Nonetheless, the emission of air pollutants in populated areas can be used as an indicator for such problems.

Noise

The noise emissions of vehicles and infrastructure can be forecast in the same way as emissions to the air: by making use of traffic forecasts (see Chapter 12) and allowing for changes in the specific noise emissions of vehicles to calculate noise contours. At the strategic level, only the total number of residents affected by a transport infrastructure plan is important, not the effect on any specific settlement. An indicative calculation is therefore sufficient.

Dispersion of the emitted noise in the area depends on:

- mitigation measures (which can be accounted for at the strategic level, because these measures are determined on the basis of regulations and policy), and
- natural conditions, such as relief and surface type, and human artefacts, about which experts can make informed assumptions.

Typical noise situations can be calculated making use of noise dispersion models (which are also used at the EIA-level) and these can then be generalised for the whole infrastructure. This approach generally is sufficiently accurate to compare infrastructure plans at the strategic level. Box 36 and Figure 11 show an example of forecasting the effects of noise in Baden-Württemberg.

The same noise contours that can be overlaid on maps of settlements can also be overlaid on maps of other areas that are sensitive to noise. These may be recreational areas and other quiet and undisturbed rural areas where local people, visitors and fauna would be disturbed even by low noise levels. An indicator is the area where the noise level caused by the transport infrastructure exceeds the existing background

noise level. Tranquil zones are sometimes included in governmental policy or promoted by interest groups.

In the SEA of the European HSR Network noise nuisance was evaluated by calculating noise contours in L_{eq} dB(A) for each section of the network. For the scenarios considered changes in noise contours were compared with the reference scenario and with the present situation. For road and rail transport the noise contour changes were expressed in distance (m), while for air transport the changes were given in the surface area (km^2) enclosed by the contour.

Risk of pollution of water resources

The impact of regular emissions from exhaust gases and material from tyres on water resources can usually be mitigated by collecting runoff water, and treating it appropriately. These impacts are generally not crucial in choosing transport modes and locations.

At the strategic level, the risk of accidents involving vehicles transporting hazardous freight can be important. Such accidents arise with any mode, but most attention is given to marine and air transport, because a single accident can have a very large impact. The proximity between the infrastructure and sensitive drinking water resources and wetlands can be a suitable indicator in the SEA of transport infrastructure plans.

14.3 Improving environmental performance

Making transport infrastructure plans better for the local environment and for biodiversity.

Transport infrastructure plans determine the type and location of infrastructure and can influence local impacts in several ways:

- Not building new infrastructure is preferable in most circumstances but new infrastructure can reduce traffic using existing infrastructure, resulting in a net reduction in existing noise nuisance.

- Choosing less intrusive modes of transport which have a smaller land take or which are more easily integrated into the landscape.

Box 37. Compensation for loss of biodiversity in the Netherlands

In the Structure Plan for Rural Areas of the Netherlands (1994) an obligation is made to compensate for the loss of biodiversity and recreation areas as a result of physical activities in ecologically valuable and in recreation areas. This obligation is based on the so-called 'not unless' principle. This means that the initiator of an infrastructure project which will affect designated areas must prove (1) that the project is a matter of major societal concern, (2) that there is no alternative solution possible and (3) that the project cannot be located in other areas. After having met these requirements, the infrastructure project may, exceptionally, be further pursued. In that case all the loss of biodiversity and recreation areas as a result of the infrastructure project must be compensated in kind (i.e. the 'no net effect' principle).

Source: Ministry of Agriculture, Ecology and Fishery, 1994.

Box 38. Improving environmental performance in the Italian HSR Milan-Bologna SEA

The example of the Italian High Speed Railway Milan-Bologna shows (Figure 10) that environmental assessment at strategic level is helpful in finding solutions for conflicting requirements of project issues. The route of the high speed rail line between Milan and Bologna is characterised by large plains, historical monuments, archaeological sites, large number of rivers and intense human use of land, including agricultural, industrial and urban areas.

Some of the few remaining natural spots are located very close to the highway. Preservation of these rare natural areas became a priority planning goal. The railway had to cross more than 50 rivers between Milan and Bologna, many of which have associated natural areas.

Each natural area became an individual case in which a feasible solution to conflicting interests was sought. Meetings were organised with the participation of all the authorities involved to compare and evaluate alternative solutions. A specific methodology was developed for the comparison of alternatives. The methodology was based on the definition of a 'natural quality index' using several ecological parameters, like rarity, fauna potential, stability index, resistance, fragility or restoration potential. The principle of the methodology was that the mitigation and compensation measures can significantly influence the dynamics of the ecosystems, and resulting in different, or even a better situation than the zero alternative. The natural quality index was determined for the existing and past situation and predicted for the zero alternative. Each alternative could be evaluated by comparing its index with the existing situation and the zero alternative. With this method it was possible to select solutions which allowed future ecological improvements.

Measures were taken in the Italian High Speed Railway to repair environmental damage created by the construction of the highway in the 1950's.

- Attracting traffic away from existing infrastructure located close to large numbers of homes, etc., to less sensitive locations.
- Locating the infrastructure in less valuable or sensitive areas.
- Providing guarantees that environmental impacts will be given appropriate weight in further decision-making (e.g. the obligation to apply the 'no net effect' principle).

The 'no net effect' principle and other policies can be important tools for reducing the local impact of infrastructure plans. Most of these policies are formulated separately, rather than as part of infrastructure plans. An example from The Netherlands is presented in Box 37. This type of policy mostly relates to the way in which decisions are made at the project level. An illustration for the Italian HSR Milan-Bologna is shown in Box 38 and in Figure 12.

14.4 Further reading

Unlike previous 'further reading' sections, this section describes international, mainly GIS, databases useful in local impact assessment.

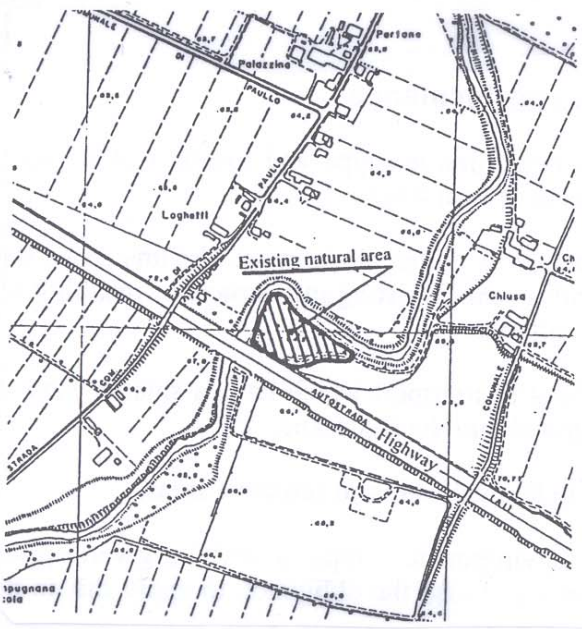
Geographic Information Systems

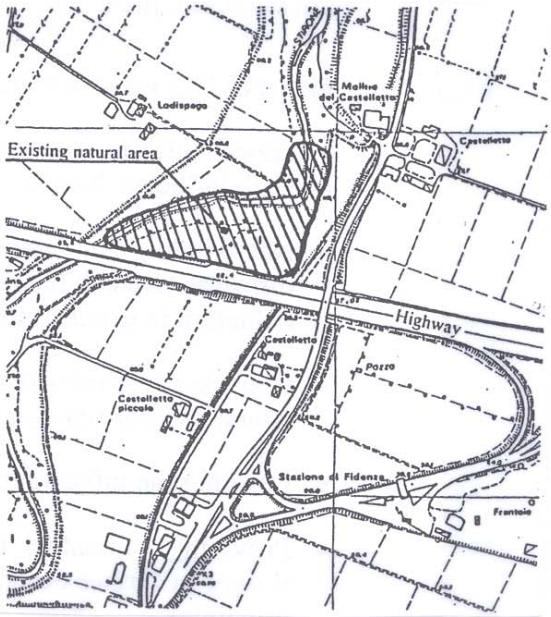
Geographic information systems (GIS) are gaining importance and widespread acceptance as a tool for decision support in transport infrastructure planning. If a GIS contains thematic computerised maps, it can assist in the preparation, analysis, display, and management of geographical data. However, it is particularly useful as an evaluative tool to support decision-making. GIS can quickly evaluate many different routes, to find a route that maximises environmental performance.

For certain impacts (e.g. the impact on ecological areas and noise nuisance) GIS can be used to analyse large amounts and various layers of information (e.g. calculating the numbers of residents living within different noise level zones).

The application of GIS depends largely on the availability of the underlying geographical and environmental data. The costs of training, support, customising, building and maintenance of central databases should not be underestimated.

Figure12. Examples of remaining natural spots along the Milan-Bologna HSR





Eurostat

Eurostat's GISCO reference database contains:

- topographic data on administrative boundaries and infrastructure;
- thematic data on hydrography, altimetry, major landmarks, Community Support Frameworks, degree of urbanisation, land and water resources, nature resources, environment;
- information on the TEN (including information on infrastructure characteristics and existing and future traffic flows);
- TEN maps are available in GISCO on a 1: 1 000 000 scale, and only contains crude information. For the road network no distinction can be made between new planned routes or upgraded links. The maps of maritime ports have not been finalised yet. The maps of airports are available, but do not yet specify specific projects;
- nearly all areas designated on the basis of international and European law or conventions, i.e.: Ramsar Convention sites, Barcelona Convention sites, special protection areas (Birds Directive), European diploma sites (COE), biogenetic reserve sites (COE), biosphere reserve sites (UNESCO), World Heritage Sites (UNESCO), national designated areas and habitat sites.

European Environment Agency

The European Environment Agency (and the European Topic Centres on Land Cover and on Nature Conservation) can provide the following maps and databases: CORINE Land Cover (inventory of biophysical land cover/land use in 44 classes); CORINE Biotopes (inventory of major sites of interest, inventory of sites designated under Community legislation (e.g SPAs) and 7 international conventions, inventory of sites designated under national legislation, soil map of EU; inventory of water quality of large rivers, lakes and reservoirs, coastal morphology and erosion risk); CORINAIR 85, 90,94 (estimates of air pollutants from all sources); AIRBASE (air quality monitoring network). The European Topic Centre on Nature Conservation is in the process of establishing a European Nature Information System (EUNIS).

BirdLife International

BirdLife International has a database on important bird areas (IBAs). This database has information on bird presence within a site specific

point co-ordinate database. The information relates to the year 1989. The database is currently being updated with more information. This update is due to be completed in 1999.

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How to obtain publications

Many European Commission publications are available at the Office for Official Publications of the European Communities, Luxembourg; or at website: http://europa.eu.int/comm/dgs_en.htm

OECD and ECMT publications are available from OECD Publications Service, 2 rue André Pascal, F-75 775 Paris Cedex 16, France, tel: (+33) 1/45 24 82 00 - Fax: (+33) 1/49 10 42 76.

World Bank publications are available by email: books@worldbank.org; or at website: http://www.worldbank.org (click on Publications).

Publications of the World Resources Institute are available at 1709 New York Avenue, NW, Washington, DC 20006, USA; or at website: http://www.wri.org/wri/

15.2 Useful sites on the Internet

International institutions

- European Commission, transport: http://europa.eu.int/en/comm/dg07
- European Commission, environment: http://europa.eu.int/en/comm/dg11
- European Union law: http://europa.eu.int/eur-lex/en/index.html
- Environmental Law homepage: http://www.unimaas.nl/~egmilieu/
- United Nations Economic Commission for Europe (UN/ECE): http://www.unece.org/ Under the UN/ECE convention on transboundary EIA, a database with SEAs and EIAs under the convention is managed under http://www.mos.gov.pl/enimpas/
- European Environment Agency: http://www.eea.dk/
  Sustainability targets and reference values: http://salmon.eea.eu.int/star
  (This database is an inventory of current environmental policy targets and sustainability reference values which apply in the EEA area countries. It is updated quarterly by the European Environment Agency and can be searched to compile and print reports or individual records. The objective of the database is to provide a general and publicly accessibly inventory of European and – where they are more stringent – national sustainability target values for each of the main environmental themes).
- Organisation for Economic Co-operation and Development: http://www.oecd/org/env/trans (This site is also the access point for European Conference of Transport Ministers papers.)

Environmental organisations

- Environmental baseline data may be obtained from organisations such as the Dutch National Institute of Public Health and the Environment

(RIVM, www.rivm.nl or www.etcaq.rivm.nl), Food and Agriculture Organisation of the United Nations (FAO, www.fao.org), World Conservation Monitoring Centre (WCMC, www.wcmc.org.uk), the World Conservation Union (IUCN, www.iucn.org), Birdlife International (www.kt.rim.or.jp/~birdinfo/birdlife) and the Economic Commission for Europe (UN-ECE, www.unece.org).

- The Infra Eco Europe web page deals with animal habitat fragmentation issues related to infrastructure planning (http://iene.vv.se).

- The European Association for Decision-Making (EADM) (www.eadm.org), provides information about publications in the area of decision analysis.

- A review of textbooks on decision analysis and risk analysis can be found on the website of the Decision Analysis Society (www.fuqua.duke.edy/faculty/daweb).

- The web page guide to effective participation, prepared by David Wilcox in 1996 (http://www.communities.org.uk/guide/main1.html), gives practical recommendations on public participation. The guide is intended to be a resource which groups and organizations can develop for their own purposes.

Transport organisations

- Links with environmental organisations in the transport sector can be found at the website of the Transport Research Board: http://www.nas.edu/trb

- International Association of Ports and Harbours: http://www.iaph.org.jp/

- International Maritime Organisation: http://www.imo.org/

- International Air Transport Association: http://iata.org/

- European Transport research publications: http://www.cordis.lu/transport/

- International Union of Railways (UIC): http://www.uic.asso.fr/

- PTRC: http://www.ptrcers.demon.co.uk

15.3 National guidance on SEA and EIA in transport infrastructure planning

This section includes examples of official guidance for the SEA and EIA for transport infrastructure plans.

France

BCEOM et Ingeroute / Ministry of Environment, 1998. *Evaluation environnemental des schémas de services collectifs dans le secteur des transports: Etude d'impacts stratégique sur l'environnement. Essai méthodologique*. Lettre de command 47/07. ME, Paris (in French).

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Germany

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The Netherlands

CUR (Civieltechnisch Centrum Uitvoering, Research en Regelgeving) / Rijkswaterstaat, Dienst Weg- en Waterbouwkunde, 1994. *Handboek natuurvriendelijke oevers (Manual on nature friendly design of banks of waterways)*. CUR, Gouda.

Ministerie van Verkeer en Waterstaat, Rijkswaterstaat, 1994. *Handboek akoestisch onderzoek wegverkeer. (Manual on acoustical investigations: road traffic)*. Dienst Weg- en Waterbouwkunde, Delft. (Publication number P-DWW-94-723).

Ministerie van Verkeer en Waterstaat, Rijkswaterstaat, 1995. *Handreiking maatregelen voor de fauna langs weg en water (Manual on mitigating measures for animals near roads and waterways).* Dienst Weg- en Waterbouwkunde, Delft. (Publication number P-DWW-95-710).

Ministerie van Verkeer en Waterstaat, Rijkswaterstaat, Tracé/m.e.r.-centrum, 1996. *Handleiding besluitvorming hoofdwegen. Deel I, II, en III (Manual for the planning of major roads).* Dienst Weg- en Waterbouwkunde, Delft. (Publication number P-DWW-96-018).

Ministerie van Verkeer en Waterstaat, Rijkswaterstaat, 1996. *Voorlopig Handboek Natuurcompensatie (Manual on compensation of adverse local impacts on biodiversity).* Dienst Weg- en Waterbouwkunde, Delft. (Publication number W-DWW-96-042).

Ministerie van Verkeer en Waterstaat, Rijkswaterstaat, 1997. *Habitat Fragmentation and Infrastructure*, *Proceedings of the International Conference on Habitat Fragmentation, Infrastructure and the Role of Ecological Engineering*, 17-21 September 1995, Maastricht and The Hague. Dienst Weg- en Waterbouwkunde, Delft. (Publication number P-DWW-97-046).

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Spain

Spanish Government, 1991. *Guías Metodológicas para el Elaboración de Estudios de Impacto Ambiental, Carreteras y ferrocariless*. Ministerio de Obras Públicas y Transportes, Madrid.

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Sweden

Boverket, Naturvårdsverket, Riksantikvarieämbetet, Socialstyrelsen, 1997. *Boken om MKB. Del 1: att arbeta med MKB för projekt (to work with EIA for*

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Vägverket,1995. *MKB för vägar - handbok. (EIA for Roads - Manual).* Report, Borlänge.

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United Kingdom

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Appendices

APPENDIX 1: CONTRIBUTING EXPERTS

This Manual has been prepared by a group of core consultants: Sibout Nooteboom (DHV Environment and Infrastructure, Amersfoort), Christopher Wood (EIA Centre, University of Manchester), with assistance from international consultants: Max Falque, Philippe Tardieu, Sami Toivanen, Dieter Wagner, and with contributions from: Adam Barker, Thomas Fischer, John Handley, Wouter Groote, Eszter Horváth, Norman Lee, Bev Lucas, Dick Rooks, Robin Smit and Tim Richardson.

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APPENDIX 2: SEAS USED AS ILLUSTRATIONS

This appendix lists the sources of information about (most of) the SEAs that serve as illustrations in this Manual.

SEAs from other parts of the world

This manual is illustrated with European case studies of SEA practice. However, SEA is not confined to Europe. It is also applied in many other parts of the world, including Canada, United States, Australia, New Zealand, and in a growing number of developing countries. The preparation of legislative and programmatic environmental impact statements has been an integral element of US practice since 1970, under the National Environmental Policy Act. It has also been applied by international donor organisations, such as the World Bank, for many years. Transport, worldwide, is one of the sectors where most SEAs have been carried out. Such cases in Australia, Canada and the US can be found in Organisation for Economic Co-operation and Development (1994) and Sadler and Verheem (1996).

The Pilot SEAs for TENS

The European Commission has initiated the preparation of a number of pilot SEAs, in furtherance of its aim to develop appropriate methods for the strategic evaluation of environmental impacts of the trans-European transport network (TEN). This manual reflects the general ideas developed and applied in these pilot SEAs, and it includes the major elements of the approaches developed in the pilot SEAs. The pilot SEAs, of which some were completed at the time of writing, are:

- a network level assessment of the spatial and ecological impacts of the TEN as a whole (details below)
- pilot SEA of the Ravenna – Venetia (E55) corridor in Italy
- pilot SEA for the Danube corridor in Austria
- pilot SEA for the trans-Pennine corridor in the United Kingdom
- the Corridord Nord in France

- the Gothenburg- Jönköping corridor in Sweden (National Road Administration, 1998).

European Environmental Agency, 1998b. *Spatial and Ecological Assessment of the TEN: Demonstration of Indicators and GIS Methods*. EEA, Copenhagen, 2nd draft.

The Trans-European Transport Network (TEN) includes long distance transport infrastructure of European importance. This multi-model network is large scale; the whole of Europe. It encompasses road, rail, high speed rail, air, inland waterways, marine transport and pipelines. It considers linear and modal infrastructure. It considers corridors at several scales. The TEN programme includes a large number of projects to extend this network. In a (pilot) SEA for this programme, the European Commission explored assessment methods.

Project on Environmentally Sustainable Transport, OECD

OECD Environment Directorate, 1998. *Project on Environmentally Sustainable Transport*. OECD, Paris.

The European High Speed Rail Network

European Commission, 1993. *The European High Speed Rail Network, Environmental Impact Assessment*. Directorate-General VII, Brussels.

The Commission of the European Communities considered the construction of a high speed rail (HSR) network in order to cope with the problems of the present European transport system, such as congestion, energy consumption, air pollution, noise and safety. The network involves the construction of 9,800 km of new lines and the upgrading of 14,400 km of existing lines by 2010.

The environmental impacts of the network were evaluated in order to assist the EC in its decisions concerning the construction of the network and the development of the high speed trains. In the SEA the environmental effects of the HSR and of conventional modes of long distance passenger transport (rail, road and air) were compared.

The Federal Transport Infrastructure Plan, Austria

Lung, E., Austrian Ministry of Transport, 1998. *Personal communication*.

The Austrian Federal Transport Infrastructure Plan is an integrated and multi-modal SEA which was under preparation by the Federal Ministry for Science and Transport in 1998. It considers roads, rail and inland waterways. The Plan and the SEA are expected to improve:

- the efficiency of the allocation of scarce resources,
- the consistency of the planned infrastructure with environmental objectives,
- statistical data-bases;
- the availability of computer-related planning tools.

Vulnerability Mapping and the Use of GIS in Flanders, Belgium

Kreft, M. and Vanhaute, L., 1997. Sneller besluiten over Wegtracés. *KenMERKen 1997 (5)* 13-16 (in Flemish).

van Straaten, D., Peyman, J. and Kuijken, E. 1998. *Vulnerability Maps as a Tools for SEA and Infrastructure*. Paper to International Association for Impact Assessment Conference, Christchurch. IAIA, Fargo, ND.

Strategic Environmental Assessment, North-South Highway Corridor, Czech Republic

Martiš, M., Nováková, E., Patrik, M. and Kopecký, M., 1996. *Intersections and Parallelism of Selected Variants of the North-South Highway Corridor through the Czech Republic with the Infrastructure of the National Network of the EECONET*. Personal Communication.

This strategic environmental assessment was undertaken in 1996/1997 as a case study adopting the European Strategy of Biological and Landscape Diversity (Sofia, 1995) to the transport section. Official and alternative variants for the location of the north-south corridor were studied during the SEA.

The assessment showed that the alternative route variants were more acceptable than the official variant, from the aspect of impact of the highway on landscape protection areas. As a result, the Government's decision was influenced by the findings of the SEA. The Government of the Czech Republic decided to postpone the construction of one part of the highway, and charged ministers to consider new possibilities.

Road Programme, England

Department of the Environment, Transport and the Regions, 1997. *Experience with the 'Policy Appraisal and the Environment' Initiative*. DETR, London.

Department of the Environment, Transport and the Regions, 1998. *A New Deal for Trunk Roads in England*. TSO, London.

The UK Department of Transport made environmental appraisals of the Trunk Road Programme in England in 1994, 1995 and 1996. The methodology of appraisal was based on a scoring and weighting system to estimate and compare the overall performance of the schemes. Priority ranking was set up based on the scoring and weighting. Benefit-cost ratios, environmental impacts and role in the network, were used as three criteria in the assessment of about 500 road schemes, which were reduced to about 150 by 1997.

A new approach was adopted in 1998 which took account of five main criteria: environmental impact; safety; economy; accessibility; and integration. After further reductions, one page appraisal summary tables of the main economic, environmental and social impacts of each of 67 trunk road schemes were completed and used to produce a 'carefully targeted programme' of 37 schemes.

Environmental Impact Assessment of the Nordic Triangle, Finland

Ministry of Transport and Communications, 1995. *Action Programme for Reducing the Adverse Impacts of Transport on the Environment*. MTC, Helsinki.

Ministry of Transport and Communications, 1996. *Environmental Impact Assessment of the Nordic Triangle*. Publication L 11.96, MTC, Helsinki.

Valve, H., 1996. *The Nordic Triangle Environmental Impact Assessment.* Finnish Environmental Institute, Helsinki.

The Nordic capitals are connected to each other by a traffic network called Nordic Triangle. In Finland the network consists of railways, highways, harbours, airports and their connections and subsidiary functions. The SEA was prepared by a task force group to study and evaluate Nordic Triangle transport projects due to be decided upon between 1996-1999. The SEA was intended to provide a basis for discussion about, and for decisions on, developing the corridors of the Nordic Triangle traffic network. Decisions are to indicate how the SEA was taken into account.

The study included traffic forecasts, development alternatives, and their environmental impacts. The evaluation focused on impacts on the national economy, regional and urban structure, the natural and cultural environment, well-being, groundwater protection, energy use, emissions and traffic safety for 2010.

At the time when the SEA was prepared, some of the transport projects were already being planned or were under construction, but other projects still needed final decisions.

Inter-modal Proposals for the A7-A9 Route in the Year 2010, France

Organisation for Economic Co-operation and Development, 1994. *Environmental Impact Assessment of Roads*. OECD, Paris. / Person. Comm. M. Skriabine (SETRA)

The French study of 'Inter-modal proposals for the A7-A9 route' aimed to identify measures to cope with the expected future saturation of the A7 and A9 motorways in the Rhône Valley. It describes changes in traffic conditions

on the A7 and A9 motorways without specific measures, and evaluates the measures considered and the investment necessary to avoid the saturation of these routes after 2010, from the aspects of traffic levels, socio-economic effects and environmental impacts. The measures considered included the construction of new roads, the increase of other modes of transport, and traffic operation measures.

Federal Transport Infrastructure Plan 1992, Germany

Wagner, D. and Kleinschmidt, V., 1995. *Case Study: The German Federal Transport Infrastructure Programme*. In: European Commission, 1995c. *Strategic Environmental Assessment Legislation and Procedures in the Community*. Directorate-General XI, Brussels.

The Federal Transport Infrastructure Plan (1992) of Germany is a multi-modal network plan. It makes decisions about priorities for further development of infrastructure of national importance, including 2,200 km of new roads, 3,200 km of new high speed railroads, and upgrading of inland waterways and airports. Among a range of evaluation criteria, a formally required 'ecological risk assessment' was undertaken for 110 proposed infrastructure projects in the FTIP. The national system of long distance road connections sets the framework for road systems of regional importance, so the FTIP has a decisive role for the whole transport system in Germany. The ecological risk assessments were not presented as separate reports, but they were integrated with the 'dossiers' for each project.

High Speed Railway Milan-Bologna, Italy

Pompilio, M., 1996. *High Speed Railway Milan-Bologna: Importance of Environmental Studies in Negotiation with Municipalities*. Paper to International Association for Impact Assessment Conference, Estoril. IAIA, Fargo, ND.

Pompilio, M., 1997. *Ecological Impacts, Mitigation and Compensation Measures in the Evaluation of Project Alternatives for the High Speed Railway Milan-Bologna*. Paper to Third Meeting of Infra Eco Network Europe. Vladimir.

Pompilio, M., 1997. *Public Participation in Alternative Corridor Evaluation*. In: European Commission, 1997. *Spatial and Ecological Assessment of the*

Trans-European Transport Network: Scope, Methods, Data, Research Needs. Technical Workshop, Brussels, 24-25 April 1997. Proceedings. Directorate-General XI, Brussels.

The Italian High Speed Railway Milan-Bologna corridor is a part of the new Turin-Naples high speed rail network. The line is approximately 180 km long and crosses the territories of about 40 municipalities, 7 provinces and 2 regions.

The basic engineering project for the Milan-Bologna line was designed by the national railway company in the early 1990s. In 1992 the preparation of detailed engineering designs were started by engineering companies.

The national railway company initiated an SEA which was conducted at the basic engineering level in 1992-1993. The SEA procedure involved active participation by the local authorities, as well as by the public. As a result, major route changes and other technical changes were made.

High Speed Rail Zuid Corridor, Amsterdam - Belgium Border, The Netherlands

European Commission, 1997b. *Case Studies on Strategic Environmental Assessment.* Directorate-General XI, Brussels.

Ministry of Housing, Spatial Planning and Environment of the Netherlands, 1987. *Scoping Guidelines SEA HSR Zuid*. MHSPE, Den Haag (in Dutch).

Ministry of Transport and Water Management and Ministry of Housing, Spatial Planning and the Environment, 1994. *New HSR Zuid Note*, Sdu, Den Haag (in Dutch).

Project Office HSR Zuid Infra, 1996. *Spatial Planning Key Decision HSR Zuid. Part 4: The Plan.* Sdu, Den Haag (in Dutch).

The HSR Zuid is a major new high speed railway from Amsterdam to Antwerp. An SEA was undertaken for the so-called Spatial Planning Key Decision (PKB) about the HSR in The Netherlands. In this decision, it was decided *whether* rail capacity between The Netherlands and the South was necessary, and *what mode* was most appropriate (making use of the existing railway network at normal speed, or a newly constructed high speed railway, or a completely different mode). The information from the international

voluntary SEA for the HSR Network between Paris-Brussels-Cologne-Amsterdam-London (PKBAL) was used again in a mandatory SEA for the PKB. It was roughly decided *where* the HSR should be routed and the impacts of many indicative routes were compared. To some extent, the vertical alignment of the railway was also considered in the SEA.

The Need and Necessity for an Extension of the Port of Rotterdam, The Netherlands

Government of The Netherlands, 1997. *Verkenning Ruimterapport Mainport Rotterdam. Samenvatting en Analyse Resulten Verkenningsfase*. Sdu, Den Haag (in Dutch).

Scholten, J., Dutch EIA Commission, 1998. *Personal communication*.

Transport Structure Plan 2, The Netherlands

van der Waard, J. and van der Hoorn, T., 1997. *Miles Ahead (?) The Dutch National Land Use Transport Policy. A Progress Note after Six Years.* Transport Research Centre (AVV). Ministry of Transport, Public Works and Water Management, Rotterdam.

Main North-South Corridor Study, Slovakia

Slovak Republic, 1997. *Main North-South Corridor Study*. Draft final report, PHARE, SR, Bratislava.

Gothenburg – Jönköping Transport Corridor, Sweden

National Road Administration, 1998. *Gothenburg – Jönköping Transport Corridor: Environmental Impact of Strategic Choice*. NRA, Borlänge.

APPENDIX 3: NATIONAL INFRASTRUCTURE PLANNING AND SEA FRAMEWORKS

Each country has its own system for transport infrastructure planning, and integrating infrastructure plans into the environment. This Manual is flexible enough to be applied in all these frameworks. The present section identifies national decisions that may be submitted to an SEA. It also indicates whether there already is an SEA practice.

There is currently a debate about the transport infrastructure planning system, or recent changes have been made to it, in -at least- France, Finland, Switzerland, the United Kingdom, Germany and The Netherlands. This debate has mainly been triggered by environmental arguments. The aim of proposed changes is to include environmental issues higher in the tiering order of decision-making, and in general to improve the quality and transparency of decision-making.

In the present situation, most EU countries have national programmes for transport infrastructure development, often dealing with the different transport modes separately. The legal status of these programmes varies. Many countries apply some form of environmental assessment to these programmes, and draw up environmental policies and laws for the transport sector, which often influence decision-making about new infrastructure.

At the level of corridors and nodal infrastructure, there are several decision-making tiers in many countries, for instance routing followed by detailed alignment. The last tier is -by definition- project level, and earlier tiers are then strategic. At least one of these levels requires a mandatory or non-mandatory SEA or EIA. If it is non-mandatory, it may either follow a formalised procedure, or it may follow an ad-hoc procedure. The systems of SEA in place normally identify the broad types of impact that have to be considered, but normally not in terms of measurable indicators and objectives.

The following table gives examples of systems in different countries for decision-making about, and SEA of, transport infrastructure of national and international importance. This is not a complete overview. Some additional information on national planning and environmental assessment can be found in European Commission (1994b).

Plan or Programme	Assessment Level	Transport Mode	Environment Considered?
Austria			
Austrian Federal Transport Infrastructure Plan (Österreichisches Bundesverkehrswegeplan)	Programme	Multi-modal	Informally
Corridor decisions	Corridor	Roads Railways Multi-modal terminals	Formally
Belgium			
Regional plans	Network	Multi-modal	Voluntary
Finland			
Finnish Transport Infrastructure 2010	Network	Multi-modal	No
Main Road Network Development Plan 2010	Network	Road	
Ten-year Development Plan for the Road Network	Network	Road	Informally
Recommendations about planning and assessment of the Nordic Triangle Transport Corridor	Corridor	Rail, Road, Air, Marine	
Pre-feasibility Study of Eastern Rail Lines	Network	Rail	

Plan or Programme	Assessment Level	Transport Mode	Environment Considered?
France			
National Road Development Programme (Schéma Directeur Routier National)	Network	Road	Formally
Initial debate (Débat préalable)	Corridor	Road	Formally
Global routing study (Etude Préliminaire)	Corridor	Road	Formally
Global design (Déclaration d'Utilité Publique)	Corridor	Road	Formally
Germany			
Federal Transport Infrastructure Plan (Bundesverkehrswegenplan)	Network	Multi-modal	Mandatory (part of more general assessment)
Spatial plan procedure (Raumordnungsverfahren) or routing procedure, depending on the state	Corridor	Road, Rail, Inland Waterways, Airports	Mandatory
Project design (Planfeststellung)	Corridor	Road, Rail, Inland Waterways, Airports	Mandatory
Italy			
High Speed Railway System	Network	Multimodal	Informally
Routing studies (e.g. High Speed	Corridor	Rail	Formally

Plan or Programme	Assessment Level	Transport Mode	Environment Considered?
Rail Milan - Bologna)			
Provincial Development plans (e.g. Milan)	Network	Multimodal	Informally
Netherlands			
Transport Structure Plan	Network	All Modes	Formally
Key decisions about spatial development and infrastructure development	Corridor	All Modes (potentially)	Formally
Spain			
Infrastructure Master Plan	Network	Multimodal	Informally
State Motorways Programme (in preparation)	Network	Road	Informally
Preliminary studies	Corridor	Road / Rail	Formally
Sweden			
National Transport (Communications) Policy	Network	All Modes	Informally
National and Regional Long-Term Infrastructure Plans	Network	All Modes	Informally
National Railway Plan	Network	Rail	Informally
National Road Plan	Network	Road	Informally

Plan or Programme	Assessment Level	Transport Mode	Environment Considered?
United Kingdom			
White Paper on Integrated Transport Strategy	Network	Multi-model	Informally
Trunk Roads Programme	Network	Road	Formally
Annual Network Management Statement by Railtrack	Network	Rail	No