4. Assessment of Relevant Impacts and Mitigation Measures

4.1 Introduction

This section describes the potential impacts on matters of NES and the possible mitigation measures for each impact. When effective mitigation measures are not available, the discussion has been broadened to include compensatory measures to offset unavoidable impacts.

In some cases impacts may be relevant to more than one matter protected, such as the assemblage of rainforest plants considered potential occurrences in the study area. In such cases the impacts have been addressed together, clearly stating the relevance of the impact to the different matters protected.

4.2 Vegetation and Habitat Loss

The raising of the Hinze Dam spillway will result in the inundation of land situated above the current Full Supply Level (FSL). The project involves both permanent inundation (to allow additional water storage) and temporary inundation (for flood mitigation and dam safety). There are essentially three potential inundation scenarios, namely:

- inundation to the proposed FSL of 94.5m AHD;
- inundation to the level reached by a flood of frequency Q100; and
- inundation to the level reached by a theoretical Probable Maximum Flood (PMF).

The majority of the area to be permanently inundated at the proposed FSL will be cleared of vegetation. Clearing will be undertaken from the current FSL to just below the proposed FSL. Where vegetation is not cleared it is assumed (for the purposes of this assessment) that it will be lost as a result of permanent inundation, although this may not necessarily be the case. The impact of the proposed FSL on vegetation communities is shown in **Figure 4-1**.

As impacts associated with the Q100 and PMF flood events would be highly infrequent, it is not intended that vegetation be cleared within these extents. Theoretically, the Q100 event will occur (on average) once every 100 years and modelling results estimate that it would take approximately three days from the onset of the storm for inundation to reach the peak level of 101.03m AHD, after which it would take approximately four days to return to the FSL. The PMF is the theoretical maximum flood level that could ever occur.

Given the temporary and infrequent nature of these events, impacts on terrestrial flora and fauna are not considered to be significant. Vegetation could withstand a periodic inundation of up to four days in the event of a Q100 storm, and although vegetation may suffer damage from currents and temporary flooding, it is considered likely to recover.

The project will require approximately 318.34 ha of remnant vegetation to be cleared and/or flooded below the proposed FSL, to enable permanent inundation for the water storage. There are also impacts on vegetation associated with infrastructure development around the existing dam wall, although no matters of NES are known from these areas. Of the total inundation area, 20.67 ha consist of Of Concern and 297.67 ha consist of Not of Concern regional ecosystems. No endangered regional ecosystems will be affected. The regional ecosystems represented in the inundation area and areas to be impacted by the proposed FSL are provided in **Table 4-1**.

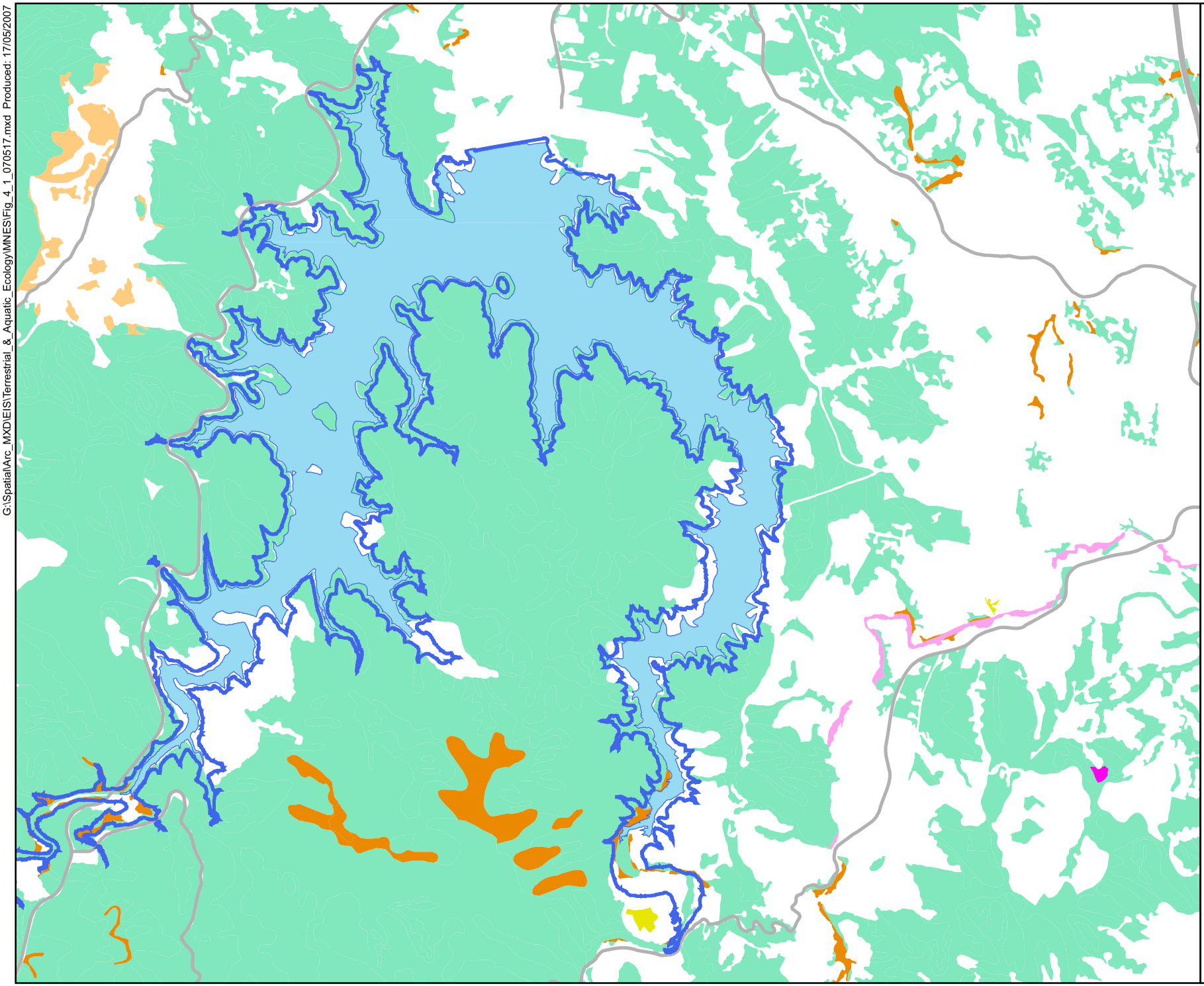


Figure 4-1
Impact of FSL on Vegetation Communities/ Regional Ecosystems
Hinze Dam Stage 3 EIS

Table 4-1 Areas of Regional Ecosystems Impacted by the Inundation Area

Regional Ecosystem	VMA Status	Area (ha)
12.11.1	NOC	1.51
12.11.3	NOC	92.48
12.11.3/12.11.1	NOC	10.73
12.11.5	NOC	170.36
12.3.7	NOC	22.59
12.3.11	OC	13.15
12.3.2	OC	7.52
Total		**318.34**

4.3 Assessment of Impacts on species known from the study area

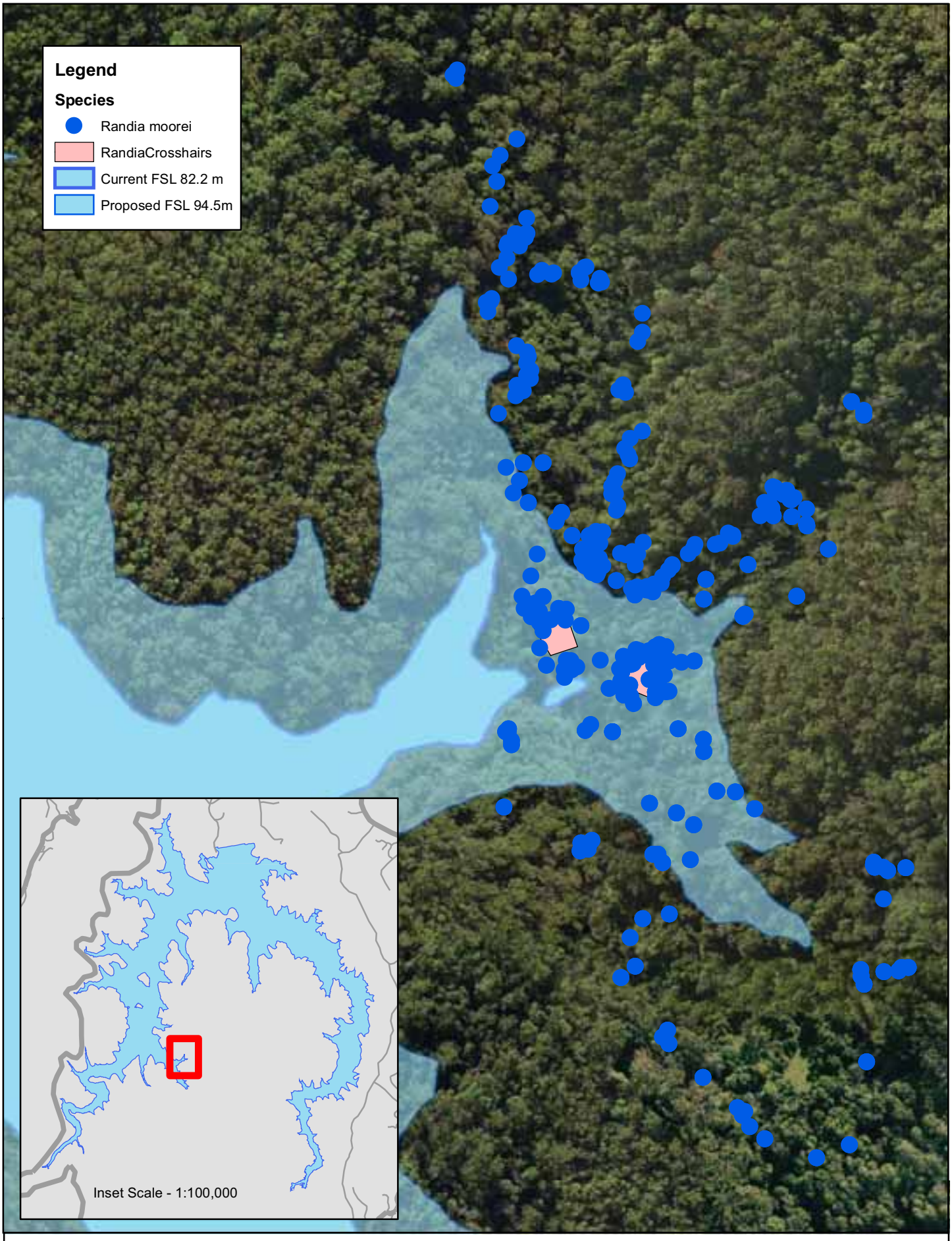
4.3.1 Spiny Gardenia (*Randia moorei*)

Impacts on population size and area of occupancy

Spiny Gardenia occurs in three discrete populations comprised of an estimated 1000, 32 and 1 individual. These plants occupy an area of approximately 6 ha, at an estimated density of 170 plants per ha.

Initial clearing activities across the project area will exclude areas of habitat known to contain this species, such that the ultimate loss of individuals will be determined by the impact of inundation to the proposed full supply level.

It is envisaged that up to 20% of the area occupied by Spiny Gardenia in the study area will be impacted by inundation in the long term, with the subsequent loss of between 250 and 300 individuals of this species, of a total known population of 1521 individuals.



N

0 25 50 100

Metres

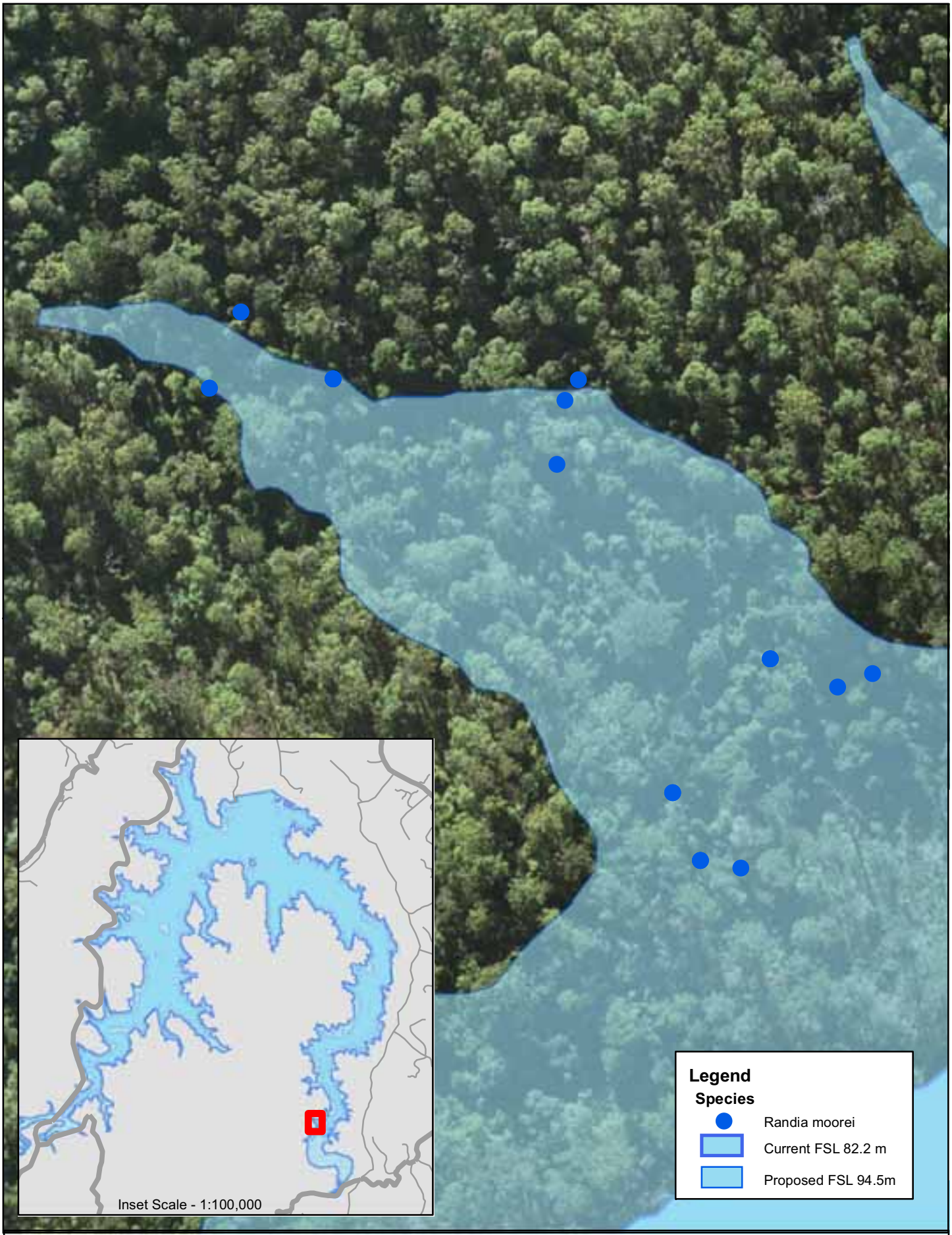
Scale - 1:3,000

Projection: MGA Zone 56

Figure 4-2a

Impact of FSL in Site A on Randia moorei populations

Hinze Dam Stage 3 EIS



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Metres

Scale - 1:1,500

Projection: MGA Zone 56

Figure 4-2b

Impact of FSL in Site 'B' on Randia moorei populations

Hinze Dam Stage 3 EIS

Impacts of fragmentation

Populations are fragmented and widely separated at the landscape scale, with isolated rainforest patches occupied in a mosaic of cleared lands and Eucalypt forests. The project will not further fragment the known populations of this species in the study area.

Impacts on the ecology of a population

Inundation to the full supply level is likely to result in the direct attrition of individual plants. The creation of new forest edges on the periphery of known habitat is likely to adversely affect individual plants by increasing exposure to sunlight and desiccating winds.

Introduction of invasive species and/or disease

Existing populations are threatened by weed invasion, particularly proliferation of Lantana which is favoured by the current fire and disturbance regimes.

There is potential for the spread and introduction of the root-rot fungus *Phytophthora cinnamomi*. Although there are no known locally affected areas, *P. cinnamomi* is known from coastal Queensland and should be regarded as a potential threat.

Mitigation Strategies

The mitigation approach for this species involves a combination of actions including protection (in part) and management of existing populations, establishment of an ex situ population prior to any site disturbance, translocation or propagated stock and development of management and monitoring programs. The overarching objective is to ensure no net loss of individuals from the study area. The following mitigation strategy is proposed for Spiny Gardenia:

- all populations of this species are to be protected from initial vegetation clearing works. A series of exclusion zones will be established around the perimeter of Advancetown Lake for the explicit purpose of protecting significant species and regional ecosystems;
- the propagation potential of the species will be reviewed during a formal propagation trial. The objective will be to establish a substantial *ex situ* population of the species derived from parent populations currently known from the study area. Ultimately it is envisaged that the *ex situ* population will be of a similar number of individuals to the entire population known from the study area, however, the propagation trial should be restricted to the minimum number if individuals to demonstrate success;
- preliminary analysis indicates that there are several substantial patches of preferred habitat (regional ecosystem 12.11.1) within the study area but outside of impact zones. A formal review of the suitability of these sites for translocation purposes will be completed, with an assessment of biotic and abiotic characters used to select proposed translocation sites. Potential translocation sites for Spiny Gardenia within the study area are shown in **Figure 4-3**;
- a Translocation Plan will be developed which directs conservation efforts for this species at the local level. It will identify translocation sites, specify methods for propagation and translocation and provide a framework for ongoing management;
- monitoring programs will be developed for in situ, ex situ and translocated populations to determine population size, health and reproductive status; and

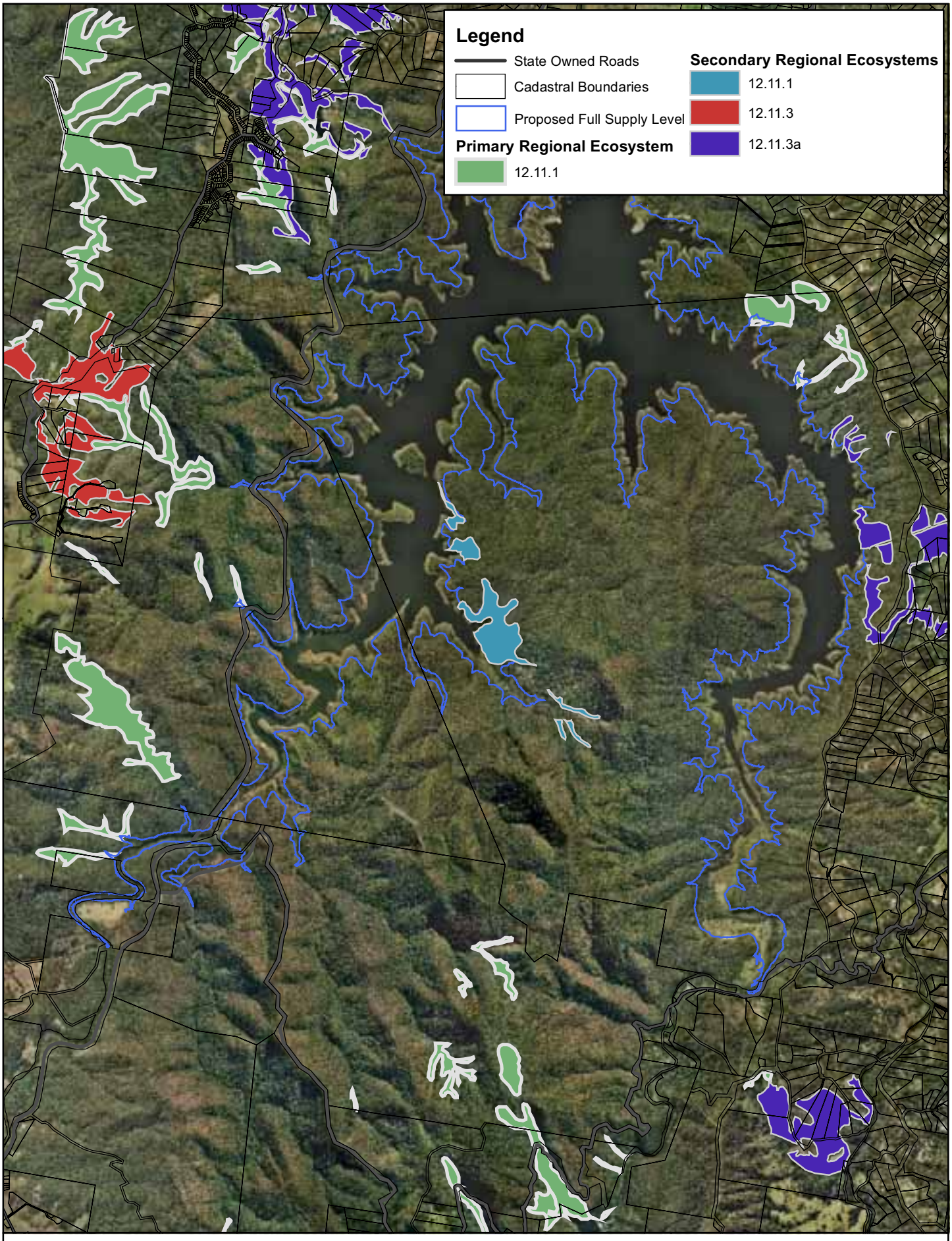
- management plans will be developed for all populations of this species within the CID. Populations in the study area are currently threatened by weed invasion and inappropriate fire regimes. The management plans should prioritise conservation actions, and include recommendations for firebreak location and specifications, rehabilitation methods and staging.

Likelihood of species decline

The combination of actions listed above is considered likely to ensure that the species does not decline at the local, regional or national scale. The proposed mitigation strategy is consistent with some of the objectives contained in the draft recovery plan for the species.

For example, objective 5 of the draft recovery plan for Spiny Gardenia is "To expand the population size of the Spiny Gardenia." The recovery plan states that research will be supported where it seeks to determine the viability of enhancing and expanding the Spiny Gardenia population. Given the low number and isolated nature of Spiny Gardenia sites, the appropriateness of population enhancement and expansion as a means of species conservation will be investigated.

In accordance with the Recovery Plan, population enhancement and expansion will be conducted utilising appropriate genetic principles, including the maintenance of diversity and managing inbreeding. Identifying the most suitable sites for enhancement is considered critical to project success. Sites for population expansion must consist of appropriate habitat and be available for planting of individuals sourced from the most suitable parentage. Of greater benefit in the context of this project would be the management of threatening processes which currently act on this species, particularly inappropriate fire regimes and heavy weed invasion.



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Kilometers

Scale - 1:50,000

Projection: MGA Zone 56

Figure 4-3

Potential Translocation Sites for Threatened Rainforest Flora

Hinze Dam Stage 3 EIS

4.3.2 Plectranthus nitidus

Impacts on population size and area of occupancy

Plecranthus nitidus occurs as a single population of approximately 50 plants in a very small area of less than 1000m^2.

Initial clearing activities across the project area will exclude areas of habitat known to contain this species, such that the ultimate loss of individuals will be determined by the impact of inundation to the proposed FSL.

It is currently envisaged that 100% of the area occupied by *Plectranthus nitidus* in the study area will be impacted by inundation in the long term, with the subsequent loss of up to 50 individuals of this species.

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N

0 10 20 40 60

Metres

Scale - 1:2,000

Projection: MGA Zone 56

Legend

- Plectranthus nitidus
- Proposed FSL 94.5m
- Current FSL 82.2 m

Figure 4-4

Impact of FSL on Plectranthus nitidus

Hinze Dam Stage 3 EIS

Impacts of fragmentation

Populations of this species are fragmented at the landscape scale. The species has specific microhabitat requirements which are only met in rocky rainforest and wet sclerophyll forest streams. The resultant pattern of distribution is one of disjunct and widely separated populations. The proposed action will not fragment known populations of this species.

Impacts on the ecology of a population

Inundation to the proposed FSL is likely to result in the direct attrition of individual plants. The creation of new forest edges on the periphery of known habitat is likely to adversely affect individual plants by increasing exposure to sunlight and desiccating winds.

Introduction of invasive species and/or disease

Existing populations are threatened by weed invasion, particularly proliferation of Mistflower which is favoured by the current fire and disturbance regimes.

There is potential for the spread and introduction of the root-rot fungus Phytophthora cinnamomi. Although there are no known locally affected areas, P. cinnamomi is known from coastal Queensland and should be regarded as a potential threat.

Mitigation Strategies

The mitigation approach for this species involves a combination of actions including protection (in part) and management of existing populations, establishment of an ex situ population prior to any site disturbance, translocation or propagated stock and development of management and monitoring programs. The overarching objective is to ensure no net loss of individuals from the study area.

The following mitigation strategy is proposed for *Plecranthus nitidus*:

- all populations of this species are to be protected from initial vegetation clearing works. A series of exclusion zones will be established around the perimeter of Advancetown Lake for the explicit purpose of protecting significant species and regional ecosystems;
- the propagation potential of the species will be reviewed during a formal propagation trial. The objective will be to establish a substantial *ex situ* population of the species derived from parent populations currently known from the study area. Ultimately it is envisaged that the *ex situ* population will be of a similar number of individuals to the entire population known from the study area, however, the propagation trial should be restricted to the minimum number if individuals to demonstrate success;
- preliminary analysis indicates that there are several patches of preferred habitat within the study area but outside of impact zones. A formal review of the suitability of these sites for translocation purposes will be completed, with an assessment of biotic and abiotic characters used to select proposed translocation sites;
- a Translocation Plan will be developed which directs conservation efforts for this species at the local level. It will identify translocation sites, specify methods for propagation and translocation and provide a framework for ongoing management; and
- monitoring programs will be developed for in situ, ex situ and translocated populations to determine population size, health and reproductive status.

Likelihood of species decline

The combination of actions listed above is considered likely to ensure that the species does not decline at the local, regional or national scale.

4.3.3 Onion Cedar (*Owenia cepiodora*)

Impacts on population size and area of occupancy

Onion Cedar occurs as a single population of approximately 90 plants in a single patch of evergreen notophyll vineforest which covers an area of approximately 7.5ha.

Initial clearing activities across the project area will exclude areas of habitat known to contain this species, such that the ultimate loss of individuals will be determined by the impact of inundation to the proposed full supply level.

It is currently envisaged that 15-20% of the area occupied by Onion Cedar in the study area will be impacted by inundation in the long term, with the subsequent loss of 35-40 individuals of this species, of a total known population of 237 plants. **Figure 4-** shows the impact of FSL on Onion Cedar.

Impacts of fragmentation

Populations of this species are (by their very nature) fragmented at the landscape scale, with isolated rainforest patches occupied in a mosaic of cleared lands and Eucalypt forests. The project will not further fragment the known populations of this species in the study area

Impacts on the ecology of a population

Inundation to the full supply level is likely to result in the direct attrition of individual plants. The creation of new forest edges on the periphery of known habitat is likely to adversely affect individual plants by increasing exposure to sunlight and desiccating winds.

Introduction of invasive species and/or disease

Existing populations are threatened by weed invasion, particularly proliferation of Lantana which is favoured by the current fire and disturbance regimes.

There is potential for the spread and introduction of the root-rot fungus Phytophthora cinnamomi. Although there are no known locally affected areas, P. cinnamomi is known from coastal Queensland and should be regarded as a potential threat.

Mitigation Strategies

The mitigation approach for this species involves a combination of actions including protection (in part) and management of existing populations, establishment of an ex situ population prior to any site disturbance, translocation or propagated stock and development of management and monitoring programs. The overarching objective is to ensure no net loss of individuals from the study area. The following mitigation strategy is proposed for Onion Cedar:

- all populations of this species are to be protected from initial vegetation clearing works. A series of exclusion zones will be established around the perimeter of Advancetown Lake for the explicit purpose of protecting significant species and regional ecosystems;
- the propagation potential of the species will be reviewed during a formal propagation trial. The objective will be to establish a substantial *ex situ* population of the species derived from parent populations currently known from the study area. Ultimately it is envisaged that the *ex situ* population will be of a similar number of individuals to the entire population known from the study area, however, the propagation trial should be restricted to the minimum number if individuals to demonstrate success;
- preliminary analysis indicates that there are several patches of preferred habitat within the study area but outside of impact zones. A formal review of the suitability of these sites for translocation purposes will be completed, with an assessment of biotic and abiotic characters used to select proposed translocation sites;
- a Translocation Plan will be developed which directs conservation efforts for this species at the local level. It will identify translocation sites, specify methods for propagation and translocation and provide a framework for ongoing management;
- monitoring programs will be developed for in situ, ex situ and translocated populations to determine population size, health and reproductive status; and
- management plans will be developed for all populations of this species within the CID. Populations in the study area are currently threatened by weed invasion and inappropriate fire regimes. The management plans should prioritise conservation actions, and include recommendations for firebreak location and specifications, rehabilitation methods and staging.

Likelihood of species decline

The combination of actions listed above is considered likely to ensure that the species does not decline at the local, regional or national scale. Aside from the actual loss of individuals, the mitigation measures proposed are entirely consistent with the Recovery Plan for Onion Cedar prepared by Landmark Ecological Surveys in (1995). That document recommended a suite of recovery actions, including the following:

- fencing/protection of known populations;
- weed removal as required;
- propagation and replanting;
- monitoring of populations;
- survey for new populations.

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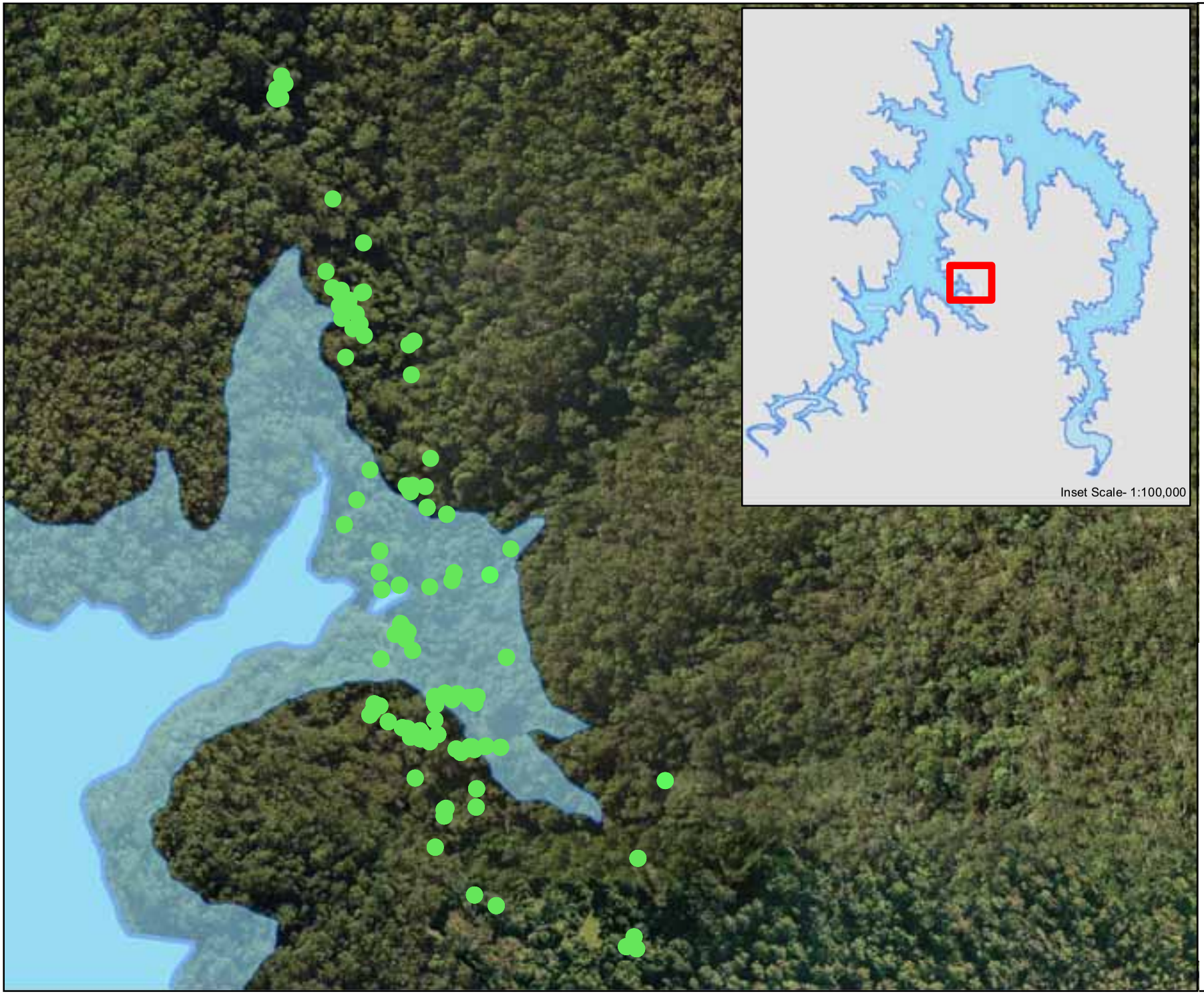


N

0 15 30 60 90

Metres

Scale - 1:3,500

Projection: MGA Zone 56

Legend

Species

Owenia cepiodora

Current FSL 82.2 m

Proposed FSL 94.5m

Figure 4-5

Impact of FSL on Owenia cepiodora

Hinze Dam Stage 3 EIS

4.3.4 Giant Barred Frog (*Mixophyes iteratus*)

Impacts on population size and area of occupancy

Population size at the Pocket Road Bridge site is unknown. This population has persisted at this location despite historical disturbance and construction of the existing bridge, indicating some capacity to cope with habitat alteration at this site.

Clearing of riparian vegetation over a width of 10m on both sides of the Nerang River may impact on individuals and will temporarily reduce the area of suitable habitat for this species. Individuals make regular (daily) movements parallel to (and crossing) the stream, though rarely move outside of the immediate riparian zone (studies in New South Wales found movements confined to an are 20m either side of the stream, in Queensland studies have found that frogs are confined to the area within 50m either side of the stream). This may interrupt dispersal of a small number of individuals.

Impacts of fragmentation

As discussed above, this species makes daily movements within the riparian zone, typically parallel to the waterway. The clearing of vegetation to accommodate bridge construction at the Pocket Road Bridge site may compromise these movement patterns in the short term (at least while the disturbed area supports no vegetation cover).

Impacts on the ecology of a population

The loss of foraging and dispersal habitat in the short term may cause the displacement of individuals. Impacts would be amplified during the breeding season (September to May) because potential breeding movements could be disrupted.

Introduction of invasive species and/or disease

This species is threatened by the transmissible fungus *Batrachochytrium dendrobatidis*, resulting in the disease chytridiomycosis (Chytrid fungal disease).

Mitigation Strategies

The following mitigation strategies are recommended for the Giant Barred Frog:

- all plant, equipment, vehicles and shoes of contractors working at the Pocket Road Bridge site must be sterilised to prevent the spread of Chytrid fungal disease. All activities on site must be consistent with the NSW National Parks and Wildlife Service Hygiene protocol for the control of disease in frogs;
- environmental Management Plans must be developed for all works adjacent to the Nerang River to prevent increased sedimentation, erosion, weed invasion and nutrient and chemical pollution;
- all disturbed areas must be revegetated as soon as practicable to establish appropriate cover for this species. Shaded areas beneath the proposed bridge should incorporate both shade-tolerant vegetation and other forms of potential cover (logs, rocks etc);
- the viability of increasing the span of the proposed Pocket Road Bridge to minimise its footprint within the riparian zone should be explored;
- pre-disturbance population monitoring should be completed to determine existing population size and structure at Pocket Road Bridge. The population should be monitored during and post construction to detect changes and potential decline; and

- If possible, construction works should be completed outside of the breeding season of this species to reduce potential impacts on pre and post breeding dispersal movements.

Likelihood of species decline

The implementation of measures outlined above are considered likely to mitigated adverse impacts on this species, and decline is not expected.

4.3.5 Bush Nuts (*Macadamia tetraphylla/M. integrifolia*)

Impacts on population size and area of occupancy

Rough-shelled Bush Nut occurs in four patches with an estimated total population of 80 individuals. The Macadamia *tetraphylla/integrifolia* hybrid is restricted to a single patch. Initial clearing activities across the project area will exclude areas of habitat known to contain this species, such that the ultimate loss of individuals will be determined by the impact of inundation to the proposed full supply level.

It is envisaged that up to 80% of the area occupied by Rough-shelled Bush Nut in the study area will be impacted by inundation in the long term, with the subsequent loss of up to 64 individuals of this species.

Impacts of fragmentation

Populations occur in isolated rainforest patches in a mosaic of cleared lands and Eucalypt forests and to a large extent are already fragmented. The project will not further fragment the two known populations of this species in the study area.

Impacts on the ecology of a population

Inundation to the proposed FSL is likely to result in the direct attrition of individual plants. The creation of new forest edges on the periphery of known habitat is likely to adversely affect individual plants by increasing exposure to sunlight and desiccating winds.

Introduction of invasive species and/or disease

Existing populations are threatened by weed invasion, particularly proliferation of Lantana which is favoured by the current fire and disturbance regimes.

There is potential for the spread and introduction of the root-rot fungus *Phytophthora cinnamomi*. Although there are no known locally affected areas, *P. cinnamomi* is known from coastal Queensland and should be regarded as a potential threat.

Mitigation Strategies

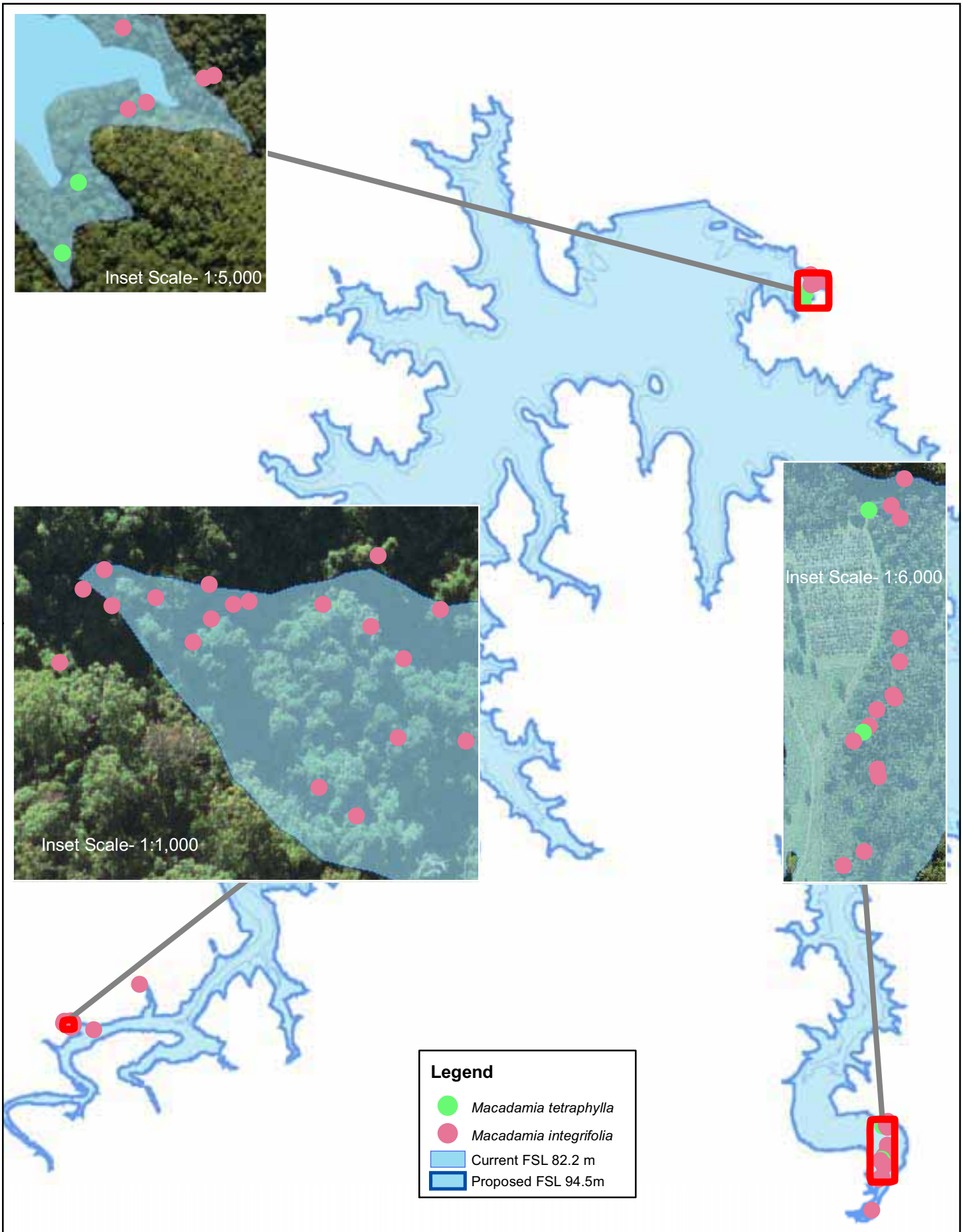
The mitigation approach for this species involves a combination of actions including protection (in part) and management of existing populations, establishment of an ex situ population prior to any site disturbance, translocation or propagated stock and development of management and monitoring programs. The overarching objective is to ensure no net loss of individuals from the study area.

The following mitigation strategy is proposed for Rough-shelled Bush Nut:

- all populations of this species are to be protected from initial vegetation clearing works. A series of exclusion zones will be established around the perimeter of Advancetown Lake for the explicit purpose of protecting significant species and regional ecosystems;
- the propagation potential of the species will be reviewed during a formal propagation trial. The objective will be to establish a substantial *ex situ* population of the species derived from parent populations currently known from the study area. Ultimately it is envisaged that the *ex situ* population will be of a similar number of individuals to the entire population known from the study area, however, the propagation trial should be restricted to the minimum number if individuals to demonstrate success;
- preliminary analysis indicates that there are several substantial patches of preferred habitat within the study area but outside of impact zones. A formal review of the suitability of these sites for translocation purposes will be completed, with an assessment of biotic and abiotic characters used to select proposed translocation sites;
- a Translocation Plan will be developed which directs conservation efforts for this species at the local level. It will identify translocation sites, specify methods for propagation and translocation and provide a framework for ongoing management; and
- monitoring programs will be developed for in situ, ex situ and translocated populations to determine population size, health and reproductive status.

Likelihood of species decline

The combination of actions listed above is considered likely to ensure that the species does not decline at the local, regional or national scale.



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Kilometres

Scale -1:40,000

Projection: MGA Zone 56

Figure 4-6

Impact of FSL on Macadamia sp.

Hinze Dam Stage 3 EIS

4.3.6 Brush-tailed Rock Wallaby (*Petrogale penicillata*)

Impacts on population size and area of occupancy

The Brush-tailed Rock Wallaby is restricted to Pages Pinnacle, a prominent outcrop located in the centre of the study area, but a substantial distance from areas of impact associated with the proposed action. It is not anticipated that there will be any direct impact on individuals of this species or loss of habitat. Home range areas of members of this population are unlikely to extend into areas impacted by construction works or inundation.

Impacts of fragmentation

The population is restricted to Pages Pinnacle and is separated from the nearest population by over 100km. The Pages Pinnacle population is not a naturally occurring population, and the long term viability (from a genetic viewpoint) of this population is questionable without intervention. Further fragmentation impacts are not expected as a result of the proposed action.

Impacts on the ecology of a population

No impacts on the ecology of this population area expected.

Introduction of invasive species and/or disease

The study area already supports cats, dogs and foxes which may pose a threat to this species at various stages of its lifecycle. The project will not introduce these species to the habitat of the Brush-tailed Rock Wallaby.

Mitigation Strategies

None proposed, although this species may benefit from proposed compensatory habitat measures associated with the project.

Likelihood of species decline

Decline of this species as a result of the carrying out of the project is considered very unlikely.

4.3.7 Grey-headed Flying Fox (*Pteropus poliocephalus*)

Impacts on population size and area of occupancy

The proposed action will remove approximately 318 ha of remnant vegetation which comprises habitat for this species on a seasonal basis. The nature of the habitat loss (predominantly comprised of linear strips of bushland lost from an existing edge) will reduce the magnitude of impacts on this species, because substantial forest blocks will remain intact and continue to provide resources. In general terms a large forest interior will be maintained with limited fragmentation.

Impacts of fragmentation

This is a highly mobile species which exploits a variety of habitats, including small and isolated remnants, individual trees and suburban yards and parks. The project will not isolate any area of habitat from currently interconnecting habitat for this species.

Impacts on the ecology of a population

No impacts on the ecology of this population area expected.

Introduction of invasive species and/or disease

The study area already supports cats, dogs and foxes which may pose a threat to this species at various stages of its lifecycle. The project will not introduce these species to the habitat of the Grey-headed Flying Fox.

Mitigation Strategies

None proposed, although this species may benefit from proposed compensatory habitat measures associated with the project.

Likelihood of species decline

Decline of this species as a result of the carrying out of the project is considered very unlikely.

4.4 Assessment of impacts on species which may occur

4.4.1 Swift Parrot (*Lathamus discolor*)

Impacts on population size and area of occupancy

The proposed action will remove approximately 318 ha of remnant vegetation which may comprise habitat for this species on a seasonal basis, although only small numbers of birds have been recorded from southeast Queensland. The nature of the habitat loss (linear strips of bushland lost from an existing edge) will reduce the magnitude of impacts on this species, because substantial forest blocks will remain intact and continue to provide resources.

Impacts of fragmentation

This is a highly mobile species which exploits a variety of habitats, including small and isolated remnants, individual trees and suburban yards and parks. It does not require extensive tracts of habitat or heavily vegetated corridors for dispersal. The project will not isolate any area of habitat from currently interconnecting habitat for this species.

Impacts on the ecology of a population

No impacts on the ecology of this population area expected.

Introduction of invasive species and/or disease

The study area already supports cats which may pose a threat to this species. The project will not introduce these species to the habitat of the Swift Parrot.

Mitigation Strategies

No species specific measures proposed, although this species may benefit from proposed compensatory habitat measures associated with the project.

Likelihood of species decline

Decline of this species as a result of the carrying out of the project is considered very unlikely.

4.4.2 Regent Honeyeater (*Xanthomyza phrygia*)

Impacts on population size and area of occupancy

The proposed action will remove approximately 318ha of remnant vegetation which may comprise habitat for this species on a seasonal basis, although only small numbers of birds have been recorded from southeast Queensland.

The nature of the habitat loss (linear strips of bushland lost from an existing edge) will reduce the magnitude of impacts on this species, because substantial forest blocks will remain intact and continue to provide resources.

Impacts of fragmentation

This is a highly mobile species which exploits a variety of habitats, including small and isolated remnants, individual trees and suburban yards and parks. It does not require extensive tracts of habitat or heavily vegetated corridors for dispersal. The project will not isolate any area of habitat from currently interconnecting habitat for this species.

Impacts on the ecology of a population

No impacts on the ecology of this population area expected.

Introduction of invasive species and/or disease

The study area already supports cats which may pose a threat to this species at various stages of its lifecycle. The project will not introduce these species to the habitat of the Regent Honeyeater.

Mitigation Strategies

None proposed, although this species may benefit from proposed compensatory habitat measures associated with the project.

Likelihood of species decline

Decline of this species as a result of the carrying out of the project is considered very unlikely.

4.4.3 Australian Painted Snipe (*Rostratula australis*)

Impacts on population size and area of occupancy

The Australian Painted Snipe is not known from the study area, but may occur on the margins of Advancetown Lake. Should the species currently utilise the study area, it is likely to continue to do so, as there will be an expansion in the potential area of occupancy as a result of this proposal.

Impacts of fragmentation

This is a highly mobile species which exploits a variety of habitats which are typically scattered throughout a mosaic of unsuitable habitats. It does not require extensive tracts of habitat or heavily vegetated corridors for dispersal. The project will not isolate any area of habitat from currently interconnecting habitat for this species.

Impacts on the ecology of a population

No negative impacts on the ecology of this species are expected.

Introduction of invasive species and/or disease

The study area already supports cats which may pose a threat to this species at various stages of its lifecycle.

Mitigation Strategies

None proposed, although this species may benefit from proposed compensatory habitat measures associated with the project.

Likelihood of species decline
Decline of this species as a result of the carrying out of the project is considered very unlikely.

4.4.4 Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)

Impacts on population size and area of occupancy
The proposed action will remove approximately 318 ha of remnant vegetation which comprises potential habitat for this species on a seasonal basis. The nature of the habitat loss (linear strips of bushland lost from an existing edge) will reduce the magnitude of impacts on this species, because substantial forest blocks will remain intact and continue to provide foraging and denning resources.

Impacts of fragmentation
The proposed action will not isolate any substantial areas of currently interconnected habitat, as disturbance will be limited to the existing perimeter of the lake and (predominantly) previously cleared areas surrounding the existing dam wall.

Impacts on the ecology of a population
No significant adverse impacts on the ecology of this population area expected.

Introduction of invasive species and/or disease
The study area already supports cats which may pose a threat to this species. The project will not introduce these species to the habitat of the Swift Parrot.

Mitigation Strategies
None proposed, although this species may benefit from proposed compensatory habitat measures associated with the project.

Likelihood of species decline
Decline of this species as a result of the carrying out of the project is considered very unlikely.

4.4.5 Coeranoscincus reticulatus

Impacts on population size and area of occupancy
No populations of this species are known from the study area.

Impacts of fragmentation
Rainforest habitats are (by their very nature) fragmented at the landscape scale, with isolated rainforest patches located in a mosaic of Eucalypt forests across the study area. The project will not further fragment rainforest patches, although it may reduce their extent at some locations.

Impacts on the ecology of a population
Inundation to the proposed FSL is likely to result in the direct attrition of some areas of habitat for this species.

Introduction of invasive species and/or disease
There are no known threatening processes afflicting this species associated with invasive species or disease.

Mitigation Strategies

The mitigation approach for these species (if located during future works) is likely to involve a combination of actions including protection (in part) and management of existing populations, establishment of an *ex situ* population prior to any site disturbance, translocation or propagated stock and development of management and monitoring programs. The overarching objective would be to ensure no net loss of individuals from the study area.

Likelihood of species decline

As this species is yet to be recorded from the study area, it is not possible to assess the likelihood of decline.

4.4.6 Rainforest Plant Assemblage

Impacts on population size and area of occupancy

No populations of Hairy-joint Grass (*Arthraxon hispidus*), Red Boppel-nut (*Hicksbeachia pinnatifolia*); Brush Sophora (*Sophora fraseri*), Small-leaved Tamarind (*Diploglottis campbelli*) or Northern Clematis (*Clematis fawcettii*) are known from the study area.

Impacts of fragmentation

Rainforest habitats occur as isolated patches located in a mosaic of Eucalypt forests across the study area. These patches are often widely separated and are essentially fragments in a predominantly non-rainforest landscape. Existing vegetated links are severed by Advancetown Lake, and the proposal will marginally increase that separation.

Impacts on the ecology of a population

Inundation to the proposed FSL is likely to result in the direct attrition of individual plants if they are present. The creation of new forest edges on the periphery of known habitat is likely to adversely affect individual plants by increasing exposure to sunlight and desiccating winds.

Introduction of invasive species and/or disease

Populations of these species are potentially threatened by weed invasion, particularly proliferation of Lantana which is favoured by the current fire and disturbance regimes.

There is potential for the spread and introduction of the root-rot fungus *Phytophthora cinnamomi*. Although there are no known locally affected areas, *P. cinnamomi* is known from coastal Queensland and should be regarded as a potential threat.

Mitigation Strategies

The mitigation approach for these species (if located during future works) is likely to involve a combination of actions including protection (in part) and management of existing populations, establishment of an *ex situ* population prior to any site disturbance, translocation or propagated stock and development of management and monitoring programs. The overarching objective would be to ensure no net loss of individuals from the study area.

Likelihood of species decline

As these species are yet to be recorded from the study area, it is not possible to assess the likelihood of decline. However, the mitigation framework to be developed for other significant flora species could be readily adapted to accommodate ant additional threatened flora.

4.4.7 Phyllodes imperialis

Impacts on population size and area of occupancy

The proposal will reduce the overall area of rainforest in the study area by inundation. This will potentially reduce the number of food plants for this species at the local level and ultimately impact on the recover of the species.

Impacts of fragmentation

The project will reduce the overall area of rainforest in the study area and marginally increase separation between habitat patches. Populations of this species are already highly fragmented, and there are limited opportunities to enhance landscape connectivity.

Impacts on the ecology of a population

Inundation to the proposed FSL is likely to result in the direct attrition of individual larval food plants. The creation of new forest edges on the periphery of known habitat is likely to adversely affect individual food plants by increasing exposure to sunlight and desiccating winds.

Introduction of invasive species and/or disease

Populations of the preferred larval food plant of this species are potentially threatened by weed invasion, particularly proliferation of Lantana which is favoured by the current fire and disturbance regimes.

Mitigation Strategies

Habitat Rehabilitation/Restoration activities within the study area will benefit this species. Introduction of appropriate fire regimes and active weed control measures will improve the condition of rainforest patches. Propagation of the larval food plant (*Carronia multisepalea*) will be investigated with a view to actively increasing the distribution and abundance of this species in the study area.

Likelihood of species decline

As this species is yet to be recorded from the study area, it is not possible to assess the likelihood of decline with confidence. However, the mitigation framework to be developed for significant flora species could be readily adapted to accommodate the larval food source of this species (*Carronia multisepalea*).

4.5 Assessment of Impacts on Migratory Species

4.5.1 Introduction

The Terms of Reference for the Environmental Impact Statement (EIS) do not contain prescriptions which specifically relate to impacts on Migratory Species. As such, this assessment has defaulted to EPBC Act Policy Statement 1.1 - Significant Impact Guidelines (Matters of National Significance). This section lists the significant impact criteria against which the proposal is to be assessed, reviews the occurrence of important habitat and ecologically significance of populations across the study area.

4.5.2 Significant Impact Criteria

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

4.5.3 Occurrence of Important Habitat in the study area

An area of 'important habitat' for a migratory species is:

a) habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or

b) habitat that is of critical importance to the species at particular life-cycle stages; and/or

c) habitat utilised by a migratory species which is at the limit of the species range; and/or

d) habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

In relation to the occurrence of significant habitat within the study area, the following is noted:

- the study area does not contain habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- the study area does not support habitat known to be of critical importance to any species at particular lifecycle stages;
- none of the species recorded is considered to be at the limits of its range in the study area; and
- none of the migratory species recorded is known to be declining in the study area.

4.5.4 Impact Assessment

The proposal will involve the loss of 318 ha of remnant vegetation which is habitat for a number of migratory species recorded from the study area, including Little Bronze Cuckoo, Black-faced and White-bellied Cuckoo Shrikes, Spangled Drongo, Common Koel and Forest and Sacred Kingfishers.

The majority of additional migratory species known or likely to occur in the study area are generalist inhabitants of swamp and lake margins, and will benefit from a net increase in lake perimeter associated with this project.

The significant impact criteria for migratory species are addressed individually below.

"substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species"

The study area is not known to contain any area of important habitat for a migratory species. As such, this criterion does not apply to the proposed action.

"result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species"

The study area is not known to contain any area of important habitat for a migratory species. As such, this criterion does not apply to the proposed action. However, the project is committed to the control and reduction of populations of invasive flora and fauna across the study area.

"seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species."

The study area is not known to contain an ecologically significant proportion of the population of any migratory species. As such, this criterion does not apply to the proposed action.

4.6 Compensatory Habitat Strategy

4.6.1 Background

A compensatory habitat strategy is to be developed for the project. The objectives of the strategy will be twofold; (a) the strategy will seek to comply with the requirements of the Queensland *Vegetation Management Act 1999* and associated Codes and Policies; and (b) the strategy will aim to provide tangible conservation benefits at the local and citywide scale, with an emphasis on threatened species conservation.

The project will require the clearing of 318 ha of mapped remnant vegetation. In order to comply with the Regional Vegetation Management Code (RVMC) for Southeast Queensland Bioregion (DNRW 2006), the applicant will be required to maintain the current extent of "Of Concern" RE's (Performance Requirement [PR] S7), Threshold RE's (PRS9), riparian (watercourse) RE's (PRS3) and Essential Habitat (PRS8).

"Maintain the current extent" is defined as follows in the RVMC:

a) not clearing; or
b) ensuring the regional ecosystem structure and function are maintained; or
c) providing an offset in accordance with the policy in force at the date the application was properly made for vegetation management offsets administered by the Department of Natural Resources and Water.

Not clearing is not a viable option for this project and it is difficult to satisfy clause (b) whilst clearing remnant vegetation. As such, the Hinze Dam Alliance has opted to provide an offset in accordance with the NRW Policy for Vegetation Offsets (the Offset Policy) released in November 2006.

It is intended that the applicant (Gold Coast City Council) enter into a deed of agreement with the Department of Natural Resources and Water (DNRW) to provide vegetation offset strategy within 12 months of lodging the vegetation clearing application. The offset strategy will form the basis of the compensatory habitat strategy for the project and will seek to comply with the performance criteria set out in the Offset Policy.

The compensatory habitat strategy is likely to involve a combination of the following options:

- securing advanced regrowth (near remnant) vegetation within and outside Gold Coast City which is representative of the RE's and essential habitat to be cleared for the project. The properties will be either be

purchased by GCCC or secured via registered covenant. In both cases the properties would be actively managed until such time as they reach remnant status;

- securing RE's of equivalent conservation status to those to be cleared for the project within and outside Gold Coast City and managing these areas until such time as they meet remnant status;
- strategic purchase of key land parcels which have been identified as key linkages or habitats for EVR taxa at the local, sub-regional or regional scale; and
- revegetation and rehabilitation of existing cleared areas of land within the study area, with a view to re-instating pre-clearing vegetation types.

4.6.2 Offset Targets

The Offset Policy sets targets for the condition, area, configuration and status of vegetation offsets, and the Compensatory Habitat Strategy will aim to meet these targets. These targets are listed in **Table 4-2**.

Table 4-2 Vegetation Offset/Compensatory Habitat Targets

Attribute to be Offset	Area Lost (ha)	Minimum Offset ratio	Minimum Offset Area (ha)	Additional Requirements
'Of Concern' RE 12.3.2	13.17	1:1.5	19.75	■ The proposed offset would ideally be the same regional ecosystem as the area proposed for clearing; ■ The proposed offset would ideally be within 20 kilometres of the area proposed for clearing; ■ The site must be non-remnant vegetation, or remnant vegetation that is otherwise committed to development; ■ The proposed offset site should have weed cover; ■ The proposed offset site should demonstrate the capacity to reach remnant status (with management), attain remnant status within a reasonable timeframe; and; ■ Ideally, the proposed offset site would require minimal revegetation.
'Of Concern' RE 12.3.11	7.89	1:1.5	11.83	As above
Threshhold RE 12.11.	1.5	1:2	3	As above
Essential Habitat	240	1:1.5	360	■ Proposed offset site must include all of the essential habitat factors—including any mandatory habitat factors—as the area of essential habitat proposed for clearing; ■ Proposed offset site be the same regional ecosystem as the area proposed for clearing; and ■ The offset must demonstrate that the impacts on the species are mitigated by the offset.
Vegetation associated with any watercourse	43.26	1:2	86.52	■ Proposed offset site must be a regional ecosystem associated with any watercourse that has the same or higher conservation status than the regional ecosystem proposed for clearing; and ■ Proposed offset must be a regional ecosystem associated with a watercourse that has at least the same stream order as the watercourse proposed for clearing.
TOTAL			**481.1**	

5. Conclusion

The combined strategies put forward in this document, which include the propagation and translocation of threatened plants, management of retained habitats (and populations contained therein) and provision of substantial areas of compensatory habitat, are considered adequate to mitigate the adverse impacts of the proposed action on matters of national environmental significance.

6. References

Ayers, D., Nash, S. and Baggett, K. 1996. *Threatened Species of Western New South Wales*. NPWS, Hurstville.

Clarke, G. & Spier-Ashcroft, F. 2003. *A Review of the Conservation Status of Selected Australian Non-Marine Invertebrates:* http://www.environment.gov.au/biodiversity/threatened/action/non-marine-invertebrates/index.html.

Cogger, H.G., Cameron, E.E, Sadlier, R.A. & Eggler, R. 1993. *The Action Plan for Australian Reptiles*: http://www.environment.gov.au/biodiversity/threatened/action/reptiles/index.html.

Dickman, C.R. and Read, D.G. 1992. *The biology and management of dasyurids of the arid zone in NSW. Species Management Report Number 11*. New South Wales National Parks and Wildlife Service, Hurstville.

Dovey, L., Wong, V. and Bayne, P. 1997. An overview of the status and management of rock-wallabies (Petrogale) in New South Wales. *Australian Mammalogy 19: 163 – 168*.

Eby, P. 1991. Seasonal movements of Grey-headed Flying-foxes, *Pteropus poliocephalus* (Chiroptera: Pteropodidae), from two maternity camps in northern New South Wales. *Wildlife Research 18: 547-559*.

Eby, P. 1995. *The biology and management of flying-foxes in NSW; Species management report number 18*. Llewellyn, L. (ed). NPWS, Hurstville.

Eby, P. 2000a. *The results of four synchronous assessments of relative distribution and abundance of Grey-headed Flying-fox Pteropus poliocephalus*. In *Proceedings of a Workshop to Assess the Status of the Grey-headed Flyingfox in New South Wales.* Richards, G. (ed): http://batcall.csu.edu.au/abs/ghff/ghffproceedings.pdf

Eby, P. 2000b. *A case for listing Grey-headed Flying-fox Pteropus poliocephalus as threatened in NSW under IUCN criterion A2*. In *Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales*. Richards, G. (ed): http://batcall.csu.edu.au/abs/ghff/ghffproceedings.pdf

Edgar, R. and Belcher, C. 1995. Spotted-tailed Quoll Dasyurus maculatus (Kerr, 1792), in Strahan, R. (Ed.) *The Mammals of Australia*. Reed Books, Chatswood.

Franklin, D. C. and Menkhorst, P.W. 1988. A History of the Regent Honeyeater in South Australia . *South Australian Ornithologist* 30: 141-145.

Franklin, D., Menkhorst, P. and Robinson, J. 1987. Field surveys of the Regent Honeyeater *Xanthomyza phrygia* in Victoria. *Australian Bird Watcher* 12: 91-95.

Franklin, D.C., Menkhorst, P.W. and Robinson, J.L. 1989. Ecology of the Regent Honeyeater Xanthomyza phrygia. *Emu* 89: 140-154.

Garnet S.T. and Crowley, G.M. 2000. *The Action Plan Birds 2000*. Environment Australia, Canberra.

Geering, D. 1997. *The Regent Honeyeater in the Capertee Valley, NSW. 1994-1996*. Unpublished report to Capertee Valley Regent Honeyeater Recovery Group and Birds Australia, Southern NSW and ACT Group.

Geering, D. and French, K. 1998. Breeding biology of the Regent Honeyeater *Xanthomyza phrygia* in the Capertee Valley, New South Wales. *Emu* 98: 104-116.

Goldingay, R., Newell, D. and Graham, M. 1999. The status of rainforest stream frogs in north-eastern NSW: decline or recovery? Pp. 64-71 in Campbell, A. (Ed.) *Declines and Disappearances of Australian Frogs*. Environment Australia, Canberra.

Greer, A.E. & Cogger, H.G. 1985. Systematics of the reduced-limbed and limbless skinks currently assigned to the genus Anomalopus (Lacertilia: Scincidae) in *Records of the Australian Museum 37 (1):11-54*.

Herbison-Evans, D., J. Moss & N. Hewett (2004). *Phyllodes imperialis* H.Druce, 1888: http://www.usyd.edu.au/macleay/larvae/cato/imper.html.

Hines, H., Mahony, M. and McDonald, K. 1999. An assessment of frog declines in wet subtropical Australia. Pp. 44-63 in Campbell, A. (Ed.) *Declines and Disappearances of Australian Frogs*. Environment Australia, Canberra.

Huck, R.B. 1992. Overview of pollination biology in the Lamiaceae. In Harley, R.M. & Reynolds, T. (eds.) *Advances in Labiate Science, pp. 167-181*. Royal Botanic Gardens, Kew.

Ingram, G.J. and McDonald, K.R. 1993. An update on the decline of Queensland's frogs. In Lunney, D. and Ayers, D. (eds) *Herpetology in Australia, p*p. 297-303. Surrey Beatty and Sons, Sydney.

Kennedy, S.J.& Overs, A. in press. *Foraging ecology and habitat use of the Swift Parrot on the western slopes of New South Wales*. Corella.

Kingsford, R.T. & Thomas, R.F. 1995. The Macquarie Marshes in arid Australia and their waterbirds: a 50-year history of decline. *Environmental Management 19, 867-878*.

Kingsford, R.T. 2000. Ecological impacts if dams, water diversions and river management on floodplain wetlands in Australia. *Austral Ecology* 25:109-127.

Landmark Ecological Services (1995). *Recovery Plan for Onion Cedar (Owenia cepiodora*). Unpublished report to the NSW National Parks and Wildlife Service.

Lane, B.A. & Rogers, D.I. 2000. The Australian Painted Snipe *Rostratula (benghalensis) australis*: an endangered species? *Stilt 36: 26-34*.

Lemckert, F. and Brassil, T. 2000. Movements and habitat use of the endangered giant barred river frog (*Mixophyes iteratus*) and the implications for its conservation in timber production forests. *Biological Conservation 96: 177-184*.

Lunney D., Law B. and Rummery C. 1997. An ecological interpretation of the historical decline of the Brush-tailed Rock-wallaby *Petrogale penicillata* in New South Wales. *Australian Mammalogy 19: 281 – 296*.

McDonald, K.R. 1977. Observations on the skink *Anomalopus reticulatus* (Gunther) (Lacertilia: Scincidae). *Victorian Naturalist 94:98-103*.

Meyer, E., Hines, H. and Hero, J.-M. 2001. *Wet forest frogs of south-east Queensland*. Griffith University, Brisbane.

Lemckert, F. 1999. Impacts of selective logging on frogs in a forested area of northern New South Wales. *Biological Conservation 89: 321-328.*

Muir, A.M., Edwards, S.A. and Dickens, J.M. 1995. Description and conservation status of the vegetation of the box-ironbark ecosystem in Victoria. Flora and Fauna Technical Report Number 136, Department of Conservation and Natural Resources, Victoria.

NSW Scientific Committee (2003j). Final determination - *Phyllodes imperialis*, southern subspecies (a moth) - endangered species listing. http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Phyllodes_imperialis_southern_subspecies_endangered.

Oliver, D. L. 1998b. Ecology and conservation of the endangered Regent Honeyeater *Xanthomyza phrygia*, in northern New South Wales. PhD thesis, University of New England. Armidale, New South Wales.

Parry-Jones, K.A. and Augee, M.L. 1992. Movements of Grey-headed Flying Foxes (*Pteropus poliocephalus*) to and from a colony site on the central coast of New South Wales. *Wildlife Research 19: 331-340.*

Quinn F. C., Williams J. B., Gross C. L. and Bruhl, J. J. 1995. Report on rare and threatened plants of north-eastern New South Wales. Report prepared for New South Wales National Parks and Wildlife Service and Australian Nature Conservation Agency.

Ratcliffe, F.N. 1932. Notes on the fruit bats (*Pteropus spp*.). *Australian Journal of Animal Ecology 1, 32–57.*

Scotts, D. 1992. *A preliminary survey for the Eastern Quoll, Dasyurus viverrinus, and other rare endangered vertebrates in Carrai State Forest, NSW*. Unpublished report for the NPWS.

Short, J. and Milkovits, G. 1990. Distribution and status of the Brush-tailed Rock-wallaby in south-eastern Australia. *Australian Wildlife Research. 17: 169 –79.*

Streatfeild, C. 1999. *Spatial movements of Mixophyes iteratus and M. fasciolatus in southeast Queensland.*

Webster, R. and Menkhorst, P. 1992. The Regent Honeyeater (*Xanthomyza phrygia*): population status and ecology in Victoria and New South Wales. Arthur Rylah Institute for Environmental Research Technical Report Series Number 126. Department of Conservation and Environment, Melbourne.

White, A. 2000. *The status of the Barred River Frogs Mixophyes balbus and M. iteratus in the Sydney Basin Region of New South Wales 1999-2000*. Unpublished Biosphere Environmental Consultants P/L report for NSW National Parks and Wildlife Service.