

Michael Pring
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Project No: 11SUTECO-0104

12th December 2011

Dear Mr Pring

RE: Independent review of Tuncurry Midge Orchid Investigations – North Tuncurry Investigation Area.

I refer to your request to undertake the above review, specifically to comment on:-

1. the adequacy of the survey effort to date for the Tuncurry Midge Orchid (TMO), the survey methodology and compliance with relevant survey guidelines; and
2. Great Lakes Council (GLC) and the NSW Office of Environment & Heritage (OEH) submissions in relation to the State Significant Site study (SSS study) requirements and their “reasonableness” in regards to additional survey required for the TMO.

In undertaking this review the following documents have been considered:-

1. Preliminary ecological review and comments to study requirements – proposed Landcom North Tuncurry Development (Great Lakes Council memo to Department of Planning and Infrastructure 7th November 2011);
2. North Tuncurry State Significant Site Study Requirements (Letter from NSW Office of Environment & Heritage to Department of Planning & Infrastructure 7th November 2011);
3. Landcom – Key Ecological Constraints Investigation Brief – North Tuncurry, February 2010
4. Letter from Landcom to DP&I, 19th January 2011, State Significant Site listing and Part 3A request – North Tuncurry.
5. ERM (2005) North Tuncurry – Ecological Constraints & Opportunities, Report to Landcom dated 20th October 2005;
6. ERM (2010a) Crown Land off the lakes way, North Tuncurry – Ecological Assessment. Report to Landcom dated 12th January 2010;

7. ERM (2010b) Tuncurry Midge Orchid Survey, letter & map to Landcom, dated 12th January 2010;
8. RPS (2011a) Ecological Inventory Report North Tuncurry. Report No. 26414 prepared by RPS Newcastle for Landcom, Final August 2011;
9. RPS (2011b) *Corunastylis littoralis* Tuncurry Midge Orchid Combined Survey Results 2010/2011 North Tuncurry Report No. 26414 prepared by RPS Newcastle for Landcom, Final August 2011;
10. Letter from RPS to OEH, 18 August 2011 (2011c), Proposed Offset Strategy for North Tuncurry Study Area, North Tuncurry, NSW
11. 26414 Credit per hectare table 281011 - summary of biodiversity credits required to offset proposed impacts of Concept Plan – 2 options

In summary, the review has found that a significant amount of survey effort has been undertaken for the TMO both in the study area, adjacent to the study area and elsewhere over the past 4 years and the ecological knowledge of the species has improved. This survey effort has been quantified but is not shown spatially in either the orchid combined survey report or the flora and fauna inventory. Further, some of the survey effort is not yet documented in RPS 2011 (i.e. Paget 2008, ERM 2010)

The current development footprint has been designed to avoid impacts as far as practical to the areas of highest abundance of TMO individuals but has not quantified this in terms of the area of confirmed habitat being impacted (within the study area and across the species range) nor the area of potential habitat (either of high, moderate or low potential). It is therefore difficult at this point in time to provide an opinion whether the magnitude of impact proposed would be supported by the various regulators.

An offset strategy has been proposed for the impact to around 5% of the currently known TMO population within and immediately adjacent to the study area. The current offset strategy has largely focussed on direct offset measures i.e. the identification of areas to protect the TMO, rather than additional or complementary indirect measures i.e. contribution to ecological studies to improve the knowledge and management requirements of the species. Whilst the proposed offset strategy has achieved the protection of a significant proportion of the on-site and local TMO population, the long term viability of the proposed offset area is likely to be low due to its linear nature and inevitable edge effects. Further consideration is required to identify an on-site offset area that has a better conservation design and/or further information should be provided regarding the management of the area.

If you have questions about any aspect of this review, please contact me on (02) 8536 8620.

Yours sincerely

Robert Humphries

Robert Humphries

Manager Biobanking and Offset Programs, Eco Logical Australia Pty Ltd

INDEPENDENT REVIEW OF NORTH TUNCURRY MIDGE ORCHID SURVEY, IMPACT ASSESSMENT AND OFFSET STRATEGY

Tuncurry Midge Orchid Survey and Impact Assessment

The Tuncurry Midge Orchid combined survey results report (RPS 2011) was reviewed by Dr Lachlan Copeland, a renowned orchid expert who is familiar with the species and the previous work by Paget (2008) and Robert Humphries of Eco Logical Australia Pty Ltd.

It is assumed that the Ecological Inventory report would provide a summary of the more detailed findings of the TMO survey report, however, there is information in the Ecological Inventory Report (survey dates, photograph, figures of plant densities etc) that are not in the detailed TMO survey report. This information should be added to the TMO report for completeness.

Taxonomy

Given that there is current uncertainty and debate as to the most appropriate name for this critically endangered species, it would have been appropriate to at least address this issue in the report. RPS has chosen to use the name "*Corunastylis littoralis*" which is the recommended name by Jones (2006) and is the name under which this species is listed under the federal *EPBC Act 1999*. In NSW, however, the most commonly applied name for this species is *Genoplesium littorale*, as recommended by the National Herbarium of NSW and their Plantnet website. This is also the name under which this species is listed under the NSW *TSC Act 1995*. Ideally this should have been spelt out in the introduction section of the report so as to avoid any future confusion.

Lack of any vouchers and/or photographs

Given the significance of this species, and the importance of getting its identification correct, it is surprising that there are no photographs of the species have been included within the TMO combined survey results report or photographs of the different populations (although a photograph is included in the RPS Ecological Inventory Report). Likewise no mention is made of any vouchers of this species being collected and lodged at a relevant herbarium such as the National Herbarium of NSW or the Australian National Herbarium in Canberra, particularly for the new populations west of the Wallamba River and Booti Booti National Park. As with most native ground orchids it is possible to gently and cleanly cut off the top of the orchid above ground level and use this as a voucher, while effectively leaving the underground part of the orchid (tuber) unharmed.

Although we assume that the ecologists from RPS have correctly identified the species during all their surveys, a single close-up photograph in the report would have been an obvious addition. There are other similar-looking species which grow in sandy coastal habitats e.g. an undescribed member of the *Genoplesium rufum* complex from less than 40 km away in Myall Lakes NP. Both grow in very similar sandy habitats close to the ocean.



Genoplesium littorale



Genoplesium rufum complex (Myall lakes)

Detail of Survey effort, dates and flowering observations

Midge orchids are notorious for their highly variable flowering time as they often flower best in response to seasonal conditions (e.g. 5-7 weeks after significant rainfall events) within their broader flowering period. Most spring-flowering orchids, in contrast, have a more consistent, reliable flowering period. Given that one of the goals of the report was to “*Provide insights into the ecology of this poorly understood species*” it would have been prudent to list the dates on which it was observed flowering. Table 2-2 in RPS 2011 Ecological Inventory includes a table of survey dates which indicates that targeted TMO surveys were conducted on 22-25th/3/2010, 29/3-1/4/2010, 19-22nd/4/2010, 3-7th/5/2010, 10-14th/5/2010, 11-13th/4/2011, 18-21st/4/2011, 27-29th/4/2011 and 3-5th/5/2011 equating to 34 days of random meanders, of which, 24 of these days (according to Table 2-1 in the Ecological Inventory Report) were within the subject site.

Table 2-2 of the Ecological Inventory Report should be included in the Orchid Report with an indication of which dates the species was detected flowering and which population/s were flowering. A figure should be included that shows the locations of the 24 days of ‘random meanders’ within the subject site (easily obtained by the GPS tracks function) and provide an indication of the number of person hours allocated to this task i.e. was most of this effort concentrated around the margins of tracks and easements or in the heart of the heath areas.

There is no reference in the TMO survey report of the 3 days of survey undertaken by ERM in March 2009 in which 15, 47 and 31 orchids were recorded within and/or adjacent to the site (ERM 2010). The 2010 ERM report also includes information on habitat preferences and flowering times. Similarly, this information and the effort by Paget (2008) is not included in Table 2-1 of the Ecological Inventory report.

Ambiguous number of populations

Most of the text in the report infers that there are “three” populations/locations of the species: Tuncurry North, Booti Booti NP and “West of Wallamba River”. The distribution map presented in Figure 3-1 however, clearly shows a fourth distinct area of occurrence (i.e. a population north east of Minimbah Nature Reserve in addition to the area south of the nature reserve some 8-10km distant. It is unclear whether the far north-western pink point is what is referred to as the “West of Wallamba River” population, or whether the greater number of both pink and yellow points further south are representative of this population. Clearly the number of known locations is of great importance and this information should be explicitly clear with no contradictions between the distribution map and the text presented in the report.

Further the legend on Figure 3-1 refers to Crown Lands North and South as well as Mid Coast Water Lands without actually labelling these areas. It is unclear which of the 3 populations these areas refer to.

Adequacy of survey effort

It appears that a relatively high level of effort has been made to search for *Genoplesium littorale* on the study site. The combined survey effort and coverage (Paget, ERM & RPS) for this species should be included in the Orchid Report as described above.

Four consecutive years of targeted survey by Paget (2008), ERM (2009) and RPS (2010 and 2011) have probably accounted for the considerable range of variation that is often present in the number of flowering plants in different seasons in a typical population of a midge orchid. RPS should be commended in finding and documenting the two or three additional new populations which represent highly significant range extensions of an otherwise poorly understood and highly restricted species, including a population occupying several sites over a 5km range in a secure conservation reserve (Booti Booti National Park).

Whilst the number of plants in the North Tuncurry Crown lands site represent a significant proportion of the total estimated population size, it is difficult to compare the relative survey effort in these new populations. The 2 or three additional sites appear to have had a total of 10 days survey effort (including recording abundance) over two years compared to 24 days by RPS, plus Paget (2008) and ERM (2010) at the subject site. If the other sites had a similar level of survey effort per unit area as the subject site, the proportional distribution of the total population size may well be quite different i.e. the North Tuncurry site may represent significantly less than 92% of the population.

Most of the documented plants within the North Tuncurry Crown land site appear to be within a few metres of existing tracks and this is likely to result from the ease for which these areas can be traversed/surveyed. RPS claim that it is also a function of these areas having been more disturbed/opened up and this is also likely to be largely true. From Dr Copeland's experience most midge orchids prefer areas of microhabitat that are relatively open and have relatively high levels of sunlight and air flow. Alongside vehicle tracks are often the most productive areas to search for these orchids (*Genoplesium* spp. in general) and this is also consistent with Dr Copeland's previous encounters with *Genoplesium littorale* in 2008 and 2009. In slashed areas beneath powerlines is another favoured habitat of this (and other) *Genoplesium* species.

A possible scenario that has not been explored is that the orchid is still present in the undisturbed areas but may not flower regularly in these areas and is therefore not detectable. This phenomenon is well documented for various other ground orchids (e.g. *Caladenia* and *Prasophyllum*) whereby the individual plants may only flower for a few years following a fire or some other form of disturbance, then will cease to flower for several years until a suitable disturbance regime opens up the habitat once again allowing the species to flower. It is poorly known to what extent *Genoplesium* spp. cease

to flower in increasingly dense habitats, but assuming that *Genoplesium littorale* is absent from dense areas where it is not observed may be an erroneous assumption. However, further survey effort in these areas is likely to have similar results unless the surveys are undertaken following a natural disturbance such as a bushfire. In the absence of being able to wait until a fire goes through the area, the habitat should still be regarded as being “potential” habitat and cautious assumptions on the likelihood of orchids being present made. This may enable the abundance of the TMO population to be expressed as the number of confirmed individuals as well as the area of confirmed and potential habitat as well as being able to quantify the impacts of development using the same categories. If there is good information regarding the disturbance history of parts of the heath area (e.g. previous sand mining and/or clearing for agro-forestry), it may be possible to assign probabilities of the orchid occurring in various parts of this “potential” habitat based on an analysis of the characteristics of the areas where it has been recorded.

Alternatively, ecological studies into the response of the TMO to various disturbances (e.g. hot and cool autumn/spring burns and/or slashing in small areas of known/confirmed and potential habitat) could be undertaken in parallel to the impact assessment to provide guidance in the management of retained areas for the TMO.

Given that other *Genoplesium spp* have been recorded flowering in the first few years following fire, it is surprising that there is no mention of the survey effort in the burnt heath area in the north east of the subject site. Of the nine quadrats that were surveyed for *Genoplesium*, none were in the burnt heath and as the location of random meanders is not shown, it is difficult to comment whether any of the random meanders included this area

In spite of the above limitations, additional survey effort in the denser, heathy areas would still be appropriate. The methodology employed in 2011 (looking intensely in nine large quadrats) only yielded plants in a single quadrat – it would be preferable to look closely at a much larger number of smaller, widely-spaced quadrats. This would have only taken slightly more survey effort but would have given a clearer picture of the presence/absence of the species across the whole site in the dense areas of heath. On page 8 of the report it is stated that the 40 x 40 metre quadrats were “randomly placed” but looking at the map of these quadrats (Figure 2-2) they can hardly be interpreted as being random as all but one are adjacent (or very close) to an existing vehicle track. The question of whether or not the orchid occurs in good numbers in dense areas of heath away from disturbed areas still remains largely unanswered.

Given the now known extent of the population and areas occupied, it should be possible to update the area of occupancy (documented as 8 km² in the NSW Scientific Committee listing) and range of occupancy (reported in the EPBC Act listing as 20km north-south and 9km east-west) and undertake more refined impact assessment calculations whereby in addition to the proportion of the population abundance being impacted, information is provided on the proportion of the area of occupancy impacted.

Further survey work and ecological information

Figure 2-2 in the Orchid Report makes reference to the identification of “suspected optimal habitat” although this is not defined as to whose definition of optimal habitat these areas relate to (i.e. Paget (2008), ERM (2010), NSW Scientific Committee or EPBC Act listing). The text in the report refers to areas where the TMO has been recorded including previously mined areas, previously burnt areas, vegetation communities with open understoreys, low and wet heaths, however the report does not include a figure which shows these features with an overlay of orchid records. The closest figure is that within the offset proposal report. It would be useful to include a similar figure in the orchid report.

In ATTACHMENT A of the requested SSS study requirements by OEH, it is requested that “*Further targeted surveys, impact assessment and understanding long-term management requirements of this*

species are required'. It is difficult to argue with this statement and it is agreed that further surveys in the heath area would be desirable, but research into the "long-term management requirements of this species" is likely to be a very difficult, long-term process. Similarly, there is a recommendation in ATTACHMENT B stating that "*research into the species ecology, lifecycle, and habitat preferences would need to be subject to further consideration...*". Once again this additional information would obviously be beneficial but acquiring such data may be easier said than done. The lifecycle of *Genoplesium* spp. is probably well understood enough in this context but it is agreed that further information on its habitat preference and response to fire/disturbance could be sought.

Subject to any development being approved, it is likely that the development would proceed over many years (10-20 years)) This provides plenty of opportunity to initiate long term ecological studies at both the potential development site and retained areas on and off-site as part of an indirect offset package. Further, a number of recommended research priorities are included below.

Likely impacts of the proposed development on *Genoplesium littorale*

At this stage, a detailed impact assessment appears not to have been undertaken as a final development layout has not been finalised. The indicative Concept Plan will result in the loss of approximately 5% of the known population, will marginally affect the extent of occurrence and more significantly affect the area of occupancy. The survey data to date should be able to quantify the area and proportion of "confirmed" habitat being potentially impacted as well as the area and proportion of potential (yet to be confirmed) habitat being affected. It should also be possible to provide a level of "probability" of occurrence, based on the results obtained to date i.e. whilst the "heath" has been identified as "potential" habitat, how likely is it that the species occurs there given the survey effort to date, the characteristics of the habitat where it has been found and the type and extent of disturbance in these areas. In addition, as pointed out by the OEH and GLC preliminary reviews, the Concept Plan and resulting retained areas will have other indirect impacts on the species which may include disruption of the pollination mechanisms (i.e. negative impacts on the small vinegar flies that pollinate *Genoplesium* spp.), and greatly increased edge effects to the species and its habitat given that the proposed offset areas are very long thin, linear areas. Such areas will no doubt be prone to weed invasion and control of these invasive herbs using traditional herbicide techniques may also have a serious effect on the remaining plants of *Genoplesium littorale*. It is likely that an increased incidence of feral animals (e.g. rabbits) following the development may also increase the grazing pressure on the species.

Recommendations for future study

The main recommendation for future study is to more accurately quantify the number of plants and area of habitat occurring in the proposed development area. While this has already been done to a reasonably high standard along the vehicle tracks it is still possible that large, additional subpopulations occur in the dense heathy areas but have simply not flowered (and were therefore not detected) during the past 4 years of survey.

Given the timeframes for any development in the area there is also scope for a range of further scientific studies into the ecology and management of the species on site and in other recently documented populations. These studies could form part of a staged approval and comprise part of a direct and indirect offset package.

The highest priority for research is to conduct slashing and/or burning of some small areas of heath where the species has not been recorded to see if *Genoplesium littorale* is observed flowering in these areas in subsequent years. A proper experimental design should also include slashing and/or burning areas with confirmed individuals during autumn and spring to see how these areas respond.

If any approval includes the loss of individuals, these plants should be salvaged for propagation and mycorrhizal fungi association trials.

A suitably qualified expert with experience in managing threatened species of *Genoplesium*, such as John Briggs of OEH Queanbeyan, should be consulted in the design of any such research program.

The data to undertake such an assessment is contained in the ecological inventory report or can be derived from the studies already undertaken and thus be used to meet GLC and OEHs request in this regard.

Impact Assessment

The need for further targeted survey in the heath areas for the TMO is consistent with the gap analysis undertaken by Dr Copeland. The “*understanding of long term management requirements*” for the TMO is a requirement difficult to meet within a reasonable development assessment timescale, however, assuming that proposed impacts are considered acceptable (i.e. less than 5% of the on-site population) can be addressed in parallel and subsequent to development decisions as part of a direct and indirect offset package, using both on and off-site populations, to inform management of the offset areas.

Offset Strategy

A biodiversity offset strategy has been proposed for the preliminary Concept Plan and a variation on this plan. The offset strategy includes both on-site and off-site conservation areas with these areas either being managed under suitable conservation covenants or as dedication to the NPWS Estate.

At this stage, the proposed offset strategy has concentrated on a secure outcome for a significant proportion of the TMO population and has not documented how it addresses the other threatened species whose habitat will be impacted.

The offset includes 254.14 ha of on-site habitat and an adjacent area of land owned by the Foster LALC. The area and vegetation communities on this parcel are not described but believed to be around 9.2 ha.

The offset strategy does not discuss how it addresses the principles for offsets in NSW (DEC 2008) or the Commonwealth Draft Offset Principles (DEWR 2007) or whether it meets an improve or maintain outcome. It does however address to an extent the measure taken to avoid and mitigate impacts and a range of development options.

The SSS study requirements requires the offset strategy to be prepared in line with the OEH Interim Policy on assessing and offsetting impacts of Part 3A, State Significant Development and State Significant Infrastructure projects (OEH June 2011). This policy provides for a three tiered approach to addressing offset requirements, with the preferred outcome (Tier 1) being fully meeting an Improve or Maintain Outcome (no impacts to red flags), followed by a Tier 2 outcome (no net loss, meets the IoM quantum of offsets but impacts to Red Flags allowed) or Tier 3 (a negotiated offset that as a minimum meets a 2:1 ratio).

RPS has undertaken some initial improve or maintain (IoM) calculations for various development scenarios using the Biobanking Credit Calculator..

There is no information whether these assessments have used any biometric plot data or whether it has been assumed that the vegetation communities are in benchmark condition.

It is noted that only the TMO has been identified as a ‘Red Flag’ issue.

It is noted that both OEH and GLC have commented on the configuration of the proposed offset lands and have described part of the proposed offsets as inappropriate due to their high edge to area ratios (i.e. they are essentially long narrow strips of vegetation that would be subject to significant edge effects thereby diminishing their value as offsets. These statements are supported and consideration needs to be given to improving the design of the proposed offsets lands to reduce edge effects and improve their ability to achieve long term viability.

OEH also raises the issue of ‘additionality’ as to whether Crown Land can participate as an offset. OEH points to Principle 12 in the Lower Hunter Regional Conservation Plan (LHRCP) that states “*areas already managed by the Government, for example.....crown reserves, cannot be used as offsets*”. It is noted that Principle 12 in the LHRCP is inconsistent with the same offset principle on the OEH website (Attachment 1) and OEHs Policy on “additionality” in the Biobanking Scheme (*Additionality and its affect on credit creation DECCW 2010*). This policy states that unless the “Act” does not specifically require certain management actions to be undertaken, the management actions are not to be taken as existing conservation obligations. In the case of Crown land, the Crown Lands Act states that ‘*Crown Reserves must generally be managed consistently with their public purpose, the principles of crown land management and any adopted Plan of Management*’. Unless a parcel of Crown land has been dedicated as a reserve under section 87 of the Crown Lands Act and a Management Plan has been prepared, there is no legal requirement to manage the land for a particular purpose. Land reserved for a public purpose, as notified in the Government gazette, can be changed to another public purpose simply by a gazettal notice. The Tuncurry Crown lands are reserved for “public purposes”. The Tuncurry Crown land therefore can be used as an offset.

References

DEC (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004. Department of Environment and Conservation (NSW), Sydney, 2004.

DEC/DPI (2005) Draft Guidelines for Threatened Species. Department of Environment and Conservation & Department of Primary Industries, July 2005.

DECC (2008). Principles for the use of biodiversity offsets in NSW. Online <http://www.environment.nsw.gov.au/biocertification/offsets.htm> (Accessed 22 July 2009)

DECC (2009a). *BioBanking Assessment Methodology and Credit Calculator Operational Manual*, Department of Environment and Climate Change (NSW), Sydney South.

DECC (2009b) Lower Hunter Regional Conservation Plan. Department of Environment & Climate Change, Sydney April 2009.

DECCW (2010) Additionality and its affect on credit creation. Department of Environment, Climate Change and Water, Sydney, May 2010.

DECCW (2011) Biodiversity Certification Assessment Methodology. Department of Environment, Climate Change and Water, Sydney, February 2011.

Great Lakes Council (2003) Draft Great Lakes Council Vegetation Strategy, Great Lakes Council, Forester NSW

Paget, A (2008) Results of searches for the Tuncurry Midge-Orchid (*Genoplesium littorale*, syn *Corunastylis littoralis*), CMA, Autumn 2008

Attachment 1: NSW Offsetting Principles

These offset principles are from the DECCW website (30/5/2010):

1. Impacts must be avoided first by using prevention and mitigation measures.

Offsets are then used to address remaining impacts. This may include modifying the proposal to avoid an area of biodiversity value or putting in place measures to prevent offsite impacts.

2. All regulatory requirements must be met.

Offsets cannot be used to satisfy approvals or assessments under other legislation, e.g. assessment requirements for Aboriginal heritage sites, pollution or other environmental impacts (unless specifically provided for by legislation or additional approvals).

3. Offsets must never reward ongoing poor performance.

Offset schemes should not encourage landholders to deliberately degrade or mismanage offset areas in order to increase the value from the offset.

4. Offsets will complement other government programs.

A range of tools is required to achieve the NSW Government's conservation objectives, including the establishment and management of new national parks, nature reserves, state conservation areas and regional parks and incentives for private landholders.

5. Offsets must be underpinned by sound ecological principles.

They must:

- include the consideration of structure, function and compositional elements of biodiversity, including threatened species
- enhance biodiversity at a range of scales
- consider the conservation status of ecological communities
- ensure the long-term viability and functionality of biodiversity.

Biodiversity management actions, such as enhancement of existing habitat and securing and managing land of conservation value for biodiversity, can be suitable offsets. Reconstruction of ecological communities involves high risks and uncertainties for biodiversity outcomes and is generally less preferable than other management strategies, such as enhancing existing habitat.

6. Offsets should aim to result in a net improvement in biodiversity over time.

Enhancement of biodiversity in offset areas should be equal to or greater than the loss in biodiversity from the impact site.

Setting aside areas for biodiversity conservation without additional management or increased security is generally not sufficient to offset against the loss of biodiversity. Factors to consider include protection of existing biodiversity (removal of threats), time-lag effects, and the uncertainties and risks associated with actions such as revegetation.

Offsets may include enhancing habitat, reconstructing habitat in strategic areas to link areas of conservation value, or increasing buffer zones around areas of conservation value and removal of threats by conservation agreements or reservation.

7. Offsets must be enduring & they must offset the impact of the development for the period that the impact occurs.

As impacts on biodiversity are likely to be permanent, the offset should also be permanent and secured by a conservation agreement or reservation and management for biodiversity. Where land is donated to a public authority or a private conservation organisation and managed as a biodiversity offset, it should be accompanied by resources for its management. Offsetting should only proceed if an appropriate legal mechanism or instrument is used to secure the required actions.

8. Offsets should be agreed prior to the impact occurring.

Offsets should minimise ecological risks from time-lags. The feasibility and in-principle agreements to the necessary offset actions should be demonstrated prior to the approval of the impact. Legal commitments to the offset actions should be entered into prior to the commencement of works under approval.

9. Offsets must be quantifiable & the impacts and benefits must be reliably estimated.

Offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable and used for calculating both the loss from the development and the gain from the offset. The methodology should include:

- the area of impact
- the types of ecological communities and habitat/species affected
- connectivity with other areas of habitat/corridors
- the condition of habitat
- the conservation status and/or scarcity/rarity of ecological communities
- management actions
- level of security afforded to the offset site.
- the best available information/data should be used when assessing impacts of biodiversity loss and gains from offsets. Offsets will be of greater value where:
 - they protect land with high conservation significance
 - management actions have greater benefits for biodiversity
 - the offset areas are not isolated or fragmented
 - the management for biodiversity is in perpetuity (e.g. secured through a conservation agreement).
 - management actions must be deliverable and enforceable.

10. Offsets must be targeted.

They must offset impacts on the basis of like-for-like or better conservation outcome. Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.

11. Offsets must be located appropriately.

Wherever possible, offsets should be located in areas that have the same or similar ecological characteristics as the area affected by the development.

12. Offsets must be supplementary.

They must be beyond existing requirements and not already funded under another scheme. Areas that have received incentive funds cannot be used for offsets. Existing protected areas on private land cannot be used for offsets unless additional security or management actions are implemented. **Areas already managed by the government, such as national parks, flora reserves and public open space cannot be used as offsets.**

13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

Offsets must be audited to ensure that the actions have been carried out, and monitored to determine that the actions are leading to positive biodiversity outcomes.