

Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities

Working Draft

November 2004

**Department of Environment and
Conservation (NSW)**



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Environment and
Conservation (NSW)

Prepared by the NSW Department of Environment and Conservation (formerly the NSW National Parks and Wildlife Service) based on a report prepared by SMEC Australia and the results of workshops with consultants, government, and other relevant practitioners and stakeholders.

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These Threatened Species Survey and Assessment Guidelines are being released as a working draft. They have not been formally endorsed. A review will be undertaken in 2005. Comments to assist in this review are welcome and should be forwarded in writing, detailing the number of the section and page number to which your comments relate, to:

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Acronyms and Abbreviations

AEC	Animal Ethics Committee
AGD	Australian Geodetic Datum
AMG	Australian Map Grid
AR Act	<i>NSW Animal Research Act 1985</i>
CAMBA	China-Australia Migratory Bird Agreement
CANRI	Community Access to Natural Resources Information
DA	Development Application
DEC	NSW Department of Environment and Conservation
Decision-makers	Consent authority, determining authority or licensing authority
DEH	Australian Government Department of the Environment and Heritage
DIPNR	Department of Infrastructure, Planning and Natural Resources (NSW)
DLWC	NSW Department of Land and Water Conservation (now part of DIPNR)
DUAP	NSW Department of Urban Affairs and Planning (later renamed PlanningNSW – now part of DIPNR))
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPI	Environmental Planning Instrument
FM Act	<i>NSW Fisheries Management Act 1994</i>
GDA	Geocentric Datum of Australia
GIS	Geographic Information System
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation of Australia
JAMBA	Japan-Australia Migratory Bird Agreement
LEP	Local Environmental Plan
LES	Local Environmental Study
NPA	National Parks Association
NPW Act	<i>NSW National Parks and Wildlife Act 1974</i>
NPWS	NSW National Parks and Wildlife Service (now part of DEC)

NVC Act	<i>NSW Native Vegetation Conservation Act 1997</i>
NV Act	<i>NSW Native Vegetation Act 2003</i>
POM	Plan of Management
RAMSAR	Convention on Wetlands of International Importance
REP	Regional Environmental Plan
RES	Regional Environmental Study
RVMP	Regional Vegetation Management Plan
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
Threatened biodiversity	In this document means threatened species, populations or ecological communities, or their habitats. This includes plants and animals but not 'fish' or marine vegetation.
TSC Act	<i>NSW Threatened Species Conservation Act 1995</i>
TSC Amendment Act	<i>NSW Threatened Species Conservation Amendment Act 2002</i>

1 INTRODUCTION

The term ‘threatened biodiversity’ is used throughout this document and means threatened species, populations or ecological communities, or their habitats.

1.1 BACKGROUND

The conservation of threatened plants, animals and their habitats in New South Wales (NSW) is integral to maintaining species diversity. As the diversity of species and their habitats may be adversely affected by developments, it is important that informed decisions regarding the impact of developments can be made. The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides the framework for decision-making under the NSW planning system. Appropriate implementation of this planning system as it relates to threatened biodiversity can be facilitated by establishing guidelines for the survey and assessment of threatened animals and plants¹.

The former NSW National Parks and Wildlife Service (NPWS) (now part of the Department of Environment and Conservation) prepared these working guidelines for threatened species survey and assessment for terrestrial animals and plants, based on a report prepared under contract by SMEC and a series of workshops with consultants, government agencies and other relevant practitioners and stakeholders. The guidelines will assist in impact assessment and management of threatened biodiversity and have relevance to any animal and/or plant survey within NSW.

It is intended that the Threatened Biodiversity Survey and Assessment Guidelines (the Guidelines) be adapted to fit the requirements of individual animal and plant surveys by outlining field techniques and considerations, relevant legislation, and the relevant method of impact assessment for threatened biodiversity. The Guidelines will assist applicants, proponents, investigators² and decision-makers by identifying their responsibilities, outlining relevant procedures and providing considerations for the interpretation of results.

These guidelines are complemented by profiles for species, populations and communities and specific environmental impact assessment profiles and guidelines being compiled by the DEC³. The environmental impact assessment profiles and guidelines contain ecological information to assist in the survey and assessment of individual species, populations and ecological communities. The Guidelines and profiles reflect current knowledge and will be subject to review to ensure they remain so.

The potential for a proposed development, activity or action to have a significant effect on threatened biodiversity will vary from proposal to proposal and location to location. These guidelines are designed to facilitate a consistent and systematic approach when deciding

¹ The terms animal and plant are defined by the TSC Act as including vertebrate and invertebrate animals and vascular and non-vascular plants respectively, and are used in this context throughout the document.

² Investigators include those who conduct and/or report on threatened species surveys and assessments eg. ecological consultants.

³ Species profiles have been completed for a limited number of species, populations and ecological communities at this time.

whether a proposed development, activity or action is likely to have a significant effect on threatened biodiversity.

Comments regarding the Guidelines and profiles should be directed to the Biodiversity Management Unit of the DEC: catherine.price@environment.nsw.gov.au

1.1 WHAT IS THE PURPOSE OF THE GUIDELINES?

The Guidelines have been prepared for use by decision makers when considering a proposed development, activity or action pursuant to Parts 4 and 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), and Part 6 of the *Threatened Species Conservation Act 1995* (TSC Act). The Guidelines also provide information and assistance to any other individuals or organisations that may be required to consider the effect of a proposal on threatened biodiversity or critical habitat⁴.

The Guidelines will facilitate informed decision-making at the local scale for individual development activities with particular regard to:

- preliminary animal and plant assessments;
- s5A Assessments of Significance under the EP&A Act⁵;
- Species Impact Statements (SISs);
- licensing under Part 6 of the TSC Act;
- Local Environmental Studies (LESs), Regional Environmental Studies (RESs) and spot re-zoning;
- Development Applications (DAs); and
- Clearing Applications (CAs) under the NVC Act.

The Guidelines aim to inform the process of survey and assessment of threatened biodiversity by describing and discussing:

- the chronological steps within the threatened biodiversity assessment process;
- the strategies, policies and legislation relevant to threatened biodiversity;
- appropriate survey techniques for detecting threatened biodiversity;
- the information required for an Assessment of Significance⁶; and
- reporting requirements and standards.

The Guidelines aim to provide a consistent and systematic approach to survey and assessment of threatened biodiversity. In particular, the guidance provided will assist in:

- setting appropriate aims for survey and assessment of threatened biodiversity;
- the planning of suitable survey techniques and the appropriate level of effort;

⁴ Critical habitat means habitat declared to be critical habitat under Part 3 of the TSC Act, whereby “The whole or any part or parts of the area or areas of land comprising the habitat of an endangered species, population or ecological community that is critical to the survival of the species, population or ecological community is eligible to be declared under this Part to be the critical habitat of the species, population or ecological community”.

⁵s5A assessments under the EP&A Act were often previously referred to as the ‘8 Part Test’.

⁶ The s5A assessment of the EP&A Act and s94 of the TSC Act, which have previously been commonly referred to as the ‘8 Part Test’, are collectively referred to as an ‘Assessment of Significance’ throughout these guidelines.

- the provision of adequate reporting;
- a justifiable interpretation of results; and
- making an informed and justifiable decision.

1.2 HOW HAVE THE GUIDELINES BEEN PREPARED?

The development of the Guidelines was coordinated and overseen by a steering committee. This steering committee comprised representatives from the former National Parks and Wildlife Service (NPWS) (now part of the NSW Department of Environment and Conservation (DEC)) and from the former Department of Urban Affairs and Planning and Department of Land and Water Conservation (now both part of the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR)). A literature review and a number of workshops with consultants and government agencies preceded preparation of the Guidelines. A draft document was prepared and further reviewed by participants in the process. A full list of the literature reviewed and stakeholders who participated in the consultation workshops is provided in **Appendices A and B** respectively.

1.3 APPLICATION OF THE GUIDELINES

Although applicable to anyone with an interest in threatened biodiversity assessments, the Guidelines are primarily aimed at three groups:

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Proponents and Applicants 2. Investigators 3. Decision makers | <p>Those who are proposing to undertake developments, activities or actions eg. Developers, councils, government agencies.</p> <p>Those who conduct and/or report on threatened biodiversity surveys and assessments eg. Ecological consultants.</p> <p>Those consent, determining and licensing authorities that are responsible for assessing impacts on threatened biodiversity eg. councils and government agencies such as DEC and DIPNR.</p> |
|--|--|

The Guidelines provide principles and generic information regarding threatened biodiversity that is applicable to a range of studies and reports such as:

- Animal and plant survey and assessment reports;
- ‘Assessments of Significance’;
- Development Applications (DAs);
- Applications under Part 5 of the EP&A Act;
- Subdivision plans;
- Local and Regional Environmental Studies (LESs & RESs) and spot re-zonings;
- Species Impact Statements (SISs);
- Regional Vegetation Management Plans (RVMPs);

- Clearing Applications (CAs); and
- Plans of Management (POMs).

1.4 CONTENTS OF THE GUIDELINES

The Guidelines have been divided into six main areas, as outlined below.

- | | |
|-----------|--|
| Chapter 1 | <i>Introduction</i> - describes the purpose and application of the Guidelines. |
| Chapter 2 | <i>Legislation</i> - answers common questions about legislation applicable to threatened biodiversity. |
| Chapter 3 | <i>Survey and Assessment Requirements and Process</i> - describes the chronological steps within the threatened biodiversity survey and assessment process, and the roles and functions of the Proponent, Investigator and Decision-makers. |
| Chapter 4 | <i>Data</i> - outlines data sources and the use of this information to define the aims, scope, design and methods of study at the pre-survey, survey, and post-survey stage. It also describes the management of data obtained and the level of detail required. |
| Chapter 5 | <i>Field Surveys</i> - provides guidance on field survey techniques and the level of effort required, and guidance on the assessment of habitat. |
| Chapter 6 | <i>Interpretation of Results</i> - assists in the interpretation of the study's findings in relation to the Assessment of Significance. |

2 LEGISLATION

'Threatened biodiversity' means threatened species, populations or ecological communities, or their habitats.

The most critical pieces of legislation for the purposes of threatened species assessment in NSW are:

- the *Threatened Species Conservation Act 1995* (TSC Act);
- the *Threatened Species Conservation Amendment Act 2002*;
- the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- the *National Parks and Wildlife Act 1974* (NPW Act);
- the *Native Vegetation Conservation Act 1997* (NVC Act);
- the *Native Vegetation Act 2003*; and
- the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A description of the above legislation and how it relates to the planning process and threatened biodiversity is provided below.

2.1 THE THREATENED SPECIES CONSERVATION ACT

2.1.1 What is the Threatened Species Conservation Act?

The *Threatened Species Conservation Act 1995* (TSC Act) commenced on 1 January 1996. This Act provides for the protection of all threatened plants and animals native to NSW and their habitats (including endangered populations and ecological communities, and their habitats). Threatened 'fish' and marine vegetation are specifically excluded as these are covered by the *Fisheries Management Act 1994*.

2.1.2 What are threatened species, populations and ecological communities?

The TSC Act provides for the listing of species, populations and ecological communities considered to be threatened in NSW. Schedule 1 of the TSC Act contains listings of endangered species, populations and ecological communities, and Schedule 2 of the TSC Act contains listings of vulnerable species⁷ (refer to section 4.2.3). Any person may nominate any species, population or ecological community for inclusion on, omission from, or amendment to Schedule 1 or 2 of the TSC Act in accordance with the criteria contained within the Act. The NSW Scientific Committee is responsible for reviewing nominations and determining which species, populations and ecological communities are listed on the Schedules of the TSC Act. The TSC Act requires that determinations made by the Scientific Committee are based on scientific criteria and considerations.

⁷ Please note that there is a future provision (under the *Threatened Species Conservation Amendment Act 2002*) to list vulnerable ecological communities under Schedule 2 of the TSC Act.

2.1.3 What is a key threatening process?

A key threatening process is defined as a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. A requirement of their listing on the TSC Act is that the process adversely affects two or more threatened species, populations or ecological communities, or that it may cause species, populations or ecological communities that are not threatened to become threatened.

The current list of key threatening processes on the TSC Act can be found at
<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Key+threatening+processes>

2.1.4 What is critical habitat?

Critical habitat is defined as an area that is crucial to the survival of an endangered species, population or ecological community. The declaration of critical habitat provides greater protection and stricter controls over activities in that area. Critical habitat is only declared after consultation with the Scientific Committee, public authorities, landholders and the wider community. Once declared, it becomes an offence to damage critical habitat (unless the action is specifically exempted by the TSC Act). A Species Impact Statement (SIS) is mandatory for all developments and activities proposed within critical habitat unless the impact is deemed trivial or negligible by the Director-General of National Parks and Wildlife. A SIS requires the concurrence of the Director-General of National Parks and Wildlife before any approval is given.

The current list of recommended and declared critical habitat can be found at
<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Critical+habitat+protection+by+doctype>

2.1.5 How are threatened species, populations or ecological communities, or their habitats, taken into account within the NSW planning and licensing system?

The TSC Act made substantial amendments to the EP&A Act and the NPW Act. One such amendment which had major implications for the NSW planning system was the introduction of a set of factors which must be considered regarding the effects of a proposed development, activity or action on threatened biodiversity. These factors are contained in s5A of the EP&A Act and s94 of the TSC Act and form the ‘Assessment of Significance’. These factors were often previously referred to as the ‘8 Part Test’.

Threatened biodiversity assessment under the EP&A Act is an integral component of the conservation of threatened biodiversity in NSW and should be viewed in the context of a range of conservation strategies promoted by the TSC Act. These include recovery planning, threat abatement planning, critical habitat declaration, joint management agreements and strategic land use planning through Part 3 of the EP&A Act.

2.1.6 How is critical habitat taken into account within the NSW planning and licensing system?

The legislative and administrative consequences of declaring critical habitat include:

- if land declared as critical habitat is land to which a LEP, REP or SEPP applies, the plan must be amended, as soon as practicable after the declaration, by the Council or DIPNR in a manner that identifies the land that is declared as critical habitat;
- developments or activities which require some form of consent or approval under the EP&A Act, which are proposed on land that is, or is part of, critical habitat, automatically require the preparation of a SIS and the concurrence of the Director-General of the Department of Environment and Conservation, or in some cases, consultation with the Minister for the Environment;
- for actions which require licensing under s91 of the TSC Act, which are proposed on land that is, or is part of, critical habitat, a SIS must be submitted with the licence application;
- where a landholder is preparing a property management plan under s91 of the TSC Act, the plan should identify whether the property contains land that is, or is part of, critical habitat;
- when a consent or determining authority is deciding whether a proposed development or activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats, it must consider whether critical habitat will be affected by the proposal;
- all consent authorities must have regard to the register of critical habitat kept by the Director-General of National Parks and Wildlife when exercising their functions under the EP&A Act;
- a recovery plan must identify any critical habitat declared in relation to the threatened species, population or ecological community which is the subject of the plan and state what must be done to protect that critical habitat; and
- public authorities must have regard to critical habitat if the land it owns or controls contains critical habitat. The public authority must also have regard to critical habitat when exercising its functions in relation to the land.

2.2 ASSESSMENT OF SIGNIFICANCE

2.2.1 What is the Assessment of Significance?

The Assessment of Significance refers to the factors that must be considered by decision-makers to assess whether a proposal is likely to have a significant effect on threatened biodiversity. These mechanisms are contained in s5A of the EP&A Act and s94 of the TSC Act.

The Assessment of Significance provides for informed decision-making regarding the effect of a proposal on threatened biodiversity. The factors are detailed at **Appendix C** of these guidelines.

Note: The factors to be taken into account when making a determination as to whether a proposed development, activity or action is likely to have a significant effect on threatened biodiversity were revised via the *Threatened Species Conservation Amendment Act 2002*.

The new factors will be proclaimed in 2005. These Guidelines will be updated when the new factors come into effect.

2.2.2 Is there a legal requirement to undertake an Assessment of Significance?

i The proponent or applicant

When undertaking a development under Part 4 of the EP&A Act, it is the responsibility of the applicant to provide the consent authority with an Assessment of Significance (as required by Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*). The proponent of an activity under Part 5 of the EP&A Act is also usually required to provide the determining authority with an Assessment of Significance.

Similarly, when applying for a s91 licence under the TSC Act it is the responsibility of the applicant to provide the licensing authority with an Assessment of Significance.

ii The consent authority

It is the responsibility of the consent authority to form a view as to whether the proposed development is likely to significantly affect threatened biodiversity. A consent authority is therefore required to take the Assessment of Significance into account when:

- deciding whether it has received a valid development application under Part 4 of the EP&A Act; and
- evaluating the likely impacts of the proposed development, including environmental impacts on both the natural and built environments, and the social and economic impacts in the locality.

iii The determining authority

A determining authority is required to take the Assessment of Significance into account when determining an activity under Part 5 of the EP&A Act. It is the responsibility of the determining authority to form a view as to whether the proposed activity is likely to significantly affect threatened biodiversity.

iv The licensing authority

It is the responsibility of the licensing authority (DEC) to decide whether the proposed action is likely to significantly affect threatened biodiversity prior to the issuing of a s91 licence under the TSC Act.

v Other

The Assessment of Significance may also be considered by the relevant authority when reviewing ‘spot’ re-zoning proposals to assess whether the re-zoning is likely to lead to land use which is likely to significantly affect threatened biodiversity.

2.2.3 Why undertake an Assessment of Significance?

In deciding whether there is likely to be a significant effect on threatened biodiversity, decision-makers have a statutory responsibility to formally consider the Assessment of Significance. In addition to fulfilling this statutory requirement, the aim of undertaking an Assessment of Significance is to improve the standard of consideration and protection afforded to threatened biodiversity in planning and decision-making processes. The outcome of any threatened biodiversity assessment should be that developments, activities and actions are undertaken in an environmentally sensitive manner and that appropriate measures are adopted to avoid or minimise adverse effects on threatened biodiversity. Where this cannot be achieved, a development, activity or action should not proceed until the likely effects of the proposal can be ameliorated.

Decision makers have a statutory obligation to consider whether a proposal is likely to significantly affect threatened biodiversity.

2.2.4 Who undertakes the Assessment of Significance?

A technical report which addresses the Assessment of Significance may be prepared by either specialist officers or consultants appointed by the decision-maker, or the decision-maker may request that the applicant or proponent provide a report which addresses these factors.

Ultimately, it is left to the discretion of the decision-maker to form a view as to whether a proposed development, activity or action is likely to have a significant effect on threatened biodiversity.

2.2.5 How does one determine the type of approval required and the relevant authority?

Environmental planning instruments (EPIs) guide and regulate the type of land use that can, and cannot, occur in specific areas. The EPIs prepared under Part 3 of the EP&A Act are: State Environmental Planning Policies (SEPPs), Regional Environmental Plans (REPs) and Local Environmental Plans (LEPs). Regional Vegetation Management Plans (RVMPs) prepared under the *Native Vegetation Conservation Act 1997* (NVC Act) are also environmental planning instruments. Land may be affected by more than one EPI.

Proponents or applicants should approach their relevant local council⁸ or the Department of Infrastructure Planning and Natural Resources (DIPNR) in the first instance for information about the EPIs that apply to the land where a development, activity or action is proposed. A decision then needs to be made as to whether an approval is required under the EP&A Act and whether it is required under Part 4 of the EP&A Act in the first instance. If Part 4 approval is not required it must then be determined whether Part 5 of the EP&A Act applies. If no approval is required under the EP&A Act a licence is likely to be required from the relevant licensing authority. Proponents or applicants should liaise with the appropriate authorities to ascertain the approvals required.

⁸ For areas not under the authority of local councils the Western Lands Commission should be approached for areas in far western NSW, and the Lord Howe Island Board for Lord Howe Island.

The following sections provide a brief outline of the requirements for assessment. These requirements may be affected by EPIs (particularly LEPs, SEPP14, SEPP 26, SEPP 44 and RVMPs) and further information about the provisions of these EPIs can be found at <http://www.dipnr.nsw.gov.au>

vi Part 4 of the EP&A Act

EPIs will provide information to determine whether approval is required under Part 4 of the EP&A Act.

a Development With Consent

If a proposal requires development consent, it then falls under the provisions of Part 4 of the EP&A Act. It should be noted that if native vegetation is to be ‘cleared’ (as defined in the NVC Act) development consent is required, except when conducted in accordance with an approved RVMP.

b Development Without Consent

SEPP 4 - Development Without Consent allows certain types of development to proceed, including relatively simple or minor changes of land or building use and certain types of development, without the need for formal development applications and development consent. The types of development permitted without consent are outlined in SEPP 4 and generally relate to developments that are of very minor environmental significance, certain developments by public authorities, and in certain cases actions on land dedicated under the NPW Act.

However, actions undertaken without development consent under Part 4 of the EP&A Act may require approval under Part 5 of the EP&A Act, or a licence under the TSC Act.

c Exempt and Complying Development (SEPP 60)

Exempt and complying developments are defined by the SEPP, and do not require a full development assessment because the impacts of these developments are not considered significant or can be pre-determined and managed. However, exempt development may require approvals or licences under other statutes such as the TSC Act and the FM Act. Complying development requires a complying development certificate.

vii Part 5 of the EP&A Act

If a proposal does not require consent under Part 4 of the EP&A Act, a decision then needs to be made as to whether an approval is required under Part 5 of the EP&A Act. For Part 5 to apply the proposal must be an ‘activity’ as defined by the EP&A Act. Projects carried out by public authorities generally fall under the provisions of Part 5 of the EP&A Act.

The decision-maker under Part 5 of the EP&A Act is referred to as the determining authority. In instances where a government authority is both the proponent and the determining authority, and where an Environmental Impact Statement (EIS) is required, then approval is also required from the Minister for Planning and Infrastructure. In cases where a private landholder is the proponent the determining authority normally requires the proponent to provide any necessary material for environmental assessment.

viii Licensing

Actions which do not require any form of consent under Part 4 or approval under Part 5 of the EP&A Act may need to be assessed under the licensing provisions of Part 6 of the TSC Act if the action results in:

- the harming or picking of a threatened species, population or ecological community;
- damage to critical habitat; or
- damage to the habitat of a threatened species, population or ecological community.

2.2.6 What happens if a threatened species, population or ecological community is added to the Schedules of the TSC Act prior to the consent, determining or licensing authority making a decision?

If a threatened species, population or ecological community is added to the Schedules of the TSC Act prior to a decision being made by the decision maker, that species, population or ecological community must be taken into account in the decision-making process. This does not apply to vulnerable species, provided that the decision-maker makes the decision within 12 months of the lodgement of the application.

Therefore, it is recommended that those endangered species, populations and ecological communities for which the Scientific Committee has made a Preliminary Determination under the TSC Act (refer to section 4.2.3) should be included in assessments. If these endangered species, populations and ecological communities are not taken into account, and are subsequently listed on the Schedules of the TSC Act prior to a decision being made, the approval process will be delayed until this information has been adequately considered.

2.2.7 Are recovery plans and threat abatement plans taken into account?

The TSC Act requires the preparation of recovery plans and threat abatement plans for listed threatened biodiversity and key threatening processes respectively. The purpose of a recovery plan is to promote the recovery of a threatened species, population or ecological community with the aim of returning the species, population or ecological community to a position of viability in nature. The purpose of a threat abatement plan is to manage key threatening processes with a view to their abatement, amelioration or elimination.

When considering development applications under Part 4 of the EP&A Act, or the carrying out, or applications for approval for the carrying out, of activities under Part 5 of the EP&A Act, or the licensing of actions under s91 of the TSC Act, it is highly appropriate that all

decision-makers consider all relevant draft and approved recovery and threat abatement plans when making decisions.

The TSC Act requires that public authorities (including councils) must not make decisions that are inconsistent with a recovery plan. If a public authority proposes to depart from the provisions of a recovery plan in the exercise of a function it must advise the Director-General of National Parks and Wildlife. A consultation process must then be undertaken. Similar provisions apply to threat abatement plans.

Draft and approved recovery plans and threat abatement plans are available at the DEC website <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Recovery+planning>

2.2.8 What happens if the assessment of significance indicates that a significant effect is likely?

If the application of the Assessment of Significance indicates that a significant effect on threatened biodiversity is likely then (also refer to Chapter 3, Step 9):

- the proposal may be modified such that a significant effect on threatened biodiversity is unlikely. This may require the original application to be withdrawn and the modified proposal to be submitted for assessment; and/or
- a Species Impact Statement (SIS) must be prepared. In relation to the EP&A Act, the concurrence of the Director-General of the National Parks and Wildlife, or consultation with the Minister for the Environment, may be required.

2.2.9 Requirements when the proposal affects declared critical habitat

If all or part of declared critical habitat is to be affected by a proposal, a SIS must be prepared (refer to section 4.2.3).

2.2.10 Advising the proponent of the need to prepare a SIS

If the decision-maker decides that the proposal is likely to have a significant effect on threatened biodiversity, the decision-maker must advise the proponent or applicant of the requirement to prepare a SIS.

It is then up to the discretion of the proponent or applicant to decide whether to:

- proceed with the proposal (or request for Part 5 approval, or licence application) and prepare a SIS;
- withdraw the application; or
- modify the proposal.

2.2.11 How to proceed with a SIS

Prior to the preparation of a SIS, the proponent must submit a request to the relevant DEC Office for Director-General's Requirements pursuant to s111 of the TSC Act. Further information about these requirements is contained in the *NPWS Threatened Species*

Management Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The ‘8 Part Test’ of Significance.

The SIS must be prepared in accordance with s109 and s110 of the TSC Act and must comply with any requirements notified by the Director-General of National Parks and Wildlife. Further information about SIS preparation is contained in the *NPWS Threatened Species Management Information Circular No. 5: Species Impact Statements*. Section 110 of the TSC Act is detailed in **Appendix D**.

Following a review of the SIS, should the decision-maker decide that the proposal is likely to have a significant effect on threatened biodiversity, and should the decision-maker decide to approve the proposal, the concurrence of the Director-General of National Parks and Wildlife must then be sought before approval may be granted. A concurrence application is not required in cases where the decision-maker decides to reject the application or if the decision-maker determines that the proposal is unlikely significantly affect threatened biodiversity. Details of concurrence and consultation provisions of the TSC Act are described in detail in the *NPWS Threatened Species Management Information Circular No. 1*.

2.2.12 What happens if the proposal is in an area where there are no threatened species, populations or ecological communities, or their habitats, or where they are unlikely to occur?

If a proposal applies to an area where no threatened biodiversity has been recorded, and it is considered unlikely that they will occur, the decision-maker is still required to have formal regard to the Assessment of Significance. In order to satisfy the legislative requirements of s90 and s111(4) of the EP&A Act, a statement must be made:

- addressing the factors of the Assessment of Significance which highlights the absence and unlikely occurrence of threatened biodiversity within the study area; and
- that the proposed development, activity or action is unlikely to have a significant effect on threatened biodiversity.

2.2.13 What happens when the proposal is not likely to have a significant effect on threatened species, populations or ecological communities, or their habitats?

If a proposal is not likely to significantly affect threatened biodiversity the decision-maker is still required to have formal regard to the Assessment of Significance to satisfy the legislative requirements of the EP&A Act.

A statement must be made which addresses the factors of the Assessment of Significance for each of the threatened species, populations and ecological communities that occur or are likely to occur in the area to be affected by the proposed development, activity or action. This statement must clearly demonstrate and substantiate that the proposal is unlikely to have a significant effect on threatened biodiversity.

2.2.14 Advertising “threatened species development”

Under the *Environmental Planning and Assessment Regulation 2000*, development that is considered to be threatened species development is classified as a form of advertised development. A development is considered to be ‘threatened species development’ if it is on land that is, or is a part of, critical habitat or is likely to significantly affect threatened biodiversity. The consent or determining authority is required to give written and published notice of the application.

2.2.15 What is the role of the DEC in relation to threatened biodiversity assessment?

The role of DEC in threatened biodiversity assessment is to:

- Prepare, coordinate and implement recovery and threat abatement plans;
- have a decision-making role where concurrence has been requested under provisions of the EP&A Act;
- have a decision-making role for activities where the NPWS (now the DEC) is a determining authority under Part 5 of the EP&A Act;
- provide Director-General Requirements when a Species Impact Statement is required; and
- in some limited circumstances the DEC can also provide specialist advice to investigators, proponents or applicants, and consent, determining and licensing authorities.

2.2.16 Are there any other approvals that might be required?

i Environment Protection and Biodiversity Conservation Act

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is Commonwealth legislation administered by the Australian Government Department of the Environment and Heritage (formerly Environment Australia). Actions that are likely to have a significant impact on a matter of national environmental significance are assessed under the EPBC Act. An action includes a project, development, undertaking, activity or series of activities. The EPBC Act’s assessment and approval provisions also apply to actions that are likely to have a significant impact on Commonwealth land, and to actions taken by the Commonwealth that will have a significant impact on the environment anywhere in the world (DEH 2004).

At the time of writing, the Act identifies the matters of national environmental significance as:

- World Heritage properties;
- National Heritage places (from 1 January 2004);
- Ramsar wetlands of international significance;
- listed threatened species and ecological communities;
- listed migratory species;
- Commonwealth marine areas; and
- nuclear actions (including uranium mining).

In terms of threatened biodiversity survey and assessment, of particular interest with regard to the above matters are the nationally listed threatened species, ecological communities and

migratory species. If these species are encountered when undertaking surveys, or they are likely to occur in the study area, this triggers the need for referral to the Department of the Environment and Heritage.

When a person proposes to take an action that they believe may need approval under the EPBC Act, they must refer the proposal to the Commonwealth Minister for the Environment. The purpose of the referral stage is to determine whether a proposed action requires approval under the EPBC Act. If the Minister determines that an approval is required, the proposed action will proceed through the assessment and approval process.

A referral is triggered if Commonwealth approval is required. Commonwealth approval requirements are triggered by the level of the impact and not simply because there is a threatened species, ecological community or migratory species present that may be affected.

Further information on EPBC Act requirements and provisions can be accessed at <http://www.deh.gov.au/epbc/index.html>

ii Other Approvals

It should be noted that other approvals may be required depending on the nature of the proposal, such as cultural heritage approvals under the *National Parks and Wildlife Act 1974* or the *Heritage Act 1977*. Details can be obtained from DEC and from the Heritage Council <http://www.heritage.nsw.gov.au>

3 SURVEY AND ASSESSMENT REQUIREMENTS AND PROCESS

'Threatened biodiversity' means threatened species, populations or ecological communities, or their habitats.

Figure 3.1 Summary of the Survey and Assessment Requirements and Process

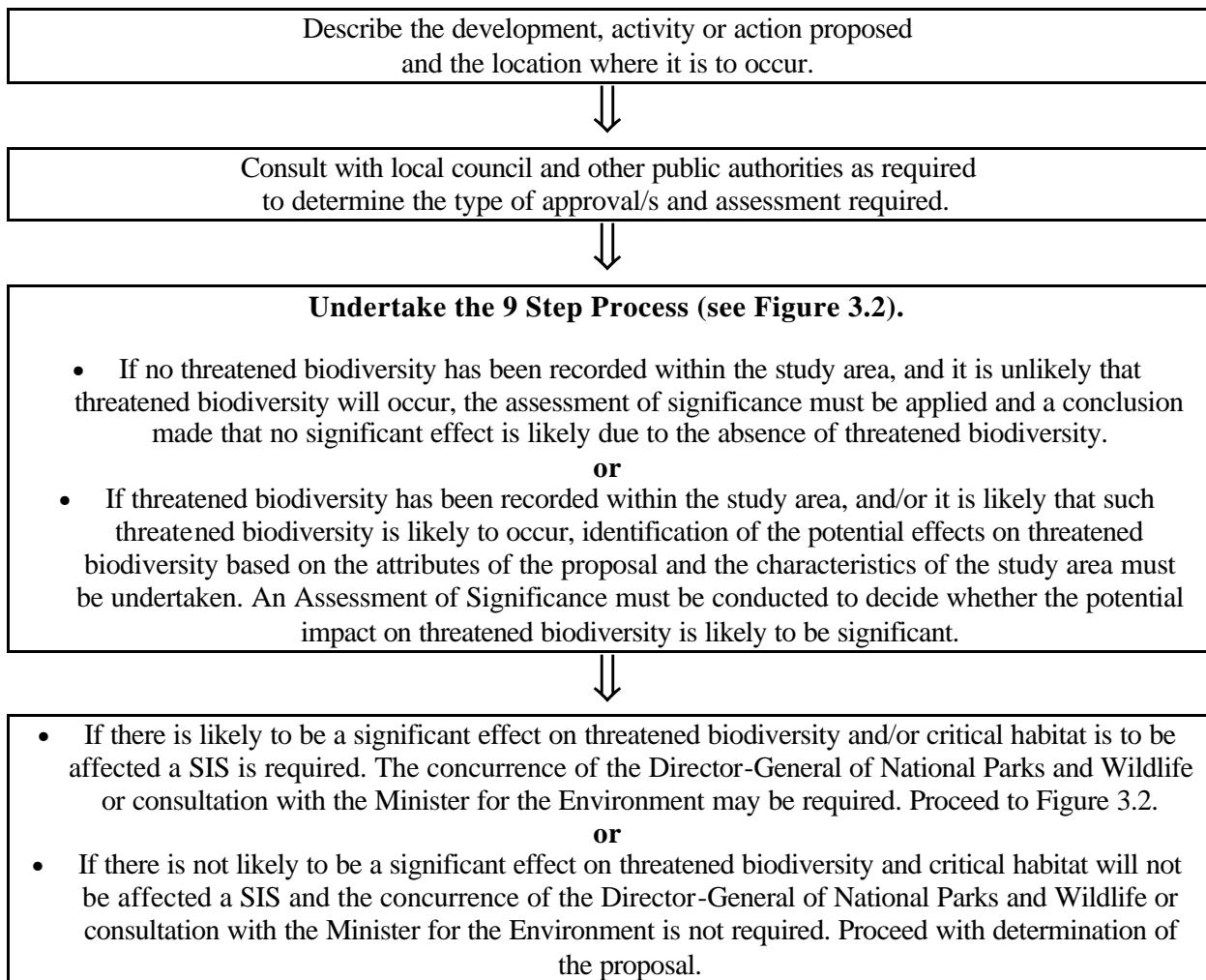
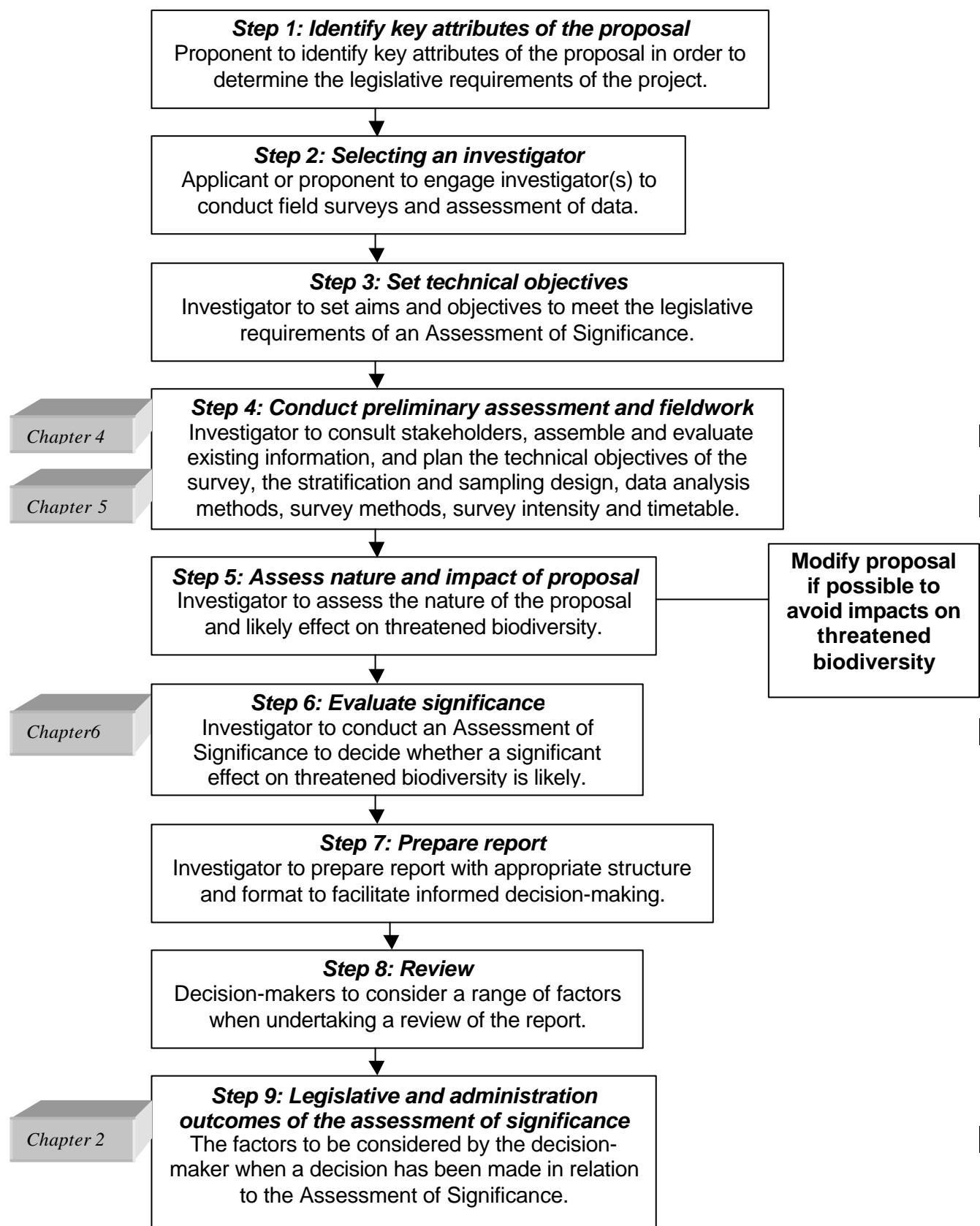


Figure 3.2 Flow Chart of the Survey and Assessment Process



STEP 1. IDENTIFY KEY ATTRIBUTES OF THE PROPOSAL

The overall aim of any Assessment of Significance is to:

“determine whether a proposed development, activity or action is likely to have a significant effect on threatened biodiversity”.

The potential effects of the proposal on threatened biodiversity are a function of the attributes of the proposal and the characteristics of the study area (NPWS 1996a). It is therefore necessary to gather information on the proposal and the study area before determining whether threatened biodiversity is likely to be affected. Identifying the key attributes of the proposal is the responsibility of the proponent or applicant and will involve:

- identifying the extent, location and context in the landscape of the subject site and study area;
- identifying vegetation and animal habitats;
- describing the proposal and predicting the potential impacts of the proposal; and
- conducting a site visit and/or aerial photographic interpretation.

This information will then determine the extent of the threatened biodiversity assessment required, the main trigger being the presence or absence of vegetation or animal habitats in the study area.

The proponent or applicant may wish to consult with the decision-maker, or select an investigator (see Step 2) to assist with the identification of the key attributes of the proposal.

Where vegetation and/or animal habitats **are absent**⁹ from the study area then an Assessment of Significance must be applied and a conclusion made that no significant effect is likely due to the absence of threatened biodiversity. This may occur for some small and minor proposals, however, it is recommended that consultation be held with the decision-maker before making such a conclusion.

Where vegetation and/or animal habitats **are present** in the study area, an assessment of whether threatened biodiversity is likely to occur is required. If the proponent or applicant can adequately predict the key attributes of the proposal at the beginning of the study, it will greatly assist the preparation of a tender brief and selecting an appropriate and qualified investigator (Step 2).

The need for specialist input via an investigator will vary depending on the nature of the site, the proposal, surrounding land uses and the existing level of knowledge of the habitat values of the study area. A certain level of expertise is required to be able to make a defensible assessment. The level of experience required can be ascertained from the advice provided in Step 2. If there is likely to be threatened biodiversity present in the study area then specialist input is generally necessary. If there is any doubt, the decision-maker will be able to provide advice as to whether specialist input is required.

⁹ Note: Even highly disturbed sites with no native vegetation can provide habitat for certain threatened species.

3.1.1 Extent and location of the subject site and study area

Subject Site: the area to be directly affected by the proposal.

Study Area: the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly.

Identifying the extent and location of the subject site and study area is critical in determining if vegetation and animal habitats are likely to be impacted. The subject site can also be referred to as the ‘development footprint’. This includes not only where the proposed development, activity or action will be directly located, but also the site of other associated developments such as access roads, as well as any off-site impacts associated with the proposal.

The study area should always be larger than the subject site as it includes adjacent areas that will be directly and indirectly affected. This may include other parcels of land that contain vegetation and animal habitats. It is therefore important to recognise that these parcels may need to be investigated and permission of landowners will need to be obtained if a field assessment is required. To adequately identify the study area, the potential impacts of the proposal will need to be adequately predicted by the proponent or applicant.

3.1.2 Vegetation and animal habitats

Vegetation:	means all vegetation including: trees, understorey plants, groundcover and plants occurring in a wetland.
Animal Habitats:	may include areas of vegetation, caves, leaf litter, dead stags, hollow-bearing trees, fallen logs, bush rock, wetlands, watercourses, lakes, ponds or dams, or human-made structures.

Differentiating between native and introduced vegetation may be difficult if past clearing or weed invasion has occurred. Even if native trees and shrubs are absent, native grasses may still persist. Moreover, in areas where weeds completely dominate, native species may be present as seedlings or part of the soil seed bank. Although native animal species are more likely to occur in areas of native vegetation, introduced vegetation may provide important habitat and must be considered in any assessment.

In some cases, animal habitats may be difficult to identify, especially if they have been created or altered by anthropogenic activities. For example, the threatened Green and Golden Bell Frog, the Large Land Snail and bats can be present in highly modified environments such as in brick pits, under rubbish, and under bridges or in derelict mines respectively. Bush Stone-curlews can nest in building sites, residential gardens and garbage tips.

3.1.3 Potential impacts

The effects of a proposal on the environment is likely to be unique due to its nature, construction, operation and location. It is important to recognise the nature of both direct and indirect impacts and their likely magnitude during the construction and operational phases of

any proposal. Examples of indirect and direct impacts that are common impacts to threatened biodiversity include:

- clearing, fragmentation, alteration and destruction of native vegetation and animal habitats;
- pollution of watercourses and wetlands;
- sediment, nutrient and pollutant run-off into adjacent vegetation and animal habitats;
- noise and vibration disturbances to bat roosting sites;
- an increase in feral plants and animals; and
- road fatalities.

Identifying direct and indirect impacts will greatly assist in determining the extent and location of the study area. It is not sufficient to only address the area of the subject site but to consider adjacent land that may be directly or indirectly affected by the proposal and other areas subject to off-site impacts. For example, clearing vegetation on one parcel of land may have indirect impacts from sediment run-off and weed invasion on adjacent bushland on another property. Conducting a site visit and/or aerial photograph interpretation will assist in identifying adjacent vegetation and animal habitats that may be affected by these impacts (section 3.1.4).

3.1.4 Site visit and aerial photograph interpretation

A site visit and/or aerial photograph interpretation will enable the proponent or applicant to conduct a preliminary review of the vegetation and animal habitats that occur not only on the site but in adjacent areas. These tools are highly recommended for the proponent or applicant to predict which areas may be affected by the proposal and to determine the requirements of a tender brief (section 3.1.5).

It may also be necessary for potential investigators to conduct their own site visit and aerial photograph interpretation to assist in addressing the tender brief requirements, the level of assessment necessary for threatened biodiversity, and an accurate proposal and costing, and may also be used in the assessment.

Aerial photographs can be ordered on-line through the NSW Department of Lands from the web page <http://www.lands.nsw.gov.au/default.htm>.

STEP 2. SELECTING AN INVESTIGATOR

Selecting an appropriate investigator is an important element of the process as it can ensure the quality and success of the study, and minimise any requests for further information from the decision-maker. The ecological investigations necessary to adequately undertake an Assessment of Significance are a professional field that requires appropriate qualifications, expertise and experience.

The proponent or applicant can achieve this by:

- providing a detailed and comprehensive brief; and
- selecting suitably qualified investigators that are experienced with assessment of threatened biodiversity in the region of the study.

The DEC is developing an accreditation scheme professionals involved in threatened species and biodiversity assessments. Accredited professionals will be advertised on the DEC website once the scheme has been established.

3.1.5 Preparing a tender brief

To select an investigator, the proponent or applicant should first provide a tender brief, which gives instructions on the aims and requirements of the study, the nature of the proposal, and any objectives, limitations and timeframes already determined. It should also describe the area in which the study will be conducted and supply enough detail for an investigator to provide an accurate submission and costing. The tender brief should also identify the types of information required in the investigator's response in order for the proponent or applicant to assess its merits. Tendering may be a two-step process if conducting a pilot or preliminary study prior to undertaking the Assessment of Significance.

The tender brief should include the following information:

1. **Conditions of Tender**, which describes the rules about the tender. This should include:
 - a description of services/goods required (eg. animal and plant assessment including Assessments of Significance);
 - details of when, where and how the bid should be submitted;
 - information on completing the bid and what a complete bid should consist of; and
 - a description of the tender process detailing how the bid will be evaluated, the expected time taken to evaluate responses and the nominated contact officer.
2. **Project Brief**, which requests specific responses from the investigator to enable the proponent or applicant to determine their suitability for undertaking the project. This should include:
 - the project title;
 - the reason for and aims of the project;
 - the physical details of the study area including size, location and any introductory vegetation details if available;

- a description of the proposal and potential direct and indirect impacts to vegetation and animal habitats (sections 3.1.20 and 3.1.21);
 - a request for the supply of technical objectives and appropriate methods to fulfil the aims of the project; and
 - a list of available resources including aerial photographs, previous investigations, and designs of the proposal including maps.
3. **Project Manager**, who will coordinate and manage the project. It is also important to discuss how much contact is required with the project manager over the life of the project (eg. number of meetings and progress reports required).
4. **General Conditions of Contract**, that are the preferred conditions of contract for the proponent or applicant. The investigator is required to comply with these conditions or suggest alternatives if they do not agree.
5. **Project Timetable**, should include:
- when the contract is expected to commence;
 - if field work is to be undertaken during certain periods (eg. during flowering period or when farmers are not harvesting so that they can provide access to properties);
 - a request for the investigator to predict when certain milestones are likely to be achieved (eg. commencement of field work and production of draft report); and
 - project completion date.
6. **Cost of the Project**. The investigator should be requested to provide a breakdown of the cost of each project task nominated and a total fee.
7. **Checklist for the Investigator**, which offers a list of questions to ensure all requirements are met regarding the content of the bid before sending.

3.1.6 Qualifications and experience of investigators

Surveys and assessments of threatened biodiversity must be undertaken by experienced and qualified investigators who, ideally, should have local knowledge of the region in question. *Curricula vitae* (CVs) for all investigators involved in the study should be appended to the proposal and outline significant studies undertaken, especially those conducted in the region, and document possession of the necessary licensing requirements.

Investigators undertaking surveys for the purposes described in these guidelines must be suitably experienced and trained. Suitable experience and qualifications include, but are not limited to:

- demonstrated extensive experience with plant and/or animal survey work and the interpretation of its conservation significance (particularly impact assessment);
- extensive experience in the field identification of plants and/or animals. Investigators must be able to identify the threatened biodiversity relevant to the locality that requires survey, as well as similar species that may be confused with these;
- experience in any additional tasks which the investigator will be undertaking;

- relevant tertiary qualifications are preferable but not essential if the above criteria are met; and
- relevant licences and approvals to undertake field investigations of plants and animals.

The proponent or applicant should consider requesting the investigator to provide referees and examples of reports completed for previous work of a similar nature. It is advisable to contact the referees and review the reports to assist in assessing the suitability of the investigator.

3.1.7 Licences, permits and authorities required to conduct fieldwork

i DEC Scientific Licence

Scientific licences are issued under s132C of the *National Parks and Wildlife Act 1974* (NPW Act). Section 132C came into effect in January 2003 and replaced the previous need for separate licences under other provisions of the NPW Act and the TSC Act.

Persons who wish to undertake scientific investigations on DEC-managed estate or undertake activities involving protected animals or plants, require a scientific licence from the DEC. For projects involving animals an Animal Research Authority must also be obtained (see section 3.1.7 iii).

The purpose of a scientific licence is to allow for the assessment of the impacts on biodiversity and to regulate this, and to provide the DEC with information on threatened biodiversity, a record of the type of studies that are being undertaken and in what area/s. Conditions may be applied to a licence to reduce the impacts of the actions proposed and to provide a measure of protection for species, populations and ecological communities. A standard condition of all scientific licences issued by the DEC is the submission of a full report of the actual work carried out under licence. In addition, details of the animals, plants or other organisms captured, observed or collected including species identification, precise locality and date of trapping, observation or collection are to be supplied to the DEC in electronic format, for incorporation into the Atlas of NSW Wildlife database. Information gained through the licensing process helps expand the current knowledge of biodiversity. The DEC is preparing a policy on the application and review of scientific licences.

A scientific licence can authorise the undertaking of an activity for scientific, educational or conservation purposes that is likely to result in one or more of the following:

- harm to any protected fauna, or to an animal that is of, or is part of, a threatened species, an endangered population or an endangered ecological community;
- the picking of any protected native plant or of any plant that is of, or is part of, a threatened species, an endangered population or an endangered ecological community;
- damage to critical habitat; or
- damage to a habitat of a threatened species, an endangered population or an endangered ecological community.

If studies are to be undertaken on lands reserved or dedicated under the NPW Act consent granted under Clause 22 of the *National Parks and Wildlife Regulation 2002* is required. This consent authorises a person to undertake research activities on land managed by the NPWS

(now the DEC) including research on, or the collection of, any animal, including invertebrates, plants, fungus, geological, hydrological, or other specimens or samples.

If surveys involve capturing and banding birds or bats with Australian Bird and Bat Banding Scheme bands, licence applicants must also hold a current “A” or “R” Class permit from the Australian Bird and Bat Banding Scheme, or must have written notification that they will be issued a consent to band birds or bats upon the granting of a complementary state licence.

A scientific licence may authorise any specified persons, or class of persons, to whom the licence is issued to undertake the actions authorised by the licence. That is, more than one person may be authorised under a single licence. Field assistants do not need to be named on the licence, however it is suggested that the primary licensee maintains a signed register of all field assistants undertaking activities authorised by the licence. This register may also be referred to in the licence conditions.

Enquiries about DEC scientific licences should be directed to the Wildlife Licensing section of the Parks and Wildlife Division, DEC, on 02 9585 6540 or e-mail: wildlife.licensing@environment.nsw.gov.au

ii Special Purposes Permit for Work in State Forests

In addition to scientific licensing requirements, a Special Purposes Permit is required to undertake biological surveys of any kind within lands controlled by State Forests of NSW, including State forests, plant reserves and timber reserves. Special Purpose Permits are issued under s32 of the *Forestry Act 1916* and Clauses 110-115 of the *Forestry Regulation 1983*.

The Special Purpose Permit is issued with conditions, including the requirement to notify NSW State Forests' regional managers within 48 hours of any sightings of species listed on Schedules 1 and 2 of the TSC Act.

The Permit application form can be obtained by contacting State Forests of NSW on 02 9980 4100 or <http://www.forest.nsw.gov.au/research/permits/default.asp>

iii Animal Research Authority

Investigators must be aware of the requirements relating to animal care and ethics when conducting wildlife surveys. The handling and capture of animals is regulated by the *NSW Animal Research Act 1985* (AR Act) and the *NSW Animal Research Regulations 1995*, which are administered by NSW Agriculture.

The AR Act (s25) requires that every person undertaking animal research must be the holder of an Animal Research Authority. Under the Act, animal research includes the use of animals in field surveys. An animal is defined by the AR Act¹⁰ as a vertebrate (excluding humans) including mammals, birds, reptiles, amphibians or fish (NSW Agriculture 2000a).

¹⁰ Please note that the AR Act definition of animal is different to that used throughout the remainder of this document and as defined by this document's glossary.

Animal Research Authorities are issued by the Director-General of NSW Agriculture, or by the Animal Ethics Committee (AEC) of an accredited research establishment (such as a University). Animal Research Authorities must conform to any conditions set by the AEC and the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes* (NHMRC 1997).

The Animal Research Review Panel, established by the AR Act, and the Animal Welfare Unit of NSW Agriculture has produced a series of guidelines that should be referred to prior to conducting animal and plant surveys. These include guidelines for wildlife surveys, the use of pitfall traps, the collection of voucher specimens, and the use of feral animals. The guidelines are regularly updated and can be obtained from the Animal Welfare Unit of NSW Agriculture, or from www.dpi.nsw.gov.au.

3.1.8 Certification of reports

To ensure integrity in animal and plant reporting, all consultants and sub-consultants should certify their report. The certification should state:

- that the results presented are a true and accurate record in the opinion of the author/s;
- whether survey work was carried out in accordance with these or other guidelines; and
- that the results are available to the public for future use and have been supplied to DEC for their Atlas of NSW Wildlife database.

In some cases proponents or applicants may insist on confidentiality agreements with investigators to not disclose the results of survey work. Proponents, applicants and investigators should be aware that disclosure of results to DEC is a statutory condition of the issuing of a scientific licence which must be obtained prior to any survey work being undertaken.

3.1.9 Liability and indemnity

All investigators undertaking animal and plant studies should be appropriately insured. The details of relevant insurance policies should be included in the proposal to undertake the work and should include: type of insurance; amount of cover; and the name of the legal entity that is insured.

3.1.10 Codes of conduct

Investigators should make themselves aware of any written codes of conduct relevant to the work they will be undertaking. The DEC is developing an accreditation scheme for professionals involved in threatened species and biodiversity assessments. The scheme is likely to include a Code of Conduct.

3.1.11 Determining the successful investigator

The proponent or applicant should develop criteria for assessing tender bids when developing the tender brief to ensure that the brief asks for information relevant to the assessment of bids. Some criteria that may be used to assess tender bids include:

- meet all criteria outlined in the brief;
- provide technical objectives that meet the desired aim of the study;
- identify potential constraints to the study;
- display an understanding of the project and the impact assessment process;
- provide references;
- provide a budget and timeframe which will achieve the outcomes of the study, and demonstrate that the project budget and timeframe can be met;
- accept additional conditions of the contract (eg. copyright and authorship attribution, and how the document is to be supplied); and
- set milestones for progress reporting.

It is important for the proponent or applicant to note that if any of the factors of the Assessment of Significance are not addressed to the satisfaction of the decision-maker then additional information and/or advice from a plant or animal expert may be sought. By ensuring the Assessment of Significance properly addresses all of the factors prior to submitting the application to the decision-maker, the need to gather further information, which can be costly and untimely, will be minimised. It is therefore important to note that the least expensive tender may not be the least expensive in the long term if it has to be supplemented with further work. Referee checks of investigators during the selection process should be included.

STEP 3. SET TECHNICAL OBJECTIVES

3.1.12 Devise technical objectives

Technical objectives need to be devised by the investigator to meet the overall aim of the Assessment of Significance, which is to determine whether a proposal is likely to significantly affect threatened biodiversity. The technical objectives set the framework for addressing the Assessment of Significance.

Defining the technical objectives will assist in:

- meeting the requirements of the tender brief (section 3.1.5);
- recognising potential constraints (section 3.1.13);
- setting the timeframe of the study (section 3.1.15); and
- determining the level and types of investigations required (Step 4 and Chapter 5).

3.1.13 Recognising and dealing with potential constraints

Potential constraints to the study should be recognised and dealt with by appropriate sampling design where possible. Many constraints, particularly those that limit the intensity and spatial extent of sampling, may restrict the level of analysis that is possible in the study. Consequently, the overall aim of the study may not be adequately met which may result in the decision maker requiring further survey work or information, particularly where the constraints cannot be overcome.

In some cases, constraints are unavoidable and therefore must be acknowledged as limitations. The report should acknowledge such limitations and adopt the precautionary principle (section 3.1.14). Potential constraints to a threatened biodiversity study that should always be considered include:

- restrictive budget and timeframe;
- availability and reliability of information;
- disturbances prior to or during the survey, such as bushfire;
- access to lands;
- seasonal or vagrant species;
- obtaining appropriate survey personnel;
- achieving an adequate survey effort;
- species that are difficult to survey (cryptic species); and
- changing weather conditions.

3.1.14 Adopt the precautionary principle

In addressing limitations to the survey and assessment process (section 3.1.13), it is always important to consider the precautionary principle. The precautionary principle is defined as (*NSW Protection of the Environment Administration Act 1991 s6(2)*):

“if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation”.

It is advised that where adequate surveys have not been conducted within the study area due to limitations, the precautionary principle should always be adopted. This involves assuming that threatened biodiversity which are likely to occur in the study area (based on the presence of suitable habitat and recent records) inhabit the whole of the study area. The Assessment of Significance would then be conducted on this basis. The precautionary principle must be considered by decision-makers in broader aspects of the impacts of a proposal on the environment.

3.1.15 Set timeframe

It is important that the proponent or applicant consider the timeframe of the study in the early phases of the project, particularly given that the appropriate timing of surveys may not always

correspond with the project's expected date of submission to the decision-maker. To achieve the aim and objectives of the study and to consider the potential constraints (section 3.1.13) the proponent or applicant and the investigator must agree upon an adequate timeframe. It is critical that enough time is allowed for an adequate sampling effort to be achieved, to ensure the study produces valid and reliable results.

Issues for the proponent or applicant and investigator to consider when setting a time-line for the threatened biodiversity study include:

- field surveys will need to be conducted in the study area in seasons which are appropriate for detecting all taxa, and over an adequate length of time;
- voucher specimens, scats, hair samples and bat call recordings will need to be identified by a specialist before they can be used as data; and
- adverse weather conditions may affect the validity of the survey techniques and surveys may need to be repeated when the weather is more suitable.

STEP 4. CONDUCT PRELIMINARY ASSESSMENT AND FIELDWORK

The main purpose of a preliminary assessment is to assess the likelihood of the study area and subject site supporting threatened biodiversity. This is the first step in establishing whether the proposal is likely to have a significant effect on threatened biodiversity. To make this assessment, the following information is required:

1. **Description of the study area.** This description must include details of the types, locations and conditions of native vegetation and animal habitats in the study area. It is important that the study area is clearly described for the benefit of the decision-maker to allow the investigator to select appropriate survey methods and effort. The study area and subject site and the relevant habitat features should also be displayed on a map. Providing photos of the study area, including the subject site, in the report is also beneficial.
2. **List of threatened species, populations or ecological communities, or their habitats, known or likely to occur in the locality.** The size of the locality will vary depending on the location of the study area and the amount of information available. For example, in Sydney the locality may be defined as a 5km radius of the subject site compared with far western NSW where the locality may be a 50km radius of the subject site due to the limited number of surveys conducted and information available.
3. **Assessment of the likelihood of those species identified in the locality (point 2) occurring or likely to occur within the study area.** This can be determined from a comparison of the habitat requirements of each threatened species or population, known or likely to occur in the locality, and the habitats present within the study area identified from a site inspection.

Table 3.1 provides a checklist to assist in the preliminary assessment of the study area.

Table 3.1 *Checklist for assessing the likely presence of threatened species, populations or ecological communities, or their habitats, within a study area*

Description of the environment	Characteristics
What threatened species, populations or ecological communities are known or likely to occur within the study area?	
What habitat(s) are present within the study area?	
What is the condition (quality and quantity) of the habitat of the species, populations or ecological communities identified above based on, but not limited to: <ul style="list-style-type: none"> • Availability of foraging substrate; • Availability of trees containing hollows; • Density of ground cover including shrubs and fallen trees; • Presence or absence of caves, rock outcrops, overhangs, crevices; and • Presence or absence of permanent or intermittent water bodies. 	
Is/Are the habitat(s) connected with similar habitat(s) occurring outside the study area and what is the extent of interconnectedness and distribution of the habitat(s) within the region?	
Does the study area contain any critical habitat, as declared under Part 3 of the TSC Act?	
What is the nature and extent of disturbance from natural or human-induced causes (incremental loss of habitat, weed encroachment, fire, introduced species, grazing, logging, pollution etc.) that already exist within the study area?	

Gathering information to fulfil the requirements of the preliminary assessment should include:

- consulting key stakeholders (section 3.1.16);
- collating and reviewing existing information (sections 3.1.17 and 3.1.18); and
- conducting a site assessment (section 3.1.19).

3.1.16 Consult key stakeholders

Key stakeholders should always be consulted for any threatened biodiversity assessment as they can assist in:

- clarifying the technical objectives of the study;
- identifying important factors to consider, including constraints imposed by natural or cultural features;

- the level of reporting and the reporting format chosen; and
- providing relevant information.

Key stakeholders relevant to a threatened biodiversity assessment can be grouped into a number of categories: natural resource agencies and organisations; local government; interest groups or organisations; and the community.

i Natural Resource Agencies and Organisations

Discussions with natural resource agencies and organisations may identify areas, communities and species of conservation concern or important habitat features of adjoining areas. They may also have knowledge of similar studies conducted in the locality, which can be incorporated into the threatened biodiversity assessment. Although natural resource bodies may be of assistance they do not have the resources to undertake work on behalf of the investigator. Natural resource bodies often hold information available in databases, including:

- Department for the Environment and Heritage (formerly Environment Australia);
- Greening Australia (non-government organisation);
- Australian Museum;
- National Herbarium;
- NSW State Forests;
- NSW Department of Infrastructure, Planning and Natural Resources;
- NSW Department of Environment and Conservation (including the former NPWS and Royal Botanic Gardens); and
- NSW Fisheries.

Appendix E lists the information that each natural resource agency or organisation will be able to provide.

ii Local Government

It is useful to contact the relevant local councils to obtain the following information relevant to the local government area (LGA):

- previous threatened biodiversity assessments associated with a development application (DA);
- regional and local biodiversity surveys and assessments;
- vegetation and habitat maps; and
- zoning and land use information.

Local councils often have the most recent threatened biodiversity records for the LGA from threatened biodiversity assessments associated with DAs. Once the DAs have been approved, these threatened biodiversity assessments are available for review by the public.

Regional biodiversity surveys and assessments relevant to the LGA may have been commissioned by the Local Government Authority. These studies provide Local Governments with an overview of the LGA's biodiversity, identify areas of high conservation significance, and provide recommendations for conservation¹¹. Some Local Government Authorities are preparing, or have adopted, shire-wide Comprehensive Koala Plans of Management under SEPP 44, which also identify areas of conservation significance.

Zoning and land use information will be necessary in assessing the current and potential impacts on threatened biodiversity. Zoning information is likely to be available in LEPs specific to each LGA and will provide an indication of the current and possible land uses of a site.

iii Interest Groups or Organisations

Community based interest groups and organisations can often provide information on threatened biodiversity relevant to the study area. Groups may include: local natural history clubs, National Parks Associations (NPAs), wildlife carers, Birds Australia, Landcare/Coastcare etc.

iv The Community

Local residents, especially those present on the subject site and on adjacent lands, can often provide a variety of relevant information relating to the ecology of the study area. Other members of the wider community with an interest in the area may also have useful information. This includes:

- the extent and timing of previous and current disturbances such as land clearing, bushfire and livestock grazing; and
- sightings of animal and plant species, including seasonal and cryptic species such as orchids and the Broad-headed Snake.

In addition, landholders should always be contacted and their permission gained if investigators are planning to conduct field surveys on, or to enter, their properties.

3.1.17 Collate and review information

All available information on threatened biodiversity needs to be considered for the decision-maker to be in a position to make a decision as to whether the proposal is likely to have a significant effect on threatened biodiversity (NPWS 1996a). Types of information to be considered includes:

- the number and locations of species records;

¹¹ In order to facilitate the application of the Assessment of Significance, it is recommended that councils in a region combine with state government agencies and other relevant bodies, such as Catchment Management Authorities, to engage the services of a consultant(s). The consultant's role is to compile and collate information relevant to their LGA on threatened biodiversity presence, distribution and habitat availability. The collation of such information will assist in the identification of areas of importance to threatened species, populations and ecological communities. The NPWS Biodiversity Planning Guide for Local Government can provide assistance in these matters. The DEC is also producing guidelines for the Assessment of Significance.

- species, populations and ecological community distributions;
- the locations and extent of suitable habitats; and
- current threats.

These types of information can be obtained from a range of sources including Recovery and Threat Abatement Plans, university libraries, website information, and consulting with relevant key stakeholders (**Appendix E**). It is also important to review and critically evaluate this information to ensure its reliability. This involves evaluating what information is accessible, what may be accessible and what is not accessible. There may be a wealth of information relating to threatened biodiversity in the locality which may have been collected by organisations for other purposes, as discussed in section 3.1.16. It is therefore important to review and critically evaluate existing information on the locality, particularly the reliability and age of any records. The collection, management and use of data is further discussed below and in Chapter 4.

3.1.18 Management of data

The suitability of existing data will be influenced by its reliability, currency and the methods by which it was gathered. Different types of data need to be treated differently. For example, some data not suited to one objective may be used for another.

Factors to consider in the management of data include:

- 1. Maximise use of existing information.** Ensure an exhaustive search of databases, and published and unpublished literature is conducted prior to the site investigation (section 4.1).
- 2. Data evaluation.** The methods by which the data was gathered (systematically or non-systematically; as presence-only, presence/absence or abundance data) will influence the way in which the data can be used. Evaluate the reliability of the source, the accuracy of the location information, and identify knowledge gaps to shape future studies (section 4.2).
- 3. Data collection during field surveys.** Ensure that systematic survey methods are followed and pro-formas are used consistently in order to maximise the value and integrity of the data collected (section 4.3).
- 4. Data collation.** Data entry into databases and spatial data packages maximises the ease of data manipulation. Sharing of data with centralised data users (particularly natural resource agencies) increases the value of the data (section 4.4).

3.1.19 Field surveys

The preliminary investigations will have provided a list of threatened biodiversity that may occur within the study area (section 3.1.17). The purpose of field investigations is to systematically survey the study area and to fill in any information gaps identified from the preliminary investigations. The field surveys should be designed to target threatened biodiversity which may occur in the area, to determine the likelihood of their presence and how the proposal will impact upon them.

Guidance is provided in Chapter 5 on the minimum survey effort required for any conclusions to be reasonably reached. It is recognised that this level of effort may not be appropriate or necessary in all circumstances, or that a greater level of effort may be required in some circumstances. Any deviation from the recommended level of effort should be fully justified.

Survey effort is generally described in relation to stratification units (section 5.1). In certain circumstances, such as for areas of one hectare or less where the site is reasonably homogeneous, the survey effort per stratification unit may be applied across the entire site. These circumstances must be justified within the report and the effort should be distributed across the stratification units within the site. For example, it may be reasonable to utilise 100 trap nights for a one-hectare site even though there are three stratification units within the site if the traps are distributed appropriately across the stratification units. Conversely, some sites in western NSW are of the order of thousands of hectares. In some circumstances it may be justified to alter the minimum survey effort per 100 hectares of stratification unit to a minimum survey effort per some larger area eg. 250 hectares.

Occasionally, the investigator will be asked to consider a study area that has little or no vegetation, very poor animal habitat and no records of threatened biodiversity that is likely to occur in the habitats present. In this case, the decision-maker should be contacted to decide whether a survey is necessary. The lack of field surveys and therefore meeting the minimum survey requirements, as identified in Chapter 5, must be justified in the report. The justification should include:

- a detailed map and photos describing the study area;
- a list of threatened biodiversity recorded in the locality;
- a description of land use in and surrounding the study area; and
- preparation of an Assessment of Significance.

i Designing and Conducting Field Investigations

Factors to consider when designing and conducting field investigations include:

1. **Survey requirements** – survey techniques to target threatened species, populations and ecological communities, and their habitats, identified as likely to occur in the study area;
2. **Recognising constraints** – limitations of the study and adopting a precautionary approach;
3. **Sampling Design** – developing a robust stratification process, recognising sources of variation, and the allocation of resources;
4. **Data Analysis** – identify how data will be analysed as this will affect sample design and survey methods (see Chapter 5); and
5. **Survey Methods** – methods utilised for assessing:
 - plants;
 - animals; and
 - their habitats.

Further consideration of factors for designing and conducting field investigations are included in Chapter 5.

STEP 5. ASSESS NATURE AND IMPACT OF PROPOSAL

Once the preliminary assessment and fieldwork has been conducted (Step 4), the nature and impact of the proposal on threatened biodiversity can be assessed. The potential effects of the proposal are a function of the attributes of the proposal and the characteristics of the study area (NPWS 1996a). This will involve identifying:

- key attributes of the proposal; and
- determining whether threatened biodiversity will be, or is likely to be, affected by the proposal.

3.1.20 Key attributes of the proposal

When discussing the proposal, it is important to be specific and quantitative so that the decision-maker can have a thorough understanding of the proposal and its potential effect on threatened biodiversity. Although much of this information is likely to be provided in the other associated documentation (eg. development application) this information should be addressed separately in the Assessment of Significance. It is also necessary to highlight those components of the proposal which are relevant to the assessment and which are likely to cause the greatest impact.

Key attributes of the proposal to consider in the assessment include:

- the location of the proposal and any additional areas which are likely to be affected by the proposal. These should be delineated on a map showing the proposal in both a local and regional¹² context;
- the type of development, activity or action including any ancillary works and intrinsic work stages;
- the duration and timing of the proposal, including staging; and
- the area affected by the proposal (directly and indirectly) in hectares.

A pro-forma for the summary of the proposal is provided at **Appendix F - Table 1**.

3.1.21 Deciding whether threatened species, populations or ecological communities, or their habitats, will be or are likely to be affected

The potential effects of the proposal are a function of the attributes of the proposal and the characteristics of the study area. Consideration needs to be given to the direct and indirect impacts during the construction and operation phases of the proposal. As these are likely to

¹² As defined in the TSC Act, the region means a bioregion defined in a national system of bioregionalisation that is determined to be appropriate for those purposes. The Director-General of the former NPWS (now the DEC) determines that a bioregion defined in *An Interim Biogeographic Regionalisation for Australia* (Thackway and Cresswell 1995) is an appropriate definition. See **Appendix J** for more information.

differ, it is important that they are addressed separately. Types of construction and operation impacts are addressed in section 3.1.3. The checklist provided at **Appendix F** - Table 2 will assist in the identification of the key attributes of the proposal.

The checklist in Appendix F will assist in identifying potential effects of the proposal, which form the basis of the decision whether there is likely to be a significant effect on threatened biodiversity.

When identifying the potential effects of the proposal, consideration should be given to the nature, extent, frequency, duration and timing of the effects. Consideration should also be given to any possible measures to avoid or ameliorate the effects of the proposal on threatened biodiversity (section 3.1.23).

Appendix F - Table 2 should not be considered as a comprehensive representation of all potential effects. It provides a list of potential effects that should be considered as a minimum. Any other issues relevant to the particular proposal and its environment should also be considered. It is recommended that a consultative process involving stakeholders be established to assist in the identification of other issues relevant to the proposal.

3.1.22 Addressing cumulative impacts

It is highly recommended that the cumulative impacts of the proposal be considered. While the Assessment of Significance for an individual proposal may conclude that a significant effect on threatened biodiversity is unlikely, the potential effect in combination with other developments, activities or actions, should be addressed. Cumulative impacts should be considered during the preparation of the Assessment of Significance and by the decision-maker when making a decision.

3.1.23 Addressing threats

One of the factors to be addressed in the Assessment of Significance is “whether the action proposed is of a class of action that is recognised as a threatening process”. Threatening processes include:

- those listed as Key Threatening Processes under Schedule 3 of the TSC Act; and
- other processes that are recognised as known threats to threatened species, populations and ecological communities, and their habitats.

Although a particular proposal may not be recognised as a threat (eg. residential development), its impacts may exacerbate known threats to threatened biodiversity through its activities (eg. vegetation clearing). It is therefore important to recognise the likely impacts of the proposal and its relationship to key threatening processes and other threats to threatened biodiversity. This information can then be addressed in the Assessment of Significance and used to develop appropriate mitigation and amelioration measures to minimise the impact of these threats (section 3.1.23 and section 6.2).

i Key Threatening Processes

Key threatening processes are described in section 2.1.3 and the current list of key threatening processes on the TSC Act can be found at

<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Key+threatening+processes+by+doctype>

ii Other Threats

It is important to not only address key threatening processes listed under the TSC Act but other known threats to threatened biodiversity and habitats in the study area. Information on other known threats can be obtained from the *NPWS Threatened Species Profiles* <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Threatened+species+publications>, which identify specific threats to each of the threatened species, population and ecological community for which a profile has been prepared. In addition, Table 3.2 lists a number of common threats to threatened biodiversity and the associated activities that may exacerbate these threats.

Table 3.2 Examples of major threats

Threat	Associated Activity
Alteration to hydrological systems; increase nutrients; salinity	Agriculture; all urban
Clearing of native vegetation	Agriculture; forestry; all urban
Bush fire management	Agriculture; all urban
Stock grazing	Agriculture
Pollution and land contamination	Agriculture; all urban
Soil erosion, sedimentation and compaction	Agriculture; all urban; extractive industry
Introduction of non-native plants	Agriculture; all urban
Introduction of non-native animals	Agriculture; all urban

Source: Fallding *et al.* (2001)

3.1.24 Reducing the level of impact through ameliorative measures

If there is a likelihood that threatened biodiversity will be affected by the proposal there is a requirement to undertake the Assessment of Significance to determine whether the impacts are likely to be significant. If the decision-maker decides that the impacts are likely to be significant a SIS will be required and may result in the proposal being refused. Investigating ways in which the expected impacts can be minimised, mitigated or ameliorated early in the process is likely to reduce the costs and time involved in obtaining approval from the decision-maker.

The decision-maker must consider these ameliorative measures as being part of the proposal when making a decision. Therefore, the mitigative and ameliorative measures should be:

- fully detailed describing the timing, location and level of effort to be applied;
- integrated in the development, activity or action proposed; and
- should be understood and accepted by the proponent or applicant.

In situations where the decision-maker refuses the proposal on the basis of an expected significant impact on threatened biodiversity, ameliorative measures may be devised and the proposal re-submitted. A new Assessment of Significance will need to be undertaken to address the amended proposal.

i Importance

Managing impacts is a vital component of any Assessment of Significance and needs to be considered in great detail by all three parties: the proponent or applicant; the investigator; and the decision-maker. In their assessment of the proposal, the decision-maker will carefully consider all proposed measures that mitigate, ameliorate, compensate or monitor threatened biodiversity and will assess these as being part of the proposal. In the final assessment, these measures may substantially influence the determination made.

It is therefore important when devising these measures that the investigator and the proponent or applicant work in collaboration instead of the investigator simply providing recommendations that may or may not be implemented by the proponent or applicant as part of the proposal. For example, the investigator may recommend that an area of vegetation be avoided but the proponent or applicant does not adopt this recommendation as it is economically unfeasible for the proposal.

It should be emphasised that measures that manage impacts are not a sufficient reason alone for a decision-maker to give consent or concurrence to a proposal. All other factors relating to the proposal must be considered.

ii Devising Measures

For nearly all proposals some form of mitigation is necessary to reduce the impacts of the proposal on ecosystems. Standard mitigation measures, which are often adopted for proposed developments, include erosion and sediment control and programs for the control of wastes. However, where threatened biodiversity may be affected more specific measures are required.

The cumulative effects of a proposal on threatened biodiversity are not reversible, however, many of these impacts can be minimised and additional activities undertaken to ameliorate and compensate for these impacts. Measures to minimise and ameliorate for impacts on threatened biodiversity must be specific to the nature of the proposal and the aspects of those threatened species, populations or communities, or their habitat, being affected. It is also important to document how, when and where these measures will be implemented.

In devising mitigative and ameliorative measures, it is important to carefully consider the range of impacts that the proposal is likely to have and which of these will impact upon

threatened biodiversity. In determining this, it may be necessary to contact natural resource agencies and organisations that may be able to provide advice on the likely impacts of the proposal on threatened biodiversity and how these impacts can be minimised. Of particular assistance are:

- DIPNR – planning and assessment related matters, soil, water, vegetation and specific habitat features; and
- DEC (formerly NSW NPWS) – native animals and plants, habitat features, critical habitat, and DEC (formerly NSW EPA) – air, noise and water.

Sources of information should also be investigated as they may provide base-line data, established procedures, useful insights into potential effects, and specific measures. Useful sources include:

- similar proposals or Assessments of Significance that cover the same species, populations or ecological communities;
- case studies;
- research papers on the type of development, activity or action being proposed or the threatened biodiversity being affected; and
- manuals or guidelines on techniques associated with particular activities eg. *EIS Guidelines for Coal mines and associated infrastructure* (DUAP 2000a).

iii Examples of Measures

Table 3.3 lists examples of measures that may be adopted by a proposal to minimise impacts to threatened biodiversity. These include protecting and avoiding significant areas. When devising a proposal's own measures, it is important to remember that they will need to be specific to the threatened biodiversity known or likely to occur in the study area and to the type and scope of the proposal.

Translocation of animals is not an appropriate ameliorative measure in the majority of circumstances. The DEC, through various licensing provisions, is the primary regulator of the translocation of animals in NSW. It is the policy of the DEC that translocation should not be used as a substitute for the protection of high quality natural areas and conservation of wild populations *in situ*. The methods, risks and consequences associated with a proposal need to be thoroughly assessed before any translocation is undertaken. The NPWS (now the DEC) prepared a *'Policy for the Translocation of Threatened Fauna in NSW'* to guide the planning and implementation of translocation programs for threatened animals in NSW.

Further, it is the DEC's policy that where the removal of threatened animal habitat is proposed in the course of carrying out a development, activity or action, and where the concurrence or consultation of the Director-General of National Parks and Wildlife is required under the EP&A Act, the emergency transfer of threatened animals will not be considered as an alternative to *in situ* conservation.

Similarly, the DEC does not consider the translocation of plants as an acceptable measure of amelioration. Plant translocation is similarly regulated by the DEC through licensing provisions. In addition to any specific licence conditions, all plant translocations should be undertaken in accordance with the Australian Network for Plant Conservation Translocation Guidelines (<http://www.anbg.gov.au/anpc/books.html#Translocation>).

Table 3.3 Examples of measures to manage impacts

Category	Examples
Protection and avoidance	Relocating or changing the design of the proposal Restricting access of construction crew and machinery Implementing stringent sediment and erosion control measures Creating buffer areas between a significant area and the footprint of the proposal
Enhancement	Bush regeneration activities Replacing animal habitats such as tree hollows and rocky outcrops The use of underpasses/overpasses in order to allow passage of native animals between natural areas
Compensation	Land acquisition Construction of artificial replicas of important habitat features (eg. artificial nesting sites for birds, frog-friendly ponds)
Management	Weed and feral animal control program Bush fire management Ongoing monitoring programs Restricting livestock, humans and domestic pets to certain areas

STEP 6. EVALUATE SIGNIFICANCE

3.1.25 Deciding whether a development, activity or action is likely to significantly affect threatened species, populations or ecological communities, or their habitats, that are known or likely to occur in the area

If it is found that the proposal has the potential to directly or indirectly impact threatened biodiversity, an assessment needs to be made of whether the proposal is likely to cause a significant effect.

When deciding whether a proposal is likely to significantly affect threatened biodiversity an Assessment of Significance must be applied to each species, population or ecological community. The results of the Assessment of Significance are used to aid the decision-maker when deciding whether a SIS is required.

The Assessment of Significance is not a ‘pass/fail’ test or technique based on a scoring system. Instead, the outcome of each factor needs to be considered as to whether effects are likely and whether they are significant (NPWS 1996a). If assessment of any of the factors,

individually or in combination, indicates that a significant effect is likely, the preparation of a SIS is required.

Additional information and/or advice from a plant or animal expert may be requested if any of the factors of the Assessment of Significance are not addressed to the satisfaction of the decision-maker. It is therefore vital that the factors of the Assessment of Significance are properly addressed and incorporate a range of information obtained from the literature review, consultation with key stakeholders, and field surveys. Ensuring this information is provided prior to submission to the decision-maker will minimise the need to gather further information, which can be costly and untimely.

NOTE: The existing assessment of significance, s5A of the EP&A and s94 of the TSC Act, is provided at Appendix C. As a result of the *Threatened Species Conservation Amendment Act 2002*, these factors will be revised.

3.1.26 Consideration of a development, activity or action proposed in an area where there are no threatened species, populations or ecological communities, or their habitats, or where they are unlikely to occur

If a proposal is in an area where no threatened biodiversity has been recorded and it is considered unlikely that they will occur in that area, the decision-maker is still required to have regard to the Assessment of Significance to satisfy the legislative requirements of s5A, s90 and s111(4) of the EP&A Act and s94 of the TSC Act.

A statement addressing the factors of the Assessment of Significance which highlights the absence and unlikely occurrence of threatened biodiversity within the study area, and that the proposal is unlikely to have a significant effect on these, must be made. This statement should be supported with relevant information pertaining to the study area eg. literature reviews, surveys, database searches.

STEP 7. PREPARE REPORT

The reporting phase of any study must be given careful attention to ensure it is readable and able to be understood. It should communicate to the decision-maker:

- how the investigations were carried out;
- what information was used in undertaking the assessment;
- how the conclusions of the assessment were reached;
- how the interpretations are justified; and
- whether other studies report similar findings.

This information must be carefully presented in reports to enable correct interpretation of results (Fallding *et al.* 2001).

Factors of particular importance include:

- outlining structure and content;
- ensuring correct terminology;
- meeting minimum reporting requirements, including maps; and
- forwarding information to centralised databases.

3.1.27 Structure and content

In general, Assessments of Significance and associated reports should follow a similar format to that of a scientific paper and, where possible, adopt a similar approach with regard to objective evaluation of results and the use of evidence and references to support conclusions. Minimum report requirements are provided below, however additional information may be required according to:

- the nature of the proposed project;
- the tender brief provided by the proponent or applicant; and
- specific requirements of key stakeholders.

Information should be presented in manageable parts (for example, chapters, sections and subsections) and have a logical flow from one to the next. The text of the report needs to be concise yet detailed enough to allow the reader to evaluate whether the investigator has summarised or interpreted the survey results correctly. To improve readability, technical information should be presented in the appendices. Investigators should carefully consider how to present the data so that critical information can be easily found and to ensure understanding of the results. Data should be summarised within the report using maps, tables and graphs wherever possible.

Maps are a powerful means of communicating information about threatened biodiversity and the impacts of the proposal. Geographic Information Systems (GIS) software is a useful tool as data can be manipulated to illustrate, for example, habitat types, vegetation communities, species distributions, geographic features such as catchments, political boundaries, and infrastructure features. Important aspects to remember when mapping include the appropriate use of scale, legends and the accuracy of the information.

The decision-maker should consider requiring photographs of the vegetation types and habitat features identified in the study area to be included in the report as they will assist in the interpretation of the report.

Table 3.4 outlines the structure and content of the report and identifies the purpose of each section.

Table 3.4 Structure and content of the Assessment of Significance report

Section	Purpose	Content
Summary	Facilitates understanding by the general public	Non-technical description of the study and its findings. It should be restricted to less than two pages where possible.
Definitions	Ease of reference	Explanation of technical terms used throughout the report.
Introduction	Sets the scene of the study	<ul style="list-style-type: none"> - the author of the study and who it was commissioned by; - a description of the proposal; - the regional context, location, geology, soils, landforms, climate, disturbance history and other relevant information relating to stratification requirements; - any constraints or limitations on the study; - how the report is structured; and - the study's aim and objectives.
Legislative Requirements	Outlines the legislative requirements and regulations pertaining to the study	<ul style="list-style-type: none"> - all applicable environmental planning instruments; - the provisions of all applicable legislation; and - all approvals, consents and licences.
Methods	Details the desktop and field survey methods employed. The technical information should be sufficiently detailed to enable the field survey to be replicated. The choice of field methods and extent of survey should be justified, and any constraints noted.	<ul style="list-style-type: none"> - description of consultation with key stakeholders; - data sources, and an explanation of how data was handled; - the methods used to determine the stratification units and how the units were sampled, and information about the spatial distribution and size of strata; - description of each stratification unit, the vegetation types in terms of structure and floristics, and a list of the dominant plant species in each growth stratum (trees, understorey, shrubs and groundcover); - as part of the habitat assessment requirements, each vegetation type must have a description of the area's disturbance (prior clearing/logging, fire regime, flooding), a description of the weeds present and their density, and comments on the suitability of the area as habitat for species, populations and ecological communities of conservation significance; - survey techniques utilised and the intensity of sampling in each strata; - type and number of traps, their layout described and mapped, baits, and the number of survey nights for each technique; - sampling dates, times and weather conditions; - the precise location and layout of the stratification units, quadrats, traverses and sampling sites, vegetation types, and relevant species distribution (presented as grid references and maps); - additional information requirements will depend on the aim of the survey being conducted. For example, if the survey targets arboreal mammals then information on the density of trees with large and/or small hollows will be relevant; and - data analysis methods, including any criteria used to categorise areas of high biodiversity.

Section	Purpose	Content
Results	Displays the findings of the study	<ul style="list-style-type: none"> - a list of all plant and animal species recorded; - a list of all threatened species, populations, ecological communities recorded or known or likely to occur in the locality; - summaries of the data, including which species were found at which sites, strata vegetation or habitat types, and by which methods they were located; - maps of survey method locations; - any general or unusual observations; - maps of environmental features, vegetation types and habitat types; - results of any modelling or statistical analysis of data; - maps of any areas of high biodiversity or other areas of special significance; - photos of the study area and subject site; and - raw data (copies of original data sheets are acceptable) should be included in an appendix.
Safeguards	Discusses measures to minimise impacts	<ul style="list-style-type: none"> - mitigation measures; and - amelioration measures.
Assessment of Significance	Assesses whether the proposal is likely to have a significant effect on threatened biodiversity by addressing the factors of s5A of the EP&A Act and s94 of the TSC Act.	<ul style="list-style-type: none"> - inclusion of Assessment(s) of Significance; and - use references from other sources to provide additional support.
Conclusion	Discusses the results	<ul style="list-style-type: none"> - a summary of the information collected, including statements on the likely presence/absence of threatened biodiversity, and the general habitat value of the study area; - interpretation of the results of the study, including statements as to whether a significant effect on threatened biodiversity is likely; - how the findings of the study can be implemented; - limitations and further issues that may need to be addressed; - recommendations for further work; and - citation of all relevant references.
References	Cites publications used in the report	Lists all documents cited within the report with author, year of publication, title of publication, journal volume and pages and/or name of publisher.
Appendices	Collates detailed information in the back of the report and allows the main body of the report to be concise.	<ul style="list-style-type: none"> - raw field survey data (copies of original data sheets are acceptable); - qualifications of the investigator and of all people involved in the sampling and preparation of the report; - certification of the report by the investigator; and - the issue number and the names of issuing bodies of any licences, permits or authorities under which the fieldwork was carried out, including photocopies of the relevant licences and permits.

3.1.28 Terminology

Careful use of terminology, consistent with legislative and current scientific usage, is required to maintain good communication and to express ecological concepts with precision (Fallding *et al.* 2001). It is important to refer to terms that are consistent with the TSC Act and the EP&A Act, and to define these in the introduction of the report or in a glossary. Terms that should always be defined in a threatened biodiversity assessment include:

- subject site;
- study area;
- locality;
- region;
- local viable population; and
- a significant effect.

Although the glossary in this document provides an explanation of these terms, it is important to define these with respect to the proposal, how they are used in the context of the assessment, and to provide a map of the site, area, locality and region relevant to the proposal.

3.1.29 Minimum requirements

A reporting checklist is provided in **Appendix G** that outlines specific reporting matters for inclusion in Assessment of Significance reports, their role and importance. This checklist provides the investigator with the minimum requirements they need to address in the report, which in turn assists the decision-maker when appraising the report.

3.1.30 The survey map

A map of the survey area is an integral part of the report. It is prepared by the investigator to record the spatial distribution of the vegetation and habitats being surveyed as well as the sampling regime used for the survey. It is important to display the locations, abundance (if known) and extent of threatened biodiversity, and the effort undertaken within the study area as it assists:

- the investigator in determining the impacts of the proposal and in managing these impacts;
- the proponent and applicant in designing the proposal to avoid or minimise impacts to important areas; and
- the decision-maker in identifying and assessing the impacts of the proposal on these important areas, and whether the survey effort is adequate.

The survey map may be prepared on a topographic map at the largest available scale or a recent (less than 5 years old where possible) satellite image or aerial photograph, preferably rectified. The map must show: the boundary of the study area; the boundary of the development, activity or action; locational information; the dominant plant communities; the stratification units adopted; and the location of sampling points and traverses (including effort).

The map must be clearly labelled with an appropriate legend, scale, northpoint and date of preparation.

i Location and Extent

It is preferable that the locations and extent of threatened species, populations and ecological communities, and their habitats, are displayed on a map or a series of maps. For ease of reference, this information should be overlayed onto:

- vegetation community boundaries and locations of habitat corridors;
- topographical features eg. creek lines and ridgelines;
- cadastral features eg. roads and property boundaries;
- existing land use of the study area and adjacent areas;
- boundaries of the subject site and study area; and
- key areas of the proposal.

The precision of data collected should always be maintained. This requires precise mapping in the field and the transfer of this information onto site maps and proposal designs. Section 4.3.2 discusses precision of data and the use of a GPS to accurately locate and record in the field and GIS mapping to display this information.

ii Species Information (Including Abundance)

Species information, including abundance, particularly for threatened species and populations, should be discussed in the text. It is preferable that this information is obtained through the use of survey pro-formas (section 4.3.3). The following information should always be provided with species data, including abundance data:

- time and date recorded;
- total effort expressed in person hours;
- weather conditions;
- location description including basic habitat; and
- observation, microhabitat and breeding type, particularly for birds.

3.1.31 Forwarding information to centralised databases

Information obtained during the threatened biodiversity assessment should be forwarded to centralised databases such as those managed by DEC, Birds Australia, the Australian Museum and the Royal Botanic Gardens.

i DEC Atlas of NSW Wildlife (the Wildlife Atlas)

A standard condition of all s132C scientific licences issued by the DEC (section 3.1.7) is the submission of a full report of the actual work carried out under licence. In addition, details of the animals, plants or other organisms captured, observed or collected including species identification, precise locality and date of trapping, observation or collection are to be supplied to the DEC in electronic format, for incorporation into the Atlas of NSW Wildlife database. An Excel spreadsheet for supplying data to the Wildlife Atlas is available from the

DEC website: http://www.nationalparks.nsw.gov.au/images/scientific_licence_datasheet.xls and in **Appendix H**.

The spreadsheet includes:

- locality (easting and northing and Australian Map Grids (AMGs));
- species name (Scientific for animals and plants and common names for animals);
- sightings per species (the number of records for each species in the search area);
- date of record;
- observer name; and
- abundance.

ii Other Databases

Investigators may be required to send information to other environmental databases including those managed by the Australian Museum, the Royal Botanic Gardens and Birds Australia. This will involve accurate recording of data in the required format for each agency. Contact each agency directly to obtain the appropriate forms and data sheets.

STEP 8. REVIEW

Ultimately, it is left to the discretion of the decision-maker to form a view as to whether a proposal is likely to have a significant effect on threatened biodiversity. Such decisions must be justifiable and in accordance with legal requirements. The decision-maker should seek to ensure that the relevant officers assessing the information are appropriately experienced and/or qualified to make such decisions. The services of a specialist may be engaged by the decision-maker to assist the authority in the decision-making process. For increased accountability, the decision-maker should maintain a record of the information they have used to arrive at a decision.

In reviewing the Assessment of Significance report the decision-maker must:

- ensure that the investigator has covered all relevant statutory and technical issues adequately and objectively;
- evaluate the significance of potential effects by taking into account the Assessment of Significance;
- evaluate consistency with any Recovery and Threat Abatement Plans;
- determine whether the conclusions are valid and acceptable; and
- determine whether a SIS is required.

Appendix C details the requirements of the Assessment of Significance, and Appendix G provides a Reporting Checklist to follow when evaluating Assessment of Significance reports. The DEC is also preparing guidelines on the Assessment of Significance. In reviewing the

Assessment of Significance report, it is important the decision-maker has a thorough understanding of the following:

- the relationship between the Assessment of Significance recommendations and the proposal (section 3.1.32);
- developments and activities which do not require consent or approval;
- the role of the DEC (section 2.2.15); and
- the requirements when a proposal is likely to have a significant effect (Step 9).

3.1.32 Relationship between Assessment of Significance recommendations and the proposal

The Assessment of Significance report is likely to have recommended a range of mitigation and amelioration measures to minimise impacts on threatened biodiversity (section 6.2). The decision-maker must consider these recommendations as being part of the proposal for either development consent under Part 4, approval under Part 5 of the EP&A Act, or licensing under the TSC Act. Therefore, mitigation and amelioration measures should be:

- fully detailed describing the timing, location and level of effort to be applied;
- integrated into the proposal; and
- should be understood and accepted by the proponent or applicant.

If the mitigation measures are not going to be integrated into the proposal, they cannot be considered as part of the Assessment of Significance. Decision-makers should ensure the proponent has confirmed that the mitigation measures are integrated into the proposal.

STEP 9. LEGISLATIVE AND ADMINISTRATIVE OUTCOMES OF THE ASSESSMENT OF SIGNIFICANCE

The Assessment of Significance will determine whether the proposal is likely to significantly affect threatened biodiversity. It is the responsibility of the decision-maker to review this assessment and determine its adequacy and validity (as described in Step 8).

3.1.33 Requirements when the proposal is likely to have a significant effect

If the decision-maker considers the proposal is likely to have a significant effect, then a SIS must accompany the application. The SIS must be prepared in accordance with Division 2 of Part 6 of the TSC Act (Appendix D).

In addition to the preparation of a SIS, the concurrence of the Director-General of National Parks and Wildlife or consultation with the Minister for the Environment is required before the decision-maker can make a decision to grant the proposal. These requirements are

described in the *NPWS Threatened Species Management Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The ‘8 Part Test’ of Significance*¹³.

If the decision-maker is of the opinion that the proposal may be modified such that a significant effect is unlikely, the Assessment of Significance must be applied to the modified proposal. This will ensure that the effect of the modified development has been properly considered and will not be significant.

3.1.34 Requirements when the proposal affects declared critical habitat

If all or part of declared critical habitat is to be affected by a proposal, a SIS and concurrence/consultation is automatically triggered, as described in section 3.1.33.

3.1.35 Advising the proponent of the need to prepare a SIS

If the decision-maker considers the proposal is likely to have a significant effect on threatened biodiversity, the decision-maker must advise the proponent or applicant of the need to prepare a SIS.

It is then up to the discretion of the proponent or applicant to decide whether to proceed with seeking approval for the proposal and prepare a SIS, or not to proceed with the proposal and withdraw the application.

3.1.36 How to proceed with a SIS

Prior to the preparation of a SIS the proponent or applicant must submit a request for Director-General’s Requirements. The process for making requests for Director-General’s Requirements are described in the *NPWS Threatened Species Management Information Circular No. 5: Species Impact Statements*. A SIS should be accompanied by an Assessment of Significance and a copy of the development application, request for Part 5 (EP&A Act) approval or licence application, and any Statement of Environmental Effects, Review of Environmental Factors or other relevant documents that may have been prepared. This ensures that the proper process of assessment is undertaken (essential for the validity of any decision-making) and that proponents and applicants undertake a level of assessment appropriate to the expected impacts.

The requirement for preparation of a SIS is contained in s109 and s110 of the TSC Act (Appendix D) and the *NPWS Threatened Species Management Information Circular No. 5: Species Impact Statements*.

Should the decision-maker, following a review of the SIS, decide that the proposal is likely to have a significant effect on threatened biodiversity, and the decision-maker has decided to approve the proposal, the concurrence of the Director-General of National Parks and Wildlife must be sought before approval is granted. A concurrence application is not required should the decision-maker decide to reject the application or if the decision-maker determines that the proposal is unlikely to have a significant effect on threatened biodiversity.

¹³ Note – This document will be revised prior to the proclamation of the new revised Assessment of Significance.

3.1.37 Requirements when the proposal is not likely to have a significant effect on threatened species, populations or ecological communities, or their habitats

If a proposal is not likely to have a significant effect on threatened biodiversity, the decision-maker is still required to have regard to the Assessment of Significance in order to satisfy the legislative requirements the EP&A Act and TSC Act.

A statement addressing the factors of the Assessment of Significance for each of the threatened species, populations and ecological communities that occur or are likely to occur, which demonstrates that the proposal is unlikely to have a significant effect on the threatened biodiversity in the study area, must be made.

4 DATA

Note: the term ‘threatened biodiversity’ means ‘threatened species, populations or ecological communities, or their habitats’.

4.1 USE OF EXISTING INFORMATION

4.1.1 Types and sources

Types of information relevant to the aims of an Assessment of Significance may include, but are not limited to:

- electronic databases and internet sources (see below);
- aerial photographs and satellite images;
- topographic maps, vegetation maps, geological maps and soil maps (including those for contamination, salinity, hazards);
- previous animal and plant surveys or field studies at any scale in published and unpublished literature;
- historic records of animal, plant and vegetation communities in the area;
- lists of threatened species, populations or ecological communities, or species that are of regional significance;
- literature about the ecology of the species, communities and habitats found or likely to be found in the study area (species profiles, scientific papers);
- relevant Recovery and Threat Abatement Plans;
- Environmental Planning Instruments relevant to the region (eg. SEPPs, REPs, LEPs, RVMPs and associated zone information and regulations);
- guidelines relevant to the study; and
- planning documents specific to the study being undertaken.

The largest sources of information are likely to be the libraries and databases of government natural resource agencies (particularly DEC, DIPNR, the Australian Museum and the Royal Botanic Gardens), councils, and libraries of the study region. Appendix E provides a list of key sources and the types of information they are likely to provide.

4.1.2 Databases

Biodiversity data found in databases is generally of two types: ‘systematic data’ which has been gathered by using a standard set of methods and standard sampling intensity; and ‘point locality data’ which has been gathered by non-systematic means. These data types are not interchangeable in terms of their application (see section 4.2.1), and care should be taken to distinguish between the two types when using data from databases.

There are several biodiversity databases in use in NSW, details of which, and the administrative procedures involved to gain access to them, are outlined in **Appendix I**. These

are useful as a basis for establishing a comprehensive inventory of threatened biodiversity known or considered likely to occur in the locality of the study area. Biodiversity databases should only be used for predictive modelling purposes to assist in the design of field surveys, and as an indication of previous animal and plant distributions in the locality. A useful starting point is the Community Access to Natural Resource Information (CANRI) website at <http://www.canri.nsw.gov.au>, which gives access from a single point to a range of natural resource information from government agencies. The CANRI database is useful for assembling information for a preliminary assessment (Chapter 3, Step 4) however it may be necessary to contact agencies individually to get sufficiently detailed information.

The biodiversity data held in databases are particularly valuable for predictive modelling purposes, to assist in the design of surveys, and as an indication of previous animal and plant distributions in the region. Where a substantial body of systematic data exists, it may be possible to combine that data directly with new systematic survey data if the same survey methods and sampling intensity are used.

Biodiversity data can include presence-only, presence/absence, or abundance data. These data types are generally not interchangeable, however abundance data can potentially be reduced to represent presence/absence. Care must be taken not to combine existing data sets, eg. quadrat data which utilises different cover scales such as a reduced 1-3 abundance scale rather than the standard modified Braun-Blanquet 1-6 scale. It also should be noted that presence-only data indicates presence and does not necessarily mean absence and the reliability to which a species is 'absent' from a study area depends largely on survey methods (see Chapter 5). The survey design should also be considered when determining the application of survey data, as appropriately designed, systematically collected data can imply relationships, however opportunistic sightings can not. More detail on survey methods and design is provided in Chapter 5.

4.1.3 Data availability

Access to existing data for a study may be made difficult by time constraints or confidentiality. Requests for data to other organisations or individuals should be made with reasonable timeframes. A small fee may be charged for the supply of data.

Any animal and plant report that is submitted to Local or State Government to support a development application is a public document and therefore available for review. Most other reports submitted to Local and State Government Departments are exhibited under the auspices of the EP&A Act. However, if a report's findings have adverse commercial or legal implications, a report may be withheld and an application under the *Freedom of Information Act 1989* may need to be lodged. The availability of unpublished data will depend upon individual contract agreements between the parties involved.

4.2 EVALUATION OF EXISTING INFORMATION

4.2.1 Evaluating existing information for the needs of the current study

Existing information should be critically assessed in terms of what it may contribute to the study. Historic information may, for example, be used to derive a list of potential species for the area now or, when compared with recent survey data, may provide a subjective indication of species that may have disappeared from the area. In contrast, recent systematic data may be added directly to new survey data if the same survey methods and sampling intensity were used, or used in the modelling of species distributions or measures of biodiversity abundance because it has been gathered systematically.

Existing information should also be critically assessed in terms of its of reliability. Records may be wrong, duplicated, or species names may have changed.

Examples of factors to consider when determining the reliability of information and its contribution to the current study include, but are not limited to, the following:

- **Date of record.** Records collected in 1900 are not as reliable as those from 1990 in indicating the species that may still be present in the area. Cut-off dates may be arbitrarily chosen, based on some biological event, or nominated by DEC if that agency has a legislative responsibility in directing the study.
- **Survey design.** Whether the data was gathered systematically (by using a standard set of methods and standard sampling intensity) or non-systematically will affect its potential use. ‘Systematic data’ can be used in analyses requiring presence/absence or abundance data while ‘point locality data’, which has been gathered by non-systematic means, can be used only in analyses requiring presence-only data.
- **Survey methods and effort.** To use existing survey data as evidence that a species is not present, the methods used must have been appropriate for detecting that species. The survey effort must also be sufficient, within the appropriate seasons or weather conditions, to provide a reasonable probability of detecting a species if it was present.
- **Accuracy of taxonomy.** Where taxonomic changes have resulted in the splitting of a species into more than one species with overlapping distributions, records that cannot be verified with a voucher specimen may be of very little use in new studies.
- **Accuracy of location of record.** Some older records have insufficiently specific location information for the purpose of some technical objectives.
- **Accuracy of identification.** Some observers will have greater specialist knowledge of species identification than others. Additionally, some species are easily confused with others.

Some sources of compiled data (such as the DEC Wildlife Atlas) already have a reliability code given to each record (Table 4.1).

Table 4.1 Reliability codes for records in the DEC Wildlife Atlas

Code	Definition
1	Specimen with Public Museum
2	Specimen with other collection
3	Voucher specimen used in identification
4	Specialist reliability
5	Standard reliability
6	Suspect sighting

Reliability codes should also be assigned to any new records collected during the current biodiversity survey to assist future users of the data in their evaluations. A coding system similar to that used by the DEC (Table 4.1) is sufficient if the detection method (trapped, spotlighted, roadkill etc.) is also recorded. Information about the habitat in which the record was made may also support the reliability of the record, particularly if it is out of the known range of the species.

4.2.2 Evaluating data gaps

The objectives of the field survey (eg. vegetation, plant, mammal, bird) will depend on the objectives of the study, and how well existing information meets those study objectives.

Gaps in the available literature highlight areas requiring further research and usually form the basis for new work. These gaps need to be treated carefully by all parties, as the results will be based on minimal information. For example, the lack of information about species requirements or distributions in relatively understudied regions of NSW make investigations difficult to design, and assessments made on minimal information can be subjective. In these circumstances, a precautionary approach should be taken, consistent with the principles of ecologically sustainable development and biodiversity conservation. Information gaps may take many forms, including:

- **spatial gaps.** For example, part of the study region has much less existing information than the rest of the region.
- **taxonomic gaps.** For example, surveys have concentrated on birds, mammals and vegetation, but not reptiles or frogs.
- **ecological gaps.** For example, surveys have concentrated on forests but not grasslands and heathlands.
- **topographic gaps.** For example, surveys have concentrated on flat areas and ridge tops, but not steep slopes or gullies.
- **tenure gaps.** For example, surveys have concentrated on national parks and state forests, but not privately owned land.

In most regions, a combination of these factors will apply. Be aware that there may be logistical reasons for some gaps. For example, it may be much more difficult to access steep slopes and gullies during surveys than it is to access flat areas and ridge tops. The survey of private lands in a study region may require the permission of dozens of landholders, rather than the permission of one or two.

The DEC is in the process of preparing threatened biodiversity (Environmental Impact Assessment) profiles to be read in conjunction with these guidelines. Profiles have been prepared for a limited number of species, populations and communities to date and are generally found within recovery plans. Species profile information is based on the latest biological research, and is intended to assist in the assessment process.

4.2.3 Up to date information

Individuals and organisations must keep abreast of the latest legislation and regulations regarding protected areas and threatened biodiversity. Legislation updates can be accessed on-line at <http://www.legislation.nsw.gov.au> and changes are published in the monthly Government Gazette.

In particular, all parties **must** be aware of changes to the Schedules of the TSC and EPBC Acts to ensure that new listings are incorporated in the study. Those species, populations and ecological communities currently being considered as a Preliminary Determination under the TSC Act should also be considered in the assessment.

TSC Act listings including Preliminary Determinations can be obtained on-line at
<http://www.nationalparks.nsw.gov.au/npws.nsf/Content>List+of+Scientific+Committee+determinations>

Information regarding the declaration of Critical Habitat can also be obtained from the DEC website

<http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Critical+habitat+protection>

EPBC Act listings can be obtained on-line at <http://www.deh.gov.au/epbc/index.html>

4.3 DATA COLLECTION DURING FIELD SURVEYS

4.3.1 Data requirements in survey

The fields of data that will be collected during the survey should be determined before the survey begins, and will depend both on the objectives of the survey and the end use of the technical outputs. Irrespective of what type of survey will be conducted, some data is essential for every new record of a species:

- Location information:
 - AMG zone, easting (6 digits) and northing (7 digits)
 - site number (as allocated for the survey);

- Date (day-month-year format);
- Observer's name;
- Observation type (trapped, sighted, heard call, roadkill etc.);
- Species identification:
 - species code (4 digit nationally-agreed codes available from the DEC)
 - species name (nationally-agreed names available from the DEC and the Royal Botanic Gardens); and
- Type of survey (systematic effort and method, or opportunistic).

The value of collecting other data fields will depend on the specific type of survey method and group of target species. For example, weather conditions (cloud cover, rain, wind speed, moon phase) are generally regarded as influencing the success of surveys for bats, reptiles, frogs and spotlighting for arboreal mammals. Some optional data fields provide information that can be useful for developing a model of the habitat preferences of a species, its reproductive behaviour or its diet.

Vegetation maps may be based on many different types of data (for example, overstorey only, or overstorey and understorey; levels of detail in floristics). The types of data used and the scale at which the mapping is done will depend on a variety of factors. These include:

- how the information will be used;
- resources available for new field survey work;
- existing information about vegetation in the area; and
- the desirability of consistency with maps made for other regions.

Table 4.2 Examples of data that may be required to fulfil some technical objectives

Objective	Suggested Data
Gather data required to produce a map of vegetation communities that will be used in modelling the distribution of ground-dwelling mammals	Plant species making up the understorey and overstorey; cover-abundance and structure measures for understorey and overstorey; disturbance history; soil type; topographic measurements; location and species of ground-dwelling mammals from trapping survey.
Gather data required to model the distribution of threatened plants	Structure measures for understorey and overstorey; disturbance history; soil type; topographic measurements; location and species of threatened plants from survey.
Gather data required to make a map of vegetation communities that will be used in modelling the distribution of arboreal mammals	Plant species making up the overstorey; cover-abundance and structure measures for overstorey; abundance and size measures of tree hollows and stag trees; abundance, size and breeding condition of any specialised plant food resources; location, number and species of arboreal mammals from survey.

A comprehensive study will have objectives that will typically include the outputs defined in the Reporting Checklist (Appendix G).

4.3.2 Precision during data collection

Data collected during field investigations should be recorded accurately, legibly, consistently and at the time of observation.

Accurate location information is essential for survey work. Global Positioning Systems (GPS) assist in providing accurate location information. It is important to note that Australian Geodetic Datum (AGD) has changed to the Geocentric Datum of Australia (GDA). Land and Property Information NSW is currently updating topographic maps from the existing AGD66 to the new GDA2000, however the transition may take up to ten years. In the interim, grid references across NSW may be 200-220 metres out, which may cause confusion when using GPS units or fixed points in the field. GPS units working on World Geodetic System 84 are synonymous with GDA. To avoid data reporting errors, it is imperative that GPS and/or topographic map users are aware of which system is in use, and report in a consistent datum ie. either AGD or GDA.

Information about samples (eg. water, sediment, voucher specimens) must be recorded at the time of collection. At a minimum, details should include the date, time, name of person collecting the sample, location, habitat and test required. These details should be kept with the sample and also recorded in a central log.

4.3.3 Use of pro-formas

The use of standard pro-formas assists in:

- allowing information to be collected and reported in a consistent format;
- prompting investigators to record all information; and
- alerting assessors (including consent, determining and licensing authorities) to omissions in data.

A survey log recording summary information for the entire field survey program should be maintained and, for each survey site, include: the dates of sampling; precise location; site number; stratification category; and the exact types of surveys (methods and functional groups targeted) conducted on each day the site was sampled. Additional information, such as the number of data sheets held for each site, assists in checking that all data has been entered into databases.

4.3.4 Taxonomy and nomenclature

The scientific name of each species must include both the genus and species name, and be consistent with the TSC Act Schedules. Scientific names of species must appear in italics and should be cited along with the common name if one exists, however the common name should not be used on its own.

At the time of writing, the most up to date lists of scientific names included:

- *CSIRO List of Australian Vertebrates* (CSIRO 1998) for mammals, birds, amphibians and reptiles. Copies of the publication can be ordered on-line at <http://www.publish.csiro.au>

- **PlantNet** produced by the Royal Botanic Gardens for all vascular plants in NSW. This database can be accessed on-line at <http://plantnet.rbgsyd.gov.au>
- ***The Taxonomy and Species of Birds of Australia and its Territories*** (Christidis and Boles 1994) available from Birds Australia.

4.4 DATA COLLATION

4.4.1 Data entry

Field data should be entered into an electronic database in its raw format, and be subsequently subjected to any modifications required for its analysis and interpretation, rather than entered as pre-manipulated information. This ensures that, amongst other benefits, the raw data is always available as a reference point against which each stage of manipulation can be checked.

Data should then be checked and validated against the original field data sheets by someone other than the person who entered the data. At this stage, duplications, taxonomic inconsistencies and errors (such as incorrect species codes) should be edited, and the sampling log and checklist of pro-formas consulted to ensure all data has been transferred.

While entering new survey data and collating it with other sources of information, care should be taken to distinguish between:

- presence-only, presence/absence, and abundance data;
- data gathered from new field surveys and already-existing data from previous field studies;
- data gathered by different methods but for survey of the same taxonomic group (eg. bat data from harp trapping and from call recording); and
- data gathered through systematic methods and effort, and data gathered opportunistically or through targeted survey.

Ideally, a copy of new raw survey data should be held in a format that is compatible with the databases of agencies and local governments that might be interested in the data.

4.4.2 Reporting data

Data should be reported in its raw form, as well as in any manipulated, analysed or summarised form required for its interpretation. Making raw data available delivers three benefits:

- the integrity of the study is enhanced by the study's transparency;
- the soundness of the study's findings can be better evaluated by reference to the source material for those findings; and
- the data becomes available to the widest possible range of other studies.

New raw survey data generated by the study's surveys (whether used in analysis or not) should be made available as an appendix to paper copies of the report, and be lodged in electronic format with one or more centralised databases such as those held by the DEC, DIPNR, State Forests or some local government areas. Ideally, both media would be used, although appendices may be impractical for large data sets. A requirement of scientific licences from the DEC and Special Purpose Permits from State Forests is that the locality of all native species, including threatened species, be supplied to those agencies (preferably as an Excel Spreadsheet, see section 3.1.31) for incorporation in those agency's databases.

Existing data that has been taken from a centralised database should not be supplied back to that database without prior consultation with the database's manager, to avoid duplicating records.

The source of all data (raw or otherwise, new or existing) used in the study should be noted in the study's report, and the report should clearly indicate the source of the data. The report should also note the protocols that were used for data selection in the study, particularly data from large centralised databases (such as those held and managed by government agencies).

Where data comes from easily available sources (such as government databases), it is not necessary to include copies of the data in appendices if protocols for data selection are well described. However, data which comes from hard-to-access sources should be included in an appendix. Any data-use agreement which prevents the supply of that data in an appendix should be noted.

Data should also be summarised within the report using maps, tables and graphs wherever possible. Reporting standards are discussed further in Chapter 3, Step 7.

5 FIELD SURVEYS

Note: the term 'threatened biodiversity' means threatened species, populations or ecological communities, or their habitats'.

Designing an appropriate field survey requires consideration of both survey methods and effort. The general methods outlined in this chapter are broadly appropriate for the most common biomes, and some considerations for surveys in western NSW and rainforests (or other tall, dense vegetation types) are given in section 5.3.5. Not all the survey methods detailed below will be appropriate or necessary in all situations, however adequate justification must be provided if appropriate survey methods are not applied.

Ideally, surveys would be undertaken during optimal climatic and seasonal conditions and would also consider issues such as migratory species movements, availability of shelter and food resources, and the statistical issues associated with minimising sampling error. In many cases this will not be possible, and the results may not be able to determine conclusively whether a species is present within the survey area.

The absence of a species from survey data does not necessarily mean it does not inhabit the survey area. It may simply mean that the species was not detected at that time with the survey method adopted and the prevailing seasonal or climatic conditions. Similarly, presence data, especially from animal surveys, is rarely sufficiently systematic to estimate population size or range - it is usually only indicative of the presence of individuals or a local population. Therefore, to comply with legislation, consideration must also be given to the presence in the survey area (or surrounding land) of the known or likely habitat components for the species. Furthermore, where surveys have not been conducted in potentially suitable habitat and/or in the appropriate season, it cannot be assumed that an undetected species is not present.

Habitat components are described generally in the literature or are known with more precision from the results of well-documented local surveys in similar environments. Documenting the habitat components of the targeted species during the survey process or the site description will add value to the survey data, both where the targeted species is observed or where it is absent using the chosen survey approach.

Similar limitations apply to the use of databases for the interpretation of presence and absence survey data. For example, in utilising records of the DEC's Atlas of NSW Wildlife, researchers are aware that they are utilising a database of available information. Landscapes are rarely systematically surveyed, some plant and animal groups are more frequently observed and surveyed than others, and the absence of records in the database does not necessarily indicate a species' absence from an area. A common approach to this difficulty is to consider these databases as only partially indicative of species' presence in an area and to use predictive models, such as assessing preferred habitat components within a survey area.

5.1 STRATIFICATION, SAMPLING AND REPLICATION

Stratification is necessary to ensure that the full range of potential habitats and vegetation types will be systematically sampled. The survey area should be initially stratified on biophysical attributes (eg. landform, geology, elevation, slope, soil type, aspect), followed by vegetation structure (eg. forest, woodland, shrubland), and then floristics (eg. species).

In a stratified random sampling design the study area may initially be stratified, using maps to provide information on the biophysical attributes, and aerial photographic interpretation and existing vegetation maps to identify vegetation structure and floristics. Aerial photographs can be used to select representative combinations of colour, tone, texture, canopy spacing and patterns that reflect vegetation and landform types. Sites may be further stratified using knowledge of the area, which may be gained from literature, topographic maps, soil maps and local knowledge. A field visit to the study area prior to survey may be advantageous to check preliminary site selection and identify vegetation types not revealed by aerial photography.

The initial stratification will result in a number of stratification units being identified, for example ‘coolabah woodland on grey clays’. Once identified, these units must be described in the report and recorded on a survey map. The initial map will reflect the initial stratification and guide the sampling intensity. Distinct stratification boundaries are rarely apparent from aerial photographs and maps as transition zones are common. Therefore the boundaries of perceived units on the initial map will change in the final version, following field inspection and sampling.

Each of the stratification units must be sampled. To sample heterogeneity within a stratification unit, a number of sampling sites may need to be established within the unit. The minimum number of sampling sites within each of these units will depend on their size.

Sampling sites must be marked on the survey map for further reference during the assessment process. Special habitats must also be mapped eg. water bodies, rocky outcrops and cliffs. These special areas must be surveyed and may require special survey techniques, determined by the nature of the site. The information gained from the investigation of these areas will complement those within the stratification units, increasing the efficiency of the fieldwork and improving the reliability of the survey.

Where only one sampling site is placed within a stratification unit, it must be located in an area which best represents the unit. Where there are multiple sites within a unit, the sampling sites should attempt to sample the geographic spread and heterogeneity of that unit. Variations in habitat should be sampled to cater for species favouring particular sites or disturbance regimes. For example, where one vegetation type represents a large area, it can be stratified and sampled according to factors such as disturbance, fire, flooding or distance from watering points.

Where the same stratification unit is fragmented or naturally patchy in structure and distribution, the calculation of the number of sampling sites required for that unit treats the area of each patch cumulatively, ie. four 75 hectare patches are treated as 300 hectares for the

calculation of sampling effort. Where more than one sample is required within that unit, the sampling sites should be spread over more than one patch.

In a stratified random sampling design, plots should be located randomly within each homogeneous unit of vegetation identified by the stratification process. However, NPWS (1995) and Wilson *et al.* (1997) recommend that plots be selected to avoid bias from edge effects and local disturbances. This means that the design is not completely random and this should be acknowledged with justification for the sampling technique selected. It may be that the effect of local disturbances such as roads, quarries and eroded areas are a factor in the sampling design, in which case sites would not be pre-selected to avoid such areas.

If edge effects are intended to be avoided plots should be selected according to the following criteria adapted from NPWS (1995):

- away from the boundaries of an environmental stratum;
- in homogeneous vegetation considered to be representative of the strata;
- away from, or free from, local disturbances such as roads, mines, quarries and eroded areas; and
- the axis of the plot should be aligned with the contour of hillsides or elongated vegetation communities (eg. riparian areas) to avoid significant environmental gradients (eg. soil moisture).

Survey effort is generally described in relation to stratification units. In certain circumstances, such as areas of one hectare or less, the survey effort per stratification unit may be applied across the entire site (where the site is reasonably homogeneous). The effort should be distributed across the stratification units within site. For example, it may be reasonable to utilise 100 trap nights for a one hectare site, even though there are three stratification units within the site, if the traps are distributed appropriately across the stratification units. Conversely, some sites in western NSW are of the order of thousands of hectares. In some circumstances it may be justified to alter the minimum survey effort per 100 hectares of stratification unit to a minimum survey effort per some larger area eg. 250 hectares. All such circumstances involving any deviation from the recommended effort must be justified within the report.

5.2 PLANTS

5.2.1 Sampling techniques

To survey the vegetation of a study area several different techniques can be employed - which techniques are employed may depend on the size and characteristics of the study area. To ensure the survey area is adequately sampled, a combination of transects and plot-based surveys should be used to provide information on vegetation boundaries, floristic diversity and the possible presence of threatened biodiversity.

Prior to more detailed transects or plot-based surveys, a general walk and/or drive should be undertaken throughout any area requiring a vegetation survey. This is valuable for:

- obtaining an understanding of the plant communities in the survey area and identifying ecological community boundaries in combination with aerial photographic interpretation;
- identifying locations for quadrat or traverse sampling within the various stratification units;
- identifying the potential distribution of threatened plants and recording inconspicuous species; and
- recording opportunistic plant (and animal) sightings.

i Transects (or Traverses)

Transects (or traverses) are valuable for obtaining an understanding of the vegetation communities in the area, identifying community boundaries and recording species (Forest Animal Surveys *et al.* 1997).

Transects must be undertaken on foot for the recording of data. The number and length of transects will vary depending on the size, dimensions, topographic diversity and number of vegetation communities of the area being surveyed.

Information recorded while undertaking transects should include all plant species observed and other relevant information relating to the distribution of plant species such as aspect, topographic position, elevation and vegetation community boundaries.

A variation on the transect type survey is the random meander method. This technique is discussed in relation to threatened plant species surveys in section 5.2.7.

Table 5.1 describes the survey effort for transects and random meanders per stratification unit.

Table 5.1 Suggested survey techniques and effort for plant transects (traverses) and random meanders

Survey technique	Suggested minimum effort	Information recorded
Transect	1x100m traverse per stratification unit <2 hectares 2x100m traverses per 2-50 hectares of stratification unit 3x100m traverses per 51-250 hectares of stratification unit 5x100m traverses per 251-500 hectares of stratification unit 10x100m traverses per 501-1000 hectares of stratification unit, plus one additional 100m traverse for each extra 100 hectares thereof	Floristics, structure, vegetation boundaries
Random meander	30 minutes for each quadrat sampled within the same stratification unit as the quadrat	Targeted for threatened species

ii Plot-based (or Quadrat) Surveys

A plot-based (or quadrat) survey has some distinct advantages over transects. Forest Animal Surveys *et al.* (1997) list the following advantages of plot-based surveys:

- they enable a quantitative examination of species distribution and abundance;

- they are more likely to detect inconspicuous or threatened species, as a smaller area is sampled in a concentrated search; and
- they provide a basis for any subsequent monitoring required.

All quadrats used must be placed parallel with the contour unless the stratification unit does not allow for this configuration (section 5.1).

The plot size used widely and recommended by McDonald *et al.* (1990), York *et al.* (1991), NPWS (1995) and Forest Animal Surveys *et al.* (1997) is a 400m² plot. The typical dimensions of a plot are 20 metres by 20 metres, however where vegetation occupies a linear space, the plot shape can be changed to fit within the vegetation type as long as the total area remains the same. Examples include a dune crest or swamp margin where a plot of 10 metres wide by 40 metres long may be needed to sample the vegetation. A minimum width of 10 metres should be maintained unless the stratification unit does not allow for this width.

Depending on the vegetation type that is being sampled, a variation of the 400m² plot (20 metre x 20 metre) may be appropriate. For example, Wilson *et al.* (1997) suggests that for relatively uniform or structurally simple communities such as sedgelands, a 10 metre by 10 metre plot can be used. Similarly, Cohn (1995) found that for sampling the structural and floristic characteristics of mallee vegetation in central western NSW, a 30 metre by 30 metre plot was better suited. In western NSW, and other semi-arid areas (essentially the slopes and plains of NSW), vegetation sample units need to be larger to compensate for the generally greater heterogeneity of vegetation. Standard size plots for these areas are 20 metres by 50 metres.

If there are doubts as to whether plot size is large enough to adequately represent the floristic composition of the vegetation, a species-area curve can be constructed. Species-area curves and the number of sample plots are discussed in section 5.2.2.

Table 5.2 describes the survey effort for quadrats per stratification unit.

Table 5.2 Suggested survey techniques and effort for plant quadrats

Survey technique	Suggested minimum effort	Information recorded
Quadrat	<p>At least:</p> <p>1 quadrat per stratification unit <2 hectares</p> <p>2 quadrats per 2-50 hectares of stratification unit</p> <p>3 quadrats per 51-250 hectares of stratification unit</p> <p>5 quadrats per 251-500 hectares of stratification unit</p> <p>10 quadrats per 501-1000 hectares of stratification unit, plus one additional quadrat for each extra 100 hectares thereof.</p>	Floristics, structure, threatened species

5.2.2 Survey effort

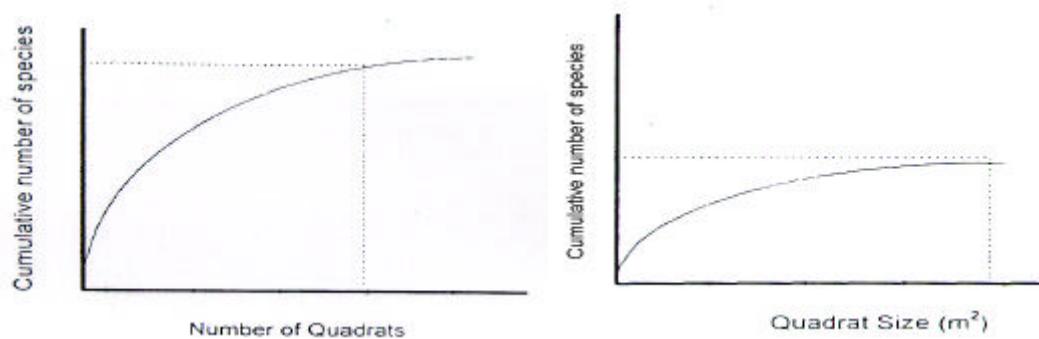
When undertaking a plant survey of the study area the appropriate level of survey effort needed to adequately describe the vegetation must be decided. Defining a minimum level of

survey effort is complicated by factors such as individual characteristics of the area or vegetation communities, and the time and budget of studies. Ideally, surveys should incorporate suitable methodologies that result in the detection of locally common species as well as cryptic and seasonal species (Forest Fauna Surveys *et al.* 1997).

To define what level of survey is adequate for a given area there are some simple techniques that can be used as a guide. Wilson *et al.* (1997) suggest a simple species-area curve can be constructed if there is doubt as to whether the plot size or number of plots is adequate to represent the floristic composition of the vegetation to be sampled. The curve is normally created with the x-axis being quadrat size or number of quadrats and the y-axis as the cumulative number of species. The purpose of this is to determine if the survey effort is adequate with respect to the cumulative number of species. With respect to the relationship between the number of quadrats and the cumulative number of species, the replication of sample plots is fundamental for statistical precision, analysis and interpretation of results in the ecological context (Krebs 1989).

Figure 5.1 shows indicative species-area curves for the number of quadrats and quadrat size with respect to the number of species observed.

Figure 5.1 Indicative species area curves



5.2.3 Plot description

A range of descriptive data should be recorded at each plot location on survey pro-forma. It may be necessary to have more than one pro-forma, for example, a physical description sheet, a vegetation sheet and sheets for voucher collections or threatened species. All sheets should be filled in at the site, with irrelevant sections crossed through rather than left blank to indicate the section was not relevant rather than forgotten.

Types of data that should be recorded in survey pro-formas include:

- date and time;
- plot number or unique identifier;
- name(s) of observers;
- plot size (and dimensions);

- location – refer to Australian map grid (AMG) giving map name and number, 6 digit easting, 7 digit northing. Use a Global Positioning System (GPS) reading if available and state the accuracy if known;
- locality description to assist relocation, for example, distance from road, track or distinctive landmark, giving walking distance and direction. Include the property name or reserve name if known;
- land tenure;
- landform type;
- soil type (clay, loam, sand, organic);
- geology (rock outcrops);
- slope (using clinometer);
- aspect (estimated using compass bearing); and
- altitude.

Section 4.3.3 further discusses survey pro-formas and where copies can be obtained.

In the field, a marked star picket may be necessary to relocate sites for monitoring. The star picket should be located at a consistent position within each plot, for example at the centre or south-western corner. It is also essential to mark the location of the plot on a reference map. If photographs are taken, the photo number and direction should also be recorded on a map.

5.2.4 Floristic data

This section outlines the type of information that should be recorded within each plot.

i Species Present

All plant species present within the plot are to be identified and recorded. Plants should be identified as far as possible to the species or subspecies level. For convenience, it may be easiest to start with the upper stratum and work down to the lowest. If a plant cannot be identified in the field, a voucher specimen should be collected for identification using taxonomic keys such as *Flora of New South Wales* (Harden 1990, 1991, 1992, 1993) or other reference material. Alternatively, specimens can be sent to the National Herbarium for identification. It should be noted that when sending specimens for identification a duplicate specimen should be kept and subsequently correctly labelled for future reference.

It is often useful when recording species within a plot to document the dominant species in each strata. This will aid in compiling a vegetation community description, which may be incorporated into the body of a report, whereas a full list of species recorded in the survey is usually presented in an appendix.

Species descriptions and other recent botanical information such as name changes and taxonomic revisions can be sourced from journals such as the *Australian Journal of Botany*, *Telopea* and *Cunninghamia*.

5.2.5 Description of sampling sites

At each sampling site a range of information relating to the physical and biological characteristics of the site should be recorded. For consistency, and to enable comparisons between sites, it is suggested that a pro-forma is used. An example of a suitable pro-forma for plant surveys, along with explanatory notes for describing the attributes and completing each section, is provided in Appendix F.

5.2.6 Habitat assessment

The value of the vegetation in the study area as habitat for threatened plants, based on the habitat requirements of those species known or expected to occur in the study area, should be assessed and documented. Where surveys are conducted outside of the appropriate season to detect threatened species, the likelihood of the vegetation community or other habitat components in the study area to support these species should be assessed. Information on local records should be sought, in particular the characteristics of any known habitat for threatened plant species in the locality.

5.2.7 Targeting threatened plants

In conducting a vegetation survey, threatened biodiversity may be identified during transect or plot surveys or by opportunistic observations such as walking or driving between sampling sites. Depending on the aims of the study, targeted surveys may be conducted for threatened biodiversity considered likely to occur in the locality. If this is the case, targeted searches should be carried out in areas of preferred habitat for these species.

Many plant species lie dormant for much of the year and there may be few or no above ground parts observable, for example orchids. If surveys are conducted at an inappropriate time of year, it cannot be assumed that the species does not occur in the study area. Checking the closest known site where such species are known to occur may assist with timing surveys when the species are most likely to be observable.

In areas of preferred habitat for threatened biodiversity, rather than undertaking transect or plot-based surveys, an area may be searched by the random meander technique. This technique can allow for greater coverage than a plot-based survey and is less time consuming. As the name suggests, the random meander technique involves traversing areas of suitable habitat in no set pattern, but roughly back and forth, whilst searching for a particular, or several, threatened plant species. If there is any uncertainty regarding identification of a threatened species, a voucher specimen should be collected and sent to the NSW Herbarium for confirmation.

Methods should be used consistently and be recorded and mapped in sufficient detail to allow replication. Table 5.2 provides details of effort required per stratification unit. The area and time spent searching and the personnel involved should also be noted. In areas where threatened biodiversity potentially occurs, more specific methods should be used to increase the chances of detecting these species. The DEC Threatened Species (Environmental Impact Assessment) Profiles give information on methods for individual species (if completed for that species).

When a threatened species, population or ecological community is found, either within a plot or during transects or random meanders, a range of information should be recorded including:

- Species, population or ecological community name and location;
- population area and size (or extent);
- reproductive state;
- age structure;
- land conservation status;
- fire response (if known);
- observer's name;
- date; and
- threats.

Section 3.1.31 details the information to be sent to the DEC's GIS Division for the Atlas of NSW Wildlife, which is one of the conditions of issue of an investigator's scientific licence. It is also a requirement of an Assessment of Significance to identify all threatened plants recorded within the study area.

5.2.8 Voucher collections

Only DEC licensed investigators are permitted to take voucher specimens, if specified on the licence. Voucher specimens are needed where: identification is doubtful; the species is outside its known range; or the species has not been recorded in the area previously.

Specimens of threatened plant species and other plant species of conservation significance must be collected and lodged at the National Herbarium of NSW. Plant specimens must be collected and processed following the guidelines prepared by the National Herbarium of NSW (Bedford and James 1995).

When collecting plants, the specimen chosen should include flowers and fruits and a piece of stem with typical, healthy leaves. Non-flowering plants should include reproductive features, rhizome and stipe where possible. If variation is apparent then material that reflects this variation should be collected. Notes should be taken regarding the precise locality, collector's name, date, and botanical information such as habit, habitat, size of plant, colour of flowers and fruit, and type and colour of bark should be recorded.

Voucher specimens should be pressed in the field where possible, however they may be kept temporarily in a paper or plastic bag and pressed later. Harden (2000) recommends pressing between newspaper and thick cardboard in a plant press followed by drying in a drying cabinet. If a drying cabinet is not available, the sheets of newspaper should be checked daily and changed if damp - this speeds up the drying process and prevents mould growing on the specimens. Drying time will vary between specimens depending on the type of plant and relative humidity. Once dry, a specimen can be labelled and mounted on sheets or placed in a folder for easy viewing.

Orchids that cannot be identified in the field should be preserved in orchid vials in 80% ethanol and kept away from light and heat.

The DEC is producing guidelines for obtaining a licence for the collection of threatened plant specimens for identification and/or submission to the National Herbarium of NSW.

5.3 ANIMALS

5.3.1 Sampling design

As a general guide, when establishing sites for trapping and other census techniques, consideration should be given to targeting special habitats such as watercourses and rock outcrops in addition to the stratification process outlined in section 5.1. A description and justification for the sampling design in relation to the stratification units should be included in the study report.

Opportunistic sightings at any location in or near the study site should also be recorded and discussed in the report. The habitat within which the species was observed and its location must be recorded. This is especially important for sparsely distributed species such as owls and raptors, which are difficult to survey. Investigators should also be aware of the requirements relating to animal care and ethics, available from the Animal Welfare Unit, NSW Agriculture <http://www.agric.nsw.gov.au>.

For each survey site, data recorded should include height/density (structure) of vegetation layers, leaf litter, fallen timber, tree hollows (position on tree and size), stags, rock shelves, soil type, presence of water and any human-made habitats. Climatic variables such as rainfall, temperature, wind speed, moon phase and cloud cover at the time of the survey should be recorded. The time and duration of the survey should be recorded. GIS coordinates should also be recorded. Refer to section 4.3.3 for discussion of survey pro-formas.

Stag watches involve observing potentially occupied hollow-bearing trees 30 minutes prior to sunset, and continuing until 60 minutes after sunset for nocturnal species. The observer needs to be in a position to allow a good view of the tree, with the tree silhouetted against the sky. Animals leaving hollows can either be heard or observed and their identity confirmed, as necessary, by other methods.

Spotlighting is also a common method of surveying. The power of a hand-held spotlight when spotlighting on foot is an important consideration. Animal movement and ‘eye shine’ (reflection of light back from the animals’ eyes) are significant factors in finding arboreal/nocturnal animals and identifying that animal to genus and species. A minimum of 30 watts of power must be used for open forest and woodland environments. In tall or closed forests, particularly along the Great Dividing Range and coastal ranges, a minimum of 50 watts of power must be used (preferably with a gel filled 12 volt battery). The higher wattage provides better light penetration through impeding understorey and mid-storey vegetation strata. It is preferable that hand-held spotlights are fitted with a dimmer knob.

5.3.2 Survey limitations

The aim of the survey is to provide a list of species present and potential habitat for threatened species not detected at the study site, however the effectiveness of a survey in detecting a given species will be affected by:

- the species' behaviour (Bell and Ferrier 1985; Recher 1988; Slater 1994);
- the species' life cycle, in particular the time of the breeding cycle (Morin and Conant 1994);
- the range of survey methods used;
- the experience of the observer (Kavanagh and Recher 1983; Catterall *et al.* 1996);
- the weather (rainfall, temperature, wind) (O'Connor and Hicks 1980). Extreme weather conditions should be avoided;
- the type of vegetation (Morin and Conant 1994);
- the season when the survey is undertaken;
- the time of day when the survey is undertaken (Shields 1977); and
- the amount of time spent surveying (Slater 1994).

Some species are only present in an area in certain seasons (eg. many species of threatened migratory birds), others are always present but can only be detected in certain seasons (eg. breeding season for certain frogs), while other species are inactive in cool weather (eg. microchiropteran bats, reptiles, frogs). Even if sampling can only be carried out in one season, it must be undertaken over a reasonable time period to maximise the chance of detecting species. Certain species are nomads or have very large home ranges and may be attracted to patchy availability of food such as blossoms. Other species may go through cycles of activity related to breeding, cloud cover, wind speed, rainfall or short-term temperature changes.

These limitations are discussed in the following sections for the various functional animal groups. Limitations of surveys should always be detailed in the survey report and taken into account when drawing conclusions from the study. Clearly, the less time spent surveying and the fewer the range of survey methods used, the less indicative the species list will be.

Where limitations cannot be overcome, an assessment of the likelihood of threatened animals utilising the habitat must be made in order to comply with legislation.

5.3.3 Habitat assessment

An assessment of the habitat characteristics of the study area in terms of the habitat requirements of threatened animals known or likely to occur must be undertaken. The habitat requirements of threatened animals can be determined by literature reviews and from previous survey data detailing the habitat in which the threatened species was recorded. Recovery plans and threatened species profiles also contain useful information regarding habitat requirements of threatened species. The habitat assessment will assist with predicting the likely occurrence of threatened animals in the study area and will guide the location and techniques for targeted surveys for threatened animals.

5.3.4 Sampling methods and effort

The following sections list general methods that are commonly used to survey a broad range of animal species and groups, and the effort required per stratification unit (section 5.1). Selection of the survey methods required will depend on the investigator's assessment of the types of animals (and habitats) potentially present on the site, based on the preliminary assessment (Step 4) and habitat assessment (section 5.3.3). Justification for selection of methods should be given in the study report. Note that the same method can be used to detect more than one animal group (eg. spotlighting).

Methods should be used consistently and recorded and mapped in sufficient detail to allow replication. The area and time spent searching and personnel involved should also be noted. All recordings of frog and bat calls need to be retained to confirm species identifications. In areas where threatened biodiversity potentially exists, more specific methods should be used to increase the chances of detecting these species, populations and ecological communities, and their habitats. The DEC Threatened Species (Environmental Impact Assessment) Profiles give further information on survey methods for individual species (if completed for that species).

If it is not possible to sample for threatened species (eg. bats, frogs) previously recorded in the general area during appropriate seasons and weather conditions, it must be assumed that these species occur in the study site if suitable habitat exists.

i Amphibians

a Methods

Several techniques are available for the census of frogs and tadpoles. Sampling should involve a combination of diurnal and nocturnal census. Experienced investigators are likely to record many more species than inexperienced investigators and all investigators should be appropriately trained.

The need to address the protocol for hygiene is discussed in section 5.4.2.

Systematic daytime searches for tadpoles and adult frogs must be conducted with a survey effort of at least one hour within the relevant habitat of each stratification unit, according to the amount of habitat requiring survey. All aspects of the watercourse and adjacent areas must be searched including under logs and rocks, in shrubs and trees, under bark and in litter.

Most frogs are nocturnal and most are easily detected by their calls. Surveys will have the greatest chance of detecting most species if undertaken at night, in wet weather. Different species have different seasonal peaks of activity and surveys should be conducted at the appropriate time of year for those species likely to occur, based on habitat characteristics and local records. Identifying a reference site nearby where a species is known to occur will assist in determining peak activity periods so that field surveys can be conducted at the appropriate time.

A combination of listening for frog calls, spotlighting, searching within habitat and call recording should be used. Heyer (1994) describes the equipment used for recording frog calls. Call playback techniques using the relevant frog calls and targeting specific habitats can also be particularly effective for some species, however overuse of call playback during the breeding season should be avoided as it can interfere with breeding patterns.

A number of species keys are available for identifying frogs and tadpoles (Robinson 1994; Barker *et al.* 1995; Cogger 2000; Anstis 2002) and calls can be identified using reference recordings, for example Nature Sound by Dave Stewart (<http://www.naturesound.com.au>). It may be necessary to have expert identifications of some calls. It should be noted that some species of frogs, including some threatened species, call and breed only after specific rainfall events and these patterns are not well understood. For example rainy weather, or the day after, is ideal for detecting burrowing frogs in western NSW.

Systems for remote call recording are being developed and are a useful technique for water bodies. If used, they should be undertaken for at least two nights during appropriate weather conditions and combined with at least one hour of spotlighting.

In habitats that contain well-defined watercourses, nocturnal streamside searches should be included. Nocturnal reptiles, particularly geckoes, may also be encountered during these searches. Fixed time searches generally involve one person undertaking two hours of effort per 200m of river, stream or gully. Frogs may also be encountered opportunistically while spotlighting for mammals or undertaking diurnal surveys for reptiles. Nocturnal searches will require a hand-held spotlight of at least 30 watts of power, preferably fitted with a dimmer knob.

Damp and watery sites such as dams, wetlands, soaks and seepages should be visited on two separate nights for 30 minutes each to search for frogs. Driving very slowly along roads during rain often enables the capture of frogs as they cross the road.

Triangulation is a technique that allows location and identification of species whose calls may be confused with other species. Triangulation involves positioning three people to surround a calling frog, the locations of each individual determined by the direction and approximate distance of the call. Each person walks slowly and quietly toward the call and, when close, all three shine a torch beam in the direction from which the call is coming. The intersection of the torch beams should indicate the location of the frog, which can then be captured and identified.

Frog detection during non-breeding periods is more difficult requiring active searching of microhabitats such as hollow logs, beneath rocks and in underground burrows. Surveys during times when frogs are aestivating are not recommended unless extreme care is taken to ensure they are not disturbed. Therefore only appropriately experienced specialist herpetologists should undertake this work. Where frog microhabitat is disturbed during searches the disturbed habitat should be replaced as close as possible to the way it was prior to the disturbance. In desert regions, searching for aestivating frogs may be the only practical technique and should also only be conducted by appropriately experienced, specialist herpetologists.

Where the investigator locates but cannot identify the tadpoles, specimens should be provided to a specialist for identification. A reference guide entitled *Tadpoles of South-east Australia: a guide with keys* (Anstis 2002) is available.

b Effort

Table 5.3 Suggested survey methods and effort for frogs

Method	Suggested minimum effort	Survey period
Systematic day habitat search	One hour per stratification unit	Varies according to the seasonal peak of activity of target species
Night habitat search of damp and watery sites	30 minutes on two separate nights per stratification unit	See above
Nocturnal call playback	At least one playback on each of two separate nights	See above
Night watercourse search	Two hours per 200m of water body edge	See above

ii Reptiles

a Methods

A range of sampling techniques is necessary for reptiles as no one technique will capture all species (Schulz and de Oliveira 1995). Techniques include pitfall trapping, active searching and spotlighting on foot. Experienced herpetologists are likely to record many more species than inexperienced investigators and all investigators should be appropriately trained.

Sampling undertaken during the warmer months, when reptiles are active, should include pitfall trapping with drift fences (Braithwaite 1983; Webb 1980). It should be noted that deep pits (>1.1m) capture many species (eg. frogs, geckoes, legless lizards, dragons and snakes) which appear to escape from shallow pits (Woinarski *et al.* 2000). However, deep pits may fill with water in heavy rain events and objects that will float must be placed in the pits to prevent trapped animals from drowning. Pitfall traps may not be appropriate in all situations, for example in very rocky substrates.

Timed, diurnal, active searches should also be undertaken during warm, calm, dry weather. It is particularly important that windy, cold and overcast or rainy weather conditions are avoided. Thirty-minute searches on two separate days per stratification unit are generally undertaken before mid-morning when reptiles have not reached their optimal body temperature. Basking individuals can be identified by sight however cryptic species require destructive searching of fallen logs, litter, decorticating and fallen bark, and of rock outcrops (NPWS 1997a). Detection of burrowing species requires raking of substrate under rocks. Rubbish and building materials such as corrugated iron also provide reptile habitats.

Nocturnal spotlighting of tree trunks and other habitat should be used to detect geckoes and nocturnal snakes. Thirty-minute searches on two separate nights should be undertaken per stratification unit.

During cold weather most reptiles will be hibernating. Sampling should involve active searching for hibernating species by experienced herpetologists. As fewer species will be recorded, the precautionary principle should be applied (section 3.1.14).

Kennett (1992) describes specialised trapping techniques involving drum nets that are required for freshwater turtles.

Investigators should be aware of the requirements relating to animal care and ethics described in *Guideline 6, Guidelines for the Use of Pitfall Traps*, available from the Animal Welfare Unit, NSW Agriculture <http://www.agric.nsw.gov.au>.

b *Effort*

Table 5.4 Suggested survey methods and effort for reptiles

Method	Effort per stratification unit up to 100 hectares on the coast and ranges, and up to 200 hectares west of the ranges	Survey period
Habitat search	30-minute search on two separate days targeting specific habitat	November to March
Pitfall traps with drift nets	24 trap nights, preferably using six traps for a minimum of four consecutive nights	November to March
Spotlighting	30-minute search on two separate nights targeting specific habitat	November to March

iii **Diurnal Birds**

a *Methods*

Many methods have been used for surveying birds, and summaries can be found in Bibby *et al.* (1992) and Gibbons *et al.* (1996). The most common methods are:

- area search methods, where observers walk around an area of pre-determined size for a pre-determined length of time. A 1ha (200m x 500m) 20-minute search is the most common method (Loyn 1986), although as described later in this section this method is not as effective as surveys of longer duration;
- point count methods, where observations are made from a series of pre-determined points for pre-determined lengths of time. By recording the bird's distance from the point, density estimates can also be made. Ten-minute observations are made at each of five points on a 500m transect (points 100m apart with observations recorded at 0-5m, 5-10 m, 10-20m, 20-30m, 30-50m and >50m distances from the point) in the State Forests EIS surveys (York *et al.* 1991).

Each method has its advantages and disadvantages (Catterall *et al.* 1996). In studies where the aim is species inventory, to record the longest list of species possible and to do so as quickly as possible, the area search method is recommended as this method is slightly more likely to detect small cryptic birds.

Birds can be identified by both sight and vocalisations, and are best surveyed early in the morning (at dawn), as overall activity decreases with time after dawn, and at dusk. Wet, windy and extremely hot weather should be avoided as bird activity is decreased under these conditions (Bibby *et al.* 1992).

Investigators should record species present within the site, flying overhead, outside the site in the same habitat or outside the site in different habitat. If possible, an estimate of the abundance of birds present should be made, in particular threatened species.

An experienced observer is likely to record many more species than an inexperienced one (Catterall *et al.* 1996) and all observers should be appropriately trained. There are many field guides to visual bird identification (Lindsey 1986; Lane 1987; Slater *et al.* 1989; Kingsford 1991; Simpson and Day 1996; Pizzey and Knight 1997; Debus 1998) and song-based identification (Lindsey 1987; Bird Observers Club of Australia 1998; Nature Sound by Dave Stewart <http://www.naturesound.com.au>).

The time spent searching is an important factor in the number of species that will be detected. Many species forage over large areas each day and it may take several visits to record their presence. Loyn (1986) showed that 3 x 20 minute censuses of a 2ha block revealed only 53% of the species present while 3 x 60 minute searches revealed 90.4 %. This matter has not yet been resolved however it is likely that a species-time curve approach should be utilised for surveying diurnal birds. For example, the survey session for a particular day may cease when no additional species are identified within a set time period. This approach better accommodates the variety of habitat types and birds found in NSW.

Birds are also more difficult to census in dense vegetation and may require longer sampling times in such areas to achieve the same level of detection as in more open areas.

For natural wetlands, a one-hour bird observation must be conducted at dawn or dusk. Birds are to be recorded as present within the wetland, flying overhead or outside the habitat. A 20-minute census at dawn or an hour before dusk should also be conducted at each identified source of water in the survey area. Opportunistic species sightings should be recorded continuously.

Many birds are seasonal migrants (eg. regent honeyeater and many species of shorebirds) - this should be taken into account in the timing of the survey or listed as a constraint of the study.

If present, raptors can often be spotted from hilltops with views over the canopy, particularly as they tend to use the thermals on warm days.

Walking through habitat is important to flush cryptic species, eg. Bush Stone-curlew.

b Effort

Table 5.5 Suggested survey methods and effort for birds

Method	Suggested minimum effort	Survey period
Area search	<i>This matter has not been resolved as yet but it is likely that a species-time curve approach should be utilised for surveying diurnal birds. For example, the survey session for a particular day may cease when no additional species are identified within a set time period. This approach better accommodates the variety of habitat types and birds found in NSW.</i> Per stratification unit.	All year
Wetland census	A one-hour census at dawn or dusk, for each identified wetland.	All year
Water source census	A 20-minute census at dawn or dusk, for each identified water source.	All year

iv Nocturnal Birds

a Methods

Calls of nocturnal birds being surveyed should be played at each site where the species is known or where its habitat is present. Habitat is inclusive of areas used for foraging, roosting, nesting and dispersal.

Several studies have found owls are most likely to be detected by call playback techniques combined with spotlighting (Debus 1995; Kavanagh and Stanton 1998). Kavanagh and Peake (1993) found that call playback more than doubled detection rate for all species. This technique involves listening for vocalisations, broadcasting using at least a 10W amplifier, and spotlighting. A 10W amplifier may be heard by owls in an approximate one kilometre radius, although it is difficult to hear *Tyto* species beyond 800 metres.

At each call playback site an initial listening period of 10 to 15 minutes should be undertaken, followed by a spotlight search for 10 minutes to detect any animal in the immediate vicinity. The calls of each target species should then be played intermittently for 5 minutes, followed by a 10-minute listening period. After all the calls have been played, another 10 minutes of spotlighting and listening must be conducted in the vicinity to check for birds that are attracted by the calls but are not vocalising.

More than one census should not be conducted on the same night unless sites are sufficiently separated (greater than one kilometre apart) to make the censuses independent.

Owls call most frequently in the early evening and before dawn and surveys should be undertaken at these times (Kavanagh and Peake 1993). Wet and windy weather should be avoided, as owls are most vocal on calm dry nights (Debus 1995).

As with diurnal birds, the time spent surveying is very important. Debus (1995) found that several sampling sessions were required to have even a 50% probability of detecting owl species that were in fact present on a site (Table 5.6). With only one sampling session, the probability of finding a species that was in fact present dropped to 20-26%. Where this level of effort is not achieved, it cannot be assumed that the species is not present, particularly in areas of potential habitat and/or if there are records from the locality.

Table 5.6 Number of sampling sessions required to find an owl species (that was in fact present on site) with a given probability (Debus 1995)

Owl Species	50% probability	90% probability
Powerful Owl	3	7
Masked Owl	4	9
Sooty Owl	3	8

It should be noted that some individual owls never reply to broadcasting (Galeotti and Pavan 1993). Some owls may not respond vocally to playback within 500 metres of core nesting and roosting areas. Individual owls may not always be utilising the territory, or individual owls may be on the edge of their range and therefore not hear the playback. Breeding habitat may not be used outside the breeding season particularly for Powerful Owls and Masked Owls. Therefore, there may be benefit in using playback in different locations for the last two nights of playback. If no evidence of owls is located an evaluation of whether the species' are likely to occupy the habitat will need to be made.

Call playback for the Bush Stone-curlew should consist of playing calls for 30 seconds, followed by 4.5 minutes of listening. This 5-minute cycle should be repeated up to three times so there is a maximum of 15 minutes survey at each point. The same 30 seconds of calls should be used throughout the survey. If a bird responds to the taped call, approximately 10 minutes should be spent listening for other birds' responses. Survey points should be approximately 2 to 4km apart depending on the weather conditions and topography of the area. Call playback should be conducted during the breeding season as there is more chance of birds responding to calls at this time. Calm, clear, moonlit nights provide the best conditions for undertaking surveys.

It is important to avoid undertaking activities that may directly affect sensitive species or species sensitive at a particular time of the year, such as nesting owls. Powerful Owls, Masked Owls and Grass Owls are known to be particularly sensitive to disturbance during the breeding and nesting season and if these species are likely to occur, all works in the area should be limited during these times to avoid potential desertion of nests by the adults. Bush Stone-curlews are also particularly sensitive to human activities when nesting and will abandon nests if continually disrupted.

Owl pellets should be collected opportunistically at each survey site and sent to a specialist for identification. Roost site surveys should also be conducted, involving looking for signs of occupancy of large tree hollows, including stag-watching.

Other nocturnal species such as the Plains Wanderer and Bush Stone-curlew require spotlighting, generally using a 12v 100W spotlight, by foot or from a slow-moving vehicle in first gear. It is preferable for cryptic species such as these to spotlight on foot to enable flushing. Flushing of Bush Stone-curlews can also be achieved during diurnal surveys by walking through suitable habitat.

b Effort

Table 5.7 Suggested survey methods and effort for nocturnal birds

Method	Suggested minimum effort	Survey period
Call playback	<p>Sites should be separated by 800 metres – 1km, and each site must have the playback session repeated as follows:</p> <ul style="list-style-type: none"> ▪ at least 5 visits per site, on different nights are required for the Powerful Owl, Barking Owl and the Grass Owl; ▪ at least 6 visits per site for the Sooty Owl, and 8 visits per site for the Masked Owl are required. <p>Sites for Bush Stone-curlew surveys should be 2-4km apart and conducted during the breeding season.</p>	All year
Day habitat search	<p>Search habitat for pellets, and likely hollows. Flushing of Bush Stone-curlews by walking through potential habitat.</p>	All year
Stag-watching	Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset.	All year
Spotlighting	Spotlighting for Plains Wanderer and Bush Stone-curlew by foot or from a vehicle driven in first gear.	All year

v Mammals (Excluding Bats)

a Methods

Several studies comparing different sampling techniques for mammals have concluded that all methods are biased towards certain animal groups (Laurance 1992; Stanton and Anderson 1998; Lindenmayer 1999). Therefore, in animal surveys it is important to include a wide variety of methods for surveying mammals.

Elliott trapping

Elliott traps come in various sizes and are typically ‘shoe box’ shaped. They have an opening at one end through which the animal is enticed by a bait placed at the other end. Once the animal takes the bait, a closing mechanism is triggered, entrapping the animal.

Elliott traps should be numbered and tagged and established in a systematic manner, following a specified sampling regime for the survey area. Sampling effort per stratification unit must equate to at least 100 trap nights. The recommended approach involves 25 traps placed for four nights. If variation of this approach is proposed it should be noted that traps must be open for a minimum of three nights, and a maximum of four nights. Trap lines should be established with a spacing of 20-50 metres. Some traps should be placed on tree branches to enable sampling of arboreal mammals. Trap saturation needs to be considered where a common species may prevent the detection of rarer species because the traps are filled. To combat this effect at least some traps should be available to animals (ie. unsprung) each morning.

It should also be noted that trapping intensity should be increased with decreased abundance of wildlife in order to detect which species may be present. For example, Elliott trapping in the Blue Mountains may result in a total capture rate of 20% while on the western plains it is often 0.1%.

For reasons of animal care and ethics, trapping should not be conducted for more than four consecutive trap nights in any trap location, as specified under Animal Care Guidelines for Wildlife Surveys. Ethics requirements may be altered dependant on recapture rates and upon consultation with the relevant AEC. Such consultation may reveal the potential to extend the number of days if there are low capture rates and extremely low recapture rates determined by marking the animals.

There is also a need to ensure that animals become accustomed to the traps, so that trap avoidance due to ‘new object response’ is minimised. Therefore three nights is the minimum duration that traps should be deployed.

Elliott traps need to be checked every morning to ensure that any animals caught are not left to dehydrate during the course of the day, and then reset in the evening. The trap should contain materials that allow the animal to keep warm during the course of the evening.

Wire cage traps

Wire cage traps are for larger mammals, and entrap animals in a similar fashion to Elliott traps. Sample effort per stratification unit is 24 trap nights, preferably using six traps for a minimum of four nights.

Note that large Elliott traps are less successful than are cage traps for many medium to large mammals, and are not appropriate for some threatened species such as Spotted-tailed Quolls. Large Elliott traps and wire cage traps should not be regarded as interchangeable.

Hair tubes

Hair tubes vary in size and are typically cylindrical to funnel in shape with one end closed where the bait is placed. Double-sided tape is attached to the inside of the tube near the bait, and as the animal enters and leaves, hair samples become attached to the tape. Hair tubes should be placed in ten pairs (ten small and ten large) in appropriate habitat, along a transect in each stratification unit. The tubes should be checked regularly and not removed for at least four days and nights if no hair samples are obtained (Suckling 1978). One of each pair may utilise a different bait or attractant. Depending on the bait used and the weather conditions, the bait may need to be replaced after two days.

When using hair tubes to sample arboreal mammals, three tubes should be used at each of the ten sampling sites. These should be placed in trees at appropriate locations to maximise the possibility of attracting the target species.

A person with specialist expertise in the analysis of animal hair samples is required to analyse the samples. Techniques described by Brunner and Coman (1974) should be considered. The name and correspondence details of this person must be included in the survey report.

Pitfall trapping

This involves the digging of a hole (pit), which is then artificially lined, into which the target species is encouraged to fall and is subsequently unable to escape. Minimum dimensions of pits should be either 28cm diameter and 40cm deep (eg. 20 litre plastic buckets) or 15cm diameter and 60cm deep (eg. PVC pipe with cap at the base). The top of the artificial lining should be at or just below ground level and the bottom of the pit covered with a layer of leaf litter. Within each pit or bucket, a rock or small piece of wood, and dirt and leaves should be placed to provide a refuge for trapped animals. Objects that float should be placed in the pit in case of heavy rains.

Each pit must have at least five metres of drift fence either side (ie. a 10m minimum per hole). These fences should be approximately 30cm high with the lower 5cm buried into the soil, supported by steel pegs and composed of a material which resists the climbing of small animals (eg. black plastic builders dampcourse). Sampling effort must involve at least 24 trap nights and pits must be open for a minimum of four nights.

Pitfall traps are not appropriate in all locations, for example in rocky substrates. Traps must be checked each morning and animals released following identification.

Investigators should be aware of the requirements relating to animal care and ethics described in *Guideline 6, Guidelines for the Use of Pitfall Traps*, available from the Animal Welfare Unit, NSW Agriculture <http://www.agric.nsw.gov.au>.

Tracks, scats and scratches

Scat, sign and track searches target animal scats and identifiable signs such as footprints, telltale scratches on trees (for example the Yellow-bellied Glider leaves a distinctive V-shaped feeding scar on tree trunks) and nests. Survey effort involves at least a 30-minute search performed in appropriate habitat. It is possible to combine this technique with other searching techniques. If dusty roads are present these should be checked early before entering

a site as tracks are likely to have been made during the course of the night and will be destroyed by traffic (which is likely to increase as the day progresses).

If investigators are unsure of the source species of any scats they have found the scats must be verified by a specialist with expertise in the analysis of scats.

Predator scats should also be collected and analyses performed on their contents (such as hair from prey) by a specialist. Names of specialists and the results of their analyses must be included in the survey report.

Spotlighting

Survey effort on foot will involve at least two searches, each for one hour with a hand-held spotlight of appropriate power for the conditions. This must be conducted on each of two separate nights along a traverse of at least one kilometre, which samples the least disturbed parts within the stratification unit. Where the stratification unit is too small to achieve a one-kilometre traverse, a proportionate amount of spotlighting must be done.

Where roads and tracks occur in a survey area, spotlighting from a vehicle may be appropriate. Spotlighting with a 100 watt spotlight from a vehicle should be undertaken twice, each over at least a kilometre within the same stratification unit at a speed not exceeding 5 km/h. This must be repeated at least once on a separate night.

Foot and vehicle spotlight traverses must involve two observers, each using spotlights. Weather and moonlight conditions should all be discussed in the report as these can affect survey results.

Sand Plots

Sand plots involve creating a smooth sand surface across a road or track, either using imported sand or raking the surface of a dirt track. Any animals using the road/track will leave footprints in the sand, which can then be identified. Six plots are required for four nights per stratification unit.

Call playback

Identification of nocturnal vocalisations, including call playback (Wemmer *et al.* 1996), should be undertaken for arboreal mammals. Call playback techniques for arboreal mammals require the same technique as that described for nocturnal birds in section 5.3.4 (iv). Species for which call playback is particularly effective include Yellow-bellied Gliders and Koalas.

Other points

Some small mammal species in arid and semi-arid zones are best captured by dry pitfall traps (section 5.3.4 (v)). Specialist techniques for species such as Koala and Platypus should be included if these species are considered likely to occur in the locality. In addition, some species will require regionally specific specialised techniques. Threatened biodiversity should be targeted using information (if available) in the DEC Threatened Species (Environmental Impact Assessment) Profiles.

b Effort

Table 5.8 Suggested survey methods and effort for non-flying mammals

Method	Effort per stratification unit up to 50 hectares, plus an additional effort for every additional 100 hectares	Animal sampled
Small Elliott traps	100 trap nights over 3-4 consecutive nights	small mammals
Large Elliott traps	100 trap nights over 3-4 consecutive nights	Medium to large mammals
Arboreal Elliott traps	24 trap nights over 3-4 consecutive nights	Arboreal mammals
Wire cage traps	24 trap nights over 3-4 consecutive nights	Medium to large mammals
Pitfall traps with drift nets	24 trap nights over 3-4 consecutive nights	small mammals
Hair tubes	10 large and 10 small tubes in pairs for at least 4 days and 4 nights	small and medium mammals
Arboreal hair tubes	3 tubes in each of 10 habitat trees up to 100 hectares of stratification unit, for at least 4 days and 4 nights	arboreal mammals
Spotlighting on foot	2 x 1 hour and 1km up to 200 hectares of stratification unit, walking at approximately 1km per hour on 2 separate nights	arboreal and terrestrial mammals
Spotlighting from vehicle	2 x 1 km of track at maximum speed of 5km per hour, up to 200 hectares of stratification unit, on 2 separate nights	arboreal and terrestrial mammals
Sand plots	6 soil plots for 4 nights	mostly medium to large terrestrial mammals
Call playback	2 sites per stratification unit up to 200 hectares, plus an additional site per 100 hectares above 200 hectares. Each playback site must have the session conducted twice, on separate nights	gliders, koalas
Stag-watching	Observing potential roost hollows for 30 minutes prior to sunset and 60 minutes following sunset	gliders and possums
Search for scats and signs	30 minutes searching each relevant habitat, including trees for scratch marks	all mammals
Track search	1km of track search with emphasis on where substrate is soft	mostly medium to large terrestrial mammals
Collection of predator scats	Opportunistic collection of predator scats for hair analysis	all mammals

vi Bats

The ecological requirements of microchiropteran bats, including foraging strategies, dietary requirements and roost site preferences are poorly known for most bat species and generalisations based on limited observations are commonly used (Parnaby 1998). It is thought that the requirements of bats vary widely within and between species, between sexes, age groups, seasons, years and on a regional basis (Parnaby 1998). Further, the distribution and taxonomy of many species in NSW is poorly understood (Duncan *et al.* 1999). Therefore, conducting surveys for threatened bats in the face of this limited knowledge is problematic.

Given the notable decline in many bat species within NSW (Parnaby 1998), the lack of knowledge regarding their ecological requirements, taxonomic uncertainties and the difficulty in identifying all the bats that may utilise an area, it is particularly important that all available records are accessed and the suitability of habitat is assessed for bats during surveys, and taken into account during Assessments of Significance.

a Methods

Some microchiropteran bat species are best identified by their unique ultrasonic echolocation calls (Woodside and Taylor 1985), while others can only be reliably identified by trapping (Helman and Churchill 1986). Therefore, a combination of both ultrasonic detection and trapping is essential as neither method can detect all species (Corben 1989; Parnaby 1992a, b; Duffy *et al.* 2000). Ultrasonic methods are more likely to record high-flying species but trapping methods are needed to detect low intensity echo locators (eg. long-eared bats and the golden-tipped bat) (Corben 1989). Roost sites are vital for the long-term viability of bat populations and the location of such sites is an integral part of bat surveys.

a.1 Roost site identification

Microchiropteran bat species can be divided into those that roost in trees (in hollows, beneath bark or amongst vegetation) and those that roost in artificial or subterranean roost sites, primarily caves, disused mines or under bridges and house roofs. Of the 20 threatened microchiropteran bat species in NSW, seven rely almost exclusively on subterranean and artificial roost sites and the remaining 13 are either exclusive tree roosters or may occasionally utilise subterranean roosts (Table 5.9).

Roost site requirements for most bat species vary seasonally in response to reproductive status and climatic conditions. Specific microclimate conditions are required during the winter months when bats enter a state of torpor, and different conditions are required in summer within maternity sites. Other factors, such as social dynamics and food availability, may also influence the selection of roosts. Some bat species are known to gather in large numbers at certain roost sites on an annual basis for breeding, preparing to breed or during torpor. The analysis of past records and data held by bat experts is vital in identifying the presence of these important sites. As such sites may only be used at certain times of the year, the apparent absence of bats does not reflect the relative importance of the site and surveys in several seasons may be required.

Roost sites may be identified by the accumulation of bat guano and evidence of foraging (eg. moth wings) at or near potential sites such as derelict mines, caves or tunnel entrances, under bridges or at the base of trees with hollow/s. Suitable trees, caves, culverts and disused buildings should be searched during the day, however care should be taken as such structures can be potentially hazardous. In addition, stag-watching or observing the entrance of potential subterranean sites at dusk will allow observation of bats as they fly out of the roost to forage. A rough abundance estimate can also be determined. For more detailed investigations, radio-tracking of bats back to their roost sites may be appropriate.

Subterranean roosting species

A review of potential subterranean roost sites is required before field surveys commence. Information on the location of caves can be obtained from the Australian Karst Index (Matthews 1985) and other literature, and the location of derelict mines can be obtained from metallogenic and geological maps and by contacting the NSW Department of Mineral Resources. In addition, the study area should be inspected for bridges and other human-made structures (such as culverts) with the potential to provide bat habitat.

Entering derelict mines, caves or exploring other such sites for the purposes of bat surveys is not recommended due to the safety concerns associated with such sites. In addition, bats are highly sensitive to roost site disturbance, in particular during breeding and torpor, and may abandon their roost as a result of disturbance. External surveys (trapping and echolocation call recording as described below) are recommended. Surveys of derelict mines which support roost sites, and the conservation and management of such sites, is discussed in detail in the Strategy for the Conservation of Bats in Derelict Mines (NPWS and DMR 2001) which is available from the Biodiversity Management Unit of the DEC.

Tree roosting species

The factors affecting the selection of roosting sites by tree-roosting bat species are poorly known. It is thought that the size and type of roost selected may vary according to a range of parameters such as species, gender, reproductive status, food availability, climatic conditions, predation risk and presence of parasites (Lewis 1995). Radio-telemetry studies indicate that bats roost in a wide range of tree types and sizes including in dead trees, dead limbs of live trees, hollows in the trunks of live trees or under bark (Lumsden and Bennett 2002). Hollow microclimate may influence the selection of tree roosts and aspect, topographic position, orientation and opening dimension may be important factors. Radio-telemetry studies have shown that tree-roosting species change roosts regularly, for example daily to 2-daily (Lunney *et al.* 1988; Lumsden *et al.* 1994; Lumsden and Bennett 2002) and it seems likely that tree-roosting bat species require a range of roost types within close proximity. It has been observed that bats generally prefer the oldest hollow-bearing trees in an area (Parnaby 1998).

a.2 Ultrasonic echolocation detection

Microchiropteran bats use high frequency echolocation to navigate and detect prey. Ultrasonic echolocation detectors are able to detect and record these high frequency calls for use in species identification. It appears that bats modify their navigation calls according to the density of vegetation or clutter in their foraging space (Reinhold *et al.* 2001) and habitat type should be noted. Temperature, humidity and atmospheric pressure data should be recorded as these variables have a substantial effect on sampling results (Corben pers. comm. 2002).

Ultrasonic detection is most effective when operated from a laptop computer. Recordings made onto a tape recorder frequently produce poor quality, ambiguous calls requiring the investigator to nominate the range of species to which the call could be attributed (Pennay pers. comm. 2001). Ultrasonic detectors can be operated automatically with the use of time delay switches and are able to operate throughout the night without attendance by an operator. This significantly increases the chance of detecting a greater percentage of the species inhabiting the area (Richards 2001a; see below).

Despite the benefits of remote echolocation recording, hand-operated detectors generally produce longer call sequences and therefore increase the chance of confident identifications. Bats can be followed by the detector's microphone, thereby increasing the chance of obtaining search-phase calls as opposed to feeding or attack pulses, which can confuse analysis (Reinhold *et al.* 2001; see below). Navigation (search phase) calls are different to the calls used when chasing prey (attack phase), the latter being less likely to enable reliable identification. A combination of hand detection and remote overnight detection would substantially improve the reliability of such surveys, both in terms of the number of species detected and the reliable identification of calls.

To assist with the analysis of calls, particularly in light of regional within-species variation, a reference call should be collected from each species caught during trapping (eg. Duffy *et al.* 2000; Pennay 2000). Reference calls are best collected by attaching a chemiluminescent tag or small piece of reflective tape onto the fur of the bat and, on release, following it with the echolocation detector's microphone. The bat should be followed for as long as possible to enable it to settle down after release and start making characteristic search phase calls.

The identification of bats by their echolocation calls is not straightforward. There is considerable subjectivity in the analysis of calls and the subsequent identification of bats (NPWS 1999). Some species are easily identified (eg. *Rhinolophus megaphyllus*, *Chalinolobus dwyeri*) while others are difficult; the ease of identification is often related to overlaps with other species in the region and call quality. Mis-identifications can result if the full sequence of calls is not examined or available (Richards pers. comm. 2001; Reinhold *et al.* 2001). In addition, within-species regional variation has been noted (eg. some *Vespadelus* species (Pennay 2000)). Those species for which identification by echolocation call has been found to be difficult or impossible are as follows (from Herr 1998; Reinhold *et al.* 2001; DEC in prep.):

- *Nyctophilus* species cannot be reliably distinguished to species level;
- *Myotis macropus* may be confused with *Nyctophilus* species on some calls and in some regions;
- *Scotorepens* species (Parnaby 1992a) and *Scotorepens greyii* cannot be distinguished from each other, and could be confused with *Chalinolobus picatus* and *Chalinolobus nigroriseus* on some calls;
- In north-east NSW, *Vespadelus vulturinus* is indistinguishable from *Vespadelus troughtoni* and some *Vespadelus pumilus* calls;
- In south-western NSW, *Vespadelus vulturinus*, *Vespadelus darlingtoni* and *Vespadelus regulus* calls are indistinguishable (Herr 1998);
- Care should be taken as *Saccopteryx flaviventris* calls may appear similar to *Mormopterus beccarii* calls in some regions;

- *Falsistrellus tasmaniensis* calls may be confused with *Scotorepens orion* and *Scoteanax rueppellii*;
- Care should be taken with *Miniopterus schreibersii oceanensis* calls, which may overlap with *Vespadelus* species for some calls in some regions. *Miniopterus schreibersii oceanensis* calls were found to be very difficult to distinguish in eastern Victoria (Duffy *et al.* 2000); and
- *Kerivoula papuensis* calls very quietly and can only be detected when very close to the microphone.

Investigators should be appropriately skilled and experienced in analysing bat calls, particularly in the local area. It is essential that the investigator undertaking call analysis have access to a library of reference calls relevant to the region being surveyed, given the presence of within-species regional variation. Search phase calls are most diagnostic and attack or feeding calls should not be analysed (Reinhold *et al.* 2001). In any sample of calls, a large number are likely to be unusable for analysis. For example, the analysis of 298 reference calls collected in NSW revealed that only 63% of all calls were of sufficient quality to identify some characteristic parameters (Pennay 2000). Further, Duffy *et al.* (2000) found that only 37% of reference calls collected were adequately diagnostic to be included in a key. It is important that identification to species level not be made if the call is in any way ambiguous.

The Key to the Calls of the Bats of south-east Queensland and north-east New South Wales is available from QDNR (Reinhold *et al.* 2001). Sample reference calls from different regions within NSW are available on the DEC web page (<http://www.nationalparks.nsw.gov.au/npws.nsf/content/batcalls>) and accompany *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats* (Pennay *et al.* 2004). The Key and Guides were based on reference calls collected using the Anabat™ system (Titley Electronics Pty Ltd), however there are other echolocation systems available (eg. Ultra Sound Advice; Petterson Electronik). Both the Key and Guides are an attempt to improve the objectivity and consistency of the identification of bats from their calls.

To assist with identification, some investigators have developed an electronic call key through which calls can be analysed (Prevett pers. comm. 2002). It is important to note that such keys are regionally specific and cannot be transferred between regions. However, they are a helpful resource particularly when analysing large numbers of calls.

Investigators should record the analysis of calls in a table detailing those species that are definite identifications, probable and possible (with the full list of species that are probable and possible). Investigators should state the number of calls on which their identification was based and the percentage of calls that were discarded. Investigators should also include in their report an example of a call for which they have made an identification to enable verification. Investigators should note that where echolocation analysis indicates the possibility of a threatened species, that species should be assumed to be present.

a.3 Trapping

Several threatened bat species are difficult to record with ultrasonic detectors, especially gleaning species that have low intensity calls, such as *Kerivoula papuensis*, and *Nyctophilus* species which cannot be identified to species level by call alone. Therefore, direct capture methods must be used to identify these species (Richards pers. comm. 2001). Churchill (1998) and Helman and Churchill (1986) provide details of methods for trapping bats. Commonly used trapping methods involve harp, mist and tripline traps.

Harp or bat traps (Tidemann and Woodside 1978; Tidemann and Loughland 1993) are suited to areas where there are restricted flyways along tracks, in forests or over water. However, the use of harp traps amongst vegetation outside flyways is recommended as an additional measure to capture bats that prefer cluttered habitats (Ellis pers. comm. 2002). Curtains of plastic or fabric can be erected surrounding the traps to direct bats into the trap, and a curtain below the trap is recommended. Refer to section 5.3.6(ii)(c) for information relating to the checking of harp traps.

In general, bat activity levels are much higher over water than within and over forest, and water bodies should be targeted wherever they occur. Trip lines can be used to catch bats where water is too deep to access mist nets (Churchill 1998) and are particularly useful in very open areas where there are no obvious flyways. This method involves stringing fishing wire in a criss-cross pattern over a dam. The line flips bats into the water as they fly down to drink. Bats then swim to the edge (often away from any light source, such as a torch or the moon (Ford pers. comm. 2002)) and can be picked up at the edge of the water. A dip net is often useful for this task. Investigators must watch the water surface at all times and retrieve those bats unable to exit the water of their own accord. Triplining should be avoided when female bats are pregnant or carrying young.

Mist nets should be used in addition to harp traps as they may trap different species of bats in the same locality (Churchill 1998). Mist nets must be monitored continuously while in operation to remove any animals caught, in accordance with animal care and ethics requirements that can be obtained from the Animal Welfare Unit of NSW Agriculture or at <http://www.agric.nsw.gov.au>.

An appropriate licence is required to undertake mist netting due to the increased chance of injury to bats. Mist nets are not suitable in areas of very high bat activity due to the large number of animals caught and the potential for stress and injury as they become entangled in the net.

Voucher Specimens

Given the taxonomic uncertainty surrounding a number of bat species, the collection of voucher specimens is important for any species where identification is uncertain. Furthermore, DNA samples are vital for taxonomic work and can be collected from live animals by collecting a small amount of blood or a wing punch, or from vouchered animals by removing the liver or kidney (Reardon pers. comm. 2002). Samples of DNA must be preserved in 70% ethanol or liquid nitrogen. Voucher specimens and DNA samples must be

deposited with the Australian Museum. Only appropriately licensed investigators may take voucher specimens.

b *Effort*

The location of traps and ultrasonic recorders within the stratification unit (see section 5.1) should be in the areas of greatest potential activity. For example, echolocation call recorders and traps could be set up in the vicinity of roost sites or near watering points (eg. dams, small pools in streams, water tanks or irrigation channels or across a stream or gully) which are often areas of high bat activity. Many species also use regular flyways, such as tracks or riparian corridors, which may be located by observation or ultrasonic detection.

Bats are most active from October to March and sampling should be undertaken during this period (Lumsden and Bennett 1995). In other months, some bats may be active, particularly in northern NSW, however the probability of recording all the species that are present is reduced. The prevailing conditions should be taken into account when planning microchiropteran bat surveys; cold temperatures, strong wind, heavy rain and full moons should be avoided when undertaking bat surveys (Law *et al.* 1998).

A recent study (Richards 2001a) has shown that the rate of species detection is such that three hours of recording immediately after dusk is required to identify 90% of species present. Further, the average time taken to detect threatened species using echolocation recording was 94 minutes, with some threatened species only detected after three hours of recording (Richards 2001a). A study by Duffy *et al.* (2000) in south-eastern Australia found that it took six hours of echolocation call recording to identify 75-90% of the species present. After an hour of recording following sunset, less than 50% of all species recorded during the entire night were detected (Duffy *et al.* 2000). Additional species were detected on the second night of echolocation surveys (Duffy *et al.* 2000).

Several species experience additional activity peaks during the night. Some species could be active later in the evening (eg. Taylor and O'Neill 1988; Law *et al.* 1998), perhaps due to commuting times from roost sites, and would not be detected earlier in the evening. The identification of these species can be improved by using sound-activated recording devices that have the potential to record all night unless the tape is filled earlier by high levels of bat activity, or by sounds from other sources such as insects. For example, continued sampling using a delay switch may increase the chance of detecting threatened species such as *Saccopteryx flaviventris*, *Miniopterus schreibersii* and *Chalinolobus picatus* (Richards 2001b). Echolocation call detection should be conducted for a minimum of four hours, however recording for the entire night is recommended. Where call recording is not conducted for the entire night, it must be recognised that the full complement of species will not have been detected.

Results of trapping studies in south-eastern Australia indicate that trapping alone is unlikely to record the full complement of microchiropteran bat species present (Parnaby 1999; Duffy *et al.* 2000). Parnaby (1999) concluded that the majority of bats trapped comprise only a small number of species present. This is supported by Duffy *et al.* (2000) who found that, in south-eastern Australia, between one and three species comprised over 50% of all animals trapped. In one region studied, 74% of all animals trapped comprised three species, with the additional

12 species captured in that region accounting for the remaining 26% of captures. The likelihood of identifying the majority of species present will be improved by increasing the number of trap sites per night, enabling greater coverage of the stratification unit. Increasing the number of nights at each site may not necessarily increase the number of individuals trapped however may increase the species richness of captures (Duffy *et al.* 2000).

Because some bats may carry the potentially fatal lyssavirus, only appropriately vaccinated persons should handle bats and gloves should be worn to avoid being bitten.

vii Megachiropteran Species (Flying-foxes, Fruit Bats)

The presence of megachiropteran bats is substantially easier to determine than microchiropteran bats, given their size and audibly detectible vocalisations. However, due to their generally high mobility and nomadic habits, determining the importance of an area for megachiropteran bats may be more difficult.

Spotlight searches combined with listening for audible calls and movements in trees should be undertaken for flying-foxes, focussing on fruiting or flowering trees and known roost sites or camps. Mist netting is the only suitable technique for the capture of the Common Blossom Bat and is also a suitable technique for the Eastern Tube-nosed Bat (Richards 2001b). The latter species also has a distinctive, clearly audible call, which provides an indication of its presence. Mist nets should be set near flowering food resources, preferably on moonless nights (Law pers. comm. 2001).

Grey-headed and Black Flying-foxes exhibit campsite fidelity and many of the regular camps in NSW are well known. Camps can be single-species or mixed-species and in northern NSW Grey-headed and Black Flying-foxes commonly roost together (Eby 1995). The composition and numbers of animals can fluctuate dramatically and rapidly over a period of days, or even overnight. Camps are often located in valleys and beside water, including in rainforest and wet sclerophyll forest, in mangroves, Casuarinas and in Paperbark swamps (Eby 1995). Camps may be used continuously, annually or intermittently, in response to the flowering or fruiting of food resources. If a camp is not occupied at the time of survey it may still be a very important roost site at another time, enabling animals to access an infrequently available food source. A mapping project of Grey-headed and Black Flying-fox camps in NSW has been completed and data on camps is available from the DEC Biodiversity Management Unit.

The analysis of foraging resources available in the study area is also an important consideration. Flying-foxes are important pollinators and seed dispersers and feed on the pollen and fruits of a range of native and introduced plants, including species used in horticulture and landscaping. In NSW, the primary food resource is the flowers of eucalypts, melaleucas and banksias, however, it is recognised that flying-foxes in NSW feed preferentially on the pollen of native eucalypts (Eby 1995). A comprehensive list of preferred food species is provided by Eby (1995). The species on which flying-foxes rely for food have irregular patterns of flowering (Eby 2000) and the animals migrate in response to the availability of food. Therefore, while the presence of flowering and fruiting trees can indicate the importance of the site for flying-foxes, the potential food resource of a study area must be assessed as it may contribute to the feeding resource of these species at some times of the year, in some years.

Because some bats may carry the potentially fatal lyssavirus, only appropriately vaccinated persons should handle bats and gloves should be worn to avoid being bitten.

Table 5.9 Appropriate Survey Methods for Threatened Bat Species (Parnaby 1998).

Abbreviations for roosts are: H-tree hollows, S-subterranean and artificial roosts, V-vegetation.

Common name	Scientific Name	Roosts	Traps	Call Survey	Additional Methods
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	S	•		Search rocks, overhangs and caves/mines
Inland Forest Bat	<i>Vespadelus baverstocki</i>	H	•		
Large Pied Bat	<i>Chalinolobus dwyeri</i>	S	•	•	Search rocks, overhangs and caves/mines
Hoary Bat	<i>Chalinolobus nigrogriseus</i>	H	•	•	
Little Pied Bat	<i>Chalinolobus picatus</i>	H	•	•	
Greater Long-eared Bat	<i>Nyctophilus timoriensis</i>	H	•		Harp traps within vegetation
Northern Long-eared Bat	<i>Nyctophilus bifax</i>	H/V	•		
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	H		•	
Great Falsistrelle	<i>Falsistrellus tasmaniensis</i>	H	•		
Large-footed Myotis	<i>Myotis aduersus</i> (also known as <i>Myotis macropus</i>)	S/H	•		Detector and spotlight around water bodies, trapping along riparian flyways
Golden-tipped Bat	<i>Kerivoula papuensis</i>	H/V	•		
Large Bentwing Bat	<i>Miniopterus schreibersii</i>	S	•		Search rocks, overhangs and caves/mines
Little Bentwing Bat	<i>Miniopterus australis</i>	S/H	•	•	Search rocks, overhangs and caves/mines
Little Eastern Mastiff Bat	<i>Mormopterus norfolkensis</i>	H	•	•	

Common name	Scientific Name	Roosts	Traps	Call Survey	Additional Methods
Beccarii's Mastiff Bat	<i>Mormopterus beccarii</i>	H	•	•	
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	H	•	•	
Yellow-bellied Sheathtailed Bat	<i>Saccopteryx flaviventris</i>	H	•	•	Spotlight observations
Black Flying-fox	<i>Pteropus alecto</i>	V			Spotlight observations, roost surveys
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V			Spotlight observations, roost surveys
Eastern Tube-nosed Bat	<i>Nyctimene robinsoni</i>	V			Audible call survey
Common Blossom Bat	<i>Syconycteris australis</i>	V			Mist nets
Eastern Horseshoe Bat <i>(Not listed on the NSW TSC Act at time of publication)</i>	<i>Rhinolophus megaphyllus</i>	S/H	•	•	Search rocks, overhangs and caves/mines
Little Red Flying-fox <i>(Not listed on the NSW TSC Act at time of publication)</i>	<i>Pteropus scapulatus</i>	V			Spotlight observations, roost surveys

* Note that the species for which call surveys are recommended are those whose calls are readily identifiable. Call surveys may be conducted for additional microchiropteran bat species, however potential limitations to positive identifications should be recognised.

Table 5.10 Suggested survey methods and effort for bats

Method	Effort per 100 hectares (or portion thereof) of stratification unit targeting preferred habitat	Survey period
Harp trapping	Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night)	October to March
Ultrasonic call recording	Two sound activated recording devices utilised <i>for the entire night (a minimum of four hours)</i> , starting at dusk for two nights	October to March
Mist netting	For targeted survey: one trap set for at least two hours duration starting at dusk, for two nights	October to March

Trip line	For targeted survey of water bodies: at least two hours duration starting at dusk, for two nights	October to March
Spotlighting and transect walking	For targeted survey near likely food resources: 2 x 1 hour spotlighting on two separate nights	All year
Day habitat search	Search for bat excreta at or near potential habitats	All year

viii Invertebrates

Invertebrates occupy a wide range of habitats and exhibit enormous spatial and temporal variability. It cannot be assumed that invertebrate associations will exhibit strong associations with vegetation types or vertebrate assemblages (Ferrier and Watson 1997).

The need to sample invertebrate animals comprehensively introduces substantial logistic constraints as general surveys often involve the use of several techniques that target different groups of insects, most of which need to be processed by experts at substantial cost (Oliver and Beattie 1993; 1996). The use of a range of techniques will give an estimate of the species diversity however is unlikely to provide an exhaustive inventory, unless temporal and spatial variation in invertebrate distribution and abundance can be taken into account. A further problem is that the sample units are not easily defined and are difficult to replicate, with a range of quantitative techniques introducing substantial systematic biases.

At present, it is generally acceptable to target only threatened invertebrate species for Assessments of Significance. The DEC threatened species (Environmental Impact Assessment) profiles should be referred to for specific techniques for these species (where completed).

5.3.5 Field survey considerations

i Western NSW and Other Semi-arid Areas

Vegetation sample sites are often larger in western NSW in order to compensate for the generally greater structural heterogeneity of vegetation (and hence to reduce the variance of measurements taken from sites within the same stratum).

The higher maximum daily temperatures, greater aridity and generally less dense and more patchy vegetation are some factors which probably influence the observability of animals in western NSW, and therefore also the choice of survey methods. Information on effort required to detect animals in western NSW is being gathered and analysed and will be available in future editions of these guidelines. Some points to consider include:

- **Elliott trapping** for small ground-dwelling mammals often has lower success rates in western NSW compared to more easterly areas. Pitfall trapping with drift fences is often the best way to detect small ground-dwelling mammals in western NSW, however is more time consuming to set up.

- **Bat trapping** may be less productive in sparse vegetation where there are few obvious flyways in which to set harp traps. Triplining of dams may be a more successful survey method.
- **Water sources** (natural and human-made) are known to strongly influence the distribution of many species of mammals (particularly large mammals) and birds.
- **The most successful time** of the day to search for reptiles will depend on the maximum and minimum temperatures of the area in that season. In eastern areas, searches in the hottest part of the day are often most successful. In the summer in western NSW where summer maximum temperatures are much higher, many reptiles are inactive in the hottest part of the day, and those that are active move too quickly for easy identification. Hence, active searches for reptiles in cooler parts of the day may be more successful than those in the hottest part of the day.
- **Searches of randomly picked survey sites** may yield little or no observations of frogs, as their observability is likely to be even more strongly linked with rainfall and water bodies than is the case in less arid areas. Surveys targeted at water bodies or at times of rain may be required.

ii Rainforest and Other Dense Tall Vegetation Types

McDonald *et al.* (1990) suggested detailed methods that are appropriate for the survey of rainforest vegetation.

Surveys of animals in rainforests are often constrained by the high density of vegetation, which results in reduced visibility and greater difficulty in traversing study sites. Consideration should be given to the following changes to methods:

- **Small mammal traps** are often placed at shorter distances from one another, such that one trap station can still be seen from the stations around it. Alternatively, points are marked between trap stations in order to guide field workers, which is likely to be a more efficient use of time.
- **Bird surveys:**
 - Observing for a longer period at each site may go some way to compensating for shorter distances of visibility and the greater difficulty of traversing the site.
 - Observations may rely less heavily on visual identifications and more heavily on identifying calls than would be the case in more open vegetation.
 - Use call playback methods to target species of particular interest. Be aware that this technique will bias the overall survey results to the species being targeted, and that if used in conjunction with area search or point locality methods, the combined results should not be used as measures of species abundance.
- **Reptile and frog surveys:** search for longer periods at each site in order to compensate for the greater structural diversity of the habitat.

5.3.6 Handling/ethics

The legal requirements relating to animal ethics are covered in Chapter 3, Step 2 of these guidelines. Investigators should be aware of their responsibilities detailed in this section. Some practical considerations relating to animal welfare while undertaking surveys, based on the NSW Agriculture Guidelines, are given below.

i General

It is necessary to minimise noise when handling animals and minimise the time spent handling animals to reduce stress. Animals should be released as soon as possible following capture, at the capture site. In some circumstances, the point of capture may not be suitable for release and the immediate surrounds should be assessed to identify the safest release point. If animals must be kept before release they should be kept in quiet, cool and well-ventilated conditions. The NPW Act requires that animals be released at the point of capture.

ii Traps

Wet pitfall traps should not be used for capture of vertebrates. If used for invertebrates, the traps should be managed to minimise inadvertent capture of vertebrates. Dry pitfall traps need to be checked more than once each day because they capture a range of nocturnal and diurnal animals.

a Frogs and Reptiles

The *Hygiene Protocol for the Control of Disease in Frogs* (NPWS 2000) should be followed when working on frogs or conducting fieldwork in wetlands or other freshwater environments. A copy of the protocol can be found on the DEC website (www.environment.nsw.gov.au). This Protocol aims to prevent the spread of pathogens, such as Chytrid fungus, which may be a cause of the apparent decline of frogs (Berger *et al.* 1998; 1999). This Protocol covers on-site hygiene issues including the cleaning and disinfection of footwear, equipment and vehicles, and the handling of frogs in the field.

The trampling or breaking of vegetation should be avoided and any habitat moved during active searching should be replaced.

Frogs should be handled as little as possible to avoid removing skin secretions and should be kept moist during identification and before release.

b Birds

Unnecessary close-range observation of feeding and breeding birds and overuse of mimicry calls should be avoided.

c *Mammals*

When trapping mammals in cold or very hot weather, insulating material such as dry leaves should be placed in and over metal-sided traps. Cage traps should be covered to reduce stress to captured animals. All traps should be inspected and emptied at first light. Traps should be closed or inspected during the day in warm weather if there is evidence that animals are being caught during the day.

Particular care should be taken when handling marsupials with advanced pouch young, as females are prone to ejecting young when under stress.

Since many bat species are very small with high metabolic rates, the time that they spend in traps must be minimised. Lactating females may also need to return to feed young. Traps must be cleared and closed within one hour of dawn, to allow released bats to find roosts before light. The frequency with which harp traps should be checked during the night will depend on the rate at which bats are captured. As a general rule, traps should be checked approximately two hours after dusk. Subsequent checks at 3-4 hour intervals may be necessary where the rate of capture is particularly high, or if re-captures are likely. In areas of very high bat activity, such as at the entrance of caves or derelict mines, traps should be attended constantly and removed once activity (ie. fly-out) has finished. Traps that have captured very few bats in the two hours after dusk may not require any further checking until the final check before dawn.

Care should be taken to ensure that bats do not become dehydrated or cold before release. Harp traps should be checked regularly to avoid predation by larger species. Harp traps should also be carefully checked to ensure all bats have been removed prior to dismantling.

If it is necessary to retain bats during the day they should be stored in a cool, dark, well-ventilated environment and fed on sugar syrup or mealy worms. If kept for more than one day, only feed at night. The horseshoe bat and Queensland blossom bat are susceptible to dehydration and should not be retained during the day. All held bats should be released at the capture site at dusk and no bats should be released during the day.

Bats captured using the triplining technique will be wet. Following identification, a small number of bats of the same species should be placed together in a calico bag in a well-ventilated place to enable them to dry and stay warm. Bats should be released at the point of capture once warm and dry.

iii Voucher Specimens

A voucher specimen should be taken and lodged with a museum to record the presence of a species outside its known range, if it is believed that an undescribed species has been captured, or to confirm the identity of a species if identification is uncertain. Only licensed investigators are to take voucher specimens. One vertebrate specimen should be taken initially and records kept on the date of capture, location (including eastings and northings), gender, identification and the collector.

The taking of voucher specimens is covered by the Australian Code of practice for the care and use of animals (NHMRC 1997). It states that:

- consultation must take place with the institution before collection regarding techniques and data collection;
- proper documentation of specimens is essential and data should be maintained with the specimens; and
- voucher specimens should be lodged with a museum or other institution that can house and curate them and make them available for further study.

All specimens must be humanely euthanased as per the conditions of the Animal Research Authority issued for the survey and an identification tag must be attached to the specimen. Collectors should be aware of the requirements relating to animal care and ethics for collecting specimens as described in *Guideline 5, Guidelines for Collection of Voucher Specimens* available from the Animal Welfare Unit, NSW Agriculture <http://www.agric.nsw.gov.au>.

In NSW, voucher specimens must be sent to:

Collection Manager (birds/mammals/herpetology/insects - as relevant to the material)
Australian Museum
6 College Street
Sydney NSW 2000.

The museum can provide advice on fixation techniques and data collection.

5.4 HEALTH AND SAFETY

All persons involved in field surveys should follow a health and safety procedure for fieldwork, which covers issues such as personal safety, emergency procedures and emergency contacts. Fieldworkers should be trained in emergency procedures, including CPR, and should carry appropriate first aid kits. Communication is to be maintained at all times between team members and with external contacts, particularly in remote locations. Prevailing conditions, physical capabilities of team members, topography and road condition must be taken into account, and driving whilst sleep-deprived is to be avoided. When handling certain groups of animals, the following additional precautions need to be taken.

5.4.1 Invertebrates

Insect bites may produce a severe allergic reaction in some people leading, in extreme cases, to anaphylactic shock. Measures should be taken to avoid insect bites and appropriate first aid kits should be carried. The venom of some ticks can seriously affect some people and care should be taken to remove and kill all ticks as soon as possible.

Venomous spiders such as Funnel Webs and Red-Backs may be captured in pit traps in some locations in NSW. Fieldworkers should be aware of the dangers of such species and of the appropriate emergency procedures should somebody be bitten.

5.4.2 Frogs

The *Hygiene Protocol for the Control of Disease in Frogs* (NPWS 2000) should be followed when working on frogs or conducting fieldwork in wetlands or other freshwater environments.

Surveys conducted in rocky areas should not be conducted alone due to the risk of slipping on rocks, which may result in severe injuries to limbs or the head. Such injuries could potentially result in drownings if assistance is not available.

5.4.3 Snakes

Experienced persons only should handle snakes. All fieldworkers should be aware of the treatment for snakebite and carry appropriate pressure bandages in their first aid kits. Protective footwear and clothing (eg. long pants, gators) should be worn during fieldwork.

5.4.4 Animal bites

Gloves should be worn when removing animals from traps. First aid kits should be carried into the field. All fieldworkers should have up-to-date tetanus vaccinations.

5.4.5 Scats and owl pellets

Scats and pellets may contain eggs of parasites as well as bacteria and viruses. Eggs of hydatid tapeworms (*Echinococcus multilocularis*), which can form lethal cysts in humans, may be present in the scats of dingoes and dogs (including foxes). All scats and pellets should be collected using disposable plastic gloves, placed in an envelope and sealed.

5.4.6 Bats

Microchiropteran bats and flying-foxes may carry the potentially fatal rabies-related lyssavirus. Therefore, all persons handling bats should have the pre-exposure rabies vaccine and gloves should be worn when handling all bats. Disturbance of soil and guano in bat roosts and caves should be avoided due to the possible presence of spores of the fungus *Histoplasma capsulatum* that can infect the lungs of humans.

Caves, mines, old bridges and other structures that provide habitat for bats can be particularly unstable and dangerous environments.

5.4.7 Plants

Native vegetation, including threatened biodiversity, is at risk from the Phytophthora root rot fungus. ‘Dieback caused by the root rot *Phytophthora cinnamomi*’ is listed as a key threatening process on the EPBC Act and the Department of Heritage and Environment (formerly Environment Australia) has prepared a Threat Abatement Plan. It is also listed as a key threatening process under the TSC Act and a Threat Abatement Plan is in preparation.

Phytophthora can be spread by human access and reference should be made to the Threat Abatement Plan with regard to minimising the risk of transmission of this fungus.

6 INTERPRETATION OF RESULTS

‘Threatened biodiversity’ means threatened species, populations or ecological communities, or their habitats.

Once the results of the field surveys and literature review are obtained, it is necessary to interpret these results with respect to the aims and objectives of the threatened biodiversity assessment. To adequately interpret the data, it should be in a form that shows the pattern, extent and types of animals and plants and their habitats for the whole of the study area, and other important overlay features (eg. topography, geology, land use). This information can then be manipulated and displayed in a form that establishes a comprehensive understanding of the:

- threatened biodiversity known or considered likely to occur in the study area;
- the likely impacts of the proposal on threatened biodiversity;
- areas of importance within the study area; and
- managing impacts to minimise disturbance to threatened biodiversity.

6.1 ASSESSMENT OF SIGNIFICANCE

Details of how to undertake the Assessment of Significance are contained in the *NPWS Threatened Species Management Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The ‘8 Part Test’ of Significance*.

The Assessment of Significance was revised by the TSC Amendment Act, and new guidelines for this assessment will be available when these amendments are proclaimed.

6.2 MANAGING IMPACTS

6.2.1 Importance

Managing impacts is a vital component of any threatened biodiversity assessment and needs to be considered in great detail by all three parties: the proponent or applicant; the investigator; and the decision-maker. In their assessment of the proposal, the decision-maker must carefully consider all proposed impact measures that mitigate, ameliorate, compensate or monitor threatened biodiversity and will assess these as an integral part of the proposal. In their final assessment, these measures may substantially influence the determination made. The decision-maker may include the ameliorative measures as conditions of consent or approval, thereby making their implementation a legal requirement.

It is, therefore, important when devising these measures that the investigator and the proponent or applicant work in collaboration to ensure that the proponent or applicant is aware of the constraints that require incorporation into the design stage of the proposal. This collaboration will also serve to avoid the additional expense associated with adjusting the proposal.

It should be emphasised that measures that manage impacts are not sufficient reasons for a decision-maker to give consent or concurrence to a proposal. All other factors must be considered.

Please note that in situations where the decision-maker refuses the proposal on the basis of an expected significant impact on threatened biodiversity, ameliorative measures may be devised and the proposal re-submitted, however a new Assessment of Significance must be undertaken addressing the amended proposal.

6.2.2 Examples of measures

Table 6.1 lists examples of measures that may be adopted by a proposal to minimise impacts to threatened biodiversity; these include protecting and avoiding significant areas. When devising a proposal's own measures, it is important to remember that they will need to be specific to the threatened biodiversity known or likely to occur in the study area and to the type and scope of the proposal.

Translocation of animals is not an appropriate ameliorative measure in almost all circumstances. The DEC, through various licensing provisions, is the primary regulator of the translocation of animals in NSW. It is DEC policy that translocation should not be used as a substitute for the protection of high quality natural areas. Also, that the conservation of wild populations *in situ* and the methods, risks and consequences associated with a proposal need to be thoroughly assessed before any translocation is undertaken. The NPWS (now the DEC) has prepared a ‘*Policy for the Translocation of Threatened Fauna in NSW*’ to guide the planning and implementation of translocation programs for threatened animals in NSW, and is available from the Biodiversity Management Unit on request.

Further, it is the DEC policy that where the removal of threatened animal habitat is proposed in the course of carrying out a proposal, and where the concurrence or consultation of the Director-General of the DEC is required under the EP&A Act, the emergency transfer of threatened animals will not be considered as an alternative to *in situ* conservation.

Similarly the DEC does not consider the translocation of plants as an acceptable measure of amelioration. All plant translocations should be undertaken in accordance with the Australian Network for Plant Conservation Translocation Guidelines.

Table 6.1 Examples of measures to manage impacts

Category	Examples
Protection and avoidance	<p>Relocating or changing the design of the proposal</p> <p>Restricting access of construction crew and machinery</p> <p>Implementing stringent sediment and erosion control measures</p> <p>Creating buffer areas between a significant area and the footprint of the proposal</p>
Enhancement	<p>Bush regeneration activities</p> <p>Replacing animal habitats such as tree hollows and rocky outcrops</p> <p>The use of underpasses/overpasses in order to allow passage of native animals between natural areas</p>
Compensation	<p>Land acquisition</p> <p>Construction of artificial replicas of important habitat features (eg. artificial nesting sites for birds, frog-friendly ponds)</p>
Management	<p>Weed and feral animal control programs</p> <p>Bushfire management</p> <p>Ongoing monitoring programs</p> <p>Restricting livestock, domestic pets and humans to certain areas</p>

7 GLOSSARY

The Glossary defines terms that are used in this document. The definitions quoted from the NSW TSC Act, NV Act and the EP&A Act are indicated.

Activity	Means: a) the erection of a building; b) the carrying out of a work in, on, over or under land; c) the use of land or of a building or work; d) the subdivision of land; e) any act, matter or thing prescribed in an environmental planning instrument under s26 of the EP&A Act as an activity; but does not include any act, matter or thing for which development consent under Part 4 is required or has been obtained or is prohibited under an environmental planning instrument (EP&A Act).
AEC (also known as ACEC)	Animal Ethics Committees control animal research. Their role is to advise, monitor, discipline and control animal research and approve animal supply for research. They must also ensure that all research conducted in their institution, or by the independent researchers they supervise, complies with the NSW <i>Animal Research Act 1985</i> and the <i>Australian Code of Practice for the Care and Use of Animals for Scientific Purposes</i> .
AMG	Australian Map Grid coordinates.
Animal	Means any animal, whether vertebrate or invertebrate, and at whatever stage of development, but does not include fish within the meaning of the FM Act other than amphibians or aquatic or amphibious mammals or aquatic or amphibious reptiles (TSC Act).
ARA	Australian Research Authority. This is a requirement for every person undertaking animal research under the NSW <i>Animal Research Act 1985</i> . The authorities are issued by either an accredited research establishment or by the Director-General of NSW Agriculture.
Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: <ul style="list-style-type: none">• Genetic diversity – the variety of genes (or units of heredity) in any population;• Species diversity – the variety of species; and• Ecosystem diversity – the variety of communities or ecosystems.

Clearing	Under the <i>Native Vegetation Act 2003</i> (yet to be enacted, as of March 2004) <i>clearing</i> native vegetation means any one or more of the following:
	(a) cutting down, felling, thinning, logging or removing native vegetation,
	(b) killing, destroying, poisoning, ringbarking, uprooting or burning native vegetation.
Consent Authority	In relation to a development application means:
	a) the council having the function to determine the application; or
	b) the Minister, public authority (other than a council) or Director-General of DIPNR where specified in an environmental planning instrument (EP&A Act).
Conservation	The protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment (NPWS 1997a-d).
Conservation Reserves	Consists of those areas gazetted as National Parks, Nature Reserves and State Conservation Areas under the NPW Act, and those areas designated as Plant Reserves under the <i>Forestry Act 1916</i> (NPWS 1996a).
Critical Habitat	Habitat declared to be critical habitat under Part 3 of the TSC Act. For the purposes of the TSC Act and other Acts amended by the TSC Act, critical habitat is the whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community (TSC Act).
DBH	Diameter of a tree at breast height.
Determining Authority	A Minister or public authority:
	a) by or on whose behalf an activity is to be carried out; or
	b) whose approval is required in order to enable the activity to be carried out (EP&A Act).
Development	In relation to land:
	a) the erection of a building on that land;
	b) the carrying out of a work in, on, over or under land;
	c) the use of land or of a building or work on that land; and
	d) the subdivision of that land;
	but does not include any development of a class or description prescribed by the EP&A Act for the purpose of this definition (EP&A Act).
Development Application	An application for consent under Division 1 of Part 4 of the EP&A Act, to carry out development (EP&A Act).

Ecological Community	An assemblage of species occupying a particular area.
Endangered Ecological Community	An ecological community specified in Part 3 of Schedule 1 of the TSC Act (TSC Act).
Endangered Population	A population specified in Part 2 of Schedule 1 of the TSC Act (TSC Act).
Endangered Species	A species specified in Part 1 of Schedule 1 of the TSC Act (TSC Act).
Environmental Weed	Any plant that is not native to the local area that has invaded the native vegetation (DLWC 1999a-c).
Habitat	An area or areas occupied, or periodically or occasionally occupied by a species, population or ecological community and includes any biotic or abiotic components.
Harm	To harm an animal (including an animal of a threatened species, population or ecological community) includes hunt, shoot, poison, net, snare, spear, pursue, capture, trap, injure or kill, but does not include harm by changing the habitat of an animal (which is damage of habitat) (NPW Act 1974).
Hollow-bearing Tree	A tree where the base, trunk or limbs contain hollows, holes and cavities that have formed as a result of decay, injury or other damage. Such hollows may not be visible from the ground, however may be apparent from the presence of deformities such as burls, protuberances or broken limbs, or where it is apparent the head of the tree has been lost or broken off (NPWS 1999).
Isolated Trees	Isolated trees are individual or scattered small clumps of trees (1-5) that occur in a highly modified landscape (eg. in a wheat paddock), where there are no understorey plants and the groundcover typically comprises non-native species. As an indication, these trees or clumps are generally spaced in excess of 100 metres apart or greater (DLWC 1999a,b).
Key Threatening Process	A threatening process specified in Schedule 3 of the TSC Act. Threatening process is defined as a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities (TSC Act).
Likely*	Taken to be a real chance or possibility (NPWS 1996a).
Life cycle	The sequence of events from the origin as a zygote, to the death of an individual (NPWS 1996a).

* Denotes that these terms have been referred to in a number of Land and Environment Court cases.

Limit of its Geographic Range	The final or furthest boundary or point that a plant or animal species continues to extends to, in relation to the known geographical extent of distribution of that species (NPWS 1996a).
Local Population	The population that occurs within the study area, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated (NPWS 1996a).
Native Vegetation	Any of the following types of indigenous vegetation: trees, understorey plants, groundcover and plants occurring in a wetland (DLWC 1999a,b).
Nest	Includes but is not limited to, a structure built by birds, or a tree hollow, or a site on the ground or in a cave used by birds for the purposes of the incubation and/or rearing of young. A nest also includes a site where the actual nest can not be seen or found, however there is clear evidence of breeding nearby and it is considered likely that a nest occurs nearby (ie. within 50 metres) (NPWS 1999).
Pick	To pick a native plant (including a threatened species, population or ecological community) means to gather, pluck, cut, pull up, destroy, poison, take, dig up, remove or injure the plant or any part of the plant (NPW Act 1974).
Plant	Means any plant-life that is indigenous to NSW, whether vascular or non-vascular and in any stage of biological development, and includes fungi and lichens, but does not include marine vegetation within the meaning of the FM Act.
Population	A group of organisms, all of the same species, occupying a particular area.
Proponent	In relation to an activity: a) any person proposing to carry out the activity; b) State Forests of NSW in respect to forestry activities authorised by State Forests on land under the management of State Forests; or c) Any determining authority which the Minister certifies in writing to be the proponent of a particular activity or for which the regulation declares to be the proponent of an activity of the kind specified in the regulation (EP&A Act).
Protected Areas	Any reserve that fits the IUCN criteria with its function being conservation. In NSW, this includes areas gazetted as National Parks, Nature Reserves and State Conservation Areas under the NPW Act, and those areas designated as Plant Reserves under the <i>Forestry Act 1916</i> (NPWS 1996b).
Protected Species	Those species defined as protected under the NPW Act. It includes all native animals, and all native plants listed on Schedule 13 of the NPW Act.

Public Authority	Under the <i>Threatened Species Conservation Act 1995</i> public authority means any public or local authority constituted by or under an Act, a government department, a statutory body representing the Crown, or a State owned corporation, and includes a person exercising any function on behalf of the authority, department, body or corporation and any person prescribed by the regulations to be a public authority
Record	Where the record pertains to animal, includes an observation of a live or dead individual of a species, or any parts of an individual, or a sign that indicates the species' presence. Where the record pertains to plant, includes any part of a plant including, but not limited to, roots, stems, branches, leaves, fruits, seeds and flowers (NPWS 1999).
Recovery Plan	A plan prepared and approved under Part 4 of the TSC Act.
Region	For the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes. If the bioregion occurs partly within and partly outside NSW, the region consists only of such much of the bioregion as occurs within NSW (TSC Act).
	The Director-General of National Parks and Wildlife (now part of the DEC) determined, pursuant to s4 (1) of the TSC Act and s4 (6A) of the EP&A Act, that the national system of bioregionalisation identified in the map entitled <i>An Interim Biogeographic Regionalisation of Australia</i> and its accompanying report <i>An Interim Biogeographic Regionalisation of Australia (IBRA): A Framework for Setting Priorities in the National Reserves System Cooperative Program Version 4.0</i> , published by the Australian Nature Conservation Agency on 31 March 1995, is appropriate for the purposes of the provisions in which the term region is used. Appendix J provides additional information on bioregions.
Risk of Extinction	A species is at risk of extinction if its numbers are reduced to such a critical level, or its habitats have been so drastically reduced, that it is in danger of becoming extinct (NPWS 1996a).
Rocky Outcrop	An area where rocks or exposed boulders cover more than 70% of any 0.1 hectare area (30 metres by 30 metres); and/or areas with skeletal soils (areas with shallow soils where rocks are exposed), supporting heath or scrub (sometimes with occasional emergent trees) (NPWS 1999).

Roost	Where the roost relates to a microchiropteran bat tree roost, it includes a tree, stag or rocky crevice where there is clear evidence that a microchiropteran bat has roosted, such as an accumulation of bat excreta or where a microchiropteran bat has been seen flying into or out.
	Where the roost relates to threatened owls, roost includes a site where an owl has been observed roosting (ie. sheltering or resting during the day); and/or a site where there is clear evidence that an owl has roosted such as where there are owl pellets, remains of prey or owl excreta (NPWS 1999).
Sap Feed Tree	A tree with recent V-notch incisions or other incisions made by a Yellow-bellied Glider or Squirrel Glider. Recent incisions are less than two years old and not closed (NPWS 1999).
Scientific Committee	The Scientific Committee constituted under Part 8 of the TSC Act.
Scientific Licence	A scientific licence is required under the NPW Act to undertake an action for scientific, educational or conservation purposes that is likely to result in one of more of the following:
	<ul style="list-style-type: none"> a) Harm to any protected fauna, or to an animal that is of, or is part of, a threatened species, an endangered population or an endangered ecological community; b) the picking of any protected native plant or of any plant that is of, or is part of, a threatened species, an endangered population or an endangered ecological community; c) damage to critical habitat; or d) damage to a habitat of a threatened species, an endangered population or an endangered ecological community. These licences are issued by the DEC.
Significant*	Important, weighty or more than ordinary (NPWS 1996a).
Species	Of an animal or plant, includes any defined sub-species and taxon below a sub-species and any recognisable variant of a sub-species or taxon.
Species Impact Statement	A statement referred to in Division 2 of Part 5 of the TSC Act and includes an environmental impact statement, prepared under the EP&A Act, that contains a Species Impact Statement (TSC Act).
Species Presumed Extinct	A species specified in Part 1 or 4 of Schedule 1 or in Schedule 2 of the TSC Act (TSC Act).
Stag	A standing dead and dry tree greater than 30 centimetres DBH, and greater than three metres in height (NPWS 1999).

* Denotes that these terms have been referred to in a number of Land and Environment Court cases.

Study Area	The subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly (NPWS 1996a).
Subject Site	The area to be directly affected by the proposal.
Threat Abatement Plan	Plan prepared and approved under Part 5 of the TSC Act (TSC Act).
Threatened Biodiversity	For the purpose of this document threatened biodiversity refers to threatened species, populations or ecological communities, or their habitats.
Threatened Species	A species specified in Schedule 1 Part 1 (endangered species), Part 4 (presumed extinct) and Schedule 2 (vulnerable species) of the TSC Act (TSC Act).
Threatened Species, Populations or Ecological Communities	Means a species, population and ecological community identified in either Schedule 1 or Schedule 2 of the TSC Act (TSC Act).
Threatening Process	A process that threatens, or may have the capability to threaten, the survival or evolutionary development of the species, population or ecological community (TSC Act).
Viable Local Population	A population that has the capacity to live, develop and reproduce under normal conditions, unless the contrary can be conclusively demonstrated through analysis of records and references (NPWS 1996a).
Vulnerable Species	A species specified in Schedule 2 of the TSC Act (TSC Act).

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APPENDIX A GUIDELINES REVIEWED

Guideline Name	Prepared By
A Framework for Public Environmental Reporting, An Australian Approach	SMEC and Australian Industry Group for Environment Australia (2000)
Animal Research Authority Guidelines 1, 5, 6, 7 and 10 and Factsheet 1	NSW Agriculture (1994, 1996, 1998, 1999, 2000a, 2000b)
Assessment of Terrestrial Ecosystems, Draft 4, EIS Manual	DUAP (1997)
Assessment of Aquatic Ecology in EIA - DUAP	Lincoln Smith (1998)
Australian Code of Practice for the care and use of animals for scientific purposes. 6 th Edition	NHMRC (1997)
Biodiversity Planning Guide for Local Government	Fallding <i>et al.</i> (2001)
Bush Fire Risk Management Plans and Guidelines	NSW Bush Fire Coordinating Committee (1998, 1999)
Community Biodiversity Survey Manual	Carlton (1998)
Conservation Value Assessment Guidelines (Site specific).	NPWS (1997c)
Environmental Assessment Guidelines - Flora and Fauna	NPWS Western Zone (1998)
Flora and Fauna Guidelines for Development – Wyong Shire Council	Wyong Shire Council (1999)
Flora and Fauna Survey Guidelines - Lake Macquarie City Council	Forest Fauna Surveys, EcoPro P/L, Fly By Night Bat Surveys P/L (1997)
General Guidelines for Impact Assessment	NPWS (1998a)
Guide to Native Vegetation Survey (Agricultural Region) using the Biological Survey of South Australia Methodology	South Australia Department of Housing and Urban Development (1997)
Guideline for the Preparation of Environmental Assessment Reports, Edition 1	DPWS Project Management Group (2000)
Guidelines and Application Form for Clearing Vegetation under the NVC Act	DLWC (1999a)
Guidelines for Assessment of Aquatic Ecology in EIA (Draft)	DUAP (1998)
Guidelines for Clearing Fauna Habitat - RTA	Sinclair Knight Merz (1999)
Guidelines for Koala Habitat Assessment	Australian Koala Foundation (1999)
Guidelines for Natural Heritage Conservation Assessment of Lands (Draft)	NPWS (1997b)
Guidelines for Protecting Urban Bushland and other Natural Areas (Draft)	DUAP (1999a)
Interim Procedures for Targeted and General Flora and Fauna Surveys and Reports under the <i>Native Vegetation Conservation Act 1997</i>	DLWC (1999b)
Internal Guidelines – Threatened Species	DUAP (2000b)

Local Greening Plans - a guide for vegetation and biodiversity management	Greening Australia (1995)
Native Vegetation Handbook 1 - support package for regional vegetation committees (Draft)	DLWC (1998)
NSW Comprehensive Regional Assessments, Vertebrate Fauna Surveys 1996-1997 - Summer Survey Season Field Survey Methods	NPWS (1997d)
SEPP 44 – Koala Habitat Protection, DUAP Circular B35	DUAP (1995)
Staff Guidelines for the assessment of clearing applications under the NVC Act	DLWC (1997)
Survey Design for Biodiversity: Bryophytes - Literature review (Draft)	Author unknown
Terms of licence under the TSC Act, State Forests, Lower North East. Appendix B	NPWS (1999)
Terrestrial Flora and Fauna Survey Guidelines (Draft)	DUAP (1999b)
Threatened Species Assessment Manual, Development Services Division	Shoalhaven City Council (2000)
Threatened Species Conservation Act 1995 – Information Circular No.1	NPWS (1996b)
Threatened Species Management Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The ‘8 Part Test’ of Significance	NPWS (1996a)
Threatened Species Management Information Circular No. 5: Species Impact Statements	NPWS (1998b)
Threatened Species Management Information Circular No. 6: Policy for Translocation of Threatened Fauna in NSW	NPWS (1998c)
Vegetation Mapping Guidelines for Reserve and Conservation Planning (Draft)	NPWS (1997e)

APPENDIX B PARTICIPATING ORGANISATIONS

The guidelines were developed following extensive industry consultation throughout NSW. The following organisations participated in the consultation program conducted by SMEC with the assistance of NPWS.

Actinotus Flora Consultants
Alan Stewart & Associates
Andrews.Neil
Arbec Garden and Parks Design
Armidale City Council
Arnhem Environmental Impact Assessors
Australasian Bat Society
Australian Nature P/L
Avifauna Studies
Ballina Shire Council
Bankstown City Council
Bathurst City Council
Baulkham Hills Shire Council
Bega Valley Council
BioDesign
Biosis Research P/L
Biosphere Environmental Consultants Pty Ltd
Blue Mountains City Council
Blue Mountains Wilderness Trust
Bushcare
Byron Council
Campbelltown City Council
Central Coast Regional Catchment Committee
Coal & Allied
Conacher & Travers
Cooma-Monaro Shire Council
CSIRO Wildlife & Ecology
Cygnet Surveys and Consultancy
Department of Land and Water Conservation
Department of Urban Affairs and Planning
Ecological Surveys and Management
Education & Environment Services Pty Ltd

Environment ACT
Environmental Research & Information Consortium
ERM Australia
Eurobodalla Shire Council
Evans Shire Council
Forest Fauna Surveys
Geoff Butler & Associates
Geoff Cunningham Natural Resource Consultants P/L
GeoLINK Group
Greater Taree City Council
Greenloaning Biostudies Pty Ltd
Greg Daly Environmental Consultant
Greg Richards & Associates P/L
Gunnedah Environmental Consultants
Holroyd City Council
Hornsby Shire Council
Hunter Catchment Management Trust
Hunters Hill Council
James Warren & Associates
Kendall & Kendall Ecological Services P/L
Land & Environment Planning
Lane Cove Council
Lemington Coal Mines Pty Ltd
LesryK Environmental Consultants
Liverpool City Council
Loftus Bushcare
Macquarie University
Maitland City Council
Mosman Council
Mount King Ecological Surveys
National Parks Association of NSW
Nature Conservation Council of NSW
North Coast Forestry and Environmental Consultants
NSW Aboriginal Land Council
NSW Agriculture
NSW Minerals Council
P & J Smith Ecological Consultants

Parramatta City Council
Penrith City Council
Pittwater Council
Powercoal P/L
Rangott Mineral Exploration P/L
Robert Clifton Consulting
Roads and Traffic Authority NSW
Rural Fire Service
RZM Pty Ltd
Shellharbour City Council
Shire of Nambucca
State Forests of NSW
Strathfield Municipal Council
Sutherland Shire Council
Sydney Water Corporation
Tallaganda Shire Council
Terra Consulting (NSW) Pty Ltd
Threatened Species Network NSW
Tree Wise Men Australia P/L
Ulan Coal Mines Ltd
Ulmarra Council
Umwelt (Aust.) Pty Ltd
University of Wollongong
Urban Bushland Management Consultants P/L
Walgett Shire Council
Warringah Shire Council
WBM Oceanics Australia
Wellington Council
Wingecarribee Shire Council
Wirrimbirra Consultants
Woollahra Council
Yass Shire Council

APPENDIX C EXCERPT FROM EP&A ACT 1979 AND TSC ACT 1995.

s5A EP&A Act 1979 and s94 TSC Act 1995: Significant effect on threatened species, populations or ecological communities, or their habitats

- (a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction,
- (b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,
- (c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed,
- (d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community,
- (e) whether critical habitat will be affected,
- (f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,
- (g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,
- (h) whether any threatened species, population or ecological community is at the limit of its known distribution.

APPENDIX D SECTION 110 OF THE TSC ACT – SIS REQUIREMENTS

S110 of the TSC Act - Content of Species Impact Statements

1. A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout and, to the fullest extent reasonably practicable, the information referred to in this section.
2. A species impact statement must include the following information as to threatened species and populations:
 - a) a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action,
 - b) an assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action,
 - c) for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it,
 - d) an estimate of the local and regional abundance of those species or populations,
 - e) a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action, (same information as (a) above)
 - f) a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region,
 - g) a full assessment of the likely effect of the action on those species and populations, including if possible, the quantitative effect of local populations in the cumulative effect in the region,
 - h) a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development,
 - i) a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations, including a compilation (in a single section of the statement) of those measures,
 - j) a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population.
3. A species impact statement must include the following information as to ecological communities:
 - a) a general description of the ecological community known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action,
 - b) for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it,

- c) a full description of the type, location, size and condition of the habitat (including critical habitat) of the ecological community and details of the distribution and condition of similar habitats in the region,
 - d) a full assessment of the likely effect of the action on the ecological community, including if possible, the quantitative effect of local populations in the cumulative effect in the region,
 - e) a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development,
 - f) a full description and justification of the measures proposed to mitigate any adverse effect of the action on the ecological community, including a compilation (in a single section of the statement) of those measures,
 - g) a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the ecological community.
4. A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement;
5. The requirements of subsections (2) and (3) in relation to information concerning the State-wide conservation status of any species or population, or any ecological community, are taken to be satisfied by the information in that regard supplied to the principal author of the Species Impact Statement by the National Parks and Wildlife Service, which information that Service is by this subsection authorised and required to provide.

APPENDIX E KEY STAKEHOLDERS, CONTACT DETAILS AND DATA SOURCES

Agency or Organisation	Relevant Administering Legislation	Information available	Web Address or other form of contact
Australian Heritage Commission (Division of the Commonwealth Department of the Environment and Heritage)	<i>Australian Heritage Commission Act 1975</i>	Register of the National Estate (listings of natural sites)	http://www.ea.gov.au/heritage/index.html
Australian Museum		Australian Museum database Specimen library Taxonomic experts	http://www.austmus.gov.au
Birds Australia		Atlas of Australian Birds Birds counts in Australia Species information (habitat, distribution, ecology)	http://www.birdsaustralia.com.au
Bureau of Meteorology	<i>Meteorology Act 1955</i>	Weather data (rainfall, temperature, wind)	http://www.bom.gov.au/climate
Commonwealth Scientific Industrial Research Organisation (CSIRO)		Biodiversity research, including threatened species Feral animal control research; CSIRO publications on biodiversity; EUCLID – computer guide to identifying eucalypts; Interactive plant identification tools	http://www.csiro.au

Agency or Organisation	Administering Legislation	Information available	Web Address or other form of contact
Department of the Environment and Heritage (formerly Environment Australia)	<i>Environment Protection Biodiversity Conservation Act 1999</i>	EPBC Act listings (Threatened species, JAMBA and CAMBA, Bonn convention). Databases: Directory of Important Wetlands, Eucalypt Data Project, Species Mapper, IBRA and EnviroMaps. Biodiversity Publications	http://www.ea.gov.au
Environmental Consultants		Environmental Reports Flora and Fauna Reports	Search DIPNR library database to find relevant reports
Council	<i>Local Government Act 1993</i> <i>Local Environmental Plans</i>	Zoning, land use and heritage information Flora and fauna consultant reports State of the Environment Reports Flora and fauna guidelines	http://www.dlg.nsw.gov.au/dlg/dlghome/dlg_home.asp
National Heritage Trust		Funding for major natural heritage programs including wetlands, landcare and rivercare	http://nht.gov.au
Nature Conservation Council of NSW		Non-government environmental information from a range of sources Code of Conduct for Ecological Consultants	http://www.nccnsw.org.au

Agency or Organisation	Administering Legislation	Information available	Web Address or other form of contact
NSW Agriculture	<i>Animal Research Act 1985</i> <i>Animal Research Regulations 1985</i>	Feral plant and animal information Land use features Animal Research Authority inquiries	http://www.agric.nsw.gov.au
NSW Department of Environment and Conservation (formerly the National Parks and Wildlife Service)	<i>National Parks and Wildlife Act 1974</i> <i>Threatened Species Conservation Act 1995</i>	DEC Wildlife Atlas Database Threatened species and reserve information Recovery Plans and Threat Abatement Plans Biodiversity Research	http://www.nationalparks.nsw.gov.au
NSW Department of Infrastructure, Planning and Natural Resources (formerly the Department of Urban Affairs and Planning)	<i>Environmental Planning and Assessment Act 1979</i> <i>Heritage Act 1977</i> <i>State Environmental Planning Policies</i> <i>Regional Environmental Planning Policies</i>	EIS Guidelines (DUAP, 1996) Library resources – Flora and Fauna Reports, Regional studies.	http://www.duap.nsw.gov.au/index1.html
NSW Department of Lands	<i>Catchment Management Act 1989</i> <i>Native Vegetation Conservation Act 1997</i> Regional Vegetation Management Plans	NSW Natural Resources Data Directory (NRDD) Aerial photographs and satellite images; Land tenure and land capability; Regional Vegetation Management Plans Maps, reports and GIS data on vegetation, topographic features, soil, geological and others	http://www.dsnp.nsw.gov.au/index1.htm http://www.nrims.nsw.gov.au

Agency or Organisation	Administering Legislation	Information available	Web Address or other form of contact
Royal Botanic Gardens, Sydney (now part of the DEC)		Royal Botanic Gardens Database (online); National herbarium; Expert taxonomic information; Botanical library and bookshop (vegetation maps, flora identification books, and scientific journals);	http://www.rbgsyd.nsw.gov.au
State Forests of NSW		Flora and fauna records and reports	http://www.forest.nsw.gov.au
Universities		Library resources Research programs	
Zoological Parks Board, NSW		Native fauna research	Taronga Zoo, Sydney Western Plains Zoo, Dubbo http://www.zoo.nsw.gov.au/index.htm

APPENDIX F PRO-FORMAS

List of Pro-formas

1. Table 1: Summary of the Proposed Development or Activity;
2. Table 2: Identifying potential effects of the proposal on threatened species, populations or ecological communities, or their habitats.
3. Field Survey Pro-formas - to be provided when completed.

Table 1 Summary of the proposed development or activity

Description of the proposed development or activity

The location of the proposal and any additional areas which are likely to be affected by the proposal, delineated on a map showing the proposal in both a local and regional (ie. based on the regions illustrated in Appendix D) context

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Type of development or activity (including any ancillary works and intrinsic work stages)

.....
.....
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.....
.....

Duration and timing of the proposal (including staging, if any)

.....
.....

Area affected by the proposal (directly and indirectly) in hectares

.....
.....

Other matters

.....
.....
.....
.....
.....

Table 2 Identifying potential effects of the proposal on threatened species, populations or ecological communities, or their habitats

Characteristics of the proposal (during construction and operation)	Potential effects
<p>How is the proposal likely to affect the life cycle of a threatened species and/or population?</p> <ul style="list-style-type: none"> a) displaces or disturbs threatened species and/or populations disrupts the breeding cycle b) disturbs the dormancy period c) disrupts roosting behaviour d) changes foraging behaviour e) affects migration and dispersal ability f) disrupts pollination cycle; g) disturbs seedbanks; h) disrupts recruitment (ie. germination and establishment of plants); i) affects the interaction between threatened species and other species in the community (eg. pollinators, host species, mychorrizal associations); and j) other matters*. 	
<p>How is the proposal likely to affect the habitat of a threatened species, population or ecological community?</p> <ul style="list-style-type: none"> a) disturbs any permanent, semi-permanent or ephemeral water bodies; b) degrades soil quality; c) clears or modifies native vegetation; d) introduces weeds, vermin or feral species; e) removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat; f) affects natural revegetation and recolonisation of existing species following disturbance; and g) other matters*. 	

* This should include an assessment as to whether the potential effects are likely to have an immediate or delayed effects on threatened species, populations or ecological communities, or their habitats.

APPENDIX G REPORTING CHECKLIST

Element	What it does	Importance	Sufficiency of Report			
			n/a	low	med	high
Licensing for all field workers	<p>Discloses the following information for all field workers associated with the survey:</p> <ul style="list-style-type: none"> • DEC scientific licence; • Animal Research Licence number (NSW Agriculture); and • Animal Ethics Committee Approval. 	Essential				
Physical Profile of the study area	Describes the physical nature of the land and past disturbances that have affected it.	Essential				
Regulatory profile of the study area	Describes the environmental planning instruments at the federal, state and local level that apply to the biodiversity of the region.	Essential				
Map of the study area	Displays the locality of the region, remnant vegetation present and extent of development.	Desirable				
Data sources	Outlines all the data sources used to obtain background information and identify any limitations.	Essential				
Survey design	Outlines the field survey techniques used, timing of surveys, the amount of effort implemented.	Essential				
Survey locations	Identifies the location of survey sites and where photographs were taken. This information should be mapped.	Essential				
Limitations and assumptions	Recognises the limitations and shortcomings of the study and the assumptions used in interpreting the data.	Essential				

Element	What it does	Importance	Sufficiency of Report			
			n/a	low	med	high
Flora inventory	<p>Lists all tree, shrub, ground cover and aquatic species, including:</p> <ul style="list-style-type: none"> • species which are protected or threatened at a regional, state and/or federal level; • introduced species; • protected or threatened species which have specific habitat requirements found within the study area. 	Desirable				
Vegetation community description	<p>Describes the vegetation communities present in the region by:</p> <ul style="list-style-type: none"> • structure (in terms of scientifically accepted classification system); • spatial distribution (ie. plant densities and patterning); • condition and integrity; and • likely original vegetation communities (pre- or at early settlement). <p>The vegetation communities of the region should be mapped to display the extent of each type.</p>	Desirable				
Hydrology	Describes the hydrology of the area and how this relates to the dynamics of vegetation communities.	Desirable				
Fauna inventory	<p>Lists all known and likely terrestrial and aquatic fauna species. This should include:</p> <ul style="list-style-type: none"> • species which are protected, threatened or listed under any international agreements; • introduced species; • species known or likely to breed in the area; and • any species which have specific habitat requirements found within the study area. 	Desirable				

Element	What it does	Importance	Sufficiency of Report			
			n/a	low	med	high
Fauna habitat description	Describes the fauna habitat types present in the region and their importance as corridors, migratory routes or drought refuges.	Desirable				
Assessment of Significance	Determines whether the proposal is likely to have a significant impact on threatened species, populations, ecological communities, or their habitats.	Essential				
Threatened species map	Displays the location and extent of threatened species, populations, ecological communities and their habitat recorded in the study area.	Essential				
Management of impacts	Outline all measures proposed to minimise impacts to threatened species detailing how, when and where they will be implemented.	Essential				
References	Lists all references cited in the study.	Essential				

APPENDIX H DEC ATLAS OF NSW WILDLIFE SPREADSHEET

An electronic copy of the spreadsheet is available at http://www.nationalparks.nsw.gov.au/images/scientific_licence_datasheet.xls

The grey colour distinguishes those fields that must contain information from those in which the information is optional. It is preferred that all fields be filled in but the ones marked in grey are essential. Codes are available in the Field Databook).

* It is essential to indicate the type of Datum you are using. If using AMG, the Datum will be AGD. If using MGA, the Datum will be GDA or WGS84. If unsure, please contact GIS.

** Latitude/Longitude only needed if AMGs (Zone, Easting, Northing) not entered.

Numbers in each column indicate the maximum number of characters that should be entered in that field.

Number	Type	Species Code	Common Name	Scientific Name	First Date	Last Date	Number	Sex Code	Estimate Code
Sequential number	Fauna (FA) or Flora (FL)	See Atlas Field Data Book (Appendix 1), or can be assigned by NPWS if unknown			Date of sighting (dd/mm/yyyy)	Last date if more than 1 day (dd/mm/yyyy)	Count of individuals	Sex, if known (see Atlas Field Data Book for codes)	Code to describe accuracy of count (see Atlas Field Data Book for codes)
		2	6	30	30	20	20	6	5
1									
2									
3									

Breeding Code	Reliability Code	Map Number	Datum*	GPS	Zone	Easting	Northing	Latitude**	Longitude**
Breeding, if recorded (see Atlas Field Data Book)	Reliability of the sighting (normally assigned by NPWS) eg 5 = standard	1:100 000 map sheet	AGD66, AGD84, GDA94 or WGS84. Please specify.	GPS used? Yes or No	Zone	Easting	Northing		
100	5	12			2	6	7	15	15

Location Description	LGA Name (if known)	Reserve Name	Altitude	Geology Code	Vegetation Code	Slope	Aspect
Describe the location as precisely as possible using place names and/or distance and direction from a named point.	Local Government Area	National Park or State Forest name if applicable.	In metres, read from a topographic map	Codes as listed in Atlas Field Data Book	Codes as listed in Atlas Field Data Book	Degrees (between 0 and 90)	Degrees (between 0 and 360)
255	20	20	4	5	5	3	3

Observer Name	Scientific Licence Number	Census Name	Observation Type	Microhabitat Type	Height	Growth Habits	Collection Code	Collection Notes	Specimen Registration
Name details can be supplied here or at the top (if only 1 observer). If >1 observer please supply contact details for each observer	If collected under Scientific Licence	If survey details recorded	For fauna only (codes as listed in Atlas Field Data Book)	For fauna only (codes as listed in Atlas Field Data Book)	For flora only, height of plant in metres.	For flora only (codes as listed in Atlas Field Data Book)	For flora only, observers personal collection code if allocated	For flora only, additional details of collection	Specify registration number where specimen registered at museum/herbarium
12		12	5	100	15	5	10	255	255

<i>Specimen Registration</i>	<i>Specimen Location</i>	<i>Unique Key</i>	<i>State Forest Compartment</i>	<i>Population Status</i>	<i>Notes</i>
Specify registration number where specimen registered at museum/herbarium	Specify place of lodgement if specimen lodged with museum/herbarium etc	If assigned, observers own unique sighting key	If relevant, specify Compartment number	Specify if part of Endangered Population, as listed on the TSC Act	Any additional notes
255	255	30	4	5	255

APPENDIX I BIODIVERSITY DATABASES

1. **The Atlas of NSW Wildlife** is administered by the DEC and contains native flora and fauna records in NSW, both historical and current. Records are obtained from field surveys conducted by the DEC and other organisations, specimens and records of herbariums, private collections and museums, scientists, reports and journals, and the general public. To obtain data from this resource, contact the Data Exchange Officer at the DEC and order historical flora and/or fauna records per 1:100,000 map sheet. The Wildlife Atlas is available at <http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp>
- 2 **CANRI** includes the NSW Natural Resources Atlas and Data Directory, as well as websites tailored for coastal management, rivers, soils, environmental reporting and wildlife. It provides information on biodiversity, salinity, Landcare, vegetation landscape management, and regional planning. Website <http://www.canri.nsw.gov.au>
- 3 **Australian Museum Fauna Database** is Australia's largest comprehensive voucher specimen collection. To obtain database records contact Australian Museum Business Service's (AMBS) general office. Data is available for a fee, and records include location. Voucher collections from most taxonomic groups are contained at the Sydney Museum premises, and positive identifications can be made if specimens are preserved and sent to AMBS with notification. Voucher collections are maintained for all functional groups including aquatic and terrestrial fauna (vertebrates and invertebrates). Website <http://www.ambs.com.au/contact/index.htm>
- 4 **Atlas of Australian Birds** is a database produced by Birds Australia. It contains records of birds throughout Australia, including rare and threatened birds, which have been recorded by volunteers. The method for searching the database can either be by a specified area or incidental searches for individual species or groups. Maps of species distributions are also available. Website www.birdsaustralia.com.au
- 5 **NSW data** is administered by the Royal Botanic Gardens and contains records of botanical specimens, including rare and threatened plants throughout NSW. To order a search of an area, contact the Royal Botanic Gardens, Sydney. Website <http://www.rbgsyd.nsw.gov.au>
- 6 **PlantNet** is a taxonomic database administered by the Royal Botanic Gardens, Sydney. The database currently provides a comprehensive listing of indigenous plants, potentially dangerous weeds and information on rare and threatened plants in NSW. Each entry includes the scientific name of the plant with common and misapplied name/s and a distribution map. The database is being expanded to give diagnostic and possibly specimen records in the future. Website <http://plantnet.rbgsyd.gov.au>
- 7 **FaunaNET** is the Australian Museum's Website, which includes the Master Names List of NSW fauna (taxonomic database), has mapping capabilities using GIS Software, and contains interactive diagnostic keys (eg the Dung Beetles of NSW). Website <http://www.faunonet.gov.au>

- 8 EPBC Act Database** is an on-line database managed by the Department of the Environment and Conservation (formerly Environment Australia). The database contains relevant information for the EPBC Act, including all of the current listings for threatened species and ecological communities, migratory species, Ramsar sites, world heritage areas, and nature conservation reserves. The database supplies records from predictive modelling rather than actual records and can be found at Website: <http://www.deh.gov.au/erin/index.html>
- 9 Botanical Databases** are a series of databases managed by the Centre for Plant Biodiversity Research, the Australian National Botanic Gardens, and the Commonwealth Department of Environment and Heritage, including the Australian Plant Name Index database, Australia's Virtual Herbarium, the Common Names of Australian Plants database, and The National Plant Photographic Index.
Website <http://www.anbg.gov.au/cpbr/databases/index.html>
- 10 Other Department of the Environment and Heritage databases** are available on-line through the Department of the Environment and Heritage website at <http://www.deh.gov.au/erin/index.html>. These may assist in both gathering and interpretation of biodiversity data. Examples of other on-line databases include the Australian Bird and Bat Banding Scheme.
- 11 Other Herbariums** exist in various institutions around NSW. Examples of regional herbariums include Canberra (Southern Coast Tablelands), Queensland Herbarium (North Coast), and the University of New England (North Tablelands/Coast).
- 12 Local Government Databases.** To request information on a project by project basis contact the local Council, eg. Lake Macquarie Council Wildlife Database.

APPENDIX J IBRA REGIONS IN NSW

The following excerpts are taken from the former National Parks and Wildlife Service (now part of the Department of Environment and Conservation) website (<http://www.nationalparks.nsw.gov.au/>).

Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. They capture the large-scale geophysical patterns across Australia. These patterns in the landscape are linked to fauna and flora assemblages and processes at the ecosystem scale, thus providing a useful means for simplifying and reporting on more complex patterns of biodiversity.

The mapping of the bioregions of Australia was undertaken by the Federal Government in cooperation with State and Territory conservation agencies to provide a consistent and robust framework for biodiversity assessment and planning. The result of this Australia-wide mapping exercise was the production of the Interim Biogeographic Regionalisation of Australia or IBRA (Thackway and Cresswell 1995), a system that divides Australia into bioregions on the basis of their dominant landscape-scale attributes. IBRA was developed as a framework primarily to identify deficiencies in the Australian network of protected areas and to set priorities for further enhancing the reserve system (Thackway and Cresswell 1995).

The term 'interim' is retained in the IBRA title because the bioregions are periodically updated as new or more reliable information comes to hand from a range of biological and environmental surveys.

Version 5.1 of the Interim Biogeographic Regionalisation of Australia (Environment Australia 2000) is the most recent version of the Australian bioregions, and can also be viewed at <http://www.deh.gov.au/parks/nrs/ibra/index.html>