Environment Institute of Australia and New Zealand

Ecological Impact Assessment Guidelines

First Working Draft

Prepared by EIANZ Ecology

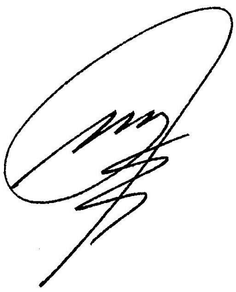
May 2010

Preface

Bill Haylock CEnvP FEIANZ, President of EIANZ

Environmental assessment and protection is a major priority for our society. To deliver good environmental outcomes, we need both good policies and good practices. Governments are ultimately responsible for delivering good policies; however, it is the profession that needs to drive the standards of best practice. The profession also needs to ensure that all practitioners are competent and accountable for good practice. Whilst a variety of policies and regulations have been developed throughout Australia and New Zealand, over the years we have seen very little in the way of best practice guidelines utilised to drive competent, ethical and accountable behaviour. This first working draft of Ecological Impact Assessment guidelines is a wonderful step in providing ecological practitioners with a set of guidelines that attempts to set out a standard of practice. As it further develops and becomes utilised, environmental outcomes on the ground will improve. In due course, these guidelines will ultimately be supported by Certified practice, further delivering good environmental outcomes for society. On behalf of the members of the Environment Institute of Australia and New Zealand, I wish to thank Simon Mustoe and the whole team for their enthusiasm, time and efforts in delivering these draft guidelines.

Regards,



Bill Haylock

These Guidelines were produced and edited by EIANZ Ecology under the guidance of Simon Mustoe (Convenor). Additional text and document review was done by Dr Matt Edmunds, Dr Judith Roper-Lindsay, Paula Peters, Paulette Jones, Robin Mitchell and John Braid.

We would like to acknowledge the practical assistance and support also provided by the New Zealand Ecological Society (NZES), the Ecological Society of Australia (ESA), the Australian Marine Sciences Association (AMSA).

Forewords

Professor Mark Burgman, FAA Adrienne Clarke Chair of Botany & Director, Australian Centre of Excellence for Risk Analysis, University of Melbourne - This document sets out practitioners' guidelines for ecological impact assessments. They are intended to apply, irrespective of the vagaries of local, state of federal laws and statutes. It represents a significant contribution to environmental management. Such guidelines are the hallmark of mature professional organisations, providing both pragmatic advice and professional credibility.

The guidelines are ambitious, covering the full spectrum of considerations in EcIA, including scoping, determining value, predicting ecological impacts, dealing with uncertainty and significance, and mitigation and management of impacts. Each one of these topics deserves a book in its own right. The challenge has been to distil the essential professional elements of each of these topics, to provide sufficient information for concise professional standards, without being prescriptive. In general, they have succeeded.

Of course, in a project as ambitious as this, there will always be opportunity for improvement. This is a draft document and it will benefit greatly from the careful review of experienced colleagues. Now is the opportunity to shape the document into something that turns the discipline from a loose-knit group of people with similar interests, into a fully fledged profession.

Dr Chris McGrath, Barrister-at-Law, Queensland- I commend the Environment Institute of Australia and New Zealand on proposing guidelines for ecological impact assessment (EcIA), particularly as a component of environmental impact assessment (EIA). I have reviewed the draft consultation document and in my opinion it will be a valuable contribution to improving the consideration of ecological impacts in development assessment and planning in Australia.

EIA in Australia takes many forms and, while legislation rarely prescribes the methodology or sets more than rudimentary standards, a number of guidelines already exist. A perennial problem in EIA is poor consideration of ecosystem effects by failing to properly consider cumulative impacts and by taking a piecemeal approach. In my opinion one of the main benefits of the EcIA guidelines is to emphasise the importance of taking an ecosystem approach to assessing impacts. As noted on page 9 of the draft consultation document, an ecosystem approach is based on an integrated assessment of a project in the context of the dynamic nature of ecosystems, uncertainty and the often unpredictable nature of ecosystem functions, behavior and responses. It inherently requires a consideration of cumulative impacts within a wider ecosystem and planning framework.

I consider that the draft consultation guidelines will be of benefit as a reference document for EIANZ members, the wider profession of environmental consultants and government.

President: Dr Anthony Boxshall
president@amsa.asn.au

Secretary: Dr Iain Fields
secretary@amsa.asn.au

AMSA
AUSTRALIAN MARINE SCIENCES ASSOCIATION INC.

PO Box 8, KILKIVAN Qld 4600
ABN 35 279 182 164
Telephone: 07 / 5484 1179
Fax: 07 / 5484 1456
Treasurer: Ms Narelle J. Hall
Treasurer's email: treasurer@amsa.asn.au

May 12th 2010

Bill Haylock, President
Simon Mustoe, Convenor EcIA Working Group
Environment Institute of Australia and New Zealand
GPO Box 211
Melbourne, Victoria 3001

Dear Bill and Simon

FRAMEWORK FOR ECOLOGICAL IMPACT ASSESSMENT PROPOSAL

Thank you for your recent email and phone conversations concerning the proposal by EIANZ to develop a framework for ecological impact assessment (EcIA), with the objective of providing professional practitioners with guidance consistent with good scientific and professional practices.

AMSA is Australia's largest professional association of marine scientists with over 900 members nationally. The AMSA mission is to advance marine science in Australia. AMSA's objectives are to:

- promote, develop and assist in the study of all branches of marine science in Australia;
- provide for the exchange of information and ideas between those concerned with marine science; and
- engage in public debate where we have specialist knowledge.

We have read the proposal description and the document *Ecological Impact Assessment: Towards the development of guidelines for Australia and New Zealand* provided to AMSA. The purpose of this letter is to offer in-principle support for the proposal, and to let you know that we would like the opportunity of involvement as the guideline develops.

We have many professional members (both scientists and managers) who may be interested in commenting and contributing to the developing guideline. We also note that such a guideline will inevitably be a document which must evolve over years or decades.

Many of our members are involved in marine ecological impact assessments at some time in their careers. AMSA acknowledges it is very important that ecological impact assessments are robust and reliable to ensure ecologically sustainable development and to protect biodiversity and ecosystem services. The draft Guidelines provide a starting point in developing a framework for scientists that provides some quality assurance for environmental management.

AMSA's final decision on endorsement of the guideline will be made by AMSA's Council, informed by our members as they contribute and comment on the document.

Yours sincerely

ABoxshall

Anthony Boxshall Ph.D
AMSA Federal President

ECOLOGICAL SOCIETY OF AUSTRALIA Inc. (ESA)
c/- The Executive Officer
PO Box 2187, Windsor, Qld 4030 Australia
email: executiveofficer@ecolsoc.org.au
http://www.ecolsoc.org.au
ABN 20 571 098 795

March 31, 2010

Environment Institute of Australia and New Zealand
GPO Box 211 Melbourne, Vic. 3001
To: Simon Mustoe (Convenor, Ecology) and Bill Haylock (President)

Dear Simon and Bill,

I refer to recent initiatives by the Environment Institute of Australia and New Zealand (EIANZ) to develop a framework for ecological impact assessment (EcIA) that is relevant to Australia and New Zealand, and targeted at improved practices to achieve ecologically sustainable development and biodiversity conservation.

The ESA understands that EIANZ has initiated a process of document development and consultation which comprises: production of a draft document, broad circulation, feedback from the scientific and stakeholder communities, and progressive refinement of the document.

ESA supports the aim of developing such guidelines and the consultative process of their development.

We recognise that the draft document "*Ecological Impact Assessment: Towards the Development of Guidelines for Australia and New Zealand*" is an important step towards this goal.

The Ecological Society of Australia (ESA) is an incorporated society of around 1500 ecological scientists and managers from around the nation. The ESA aims to promote the advancement and exchange of ecological knowledge and its sound application in environment and society.

Sincerely,

Carla P. Catterall
President

Introduction

Purpose and Context

Ecological Impact Assessment (EcIA) is not in the common or legislative vocabulary of Australia and New Zealand. Whether knowingly or otherwise, ecological practitioners implement EcIA every day. It is not confined to environmental impact assessment (EIA) but is very much part of it. EcIA is designed to ensure that ecological work can integrate properly within any EIA process and is compatible with any other non-ecological environmental studies.

EcIA is a prominent tool of sustainable development and the profession needs to align itself with an agreeable, consistent and contemporary approach to EcIA, to facilitate better decision-making.

In ecology it is rarely possible, if ever, to prove that a particular outcome will definitely occur so differences in opinion are acceptable traits of an investigation. Variation in judgement may also reflect real environmental variation but opinions are only valid when they are based upon appropriate evidence. This means the information that is used to form an opinion must be collected in the right manner. EcIA provides is the basis of evidence and expert judgement, because it addresses the inherent uncertainties in making ecological predictions.

Guidelines for EcIA developed by the Institute of Ecology and Environmental Management (Institute of Ecology and Environmental Management, 2005) in the UK were based on well-established best practice and have been adopted or reflected worldwide e.g. in Special Publications of the International Association for Impact Assessment (IAIA) (IAIA, 1999, 2005). This current (EIANZ) consultation document draws heavily on the content of the IEEM Guidelines and merges these with IAIA principles and practice.

These days, legislation rarely prescribes the scientific approach for assessments. Even to apply rudimentary legal "minimum" requirements requires methodological foresight. Further, EcIA is not just used in statutory systems like EIA. It applies to all management decisions whether they are part of commercial development, strategic environmental assessment, habitat or species management, land or water management. Also, there is an increasing burden on developers to satisfy the requirements of third parties such as insurance companies and banks in the areas of sustainability or biodiversity protection. For example, where is a compelling case for applying best practice to address requirements of the Equator Principles[1]. Similarly, legislative requirements are rarely enough to satisfy concern from local communities. There are substantial financial and opportunity costs for decisions that would have significant or uncertain consequences for local or indigenous communities.

Ultimately, EIANZ Ecology aims to create Ecological Impact Assessment Guidelines for Australia and New Zealand, to support implementation of best practice methods for creating biodiversity outcomes. This requirement has been identified in a number of consultation exercises by EIANZ Ecology[2]. This document is a substantial part of that process. EcIA Guidelines will be just one of a range of tools available to biodiversity managers and decision-makers (see Figure 1).

---

[1] www.equator-principles.com/

[2] EIANZ Submission to the Senate Inquiry on the EPBC Act http://ecology.eianz.org/2008/08/eianz-submission-to-senate-inquiry.html (August 2008). Forum on best practice in ecology http://ecology.eianz.org/2008/04/best-practice-forum-apr-17-2008-results.html (April 2008)

The purpose of such guidelines will be to provide a reference, developed by the profession, describing what EcIA is and how it should be done. The Guidelines will help to:

- improve confidence in the profession's ability to independently and objectively implement environmental standards;
- guide the development of statutory policy, including raising expectation for professional standards;
- improve consistency in EcIA (as a component of EIA), so decision-makers can have more confidence in the accuracy of the information provided;
- fill some of the gaps in policy, where it may not necessarily be prudent to codify standards in law;
- address some of the common difficulties in EcIA;
- ensure that EcIA is given appropriate consideration within the broader EIA process; and
- provide a source of reference for new and upcoming consultants to learn about one of the key components of their trade, for their own professional development.

Who are EIANZ?

EIANZ Ecology is a Special Interest Section of the Environment Institute of Australia and New Zealand (EIANZ). The Institute is the peak professional body for environmental practitioners in Australasia, and promotes independent and interdisciplinary discourse on environmental issues. EIANZ advocates that best environmental practice be delivered by competent and ethical environmental practitioners. EIANZ Ecology was set up specifically to provide an Australasian focus on professional standards for practising ecologists.

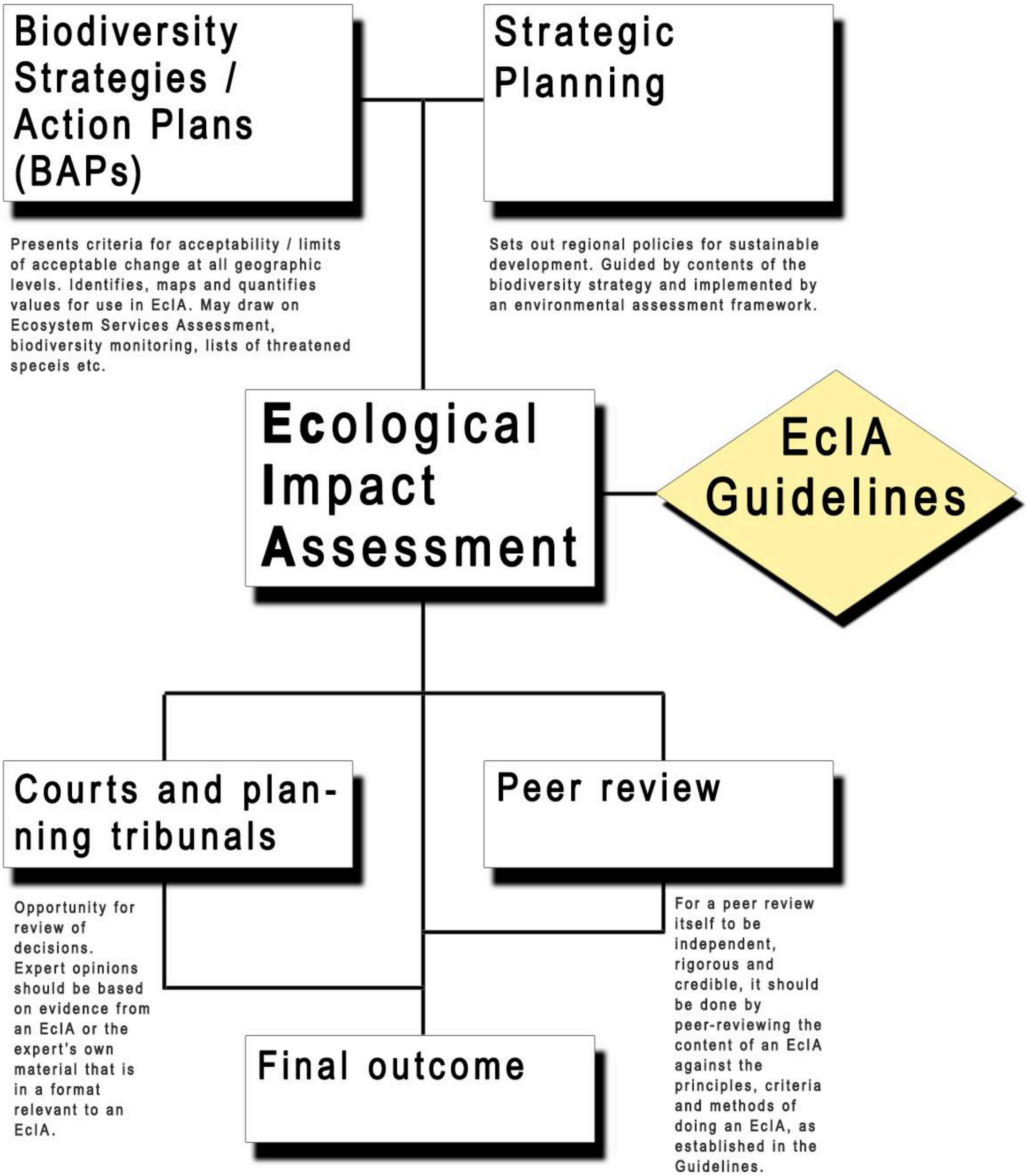


Figure 1: *The role of ecological impact assessment guidelines in biodiversity decision-making*. The range of tools commonly available for biodiversity management (pictured above). All have a role to play in EcIA but may not all exist or may not be comprehensive. EcIA is flexible enough to fill some of the gaps. It is important that EcIA remains independent and objective. Problems can occur when EcIA is used instead of these other processes, or vice-versa. For example, if EcIA is used to determine criteria for acceptable change, or if expert witness opinion is used instead of EcIA. For EcIA to function effectively, it must be integrated with other socio-economic considerations.

What is Ecological Impact Assessment?

Ecological impact assessment (EcIA) is an independent, stand-alone, and specific scientific discipline that usually forms an integral part of Environmental Impact Assessment (EIA). Although it is commonly used for individually intensive developments, EcIA might equally apply to monitoring and management of reserves, or more broadly, in the monitoring of biodiversity across whole landscapes - anywhere there is a need to assess changes, including Strategic Environmental Assessment (SEA). EcIA is not just about understanding single topics such as avian mortality or predicting behavioural change in animals. It is about evaluating biodiversity loss, managing the loss and assessing the success of any ameliorative actions.

> *"EcIA is firmly rooted in ecological science, drawing on traditional techniques of survey, monitoring, functional analysis and predictive modelling. In addition however, EcIA requires evaluation of the implications of any predicted outcomes. It is this aspect of evaluation which distinguishes EcIA from the pure science of ecology and which has created demand for new approaches to the ways in which ecological information is handled...Ecological outcomes must therefore be translated into a common language or scale for comparison with other findings, whether these are of a social, economic or political nature. In short, EcIA should provide a scientifically defensible rationale for decision making and for environmental management" (Treweek, 1999).*

Treweek, (1999) defines EcIA as the process of identifying, quantifying and evaluating the potential impacts of defined actions on ecosystems or their components; and providing a scientifically defensible approach to ecosystem management. Impact assessment is defined by the International Association for Impact Assessment (IAIA) as the process of identifying the future consequences of a current or proposed action. It is used to ensure that policies, plans, programmes and projects are economically viable, socially equitable and environmentally sustainable (IAIA, 1999).

EcIA is required at the following stages:

- in scoping - a broad assessment is needed which forms the basis for selecting those valued ecological resources to be subject to detailed assessment due to likely significant impacts;
- during the evolution of the project, in order to identify the need for impact avoidance and mitigation and opportunities for enhancement;
- after the mitigation strategies have been fully devised and their likely success considered, the residual impacts are assessed; and
- finally, if significant negative impacts are still likely, it may be necessary to consider the need for and value of ecological compensation. The positive impacts of such compensation proposals should be properly assessed.

Ecological Impact Assessment and Biodiversity

The IAIA Special Publication No. 3 *Biodiversity in Impact Assessment* (IAIA, 2005) says:

"biodiversity matters to everyone. Its loss impoverishes the environment and reduces its capacity to support people now and in the future. Impact assessment can help to ensure development is compatible with the conservation and sustainable use of biodiversity".

- Biodiversity is the total range of variability among systems and organisms.
- Biodiversity is the driver for the planet's life-support systems such as climate, water, nutrient cycles etc.

- Biodiversity provides essential ecosystem services that sustains human capital venture and supports all social, economic and cultural aspects of human existence.

Biodiversity is quantified by applying ecological methods and theory, so ecological impact assessment is the key to understanding biodiversity. Biodiversity (and ecology) are over-riding factors in EIA / EcIA because biodiversity underpins the processes that support human existence. Adequate ecological impact assessment is an imperative for sustainable development, because it creates biodiversity management outcomes. To provide an understanding of how biodiversity is likely to respond to a proposed activity, impacts at each level of diversity can be best assessed in terms of:

- Composition: what biological units are present and how abundant they are;
- Structure (or pattern): how biological units are organised in time and space;
- Function: the role different biological units play in maintaining natural processes and

The significance of these responses depends critically on uses and values of biodiversity (IAIA, 2005).

The Principles and Aims of Ecological Impact Assessment

Those involved in EcIA should seek to obtain the best possible biodiversity outcomes from land use changes. It is important that all interested parties can understand the process by which the assessment has been made, and how and by whom any actions needed to deliver biodiversity objectives will be implemented and monitored. Therefore, the EcIA must provide reliable information about, and interpretation of, the ecological implications of any project, from its inception to its operation and, where appropriate, its decommissioning.

It is the role of all ecologists involved in EcIA to:

- provide an objective and transparent assessment of the ecological effects of the project to all interested parties, including the general public;
- facilitate objective and transparent determination of the consequences of the project in terms of national, regional and local policies relevant to nature conservation and biodiversity; and
- set out what steps will be taken to adhere to legal requirements relating to designated sites and legally protected or controlled species, communities.

Principles of EcIA incorporating principles for EIA and for integration of biodiversity in impact assessment are shown in Box 1.

Box 1: Principles of Ecological Impact Assessment adapted from the IAIA (1999) Principles of Environmental Impact Assessment Best Practice, and IAIA (2005) Biodiversity in Impact Assessment

BASIC PRINCIPLES

Purposive - the process should inform decision making and result in appropriate levels of environmental protection and community well-being.

Rigorous - the process should apply "best practicable" science, employing methodologies and techniques appropriate to address the problems being investigated.

Practical - the process should result in information and outputs which assist with problem solving and are acceptable to and able to be implemented by proponents.

Relevant - the process should provide sufficient, reliable and usable information for development planning and decision making.

Cost-effective - the process should achieve the objectives of EIA within the limits of available information, time, resources and methodology.

Efficient - the process should impose the minimum cost burdens in terms of time and finance on proponents and participants consistent with meeting accepted requirements and objectives of EIA.

Focused - the process should concentrate on significant environmental effects and key issues; i.e., the matters that need to be taken into account in making decisions.

Adaptive - the process should be adjusted to the realities, issues and circumstances of the proposals under review without compromising the integrity of the process, and be iterative, incorporating lessons learned throughout the proposal's life cycle.

Participative - the process should provide appropriate opportunities to inform and involve the interested and affected publics, and their inputs and concerns should be addressed explicitly in the documentation and decision making.

Interdisciplinary - the process should ensure that the appropriate techniques and experts in the relevant bio-physical and socio-economic disciplines are employed, including use of traditional knowledge as relevant.

Credible - the process should be carried out with professionalism, rigour, fairness, objectivity, impartiality and balance, and be subject to independent checks and verification.

Integrated - the process should address the interrelationships of social, economic and biophysical aspects.

Transparent - the process should have clear, easily understood requirements for EIA content; ensure public access to information; identify the factors that are to be taken into account in decision making; and acknowledge limitations and difficulties.

Systematic - the process should result in full consideration of all relevant information on the affected environment, of proposed alternatives and their impacts, and of the measures necessary to monitor and investigate residual effects.

Guiding Principles

Aim for Conservation and "No Net Loss" of Biodiversity - biodiversity must be conserved to ensure it survives, continuing to provide services, values and benefits for current and future generations.

Take an Ecosystem Approach - because people and biodiversity depend on healthily functioning ecosystems that have to be assessed in an integrated way, not constrained by artificial boundaries. The ecosystem approach is participatory and requires a long-term perspective based on a biodiversity-based study area and adaptive management to deal with the dynamic nature of ecosystems, uncertainty and the often unpredictable nature of ecosystem functions, behavior and responses.

Seek Sustainable Use of Biodiversity Resources - protect and promote sustainable use of biodiversity so that yields/harvests can be maintained over time. Recognize the benefits of biodiversity in providing essential life support systems and ecosystem services such as water yield, water purification, breakdown of wastes, flood control, storm and coastal protection, soil formation and conservation, sedimentation processes, nutrient cycling, carbon storage, and climatic regulation as well as the costs of replacing these services.

Ensure Equitable Sharing - ensure traditional rights and uses of biodiversity are recognised and the benefits from commercial use of biodiversity are shared fairly. Consider the needs of future as well as current generations (inter-generational needs): seek alternatives that do not trade in biodiversity "capital" to meet short term needs, where this could jeopardise the ability of future generations to meet their needs.

Apply the Precautionary Principle - apply the precautionary principle in any situation where important biodiversity may be threatened and there is insufficient knowledge to either quantify risks or implement effective mitigation. Application of the precautionary principle requires that development consent should be delayed while steps are taken to ensure that best available information can be obtained through consultation with local stakeholders/experts and/or new information on biodiversity can be obtained/consolidated.

Take a Participatory Approach - consult widely to ensure that all stakeholders have been consulted and that important biodiversity values are taken into account. Valuation of biodiversity can only be done in negotiation with the different groups or individuals in society (stakeholders) who have an interest in biodiversity. Use traditional and indigenous knowledge wherever appropriate. Work carefully with indigenous communities to ensure that knowledge of biodiversity is not inappropriately exploited.

OPERATING PRINCIPLES

Screening - to determine whether or not a proposal should be subject to EcIA and, if so, at what level of detail. Use biodiversity inclusive screening criteria to determine whether important biodiversity resources may be affected. Encourage development of a biodiversity screening map indicating important biodiversity values and ecosystem services. If possible, integrate this activity with the development of a National Biodiversity Strategy and Action Plan (NBSAP) and/or biodiversity planning at sub-national levels (e.g., regions, local authorities, towns) to identify conservation priorities and targets.

Scoping - to identify the issues and impacts that are likely to be important and to establish terms of reference. Use as an opportunity to raise awareness of biodiversity concerns and discuss alternatives to avoid or minimize negative impacts on biodiversity.

Examination of alternatives - Examination of alternatives - to establish the preferred or most environmentally sound and benign option for achieving proposal objectives.

Impact analysis - to identify and predict the likely environmental, social and other related effects of the proposal.

Mitigation and impact management - to establish the measures that are necessary to avoid, minimize or offset predicted adverse impacts and, where appropriate, to incorporate these into an environmental management plan or system. Look for opportunities to positively enhance biodiversity. Acknowledge that compensation will not always be possible; there will still be cases where it is appropriate to say "no" to development proposals on grounds of irreversible damage to biodiversity.

Evaluation of significance - to determine the relative importance and acceptability of residual impacts (i.e., impacts that cannot be mitigated).

Preparation of environmental impact assessment (EIA) or report - to document clearly and impartially impacts of the proposal, the proposed measures for mitigation, the significance of effects, and the concerns of the interested public and the communities affected by the proposal. Address biodiversity at all appropriate levels and allow for enough survey time to take seasonal features into account. Focus on processes and services which are critical opportunity to raise awareness of biodiversity concerns and discuss alternatives to avoid or minimize negative impacts on biodiversity.

Review for decision-making - to determine whether the report meets its terms of reference, provides a satisfactory assessment of the proposal(s) and contains the information required for decision making. This should be carried out by a specialist with appropriate expertise where biodiversity impacts are significant. Depending on the level of confidentiality of public decision-making, consideration should be given to the involvement of affected groups and civil society.

Decision making - Avoid pitting conservation goals against development goals; balance conservation with sustainable use for economically viable, and socially and ecologically sustainable solutions. For important biodiversity issues, apply the precautionary principle where information is insufficient and the no net loss principle in relation to irreversible losses associated with the proposal.

Management, monitoring, evaluation and auditing - it is important to recognise that all prediction of biodiversity response to perturbation is uncertain, especially over long time frames. Management systems and programs, including clear management targets (or Limits of Acceptable Change (LC)) and appropriate monitoring, should be set in place to ensure that mitigation is effectively implemented, unforeseen negative effects are detected and addressed, and any negative trends are detected. Provision is made for regular auditing of impacts on biodiversity. Provision should be made for emergency response measures and/or contingency plans where upset or accident conditions could threaten biodiversity.

The Process of EcIA

EcIA is a process that follows a series of steps, ultimately finishing in the evaluation of *residual impacts* and any necessary management approaches (Figure 2). The quality of the EcIA is to a very great degree dependent on thorough, inclusive and comprehensive project scoping and a determination of value.

For EcIA to work, each step must be done using procedures that are both rigorous and in keeping with the principles. However, EcIA is also iterative. For example, scoping is an essential prerequisite for viable EcIA but field investigations often reveal additional constraints that may mean revision of the project scope. Although experienced ecologists should closely predict the range of likely constraints, based on a desktop study and personal knowledge of natural history and ecology, this can never be done with 100% certainty. This is why community consultation and fieldwork are both essential and why adequate time needs to be given to preparing assessments in case a second round of fieldwork suddenly becomes necessary.

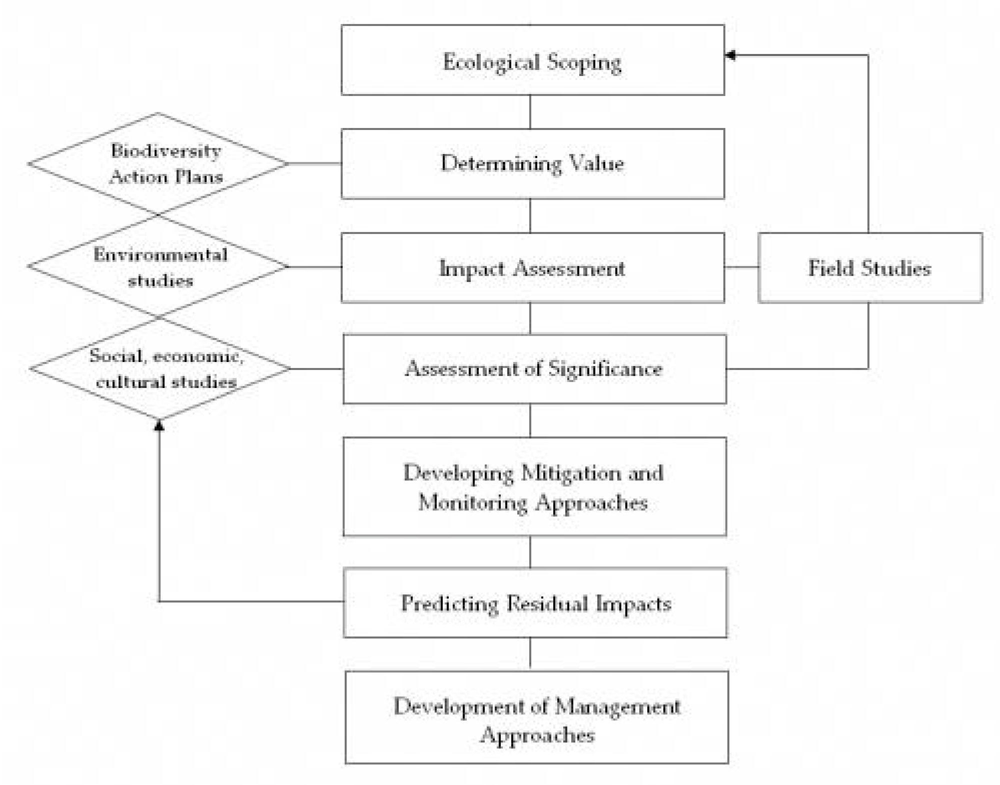


Figure 2: *Process of EcIA.* EcIA is central to the assessment of values lost but until investigations begin, the scope of the value is not always known. The scoping process itself is like a mini-EcIA and would draw on the content of BAPs and what is known about human values and ecosystem services. Once full EcIA begins, the impact assessment field studies may reveal additional constraints that require the scope to be revisited. Also, other environmental studies, such as contaminated land, water quality etc., may reveal vulnerabilities and these can have ecological consequences with social, economic and cultural knock-on effects. This too may result in an iteration of the scoping phase and further investigation. One of the final steps of the EcIA process is to determine residual impacts and this information needs to feed into social, economic and cultural studies, so the final ecological significance can be determined.

We have split EcIA into four phases: **Preparation**, **Prediction**, **Mitigation** and **Net Gain / No Net Loss**. EcIA is most commonly associated with predicting impacts but the other phases are vital to the integrity of the process, especially if the aim is to create a no-net-loss outcome. The creation of biodiversity outcomes is increasingly demanded by governments, companies, community groups and financiers, even in the absence of specific legislation. In each of the following sections, we describe recommended methods of approach that are consistent with best practice.

Ecological Assessment – Preparation

Determining Value

This chapter provides guidance on how to assign values to ecological features and resources. There is no equation for determining the value of an ecological asset. It depends on an integration of factors and the importance of each varies on the merits of the particular situation. Valuation has to be done by first identifying then teasing apart these different factors.

Values can never be guessed via the opinion of an individual ecologist or institution as their very nature is socio-political. Value judgements can only be based on a pre-existing standard of social, cultural, economic or biodiversity importance. This might include documentation about the dollar value of tourism, the perceived importance of ecosystem services (e. g. water quality, rainfall, erosion), the existence of public land such as reserves, the whether a species is protected (as a component of biodiversity processes), or indigenous spiritual needs. The valuation process is critical to the integrity of EcIA and must be done prior to predictions of significance in the impact assessment. This would usually be as part of a National Biodiversity Strategy, otherwise known just as a Biodiversity Action Plan. Development of such plans is recommended by the IAIA (IAIA, 2005) but don't always exist. The values that are identified are biodiversity value, social / community / indigenous value and economic value.

Legal protection needs to be considered separately from value. Features that are important for social / community / indigenous or economic reasons should be identified as part of the assessment of the socio-economic or community effects of a project. Values may be direct e. g. the value of a resource taken from the environment, or indirect e. g. the value of ecosystem processes in supporting ecosystem integrity and human health. The socio-economic value of these features may require a landscape-scale understanding of ecology but the significance of any impacts will then be determined by the socio-economic/community specialist. The value that is attached to an ecological resource influences:

- whether, as part of screening, potentially affected features or resources are considered sufficiently valuable that there could be a significant effect that would trigger an EIA;
- whether, as part of scoping, ecological features or resources are considered for inclusion in the EcIA - this is influenced by their value in relation to a 'threshold' level of value that should be defined during scoping;
- deciding what mitigation is appropriate.
- considering legal and policy implications.

Guidance on EcIA tends to set out categories of ecological or nature conservation value that relate to a geographical framework (e. g. international, local) together with examples of the ecological features or resources that qualify for each category. It is generally straightforward to evaluate designated sites against specific categories (e. g. National Parks and Ramsar sites); although for sites of local value these may not be predetermined. Plus, within protected areas, there may be values that are separately relevant to local communities. The same problem applies to evaluating habitats and species.

Ecosystem Services

Many of the values discussed in the following sections may be expressed as Ecosystem Services[3]. Ecosystem Services are benefits that humans draw from the environment and there is a direct relationship between human health, welfare and sustainability e. g. if biodiversity value drops, then natural resources decline and our economy suffers as much of what we do depends on trading natural capital.

Ecosystem Services that derive from habitat and species include things like forestry, fisheries, tourism and spiritual values. These are directly beneficial to humans and easily perceived if not valued in quantitative terms. However, some of the most important ecosystem services are those that support and regulate the environment, such as water quality and atmospheric carbon cycles. These are much more difficult to quantify but should not be overlooked. For example, the cumulative impact of land clearance is one of the drivers of climate change.

The principles of reversing biodiversity loss (Box 1) are aimed at addressing these serious problems. Their value should not be underestimated. Ecologists should be proactive in identifying situations where specialist economic / indigenous / other cultural input might be required. This will ensure that implications of ecological

[3] Millennium Ecosystem Assessment. (2005) Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. . http://www.millenniumassessment.org/

change are properly included in an assessment. Ecologists may need to work together with other scientists to identify important resources. The ecologist will be responsible for describing the ecological changes resulting from the project, which an economist, social scientist or indigenous culture expert will use to assess the economic impacts in qualitative or, preferably, quantitative terms. Any economic appraisal should be open to consultation as soon as possible, with the methodology presented transparently so that stakeholders can give a view on the values assigned.

Social and Indigenous Value

People derive benefits from biodiversity in various ways, including:

- critical life support offered by ecosystem processes;
- a population of a species that is enjoyed each year by large numbers of local people or visitors;
- a population of animals that are valued visitors to gardens in a large number of adjoining gardens or schools;
- spiritual significance of a site or its wildlife;
- formal recreational enjoyment of hunting or fishing;
- health aspects;
- informal recreational activity e. g. countryside walks;
- sites that provide the only visually and/or physically accessible area of semi-natural green-space for a local community; and
- use of habitat areas for the purpose of learning about wildlife.

The extent to which a site and its wildlife provide a resource that people use or enjoy often informs the designation of reserves. In such cases, the social or indigenous value that is attached to a site may be defined on the basis of the level of importance at which the site has been designated (e. g. state, shire, etc.). In other circumstances, it may be necessary to make a judgement about the value of the site based on other criteria, such as the extent to which the site is used by local people and others and the availability of other accessible green space in the vicinity. It should be noted that even where designation systems reflect social values, they may not have involved a comprehensive survey of the social value of all the relevant areas. As a result, an EcIA, EIA or other social/environmental studies may identify previously unrecognised (and un-designated) sites of social or indigenous importance.

The social or indigenous effects of a project that might affect a local site that has been designated partly for social reasons are often neglected in EcIAs, as no one member of the team may feel able to fully address the issues. Effects on socially valued areas are even more likely to be neglected. To avoid this situation, it may be useful to separate 'social values' from those specifically related to the conservation of biodiversity in order to ensure that all potentially significant values are recognised. Wherever possible, subjective judgements about social value should be supported by quantitative data and surveys of opinion by local residents if the issue is sufficiently critical.

Having identified the important sites/species, the ecologist should carry out the assessment of how the ecology of these sites/species might be affected by the project. Ideally, a sociologist would then make the assessment of the social consequences of the ecological changes. Information about social impacts can then be considered alongside biodiversity impacts in developing mitigation/compensation/enhancement measures, in determining the significance of impacts and, ultimately, in the decision-making process. Care should also be taken to ensure that short-term social needs do not over-shadow the need to protect the long-term integrity of the environment. The indirect and cumulative costs of land clearance, for example, may be greater than the benefits derived from short-term timber harvesting.

Economic Value

Direct economic implications may result from impacts on certain ecological features and resources that are financially valuable, for example:

- paying visit to nature reserves;
- populations of fish for angling;
- populations of shell fish in estuaries;
- rare breeding birds at publicly accessible breeding sites that attract large numbers of overseas visitors, who bring economic benefits to the local economy;
- areas where hunting or stalking takes place; and
- urban green space might play a valuable role in contributing to the health and wellbeing of local communities with consequent economic benefits;

Criteria relating to economic value typically reflect considerations such as the contribution to the economy derived from the ecological resource, e. g. the number of jobs that are supported. These need to be considered in relation to direct ‘upstream’ and ‘downstream’ economic activities. This would normally be done in the context of values adopted in the wider socio-economic assessment. Guidance on this subject is beyond the scope of this document.

Geographic Frame of Reference

The value or potential value of an ecological resource or feature should be determined within a defined geographical context. It is recommended that the following frame of reference be used (or be adapted to meet local circumstances):

- International;
- National (e. g. New Zealand / Australia);
- Regional (State, Territory or Island);
- District or Catchment Management Area;
- Local Shire; or
- within zone of influence only (which might be the project site or a larger area).

In some EIAs (or other integrated assessments), the ecologist may be required to use other approaches to assigning levels of value (in order to be consistent across different technical subjects). In such cases, it is often helpful for the prescribed terms to be translated into the geographical scale that is set out above, so that the legal and policy consequences of any significant impact can be clearly understood by all ecologists.

Designated Sites and Features

Some sites have already been assigned a level of nature conservation value through designation. The reasons for this designation need to be taken into account in EcIA e. g. the Ramsar Information Sheets for Wetlands of International Importance, or the Management Plans for National Parks and Reserves. Where a feature has value at more than one level, its overriding value is that of the highest level but the features for which the site has been designated at each level may differ and should be valued accordingly. Features of the site that are not the reasons for its designation(s) may need to be assessed and valued according to their intrinsic or other value.

Measuring Biodiversity Value

Overview

The value of areas of habitat and plant communities at given geographic scales, should be measured against published selection criteria where available. These documents vary considerably from place to place. Some parts of Australia and New Zealand have completed habitat benchmarking for regional vegetation classes and have existing, sophisticated calculators for determining value based on structure, species and extent of cover at pre-European settlement. Biodiversity Action Plans, or their equivalent, might also provide an indication of habitats that are considered important at the local scale.

Where there are no published selection criteria, for example in most of the marine environment or in poorly mapped regions, it may be necessary to estimate value based on particular criteria. The following criteria are well-established for assigning conservation value in any habitats. For example, they have been used in the selection of Marine Protected Areas (ANZECC, 1998) (Box 2).

Box 2: ANZECC criteria for assigning conservation value for marine protected areas.

Representativeness
Does the area represent a substantial proportion one or more ecosystems within a bioregion and to what degree?

Ecological Importance
Does the area:

- contribute to the maintenance of essential ecological processes or life-support systems;
- contain *habitat* for rare or endangered species;
- preserve genetic diversity i. e. is diverse or abundant in species;
- contain areas on which species or other systems are dependent e. g. contain nursery or juvenile areas or feeding, breeding or resting areas for migratory species; or
- contain a substantial part of a landscape that is a biologically functional, self-sustaining ecological unit?
- International, national, regional or local importance
- Is the area rated, or has the potential to be listed on any relevant conservation agreement or policy from the international to local level?

Uniqueness
Does the area

- contain unique species, populations, communities or ecosystems;
- contain unique or unusual geographic features?

Productivity
Do the species, populations or communities of the area have a high natural biological productivity?

Vulnerability
Are the ecosystems and/or communities vulnerable to natural processes?

Biogeographic Importance
Does the area capture important biogeographic qualities?

Naturalness
How much has the area been protected from, or not been subjected to human-induced change?

Other characteristics that can be used to identify ecological resources or features likely to be important in terms of biodiversity include:

- habitat diversity, connectivity and/or synergistic associations;

- notably large populations of animals (e. g. shorebirds) or concentrations of animals considered uncommon or threatened in a wider context;
- plant communities (and their associated animals) that are considered to be typical of valued natural/semi-natural vegetation types - these will include examples of naturally species-poor communities;
- species on the edge of their range, particularly where their distribution is changing as a result of global trends and climate change; and
- typical faunal assemblages that are characteristic of homogenous habitats.

Consultation, especially with local specialists, can be crucial for identifying less obvious important resources and features. The relative ecological importance of different ecological features and resources in the landscape may also change in response to changing conditions. For example, climate change could increase the need for large-scale habitat networks that are designed to maintain important biodiversity processes, such as pollination or seed dispersal by land birds and invertebrates.

Valuing Species

This part of the guidance deals with species that need to be assessed because they are of biodiversity value rather than because they are legally protected (although some species may fit in both categories). In assigning value to a species, it is necessary to consider its distribution and status, including a consideration of trends based on available historical records. A non-mobile species can generally be assumed to occur regularly on a site, even after just one recent reliable record. However, records over a longer period, for example five years, may be needed for mobile species or species that are in rapid decline. The occurrence of species that are not typical of the habitat from which they have been recorded should be investigated in greater detail.

Due to sheer size and lack of high resolution data on species in Australia and New Zealand, a precautionary approach based on habitat assessment may also be prudent. The valuation of populations should make use of any relevant published evaluation criteria, for example, criteria for defining nationally and internationally important populations of waterfowl under the Ramsar Convention.

Rarity is an important consideration because of its relationship with threat and vulnerability of habitats. Some species are inherently rare, so it is necessary to look at rarity in the context of status. A species that is rare and declining may be assigned a higher level of importance than one that is rare but known to be stable. Other rarity-related evaluation criteria include the need to protect populations where Australia or New Zealand holds a large or significant proportion of an international species, especially endemic species. There are numerous species whose populations are in decline throughout Australia and New Zealand. Those for which the decline is most serious, may be the subject of action plans / action statements / recovery plans / biodiversity action plans ("action plans").

As with habitats, the existence of an action plan or its equivalent should reflect the fact that the species' habitat is in a sub-optimal state. Note, just because an action plan exists for a species does not imply any specific level of value for the species (in the same way as an absence of an action plan does not imply a total lack of value). The value of the population of a species should be determined using the same approach as with other species (above). Likewise, inclusion of species in lists of declining species (e. g. critically endangered, endangered, vulnerable) is not in itself a sufficient criterion for assigning a level of value to the species concerned. This is because such lists include species in decline for a number of different reasons and ecological value can vary between listed species.

Multi-functional Features

Some habitats or species may have biodiversity, social and economic value. In this instance, the impact of a project on all three aspects should be assessed separately before an integrated assessment is carried out.

Legal Issues

The approaches described above should be used to evaluate the biodiversity value of a feature in order to provide advice on the policy implications of any impacts. In addition to this approach, EcIA must demonstrate how the project being considered will be taken forward such that the legal requirements will be met.

It should be noted that for some projects, features may be of insufficient biodiversity, social or economic value to merit assessment within an EcIA (e. g. because they are below the defined threshold for biodiversity value) other than the need to consider them within the context of the relevant legislation. A common example of the above is the need to consider legally controlled weeds and other pests. The presence of such species may be assessed as being an ecological, social or commercial disbenefit, although they may have some ecological merit. Advice should be provided on the legal consequences of their presence and the ecological impacts assessed in this context.

Impact Assessment - Prediction

Introduction

Assessment of ecological impacts is required at the following stages:

in scoping - a broad assessment is needed which forms the basis for selecting those valued ecological resources to be subject to detailed assessment due to likely significant impacts;

during the evolution of the project, in order to identify the need for impact avoidance and mitigation and opportunities for enhancement;

after the mitigation strategies have been fully devised and their likely success considered, the residual impacts are assessed; and

finally, if significant negative impacts are still likely, it may be necessary to consider the need for and value of compensation / offsets. The positive impacts of such proposals should be properly assessed.

The starting point for any assessment is to determine which ecological features or resources within the zone of influence are both of sufficient value to be included in the assessment and vulnerable to significant impacts arising from the project. The determination of value should make use of the guidance here]. The rationale for selecting features for inclusion in the EcIA will differ, depending on the situation, and so, ideally, it should be agreed through consultation during scoping. For those ecological resources or features that are to be included in the assessment i.e. have been ‘scoped in’, the next step is to describe the changes to the baseline / existing conditions likely to arise from the project and the resulting ecological impacts. If, at scoping these impacts are considered likely to be significant, they should be investigated further and clearly described in ecological terms, before the legal, policy, social or economic implications are considered.

Description of Baseline / Existing Conditions

Baseline conditions or 'existing conditions' are usually described for the time of the development. However, it may also be necessary to consider the conditions as they might be when the project is due to begin. For example, if a coastal development is not due to start for five years, the predicted ecological impacts may be greater than if the development were to start now, if during the intervening period there is a rise in sea level. Similarly, it may be necessary to consider the implications of other developments that would occur. As a minimum, baseline / existing conditions would normally include developments that have been approved even if these have not yet proceeded. It is important therefore, that consultants are given adequate resources and information about existing or predicted pressures. This ensures that cumulative impacts are properly addressed.

Predicting and Characterising Ecological Impacts

Having identified the activities likely to cause significant impacts, it is then necessary to describe the resultant changes and to assess the impact on valued ecological resources. It will be necessary for the proponent's ecologist to liaise with other members of the proponent's team as the changes to be considered may relate, for example, to noise, air quality, hydrology or water quality. This guidance recommends that the process of identifying impacts should make explicit reference to aspects of ecological structure and function on which the feature depends. Some of the elements that may be considered are identified in Box 3.

Box 3: Examples of aspects of ecological structure and function to consider when predicting impacts

Available resources
Territory: hunting/foraging grounds; shelter and roost sites; breeding sites; corridors for migration and dispersal; stop-over sites.
Food and water (quantity and quality).
Soil minerals and nutrients and hydrochemistry.
Solar radiation and gaseous resources.
Stochastic processes
Flooding, drought, wind blow and storm damage, disease, eutrophication, erosion, deposition and other geomorphological processes, fire and climate change.
Ecological processes
Population dynamics: population cycles; survival rates and strategies; reproduction rates and strategies; competition; predation; seasonal behaviour; dispersal and genetic exchange; elimination of wastes.
Vegetation dynamics: colonisation; succession; competition; and nutrient-cycling.
Human influences*
Animal husbandry, cutting, burning, mowing, draining, irrigation, culling, hunting, excavations, maintenance dredging, earth shaping, ploughing, seeding, planting, cropping, fertilising, pollution and contamination, use of pesticides and herbicides, introduction of exotics, weeds and genetically modified organisms and disturbance from public access and recreation, pets and transport.
Historical context
Natural range of variation over recorded historical period.
Irregular perturbations beyond normal range (such as very infrequent storm events).
Ecological relationships
Food webs, predator-prey relationships, herbivore-plant relationships, herbivore-carnivore relationships, adaptation, and dynamism.
Ecological role or function
Decomposer, primary producer, herbivore, parasite, predator, keystone species.
Ecosystem properties
Fragility and stability, carrying capacity and limiting factors, productivity, community dynamics.
Connectivity.
Source/sink.
Numbers in a population or meta-population, minimum viable populations.
Sex and age ratios.
Patchiness and degree of fragmentation.
** Note: Many of our semi-natural habitats and wild species have co-evolved with humans and are adapted to management practices that now sustain their current conservation status. (Derived from Oxford, 2001)*

Confidence in predictions

It is important to consider the likelihood that a change/activity will occur as predicted and also the degree of confidence in the assessment of the impact on ecological structure and function. The limitations to certainty should be described and the consequences for confidence in predictions must be stated clearly. A qualitative description may be adequate, though an objectively defined scale defined according to a stated convention is probably more helpful, and can be used even if the decision as to confidence level can only be based on expert judgement, rather than frequency data, as long as this limitation is stated. Hence, a scale that is meaningful in normal language might be: Certain, Probable, Unlikely. Alternatively, based on the fact that the 5% confidence level is conventionally chosen as the lowest limit for acceptable statistical significance in common scientific practice, a four-point scale that could be usefully employed is:

- Certain/near-Certain: probability estimated at 95% chance or higher.
- Probable: probability estimated above 50% but below 95%.
- Unlikely: probability estimated above 5% but less than 50%.
- Extremely Unlikely: probability estimated at less than 5%.

The reason for including a confidence level category of 'extremely unlikely' is that some effects may be very improbable, but extremely serious should they occur and hence merit contingency planning. Where doubt exists as to which of two categories of probability best fits the level of professional confidence, the more conservative level should be cited. In some cases, ongoing survey or monitoring may be required to refine predictions or activate mitigation proposals. When describing changes/activities and impacts on ecosystem structure and function, reference should be made to the following parameters, which are discussed below:

- positive or negative;
- magnitude;
- extent;
- duration;
- reversibility; and
- timing and frequency.

Positive or negative

Is the impact likely to be positive or negative? Positive impacts merit just as much consideration as negative ones, as international, national and local policies increasingly press for projects to deliver positive biodiversity outcomes.

Magnitude

Magnitude refers to the 'size' or ‘amount’ of an impact, determined on a quantitative basis if possible. For example: a likely increase of three in the number of wombats killed per year on a road; a total loss of the structure and function of semi-natural grassland replaced by tarmac; a partial loss of the structure and function of grassland subject to increased risk of wind-blown biocide. Whilst it may not be possible to provide a quantitative assessment in the latter example, application of some of the following parameters will provide a more accurate understanding of the likely impact.

Extent

The extent of an impact is the area over which the impact occurs. When the receptor being considered is the habitat itself, magnitude and extent may be synonymous.

Duration

The time for which the impact is expected to last prior to recovery or replacement of the resource or feature. This should be defined in relation to ecological characteristics (for example species lifecycles) rather than human timeframes. For example, five years, which might seem short-term in the human context or that of any other long-lived species, would span at least five generations of dragonflies. The duration of an activity may differ from the duration of the resulting impact caused by the activity. For example, if short-term construction activities cause disturbance to birds during their breeding period, there may be longer-term implications due to a failure to reproduce in the disturbed area during that season.

Reversibility

For the purposes of this guidance, an irreversible (permanent) impact is one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. A reversible (temporary) impact is one from which spontaneous recovery is possible or for which effective mitigation is both possible and an enforceable commitment has been made. In some instances, the same activity may cause both irreversible and reversible impacts. For example, consider two of the potential impacts arising from the placement of a temporary access through a forest that is subsequently allowed to grow over. The change experienced by common birds of the loss of food and shelter may be reversible, as these resources will be replaced once the access route has grown over. Many birds are sufficiently mobile and adaptable to accommodate this change with no significant impact on populations. But, the impact on ground flora along the route of the access may be irreversible (or effectively so) if fragile woodland soils have been compacted.

Timing and frequency

Some changes may only cause an impact if they happen to coincide with critical life-stages or seasons (for example, a bird nesting season). This may be avoided by careful scheduling of the relevant activities, e.g. by the implementation of an Environmental Management Plan that specifies important constraints in relation to the timing of works. The frequency of an activity and hence the resulting impact should also be considered. For example, there may be occasions when a single person walking a dog will have very limited effect on nearby waders using wetland habitat. However, if numerous walkers subject the waders to frequent disturbance, then feeding success may be significantly reduced. In extreme cases the birds could be permanently displaced.

Characterisation of the change and impact

In order to characterise the likely change and impact, it is necessary to take into account all the above parameters. An illustration of this is given below: e.g. the operational phase of a temporary access road through a wood will create an increase in noise. An assemblage of woodland-edge birds, in 5ha of quality breeding habitat within a distance of 5km from the road, will experience an increase on average, of 20 decibels of noise for three hours per day for two breeding seasons. Confidence in describing these changes is high, based on information from the engineers and the noise and traffic assessments. However, the impact on the breeding success of the birds is less certain, as the response of all species to increased noise levels is not fully understood. From reference to published research it is probable that the assemblage of breeding birds will change in composition as the more susceptible species within the assemblage will fail to breed in the zone of influence during the operational period, but others will continue to breed and some may be more successful than usual by taking advantage of the spare resources not employed by the susceptible species. As there is alternative suitable breeding habitat contiguous with the zone of influence, it is likely that the susceptible birds will move back in after the temporary access is removed, although it may be several generations before the assemblage resembles its baseline condition.

Risk and Uncertainty

Risk Assessment

Risk assessment is fundamental to EcIA but the type of risk assessment most commonly used in project EIA has a different purpose. This section describes the relationship between EcIA and the risk assessment process often applied to whole-project EIA, where a matrix may be used, such as the Australian and New Zealand standard for risk assessment (AS/NZS 4360:2004), which multiplies the "likelihood" of an event by its "consequence". Risk assessment must be used with caution and with the following considerations:

- Although whole-project risk matrices can be used to map-out the characteristics of a multi-faceted EIA, they are not a substitute for EcIA.
- EcIA is by its nature a risk assessment because the impact consequence can never be proved - it can only be predicted within degrees of confidence.
- To establish the "consequence" criterion in an overall EIA risk assessment, the EcIA first needs to be completed so the prediction of likely impacts has a rigorous scientific basis.

For any given likelihood, there is a particular consequence. For example, if noise occurs regularly, then it is very likely and the consequence of effects on a nearby nesting bird may be severe but if noise likelihood is unlikely, then the predicted consequence may be negligible.

During the assessment of effects, we have to take the most likely "likelihood" and base the impact assessment on this. For example, a noise specialist may deduce that a particular threshold would be exceeded on average, several times a day, give or take a margin of error. We then predict the subsequent impact, which is also within a range of variation, reflecting degrees of uncertainty as well as real environmental fluctuations.

Hence, "consequence" is the embodiment of impact prediction in EcIA. Because "likelihood" is the basis for prediction of "consequence", EcIA is by its nature a risk assessment. Integrating impact assessment results into a final project risk assessment, combining other environmental, social, economic and cultural factors, needs to be done with great care. By taking the "consequence" from the EcIA and arbitrarily re-multiplying it by additional likelihood criteria, there is a risk of 'double-dipping' and diluting the significance of ecological predictions.

These final risk assessments are also sensitive to modification of likelihood and consequence thresholds. Critics might suggest that results can be 'made-to-fit' but in truth, it remains such a crude representation of underlying EcIA, that modifying thresholds would create as many problems as solutions. Critically, the final risk assessment should be viewed in the context of its objective, that is to crudely map-out project risk characteristics. Risk assessment is most appropriately used to

i) systematically review matters and make sure everything of importance has been assessed to a level roughly proportional to project risk;

ii) to combine ecological data with all other data and inform decisions about project alternatives.

Therefore, although risk assessment is a useful decision support tool, it is a parallel process to EcIA and should never be used as a substitute. Whole-project risk assessment, using a crude matrix of likelihood x consequence predictions is not a basis for decision-making as it does not reflect significance. The significance of an asset has nothing to do with likelihood x consequence, it has to do with the most likely range of consequences x the *value* of the loss in socio-economic, cultural and biodiversity terms.

Uncertainty Analysis

Uncertainty is at the heart of risk assessment and EcIA but is not directly equivalent. As discussed above, risk assessment models are not completely reliable so EcIA managers and decision-makers should be aware of some of the characteristics of uncertainty and how they should be presented in EcIA reports.

A key source of uncertainty is lack of information to inform the EcIA process. The early development and inclusive process of EcIA for scoping and determination of value are both integral to reducing this key uncertainty. Other common sources of uncertainty are to do with the inherent variability of the environment.

The implementation of appropriate survey and reporting aims to reduce this by taking into account ecological variability. For example, surveys should be done in different seasons or across different habitats and unavoidable sources of sampling bias should be identified. The manner in which a report author reached their conclusion should be clearly given, wherever possible referenced to independent literature and using conventional terminology.

Uncertainty can also derive from the way something is written and it is important that the author makes every effort to explain things clearly and unambiguously. This is helped by applying judgement in relation to predetermined values, as discussed above. These subjective judgements are an unavoidable component of EcIA but need to be evidence-based, so depend on a rigorous EcIA process rather than guess work. Where there is no evidence available, this should be stated so all opinions are wholly omitted from the EcIA report. Note, opinions may form part of the process for an expert witness but should still be based on relevant supporting evidence.

Quantitative measurement of uncertainty in risk assessment and EcIA may be possible where results depend on a mathematical model. Elsewhere, judgement based on rudimentary ecological theory leads to a range of possible conclusions rather than a single result. Proof is rarely if ever possible and statements such as "there will be no impact" are usually inappropriate. Where the results of an investigation reveal a range of conditions e.g. upper and lower 95% confidence limits, it is best to present the range rather than the mean / average. Uncertainty is an inherent fact in ecology and should not be used as an excuse to disregard any reasonable evidence or proceed to approval without any monitoring. All available evidence should be considered on merit but whether they are appropriate to the question of ecological impacts depends on whether a robust EcIA process has been followed. Research studies are not normally applicable directly to EcIA, though they may inform the process. Statistical power, based on simple measures e.g. of a species' population, are usually inappropriate surrogates for biodiversity loss. This depends on more holistic assessment of ecological function and process, which is measured in different ways. The result is the sum of all changes in the environment from an ecosystem perspective not any one variable.

Assessment of Whether Impacts are Ecologically Significant

Determining Ecologically Significant Impacts

Legislation and policy guidance often require 'significant' (or an equivalent term) negative or positive impacts or adverse effects to be distinguished from others. In this guidance an ecologically significant impact is defined as an impact (negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats, communities, species or critical ecosystem processes within a given geographical area.

The value of any feature that will be significantly affected is then used to identify the geographical scale at which the impact is significant*. This value relates directly to the consequences, in terms of legislation, policy and/or development control at the appropriate level. So, a significant negative impact on a feature of importance at one level would be likely to trigger related planning policies and, if permissible at all, generate the need for development control mechanisms, such as planning conditions or legal obligations, as described in those policies. If such policies do not exist, then the mechanism to address the impacts may be voluntary e.g. based on biodiversity offsets procedures.

It is important that value is pre-determined and used to establish the geographic context of significance. It is inappropriate for a consultant to work backwards, having quantified the impact, to decide whether this is of any particular geographic importance. To do so would undermine the need to determine values independently and undermine the independence of the impact assessment process.

During the assessment process, it may be found that a site or ecosystem considered likely to be subject to a significant impact and therefore 'scoped in', is, on further investigation, unlikely to suffer a negative impact to its integrity. However, this will not preclude there being features within that site that are themselves of sufficient value to meet the threshold for the assessment and for which there is likely to be a significant effect on their conservation status. For example, whilst a particular impact may not be considered likely to have a negative effect on the integrity of a Ramsar Site, it may be found to be likely to have a significant impact on the conservation status of a population within the Ramsar site (not a qualifying species) that is of local value.

To summarise, if an ecological resource or feature is likely to experience a significant impact, the consequences in terms of development control (e.g. avoid, minimise, mitigate, remediate / offset), policy guidance and legislation will depend on the level at which it is valued. Significant impacts on features of ecological importance should be mitigated or compensated for in accordance with guidance derived from policies applied at the scale relevant to the value of the feature or resource. Any significant impacts remaining after mitigation (the residual impacts), together with an assessment of the likelihood of success in the mitigation, are the factors to be considered against legislation, policy and development control in determining the application. There may be conditions or legal agreements attached to a consent to ensure the delivery of the proposed mitigation. The willingness of the proponent to enter into such arrangements will influence the assessment of the likelihood of success of the mitigation.

Integrity

In order to test whether or not an impact will affect the integrity of a site or ecosystem (and is thereby significant) it is necessary to understand whether the changes arising from the proposed project are likely to move the baseline / existing conditions at the site or ecosystem closer to, or further from, the condition which constitutes 'integrity' for that system. Another way of putting this is to consider the change against what would be considered benchmark biodiversity. In New South Wales and in accordance with the EIANZ Ecology Final Draft Discussion Paper on Biological Diversity[4] ("Biodiversity") this means:

That biodiversity is conserved, in situ, across all levels and scales - structure, function and composition are conserved at site, regional, state and national scales;

that examples of all ecological communities are adequately managed for conservation; and

---

[4] EIANZ Ecology (2009) *Biodiversity – A Framework for Understanding* http://ecology.eianz.org/2008/11/biodiversity-framework-for.html

that ecological communities are managed to support and enhance viable populations of flora and fauna and ecological functions.

A site/ecosystem that achieves this level of coherence is considered to be at favourable condition. To help understand this further, the components of ecological integrity of a site/ecosystem may include the following:

the assemblage of different ecosystem processes, including human influences;

the dynamics of the ecosystem at different scales; and

the levels of habitats and/or populations, where the desired condition is the average level that would be considered 'acceptably characteristic of the site or ecosystem'.

In some jurisdictions, there are statutory / policy mechanisms for measuring biodiversity against benchmark habitats. For many sites, neither the favourable nor the baseline condition is described in these or any other terms. The ecologists contributing to the EcIA will therefore have to make their own assessments of what constitutes the baseline and favourable (benchmark) conditions. One way to do this is to follow recommendations made by the Business Biodiversity Offsets Program - see [#Biodiversity_Offsets_995680496_12613546242937446 Biodiversity Offsets] . In order to assist ecologists to determine whether there is likely to be an effect on the integrity of a site or ecosystem, the answers to the following questions should be considered: 1. Will any site/ecosystem processes be removed or changed? 2. What will be the effect on the nature, extent, structure and function of component habitats? 3. What will be the effect on the average population size and viability of component species? This should be in the light of the overall question:

Will this move the condition of the ecosystem/site towards or away from favourable (benchmark) condition?

It should be noted that it is very unlikely to be possible to evaluate impacts in terms of integrity without considering functions and processes acting outside a site's formal boundary, particularly where a site clearly falls within a wider ecosystem. Thus any predictions should always consider wider ecosystem processes i.e. be evaluated in the context of the regional landscape. Many ecosystems have a certain 'freeboard' in terms of biophysical change that can be absorbed before the fundamental ability of the site or ecosystem to support characteristic communities or species' populations is compromised. Clearly there will sometimes be an element of doubt as to whether the change is sufficient to cause such changes to condition described above. This should be reflected in confidence levels attached to the prediction. Mitigation measures may then be proposed to increase the level of confidence in that prediction, even when a negative effect on integrity is not predicted. When assessing potential impacts on sites with international and national designations, integrity should be considered with detailed reference to the published citations and conservation strategies. Many such strategies list conservation objectives with associated 'criteria features', 'attributes', 'measures' and 'targets' against which likely changes can be assessed. In cases of reasonable doubt, especially in relation to sites of National or International value, a precautionary view should always be taken, and a negative effect on integrity predicted. For beneficial effects that may result in the creation of new sites or ecosystems, or intervention to restore degraded examples, the concept of integrity is equally applicable in that the intervention must be sufficiently robust as to sustain the new level of value created in all reasonably predictable scenarios.

Conservation Status

It is recommended that the concept of 'conservation status' is used to determine whether an impact on a habitat or species is likely to be ecologically significant. There are likely to be a range of documents available to make this judgement, at an international, national and state level. Conservation status may be evaluated for any defined study area at any defined level of ecological value.

The extent of the area used in the assessment will relate to the geographical level at which the feature is considered important. In some cases, there may be an existing statement of the conservation status of a feature with formal objectives and targets. Most species or habitats will not be described in this way. In this case, the conservation status of each feature being assessed should be agreed between the ecologists working on the assessment during the scoping process. When assessing potential effects on conservation status, the same reasoning should be applied as set out above in relation to integrity. The known or likely trends and variations in population size should be considered. The level of ecological resilience likely to exist, in terms of the quality of physical and biotic conditions, that would permit the given population of a species or area of habitat to continue to exist at a given level, or continue to increase along an existing trend, should also be estimated. A significant positive impact could be defined as one that prevented or slowed and existing decline as much as one that permitted a population or habitat area to increase.

Impact Management - Mitigation

Overview

Mitigation includes any deliberate action taken to alleviate adverse effects, whether by controlling the source of impacts, or the exposure of ecological receptors to them (Treweek, 1999). Mitigation methods can be categorised into several types (Box 4).

Box 4: Types of ecological impact mitigation (derived from Treweek, 1999).

Avoidance
Sensitive design
Siting based on least damage criteria
Avoidance of key areas (e.g. protected or important habitat)
Avoidance of key periods (e.g. breeding season)
Desisting from impact-generating actions.
Reduction, moderation, minimisation
Emission controls
Noise barriers
Oil interceptors
Controlled access during construction / operation
Wildlife bridges, tunnels, 'ecoducts'
Wildlife fences
Rescue (relocation, translocation)
Translocation of plants or animals
Translocation of habitat
Repair, reinstatement, restoration
Reinstatement of habitat (woodland, wetland, grassland etc.)
Re-seeding of grassland
Restoration of damaged hydrological function (e.g. reinstatement of raised water level areas)
Compensation
Financial contributions to conservation
Biodiversity offsets

To meet the demand for net ecological gain rather than simply achieving damage limitation, proponents of any scheme should incorporate, as part of the proposals for scheme design and implementation, measures to facilitate ecological enhancements through offsets. However, as discussed later in this document, this may need to be done subsequent to the EcIA process and may not be statutorily required. Nevertheless, it is a growing demand for which there are statutory requirements in some jurisdictions and is increasingly necessary to address macro-environmental problems associated with biodiversity loss, such as loss of water resources, soil erosion, impacts on nature- or landscape-based tourism and carbon sequestration.

There is a limit to how much biodiversity loss can be realistically offset if objectives of 'no net loss' or 'net gain' are to be achieved either now or in the future. The process has to be scientifically and financially realistic i.e. what is lost cannot be so valuable as to rule out its replacement within a reasonable time-scale elsewhere. Therefore, before any decision is made to approve the loss of biodiversity, everything should be done to avoid and minimise impacts. In Box 4 (above), this means mitigation measures under the first four main headings. Impacts should be avoided, especially those that could be significant.

Significant loss can be defined as a loss that is irreversible or affects a biodiversity component that is vulnerable to extinction. The geographic scale of significance varies. For example, a local vegetation community may be considered highly endangered and therefore irreplaceable, either at a strategic or a site-specific level.

Once everything has been done to avoid impacts, everything should then be done to minimise or reduce negative impacts that cannot be avoided. Only then can workable offsets actually be achieved. Wherever possible, mitigation measures should be developed and incorporated into a project as part of the design process, as measures that are fully integrated into a project have a greater guarantee of delivery.

The objective should always be to agree the identified measures with the proponent of a project so that they become part of the scheme that is subject to detailed assessment (e.g. as part of an Environmental Management Plan, or its equivalent). A shopping list of 'proposed mitigation' at the end of an EcIA is of very little value as it requires the responsible authority to enter into discussion with the proponent to agree what will be implemented.

An EcIA is effectively meaningless if it provides an assessment of the significance of the residual impacts of a scheme based on the proposed mitigation measures being implemented even though these measures have not been agreed by the developer or their efficacy tested in the EcIA process.

Priority should be given to the avoidance of impacts at source, whether through the re-design of a project or by regulating the timing or location of activities. If it is not possible to avoid significant negative impacts, opportunities should be sought to reduce the impacts, ideally to the point that they are no longer significant or, where absolutely necessary, biodiversity loss can be offset.

Offsets are designed to meet specific ecological objectives that will deliver meaningful and equivalent replacement for the negative impacts that are predicted. This is not the same as on site enhancement or rehabilitation. These are part of mitigation measures but are unlikely to secure an increase in biodiversity value due to the small size and fragmented nature of remnants. Similarly, compensation, although a potential source of funding for offsets, will not create biodiversity gain if it is research-based rather than practical.

Compensation is not recommended unless there is a measurable and deliverable biodiversity gain to be had. As discussed later in this document, the creation of offsets may be done as part of the EcIA process or subsequent to approval.

In some parts of Australasia there are statutory mechanisms for offsets and in other parts, its implementation may be voluntary. With or without legislation, there is a strong business case for biodiversity offsets, which by their nature, address important socio-economic and cultural needs. Due to the uncertainty associated with the success of proposed mitigation measures, evidence should be provided of the effectiveness of recommended mitigation and to what extent their success can be guaranteed e.g. a review of technical limitations, the timescale over which predicted benefits are to be realised and the level of commitment in terms of resources, including variations through adaptive management.

If possible, information from similar projects should be used to support statements about the level of success that can be reasonably expected. Mitigation should be presented in terms of the integrity or conservation status of the resources or features to which it applies. For example, mitigation may be designed to ensure that the status of a species' habitat can be maintained following development.

Monitoring and Management

In EcIA, monitoring is specifically used to inform management actions, by measuring change in habitat condition. Monitoring for any other purpose is simply surveillance and is not relevant to EcIA.

If mitigation/compensation measures are part of planning conditions or obligations, the proponent has a requirement to implement them fully. These conditions or obligations may require the implementation of a monitoring program as a basis for remedial measures.

It is good practice to monitor the success of mitigation measures and to remedy the situation should any of the implemented measures fail e.g. due to lack of management or uncertainty in the precise outcome. It is important to clearly and explicitly define objectives. An Environmental Management Plan (or its equivalent) can be a useful means of drawing together mitigation, management and monitoring proposals.

Joint agreement of plans by proponents and consultees can strengthen their implementation. Such a plan may be enforced by legal agreement. Follow-up and monitoring is more likely to take place if it is built into legal agreements or planning conditions. Ideally, measurable objectives, which set the trigger thresholds and targets for management action, should be agreed by all of the ecologists involved in the EcIA process.

Monitoring metrics should use the same principles for biodiversity assessment in EcIA and not necessarily be limited to protected species. Although it may be helpful to monitor populations, individual species are rarely an appropriate surrogate for biodiversity. Even a species' population may not be the best measure of its own ecological requirements.

Care should be taken to ensure that the chosen range of monitoring metrics are ecosystem-relevant. These will most likely relate to the most important matters identified in the project scoping. Monitoring variables would indicate change in ecological structure and function, as well as the abundance and behaviour of species. If monitoring incorporates the creation of biodiversity offsets, a balance sheet showing gains and losses may be used to indicate the value of the contribution.

Adaptive Management and Continual Improvement

Due to inherent uncertainty in EcIA, predictions about the extent of biodiversity loss, the ability to minimise loss and the outcomes of biodiversity offsets can never be perfectly guaranteed. The objective of EcIA should be to create a measurable outcome (either minimise loss or compensate through offsets). Monitoring and management can help but the precise nature of the resulting habitat is unknown so there has to be a framework for adapting to unforseen ecological constraints and continuously improving the outcome.

For example, fluctuations in rainfall may alter soil humidity resulting in a different vegetation community than expected around the edges of a wetland. Where there is the expectation that vegetation can be replaced "like for like" this is almost never achievable, which is why replacement of high quality intact vegetation is particularly unrealistic. The community of species that eventually occupy the replaced / enhanced habitat will also be different so care needs to be taken to ensure that mitigation objectives are not overly optimistic with respect to threatened species. This is particularly in terms of minimum viable patch size and connectivity with the surrounding landscape.

To maximise biodiversity value, management will focus on the structure and function of habitat. Simply monitoring species does not necessarily achieve this. The aim is to actively create a mosaic of different overlapping habitat niches so the diversity and abundance of species increases. Monitoring should be a combination of physical habitat variables, as well as a full range of species, threatened or otherwise, that are indicative of structure and function.

Management needs to be on the ground and might include selective planting, mowing, thinning, burning or grazing. Adaptive management therefore, means maximising outcomes within the constraints that the environment imposes. Although there may be legal obligations associated with this, it is not constructive to bind proponents of development to a particular outcome when there is doubt this may be achieved. Conditions should be flexible enough to acknowledge natural variation but robust enough to control the level of effort, so impacts are mitigated to the greatest extent practicable. If this can be done by creating measurable biodiversity offsets this is best, as it provides an auditable account of the proponent's achievements. A measurable no net loss / net gain solution would provide proponents with the best guarantee of compliance.

Identifying Residual Impacts

It is often helpful to set out in an EcIA report how a project has evolved in response to ecological considerations and to indicate how mitigation that has been incorporated into the scheme design has avoided / minimised ecological impacts. This is especially important where is any uncertainty about the efficacy of mitigation measures. The resulting assessment is the assessment of "residual impacts". The identification of significant residual impacts follows the same process as the identification of impacts. Note, if the purpose is to proceed to biodiversity offsets, other residual impacts may be relevant and not just those deemed "significant".

Where mitigation is fully integrated into the scheme and there is high confidence that it will be implemented and will deliver the desired outcomes, it may be appropriate to skip straight to the assessment of significance of residual impacts of the mitigated project.

The residuals are impacts that remain once everything has been done to avoid and minimise significant biodiversity loss. Note, offsets and compensation are not part of mitigation. The assessment of residual impacts (and their value) is what determines the extent of offset and / or compensation that is required. The assessment of residual impacts is always the final step in the process of impact assessment.

Impact Management - No Net Loss / Net Gain

Overview of Biodiversity Offsets

Biodiversity Offsets are measurable conservation outcomes resulting from actions designed to compensate for residual adverse biodiversity impacts arising from project development and persisting after appropriate prevention and mitigation measures have been implemented.

In some jurisdictions, there are existing statutory mechanisms for creating offsets and the relevant metrics for measuring biodiversity loss / gain already exist. Where these do not exist, a suitable alternative method is available from the Business Biodiversity Offsets Program (BBOP)[5]. The goal of offsets is to achieve no net loss, or preferably a net gain, of biodiversity.

In order to demonstrate no net loss of biodiversity, offset developers must be able to define and measure the residual impact on biodiversity lost at the impact site and the amount of biodiversity gained from the offset. The

[5] Business and Biodiversity Offsets Program. http://bbop.forest-trends.org/

steps in creating offsets are outlined in Box 5. Although the process may appear arduous, with foresight the majority can be done as part of the steps outlined in the EcIA process above.

The BBOP method uses a Habitat Hectares approach, derived from the model used in Victoria (Australia) (DSE, 2002) and similar to the process used in New South Wales, so some developers will already be doing this as part of development approval processes in the region. Elsewhere, the methods can be adapted to suit. Note however, the viability of offsets still depends on the quality of the foundation EcIA, particularly the need to avoid and minimise impacts on site, so the principles and procedures outlined earlier should be rigorously implemented.

Box 5: Steps in the creation of offsets (derived from BBOP).

- Quantify losses with respect to key habitats at the impact site
- Identify a benchmark site
- Select and weight the benchmark attributes and record the reference level of each
- Quantify the pre-project condition of the attributes at the impact site
- Predict the post-project condition for each attribute
- Calculate the predicted biodiversity loss at the impact site
- Where necessary, quantity losses with respect to key species at the impact site
- Identify species that require a species-specific quantification of losses
- Select and appropriate metric for each species
- Identify a benchmark population for each species
- Assess likelihood of persistence of the benchmark population
- Assess likelihood of persistence of the impact site population (pre-project)
- Calculate losses with respect to the species at the impact site
- Develop a shortlist of potential offset sites
- Determine whether the offset is a candidate for an out-of-kind offset
- Identify potential offset sites
- Select appropriate offset sites and calculate offset gains
- Screen sites on the basis of the biodiversity components they support
- Screen sites on the basis of their potential to demonstrate additionality
- Quantify and map pre-intervention condition classes at each shortlist offset site
- Assess the threats facing each potential offset site
- Identify interventions to address threats facing each site
- Calculate biodiversity gained at each shortlist offset site (for habitats, and, if necessary, for species populations)
- Screen sites on the basis of their sufficiency to support key biodiversity components into the long term

Classify candidate offset sites on the basis of their conservation priority

Prioritize candidate offset sites within each level on the basis of additional criteria

Review landscape-level planning opportunities and constraints

Consider socio-economic gains possible at each candidate offset site

Assess whether biodiversity multipliers are required and calculate area ratio required

Define the activities for the biodiversity offset and their location

Review the outputs generated in the selection of sites and calculation of offsets

Develop an overall objective for the offset

Further define the offsetting activities to be undertaken Detail a specific location and rationale for each activity, and consider what will be required to successfully implement the offset

As it is outside the scope of this document to reiterate the BBOP documentation, only an outline is provided. For more detail, refer directly to the BBOP Toolkit, available online at http://bbop.forest-trends.org/guidelines/ .

Principles of Biodiversity Offset

The following principles for biodiversity offset were agreed by the Advisory Committee of the Business Biodiversity Offsets Program. It is notable that most of these principles are the same as those recommended for EcIA, hence the process of addressing offsets can be done fairly readily within the EcIA framework.

No net loss: A biodiversity offset should be designed and implemented to achieve in situ,measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity.

Additional conservation outcomes: A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. Offset design and implementation should avoid displacing activities harmful to biodiversity to other locations.

Adherence to the mitigation hierarchy: A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimization and on-site rehabilitation measures have been taken according to the mitigation hierarchy.

Limits to what can be offset: There are situations where residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected.

Landscape Context: A biodiversity offset should be designed and implemented in a landscape context to achieve the expected measurable conservation outcomes taking into account available information on the full range of biological, social and cultural values of biodiversity and supporting an ecosystem approach.

Stakeholder participation: In areas affected by the project and by the biodiversity offset, the effective participation of stakeholders should be ensured in decision-making about biodiversity offsets, including their evaluation, selection, design, implementation and monitoring.

Equity: A biodiversity offset should be designed and implemented in an equitable manner, which means the sharing among stakeholders of the rights and responsibilities, risks and rewards associated with a project and offset in a fair and balanced way, respecting legal and customary arrangements. Special consideration should be given to respecting both internationally and nationally recognized rights of indigenous peoples and local communities.

Long-term outcomes: The design and implementation of a biodiversity offset should be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity.

Transparency: The design and implementation of a biodiversity offset, and communication of its results to the public, should be undertaken in a transparent and timely manner.

Science and traditional knowledge: The design and implementation of a biodiversity offset should be a documented process informed by sound science, including an appropriate consideration of traditional knowledge.

The Role of EcIA in Planning of Biodiversity Offsets

Impact assessment incorporates well established procedures for collecting and interpreting information on biodiversity and ecosystem services, and can be used to provide a "before and after" picture of the distribution, status and condition of biodiversity affected by a proposed plan or project (Box 10). When integrated with environmental management systems and plans, impact assessment offers a potential delivery mechanism for offsets and a basis for ongoing monitoring and adaptive management. Early consideration of possible requirements for biodiversity offsets and their integration with impact assessment can help to avoid duplication of effort in the collection of data. Biodiversity offsets can make an important contribution to the conservation and sustainable use of biodiversity. Impact assessments can be strengthened as a tool for sustainable development by incorporation of the concept of "no net loss" or "net gain" to help deliver a more outcome-oriented approach.

Box 6: How impact assessment can contribute to the design and implementation of biodiversity offsets (Business and Biodiversity Offsets Programme, 2009)

- providing a structured approach to the collection of information on biodiversity
- quantifying potential losses of biodiversity associated with a proposal
- providing information needed to determine whether 'no net loss' of biodiversity can be achieved
- interpreting the significance of impacts on biodiversity/ biodiversity losses
- identifying biodiversity impacts which require mitigation, and residual adverse impacts remaining after mitigation which could be offset
- generating information on biodiversity distribution and status which is needed to interpret impact significance for different geographical contexts
- generating contextual information on biodiversity distribution and status which is needed for planning the design of offsets and for the selection of suitable offset locations
- providing a standardized and widely used approach

The extent to which planning for offsets should be fully incorporated as an integral part of the EIA process may vary as it can potentially overload the EcIA process. The aim of EcIA is to demonstrate that impacts on biodiversity have been reduced to an acceptable level, such that development consent can be given to a proposal. In cases where a significant residual adverse impact on biodiversity will remain following implementation of proposed mitigation, the planning of the offset could be pursued as part of the EcIA or accounted for separately e.g. as a requirement of the project EMP.

Offsets integrated within EcIA

Effective integration requires an iterative approach in which the potential use of offsets is considered at an early stage (during scoping or sooner). The resource requirements for offsets need to be considered during the scoping phase, such as the availability of land, skills to expedite an offset plan and any financial or time constraints that may be needed in addition to the EcIA process. The study area also needs to be confirmed, based on a review of proposed activities (i.e. during scoping) but baseline studies may need extending to include appropriate benchmark sites - sites that are used as a measure of 'good condition, providing a set of measurable set of objectives that offset sites are managed towards. Table 1 outlines the integration of offset planning within EcIA.

Table 1: Integration of offsets planning with EcIA.

Stage in planning of development	Stage in assessment	Information required for offset planning
During business case development / pre-feasibility	Strategic review (through SEA or existing national data)	Gain understanding of: Biodiversity risks and opportunities Biodiversity policy and goals Background trends in threats and rate of loss of biodiversity associated with this type of activity e.g. level of cumulative

		impact Key partners and capacity Potential role of offsets and availability of implementation frameworks, e.g. to meet policy goals
During inception phase for project (e.g. scoping)	Possible baseline assessment or preliminary risk assessment	Review location-specific risks and opportunities Identify stakeholders who should be involved and the level of involvement
Project development / design (e.g. when determining value)	EcIA and Social / Cultural Impact Assessment	Presence of biodiversity triggers for EcIA may also suggest possible need for offsets (risks to valued biodiversity)
Project Feasibility or design	EcIA (during scoping)	Possibility of offsets informs scope. Stakeholder engagement is a key component for offset planning. Consider possible needs for finances to support offsets as well as possible need for land procurement and negotiations with land-owners.
Detailed design	Impact Assessment]	Impact assessment process quantifies losses
Detailed design	Identification of mitigation measures	Include identification of need for offsets in cases where residual adverse effects remain after mitigation hierarchy is followed. Plan offsets to achieve "no net loss". Possible gains through offsets need to be quantified to demonstrate this.
Project development / construction	EMP implementation and / or follow-up	Implement offsets and monitor their success / effectiveness. A balance sheet showing losses and gains may need to be produced to that the contribution made by the offset is clear.

The main advantages of having offset design fully integrated with EcIA are:

- EcIA can provide a rationale for the offset by identifying and quantifying impacts on biodiversity.
- Through application of the mitigation hierarchy, EcIA demonstrates which impacts can be avoided and which can‟t, in order to identify unavoidable significant adverse residual impacts for which an offset might be appropriate.
- EcIA provides the information needed to calculate losses and gains in biodiversity in order to determine how "no net loss" can be achieved through an offset.
- Through the Environmental Statement, EIA can provide a documented biodiversity "loss/gain account" to demonstrate how offsets have been calculated
- Using EIA to collect the information needed to design and implement offsets keeps costs down.
- Decision-makers can evaluate reliably the net outcome of the development taking into account planned mitigation and offsets, and include offset conditions as part of the consent for development.

The implementation of offsets in practice may well require land purchase or complex management agreements with landowners or communities. Integrating offset design with the EIA process may help to identify possible budget requirements early. This only applies if sufficient time is allocated to the EcIA process however.

References

ANZECC. (1998). Guidelines for Establishing the National Representative System of Marine Protected Areas ANZECC Task Force on Marine Protected Areas Australian and New Zealand Environment and Conservation Council

Business and Biodiversity Offsets Programme. (2009). The Relationship between Biodiversity Offsets and Impact Assessment: A BBOP Resource Paper. BBOP, Washington, D.C. .

DSE. (2002). Victoria's Native Vegetation Management - a Framework for Action. State of Victoria, Melbourne.

IAIA. (1999). Principles of Environmental Impact Assessment Best Practice. International Association for Impact Assessment and Institute of Environmental Assessment UK Fargo, USA.

IAIA. (2005). Biodiversity in Impact Assessment.

Institute of Ecology and Environmental Management. (2005). Guidelines for Ecological Impact Assessment in the United Kingdom. Final Draft 3 February 2006. . IEEM.

Oxford, M. (2001). Developing Naturally. A handbook for incorporating the natural environment into planning and development. Association of Local Government Ecologists.

Treweek, J. (1999) *Ecological Impact Assessment* Blackwell Science, Oxford.