Guidelines for Cumulative Effects Assessment in SEA of Plans

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Introduction

These guidelines provide an approach for undertaking cumulative effects assessment (CEA) at strategic level. CEA can be undertaken as part of regional planning and land use studies but these guidelines have been developed to incorporate CEA into strategic environmental assessment (SEA) of development plans.

The Strategic Environmental Assessment (SEA) Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment, which was adopted on the 27th of June 2001¹, provides an opportunity to address cumulative effects at strategic levels. The SEA Directive requires the consideration of: ‘the likely significant effects...including cumulative and synergistic effects on the environment...’ (Annex1)².

The SEA Directive applies to a wide range of plans and programmes, including local authority development plans and Regional Planning Guidance and the proposed Local Development Frameworks and Regional Spatial Strategies. The ODPM has issued guidance³ on the application of the SEA Directive for those plans in England.

These guidelines should complement the ODPM SEA guidance and other planning guidelines by providing a detailed process for considering cumulative effects. The purpose of these guidelines is to assist planners and practitioners to systematically address cumulative impacts at various stages within the SEA process. It could also be useful to decision makers, statutory consultees and other agencies involved in the planning and SEA processes. The guidelines consist of two parts:

- Part I provides the background and context for cumulative effects assessment. This section introduces the concept of cumulative effects and discusses the importance of addressing these impacts at a strategic level. The CEA process at strategic level is presented. Finally, it defines the role of CEA in the SEA process.

- Part II consists of the guidelines. Initially, guiding principles for CEA are outlined. Then it explains how CEA fits within each stage of the SEA and plan preparation processes. Methods for addressing cumulative effects at each stage are discussed in terms of their strengths and weaknesses.

²CEC (2001), ibid.
Section I  Background

1  What are cumulative effects?

1.1 Many environmental problems, such as loss of open spaces or increase in air pollution result from the cumulative effects of human activities. Other well-known examples of cumulative effects are acid rain, climate change and loss of biodiversity. Cumulative effects are the combined impacts of a single activity or multiple activities. The individual impacts from a single development may not be significant on their own but when combined with other impacts, those effects could become significant.

1.2 Cumulative effects have been defined as “the net result of environmental impact from a number of projects and activities”\(^4\).

1.3 With reference to development plans, cumulative effects can occur from the combined impacts of policies and proposals on specific areas or sensitive receptors.

1.4 Cumulative effects can occur from the following situations:

- Combined impacts of a plan with impacts of another plan, affecting the same receptor. For example, proposals from land use and transport plans could interact and affect a nature reserve. This is illustrated in Figure 1.

- Interaction of policies within a plan on the same receptor. For example, a policy to encourage development which promote jobs and a housing policy to provide more housing to meet the borough’s target could result in a cumulative loss of open space.

- Interaction of impacts from proposals within a plan affecting the same receptor. For example, proposals to build roads, commercial premises and housing in a particular area within a short period of time could result in cumulative impacts (e.g. cumulative noise impacts from construction activities or the combined effect of noise, dust and visual effects) on the residents nearby.

Figure 1. Diagram illustrating the concept of cumulative impacts of plans

1.5 Cumulative effects occur when there is:

- Spatial crowding or temporal overlap between plans, proposals and actions
- Repeated removal or addition of resources due to proposals and actions
- Repeated alteration of the landscape in the plan area

1.6 Types of cumulative effects are shown in Table 1.

<table>
<thead>
<tr>
<th>Type</th>
<th>Main characteristics</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time crowding</td>
<td>Frequent, repetitive and simultaneous impacts on an</td>
<td>Incremental noise from a number of separate developments</td>
</tr>
<tr>
<td></td>
<td>environmental resource</td>
<td></td>
</tr>
<tr>
<td>Time lag</td>
<td>Long delays between cause and effect</td>
<td>Changes in water table which affects the ecology of wetlands</td>
</tr>
<tr>
<td>Space crowding</td>
<td>High spatial density of impacts on an environmental</td>
<td>Traffic congestion resulting from increase in activities in an area or</td>
</tr>
<tr>
<td></td>
<td>system</td>
<td>progressive fragmentation of wildlife habitats from a variety of sources</td>
</tr>
<tr>
<td>Cross-boundary movement</td>
<td>Impacts occur some distance away from source</td>
<td>Long range transport of air pollutants</td>
</tr>
<tr>
<td>Fragmentation</td>
<td>Change in landscape pattern</td>
<td>Fragmentation of woodlands</td>
</tr>
<tr>
<td>Compounding / synergistic</td>
<td>Effects resulting from multiple sources or impacts which</td>
<td>Combination of SOx and NOx to produce smog</td>
</tr>
<tr>
<td>effects</td>
<td>may be different in nature from the individual impacts</td>
<td></td>
</tr>
<tr>
<td>Indirect effects</td>
<td>Secondary impacts resulting from a primary activity</td>
<td>Induced commercial and residential development associated with road</td>
</tr>
<tr>
<td></td>
<td></td>
<td>construction</td>
</tr>
<tr>
<td>Triggers and thresholds</td>
<td>Fundamental changes in system behaviour or structure</td>
<td>Deterioration of aquatic systems through chemical contamination from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>run-off and siltation</td>
</tr>
<tr>
<td>Nibbling</td>
<td>Incremental or decreasing effects</td>
<td>Gradual loss of natural areas such as woodlands or greenbelt through</td>
</tr>
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<td></td>
<td></td>
<td>discreet developments</td>
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1.7 There are many examples of cumulative environmental effects, from the effect of car emissions on the climate, the piecemeal loss of lowland heathland, to the loss of water resources from over abstraction. In the Thames Estuary for example, there has been a 65% reduction in the extent of grazing marshes between 1935 and 1989. Since 1989, these grazing marshes have continued to decline in both extent and value despite nature conservation designation and

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under increasing threat from surrounding urban areas, climate change and difficulties of traditional management.\textsuperscript{7}

1.8 Land use planning provides an opportunity to initiate policies, which can result in positive cumulative effects. For example, some urban regeneration strategies have resulted in improved environmental quality for communities such as enhanced visual effects, linked access for pedestrians and public spaces.

1.9 Impact Pathways: These effects can accumulate through additive or interactive processes.\textsuperscript{8}

- Incremental effects are those where impacts are repeated additions of the same nature. \((a + a + a + a \ldots)\)
- Interactive or synergistic effects occur when the resulting impact is different in nature to the individual ones. \((a + b + c \ldots + n\) results in a significant impact).

1.10 Cumulative effects become significant when these impacts on the environment:

- “occur so frequently in time or so densely in space that they cannot be assimilated or
- combine with effects of other activities in a synergistic manner”\textsuperscript{9}.

There are thresholds where additional disturbance can result in significant deterioration of resources or ecosystems. Cumulative effects become apparent when such thresholds are breached.

2 What is Cumulative Effects Assessment?

2.1 Cumulative effects assessment is a systematic procedure for identifying and evaluating the significance of effects from multiple activities. The analysis of the \textit{causes}, \textit{pathways} and \textit{consequences} of these impacts is an essential part of the process.

2.2 These three elements define the complex cause-effect relationship that is central to cumulative effects assessment:

- **Identifying sources** – the multiple activities that cause potential impacts or environmental change;
- **Considering processes** – pathways of impacts between the sources and receptors and the linkages among these impacts;
- **Effects** – analysis of the attributes of these effects - whether such impacts are additive, antagonistic or synergistic.


2.3 Cumulative effects assessment can be undertaken at different planning levels: project and strategic. Cumulative effects occurring at a regional scale can only be controlled through planning processes directing development at that scale. Effective control of cumulative effects therefore requires regional or area-wide planning and inter-agency cooperation. CEA at strategic level is undertaken to aid planning in addressing these effects. Table 2 summarises some characteristics of strategic CEA.

<table>
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<tr>
<th>Aspects</th>
<th>CEA at strategic level</th>
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<tr>
<td>Focus</td>
<td>Impacts of plan options, policies &amp; proposals combined with impacts from other plans</td>
</tr>
<tr>
<td>Purpose</td>
<td>Improve planning and assist environmental management</td>
</tr>
<tr>
<td>Context</td>
<td>SEA and planning process</td>
</tr>
<tr>
<td>Strengths</td>
<td>Proactive, early in planning process</td>
</tr>
<tr>
<td></td>
<td>Can address small actions not covered by EIA regulations</td>
</tr>
<tr>
<td></td>
<td>Can facilitate project EIA</td>
</tr>
<tr>
<td>Limitations</td>
<td>Analysis mainly qualitative</td>
</tr>
<tr>
<td></td>
<td>Large number of variables</td>
</tr>
<tr>
<td></td>
<td>Greater uncertainty</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Planning authority</td>
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</tbody>
</table>

2.4 CEA at strategic level addresses the overall effects of policies and proposals of the development plan. Furthermore, it can assess cumulative effects from gradual, piecemeal environmental change caused by a number of individually small projects. It identifies resources that are at risk from cumulative change. Considerations in CEA are listed in Box 1.

**Box 1. Considerations for CEA at strategic level**

- Assess effects over a larger area than the plan area (regional or across regions);
- Assess effects over a long time period, including the past and future;
- Consider effects on valued resources due to the interaction of the plan and other plans and actions;
- Include other past, present and future plans and actions;
- Evaluate significance in terms of its effect over the wider area;
- Ensure that the plan addresses major concerns relating to the cumulative effects in the plan area, including setting critical thresholds and targets.

2.5 In terms of specific policies, plans or programmes, cumulative effects can be assessed from several perspectives as shown in Box 2.

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Box 2 Perspectives for assessing cumulative effects of policies, plans and programmes\textsuperscript{12}

- accumulation of the same impact of a number of projects (e.g. dioxin emissions of a number of waste incinerators in the region);
- accumulation of different impacts from a number of projects:
  - for one type of impact (e.g. neighbourhood noise from various sources);
  - for different types of impacts (e.g. combined effect on human health from different sources of pollution);
- accumulation over time of the same or different types of impacts (e.g. build up of toxic contaminants and trace elements in ecosystems);
- loss of resources over time (e.g. loss of habitats, species, open spaces).

2.6 CEA Process

The main stages for undertaking CEA at strategic level are shown in Figure 2. While specific steps are indicated, the process is iterative and linked. For example, baseline data for the assessment are collected during several phases such as scoping and analysis. When CEA is undertaken as part of SEA, these steps are integrated into the SEA as shown in Figure 4 in Part II, the main part of these Guidelines.

\textsuperscript{12} Adapted from Sadler (1996), \textit{op cit.}
3 The importance of addressing cumulative effects in planning

3.1 Cumulative effects should be considered in strategic planning and strategic environmental assessments because these effects can erode environmental quality. These effects are addressed more appropriately at strategic level. In general, these effects are not dealt with effectively in project environmental impact assessments (EIAs) because of limitations in scope. For example, the cumulative effects of landtake by small housing developments can lead to the gradual loss of open spaces and fragmentation of habitats which are not assessed in EIAs. Also, the potential impacts of many individual small-scale developments can become more apparent from strategic perspective.

3.2 The need to consider cumulative effects in planning is recognised in current guidance for SEA and sustainability appraisals. Sustainability appraisal is recognised as a means of helping reconcile economic, social and environmental concerns. Sustainability appraisals have been undertaken regional planning authorities and some local planning authorities.
The Strategic Environmental Assessment Directive: Guidance for Planning Authorities\textsuperscript{13} suggests that in predicting the effects of the plan, cumulative and/or synergistic effects should be considered.

The DETR Guide for Sustainability Appraisal of Regional Planning Guidance\textsuperscript{14} draws attention to the importance of considering cumulative effects in sustainability appraisals. This Guide suggests that the assessment of cumulative effects should follow the appraisal of direct and secondary impacts and identifies two ways of determining cumulative impacts:

i) assessing the combined impacts of all policies and proposals on specific areas, for example, areas where there are repeated negative impacts; and

ii) assessing repeated impacts on specific objectives and targets.

The Town and Country Planning Association’s Guide to Sustainability Appraisal suggests that cumulative effects arising from the interaction of policies and proposals should be considered\textsuperscript{15}.

4 Addressing cumulative effects through Strategic Environmental Assessment

4.1 Cumulative effects are best considered at plan or programme levels, where decisions about future developments are made. Strategic Environmental Assessment is a systematic process of addressing the environmental consequences of proposed policy, plans and programmes\textsuperscript{16}.

4.2 SEA can facilitate the analysis of cumulative effects since the scope of SEA is appropriate to the temporal and geographical scales at which cumulative effects occur\textsuperscript{17}. Policies, plans and programmes can lead to projects and activities with potential impacts. SEA allows an early, overall perspective of the potential impacts and their relationships which could lead to cumulative effects. It also facilitates the analysis of alternatives earlier in the process and so plan options that are less likely to cause significant contributions to cumulative impacts can be selected.

4.3 It should be noted that for SEA to be effective, the assessment of cumulative effects should be an integral part of the process and that CEA should provide inputs at each stage. CEA’s role in this process is to focus the analysis on the effects, interactions of these effects and the sensitivities and capacities of the receiving environment. The SEA guidance indicates how SEA can form part of sustainability appraisals. Figure 3 illustrates the relationship between CEA, SEA and sustainability appraisal.

\textsuperscript{13} ODPM (2003), \textit{op cit.}
\textsuperscript{17} Sadler (1996), \textit{op cit.}
5 Legislative context

5.1 Directive (2001/4/42/EC)\(^\text{18}\) refers to cumulative effects in two ways. It requires that cumulative effects should be considered when evaluating the likely significant effects of the plan. It is also a criterion for determining the likely significance of the effects in terms of the characteristics of the effects and of the area likely to be affected.

The SEA Directive 2001/4/42/EC on the assessment of certain plans and programmes on the environment requires the consideration of: ‘the likely significant effects...including cumulative and synergistic effects on the environment...’ (Annex 1) and the criteria for determining the likely significance of effects include the “cumulative nature of the effects” (Annex II).

5.2 In the first instance, cumulative effects should be included in evaluating potential impacts and these should be described in the environmental report. Secondly, cumulative effects criteria can be used in screening as to whether a plan or programme would require an SEA.

5.3 The Directive makes two distinctions regarding its application: i) SEA is mandatory for certain plans and programmes and ii) for other plans, SEA is only required where they are likely to have significant effects\(^\text{19}\). For the latter, a screening process is needed to determine whether such plans are likely to have significant environmental effects and in that case, an SEA would be required.

5.4 Annex II of the Directive lists criteria for determining the likely significance of the environmental effects, including the characteristics of the effect and of the area likely to be affected. One of these ‘significance criteria’\(^\text{20}\) is the cumulative

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\(^\text{18}\) CEC (2001), op cit.
nature of the effects and should be taken into account when deciding whether plans for small areas at local level (Article 3 (3)), minor modifications to plans and plans which set the framework for future development consent of projects (Article 3 (4)) would require an SEA.

5.5 To help determine whether significant cumulative effects could result from the implementation of those plans, a series of questions are set out in Box 3 which can trigger an SEA.

**Box 3. Cumulative Effects Screening Criteria**

<table>
<thead>
<tr>
<th>Criteria Questions</th>
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<tr>
<td>Are the potential effects from the plan together with the impacts from other plans likely to be significant?</td>
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<tr>
<td>Are the potential effects from the plan or proposals within it likely to be cumulative?</td>
</tr>
<tr>
<td>Are there valued environmental resources in the wider plan area likely to be affected by the plan’s proposals?</td>
</tr>
<tr>
<td>What is the sensitivity or capacity of these valued environmental resources? What is its state in relation to environmental quality standards or thresholds? Would additional impacts result in limits to be breached?</td>
</tr>
<tr>
<td>How long and frequent are the potential impacts?</td>
</tr>
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</table>

5.6 These guidelines on CEA have been prepared in the context of an SEA for land use development plans. It could also be used in SEAs of small areas at local level, plan modifications or plans which set the framework for future development control of projects (Article 3 (3)) which require an SEA. Furthermore, since these guidelines followed the procedure for SEA prescribed by the Directive, it could also be applied to other SEAs of other plans, such as those prepared in the context of the Habitats Directive (Article 6 and 7 of Directive 92/43/EEC)\(^\text{21}\).

5.7 These guidelines consist of proposals to assist planning authorities and those preparing the SEA. It is envisaged that those responsible for the SEA should also undertake the CEA component. The next section describes a framework and procedure for assessing cumulative effects in SEA of plans.

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II The Guidelines

1 Introduction

This guidance describes a process for considering cumulative effects in SEA of plans. Although the CEA will follow a procedure in order to identify and assess cumulative effects, it will be integrated into the SEA process. Since the Directive requires that the SEA should be carried out during plan preparation, it is envisaged that the consideration of cumulative effects would also be integrated into that process. Methods that can be used for identifying and assessing cumulative effects are described for each stage of the SEA.

2 Guiding Principles for CEA in SEA of Plans

The main objective of the CEA is to assess potential cumulative effects and their likely significance. To guide the assessment, guiding principles were developed from best practice in CEA identified in the literature and findings from case study research, which investigated actual approaches used by planning authorities to address cumulative effects. The guiding principles are listed in Box 4.
### Box 4. Guiding principles

**Guiding Principles for CEA in SEA of Plans**

- **Goals and objectives**  
  CEA should be guided by the goals and objectives of the SEA and the development plan.

- **Area-wide Perspective**  
  Adopt a broad, area-wide perspective when considering cumulative effects.

- **Integrated Approach**  
  Undertake CEA as part of the strategic environmental assessment (SEA) of plans by integrating cumulative effects considerations at each stage of the SEA and plan-making process.

- **Systems Approach**  
  Adopt a systems approach in defining cumulative effects and impact relationships.

- **Adequate scope**  
  Establish expanded temporal and spatial boundaries to include all potential sources of effects. Study area boundaries for the assessment should reflect impact and valued resource boundaries.

- **Assessment Focus**  
  Focus assessment on potential cumulative effects that would significantly affect sensitive or important environmental resources. Characterise the baseline condition, the stresses affecting these resources and consider trends. Establish thresholds and indicators.

- **Consideration of other actions**  
  Consider potential cumulative effects of the plan and other plans and actions that are likely to affect important or valued environmental resources.

- **Impact Assessment**  
  Assess direct, indirect, secondary, higher order and cumulative effects of the plan’s preferred options, policies and proposals on the important resources. Determine the significance of these effects using criteria based on standards or acceptability.

- **Mitigation measures**  
  Propose mitigation measures for cumulative adverse effects and suggest enhancement measures for valued resources. Assess the significance of residual impacts after mitigation.

- **Stakeholder Involvement and partnership approach**  
  Apply a partnership approach among parties concerned and involve stakeholders in identifying cumulative effects issues and determining impact significance.

- **Monitoring and Management**  
  Monitoring of significant cumulative effects should be undertaken as part of the overall monitoring of impacts of the plan to evaluate the accuracy of impact prediction and help improve future assessments. Feedback from monitoring should be incorporated into the management plan for the area.

- **Iterative Process**  
  The process should be iterative and the findings from the CEA should be fed back into the next assessment.

- **Precautionary Principle**  
  Due to the uncertainties in assessing and predicting cumulative effects, the precautionary principle should be adopted.
3 Integrating CEA within SEA

3.1 CEA approach

The CEA approach presented in these Guidelines is based on a cause-effect model to establish how multiple stressors are affecting valued resources and the resulting trends evaluated against identified objectives and indicators. The CEA framework presented here was developed through an extensive review of CEA frameworks and guidelines,\(^{22}\) which were adapted to incorporate the requirements of the EC SEA Directive\(^{23}\). EC guidance on the implementation of the Directive\(^ {24}\), the ODPM draft implementing regulations\(^ {25}\) and the ODPM’s SEA Guidance were taken into account.

3.2 CEA within the SEA Process

3.2.1 The SEA Directive delineates a number of procedural steps necessary for its implementation and lists the information that should be included in the environmental report, which should include findings on cumulative effects. The SEA Guidance\(^ {26}\) indicates how the assessment can be integrated with sustainability appraisals, which are undertaken by regional and local authorities in the UK. It should be noted that these CEA guidelines are designed within the context of SEA. With regard to sustainability appraisal, the Framework could be applied to that process, providing that it has been modified to incorporate the requirements of the SEA Directive. In particular, sustainability appraisal, which is objectives-led, will require baseline data on valued resources to be able to assess the significance of additional impacts on those resources.

3.2.2 The SEA Guidance identifies the stages of plan-making\(^ {27}\) and SEA. These stages are taken as the starting point for the CEA and the SEA. The purpose of integrating CEA within SEA is to identify and predict the cumulative effects of options, policies and proposals. The framework for incorporating CEA into SEA and its linkages with the Plan-making process is shown in Figure 4. The following sections provide guidelines for each stage of the CEA.


\(^{23}\) CEC (2001), op cit.

\(^{24}\) CEC (2003), op cit.

\(^{25}\) ODPM (2004), op cit.

\(^{26}\) ODPM (2003), op cit.

Figure 4. Integrating CEA within SEA and linkages with the Plan-making Process

Plan-making process

- Identify issues and options
  - Undertake a policy context review
  - Carry out assessment of adopted plan
  - Carry out research and studies
  - Develop strategic options
  - Develop participation strategy
  - Prepare issues and options report

- Consult public on issues and options

- Prepare plan
  - Develop preferred strategy
  - Identify proposals
  - Develop policies
  - Propose monitoring of plan
  - Draft plan

- Conduct public consultations

- Finalise and adopt plan
  - Amend plan including changes as a result of the SEA and the Inspector’s modifications

- Publish adopted plan

- Monitor plan implementation

Strategic Environmental Assessment

- Setting the context
  - Identify other relevant plans and programmes
  - Identify environmental protection objectives
  - Propose SEA objectives
  - Propose indicators

- Establish the baseline
  - Collect baseline data and trends
  - Identify environmental problems

- Deciding scope and developing alternatives
  - Identify alternatives
  - Choose preferred alternatives
  - Consult authorities with environmental responsibilities

- Assess the effects of the plan
  - Predict and evaluate effects
  - Propose mitigation measures
  - Propose monitoring against objectives

- Assess cumulative effects
  - Predict and evaluate cumulative effects
  - Propose mitigation measures for cumulative effects
  - Propose monitoring for cumulative effects

- Prepare Environmental Report and consult with the public and environmental authorities

- Take the findings of the consultation into account and integrate environmental considerations to amendments to the plan

- Provide information on how the Environmental Report and consultees’ opinions have been taken into account

- Monitor significant environmental effects

Cumulative Effects Assessment

- Scoping for cumulative effects
  - Identify cumulative effects issues
  - Select valued environmental resources/components
  - Set temporal and geographical boundaries
  - Identify other plans and programmes affecting valued resources

- Establish baseline conditions and trends for valued resources

- Identify cumulative effects problems

- Monitor significant cumulative effects

4. Scoping

4.1 Introduction

4.1.1 Scoping is the process of identifying, from a wide range of problems, a number of priority issues to be addressed. Scoping of key issues relating to cumulative effects is undertaken during Stages A and B of the SEA. In order to be able to assess cumulative impacts later on, there are some tasks that should be undertaken at this stage. These tasks are:

- Identify cumulative effects issues;
- Select sensitive or important elements of the receiving environment\(^{29}\)/valued environmental resources where cumulative effects may be a problem;
- Delineate temporal and geographical boundaries for these elements and cumulative effects issues;
- Propose assessment objectives and indicators for cumulative effects;
- Identify other plans and programmes that may affect those valued resources

Each of these tasks will be discussed in the following sections.

4.2 Scoping cumulative effects issues

4.2.1 This involves identifying cumulative effects problems and the valued resources being affected in the area. The SEA guidance indicates that baseline data, including likely future trends is undertaken at this stage. Cumulative effects issues can be identified from the information on major resources and trends. Some examples of cumulative effects issues are listed in Box 5.

**Box 5. Examples of cumulative effects issues**

| - Increase in air pollution resulting in degradation of regional air quality
  - Increase in traffic congestion affecting urban environmental quality
  - Changes in ecological integrity of protected areas
  - Changes in quality of water bodies from increased surface water run-off
  - Reduction or contamination of ground water supplies
  - Loss of habitats through residential, commercial and industrial development
  - Loss of historic heritage through developments
  - Loss of open countryside or green spaces
  - Changes in hydrological regimes of water courses
  - Habitat fragmentation from infrastructure construction or changes in land use
  - Habitat degradation
  - Loss of biological diversity
  - Loss of amenity |

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\(^{29}\) The SEA Directive refers to important elements of the receiving environment to include people, resources species and habitats. In CEA these are referred to as valued environmental resources to emphasise that the CEA focuses on selected resources which are at risk from cumulative effects.
4.2.2 Questions to guide the baseline collection relating to cumulative effects issues are set out in Box 6.

**Box 6. Identifying potential cumulative effects issues**

<table>
<thead>
<tr>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Are there any sensitive or valued resources in the area? What is the state of these resources (trends, thresholds)?</td>
</tr>
<tr>
<td>2. Are these resources likely to be affected by the plan?</td>
</tr>
<tr>
<td>3. What activities have impacted these resources in the past?</td>
</tr>
<tr>
<td>4. Are there any other plans or programmes which might affect the same resource?</td>
</tr>
<tr>
<td>5. Which government policies, regulations and standards are relevant to this issue?</td>
</tr>
<tr>
<td>6. Are there cumulative effects issues in the area?</td>
</tr>
<tr>
<td>7. Have there been any studies on these issues (e.g. erosion of salt marshes)?</td>
</tr>
</tbody>
</table>

4.2.3 Another source of information for cumulative effects issues are the authorities with environmental responsibilities in the area who are to be consulted on the scope of the SEA.

4.2.4 Examples of cumulative effects issues and likely causes are listed in Table 3. These were identified from consultations with regional and local authority planners and officers from government agencies and environmental NGOs.

**Table 3. Cumulative effects issues in the Thames Gateway**

<table>
<thead>
<tr>
<th>Cumulative Effects issues</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in traffic and congestion</td>
<td>increase in transport movement and commuting</td>
</tr>
<tr>
<td>Increase in air pollution</td>
<td>greater use of private vehicles, industrial releases of nitrogen oxides</td>
</tr>
<tr>
<td>Increase in flood risk</td>
<td>new developments (housing) on or close to the floodplain, increase in water run-off from built up areas, sea level rise and climate change, farming practices</td>
</tr>
<tr>
<td>Reduction in water supplies and groundwater contamination</td>
<td>many new developments (commercial and housing) in the area</td>
</tr>
<tr>
<td>Habitat loss and fragmentation</td>
<td>use of land for development and transport infrastructure</td>
</tr>
<tr>
<td>Loss of open spaces and disruption to network of green spaces</td>
<td>development on open spaces and brownfield sites</td>
</tr>
<tr>
<td>Loss of inter-tidal area; erosion of salt marshes</td>
<td>sea level rise, encroachment</td>
</tr>
<tr>
<td>Increase in waste production</td>
<td>increase in industrial, commercial and residential activities</td>
</tr>
<tr>
<td>Impact on water quality of estuary and rivers and on freshwater and marine habitats</td>
<td>increased activity on riverside</td>
</tr>
<tr>
<td>Increased demand for utilities (electricity), and services (schools, health and recreational facilities)</td>
<td>growth in population</td>
</tr>
<tr>
<td>Impact on urban environment and health (increase in noise)</td>
<td>traffic, construction activities, noise, air pollution</td>
</tr>
<tr>
<td>Positive impacts on environmental quality- improved public spaces, public transport, visual quality</td>
<td>urban regeneration programmes: redevelopment of derelict sites, improvement in design standards, provision of public transport, pedestrian &amp; cycle lanes</td>
</tr>
</tbody>
</table>

---

4.2.5 Various methods can be used to determine which issues are important. One way would be to construct an interaction matrix listing plan activities against resources. Another method is to use a checklist of questions for each environmental element that could be affected by the plan. A useful method is network analysis indicating which impacts interact and lead to higher order ones. In the Cumulative Impact Study for the Millenium Quarter Developments in Tower Hamlets for example, a matrix was used to indicate potential cumulative impact issues from five development proposals. This is shown in Table 4.

<table>
<thead>
<tr>
<th>Type of impact</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additive</td>
<td>Archaeology and Cultural Heritage</td>
</tr>
<tr>
<td></td>
<td>Ecology</td>
</tr>
<tr>
<td></td>
<td>Shadow</td>
</tr>
<tr>
<td></td>
<td>Soil Conditions and Contamination</td>
</tr>
<tr>
<td>Synergistic</td>
<td>Traffic and Transport</td>
</tr>
<tr>
<td></td>
<td>Air Quality</td>
</tr>
<tr>
<td></td>
<td>Noise (Construction and Traffic)</td>
</tr>
<tr>
<td></td>
<td>Water Resources</td>
</tr>
<tr>
<td></td>
<td>Television and Radio Reception</td>
</tr>
<tr>
<td>Neutralising</td>
<td>Townscape and Views</td>
</tr>
<tr>
<td></td>
<td>Wind</td>
</tr>
</tbody>
</table>

4.3. Selecting valued resources

4.3.1 The focus of CEA is on valued resources which are likely to be affected by the plan. Valued resources are those considered important by the public for environmental, social, scientific or aesthetic reasons. These could be environmental resources such as air quality, water resources, habitats or community resources, such as urban parks and heritage districts. Valued resources also include people. For example, these could be residents in the borough who will be affected by noise and air pollution from proposals to redevelop an area. Valued resources can be identified through the baseline study and consultations with statutory consultees, environmental organisations and the public. In order that key resources are identified, proactive and deliberative forms of public participation may be appropriate or necessary.

4.3.2 It would not be practical or realistic to apply CEA to all resources. The key therefore is to prioritise the environmental resources of concern. Some will be apparent, such as designated protected areas while others will need further consideration and consultations with local organisations or environmental authorities. International and national legislation could also provide a basis for determining priorities.

4.3.3 It is essential that the status of these resources and historical context are established. In this, trends analysis can help understand the existing condition of the resources and the factors that have affected them. Trend analysis will therefore highlight those resources, which are at risk from cumulative change.

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4.4 Delineating Temporal and Spatial Boundaries

4.4.1 After identifying the issues and valued resources, temporal and spatial boundaries of the assessment can be established. These are based on the types of cumulative effects to be addressed or the resources. There may be a need for different boundaries for different effects or resources.

4.4.2 Delineating appropriate geographical boundaries in a CEA may be based on relevant landscape units, watersheds or ecological boundaries of the valued resource. The end of the boundary will be the point where the effect becomes insignificant. For development plans, a regional study area may be established to include possible interactions with other plans and programmes.

4.4.3 Examples of possible geographical areas for analysis based on resources are listed in Table 5.

Table 5. Geographical areas for assessing cumulative effects

<table>
<thead>
<tr>
<th>Resource</th>
<th>Possible geographical areas for analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air quality</td>
<td>Metropolitan or regional area, airshed</td>
</tr>
<tr>
<td>Water quality</td>
<td>Estuary, river basin, aquifer, watershed</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Woodland, forest or landscape units</td>
</tr>
<tr>
<td>Wildlife</td>
<td>Species habitat including breeding and feeding areas</td>
</tr>
<tr>
<td>Historic heritage</td>
<td>Historic district or area</td>
</tr>
<tr>
<td>Marshland/wetland</td>
<td>Wetland area</td>
</tr>
<tr>
<td>Coastal zone</td>
<td>Coastal area</td>
</tr>
<tr>
<td>Waterfront</td>
<td>Land and intertidal areas</td>
</tr>
<tr>
<td>Recreational areas</td>
<td>Area surrounding a river, lake or park area</td>
</tr>
</tbody>
</table>

4.4.4 Examples of actual cases of geographical and temporal boundaries set relating to cumulative effects are shown in Table 6.

Table 6. Examples of geographical and temporal boundaries

<table>
<thead>
<tr>
<th>Case</th>
<th>Cumulative effect</th>
<th>Geographical boundary</th>
<th>Temporal boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millennium Quarter Cumulative Impact Study</td>
<td>Noise</td>
<td>Area surrounding five developments</td>
<td>Construction period</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
<td>Study area</td>
<td>Construction until operation</td>
</tr>
<tr>
<td>Creekside/West Greenwich Development and Environment Plan</td>
<td>Habitats and species loss and disturbance</td>
<td>Area alongside Deptford Creek</td>
<td>Implementation of Plan covering construction of developments until operation</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
<td>Whole of Creekside</td>
<td></td>
</tr>
<tr>
<td>Ebbsfleet Development and Environment Framework</td>
<td>Ecological effects – loss of habitats</td>
<td>Area around Ebbsfleet river Ebbsfleet valley and Kent thameside</td>
<td>Implementation of plan</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thames Estuary Flood Risk Management Plan</td>
<td>Flooding effects</td>
<td>Estuary and watershed</td>
<td>Implementation of Plan</td>
</tr>
</tbody>
</table>

4.4.5 In a study to assess the cumulative effects of marine activities in Liverpool Bay commissioned by the Countryside Council for Wales, the spatial boundaries were set taking into account the following considerations: natural processes, past, current and future activities; the study area must be large enough to allow ecological requirements of the selected valuable ecological components to be investigated and project budget\(^{33}\). The spatial limits established were:

- Western limit – Great Ormes Head
- Northern limit – Ribble Estuary
- Inshore limit – mean low water mark

4.4.6 Temporal boundaries establish how far back the assessment should consider baseline data and trends and how far into the future should impacts be considered. Historical records, such as monitoring data can be used to establish incremental changes over time. For nature conservation areas, for example, the past boundary could go as far back as the point in time when the area was designated. At a pragmatic level, the temporal boundaries could be dictated by the historical data available. The purpose of setting past boundaries is to identify other actions that have affected the valued resource.

4.4.7 In terms of the future boundary, it is important that future policies or management strategies for the affected resource are identified as well as any planned activities that might impact on that resource. Future actions may include:

- proposals, plans or programmes that have been approved or pending approval by the planning authority.
- Plans and proposals by other agencies likely to affect the resources

4.4.8 Some suggestions for establishing temporal boundaries are set out in Box 7.

**Box 7. Establishing temporal boundaries\(^ {34}\)**

<table>
<thead>
<tr>
<th>Establishing past boundary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- When effects similar to those of concern first occurred</td>
</tr>
<tr>
<td>- The time at which certain land use designation was made (for example, establishment of a nature reserve, park or planning area)</td>
</tr>
<tr>
<td>- At a time previous to any developments in the area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Establishing future boundary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- End of plan implementation or until the next plan review</td>
</tr>
<tr>
<td>- Time when the valued resource has been restored to pre-disturbance conditions</td>
</tr>
<tr>
<td>- When the resource is expected to meet environmental quality standards (water quality, air quality)</td>
</tr>
</tbody>
</table>


\(^{34}\) modified from Hegmann et al (1999). *op cit.*
4.5 Identifying objectives, thresholds and indicators

4.5.1 After identifying the affected resources and establishing the boundaries, the next step would be to identify the CEA objectives. These objectives should relate to the valued resources selected earlier but take into account the plan and SEA objectives. For example if an SEA objective is to ‘ensure the sustainable management of key wildlife sites and the ecological processes on which they depend’ then a CEA objective would be ‘reduce further cumulative impacts on key wildlife sites’. Another CEA objective might be to highlight impacts identified in the SEA that are likely to be cumulative.

4.5.2 Thresholds are limits beyond which cumulative change becomes an important concern, such as loss or degradation of habitat leading to decline of bird population or when air pollution levels result in health problems. Thresholds may be defined in terms of goals or targets, standards and guidelines, carrying capacity or limits of acceptable change. In CEA, environmental thresholds relate to the point where cumulative impacts on the valued resource result in significant effects. Establishing thresholds depend on the resource under consideration. It can be based on standards established by regulations or contained in guidelines (for example, noise, air and water quality standards used in the UK) or value judgements based on scientific, legal and political considerations. For example, biodiversity thresholds have been identified in Local Biodiversity Plans. The objective of establishing thresholds in CEA is to determine whether further impacts on the resource could become significant and identify measures to avoid further damage.

4.5.3 Carrying capacity is the maximum level of use or activity that a system can sustain without undesirable consequences. One example is the visitor capacity in a park, beyond which the area gets too crowded. Limits of acceptable change refer to the change in environmental components that society is prepared to accept. After defining what acceptable conditions are, then levels of use can be determined, a benchmark against which the effects can be assessed.

4.5.4 CEA indicators can measure the achievement of objectives. For example, for the CEA objective to ‘ensure that there would be no further cumulative impacts on key wildlife sites’ possible indicators are: no habitat loss from future activities or reduction of disturbance to wildlife sites from future developments.

4.5.5 Environmental indicators in CEA can be useful in describing baseline conditions and establishing trends. Alterations of indicators can be used to predict cumulative effects. Criteria for selecting indicators for CEA\(^\text{35}\) include the following:

- Availability of secondary data sources;
- Provision of information on selected valued resources;
- Compatibility with indicators used in monitoring programmes in the area
- Usefulness in measuring cumulative effects which are significant and irreversible or those causing higher order effects;

• Sensitivity to the magnitude, direction and duration of stress;
• Usefulness for predicting thresholds, measuring assimilative capacities and monitoring change

4.6 Identifying relevant plans and programmes that may affect the same valued resources

4.6.1 The SEA Directive requires that the environment report should provide information on the plan’s ‘relationship with other relevant plans and programmes’ Annex 1, SEA Directive.

4.6.2 In assessing cumulative impacts, the relevant plans and programmes, are those that are likely to affect the selected valued resources. For a local plan, a relevant plan would be the regional plan. These set out future developments in the wider area, which could have impacts on the valued resource. Other plans that would be relevant are, for example, an urban regeneration plan and transport plan of a neighbouring authority, which, together with the plan proposal for housing development could have a cumulative impact on transport.

4.6.3 Criteria for determining relevant plans or programmes:

• Geographical proximity
• Affects the same resource
• Common impact causing activities that could lead to cumulative effects.

4.7 Conducting consultations

4.7.1 The SEA Directive requires that EU Member States designate authorities with environmental responsibilities to be consulted in the SEA process since they are likely to be concerned with the environmental impacts of the plan.

These authorities should:
‘be consulted when deciding on the scope and level of detail of the information which must be included in the environmental report (Article 5(4)) and
‘be given an early opportunity within appropriate time frames to express their opinion on the draft plan or programme and the accompanying environmental report’ (Article 6 (2)). SEA Directive

4.7.2 The SEA guidance suggests that the following agencies should be consulted: Environment Agency, Countryside Agency, English Nature and English Heritage. In some cases it may be appropriate to institute more inclusive and deliberative participation processes, e.g. with regard to transport impacts in urban regeneration plans\textsuperscript{36}.

4.7.3 Since CEA requires that past activities that have affected the resource be investigated, wider consultations with other agencies early in the process would be useful. Input from local organisations could be valuable in defining past activities relating to valued resources in the area. In this case, local environmental NGOs and public interest groups should be consulted. For example, in preparing the sustainability appraisal of the Kent and Structure Plan, workshops to identify key sustainability issues involved internal and external stakeholders.

4.7.4 Some issues that consultees need to be aware of which could assist the CEA are listed in Box 8.

**Box 8 Consultation issues relating to valued resources**

<table>
<thead>
<tr>
<th>Valued environmental resources in the area that might be affected by the plan and information relating to these resources:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Attributes, status, historical background and trends;</td>
</tr>
<tr>
<td>• Geographical and temporal dimensions;</td>
</tr>
<tr>
<td>• Quality and extent of baseline data;</td>
</tr>
<tr>
<td>• Any researches, surveys and monitoring data;</td>
</tr>
<tr>
<td>• Stressors (past, and existing) and effects;</td>
</tr>
<tr>
<td>• Factors determining their present condition;</td>
</tr>
<tr>
<td>• Pressures that the resource is vulnerable to;</td>
</tr>
<tr>
<td>• Potential impacts from plan policies and proposals and other plans;</td>
</tr>
<tr>
<td>• Parameters best used to measure effects;</td>
</tr>
<tr>
<td>• Objectives, thresholds and standards;</td>
</tr>
<tr>
<td>• State of management system;</td>
</tr>
<tr>
<td>• Legal, policy, political and social considerations;</td>
</tr>
<tr>
<td>• Stakeholder concerns;</td>
</tr>
<tr>
<td>• Gaps in data.</td>
</tr>
</tbody>
</table>

4.8 **CEA Methods for scoping**

4.8.1 There are various methods or techniques for identifying cumulative effects that could be used in CEA and SEA. For scoping, the methods that could be useful are:

- Questionnaires, interviews and panels (for identifying issues, valued resources)
- Checklists (for identifying issues and potential effects)
- Matrices (for identifying issues by setting activities against resources)
- Networks and systems diagrams (for identifying potential direct and indirect effects and impact relationships).

4.8.2 The network analysis method can be used to identify primary, secondary and higher order effects and impact relationships that could lead to cumulative effects. Simple networks are particularly suitable for scoping. An introduction to the method is presented in Section 7.

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5 Establish Baseline Conditions

5.1 Baseline information requirements

5.1.1 The SEA Directive requires that the baseline conditions of the environment should be established. The information to be provided includes the environmental characteristics of the areas likely to be significantly affected by the plan. The baseline should include detailed information on the selected valued resources.

The environmental report should include information on:
- “the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme”
- “the environmental characteristics of the areas likely to be significantly affected”
- “any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of particular environmental importance, such as areas designated pursuant to Directive 79/409/EEC and 92/43/EEC.

(Annex 1, SEA Directive)

5.2 Establishing the baseline for valued resources

5.2.1 The SEA Guidance suggests that baseline data should be collected during Stage A and clarified during Stage B. The baseline data recording for the SEA would need to be adapted to take account of cumulative effects. Data on selected valued resources will include past factors that have affected the resource, existing pressures on the resource and future pressures on them. Furthermore, data will be required in order to carry out trends analysis. Establishing the baseline condition for CEA should include:

- Characterising the current status of valued resources identified in scoping, particularly their state in relation to thresholds and capacity;
- Characterising the stresses affecting these resources including stresses from past activities;
- Establishing the regional or wider context for these resources by identifying future relevant developments, government regulations and standards and how they are likely to affect the resource;
- Defining the baseline condition for the resource based on trends analysis.

5.2.2 Data on the status of resources can be found in state of the environment reports, biodiversity action plans, conservation plans and research studies. For example, air quality monitoring data can establish pollution levels. Similarly, noise monitoring data can establish current state and these can be related to thresholds.
In the Millennium Quarter Plan Transport Study\textsuperscript{38}, for example, the capacity of the transport infrastructure (DLR, Jubilee Line and buses) was established in order to assess the cumulative impact of developments on the transport infrastructure. In the Creekside area, survey data on ecological and archaeological resource and historical data on impacts of past developments established a baseline from which cumulative effects could be assessed.

5.2.3 It should be possible to identify the pressures each valued resource is subject to from the state of environment report. Data that characterise important stress factors that are likely to affect the environment should include the types, distribution and intensity of key activities within the area or region and individual indicators of stress on specific resources. Regulatory, administrative and planning information can help define the development pressures within a region.

5.2.4 Trends data would be useful in order to:

- Establish the baseline for the affected environment more accurately (incorporating variations over time and the likely change in the absence of the proposed plan or action).

- Evaluate the significance of effects relative to historical degradation (how close the resource is to threshold of degradation).

For example, in establishing the baseline for the Thames Estuary Management Plan SEA\textsuperscript{39}, trends relating to ecological resources were identified based on historical data sources (e.g. grazing marsh and saltmarsh).

5.3 Data Sources

5.3.1 Most of the information needed to describe the affected environment can be obtained from regional, local and national centres. Possible sources of information include the local planning authority, proposed regional observatories, research institutions, government agencies, private organisations, environmental NGOs and other consultees. The planning authority holds data on past and future developments, which can be used to determine other activities affecting the valued resource. The Environment Agency, English Nature and RSPB and other bodies hold monitoring data that could be used in trends analysis. This is an area where co-operation among public and private organisations would be helpful.

6 Identifying potential cumulative effects of alternatives

6.1 The SEA Directive requires consideration of alternatives and the reasons for selecting alternatives.

The environmental report should consider ‘reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme’ (Article 5.1).

The environmental report should provide ‘an outline of the reasons for selecting the alternatives dealt with’ SEA Directive (Annex 1h)

6.2 Stage B of the SEA Guidance includes developing alternatives. The SEA guidance proposed that the alternatives considered at this stage would be strategic. More detailed alternatives relating to policies and proposals can be considered in their formulation. CEA needs to take place at the beginning of the plan-making and SEA processes so that different options can be weighed against each other and the policies and proposals of least cumulative impact can be chosen.

6.3 The role of CEA here is to appraise the overall potential cumulative effects of the various alternatives or options on valued resources. One advantage of using CEA at this stage of the SEA is that direct, indirect impacts and impact relationships can be considered. Furthermore, CEA also brings into decision-making the consideration of other plans or activities. Some cumulative effects considerations when comparing options are set out in Box 9.

Box 9. Cumulative effects considerations of options

For each option consider:
- Will this option have an impact on the selected valued resources?
- What are the potential cumulative effects?
- Are the effects likely to be significant?
- Are there other plans or actions relevant to this option that are likely to affect those resources?

6.4 At the level of broad options relating to spatial alternatives of development, CEA could be used to compare options by considering which option is likely to cause significant contributions to significant effects. An example of how the cumulative effects of alternative spatial strategies are set out in Table 8.
Table 8. Comparison of options considering potential cumulative effects

<table>
<thead>
<tr>
<th>Options</th>
<th>Affected valued environmental resources</th>
<th>Other stressors</th>
<th>Potential cumulative effects</th>
<th>Likely significance Major or Minor Long or short term</th>
</tr>
</thead>
</table>
| 1. Concentrated development through urban regeneration | Air quality Urban environment Urban open spaces | Existing traffic & congestion | - Increase in traffic & air pollution  
- Loss of urban open space rich in biodiversity  
+ visual effects through better designed urban regen. schemes  
+ redev of brownfield sites  
+ preservation of countryside | Thresholds can be used to determine significance: Will increase in air pollution mean that the threshold is breached? |
| 2. Concentrated development through urban regeneration & expansion of smaller towns | Air quality Urban open spaces & outlying areas | Existing traffic & congestion | - Increase in traffic & air pollution in urban and outlying areas  
- loss of open spaces, urban and countryside  
+ visual effects through urban regeneration | |
| 3. Devt through urban regeneration & expansion & new settlements | Air quality in urban areas Urban open spaces Open countryside | Existing traffic & congestion | - Increase in traffic congestion & air pollution in urban areas  
- loss of green spaces  
- induced developments near new settlement | How valuable is the land that would be lost in creating a new settlement? |
7. Assessing the cumulative effects of the plan

7.1 Introduction

7.1.1 The SEA Directive requires that the effects on the environment should be assessed, including cumulative effects. In the Environment Report, the “likely significant effects on the environment of implementing the plan ... and reasonable alternatives... are identified, described and evaluated” (Article 5.1). Furthermore, the Environmental Report should include information that may “reasonably be required taking into account current knowledge and methods of assessments, the contents and level of detail of the plan,... its stage in the decision-making process...” (Article 5.2).

Information to be provided in the Environmental Report include:

- “the likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors.” (Annex 1 (f))

- “These effects should include secondary, cumulative, synergistic, short, medium and long-term, permanent and temporary, positive and negative effects.” (Footnote, Annex 1 (f))

7.1.2 The assessment of cumulative effects are undertaken as part of the assessment of the plan’s effects. However, considering cumulative effects extends the analysis of these effects in two ways:

- it focuses the analysis of effects on selected environmental resources
- it considers past impacts and future impacts relating to these resources.

7.2 Assessing potential cumulative effects of plan options

7.2.1 Determining the environmental effects involves describing the cause-effect relationships producing cumulative effects and summarising the total effect of each plan option. This requires identifying the main sources of stress, pathways of change and the environmental changes affecting valued resources. The main steps for predicting cumulative effects are:

- Identify and describe cause-effect relationships for valued resources;
- Determine environmental changes that affect these resources;
- Predict response of the environmental resource to change;
- Evaluate magnitude and significance of cumulative effects.
Identify and describe cause-effect relationships

7.2.2 Identifying cause-effect relationships between the stresses and valued resources requires determining stresses resulting from the proposed options and their likely effects on valued resources. For example, one option for housing provision is a regeneration strategy comprising high-density housing on brownfield sites near a river, which has been designated a Site of Nature Conservation Importance. The stresses/causes here are construction of housing units, roads and infrastructure while the valued resource is the river. Potential effects are disturbance and loss of habitats. The effects from these activities, and the effects from previous developments on the riverside and future activities could result in cumulative effects.

7.2.3 A useful method for identifying primary, secondary and higher order effects that can lead to cumulative effects is the network analysis method. Networks and systems diagrams can be used to conceptualise cause-effect relationships. Conceptual models can be developed using available data and expert knowledge. The cause-effect model can assist in identifying past, present and future activities and a number of activities in an area can be depicted as they interact, individually and in combination, with environmental components. Networks are a useful means of representing cumulative impacts as “workable methods with practical application to local and regional planners and decision makers”.

7.2.4 Network analysis traces interaction pathways between the elements of the environment, and can be used by the practitioner to select what aspects should be looked at in more detail or what further information is required for the assessment. Although the method is qualitative, it can provide a basis for choosing which elements need to be quantified or modelled in more detail. If there is sufficient data available, it may be possible to include quantitative measurements in the network diagram.

7.2.5 The basic component of network diagrams is the impact chain. Impact chains show the process of cause and effect, indicating secondary and indirect effects. These impact chains can be linked together to produce more complex diagrams. In order to apply the network analysis method to plans, various activities are required and these are listed in Box 10.

Box 10. Using the network analysis method to identify potential cumulative effects of plan options

<table>
<thead>
<tr>
<th>Steps in network analysis:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- List activities associated with the plan option (principal causes driving development in the plan area)</td>
</tr>
<tr>
<td>- Indicate the key impacts induced by these demands on the plan area</td>
</tr>
<tr>
<td>- Identify valued environmental resources or receptors</td>
</tr>
<tr>
<td>- Identify direct impacts of plan options on receptors</td>
</tr>
<tr>
<td>- Identify pathways of impacts</td>
</tr>
<tr>
<td>- Identify secondary and tertiary impacts on the main receptor and other receptors</td>
</tr>
<tr>
<td>- Identify other plans or actions that could impact on the same receptors</td>
</tr>
</tbody>
</table>

---

7.2.6 Examples of simple network analysis diagrams are shown in Figure 5. Other examples of network diagrams are included in Appendix 1.

**Figure 5. Examples of network analysis diagrams**

**Single development impacts**

<table>
<thead>
<tr>
<th>Cause</th>
<th>primary impacts</th>
<th>Secondary impacts</th>
<th>Receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing devt.</td>
<td>Land take</td>
<td>Loss of open space</td>
<td>Humans</td>
</tr>
<tr>
<td></td>
<td>Change in land use</td>
<td>Habitat loss</td>
<td>Fauna</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loss of vegetation</td>
<td>Flora</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in water run-off</td>
<td>Groundwater</td>
</tr>
</tbody>
</table>

*cumulative effect*

**Multiple causes of impacts**

<table>
<thead>
<tr>
<th>Causes:</th>
<th>primary impacts</th>
<th>secondary impacts</th>
<th>Receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>housing</td>
<td>Land take</td>
<td>Loss of open space</td>
<td>Humans</td>
</tr>
<tr>
<td></td>
<td>Change in land use</td>
<td>Habitat loss</td>
<td>Fauna</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landscape change</td>
<td>Flora</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loss of vegetation</td>
<td>Water</td>
</tr>
<tr>
<td>road</td>
<td>noise</td>
<td>Disturbance</td>
<td>Air</td>
</tr>
<tr>
<td></td>
<td>Air emissions</td>
<td>Air pollution</td>
<td>Soils</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil contamination</td>
<td></td>
</tr>
</tbody>
</table>

*cumulative effect*
**Determine the environmental changes that affect valued resource**

7.2.7 Based on the network diagram which identified impact causing activities and potential impacts, the next step is to determine what are the environmental changes resulting from these activities that would affect the valued resource. This requires analysing the pathways of the impacts and impact relationships.

7.2.8 Using the example shown in Figure 5, the development of an area for housing leads to loss of vegetation and habitats and species. Both these impacts affect wildlife in the area: one pathway is direct (loss of habitats and species) and another pathway is indirect (loss of vegetation). Another example is increase in road traffic which results in increase in air pollution. One pathway is through the air while other pathways are through pollution deposition where contaminants deposit on vegetation and soil, which potentially affect vegetation (growth), wildlife (consumption of contaminated vegetation) and water quality (contamination).

**Predict response of the value resource**

7.2.9 To predict the response of the resource to environmental change, data on the status of the resource and trends are required. Monitoring data would be particularly useful in defining trends. Trends analysis can be used to model the effects over time. The response of the valued resource to cumulative impacts depends on several factors, such as the sensitivity of the resource and how close it is to the threshold, where additional impacts might cause the threshold to be breached. When quantitative data is available (e.g. noise or air pollution levels), it may be possible to predict impacts quantitatively.

7.2.9 Considering cumulative effects include the following:\footnote{Hegmann, G and Yaranton, G (1995). *Cumulative Effects and the Energy Resources Conservation Board Review Process.* Prepared by the MacLeod Institute for Environmental Analysis for the Energy Resources Conservation Board, University of Calgary, Calgary, Alberta.}:

- the parameters for measuring the effects on the valued resources;
- what determines their present condition; and
- how would the proposed plan in combination with other existing or approved actions or plans affect their condition.

**Evaluate magnitude and significance of cumulative effects**

7.2.11 The magnitude and significance of cumulative effects need to be determined in the context of other past, present and future activities and thresholds. An appropriate baseline condition and threshold should be established, beyond which adverse impacts may occur. There are regulatory thresholds that can be used, such as those for air quality (for example, limits for NO₂ and PM₁₀ were set by the EU Directive 99/30/EC) or for noise (Planning Policy Guidance 24\footnote{DOE (1994). *Planning Policy Guidance: Planning and Noise.* London: HMSO.} recommends noise exposure categories). Significance of effects can also be determined in the context of the SEA/CEA objectives identified earlier.
7.2.12 The magnitude of cumulative effects on valued resources can be considered by initially determining the separate effects of past actions and present actions, the proposed plan and other future plans and actions. The cumulative effects on a specific resource will not necessarily be the sum of all the effects. The assessment will need to consider whether the effects will be additive, antagonistic or synergistic. The assessment can be summarised as shown in Table 9.

Table 9 - Description of cumulative effects on valued resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Past Actions</th>
<th>Present Actions</th>
<th>Proposed Actions</th>
<th>Future Actions</th>
<th>Cumulative Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>Air pollution impacts (NO(<em>2) and PM(</em>{10})) from road traffic</td>
<td>Increase in pollution levels due to increase in road traffic</td>
<td>Further increase in road traffic but standards met</td>
<td>Increase in vehicle emissions expected</td>
<td>Standards for both NO(<em>2) and PM(</em>{10}) breached causing human health problems (synergistic)</td>
</tr>
<tr>
<td>Habitats alongside an urban creek, a locally important site</td>
<td>Industrial developments and quays on creekside causing disturbance to wildlife</td>
<td>Loss of habitats from rebuilding of creek walls</td>
<td>Redevelopment of sites along creek causing loss of habitats</td>
<td>Continued loss of habitats</td>
<td>Significant cumulative loss of habitats and species (additive)</td>
</tr>
</tbody>
</table>

7.2.13 To determine the magnitude of impacts, indicators identified earlier can be used. Indicators provide a measure of the effects on a valued resource. Indicators can measure attributes of activities that lead to effects (e.g. road densities, area cleared) or attributes of surrounding environment (e.g. fragmentation indices, biodiversity indices). For some impacts, the magnitude can be quantified. For example, the area of land used for housing, area of habitat loss or the combined effect of noise from several sources. However, for some effects, such as visual impacts the cumulative loss of views may have to be described qualitatively.

7.2.14 The significance of effects should be evaluated beyond its local and direct effects. Factors to consider are context and intensity. The significance of the effects depends on the importance of the affected resource in terms of local, regional or national context. Intensity can be determined by using the following criteria: geographic extent, duration and frequency of the effects. Some questions for evaluating significance are listed in Box 11 below.

**Box 11. Some useful questions for evaluating significance of cumulative effects:**

- Will the proposed plan cause cumulative effects that might exceed thresholds as defined in regulations and guidance?
- Is the plan likely to affect an important resource or element of the environment?
- Is this valued resource subject to disturbance during existing conditions and to what degree?
- Will any cumulative effects be significant when taking into account the current state of the affected resource?
- Will there be an increase in the plan’s effect on the valued resource in combination with the effects of other plans and actions?
- Will the resulting effect be unacceptable (exceed threshold)?
- Will the effect be permanent?
- If not permanent, how long will it take for the affected resource to recover?
7.3 Assessing the cumulative effects of plan policies and proposals

The analysis of the cumulative effect of plan policies and proposals involves identifying the main sources of stress, the pathways of change and their overall effect on the valued resources. The process is similar to assessing the impact of the plan option, but at a more detailed level, particularly in terms of the proposals. For example, interactions of proposals (housing and commercial developments) may cause cumulative effects on a particular resource (water).

7.4 Assessment Methods

7.4.1 There are a number of tools that can be used for predicting cumulative effects. Some examples of tools for analysis are presented below in Table 10, which consist of simple and more complex tools. The use of the appropriate tool depends on several factors, such as the type of cumulative effect being investigated, expertise, resources and available data.

<table>
<thead>
<tr>
<th>Tools</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact models-networks or systems models</td>
<td>Detailed assessment of cause-effect relationships between action and valued resources and impact interactions</td>
</tr>
<tr>
<td>Trends analysis</td>
<td>Assesses the status of a resource and changes in the occurrence or intensity of stresses over time.</td>
</tr>
<tr>
<td>Indicators of change</td>
<td>Select indicators of environmental quality for an area and establish an allowable target or threshold for this indicator, which is then used to evaluate the cumulative effects of existing and future developments.</td>
</tr>
<tr>
<td>Carrying capacity</td>
<td>Measures cumulative effects against threshold</td>
</tr>
<tr>
<td>Indices</td>
<td>Habitat indices or biological diversity indices</td>
</tr>
<tr>
<td>Scenario analysis</td>
<td>Predicting outcomes of various scenarios</td>
</tr>
<tr>
<td>Computer modelling</td>
<td>Quantifies cause-effect relationships leading to cumulative effects (e.g. air, hydrological, water quality, noise, transport)</td>
</tr>
<tr>
<td>Spatial analysis using Geographic Information System (GIS)</td>
<td>Can analyse landscape parameters and identify where effects are worse. It can quantify results of actions (e.g. area of land cleared) and changes to landscape features (e.g. loss of woodland)</td>
</tr>
<tr>
<td>Tables and matrices</td>
<td>Evaluation and comparison of variables</td>
</tr>
<tr>
<td>Checklists</td>
<td>Can show whether the plan has an impact and impact type</td>
</tr>
</tbody>
</table>

7.4.2 Some of these tools are already used in planning (e.g. carrying capacity, scenario analysis, modelling and GIS) and sustainability appraisals (e.g. tables and matrices and use of indicators). PPG 12, for example, recommends the use of GIS. Spatial analysis using a Geographic Information System (GIS) involves

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assessing the effects of the proposed action on a component of the environment, using an overlay technique.

7.4.3 An example where GIS was used is the research commissioned by the Countryside Council for Wales to develop a methodology for cumulative effects assessment for offshore industries. Here, GIS was used to overlay data related to baseline environment and projected activities.\textsuperscript{44} GIS is a powerful tool for analysing cause-effect relationships, allowing large areas to be investigated and quantifying results. However, descriptive data in spatial form is necessary and compatibility of data from various sources is an issue. If planning data is available in GIS format, this is a method that would be worth considering.

\textsuperscript{44} Oakwood Environmental Limited (2002) \textit{op cit.}
8. Mitigation measures

8.1. Introduction

The SEA Directive refers to mitigation measures and their documentation.

Information should be provided on: “the measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan or programme”

SEA Directive (Annex 1f)

8.2 Types of mitigation measures

8.2.1 SEA provides a huge opportunity to address potential cumulative effects, particularly those relating to irreversible loss or damage. Addressing these effects over a larger geographical area allows a more accurate and realistic assessment of these effects. SEA also permits advanced mitigation of potential cumulative effects from developments. CEA assists in this process by highlighting resources at risk and therefore promotes avoidance of effects.

8.2.2 Mitigation measures to deal with cumulative effects require an analysis of the cause-effect relationships which lead to cumulative effects. This means determining which of the cause effects pathways results in the most effect. By analysing pathways, measures to mitigate impacts can be identified as shown in Box 12.

Box 12. Types of mitigating measures

<table>
<thead>
<tr>
<th>Avoidance</th>
<th>Measures taken to avoid adverse cumulative effects, such as selection of options where proposed developments are located away from protected areas, highly sensitive areas or highly built-up areas approaching environmental thresholds.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitigation</td>
<td>Measures taken to reduce adverse cumulative effects from road traffic (e.g. congestion, noise and air pollution) policies can be introduced such as: limiting road parking, promoting use of public transport, providing cycle lanes and pedestrian pathways. In some regeneration plans (Kent- thameside and Ebbsfleet, Creekside and Millennium Quarter) the cumulative impacts of traffic were addressed through the use of such policies.</td>
</tr>
<tr>
<td>Compensation</td>
<td>Measures taken to compensate effects which cannot be mitigated. For example, loss of open space to developments (commercial and housing) can be off set by providing a public plaza, which is accessible to local residents. The cumulative loss of urban habitats can be compensated for by requiring ‘green or brown roofs’ in urban regeneration developments, such as those in the Creekside area of the London Boroughs of Greenwich and Lewisham.</td>
</tr>
<tr>
<td>Enhancement</td>
<td>Enhancement means improving the present environment. Positive cumulative effects, such as provision of walkways, cycle ways and public transport in urban regeneration schemes cumulatively provide a better environment.</td>
</tr>
</tbody>
</table>
8.3 Proposing mitigation measures

8.3.1 Cumulative effects can occur over a large area and over a long period of time. It is usually due to several factors and so mitigation measures need to be at a strategic level. To be effective, mitigation measures at the plan level should be long term and area-wide or regionally based and should rely on inter-agency efforts to mitigate regional or area wide effects. An example is the cumulative effects of air pollution from transport, which cross local authority boundaries and require co-operation between the relevant authorities. Mitigating ecological effects may also need inter-agency coordination. In this context, there is a need to mitigate to agreed standards and thresholds. An example of partnership approaches to mitigate cumulative effects is demonstrated in some urban regeneration strategies as shown in Table 11.

Table 11 Mitigating cumulative effects through a partnership approach

<table>
<thead>
<tr>
<th>Case</th>
<th>Effect</th>
<th>Mitigation measures</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creekside</td>
<td>Loss of habitats and species; disturbance of species from multiple</td>
<td>Ecological survey of area before development; Proposals for intertidal areas, brownfield roofs for habitat compensation and creation;</td>
<td>Local planning authorities (Greenwich and Lewisham Councils); Local ecology group; Local forum; Environment Agency; Local organisations and individuals; Riverside owners; Creekside regeneration programme;</td>
</tr>
<tr>
<td>regeneration</td>
<td>developments and rebuilding of Creek walls</td>
<td>Proposals for monitoring of habitats and species; Proposals for river wall enhancements</td>
<td></td>
</tr>
<tr>
<td>Ebbsfleet Valley</td>
<td>Transport impacts from increase in population due to new developments in</td>
<td>Transport strategy by Kent-thameside to promote use of public transport and less car use; Development of transport model to assist assessment of transport effects; Promotion of green corridors for walking and cycling</td>
<td>Local planning authorities (Dartford and Gravesham Councils); Kent thames-side partnership; Kent County Council; Landowners; Developers and other organisations</td>
</tr>
<tr>
<td></td>
<td>the area: transport infrastructure, commercial and housing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.3.2 Mitigation of potential cumulative effects during the SEA process can be undertaken through the selection of more sustainable options - those with the least cumulative impacts. Some tools that planning authorities can use to mitigate cumulative effects at strategic level include: amending policies; use of supplementary planning guidance; preparing planning and environment frameworks for areas likely to have potential for cumulative effects and setting relevant criteria for evaluating development proposals for planning permission. In Ebbsfleet, for example, mitigation measures to address impacts were proposed at strategic level and these are shown in Box 13.

8.3.3 Mitigation measures can include habitat creation in another part of the plan area or region. The concept of “no net loss” has been put forward as an appropriate mitigation measure for regional cumulative effects. No net loss requires that any land or waterbody, which has been affected should be replaced with an
equivalent area so that the capability of habitat to support wildlife or fish is maintained in the region.\textsuperscript{45}

**Box 13 Mitigation measures at strategic level**

<table>
<thead>
<tr>
<th>Mitigation measures under Policy MDS1 Ebbsfleet\textsuperscript{46}:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• creation of a network if Green Grid spaces/links to provide a high degree of public access in throughout the area</td>
</tr>
<tr>
<td>• establishment of community woodlands to mitigate change in landscape character;</td>
</tr>
<tr>
<td>• retention and enhancement of water courses and habitats;</td>
</tr>
<tr>
<td>• development of area designed around the presence of power lines in order to ensure safety and visual amenity for the new population living and working at Ebbsfleet;</td>
</tr>
<tr>
<td>• developing criteria for evaluating impacts of project proposals seeking to gain planning permission;</td>
</tr>
<tr>
<td>• adopting policy which reduces the need to travel by private car (no more than 37% of work journeys to and from the development excluding to the station) and encouraging travel by more energy efficient means;</td>
</tr>
<tr>
<td>• concentration of developments at nodal points and along public transport corridors;</td>
</tr>
<tr>
<td>• extensive managed public open space;</td>
</tr>
<tr>
<td>• phasing of proposals in the area so that facilities grow in line with and not in advance of the needs of the new community.</td>
</tr>
</tbody>
</table>

**8.4 Evaluating significance of residual impacts**

Although mitigation measures for the plan, policies and proposals could be proposed, there will inevitably be some residual effects. There is a need to assess the significance of residual impacts because they could lead to cumulative effects. The approach for determining significance (discussed in Section 7.2.9) can be used. The predicted residual impacts should be compared against regulatory thresholds and SEA objectives.

\textsuperscript{45} Hegmann et al (1999) op cit.

9 Monitoring

9.1 Introduction

The SEA Directive requires that significant effects which includes cumulative effects should be monitored, as stated below.

“Member states shall monitor the significant environmental effects of the implementation of plans and programmes in order, inter alia, to identify at an early stage unforeseen adverse effects and to be able to undertake appropriate remedial action.” (Article 10.1)

Information to be provided in the environmental report should include: “a description of the measures envisaged concerning monitoring in accordance with Article 10”. (Annex 1,i)

9.2 Proposing monitoring of cumulative effects

9.2.1 The ODPM’s Guide to Plan-making\(^{47}\) states that the establishment of an appropriate monitoring mechanism by working with partners is basic to the plan preparation and delivery process. The monitoring programme of the plan’s effects should include the monitoring of the overall cumulative effects on valued resources. The SEA guidance suggests that indicators used for describing the baseline environment and making SEA predictions should be used. In monitoring cumulative effects, the indicators used for describing the baseline of the valued resources should be used.

9.2.2 Because of the complexity of cumulative effects problems at a strategic level, there will be a great deal of uncertainty about impact predictions and so monitoring is critical in order to:

- assess the accuracy of the predictions and
- to monitor the effectiveness of mitigation measures.

9.2.3 Monitoring is important because it can be a means of assessing causality and improve forecasting abilities. This requires however, that indicators used in the monitoring should be the same as those used in the CEA. In addition, monitoring allows the planning authority to evaluate and improve impact management performance.

9.2.4 Steps in developing a monitoring programme are listed in Box 14. The first five steps are undertaken during the CEA and SEA. The implementation of the monitoring programme occurs during the plan implementation.

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\(^{47}\) ODPM (2002) *op cit.*
<table>
<thead>
<tr>
<th>Component</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Identify and define main cumulative effects</td>
<td>- Identify significant cumulative effects to be monitored and scope.</td>
</tr>
<tr>
<td>2) Coordinate with agencies in developing a monitoring programme</td>
<td>- Identify relevant agencies with monitoring responsibilities in the affected area; - Identify agencies’ areas of concern and relevant type of cumulative effects they are responsible for; - Identify each agency’s authority for controlling cumulative effects: planning, decision-making, monitoring or enforcement. - Decide roles and responsibilities of agencies involved.</td>
</tr>
<tr>
<td>3) Define monitoring objectives</td>
<td>- Define objectives relating to potential effects; - Define objectives relating to the affected resources in terms of the CEA and SEA objectives; - Define purpose of monitoring: to monitor effects, mitigation measures and to establish baseline conditions for future assessments.</td>
</tr>
<tr>
<td>4) Determine data requirements</td>
<td>- Select measurable indicators to assess the magnitude of change; - Decide on frequency and timing of data collection. Frequency relates to what is required for trend analysis, enforcement of regulations and correlation of cause and effects. Timing relates to the timing of activities causing the cumulative effect. - Select monitoring areas based on the location of activities causing cumulative effects and areas most likely to be affected. - Determine method of data collection (e.g. for vegetation cover field or remote sensing techniques) and method of analysis; - Determine data storage and format.</td>
</tr>
<tr>
<td>5) Develop implementation plan and agencies responsible for various elements</td>
<td>- Determine budgetary, personnel and time requirements for obtaining and analysing data; - Determine feasibility and if the programme has to be reduced, there are some approaches that may be useful: reduce scope of monitoring; alternative indicators selected; frequency of data collection reduced or alternative data collection methods selected.</td>
</tr>
<tr>
<td>6) Collect and analyse the monitoring data</td>
<td>- Identify baseline condition and effects trends and rate of change; - Identify cumulative effects that have reached critical levels and those that have exceeded legal limits. - Evaluate effectiveness of mitigation measures</td>
</tr>
<tr>
<td>7) Implement management activities to manage or mitigate adverse cumulative effects</td>
<td>- Plan responses to cumulative effects trends. Responses to unacceptable effects can be directed at the activity causing effect or the effect itself. - For effects that have reached critical levels: stop or modify activities causing effects and address effects. - Mitigation measures can be revised, terminated or new ones can be added as appropriate.</td>
</tr>
<tr>
<td>8) Prepare periodic monitoring reports</td>
<td>- Prepare reports at regular intervals to document the monitoring programme, key environmental trends and response actions.</td>
</tr>
</tbody>
</table>

10 Documentation of findings on cumulative effects assessment and consultations on the Environmental Report

The findings on potential cumulative effects should be included in the relevant parts of the Environmental Report: baseline conditions, environmental characteristics of areas to be affected (selected valued resources), existing environmental problems (cumulative effects issues), assessment of effects, mitigation measures and proposed monitoring programme. Any comments on cumulative effects aspects from consultations should be taken into account in any revisions to the Environmental Report.

11 Quality assurance for cumulative effects considerations

11.1 The SEA Directive requires that Member states should ensure that environmental reports are of a sufficient quality to meet the requirements of the Directive and should communicate to the Commission any measures taken concerning the quality of the reports (Article 12.2). In order to determine whether cumulative effects considerations have been integrated into the SEA process, a set of criteria is presented in Appendix 2. A good quality SEA should deal adequately with cumulative effects during each stage of the process. Failure to do so may mean that significant effects could result from the plan.

11.2 The Quality Assurance checklist can be used by anyone involved in the SEA or the planning process who is concerned about how cumulative effects are being addressed in that process: the planning authorities that undertook the SEA, consultees, organisations or members of the public. It is designed to be part of the Quality Assurance for the SEA but focusing on cumulative effects.
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Karl Fuller  IEMA
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Rachael Hill  Environment Agency (TEFRM Plan)
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Roger Smithson  ODPM
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Riki Therivel  Oxford Brookes
John Towner  Environ
Jo Treweek  ITE
Chris Vivian  CEFAS, DEFRA
Paul Williams  DTLR
Leon Yates  Lewisham Council (planning and regeneration)
John Zetter  UCL
Glossary

Additive effects: sum of all the impacts

Cause-effect relationship: The relationship between an action’s disturbance (cause) and its effect on the environment.

Cumulative effects: effects that result from incremental changes caused by the plan together with past, present and future actions.

Cumulative Effects Assessment: an assessment of the incremental effects of an action or plan on the environment when the effects are combined with those from other past, existing and future actions.

Environmental Assessment: a tool for integrating environmental considerations into decision-making by ensuring that significant environmental effects of the decision are taken into account.

Impact: any aspect of an action that may cause an effect: for example land clearing during construction is an impact whilst a possible effect is loss and fragmentation of wildlife habitat.

Indicators: measures the condition of the resource of interest, used as variables in the modelling of changes in environmental systems over time.

Monitoring: a continuing assessment of conditions relating to an action.

Network Diagram: an illustration of cause-effect relationships between an action’s impact and an effect.

Neutralising effects: impacts counteract each other, thereby reducing the overall impact

Residual effects: effects that remain after mitigation has been applied.

Scoping: process for identifying the main issues and selecting the valued resources to be examined in the CEA, the temporal and spatial boundaries for the study and deciding methods and approach to use.

Secondary (and tertiary effects): effects that are consequential from direct or primary effects of the action

Strategic Environmental Assessment: environmental assessment as applied to policies, plans and programmes.

Sustainability Appraisal: a form of assessment used in the UK (for RPGs and development plans) to consider social, economic and environmental effects.

Synergistic effects: cumulative effects that result when the interaction of a number of impacts is greater than the sum of the individual impacts. Some examples:
- the combined impact of construction noise from various developments is greater than the sum of the individual noise impacts.
- when a different type of impact occurs from the original impacts, such as the combination of SOx and NOx produces smog

**Threshold:** A limit of tolerance of an environmental resource to an effect, which if exceeded, results in an adverse response by that resource.

**Valued Environmental Resource:** any part of the environment that is considered important by the stakeholders, public, the scientific community or the government involved in the assessment process. Importance can be determined by cultural values or scientific concern.
Appendix 1. The network analysis method

Two examples of network analysis diagrams are presented here:

1) Network Diagram 1 demonstrates the use of network analysis in illustrating the cumulative impacts of urban regeneration on transport.

2) Network Diagram 2 indicates potential cumulative effects of a regeneration plan. This example is based on the proposed Ebbsfleet Development in Ebbsfleet Valley, located in Dartford and Gravesham. Ebbsfleet Development is a mixed-use development consisting of an international station, housing and commercial areas.

Potential cumulative effects of development on transport

**URBAN REGENERATION PROGRAMME**

- **Project Developments**
  - Increased road usage
  - Increase in road traffic
  - congestion
  - Increase in travel times

- **Provision of road infrastructure**
  - loss of land
  - loss of amenity
  - severance of community
  - visualization of habitats
  - fragmentation of habitats
  - impact on wildlife

- **Provision of public transport**
  - increased connectivity of communities
  - reduced congestion
  - greater ease of travel
  - increased mobility
  - reduced pollution
  - increased levels of exercise for local population
  - improved health

- **Anti freeze and salting of roads**
  - reduced water quality
  - algal blooms

- **Potential cumulative effects of development on transport**
  - increased road usage
  - increased road traffic
  - congestion
  - noise
  - health impacts
  - air pollution
  - discolouration of buildings
  - soil contamination

- **Increased road usage**
  - increased in parked vehicles
  - road accidents

- **Increased levels of exercise for local population**
  - reduced pollution
  - increased mobility
  - improved health

- **Quaternary impact**
  - increased road usage
  - increased connectivity of communities

**LMCOOPER 11/2002**
cause

Station Quarter North, Station & business areas

Station Quarter south, Business and residential areas

Northfleet Rise, mixed uses; residential with businesses & small shops

Springhead, mainly residential with workshops & small business units

underground car park

road infrastructure

primary impacts

disturbance to archaeological features

loss of grassland and vegetation

alter surface run-off

culverting & channel modifications of River Ebbfleet

visual impact

loss of good quality agricultural land

encroachment of Area of Local Landscape Significance

loss of land in southern end of valley

removal of waste from Southern quarry

removal of potentially contaminated waste on land adjacent to sewage works

increase in traffic

construction impacts: land take, traffic, noise & dust

secondary impacts

impact on groundwater resources

impact on local community

impact on local community

air pollution

congestion

noise

tertiary impacts

habitat loss

loss of wetlands and reedbeds

health problems

network analysis of Ebbsfleet Development

incooper (2003)
Appendix 2 - Quality Assurance Checklist

Evaluation criteria to assess the integration of CEA into the SEA and plan-making process, which should be addressed as the SEA process progresses.

Criteria for efficient scoping
1. Were cumulative effects mentioned or discussed?
2. Were spatial boundaries delineated to address cumulative effects?
3. Was the time frame long enough to allow detection of possible cumulative effects?

Criteria for effective baseline description
4. Were all plans and activities individually or cumulatively affecting the resource identified?
5a. Were the effects of past, present and foreseeable future actions identified?
5b. Were actions analysed?

Criteria for determining environmental consequences
6. Were all possible aspects of the plan considered?
7a. Were all possible stresses/impacts/effects on the resource identified and characterised?
7b. Were all potentially affected resources considered?
7c. Were individually minor effects or multiple actions over time considered?
7d. Were the effects quantified? If effects cannot be quantified, were qualitative analyses conducted?
7e. Were delayed or secondary effects assessed?
7f. Were possible effects away from the source identified?
7g. Were additive or synergistic effects evaluated?
8. Was the environmental threshold, pollution climate or baseline conditions fully understood or established?
8. Was there a focus on resource sustainability?
9. Were tools used to evaluate cumulative effects (e.g. network analysis, carrying capacity, ecosystem analysis)?
10. Was loss or fragmentation of habitats a consideration?

Criteria for mitigation and monitoring
11. In mitigation recommendations, were alternatives recommended to mitigate cumulative effects specifically?
12. Were possible cumulative effects included in the monitoring or management plan?

Criteria for consultations and stakeholder involvement
13. Were consultations on cumulative effects considerations held during scoping?
14. Were the consultees, stakeholders and the public provided with the opportunity to comment on the draft plan, draft environmental report and the CEA findings?
15. Were the findings of the CEA made available to the consultees, stakeholders and the public?

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