



Environmental Protection Authority

# Guidance for the Assessment of Environmental Factors

(in accordance with the  
Environmental Protection  
Act 1986)

## **Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia**

No. 54

December 2003

Western Australia

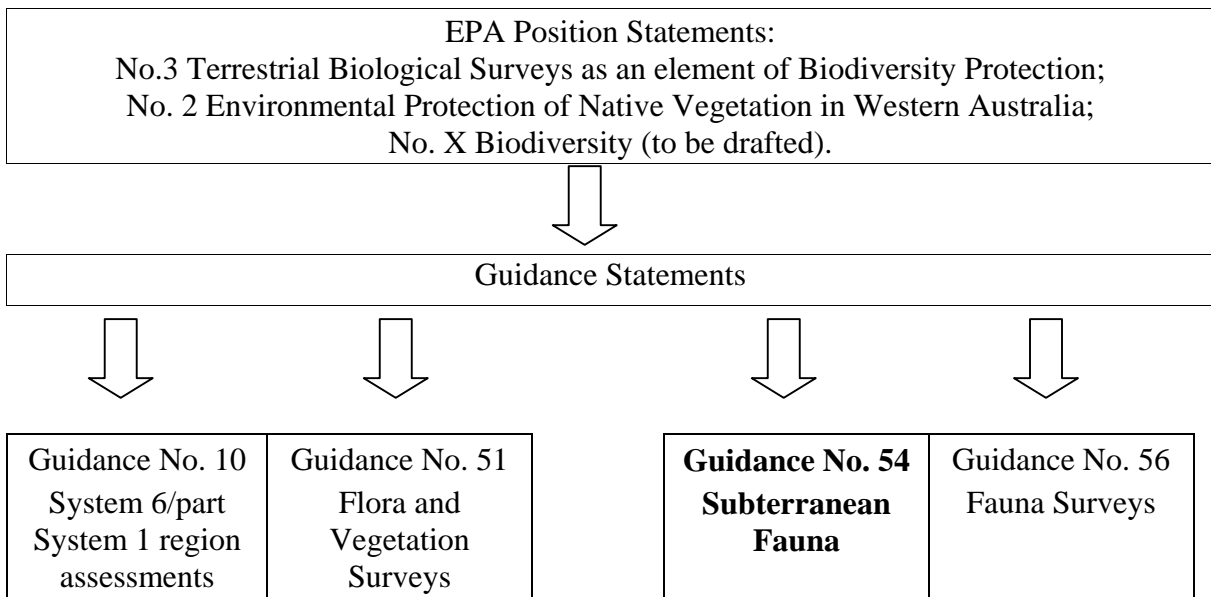
# FOREWORD

The Environmental Protection Authority (EPA) is an independent statutory authority and is the key provider of independent environmental advice to Government.

The EPA's objectives are to protect the environment and to prevent, control and abate pollution. The EPA aims to achieve some of this through the development of environmental protection Guidance Statements for the environmental impact assessment (EIA) of proposals.

This document is one in a series being issued by the EPA to assist proponents, consultants and the public generally to gain additional information about the EPA's thinking in relation to aspects of the EIA process. The series provides the basis for the EPA's evaluation of, and advice on, development proposals subject to EIA. The Guidance Statements are intended to assist proponents in achieving an environmentally acceptable proposal. Consistent with the notion of continuous environmental improvement and adaptive environmental management, the EPA expects proponents to take all reasonable and practicable measures to protect the environment and to view the requirements of this Guidance as representing the minimum level of information necessary to enable the assessment of subterranean fauna in groundwater and caves as an environmental factor.

This Statement provides guidance on collecting the appropriate data for decision-making associated with the protection of Western Australia's subterranean faunal biodiversity and its habitat. The flowchart below shows the relationship between Position Statements and this and other Guidance Statements.



This Guidance Statement has the status 'of **'Final'** which means that it has been reviewed by stakeholders and the public. The EPA has signed off on the Guidance Statement and published it.

While guidance is provided specifically in relation to the Western Australian *Environmental Protection Act 1986* proponents are reminded to ascertain any responsibilities they may have in regard to this issue under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the Western Australian *Wildlife Conservation Act 1950*.

I am pleased to release this document which now supersedes the draft version.

A handwritten signature in black ink, appearing to read "W. J. Cox".

**Walter Cox**  
CHAIRMAN  
ENVIRONMENTAL PROTECTION AUTHORITY

1 December 2003

Copies of this document are available on the EPA's website at [www.epa.wa.gov.au](http://www.epa.wa.gov.au) under 'Guidance Statements' in the 'Environmental Impact Assessment' section or by phoning Chris Cornish on (08) 9222 7105

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## **Guidance Statement No. 54**

# **Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment**

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**Key Words:** stygofauna, troglofauna, groundwater, caves, voids, subterranean

## **1 INTRODUCTION**

### **1.1 Purpose**

Guidance Statements are developed by the Environmental Protection Authority (EPA) to provide advice to proponents and the public about the minimum requirements for environmental management that the EPA would expect to be met when the EPA considers a proposal during the assessment process. The generic process is set out in the Appendix.

This Guidance Statement is termed 'Final', and should be viewed as a general guide to EIA when there is a likelihood of subterranean fauna occurring in groundwater or caves. The content of this guidance has been developed in close consultation with the Department of Conservation and Land Management (DCLM) and with input from the Western Australian Museum and other interested parties.

### **1.2 Policy content**

This Guidance Statement specifically addresses the conservation of stygofauna in groundwater systems and troglofauna and stygofauna in subterranean caves. This document provides guidance on the information that the EPA will consider when assessing proposals where the protection of stygofauna or troglofauna is a relevant environmental factor. It takes into account:

- (a) protection of the environment as defined by the *Environmental Protection Act 1986* (EP Act) with a focus on conservation of stygofauna and troglofauna, their habitats and the bio-physical processes that support them; and

- (b) the conservation of stygofauna and troglafauna as required by the *Wildlife Conservation Act 1950*.

While guidance is provided specifically in relation to the Western Australian *Environmental Protection Act, 1986*, proponents are reminded to ascertain any responsibilities they may have in regard to this issue under the Commonwealth *Environment Protection and Biological Conservation Act, 1999*.

### **1.3 Limitations of this guidance**

This is a Guidance Statement and proponents are encouraged to consider their proposals in the light of the guidance given. A proponent wishing to deviate from the minimum level of performance set out in this Statement would be expected to put a well-researched, clear and robust justification for the proposed departure.

## **2 THE ISSUE**

Many different sorts of animals have adapted to inhabit subterranean areas of the Earth. They are usually characterised by the loss of eyes and body pigment. This guidance statement deals with two groups of subterranean animals - stygofauna and troglafauna. Stygofauna are aquatic subterranean animals, found in a variety of groundwater systems, while troglafauna occur in air chambers in underground caves or other smaller voids. In the context of this Guidance Statement, subterranean fauna means stygofauna and troglafauna.

Recent work by the Western Australian Museum has shown that the Pilbara and Yilgarn regions contain stygofaunal communities in calcrete and alluvial aquifers that are rich by global standards on stygofauna, while Cape Range contains rich cave stygofaunal and troglafaunal communities (Humphreys 1999, 2001). The coastal karst systems of the Swan Coastal Plain, Leeuwin-Naturaliste Ridge and Nullarbor Plain also contain rich subterranean communities, and both sandstone and limestone environments in the Kimberley have similar values (Humphreys, 1995). Moreover, suitable habitats are found in palaeodrainages in the inland deserts, where locally endemic faunas occur, particularly in groundwater calcretes (Watts & Humphreys, 2001; Cooper et al, 2002). Thus, significant stygofaunal or troglafaunal communities may occur in many parts of Western Australia.

Western Australian stygofauna and troglafauna exhibit high levels of endemism and many of the species appear to have restricted ranges, which is a feature of subterranean animals everywhere (Strayer 1994). In addition to being endemic, many Western Australian species have considerable scientific importance and conservation significance because they appear to represent links to the time when Australia was part of Gondwanaland, bordered by the Tethys Sea (Humphreys 1999, 2000, 2003; Jaume et al 2001).

The lack of connectivity between aquifers may have contributed to *in situ* speciation, so that some species groups appear to show extremely localised patterns of distribution as a result of small range endemism (Watts & Humphreys, 2001; Cooper et al, 2002). Conservation strategies for such species will need to reflect this localised distribution through site-specific evaluation and planning.

Most stygal and troglobitic species in Western Australia are invertebrates, although stygal fish and troglobitic snakes do occur in subterranean caves. Crustaceans form the richest group of stygofaunal invertebrates, with the greatest biogeographic significance.

Stygofauna occur at a variety of depths, with some species being found in surface waters as well as deep aquifers (Halse 2002). As a general rule, the greater the distance between a groundwater habitat and surface water, the stronger the groundwater affinity of the fauna. The distribution of fauna will also be affected by the physical characteristics of the aquifer, such as its salinity and dissolved oxygen levels (Humphreys 2002).

Troglofaunal invertebrates include spiders, scorpions, centipedes, millipedes, insects and crustaceans. Troglofauna are sometimes easily observed and are readily sampled, but more commonly they occur under rocks and in crevices and small cavities in the cave systems. Humid micro-environments, which occur even in the arid zone, are a requirement.

Extrapolation from the study of surface waters suggests that stygofauna have important ecosystem service functions, such as the maintenance of water quality in groundwater aquifers. Much of Western Australia's water supply, especially in the arid zone, is drawn from groundwater.

In a recent review of issues relevant to the management of subterranean biotas in Western Australia, Dr Phillip Playford (Playford 2001) made the case for the importance of these biotas and made a number of recommendations. This Guidance Statement addresses three of Dr Playford's eleven recommendations.

Dr Playford noted, 'it is clear that these biotas constitute uniquely important features of Australian biology.' Dr Playford further noted that 'one of the major problems experienced in stygofauna assessments ... is that of unpredictable sampling results.'

Dr Playford also recommended that 'The EPA should develop guidelines on stygofauna conservation, outlining requirements for studies to be undertaken by

companies, individuals and Government authorities (a) before development projects are approved, (b) during development operations, and (c) after those operations are completed.'

A guidance statement such as this one also seeks to give effect to Dr Playford's suggestion that 'There is a general view that educational processes need to be put in place to inform companies and the public regarding subterranean faunas.'

The primary focus herein is to outline the type of technical information proponents should collect to facilitate assessment of the likely impact of development on stygofauna. In addition, the guidance highlights the importance of troglifauna and the need for its conservation.

Few surveys have been done and the distribution, conservation status and optimal survey techniques for most subterranean species are poorly known. Rather than outline the specifics of possible sampling regimes in this document, the intent is to emphasise the key questions to be addressed and the importance of seeking advice on a case-by-case basis from appropriate specialists in DCLM, WA Museum, academia or other agencies. As DCLM has statutory responsibility for the protection of wildlife, contact should be made with this agency in each case.

### **3 THE GUIDANCE**

#### **3.1 Application of the guidance to assessment**

The objective of the EPA in relation to subterranean fauna species is to ensure adequate protection of important habitats for these species. In addition, on advice from DCLM, the EPA will ensure that proposals do not potentially threaten the viability of any subterranean species, in accordance with the *Wildlife Conservation Act 1950*. The object of this Act is 'to provide for the conservation and protection of wildlife' and it does not permit the Minister for the Environment (the Minister) to issue a licence to take fauna where that taking might lead to extinction.

Proposals that, if implemented, could potentially have a significant impact on stygofaunal or troglifaunal habitat by:

- lowering the water table sufficiently to dry out the zone in which some species live, or otherwise artificially changing water tables; or
- changing water quality (e.g. increasing salinity levels or altering haloclines, increasing nutrient levels or the availability of organic matter, or introducing other pollutants); or
- destroying or damaging caves (including changing their temperature and humidity);

will be subject to formal EIA under the EP Act.

The EPA recognises the difficulties facing proponents when subterranean fauna is a relevant factor in an assessment. At times, sampling produces only a small number of animals over a restricted range, and this leaves open the question as to whether the species will be threatened by a proposal. This brings into focus the requirements of the *Wildlife Conservation Act 1950*, administered by DCLM, which provides special protection for threatened species. Clearly, approval could not be granted if there is a significant risk of a species becoming extinct.

It is in this context that the EPA is seeking from the proponent sufficient information, through sampling and within the constraints of reasonably available knowledge, to enable the EPA to advise the Minister that, as a consequence of the proposal, there would be a low likelihood that a subterranean fauna would meet the criteria for special legal protection as a threatened species under the *Wildlife Conservation Act*. Where a species of subterranean fauna is already listed as having special protection, the sampling would need to provide sufficient contextual information on distribution and abundance to allow a decision to be made as to whether or not approval could be given for the species to be ‘taken’, pursuant to the *Wildlife Conservation Act*. For instance, if only a small proportion of a listed species is planned to be ‘taken’, it may be possible for approval to be given.

Guidance for assessing the acceptability of proposals is set out below.

## **3.2 Guidance for Achieving Desired Outcomes**

### **3.2.1 Stygofauna**

#### **3.2.1.1 Sampling**

The EPA will require proponents to undertake a survey for stygofauna when a project may potentially have a significant impact on groundwater levels, groundwater quality, or subterranean cave and void systems.

The design of a sampling program needs to take into account the circumstances of the particular environment and the project proposed. Accordingly, proponents should design their proposed methodology in consultation with appropriate experts and seek endorsement from the appropriate authorities before expending resources on field surveys for subterranean fauna. Sampling methods for stygofauna are likely to continue to evolve and this guidance will not prescribe specific sampling methods. However, to provide sufficient information for an assessment, proponents should note the following when undertaking sampling:

- Methods used should be appropriate for collecting micro invertebrates (including copepods, ostracods, bathynellids etc.) as well as macro invertebrates (including amphipods, oligochaetes, isopods etc.);

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- Sampling intensity within the zone of impact should be sufficiently comprehensive to collect all species of fauna present. Data on collecting effort in relation to number of species recorded should be provided to demonstrate the likelihood that all species have been sampled;
- Boreholes will usually provide the most suitable sampling sites for calcrete, alluvial and other aquifers but it should be recognized that use of inappropriately cased boreholes often jeopardizes the chances of collecting stygofauna. A description of the boreholes sampled will be required;
- Care should be taken to ensure that sampling methods do not contaminate or significantly damage subterranean ecosystems;
- Sampling water in subterranean caves requires specialist diving techniques unless the caves are only partially flooded and contain large openings. Even when re-breathing apparatus is used, sampling can cause major disturbance and should be undertaken only after prior consultation with the EPA and DCLM about methodology; and
- Basic water quality data must be collected in conjunction with stygofaunal sampling (i.e. salinity, pH, dissolved oxygen).

Adequate interpretation of results is as important as sampling itself. In this respect, the EPA will require that:

- Animals are identified to species, whenever the taxonomy permits, or otherwise to the lowest taxonomic unit possible (the EPA recognizes, however, that the lack of taxonomic framework and limited expertise makes identification and assessment of the conservation status of some common stygofaunal groups, such as nematodes, virtually impossible or very time consuming). The use of voucher numbers is encouraged to differentiate species that have not been formally described;
- The proponent undertakes an assessment using available data on the distribution and conservation status of all species collected with respect to their occurrence outside the impact zone; and
- Voucher specimens are lodged with the Western Australian Museum and, if appropriate, other institutions in order to facilitate the exchange of information between interested parties. Better information exchange is likely to lead to more rapid understanding of species distributions and ecology.

Proponents are encouraged to use genetic testing where appropriate to assist in determining taxonomic relationships.

The EPA suggests that proponents provide an explicit statement, based on the best information available, about the distribution of stygofauna found in the zone of influence of the proposal, their occurrence outside that zone and the likely effect of the development on species populations. The implications of the development with respect to potential species extinctions in terms of the *Wildlife Conservation*

*Act 1950* and the *Environment Protection and Biodiversity Conservation Act 1999* should also be addressed.

The EPA also suggests that proponents make as much use as possible of existing information about the habitats and ecology of stygofauna when planning surveys, especially when trying to locate populations outside zones of impact. The collection of hydrological data from boreholes will assist in identifying prospective habitats.

### **3.2.1.2 Demonstrating lack of threat**

During the environmental impact assessment process the proponent should show, to the satisfaction of the EPA, whether or not the proposal is likely to pose a threat to stygofauna. The EPA will seek the advice of DCLM, as the agency responsible for the administration of the *Wildlife Conservation Act, 1950*. The EPA may also seek advice from other experts, as appropriate.

Upon identification of stygofauna within the zone of influence of a proposed development, proponents should address each of the following three approaches to demonstrating that the development poses no threats to the animals:

- Show that species within the potential impact zone also occur outside this area (i.e. no species is restricted to the impact zone);
- Provide evidence that likely impacts will not significantly affect species within the potential impact zone;
- Produce a management plan for the potential impact zone and species within it. This plan should ensure persistence of those species (e.g. constant recharge of the aquifer within selected parts of the drawdown zone until completion of the project and return of water levels to pre-development levels).

It is particularly important that detailed ecological information be obtained to gain approval for a proposal on the basis that groundwater impacts will not significantly affect stygofauna or that a management plan can be implemented to ameliorate impacts adequately. Such information is likely to require a substantial targeted drilling and research program.

### **3.2.1.3 Management Systems**

A management plan to conserve stygofauna within an impact area (or approval on the basis that likely groundwater impacts will not be significantly detrimental to stygofauna) would require the proponent to demonstrate based on reasonably available data that an environmental management system exists which contains the following elements:

- (a) An environmental policy and corporate commitment to it;
- (b) Mechanisms and processes to ensure that:
  - i) environmental requirements of the species are sufficiently understood and that appropriate planning has occurred to meet the requirements;
  - ii) technology and expertise exist to implement necessary management actions;
  - iii) the species-monitoring program is sufficiently sensitive to give adequate warning of a decline in species numbers well prior to any threat of extinction.
- (c) A technically feasible and practicable alternative for rescuing species in the event that the original management plan fails to achieve its species protection objectives.

### **3.2.2 Troglifauna**

Principles similar to those for stygofaunal sampling apply to troglifauna. However, different sampling techniques will need to be employed. At present, most proposals before the EPA concerned with subterranean faunas involve stygofauna rather than troglifauna. Case-by-case advice should be sought from the relevant authorities.

## **4 APPLICATION**

### **4.1 Area**

This Guidance Statement applies to all applications for proposals that may significantly affect stygofauna or troglifauna throughout the State of Western Australia.

### **4.2 Duration and Review**

The duration of this Guidance Statement is for five years unless some unforeseen circumstances or major advances in knowledge require it to be reviewed earlier.

## **5 RESPONSIBILITIES**

### **5.1 Environmental Protection Authority responsibilities**

The EPA will apply this Guidance Statement during the assessment of proposals under Part IV of the EP Act where the factor of stygofauna or troglifauna is relevant.

## 5.2 Department of Environment responsibilities

The Department of Environment (DoE), through the EPA Service Unit (EPASU), will assist the EPA in applying this Guidance Statement in environmental impact assessment and in conducting its functions under Part V of the EP Act.

## 5.3 Department of Conservation and Land Management responsibilities

DCLM will advise the EPA and the DoE regarding the conservation of subterranean animals. DCLM will also advise the Minister for the Environment regarding licensing, under the *Wildlife Conservation Act 1950*, of actions that may significantly affect subterranean animals.

## 5.4 Proponent responsibilities

Assessment is likely to be assisted if proponents demonstrate to the EPA that the requirements of this Guidance Statement are incorporated into proposals.

## 6 DEFINITIONS

<b>Cave</b>	Subterranean space, sufficiently large to admit a person
<b>Gondwanaland</b>	The southern super-continent consisting of what is now South America, Africa, Australia, Antarctica, India and New Zealand
<b>Stygofauna</b>	Aquatic groundwater animals
<b>Subterranean fauna</b>	Stygofauna and troglofauna
<b>Tethys Sea</b>	The epicontinental sea that separated Gondwana from the northern super-continent, Laurasia
<b>Troglofauna</b>	Air-breathing subterranean animals found in caves or voids
<b>Void</b>	Subterranean space, of any size smaller than a cave

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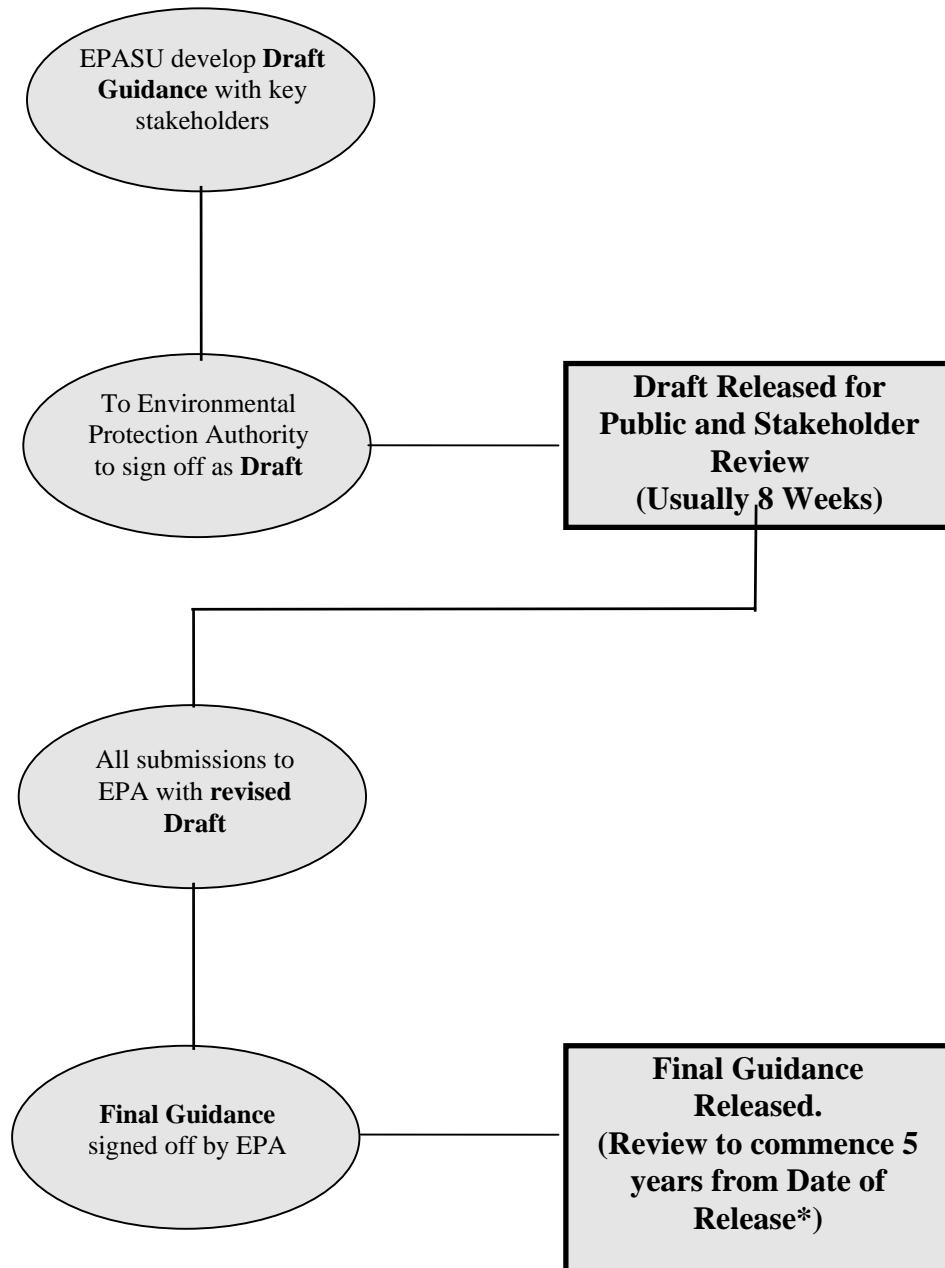
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## Appendix

### Generic Flow Diagram for the Guidance Statement Process



\* Guidance may be reviewed earlier if circumstances require it.