

APPENDICES

Appendix 1: Summary of Qualifications and Experience of Survey Members

This appendix details the qualifications and experience of team members involved in the survey work.

RHIDIAN HARRINGTON**CURRICULUM VITAE****POSITION:**

Senior Ecologist, Biosis Research Pty. Ltd.

QUALIFICATIONS:

Bachelor of Science (Hons), James Cook University
 Masters Science (Zoology), University of the Witwatersrand
 Doctor of Philosophy (Zoology), University of Melbourne

EMPLOYMENT PROFILE:

2003 Senior Ecologist, Biosis Research Pty. Ltd.
 2002-03 Project Officer, Black-eared Miner Recovery Team, La Trobe University, Melbourne
 2002 Scientific writer, Institute of Land and Food Resources (ILFR), University of Melbourne
 1998-01 Research coordinator/demonstrator, Melbourne University
 1998-02 Research Assistant, Puckapunyal Army Reserve, Victoria
 1995-96 Research assistant, Botswana National Parks
 1993-95 Lecturer/Demonstrator, University of the Witwatersrand, South Africa
 1992 Research assistant for OTC and National Parks Queensland, Australia
 1992 Research assistant, Australian Centre for Tropical and Freshwater Research, Queensland
 1987 Volunteer research assistant, National Park and Wildlife Service, Zimbabwe

FIELDS OF COMPETENCE:

- ✓ Terrestrial ecology
- ✓ Zoology
- ✓ Flora survey and identification
- ✓ Identification of Australian vertebrates
- ✓ Literature reviews
- ✓ Experimental design
- ✓ Expert evidence
- ✓ Statistical data analysis
- ✓ Environmental impact assessment
- ✓ Impact minimisation (mitigation) guidelines
- ✓ Project management

PROFESSIONAL EXPERIENCE:

Rhidian has over ten years experience in applied conservation biology and consulting. A sample of key professional experience is presented below.

Project Officer, Black-eared Miner Recovery Team (2002-2003 for *La Trobe University, Melbourne*)

Scientific Writer, Institute for Land and Food Resources (ILFR) (2002 for the *University of Melbourne*)

Project Manager/Zoologist, Environmental Baseline Survey of Khirthar National Park, Pakistan, (2000-2001 for *Premier-Shell and the Sindh Wildlife Department, Pakistan*)

Chief Investigator, studying the impacts of artificial water points on avifaunal distribution and abundance in the arid mallee habitat of southeast Australia

Research Assistant, Kangaroo Census Team, Puckapunyal Army Reserve, Victoria (1998-2002 for the *Department of Defence*).

Research Assistant, aerial and ground census, wildlife monitoring and data analysis (1995-1996 for *Botswanan National Parks*).

Chief Investigator, determining the causes of the roan antelope decline in Kruger National Park, South Africa (1993-1995 for *the National Parks Service, South Africa*).

Lecturer in Ecology, teaching and coordinating ecology and conservation biology for first year students (1995 for *the University of the Witwatersrand, South Africa*).

Research Assistant, fauna survey of Prudhoe Island Queensland (1992 for *OTC and Queensland National Parks*).

Chief Investigator, studying the importance of riparian vegetation to avifauna in the tropical woodlands of north Queensland.

Research Assistant, fauna surveys of the Burdekin River Floodplains, Queensland (1992 for *Australian Centre for Tropical and Freshwater Research*)

Research Assistant for research into management of aspects of savanna ecology including soil erosion (1987 for *the National Parks Service, Zimbabwe*)

PUBLICATIONS:

Rhidian has written over 10 scientific papers and reports.

MARTIN PREDAVEC**CURRICULUM VITAE****POSITION:**

Senior Ecologist, Sydney Resource Group, Biosis Research Pty. Ltd.

PROFESSIONAL AFFILIATIONS AND MEMBERSHIPS:

Australasian Wildlife Management Society
 Ecological Society of Australia
 Royal Zoological Society of New South Wales

QUALIFICATIONS:

Doctor of Philosophy (Terrestrial Ecology), University of Sydney
 Bachelor of Science (Hons -Terrestrial Ecology), University of Sydney

EMPLOYMENT PROFILE:

2001-2003 Senior Ecologist, Biosis Research Pty. Ltd.
 2000-01 Senior Lecturer in Vertebrate Ecology, Monash University.
 1996-00 Lecturer in Vertebrate Ecology, Monash University.
 1995-96 Postdoctoral Research Fellow, University of British Columbia.
 1994-95 Associate Lecturer, University of Sydney.
 1992 Technical officer, NSW National Parks and Wildlife Service
 1991-94 Tutor, University of Sydney
 1989-91 Technical Assistant, Australian Museum.

FIELDS OF COMPETENCE:

- ✓ Terrestrial ecology
- ✓ Zoology
- ✓ Identification of Australian vertebrates
- ✓ Literature reviews
- ✓ Experimental design
- ✓ Statistical data analysis
- ✓ Environmental impact assessment
- ✓ Project management

PROFESSIONAL EXPERIENCE:

Martin has eleven years experience in both practicing and teaching terrestrial ecology and managing research projects. A sample of key professional experience is presented below.

Project Manager/Ecologist: F3 to Branxton National Highway Link Supplementary Flora and Fauna Studies (2002 – present for RTA)

Project Manager/Ecologist: Response to Disturbance and Land Management Practices in the Brigalow Belt South Bioregion. (2002 for PlanningNSW).

Project Manager/Ecologist: Dendrobium Coal Mine Flora and Fauna Management Plan. (2001 for Earth Air Water Consulting).

Project Manager/Ecologist: Kurri Sand Swamp Woodland recovery assessment. (2001 for NSW Roads and Traffic Authority and National Parks and Wildlife Service).

Project Manager/Zoologist: Natural and cultural heritage assessment of Sydney Kingsford Smith Airport. (2001 for Salomon Smith and Barney).

Project Manager: Assessment of the potential impact of dredging on bird populations in Mill Stream and the risk of bird strike. (2001 The Ecology Lab).

Project Manager: Monitoring of vegetation on Tuppall Creek and provision of advice on future experimental methodology. (2001 for Murray Irrigation).

Project Manager/Ecologist: Fauna assessment associated with the upgrade of the Berry Sewerage Works. (2001 for Department of Public Works and Services).

Chief Investigator/Team Leader: studying the role of food in irruptions of Australian desert rodents.

Chief Investigator/Project Manager: studying the ecology and physiology of water rats in urban habitats of Melbourne.

Chief investigator: developing new techniques to date previous population peaks of lemmings in the Canadian Arctic.

Project Manager: developing new multimedia software tools to replace the use of animals in first year biology teaching.

Supervisor: range of Honours and Postgraduate projects investigating aspects of vertebrate ecology in eastern Australia. For example, the use of roadside reserves by the eastern bearded dragon, the response of small mammals to changes in natural illumination and habitat use by ringtail possums in remnant bushland.

Senior Lecturer in Vertebrate Ecology: teaching and coordinating in a range of subjects from basic ecology to wildlife management and conservation biology.

PUBLICATIONS:

Martin has written over 40 scientific papers and reports.

MATTHEW B.G. RICHARDSON**CURRICULUM VITAE****POSITION:**

Botanist, Biosis Research Pty. Ltd.

QUALIFICATIONS:

Bachelor of Science (Hons I) (Plant Ecology/Population Genetics)

EMPLOYMENT PROFILE:

1998- Botanist, Biosis Research Pty. Ltd.
 1998 Research Assistant, Australian Museum Business Services (AMBS)
 1997-98 Field Botanist, Gary Leonard and Associates Botanical and Horticultural Consultants
 1997-98 Research Assistant, Ecological Genetics Laboratory; University of Wollongong

FIELDS OF COMPETENCE:

- ✓ project management
- ✓ flora survey and identification
- ✓ native vegetation classification and mapping
- ✓ rare or threatened species assessment
- ✓ environmental impact statement – natural environment
- ✓ impact minimisation (mitigation) guidelines
- ✓ expert evidence
- ✓ plant mating system research
- ✓ plant population genetics and gene flow research
- ✓ manipulative field and laboratory experimental techniques

PROFESSIONAL EXPERIENCE:

Matthew has over six years experience in applied conservation biology and consulting. A sample of key professional experience is presented below.

Project Manager/Botanist, assessment of potential impacts of subsidence on terrestrial and aquatic ecological values above workings of the Appin and West Cliff Collieries (2002 for BHP Billiton)

Botanist, Assessment of instream and riparian vegetation of the Woronora River for management purposes through environmental flows (2002 for Patterson Britton)

Project Manager/Botanist, targeted surveys for *Acacia baueri* ssp. *aspera* on the proposed Stage Three Coal Wash Emplacement at West Cliff Colliery (2002 for BHP Billiton)

Project Manager/Botanist, identification of areas of ecological significance and development constraints and opportunities for the proposed stages 14 and 15 of the Rouse Hill residential development area (2001-2002 for Rouse Hill Infrastructure Pty Ltd)

Project Manager/Botanist, targeted surveys for threatened flora and fauna species with the site of the proposed Two-Fold Bay Naval Ammunitioning Facility, Eden (2001 for GHD)

Project Manager/Botanist, identification of ecological values occurring on private lands for potential inclusion in public the Gosford City Council reserve system, Gosford, (2001 – ongoing for Gosford City Council)

Project Manager/Botanist, assessment of the potential impacts associated with mine subsidence on upland swamps, creek and river systems for the proposed Dendrobium Coal Project (2001 for BHP Illawarra Coal)

Botanist, preparation of vegetation mapping for the Menindee Lakes, Ecological Sustainable Development Project (2001 for DLWC)

Project Manager/Botanist, presentation of expert evidence at the Dendrobium Coal Project Commission of Inquiry (2001 for BHP Illawarra Coal)

- Project Manager/Botanist**, assessment of the impact of a proposed commercial development on threatened species and an endangered ecological community, North Ryde (2001 for *Bovis Lend Lease Developments*)
- Project Manager/Botanist**, targeted threatened species impact assessment for the proposed Dendrobium Coal Mine Project (2001 for *BHP Illawarra Coal*)
- Project Manager/Botanist**, habitat level assessment for the proposed Dendrobium Coal Mine Project in the Illawarra (2000 for *BHP Illawarra Coal*)
- Botanist**, review of an assessment of the impact of a proposed development on an Endangered Ecological Community, Eastern Suburbs Banksia Scrub (2000 *Colin Ging and Partners*)
- Botanist**, assessment of the potential impact of a proposed industrial development on *Wilsonia backhousei*, a threatened species saltmarsh species, and preparation of expert evidence for the Land and Environment Court (2000 for *Trafalgar Corporate*)
- Botanist**, preparing the flora and fauna component of the Environmental Impact Assessment for the proposed widening of the Princes Highway near Mogo on the NSW South Coast (2000 for *Ove Arup*)
- Botanist**, assessment of the impacts of a proposed optical fibre trench in threatened flora species, Pheasants Nest (1999 for *Kinhill*)
- Project Manager/Botanist**, review an assessment of the impact of a proposed mineral water bore on flora and fauna values of a site in the Blue Mountains, Wentworth Falls (1999 *Koh Blue Mineral Spring Water*)
- Botanist**, preparing a Native Vegetation Management Plan for Section A of the proposed Queensland Interconnection Transmission Line, Northern Table Lands, NSW (1999 for *TransGrid*)
- Botanist**, implementing Site Assessment Protocols, including rapid flora survey, threatened species impact assessment and report preparation from Section A of the proposed Queensland Interconnection Transmission Line, Northern Table Lands, NSW (1999 for *TransGrid*)
- Botanist**, targeted threatened flora survey of the proposed Hume Freeway by-pass, Albury-Wodonga (1998 for *VicRoads*)
- Project Manager/Botanist**, flora assessment of riparian and aquatic vegetation of Maxwell's Creek at Casula (for Site Image (*Australasia] Pty. Limited*))
- Botanist**, flora survey, mapping of *Acacia pubescens* and assisting in the preparation a plan of management for vegetation of the Yennora Woolstores (for *A. T. Cocks and Partners Pty Ltd*)
- Botanist**, flora survey and vegetation mapping of Middle and Georges Heads, Sydney Harbour National Park (*Root Projects*)
- Botanist**, assessment of natural vegetation remnants along the Georges River Foreshore for Hurstville LGA Environmental Audit (for *Hurstville Council*)
- Research Assistant**, field work and manipulative field experiments of aquatic plants in the Hawkesbury-Nepean River system (Australian Museum Business Services)

PUBLICATIONS:

Matthew has been involved in publishing of over 70 consultants reports and one scientific paper.

TERRI-ANN ENGLISH**CURRICULUM VITAE****POSITION:**

Zoologist, Biosis Research Pty. Ltd.

QUALIFICATIONS:

Bachelor of Applied Science (Environmental Science) Charles Sturt University, Wagga Wagga
Currently undertaking Masters in Environmental Science at University of Western Sydney

EMPLOYMENT PROFILE:

2001 - Zoologist, Biosis Research Pty. Ltd.
1999 – 01 Zoologist/Technical Assistant, Biosis Research Pty. Ltd.
1996 Technical Officer Scientific NSW NPWS

FIELDS OF COMPETENCE:

- ✓ fauna survey
- ✓ mammalian fauna research
- ✓ frog surveys
- ✓ bird surveys
- ✓ habitat and biodiversity assessment
- ✓ rare and threatened species assessment

PROFESSIONAL EXPERIENCE:

Terri has 3 years experience in flora and fauna surveys. A sample of key professional experience is presented below.

Zoologist: targeted survey for two threatened bird species within River Red Gum and Box woodlands for a proposed bridge crossing in western NSW (2002 for *VicRoads*)

Project Manager/Zoologist: monitoring of Long-nosed Bandicoots for a residential development at Manly (2002-ongoing for *Lend Lease*)

Project Manager/Zoologist: Eight Part Test assessment for proposed residential development in the Blue Mountains (2002 for *Hitchins*)

Zoologist: targeted surveys for four threatened flora species and two threatened frog species within hanging swamps. Vegetation mapping and assessment of flora issues along water pipeline between Katoomba and Wentworth Falls in the Blue Mountains (2002 for *SCA*)

Zoologist: assessment of potential impacts of subsidence on terrestrial and aquatic ecological values above workings of the Appin and West Cliff Collieries (2002 for *BHP Billiton*)

Zoologist: targeted surveys for threatened flora and fauna within a proposed school site (2002 for Department of Public Works and Services)

Zoologist: fauna survey including targeted searches for threatened species, populations within nine proposed school sites from Wyong to Shell Harbour (2002 for *Department of Public Works and Services*)

Zoologist/Technical Assistant: assisted in fauna survey associated with an Environmental Impact Assessment for a proposed highway upgrade from Mooreland to Herons Creek (2002 for *RTA*)

Project Manager/Zoologist: targeted survey for the Green and Golden Bell Frog for a proposed industrial development at Yennora Wool Distribution Park (2001 for *Urbis*)

Zoologist: assessment of potential impacts of subsidence on riparian vegetation and fauna habitats at Cataract Creek and Ousedale Creek above workings of the West Cliff Colliery (2001 for *BHP*)

Zoologist: assessment of the impact of a proposed industrial development at Yennora Wool Distribution Park (2001 for *Urbis*)

- Zoologist:** assisted in the assessment of the impact of subsidence on upland swamp communities on the Woronora Plateau (2001 for BHP)
- Technical Assistant:** project assessing waterbird requirements of Menindee Lakes. (2000 – Present for Department of Land and Water Conservation).
- Zoologist:** fauna assessment component of the Environmental Impact Assessment for the proposed transport extension for Friskies Pet Care, Blayney. (2001 SEMF)
- Project Manager/Zoologist:** fauna and Flora component of the Environmental Impact Assessment for the proposed Sawmill Facility at Bombala. (2001 for SEMF)
- Zoologist:** bird assessment for the proposed dredging operation for Sydney Airport. (2001 for Sydney Airport Authority)
- Zoologist/Technical Assistant:** fauna and flora survey associated with a Species Impact Statement for proposed mining operation at Wollongong. (2001 for BHP)
- Zoologist:** fauna assessment associated with communication upgrade. (2000 for TransGrid)
- Zoologist:** fauna assessment associated with buffer assessment for an industrial development at Silverwater. (2000 for Trafalgar Corporate)
- Zoologist:** habitat assessment of the Red Crowned Toadlet within an urban golf course. (2000 for Avondale Golf Club)
- Zoologist:** assisted biologist with habitat assessment for threatened species on an urban golf course. (2000 for Avondale Golf Club)
- Assistant Zoologist:** assisted senior biologist with habitat assessment along proposed optic fibre cable rollout line in NSW. (2000 for ID&A Pty Ltd)
- Technical Assistant:** desktop study on proposed spring mineral water development in the Blue Mountains (1999 for Koh Blue Mountain Mineral Springs).
- Volunteer Assistant:** assisted in a bird survey of wildlife corridors in the Cental West region of NSW. (1997 for the Australian Museum)
- Volunteer Zoologist:** assisted in fauna surveys of Goobang National Park and Evans Crown Nature Reserve in Central Western NSW. (1997 for NSW National Parks and Wildlife)
- Volunteer Zoologist:** assisted with the methodology, implementation and reporting of a fauna survey for a proposed development in the Riverina, NSW. (1995 for the Farrer Centre)

PUBLICATIONS:

Terri has written and contributed to over 50 reports.

THOMAS NORMAN LESLIE O’SULLIVAN CURRICULUM VITAE

POSITION:

Ecologist, Biosis Research Pty. Ltd.

QUALIFICATIONS:

Tertiary

- 1997 - Masters of Wildlife Management (Macquarie University) (In progress)
- 1994 – 96: Masters of Environmental Studies (University of New South Wales) (transferred).
- 1994: Statement of Attainment. Environmental Management. (TAFE)
- 1991: BA Zoology/Physical Geography (University of New England)
- 1989: Diploma in Visual Disability & Rehabilitation (Royal Guide Dog Association)

EMPLOYMENT PROFILE:

- 2000 - Biosis Research Pty. Ltd. - Ecologist
- 1995 - 00 Australian Museum Business Services. AMBS Consulting - Ecologist
- 1995 - 96 Southern Sydney Regional Organisation of Councils (SSROC). – Data Analysis for SoE Reporting
- 1993 - 95 Birnbaum Gardening Service. - Horticultural & Landscape Assistant.
- 1993 - 94 Taronga Zoo. - Research Assistant
- 1993 Environmental Defenders Office. - Office Assistant

FIELDS OF COMPETENCE:

- ✓ terrestrial flora and fauna identification
- ✓ habitat and biodiversity assessment
- ✓ rare and threatened species targeted surveys and assessment
- ✓ environmental impact statement – natural environment
- ✓ impact minimisation (mitigation) guidelines
- ✓ flora/vegetation survey and identification
- ✓ native vegetation classification and mapping
- ✓ fauna survey (across a wide range of taxa)
- ✓ mammalian fauna research (eg. fauna overpass studies)
- ✓ diurnal and nocturnal field surveys
- ✓ literature reviews
- ✓ experimental design
- ✓ project management
- ✓ GIS mapping

PROFESSIONAL EXPERIENCE:

Tom has over seven years experience in formal field collection and identification of terrestrial flora and fauna throughout NSW, with extensive experience within the Sydney Basin Bioregion. A sample of key professional experience is presented below.

Project Manager, Targeted trapping and monitoring studies for threatened species at ‘Poplars’ and ‘Tralee’. (2002-3 for Queanbeyan City Council)

Project Officer, Targeted surveys for squirrel gliders and koalas for the proposed F3 Freeway to Branxton. (2003 for Roads and Traffic Authority of NSW)

Project Officer, Targeted surveys for frogs for the proposed F3 Freeway to Branxton. (2002-3 for Roads and Traffic Authority of NSW)

- Project Officer**, Targeted surveys and eight part tests for threatened species for proposed infrastructure works within the Balmoral Release Area. (2002 for Rouse Hill Infrastructure Consortium)
- Project Manager**, Vegetation assessment of the Holsworthy Military Area. (2002 for GHD & Department of Defence)
- Project Manager**, Assessment of natural habitats and endangered ecological communities at Matraville. (2002 for Sydney Ports Corporation)
- Project Manager**, Flora and fauna assessment, Palm Beach. (2002 for Gordon and Valich)
- Project Manager**, Independent assessment of the ecological values of Kurnell Peninsula. (2002 for Environment Australia)
- Project Manager**, Assessment of public school redevelopment, Killara. (2002 for DPWS)
- Project Manager**, Assessment of Green and Golden Bell Frog *Litoria aurea* habitat at Greenacre. (2002 for Goodman Fielder)
- Project Manager**, Habitat assessment for proposed rezoning Wahroonga. (2002 for Urbis)
- Project Manager**, Flora and fauna assessment and eight part test for *Acacia pubescens*, Yennora. (2002 for Prime Constructions)
- Project Officer**, Dendrobium flora and fauna assessment, Illawarra Coal. (2000-1 for BHP Billiton)
- Project Manager**, Review of Environmental Factors for water pipeline maintenance: Cascades to Leura, Blue Mountains. (2001 Sydney Catchment Authority)
- Project Manager**, Assessment of the terrestrial, aquatic and cultural heritage for the Bate Bay Management Plan. (2001 for Patterson Britton)
- Project Manager**, Assessment of the natural and cultural heritage of Cooks Cove. (2001 for Hassell)
- Project Manager**, Assessment of the distribution and abundance of *Dillwynia tenuifolia*, Londonderry. (2001 for Penrith City Council)
- Project Manager**, Review of Eight Part Test assessments Rouse Hill. (2001 for DPWS)
- Project Manager**, Terrestrial Flora and Fauna Survey and Habitat Assessment for the Proposed pump station upgrade, Hornsby. (2001 for GHD)
- Project Manager**, Assessment of potential Long-nosed Bandicoot *Peramales nasuta* habitat at Manly. (2000)
- Project Manager**, Assessment of rock outcrop habitat, Blakehurst. (2000)
- Project Manager**, Investigation of the movements of arboreal marsupials in relation to roads and overpass structures. (2000 for Roads & Traffic Authority of NSW)
- Project Manager**, Assessment of Bridge Refurbishment at Lycester Creek, Lismore. (2000 for GHD)
- Project Manager**, Assessment of Little Grassbird *Megalurus gramineus* habitat. (2000 for Marrickville Council)
- Project Officer**, Biodiversity benchmarking survey of the Coleambally Irrigation Area and the development of management guidelines for threatened flora and fauna. (1999-2000 for Coleambally Irrigation Corporation)
- Project Manager**, Baseline Flora and Fauna Study for the Stage 2 Development Area 24a; Parklea. (1999 for Rouse Hill Infrastructure Consortium)
- Project Manager**, Terrestrial Flora and Fauna Survey and Habitat Assessment for the Proposed Water Treatment Plant at Sunset Strip, NSW. 1999 for DPWS
- Project Manager**, Flora and Fauna Assessment for the Milford Drive Sewer Carrier, Rouse Hill. 1999 for Rouse Hill Infrastructure Consortium
- Project Manager**, Targeted Surveys for the Land Snail *Meridolum corneovirens* and Green and Golden Bell Frog *Litoria aurea* at Rouse Hill. 1999 for Rouse Hill Infrastructure Consortium
- Project Manager**, Flora and Fauna Habitat Assessment for the RHIC Stage 2: Water, Sewerage and Drainage Infrastructure Works. 1999 for Rouse Hill Infrastructure Consortium
- Project Manager**, Vertebrate Fauna Survey Middle Head and Georges Head, Sydney Harbour National Park. 1999 for Root Projects Australia

PUBLICATIONS:

Tom has written and contributed to over 90 technical and project reports.

SELGA MARY HARRINGTON**CURRICULUM VITAE****POSITION:**

Botanist, Biosis Research Pty. Ltd.

QUALIFICATIONS:

Bachelor of Science (Hons I) (Plant Ecology/Botany)

EMPLOYMENT PROFILE:

2001- Botanist, Biosis Research Pty. Ltd.
 1999-2000 Research Assistant, Plant Ecology Laboratory; University of Sydney
 1999-2001 Herbarium/Research Assistant; John Ray Herbarium; University of Sydney

FIELDS OF COMPETENCE:

- ✓ flora survey and identification
- ✓ weed management and mapping
- ✓ native vegetation classification
- ✓ rare or threatened species assessment
- ✓ environmental impact statement – natural environment
- ✓ manipulative field and laboratory experimental techniques
- ✓ fauna survey
- ✓ impact minimisation (mitigation) guidelines

PROFESSIONAL EXPERIENCE:

Selga has 3 years experience in flora and fauna surveys and experimental research. A sample of key professional experience is presented below.

Botanist: preparation of an Environmental Impact Assessment for a proposed highway upgrade from Moorland to Herons Creek (2002 for RTA)

Botanist: targeted surveys for four threatened flora species and two threatened frog species within hanging swamps. Vegetation mapping and assessment of flora issues along water pipeline between Katoomba and Wentworth Falls in the Blue Mountains (2002 for SCA)

Botanist: targeted surveys for *Acacia bynoeana* along a seismic line associated with West Cliff Colliery near Appin (2002 for BHP Billiton)

Project Manager/Botanist: targeted surveys for threatened flora and fauna and Eight Part Tests for a proposed Ecotourism resort in Pokolbin (2002 for TreeTops Pty Ltd)

Project Manager/Botanist: targeted surveys for threatened flora and fauna within a proposed school site (2002 for Department of Public Works and Services)

Project Manager/Botanist: flora and fauna assessment of a proposed wetland site in Georges Hall (2001 for Storm Consulting)

Botanist: flora survey, vegetation community mapping and assessment of the impact of a proposed development on an Endangered Ecological Community, Eastern Suburbs Banksia Scrub (2002 for Sydney Ports Authority)

Botanist: flora survey including targeted searches for threatened species, populations and communities within nine proposed school sites from Wyong to Shell Harbour (2002 for Department of Public Works and Services)

Botanist: preparation of a recovery plan for an Endangered Ecological Community (Kurri Sand Swamp Woodland) and assessment of the impact of the proposed F3 freeway to Branxton highway link on the recovery of this community (2001 for RTA/ NPWS)

Project Manager/Botanist: flora and fauna surveys of proposed borehole sites in the vicinity of Appin (2001 for BHP)

- Project Manager/Botanist:** assessment of potential impacts of subsidence on riparian vegetation and fauna habitats at Cataract Creek and Ousedale Creek above workings of the West Cliff Colliery (2001 for BHP)
- Botanist:** identification of ecological values occurring on private lands for potential inclusion in public the Gosford City Council reserve system, Gosford, (2001 – ongoing for Gosford City Council)
- Botanist:** assessment of the impact of a proposed industrial development at Yennora Wool Distribution Park (2001 for Urbis)
- Botanist:** flora survey and vegetation community conservation significance assessment of remnant bushland in Sutherland Shire (2001 for Urbis)
- Botanist:** assessment of the impact of subsidence on upland swamp communities on the Woronora Plateau (2001 for BHP)
- Botanist:** flora survey of a regenerating bushland reserve (2001 for Bankstown City Council)
- Field Assistant:** flora and fauna surveys and manipulative experiments in the Simpson Desert (NSW, QLD, NT), (2000 for Terrestrial Ecology Laboratory; University of Sydney)
- Field Assistant/Botanist:** field work and manipulative experiments in mallee at Round Hill Nature Reserve (2000-2001 for Plant Ecology Laboratory; Macquarie University)
- Research Assistant:** assessment of the changes in wading bird habitat in Botany Bay since 1770 (2001 for NPWS)
- Botanist:** flora survey of double banded plover overwintering area at Sydney Airport (2001 for NPWS)
- Herbarium Assistant/Botanist:** plant identification, examining species delineation, writing species descriptions for publication and herbarium curation (1999-2001 for Dr Murray Henwood; John Ray Herbarium and Plant Systematics Laboratory; University of Sydney)
- Research Assistant:** field work and manipulative field, lab and glasshouse experiments of *Trachymene* spp. (2000-2001 for Dr Glenda Wardle; Plant Ecology Laboratory; University of Sydney)
- Botanist/Ecologist:** a study of the reproductive biology and the consequences of dimorphic fruit in *Actinotus forsythii* (pink flannel flower). Work included predicting population locations through the examination of biotic and abiotic characteristics of known locations and determination of indicator species. Research involved fieldwork and manipulative field, laboratory and glasshouse experiments (1999-2000 for Plant Systematics Laboratory, University of Sydney)

PUBLICATIONS:

Selga has written and contributed to over 50 reports.

NATHAN W. SMITH**CURRICULUM VITAE****POSITION:**

Botanist, Biosis Research Pty. Ltd.

QUALIFICATIONS:

Bachelor of Science (Resource & Environmental Management), School of Earth Sciences, Macquarie University, Sydney.

Certificate II & IV Bushland Regeneration, School of Horticulture, Northern Sydney Institute of Technology and Further Education, Ryde.

Statement of Attainment in Spatial Information Systems, School of Surveying, Sydney Institute of Technology, Ultimo.

EMPLOYMENT PROFILE:

- 2003-2005 Botanist, Biosis Research Pty. Ltd.
- 2001-2003 Toolijooa Environmental Restoration Pty Ltd, Native Plant Seed Collector and Bush Regeneration Project Manager.
- 2000-2003 North Sydney Council, Bushcare Supervisor.
- 1998-2003 Australian Bushland Restoration Pty Ltd, Bushland Management Supervisor.
- 1996-1997 Agserv Pty Ltd, Weed Control Operator & Bush Regeneration Supervisor.

FIELDS OF COMPETENCE:

- ✓ bushland management & site assessment
- ✓ native plant and weed identification
- ✓ threatened species assessment (including EECs)
- ✓ native vegetation classification
- ✓ habitat restoration and mine site rehabilitation

PROFESSIONAL EXPERIENCE:

Nathan has 9 years experience in natural area management.

He has supervised an array of habitat restoration and bush regeneration projects throughout the Sydney & Illawarra region including a range of vegetation types their associated plant assemblages. These include; Blue Gum High Forest, Cumberland Plain Woodland, Hawkesbury Sandstone Forest and Heath, Coastal Heath, Littoral Rainforest, Sydney River Flat Forest, Duffy's Forest and Warm Temperate Rainforest. He has also worked on sites with rare, uncommon or endangered species. Notable amongst these are *Eucalyptus camfieldii*, *E. leuhmanniana*, *Darwinia biflora* and *Grevillea caleyi*.

Amongst other things he has prepared; Bushland Plans of Management for Development Applications for various local councils including Warringah, Willoughby and Pittwater; successful proposals for Bush Regeneration projects; annual work plans and reports; site species lists including native and weed species; site plans and weed density maps.

These contracts have involved post-bushfire weeding, the creation of Fire Access Management Zones, large-scale revegetation projects, storm-water remediation, weed spraying and supervision of Bushcare volunteers.

Nathan has been involved with the F3 to Branxton project since he joined Biosis in December 2003.

JENNIFER CHARLTON**CURRICULUM VITAE****POSITION:**

Zoologist, Biosis Research Pty. Ltd.

PROFESSIONAL AFFILIATIONS AND MEMBERSHIPS:

Waterfall Springs Conservation Association, NSW, Australia.

QUALIFICATIONS:

Bachelor of Science in Zoology, University of New South Wales, Sydney.

Other:

Senior First Aid Certificate – St John Ambulance, January 2005.

EMPLOYMENT PROFILE:

2004- Zoologist, Biosis Research Pty. Ltd.
 2003-2004 Technical Officer, Australian Museum Business Services.
 2003-2004 Mammal Keeper Assistant, The Australian Reptile Park, Somersby.
 2003- Records Officer, Waterfall Springs Sanctuary, Kulnura.
 2001-2004 Database Co-ordinator, Wildlife ARC, Central Coast, NSW.

FIELDS OF COMPETENCE:

- ✓ fauna survey (diurnal and nocturnal)
- ✓ mammalian fauna research
- ✓ frog and reptile surveys
- ✓ bird surveys
- ✓ radio-tracking surveys
- ✓ habitat and biodiversity assessment
- ✓ database design and management

PROFESSIONAL EXPERIENCE:

Jennifer has three years experience as a zoologist. A sample of key professional experience is presented below.

Project Manager/Zoologist, Terrestrial flora and fauna assessment for proposed Hamlyn Terrace Primary School, Hamlyn Terrace (2005 for Department of Education and Training).

Zoologist, Terrestrial fauna habitat location for protection and/or relocation of fauna species during road upgrade, Baulkham Hills and Kellyville (2005 for Maunsell Australia Pty. Ltd.).

Zoologist, Terrestrial fauna habitat assessment for conservation significance and land valuation, Eastern Creek (2005 for Minter Ellison Lawyers).

Zoologist, Terrestrial fauna habitat assessment for proposed flood mitigation works, Tarrawanna (2005 for Forbes Rigby Pty. Ltd.).

Zoologist, Terrestrial fauna habitat assessment for proposed temporary boardwalk, The Entrance Rd, Erina (2005 for RTA).

Zoologist, Terrestrial fauna monitoring to assess the potential impacts of subsidence in Dendrobium Area 1, seasonal surveys (2004 and 2005 for BHP Billiton).

Zoologist, Assisted in terrestrial fauna surveys including targeted searches for threatened species for F3 – Raymond Terrace Pacific Highway Upgrade, preliminary constraints overview (2004 for Maunsell Australia).

Technical Officer, Targeted surveys for threatened frog species at Sydney Olympic Park, including the Green and Golden Bell Frog, *Litoria aurea*.

Records Officer, Developed and maintained Access database for Waterfall Springs Sanctuary. Collated captive macropod data to be used for Brush-tailed Rock Wallaby breeding program.

- Mammal Keeper Assistant**, Study of native Australian mammals' behaviour, habitat, dietary requirements, and social interactions for Australian Reptile Park. Includes Koalas, Eastern Grey Kangaroos, Spotted-tail Quolls, Echidnas and Wombats.
- Database Co-ordinator**, Managed Access database of native mammals, birds, reptiles and amphibians for Wildlife ARC, Central Coast, NSW.
- Research Assistant**, Elliot Trapping surveys for Swamp Rats, Eastern Chestnut Mice, New Holland Mice and Brown Antechinus in heath habitat, Myall Lakes National Park, for ACU.
- Research Assistant**, Radio-tracking of collared Swamp Wallabies to map territories, Cowan, NSW.
- Research Assistant**, Biodiversity survey of the Dananbilla/Koorawatha region with NSW NPWS. Surveyed for birds, invertebrates, reptiles, and mammals, including bats.
- Research Assistant**, Radio-tracking of Little Penguins for the Sydney Harbour Little Penguin Project to observe and monitor daily movements.

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- Wilkins S. and **Charlton J.** 2005. Lot 4 DP 262213, Old Wallgrove Road, Eastern Creek: Draft Flora and Fauna Assessment (for Minster Ellison Lawyers).
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- Gorrod E., **Charlton J.** and Wilkins S. 2005. Flora and Fauna Assessment for a Proposed Temporary Boardwalk, The Entrance Rd, Erina (for RTA Central Coast).
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Appendix 2: Vegetation Community Descriptions

Vegetation community descriptions provided below are taken from LHCCREMS (NPWS 2000e).

Alluvial Tall Moist Forest

MU5

Canopy Label: *Eucalyptus saligna*/*Syncarpia glomulifera*/*Glochidion ferdinandi*

No. Sites: 26

Structural Classification (Specht): Tall Open Forest – Open Forest

FIS Classification: Sydney Blue Gum Open Forest

Description: Alluvial Tall Moist Forest occurs in areas of higher rainfall on deep alluvial soils. The tallest stratum in this community ranges between a sparse eucalypt emergent and a tall open forest. Below this is a moderately dense small tree canopy consisting of rainforest species and *Melaleuca* spp. In the Wyong and Ourimbah Creek valleys, the *Melaleuca* component of this small tree canopy is replaced by substantial development of rainforest. Understorey vegetation consists largely of mesic small trees, herbs and ferns. The tree stratum is highly varied with combinations of *Eucalyptus saligna*, *Syncarpia glomulifera*, *Angophora floribunda*, and *Eucalyptus robusta* most common.

In Gosford and Wyong *Eucalyptus pilularis* tends to be the canopy dominant. On the Williams River at Port Stephens and near Minmi at Newcastle *Eucalyptus grandis* replaces *E. saligna*. In drier environment west of Wallsend at Mount Sugarloaf trees may include *Corymbia maculata*, *E. microcorys* and *E. acmenoides*. As alluvial valleys fan outward *E. tereticornis* becomes dominant.

The small tree stratum is typified by *Glochidion ferdinandi*, *Acmena smithii*, *Melaleuca styphelioides*, *Ficus coronata*, *Melaleuca linariifolia*, *Callistemon salignus* and *Backhousia myrtifolia*. The shrub layer is floristically variable but commonly includes species *Breynia oblongifolia*, *Gahnia clarkei* and *Acacia irrorata* ssp. *irrorata*. The understorey in this community also supports a moderately high diversity of climbers and twiners (11 species), the most common being *Geitonoplesium cymosum* and *Dioscorea transversa*. The moderately dense ground layer is comprised of grasses, ferns and herbs such as *Adiantum aethiopicum*, *Pseuderanthemum variabile*, *Entolasia marginata*, *Lomandra longifolia*, *Oplismenus imbecillis* and *Pratia purpurascens*.

Alluvial Tall Moist Forest represents the gradient between well developed rainforest on alluvium and Swamp Mahogany - Paperbark Swamp Forest. Distinguishing between these map units will need to consider the variation in abundance of swamp species and mesic species.

There is no equivalent community described or mapped in the north coast region (NPWS, 1999a). Further analysis may be required to establish relationships between sites north and south of the Hunter River. No known vegetation community profile provides an indication of the characteristic combination of swamp (eg. *Melaleuca* spp. and *Ghania*

spp.) and mesic species which mark this assemblage. One explanation is could be that alluvial valleys remain relatively unsampled on the north coast.

Mean Species richness: 50.3 ± 13.7 (0.04 ha)

Vegetation Structure (n=23)

Stratum	Mean height (m)	Range (m)	Mean cover (%)	(sd)	n
Emergent	30.80	23 - 35	11.40	(12.0)	5
Tallest	25.83	8 - 40	40.00	(16.7)	23
Mid	8.70	0 - 15	36.80	(22.7)	10
Mid 1	13.69	3 - 20	38.08	(17.9)	13
Mid 2	5.15	1 - 10	39.62	(20.8)	13
Mid 3	2.00	1 - 2	20.00		1
Lowest	1.00	0 - 1	55.70	(31.9)	23

Diagnostic plant species

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
Emergents	<i>Eucalyptus saligna</i>	50%	3	3%	3	positive
	<i>Syncarpia glomulifera</i>	38%	3	17%	2	positive
	<i>Eucalyptus grandis</i>	7%	4	0%	0	positive
	<i>Angophora floribunda</i>	26%	1	14%	2	uninformative
	<i>Eucalyptus robusta</i>	23%	3	2%	3	uninformative
	<i>Eucalyptus pilularis</i>	15%	3	4%	3	uninformative
	<i>Eucalyptus tereticornis</i>	11%	3	3%	2	uninformative
	<i>Eucalyptus deanei</i>	7%	3	4%	3	uninformative
	<i>Eucalyptus microcorys</i>	7%	3	1%	3	uninformative
	<i>Eucalyptus piperita</i>	7%	3	10%	3	uninformative
	<i>Eucalyptus acmenoides</i>	7%	2	2%	3	uninformative
	<i>Eucalyptus resinifera</i> ssp. <i>resinifera</i>	7%	2	2%	1	uninformative
	<i>Casuarina glauca</i>	7%	4	2%	3	uninformative
	<i>Corymbia maculata</i>	7%	4	14%	3	uninformative
	<i>Corymbia gummiifera</i>	3%	3	15%	2	uninformative
<i>Eucalyptus acmenoides</i>	3%	3	3%	2	uninformative	
Tallest	<i>Glochidion ferdinandi</i>	76%	2	8%	1	positive
	<i>Acmena smithii</i>	57%	3	5%	2	positive
	<i>Melaleuca styphelioides</i>	50%	3	3%	1	positive
	<i>Ficus coronata</i>	46%	2	2%	1	positive
	<i>Melaleuca linariifolia</i>	42%	2	2%	2	positive
	<i>Backhousia myrtifolia</i>	38%	3	8%	3	positive
	<i>Callistemon salignus</i>	38%	3	1%	1	positive
	<i>Alphitonia excelsa</i>	38%	2	4%	1	positive
	<i>Symplocos stawellii</i>	3%	1	0%	0	positive
	<i>Allocasuarina torulosa</i>	26%	1	19%	2	uninformative
	<i>Melaleuca biconvexa</i>	7%	3	0%	4	uninformative
	<i>Livistona australis</i>	3%	1	3%	1	uninformative
	Lower Mid	<i>Gahnia clarkei</i>	50%	3	4%	2
<i>Gymnostachys anceps</i>		46%	2	5%	1	positive
<i>Breynia oblongifolia</i>		76%	1	24%	1	uninformative
<i>Acacia irrorata</i> ssp. <i>irrorata</i>		65%	1	4%	1	uninformative
Lowest (<1 m)	<i>Adiantum aethiopicum</i>	73%	2	11%	2	positive
	<i>Pseuderanthemum variabile</i>	73%	2	13%	2	positive
	<i>Entolasia marginata</i>	65%	2	15%	1	positive
	<i>Lomandra longifolia</i>	61%	2	31%	1	positive
	<i>Oplismenus imbecillis</i>	61%	2	11%	2	positive
	<i>Pratia purpurascens</i>	61%	2	26%	2	positive
	<i>Oplismenus aemulus</i>	53%	3	7%	2	positive
	<i>Dichondra repens</i>	53%	2	20%	2	positive

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
	<i>Pteridium esculentum</i>	53%	2	27%	2	positive
	<i>Hydrocotyle laxiflora</i>	42%	2	6%	2	positive
	<i>Viola hederacea</i>	42%	2	9%	2	positive
	<i>Doodia aspera</i>	38%	2	9%	2	positive
	<i>Austrosteenisia blackii</i>	3%	1	0%	0	positive
	<i>Sparganium subglobosum</i>	3%	1	0%	0	positive
	<i>Youngia japonica</i>	3%	1	0%	0	positive
	<i>Hypolepis muelleri</i>	30%	3	1%	2	uninformative
	<i>Calochlaena dubia</i>	30%	2	7%	2	uninformative
Vines and Epiphytes	<i>Geitonoplesium cymosum</i>	84%	2	12%	1	positive
	<i>Dioscorea transversa</i>	65%	2	5%	2	positive
	<i>Morinda jasminoides</i>	61%	2	6%	2	positive
	<i>Smilax australis</i>	57%	2	11%	2	positive
	<i>Glycine clandestina</i>	50%	2	25%	2	positive
	<i>Pandorea pandorana</i>	38%	2	21%	1	positive
	<i>Parsonsia straminea</i>	69%	1	8%	1	uninformative
	<i>Stephania japonica</i> var. <i>discolor</i>	61%	1	7%	1	uninformative
	<i>Cissus antarctica</i>	42%	1	7%	1	uninformative
	<i>Eustrephus latifolius</i>	42%	1	19%	1	uninformative
	<i>Sarcopetalum harveyanum</i>	38%	1	5%	1	uninformative

Rare/endangered Species: *Melaleuca biconvexa*, *Syzygium paniculatum*

Central Hunter Riparian Forest

MU13

Canopy Label: *Eucalyptus tereticornis* /*Casuarina glauca*/*Angophora floribunda*

No. Sites: 16

Structural Classification (Specht): Open Forest-Tall Open Forest

FIS Classification: Partly Swamp Oak Open-forest

NOTE: Central Hunter Riparian Forest was included in the final determination of the endangered ecological community River-Flat Eucalypt Forest on Coastal Floodplain in December 2004.

Description: Central Hunter Riparian Forest remains only as small heavily disturbed patches along tributaries of the Hunter Valley. The remaining areas contain some large old trees comprising *Eucalyptus tereticornis*, *Angophora floribunda*, *E. amplifolia*, and *E. camaldulensis* in association with *E. melliodora* and *E. moluccana*.

Casuarina glauca and *Allocasuarina luehmannii* often dominate the canopy on minor streams. A mid strata is generally absent. The ground cover supports a range of grasses and herbs including species such as *Cynodon dactylon*, *Microlaena stipoides* var. *stipoides* and *Commelina cyanea*.

The LHCCREMS Study Area represents the eastern limit of this forest in the Hunter Region. Sites describing this community were located in riparian environments near Ellalong Lagoon near Cessnock. Other sites exist from outside the study area at Singleton Army Base and Greta. Much of it has been heavily depleted across the central to upper Hunter Valley.

No equivalent communities have been described in NPWS (1999a).

Mean Species richness: 34.25 ± 15.2 (0.04 ha)

Vegetation Structure (n=2)

Stratum	Mean upper height (m)	Range (m)	Mean cover (%)	(sd)	n
Tallest	22.5	12 - 25	42.5	(24.7)	2
Mid 1	12	6 - 12	20		1
Mid 2	3	1 - 3	20		1
Lowest	1	0 - 1	52.5	(31.8)	2

Diagnostic plant species

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
Tallest	<i>Casuarina glauca</i>	56%	4	2%	2	positive
	<i>Eucalyptus tereticornis</i>	37%	3	3%	2	positive
	<i>Eucalyptus camaldulensis</i>	6%	4	0%	0	positive
	<i>Angophora floribunda</i>	25%	1	14%	2	uninformative
	<i>Eucalyptus moluccana</i>	18%	1	4%	2	uninformative
	<i>Eucalyptus fibrosa</i>	12%	4	11%	3	uninformative
	<i>Eucalyptus melliodora</i>	12%	3	1%	3	uninformative
	<i>Eucalyptus crebra</i>	12%	2	13%	2	uninformative
	<i>Eucalyptus amplifolia</i> ssp. <i>amplifolia</i>	6%	3	0%	1	uninformative
	<i>Eucalyptus punctata</i>	6%	2	25%	2	uninformative
Mid	<i>Allocasuarina luehmannii</i>	31%	4	1%	1	uninformative
Lowest (<1 m)	<i>Cynodon dactylon</i>	75%	2	2%	2	positive
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	68%	2	22%	2	positive
	<i>Commelina cyanea</i>	56%	2	8%	1	positive
	<i>Aristida vagans</i>	37%	2	12%	2	positive
	<i>Eragrostis leptostachya</i>	37%	2	3%	2	positive
	<i>Paspalidium aversum</i>	37%	2	1%	2	positive
	<i>Amaranthus macrocarpus</i> var. <i>macrocarpus</i>	6%	1	0%	0	positive
	<i>Damasonium minus</i>	6%	1	0%	0	positive
	<i>Goodenia gracilis</i>	6%	1	0%	0	positive
	<i>Linaria pelisseriana</i>	6%	2	0%	0	positive
	<i>Microtis unifolia</i>	6%	1	0%	0	positive
Vines and Epiphytes	<i>Lysiana exocarpi</i> ssp. <i>tenuis</i>	37%	2	0%	1	positive

Rare/endangered Species: *Eucalyptus glauca*

Coastal Foothills Spotted Gum - Ironbark Forest

MU15

Canopy Label: *Corymbia maculata*/*Eucalyptus umbra*/*Eucalyptus siderophloia*

No. Sites: 91

Structural Classification (Specht): Forest – Open Forest

FIS Classification: Seahampton Gully Open Forest

Description: Coastal Foothills Spotted Gum - Ironbark Forest is a moderately tall open forest dominated by *Corymbia maculata* in combination with one or several ironbark

species *E. siderophloia*, *E. paniculata* or *E. fibrosa*. *E. acmenoides*, *E. umbra* and *Syncarpia glomulifera* are common associate trees. Localised abundance of canopy species varies with notable outliers including the codominance of *E. microcorys* on the Mandalong foothills behind Wyong and the dominance of *E. paniculata* and absence of *C. maculata* at Point Woolstoncraft near Lake Macquarie. The upper mid-storey is often composed of an open stratum of *Allocasuarina torulosa*. Depending on recent fire history mesic understorey elements can be present or absent. Typically the shrub layer is open with species such as *Persoonia linearis*, *Polyscias sambucifolius*, *Breynia oblongifolia* and *Daviesia ulicifolia*. In the northern extent around Lake Macquarie *Pultenaea villosa* and *Podolobium ilicifolium* can become more prevalent. In the southern extent around Wyong the shrub layer often contains *Melaleuca nodosa*. The ground cover is dominated by a number of common grasses including *Imperata cylindrica* var. *major*, *Entolasia stricta*, *Themeda australis* and *Microlaena stipoides* var. *stipoides*.

The coastal foothills from Ourimbah to Beresfield represent the length of its range. The crests and slopes of ridgelines on the northern rim of Lake Macquarie extend to coastal locations at Glenrock State Recreational Area. Outcrops of this assemblage also occur near Toronto and on Pulbah Island. At the drier extremes of its range this assemblage merges with Map Unit 17. Examples of such cross overs occur near the northern limit of the Sugarloaf range and on the western extent of the Myall Range at Quorrobolong. It is also floristically and structurally similar to Map Unit 16 Seaham Spotted Gum – Ironbark Forest.

To the north of the region this assemblage aligns to Forest Ecosystem 52: Foothills Grey Gum-Ironbark-Spotted Gum (NPWS, 1999a). Understorey features suggest a close resemblance although canopy species vary with *E. punctata* giving way to *E. propinqua* and *E. umbra* merging to *E. carnea* as the northerly distance from the Hunter River increases.

Mean Species richness: 39.7 ± 6.9 (0.04 ha)

Vegetation Structure (n=1)

Stratum	Mean upper height (m)	Range (m)	Mean cover (%)	(sd)	n
Tallest	20	- 20	60		1
Mid 1	10	- 10	30		1
Mid 2	2	- 2	60		1
Lowest	1	0 - 1	10		1

Diagnostic plant species

Stratum	Species	Within Community		Other Communities		
		Frequency	c/a	Frequency	c/a	Fidelity Class
Tallest	<i>Corymbia maculata</i>	82%	3	12%	2	Positive
	<i>Eucalyptus umbra</i>	65%	2	6%	2	Positive
	<i>Eucalyptus siderophloia</i>	51%	2	3%	1	Positive
	<i>Syncarpia glomulifera</i>	47%	1	17%	1	Uninformative
	<i>Angophora costata</i>	36%	1	22%	2	Uninformative
	<i>Eucalyptus propinqua</i>	33%	2	0%	2	Uninformative
	<i>Eucalyptus acmenoides</i>	31%	2	2%	2	Uninformative

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
	<i>Eucalyptus punctata</i>	31%	1	25%	2	Uninformative
	<i>Eucalyptus fibrosa</i>	18%	1	12%	2	Uninformative
	<i>Eucalyptus microcorys</i>	18%	2	1%	2	Uninformative
	<i>Eucalyptus globoidea</i>	16%	2	2%	1	Uninformative
	<i>Eucalyptus paniculata</i> ssp. <i>paniculata</i>	13%	1	4%	1	Uninformative
Upper Mid	<i>Allocasuarina torulosa</i>	69%	1	19%	1	Uninformative
Mid	<i>Persoonia linearis</i>	64%	1	44%	1	uninformative
	<i>Polyscias sambucifolia</i>	56%	1	15%	1	uninformative
	<i>Breynia oblongifolia</i>	51%	1	24%	1	uninformative
	<i>Daviesia ulicifolia</i>	51%	1	10%	1	uninformative
	<i>Melaleuca nodosa</i>	13%	1	7%	2	uninformative
Lowest (<1 m)	<i>Pratia purpurascens</i>	89%	2	25%	1	positive
	<i>Imperata cylindrica</i> var. <i>major</i>	87%	2	18%	1	positive
	<i>Entolasia stricta</i>	84%	2	41%	2	positive
	<i>Themeda australis</i>	67%	2	26%	2	positive
	<i>Pseuderanthemum variabile</i>	64%	2	13%	1	positive
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	55%	2	22%	1	positive
	<i>Pterostylis baptistii</i>	4%	1	0%	0	positive
	<i>Brachycome graminea</i>	2%	1	0%	0	positive
	<i>Pterostylis furcillata</i>	2%	1	0%	0	positive
	<i>Dianella caerulea</i>	87%	1	43%	1	uninformative
	<i>Vernonia cinerea</i> var. <i>cinerea</i>	71%	1	11%	1	uninformative
	<i>Eustrephus latifolius</i>	60%	1	18%	1	uninformative
	<i>Lomandra longifolia</i>	56%	1	31%	1	uninformative
	<i>Billardiera scandens</i>	55%	1	27%	1	uninformative
	<i>Desmodium rhytidophyllum</i>	55%	1	9%	1	uninformative
	<i>Maytenus silvestris</i>	55%	1	15%	1	uninformative
	<i>Glycine clandestina</i>	67%	1	24%	1	uninformative
Vines and Epiphytes	<i>Hardenbergia violacea</i>	67%	1	26%	1	uninformative

Rare/Endangered Species: *Macrozamia flexuosa*, *Tetratheca juncea*

Lower Hunter Spotted Gum - Ironbark Forest

MU17

Canopy Label: *C. maculata*/*E. fibrosa*/*E. punctata*

No. Sites: 95

Structural Classification (Specht): Woodland-Open Forest

FIS Classification: Spotted Gum/Ironbark Open-forest

Description: Lower Hunter Spotted Gum – Ironbark Forest is widespread throughout the central to lower Hunter Valley. *Corymbia maculata* and *Eucalyptus fibrosa* typically dominate the canopy. In localised areas *Eucalyptus punctata* and/or *E. canaliculata* may occur as a dominant to codominant feature. There is a wide variety of infrequently occurring eucalypts reflecting subtle variations in substrate characteristics. These include the northern limit of *Corymbia eximia*, *Eucalyptus fergusonii* ssp. *fergusonii* and species common to the coastal ranges such as *E. acmenoides*, *E. umbra* and *E. paniculata*. The understorey is marked by prickly shrubs *Daviesia ulicifolia*, *Acacia parvipinnula* and *Melaleuca nodosa*. *Melaleuca nodosa* often forms dense shrub thickets. The ground layer

is very diverse but notable by the frequent occurrence of *Cheilanthes sieberi* ssp. *sieberi*, *Entolasia stricta*, *Pomax umbellata*, *Pratia purpurascens*, *Themeda australis*, *Phyllanthus hirtellus*, and *Dianella revoluta* var. *revoluta*.

Forests between Cessnock and Beresfield form the core of its distribution. At Beresfield this assemblage merges with Map Unit 15 Coastal Foothills Spotted Gum – Ironbark Forest where higher rainfall supports the dominance of the Grey Ironbarks *E. paniculata* and *E. siderophloia* and White Mahoganies *E. acmenoides* and *E. umbra*. A number of outliers of this assemblage can be found on the eastern escarpment of Pokolbin and Corrabare State Forests on Narrabeen Sandstones.

Similar to Map Unit 18 this assemblage is characterised by stands of young regrowth eucalypts from previous timber management activities. Evidence of regular fire disturbance is also apparent across its range.

A similar forest ecosystem in the adjacent northern region is not evident in NPWS (1999a).

Mean Species richness: 40.2 ± 10 (0.04 ha)

Vegetation Structure (n=80)

Stratum	Mean height (m)	Range (m)	Mean cover (%)	(sd)	N
T	21.30	8 - 30	27.63	(6.8)	80
M	4.14	0 - 8	24.39	(19.8)	44
M1	9.31	2 - 20	17.94	(13.4)	36
M2	3.03	0 - 10	22.31	(16.9)	36
L	1.03	0 - 3	38.13	(20.9)	77

Diagnostic plant species

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
Tallest	<i>Corymbia maculata</i>	87%	3	10%	3	positive
	<i>Eucalyptus fibrosa</i>	73%	3	9%	2	positive
	<i>Eucalyptus punctata</i>	36%	2	24%	2	positive
	<i>Eucalyptus crebra</i>	20%	2	13%	2	uninformative
	<i>Eucalyptus moluccana</i>	10%	2	4%	2	uninformative
	<i>Eucalyptus agglomerata</i>	9%	2	3%	2	uninformative
	<i>Eucalyptus umbra</i>	8%	3	7%	3	uninformative
	<i>Corymbia gummifera</i>	8%	2	16%	2	uninformative
	<i>Syncarpia glomulifera</i>	7%	2	18%	2	uninformative
	<i>Eucalyptus globoidea</i>	7%	1	2%	2	uninformative
	<i>Eucalyptus siderophloia</i>	5%	2	4%	2	uninformative
	<i>Eucalyptus paniculata</i> ssp. <i>paniculata</i>	4%	2	3%	2	uninformative
	<i>Eucalyptus sparsifolia</i>	4%	2	14%	2	uninformative
	<i>Angophora costata</i>	4%	1	22%	2	uninformative
	<i>Eucalyptus acmenoides</i>	3%	2	2%	3	uninformative
	<i>Eucalyptus fergusonii</i> ssp. <i>fergusonii</i>	3%	2	0%	3	uninformative
<i>Eucalyptus tereticornis</i>	3%	2	4%	2	uninformative	
<i>Eucalyptus nubila</i>	2%	2	1%	3	uninformative	
<i>Corymbia eximia</i>	2%	1	6%	2	uninformative	
Mid	<i>Daviesia ulicifolia</i>	55%	2	9%	1	positive
	<i>Acacia parvipinnula</i>	46%	2	6%	2	positive
	<i>Melaleuca nodosa</i>	38%	3	6%	3	positive

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
	<i>Oxylobium ellipticum</i>	1%	1	0%	0	positive
	<i>Daviesia leptophylla</i>	1%	1	0%	0	positive
	<i>Persoonia linearis</i>	38%	1	44%	1	uninformative
	<i>Lissanthe strigosa</i>	34%	2	3%	1	uninformative
	<i>Breynia oblongifolia</i>	32%	1	24%	1	uninformative
	<i>Pultenaea cunninghamii</i>	22%	2	2%	2	uninformative
Lowest (<1 m)	<i>Cheilanthes sieberi</i> ssp. <i>sieberi</i>	82%	2	24%	2	positive
	<i>Entolasia stricta</i>	82%	2	40%	2	positive
	<i>Pomax umbellata</i>	73%	2	26%	1	positive
	<i>Pratia purpurascens</i>	67%	2	25%	2	positive
	<i>Dianella revoluta</i> var. <i>revoluta</i>	65%	2	17%	1	positive
	<i>Glycine clandestina</i>	57%	2	23%	2	positive
	<i>Lepidosperma laterale</i>	55%	2	29%	1	positive
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	54%	2	21%	2	positive
	<i>Themeda australis</i>	52%	3	25%	2	positive
	<i>Phyllanthus hirtellus</i>	50%	2	24%	1	positive
	<i>Vernonia cinerea</i> var. <i>cinerea</i>	47%	2	10%	1	positive
	<i>Cymbopogon refractus</i>	42%	2	10%	2	positive
	<i>Aristida lignosa</i>	1%	2	0%	0	positive
	<i>Austrodanthonia induta</i>	1%	1	0%	0	positive
	<i>Calotis cuneata</i> var. <i>cuneata</i>	1%	2	0%	0	positive
	<i>Pterostylis ophioglossa</i>	1%	1	0%	0	positive
	<i>Solanum papaverifolium</i>	1%	2	0%	0	positive
	<i>Sporobolus caroli</i>	1%	1	0%	0	positive

Rare/endangered Species: *Macrozamia flexuosa*, *Persoonia pauciflora*, *Grevillea montana*, *Eucalyptus fergusonii* ssp. *fergusonii*

Hunter Lowland Redgum Forest

MU19

Canopy Label: *Eucalyptus tereticornis*/*Eucalyptus punctata*/*Eucalyptus crebra*/
Angophora floribunda/*Corymbia maculata*

No. Sites: 20

Structural Classification (Specht): Open Forest

FIS Classification: Allandale Open-forest

Description: Hunter Lowland Redgum Forest is an open forest that characterises simple open depressions and drainage flats on the Permian Sediments of the Hunter Valley floor. An array of Eucalypts occurs, with the most frequently recorded being *Eucalyptus tereticornis* and *E. punctata*. It is not uncommon that *Angophora floribunda*, *E. crebra*, *E. moluccana* and *Corymbia maculata* appear where the assemblage grades with the surrounding Spotted Gum-Ironbark Forests. The mid-strata are generally open with sparse shrubs of *Breynia oblongifolia*, *Leucopogon juniperinus*, *Daviesia ulicifolia*, and *Jacksonia scoparia*. More obvious is the consistent layer of grasses and herbs *Microlaena stipoides* var. *stipoides*, *Cymbopogon refractus* and *Echinopogon caespitosus* var. *caespitosus*, *Cheilanthes sieberi* and *Pratia purpurascens*.

Hunter Lowland Redgum Forest extends from Muswellbrook to the Lower Hunter where it appears on gentle slopes arising from depressions. Much of its former extent has been depleted for agricultural activities.

A comparable Forest Ecosystem for the North Coast (1999a) does not easily equate with Hunter Lowland Redgum Forest. Forest Ecosystem 47: Redgum-Apple describes a forest of similar structure and some similarity in shrub and grass species. However canopy species differ and do not reflect the frequency and abundance of those recorded in this Map Unit.

Species richness: 56.35 ± 11.6 (0.04 ha)

Vegetation Structure (n=19)

Stratum	Mean Upper height (m)	Range (m)	Mean cover (%)	(sd)	n
T	24.42	10 - 30	27.11	(7.1)	19
M	5.25	1 - 10	18.75	(6.4)	8
M1	10.45	1 - 15	21.82	(14.0)	11
M2	3.09	0 - 5	28.64	(19.9)	11
L	0.95	0 - 1	59.44	(30.0)	18

Diagnostic plant species (n=20)

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
Tallest	<i>Eucalyptus tereticornis</i>	60%	3	3%	2	positive
	<i>Eucalyptus punctata</i>	55%	2	25%	2	positive
	<i>Eucalyptus crebra</i>	50%	3	13%	2	positive
	<i>Angophora floribunda</i>	45%	3	14%	2	positive
	<i>Corymbia maculata</i>	40%	3	13%	3	positive
	<i>Eucalyptus moluccana</i>	20%	3	4%	2	uninformative
	<i>Eucalyptus eugenioides</i>	20%	1	1%	2	uninformative
	<i>Eucalyptus globoidea</i>	15%	3	2%	2	uninformative
	<i>Eucalyptus fibrosa</i>	15%	1	11%	3	uninformative
	<i>Eucalyptus pilularis</i>	10%	3	4%	3	uninformative
	<i>Eucalyptus paniculata</i> ssp. <i>paniculata</i>	10%	2	3%	2	uninformative
	<i>Angophora costata</i>	5%	3	22%	2	uninformative
	<i>Eucalyptus acmenoides</i>	5%	3	2%	3	uninformative
	<i>Eucalyptus amplifolia</i> ssp. <i>amplifolia</i>	5%	3	0%	1	uninformative
<i>Eucalyptus umbra</i>	5%	3	7%	3	uninformative	
<i>Syncarpia glomulifera</i>	5%	3	17%	2	uninformative	
Mid	<i>Breynia oblongifolia</i>	65%	2	24%	1	positive
	<i>Leucopogon juniperinus</i>	60%	2	4%	1	positive
	<i>Daviesia ulicifolia</i>	45%	2	11%	1	positive
	<i>Persoonia linearis</i>	40%	2	44%	1	positive
	<i>Jacksonia scoparia</i>	35%	2	5%	2	positive
Lowest (<1 m)	<i>Cheilanthes sieberi</i> ssp. <i>sieberi</i>	100%	2	25%	2	positive
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	100%	2	22%	2	positive
	<i>Pratia purpurascens</i>	95%	2	26%	2	positive
	<i>Cymbopogon refractus</i>	80%	2	11%	2	positive
	<i>Lomandra multiflora</i> ssp. <i>multiflora</i>	75%	2	21%	1	positive
	<i>Pomax umbellata</i>	70%	2	28%	1	positive
	<i>Dichondra repens</i>	65%	2	20%	2	positive
	<i>Vernonia cinerea</i> var. <i>cinerea</i>	65%	2	11%	1	positive
	<i>Brunoniella australis</i>	60%	2	7%	2	positive
	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	60%	2	7%	2	positive
	<i>Lagenifera stipitata</i>	55%	2	9%	1	positive
	<i>Desmodium varians</i>	50%	2	19%	2	positive
	<i>Eragrostis leptostachya</i>	50%	2	2%	2	positive
	<i>Imperata cylindrica</i> var. <i>major</i>	50%	3	19%	2	positive

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
	<i>Panicum simile</i>	50%	2	14%	2	positive
	<i>Solanum prinophyllum</i>	50%	2	6%	1	positive
	<i>Themeda australis</i>	50%	2	26%	2	positive
	<i>Digitaria parviflora</i>	45%	2	6%	1	positive
	<i>Entolasia stricta</i>	45%	2	42%	2	positive
	<i>Billardiera scandens</i>	40%	2	27%	1	positive
	<i>Lomandra longifolia</i>	40%	2	31%	1	positive
	<i>Eragrostis brownii</i>	35%	2	7%	2	positive
	<i>Paspalidium distans</i>	35%	2	5%	2	positive
	<i>Austrodanthonia monticola</i>	5%	2	0%	0	positive
	<i>Glycine clandestina</i>	80%	2	24%	2	positive

Rare/endangered Species: none

Coastal Plains Smooth-barked Apple Woodland

MU30

Canopy Label: *Angophora costata*/*Corymbia gummifera*/*Eucalyptus capitellata*/
Eucalyptus umbra

No. Sites: 94

Structural Classification (Specht): Woodland -Open Forest

FIS Classification: Ridgetop Woodland

Description: Coastal Plains Smooth-barked Apple Woodland is a dry shrubby forest occurring along the coastal plain south from the Wyong Region to Medowie near Port Stephens in the north. *Angophora costata* and *Corymbia gummifera* consistently occur as dominant canopy species usually to height of between 20-25 metres. In some areas *Eucalyptus umbra* and *E. capitellata* will be dominant or co-dominant. Other noticeable variations in canopy species include the presence of *E. piperata* and *E. globoidea* in Medowie State Forest and the occasional occurrence of *C. maculata* near Wallsend to the north west of Lake Macquarie. The dry shrubby mid-story is characterised by the occurrence of *Allocasuarina littoralis*, *Banksia spinulosa* and *Acacia myrtifolia*. These features often become well developed where the forest canopy is more open. Less commonly found in the mid-story are *Leptospermum polygalifolium*, *Dodonaea triquetra*, *Lambertia formosa* and *Dillwynia retorta*. The ground layer is dominated by grasses such as *Entolasia stricta* and *Themeda australis*. Other common species found among the lower stratum are *Lomandra obliqua*, *Pteridium esculentum*, *Phyllanthus hirtellus*, *Imperata cylindrica* var. *major* and *Lepidosperma laterale*.

This community is distributed across a range of sedimentary geologies from the Narrabeen Group, Permian Coal Measures and Medowie sediments on low to undulating topography. Soil landscapes of Doyalson, Awaba and Medowie support typical examples of this assemblage. Evidence of frequent and/or recent fire events are apparent across its distribution in the region, as are the impacts of urban expansion.

This assemblage often merges with Map Unit 31: Coastal Plains Scribbly Gum Woodland. Floristically the map units are similar, particularly as *E. haemastoma* and *E. racemosa* occur in both. Many of the shrub species occur in both groups although the

conspicuous *Banksia oblongifolia* replaces *B. spinulosa* in Map Unit 31. However, structurally Map Unit 31 tends toward an open woodland rather than forest.

Corresponding vegetation assemblages in the adjacent northern region are not well defined. Sites describing this assemblage fall within areas mapped as Forest Ecosystem 105: Smooth-barked Apple (NPWS, 1999a) at Medowie State Forest. Source mapping for this area originates from SFNSW (*anon*) where Forest Type 105: Smooth-barked Apple has been used to describe large areas of dry coastal forests. Broad similarities with groups of eucalypts (Stringybarks, Red Bloodwoods and White Mahoganies) are apparent although no species-specific information is available.

Mean Species richness: 46.7 ± 8.9 (0.04 ha)

Vegetation Structure (n=50)

Stratum	Mean Upper height (m)	Range (m)	Mean cover (%)	(sd)	n
Tallest	20.52	7 - 25	32.90	(10.0)	50
Mid	4.60	1 - 10	28.87	(26.0)	15
Mid 1	7.52	2 - 15	16.15	(10.4)	33
Mid 2	2.55	0 - 6	37.00	(21.7)	33
Lowest	1	0 - 2	70.40	(21.5)	50

Diagnostic plant species

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
Tallest	<i>Angophora costata</i>	92%	3	18%	2	positive
	<i>Corymbia gummifera</i>	82%	3	12%	2	positive
	<i>Eucalyptus capitellata</i>	46%	3	2%	2	positive
	<i>Eucalyptus umbra</i>	41%	3	6%	3	positive
	<i>Eucalyptus piperita</i>	25%	2	9%	3	uninformative
	<i>Eucalyptus racemosa</i>	20%	3	1%	3	uninformative
	<i>Eucalyptus haemastoma</i>	18%	2	4%	3	uninformative
	<i>Eucalyptus punctata</i>	15%	2	25%	2	uninformative
	<i>Eucalyptus resinifera</i> ssp. <i>resinifera</i>	15%	2	1%	1	uninformative
	<i>Corymbia maculata</i>	14%	3	14%	3	uninformative
	<i>Syncarpia glomulifera</i>	13%	2	17%	2	uninformative
Upper Mid	<i>Allocasuarina littoralis</i>	57%	2	8%	1	positive
	<i>Banksia spinulosa</i>	57%	2	9%	2	positive
	<i>Acacia myrtifolia</i>	54%	2	4%	1	positive
	<i>Leptospermum polygalifolium</i>	44%	2	8%	2	positive
	<i>Dodonaea triquetra</i>	43%	2	11%	1	positive
	<i>Lambertia formosa</i>	39%	2	8%	2	positive
	<i>Dillwynia retorta</i>	39%	2	8%	2	positive
	<i>Gompholobium latifolium</i>	38%	2	8%	1	positive
	<i>Xanthorrhoea latifolia</i> ssp. <i>latifolia</i>	37%	2	3%	2	positive
	<i>Pultenaea paleacea</i>	35%	2	1%	2	positive
	<i>Melaleuca nodosa</i>	10%	2	7%	3	uninformative
Lowest (<1 m)	<i>Entolasia stricta</i>	97%	3	39%	2	positive
	<i>Themeda australis</i>	90%	3	24%	2	positive
	<i>Lomandra obliqua</i>	72%	2	14%	2	positive
	<i>Pteridium esculentum</i>	68%	2	25%	2	positive
	<i>Imperata cylindrica</i> var. <i>major</i>	62%	2	17%	2	positive
	<i>Phyllanthus hirtellus</i>	62%	2	24%	1	positive
	<i>Lepidosperma laterale</i>	59%	2	28%	1	positive
	<i>Pimelea linifolia</i>	58%	2	15%	1	positive
	<i>Panicum simile</i>	48%	2	13%	2	positive

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
	<i>Pratia purpurascens</i>	38%	2	26%	2	positive
	<i>Pseuderanthemum variabile</i>	38%	2	13%	2	positive
	<i>Epacris pulchella</i>	36%	2	8%	2	positive
	<i>Gonocarpus tetragynus</i>	36%	2	7%	2	positive
	<i>Aristida vagans</i>	35%	2	12%	2	positive
	<i>Mirbelia rubiifolia</i>	35%	2	4%	2	positive

Rare/Endangered Species : *Tetratea juncea*, *Macrozamia flexuosa* and *Angophora inopina*

Kurri Sand Swamp Woodland

MU35

Canopy Label: *Eucalyptus parramattensis ssp. decadens*/ *Angophora bakeri* /*Melaleuca nodosa*

No. Sites: 12

Structural Classification (Specht): Woodland

FIS Classification: Beresfield Open Forest and Kurri Kurri Open Scrub

Description: Kurri Sand Swamp Woodland occurs on poorly drained Tertiary sand deposits that blanket Permian sediments around Kurri Kurri. The canopy is generally low and open rarely exceeding 15 metres in height and comprises *Eucalyptus parramattensis ssp. decadens*, with *Angophora bakeri* and occasionally *Eucalyptus signata* and *Eucalyptus sparsifolia*. Below this woodland canopy is a distinctive shrubby mid-storey which merges into a low heath shrub ground layer. The mid-storey is typified by *Melaleuca nodosa*, *Banksia spinulosa*, *Jacksonia scoparia*, *Hakea dactyloides*, *Acacia ulicifolia* and *Lambertia formosa*. The ground layer is comprised of grasses and shrubs such as *Entolasia stricta*, *Pimelea linifolia*, *Dillwynia retorta*, *Lissanthe strigosa* and *Melaleuca thymifolia*.

Kurri Sand Swamp Woodland extends from Cessnock in poorly drained deposits as pockets within broader Permian Sediments east to the Kurri Kurri-Tomalpin area. Floristically this assemblage is closely related to Map Unit 36: Tomago Sand Swamp Woodland, however moist sedges characterise this assemblage. Elsewhere, similar species assemblages occur on Tertiary sands at Mellong Swamps and Agnes Banks (near Penrith), however a different subspecies of *E. parramattensis* occurs and a different suite of *Melaleuca* spp. are present.

The distinctive soils underlying this community make it readily distinguishable. However mapping of this community has been difficult, as not all sand deposits have been marked on the available soil landscape maps for the region. Both its former and current estimations of distribution are likely to be underestimated.

Mean Species richness: 37 ± 13.2 (0.04 ha)

Vegetation Structure (n=12)

Stratum	Mean Upper height (m)	Range (m)	Mean cover (%)	(sd)	n
Tallest	14.75	4- 25	20.83	(8.2)	12

Mid	2.71	1 - 4	38.57	(19.5)	7
Mid 1	9.75	2 - 15	31.25	(23.9)	4
Mid 2	3.25	1 - 6	52.50	(34.3)	4
Lowest	1.17	0 - 3	35.00	(26.0)	12

Diagnostic plant species

Stratum	Species	Within Community		Other Communities		Fidelity Class
		Frequency	c/a	Frequency	c/a	
Tallest	<i>Eucalyptus parramattensis</i> ssp. <i>decadens</i>	75%	2	0%	5	positive
	<i>Angophora bakeri</i>	58%	3	4%	2	positive
	<i>Eucalyptus agglomerata</i>	50%	1	3%	2	uninformative
	<i>Eucalyptus fibrosa</i>	33%	1	11%	3	uninformative
	<i>Eucalyptus signata</i>	16%	3	1%	3	uninformative
	<i>Eucalyptus sparsifolia</i>	16%	3	13%	2	uninformative
Mid	<i>Melaleuca nodosa</i>	100%	3	6%	3	positive
	<i>Banksia spinulosa</i>	83%	2	11%	2	positive
	<i>Jacksonia scoparia</i>	66%	2	5%	2	positive
	<i>Hakea dactyloides</i>	58%	2	12%	1	positive
	<i>Acacia ulicifolia</i>	50%	2	16%	1	positive
	<i>Lambertia formosa</i>	50%	2	9%	2	positive
	<i>Melaleuca decora</i>	41%	2	1%	2	positive
	<i>Grevillea linearifolia</i>	41%	2	1%	2	positive
	<i>Persoonia linearis</i>	50%	1	43%	1	uninformative
Lowest (<1 m)	<i>Entolasia stricta</i>	91%	2	42%	2	positive
	<i>Dillwynia retorta</i>	58%	2	9%	2	positive
	<i>Lissanthe strigosa</i>	58%	2	4%	2	positive
	<i>Melaleuca thymifolia</i>	58%	2	2%	2	positive
	<i>Pimelea linifolia</i>	91%	1	17%	1	uninformative
	<i>Dianella revoluta</i> var. <i>revoluta</i>	66%	1	19%	1	uninformative
	<i>Phebalium squamulosum</i>	58%	1	4%	2	uninformative
	<i>Macrozamia flexuosa</i>	33%	2	1%	1	uninformative

Rare/endangered Species : *Macrozamia flexuosa*, *Eucalyptus parramattensis* ssp. *decadens*

Appendix 3: Flora Recorded Within the Vicinity of the F3 to Branxton Link

Flora species recorded in the vicinity of the proposed Link during the compensatory habitat surveys (Bali and Predavec 2003).

Family	Species	Common Name
Ferns and Fern-like Plants		
Adiantaceae		
	<i>Adiantum aethiopicum</i>	Common Maidenhair
	<i>Adiantum hispidulum</i> var. <i>hispidulum</i>	Rough Maidenhair
	<i>Cheilanthes sieberi</i> ssp. <i>sieberi</i>	Narrow Rock-fern
Blechnaceae		
	<i>Blechnum cartilagineum</i>	Gristle Fern
	<i>Doodia aspera</i>	Prickly Rasp Fern
Dennstaedtiaceae		
	<i>Pteridium esculentum</i>	Bracken
Dicksoniaceae		
	<i>Calochlaena dubia</i>	Common Ground Fern
Lindsaeaceae		
	<i>Lindsaea microphylla</i>	Lacy Wedge Fern
Zamiaceae		
	<i>Macrozamia communis</i>	Macrozamia 6252
	<i>Macrozamia flexuosa</i>	Macrozamia 6257 (E)
Monocotyledons		
Anthericaceae		
	<i>Caesia parviflora</i> var. <i>parviflora</i>	Pale Grass-lily
	<i>Caesia parviflora</i> var. <i>vittata</i>	Pale Grass-lily
	<i>Caesia</i> spp.	Caesia 9154
	<i>Laxmannia gracilis</i>	Slender Wire-lily
	<i>Thysanotus tuberosus</i> ssp. <i>tuberosus</i>	Common Fringe-lily
	<i>Tricoryne elatior</i>	Yellow Autumn-lily
Araceae		
	<i>Gymnostachys anceps</i>	Settler's Flax
Asteliaceae		
	<i>Cordyline stricta</i>	Narrow-leaved Palm Lily
Colchicaceae		
	<i>Burchardia umbellata</i>	Milkmaids
Commelinaceae		
	<i>Commelina cyanea</i>	Native Wandering Jew
	<i>Tradescantia albiflora</i>	Wandering Jew
Cyperaceae		
	<i>Carex appressa</i>	Tall Sedge
	<i>Cyperus polystachyos</i>	Bunchy Flat-sedge
	<i>Eleocharis pusilla</i>	Small Spike-sedge
	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge
	<i>Gahnia clarkei</i>	Tall Saw-sedge
	<i>Gahnia melanocarpa</i>	Black-fruit Saw-sedge
	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge
	<i>Gahnia</i> spp.	Gahnia 9391
	<i>Lepidosperma gunnii</i>	Slender Sword-sedge
	<i>Lepidosperma laterale</i>	Variable Sword-sedge
	<i>Lepidosperma neesii</i>	Stiff Rapier-sedge
	<i>Ptilothrix deusta</i>	Ptilothrix 7203
	<i>Schoenus brevifolius</i>	Zig-zag Bog-sedge
Dioscoreaceae		
	<i>Dioscorea transversa</i>	Native Yam
Doryanthaceae		
	<i>Doryanthes excelsa</i>	Gynea/Giant Lily
Haemodoraceae		
	<i>Haemodorum planifolium</i>	Haemodorum 5632
Iridaceae		
	<i>Patersonia glabrata</i>	Leafy Purple-flag
Juncaceae		
	<i>Juncus subsecundus</i>	Finger Rush
	<i>Juncus usitatus</i>	Billabong Rush
Lomandraceae		

Family	Species	Common Name
	<i>Lomandra brevis</i>	Lomandra 6180
	<i>Lomandra confertifolia</i> ssp. <i>rubiginosa</i>	Lomandra 6182
	<i>Lomandra cylindrica</i>	Needle Mat-rush
	<i>Lomandra filiformis</i> ssp. <i>coriacea</i>	Wattle Mat-rush
	<i>Lomandra filiformis</i> ssp. <i>filiformis</i>	Wattle Mat-rush
	<i>Lomandra glauca</i>	Pale Mat-rush
	<i>Lomandra gracilis</i>	Lomandra 6187
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
	<i>Lomandra multiflora</i> ssp. <i>multiflora</i>	Many-flowered Mat-rush
	<i>Lomandra obliqua</i>	Lomandra 6192
	<i>Lomandra</i> spp.	Lomandra 9548
Luzuriagaceae		
	<i>Eustrephus latifolius</i>	Wombat Berry
	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Orchidaceae		
	<i>Dipodium variegatum</i>	Blotched Hyacinth-orchid
	<i>Thelymitra ixioides</i> var. <i>ixioides</i>	Dotted Sun Orchid
	<i>Thelymitra</i> spp.	Thelymitra 9876
Phormiaceae		
	<i>Dianella caerulea</i> var. <i>caerulea</i>	Paroo Lily
	<i>Dianella caerulea</i> var. <i>producta</i>	Dianella 4398
	<i>Dianella revoluta</i> var. <i>revoluta</i>	Dianella 4408
	<i>Stypandra glauca</i>	Nodding Blue Lily
Poaceae		
	<i>Andropogon virginicus</i>	Whisky Grass
	<i>Anisopogon avenaceus</i>	Oat Speargrass
	<i>Aristida ramosa</i> var. <i>ramosa</i>	Aristida 1578
	<i>Aristida vagans</i>	Threeawn Speargrass
	<i>Aristida warburgii</i>	Aristida 1592
	<i>Austrodanthonia fulva</i>	Copper-awned Wallaby-grass
	<i>Austrodanthonia induta</i>	Shiny Wallaby-grass
	<i>Austrodanthonia tenuior</i>	Purplish Wallaby-grass
	<i>Austrostipa pubescens</i>	Austrostipa 2069
	<i>Cymbopogon refractus</i>	Barbed Wire Grass
	<i>Cynodon dactylon</i>	Common Couch
	<i>Dichelachne crinita</i>	Longhair Plumegrass
	<i>Dichelachne</i> spp.	Dichelachne 9309
	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass
	<i>Entolasia stricta</i>	Wiry Panic
	<i>Eragrostis brownii</i>	Brown's Lovegrass
	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
	<i>Oplismenus aemulus</i>	Oplismenus 6579
	<i>Panicum decompositum</i>	Native Millet
	<i>Panicum simile</i>	Two-colour Panic
	<i>Poa labillardierei</i> var. <i>labillardierei</i>	Tussock
	<i>Poa</i> spp.	Poa 9718
	<i>Themeda australis</i>	Kangaroo Grass
Restionaceae		
	<i>Leptocarpus tenax</i>	Slender Twine-rush
Smilacaceae		
	<i>Smilax australis</i>	Sarsaparilla
	<i>Smilax glycyphylla</i>	Sweet Sarsaparilla
Xanthorrhoeaceae		
	<i>Xanthorrhoea fulva</i>	Xanthorrhoea 8070
	<i>Xanthorrhoea latifolia</i> ssp. <i>latifolia</i>	Xanthorrhoea 8074
	<i>Xanthorrhoea macronema</i>	Xanthorrhoea 8076
	<i>Xanthorrhoea resinifera</i>	Xanthorrhoea 8080
	<i>Xanthorrhoea</i> spp.	Xanthorrhoea 9928
Dicotyledons		
Acanthaceae		
	<i>Brunoniella australis</i>	Blue Trumpet
	<i>Brunoniella pumilio</i>	Dwarf Blue Trumpet
Apiaceae		

Family	Species	Common Name
	<i>Hydrocotyle geraniifolia</i>	Forest Pennywort
	<i>Hydrocotyle verticillata</i>	Shield Pennywort
Araliaceae		
	<i>Polyscias sambucifolia</i>	Elderberry Panax
Asteraceae		
	<i>Ageratina adenophora</i>	Crofton Weed
	<i>Brachyscome multifida</i> var. <i>multifida</i>	Cut-leaf Daisy
	<i>Bracteantha viscosa</i>	Sticky Everlasting
	<i>Calotis lappulacea</i>	Yellow Burr-daisy
	<i>Cassinia uncata</i>	Sticky Cassinia
	<i>Chrysocephalum apiculatum</i>	Common Everlasting
	<i>Cirsium vulgare</i>	Spear Thistle
	<i>Olearia microphylla</i>	Olearia 6556
	<i>Onopordum acanthium</i>	Onopordum 6575
	<i>Ozothamnus diosmifolius</i>	White Dogwood
	<i>Pseudognaphalium luteo-album</i>	Jersey Cudweed
	<i>Senecio</i> spp.	Senecio 9815
	<i>Taraxacum officinale</i>	Dandelion
	<i>Vernonia cinerea</i> var. <i>cinerea</i>	Vernonia 7975
Bignoniaceae		
	<i>Pandorea pandorana</i> ssp. <i>pandorana</i>	Pandorea 6647
Cactaceae		
	<i>Opuntia stricta</i>	Opuntia 6589
Campanulaceae		
	<i>Wahlenbergia gracilis</i>	Sprawling or Australian Bluebell
Casuarinaceae		
	<i>Allocasuarina littoralis</i>	Black Sheoak
	<i>Allocasuarina luehmannii</i>	Bulloak
	<i>Allocasuarina torulosa</i>	Forest Oak
Celastraceae		
	<i>Maytenus silvestris</i>	Narrow-leaved Orangebark
Convolvulaceae		
	<i>Dichondra repens</i>	Kidney Weed
Cunoniaceae		
	<i>Schizomeria ovata</i>	Crabapple
Dilleniaceae		
	<i>Hibbertia aspera</i> ssp. <i>aspera</i>	Hibbertia 5731
	<i>Hibbertia diffusa</i>	Wedge Guinea-flower
	<i>Hibbertia pedunculata</i>	Stalked Guinea-flower
	<i>Hibbertia scandens</i>	Climbing Guinea Flower
	<i>Hibbertia</i> spp.	Hibbertia 9452
Epacridaceae		
	<i>Astroloma humifusum</i>	Native Cranberry
	<i>Epacris pulchella</i>	Epacris 4788
	<i>Leucopogon juniperinus</i>	Long-flower Beard-heath
	<i>Leucopogon lanceolatus</i> var. <i>lanceolatus</i>	Lance Beard-heath
	<i>Lissanthe strigosa</i> ssp. <i>strigosa</i>	Lissanthe 6168
	<i>Monotoca scoparia</i>	Prickly Broom-heath
	<i>Monotoca</i> spp.	Monotoca 9610
	<i>Styphelia triflora</i>	Styphelia 7732
	<i>Trochocarpa laurina</i>	Tree Heath
Euphorbiaceae		
	<i>Breynia oblongifolia</i>	Coffee Bush
	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	Cheese Tree
	<i>Micrantheum</i> spp.	Micrantheum 9593
	<i>Phyllanthus hirtellus</i>	Thyme Spurge
	<i>Poranthera ericifolia</i>	Poranthera 7060
Fabaceae (Mimosoideae)		
	<i>Acacia brownii</i>	Heath Wattle
	<i>Acacia elongata</i>	Swamp Wattle
	<i>Acacia falcata</i>	Acacia 0365
	<i>Acacia irrorata</i>	Green Wattle

Family	Species	Common Name
	<i>Acacia linearifolia</i>	Narrow-leaved Wattle
	<i>Acacia longifolia</i>	Coast/Sallow Wattle
	<i>Acacia myrtifolia</i>	Red-stemmed Wattle
	<i>Acacia parvipinnula</i>	Silver-stemmed Wattle
	<i>Acacia prominens</i>	Gosford Wattle
	<i>Acacia</i> spp.	Acacia 9003
	<i>Acacia stricta</i>	Straight Wattle
	<i>Acacia ulicifolia</i>	Prickly Moses
Fabaceae (Faboideae)		
	<i>Aotus ericoides</i>	Common Aotus
	<i>Bossiaea obcordata</i>	Spiny Bossiaea
	<i>Bossiaea rhombifolia</i> ssp. <i>concolor</i>	Bossiaea 2602
	<i>Bossiaea rhombifolia</i> ssp. <i>rhombifolia</i>	Bossiaea 2609
	<i>Daviesia corymbosa</i>	Daviesia 4270
	<i>Daviesia</i> spp.	Daviesia 9297
	<i>Daviesia squarrosa</i>	Daviesia 4275
	<i>Daviesia ulicifolia</i> ssp. <i>ulicifolia</i>	Gorse Bitter-pea
	<i>Desmodium gunnii</i>	Southern Tick-trefoil
	<i>Desmodium rhytidophyllum</i>	Desmodium 4369
	<i>Desmodium varians</i>	Slender Tick-trefoil
	<i>Dillwynia glaberrima</i>	Smooth Parrot-pea
	<i>Dillwynia retorta</i> (J.C.Wendl.) Druce species complex	Dillwynia 4481
	<i>Glycine clandestina</i>	Twining Glycine
	<i>Glycine microphylla</i>	Small-leaf Glycine
	<i>Glycine tabacina</i>	Variable Glycine
	<i>Gompholobium grandiflorum</i>	Large Wedge Pea
	<i>Gompholobium minus</i>	Dwarf Wedge Pea
	<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
	<i>Hardenbergia violacea</i>	False Sarsaparilla
	<i>Hovea linearis</i>	Hovea 5811
	<i>Jacksonia scoparia</i>	Dogwood
	<i>Kennedia rubicunda</i>	Red Kennedy Pea
	<i>Mirbelia rubiifolia</i>	Heathy Mirbelia
	<i>Podolobium ilicifolium</i>	Prickly Shaggy Pea
	<i>Pultenaea cunninghamii</i>	Pultenaea 7229
	<i>Pultenaea paleacea</i>	Chaffy Bush-pea
	<i>Pultenaea retusa</i>	Blunt Bush-pea
	<i>Pultenaea spinosa</i>	Grey Bush-pea
	<i>Pultenaea villosa</i>	Pultenaea 7262
	<i>Vicia sativa</i>	Common Vetch
Geraniaceae		
	<i>Geranium homeanum</i>	Northern Cranesbill
Goodeniaceae		
	<i>Goodenia bellidifolia</i> ssp. <i>bellidifolia</i>	Daisy Goodenia
	<i>Goodenia hederacea</i> ssp. <i>hederacea</i>	Ivy Goodenia
	<i>Goodenia heterophylla</i> ssp. <i>heterophylla</i>	Variable Goodenia
	<i>Scaevola ramosissima</i>	Hairy Fan-flower
Haloragaceae		
	<i>Gonocarpus tetragynus</i>	Common Raspwort
Lamiaceae		
	<i>Prostanthera incana</i>	Velvet Mint-bush
Lauraceae		
	<i>Cassytha glabella</i> f. <i>dispar</i>	Slender Dodder-laurel
	<i>Cassytha glabella</i> f. <i>glabella</i>	Slender Dodder-laurel
	<i>Cassytha pubescens</i>	Cassytha 3559
Lobeliaceae		
	<i>Pratia purpurascens</i>	Whiteroot
Loranthaceae		
	<i>Dendrophthoe vitellina</i>	Long-flower Mistletoe
Malvaceae		
	<i>Hibiscus heterophyllus</i> ssp. <i>heterophyllus</i>	Native Rosella

Family	Species	Common Name
	<i>Sida rhombifolia</i>	Paddy's Lucerne
Menispermaceae		
	<i>Sarcopetalum harveyanum</i>	Pearl Vine
	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
Myrtaceae		
	<i>Acmena smithii</i>	Lilly Pilly
	<i>Angophora bakeri</i>	Narrow-leaved Apple
	<i>Angophora costata</i>	Sydney Red/Rusty Gum
	<i>Baeckea diosmifolia</i>	Baeckea 2182
	<i>Callistemon linearis</i>	Narrow-leaved Bottlebrush
	<i>Callistemon salignus</i>	Willow Bottlebrush
	<i>Callistemon sieberi</i>	River Bottlebrush
	<i>Corymbia gummifera</i>	Red Bloodwood
	<i>Corymbia maculata</i>	Spotted Gum
	<i>Eucalyptus acmenoides</i>	White Mahogany
	<i>Eucalyptus capitellata</i>	Brown Stringybark
	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark
	<i>Eucalyptus fibrosa</i>	Red Ironbark
	<i>Eucalyptus globoidea</i>	White Stringybark
	<i>Eucalyptus moluccana</i>	Grey Box
	<i>Eucalyptus parramattensis</i> ssp. <i>decadens</i>	Eucalyptus 5106 (V)
	<i>Eucalyptus punctata</i>	Grey Gum
	<i>Eucalyptus resinifera</i> ssp. <i>resinifera</i>	Eucalyptus 5148
	<i>Eucalyptus saligna</i>	Sydney Blue Gum
	<i>Eucalyptus siderophloia</i>	Grey Ironbark
	<i>Eucalyptus sparsifolia</i>	Narrow-leaved Stringybark
	<i>Eucalyptus</i> spp.	Eucalyptus 9373
	<i>Eucalyptus tereticornis</i>	Forest Red Gum
	<i>Eucalyptus umbra</i>	Eucalyptus 5194
	<i>Kunzea ambigua</i>	Tick Bush
	<i>Leptospermum parvifolium</i>	Leptospermum 6098
	<i>Leptospermum polygalifolium</i> ssp. <i>polygalifolium</i>	Leptospermum 6105
	<i>Leptospermum trinervium</i>	Paperbark Tea-tree
	<i>Melaleuca decora</i>	Melaleuca 6332
	<i>Melaleuca linariifolia</i>	Melaleuca 6341
	<i>Melaleuca nodosa</i>	Melaleuca 6342
	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree
	<i>Melaleuca thymifolia</i>	Melaleuca 6345
	<i>Rhodamnia rubescens</i>	Scrub Turpentine
	<i>Syncarpia glomulifera</i> ssp. <i>glomulifera</i>	Syncarpia 7765
	<i>Synoum glandulosum</i> ssp. <i>glandulosum</i>	Synoum 7766
	<i>Syzygium</i> spp.	Syzygium 9862
Oleaceae		
	<i>Notelaea longifolia</i>	Large Mock-olive
	<i>Notelaea ovata</i>	Notelaea 6499
	<i>Olea europaea</i>	Common Olive
Oxalidaceae		
	<i>Oxalis</i> spp.	Oxalis 9662
Pittosporaceae		
	<i>Billardiera scandens</i> var. <i>scandens</i>	Common Apple-berry
	<i>Bursaria spinosa</i> ssp. <i>spinosa</i>	Sweet Bursaria
	<i>Pittosporum revolutum</i>	Rough Fruit Pittosporum
	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Plantaginaceae		
	<i>Plantago lanceolata</i>	Lamb's Tongues
Polygalaceae		
	<i>Comesperma defoliatum</i>	Leafless Milkwort
Polygonaceae		
	<i>Rumex crispus</i>	Curled Dock
Proteaceae		
	<i>Banksia oblongifolia</i>	Banksia 2269

Family	Species	Common Name
	<i>Banksia spinulosa</i> var. <i>collina</i>	Banksia 2285
	<i>Banksia spinulosa</i> var. <i>spinulosa</i>	Banksia 2295
	<i>Grevillea linearifolia</i>	Small-flower Grevillea
	<i>Grevillea montana</i>	Grevillea 5572
	<i>Grevillea mucronulata</i>	Grevillea 5573
	<i>Grevillea parviflora</i> ssp. <i>parviflora</i>	Grevillea 5583 (V)
	<i>Grevillea sericea</i> ssp. <i>sericea</i>	Grevillea 5596
	<i>Hakea dactyloides</i>	Finger Hakea
	<i>Hakea gibbosa</i>	Downy Hakea
	<i>Hakea sericea</i>	Bushy Needlewood
	<i>Isopogon anemonifolius</i>	Isopogon 5906
	<i>Lambertia formosa</i>	Mountain Devil
	<i>Lomatia silaifolia</i>	Crinkle Bush
	<i>Persoonia levis</i>	Broad-leaved Geebung
	<i>Persoonia linearis</i>	Narrow-leaved Geebung
	<i>Persoonia pinifolia</i>	Pine-leaved Geebung
Ranunculaceae		
	<i>Clematis aristata</i>	Mountain Clematis
Rhamnaceae		
	<i>Pomaderris intermedia</i>	Citron Pomaderris
Rosaceae		
	<i>Rubus</i> spp.	Rubus 9780
Rubiaceae		
	<i>Galium aparine</i>	Goosegrass
	<i>Galium gaudichaudii</i>	Rough Bedstraw
	<i>Morinda jasminoides</i>	Jasmine Morinda
	<i>Opercularia aspera</i>	Coarse Stinkweed
	<i>Pomax umbellata</i>	Pomax
Rutaceae		
	<i>Acronychia oblongifolia</i>	Common Acronychia
	<i>Phebalium squamulosum</i> ssp. <i>squamulosum</i>	Forest Phebalium
Santalaceae		
	<i>Exocarpos cupressiformis</i>	Native Cherry
	<i>Exocarpos strictus</i>	Dwarf Cherry
Sapindaceae		
	<i>Dodonaea triquetra</i>	Large-leaf Hop-bush
Scrophulariaceae		
	<i>Veronica plebeia</i>	Trailing Speedwell
Solanaceae		
	<i>Solanum mauritianum</i>	Wild Tobacco Bush
	<i>Solanum pungetium</i>	Eastern Nightshade
	<i>Solanum</i> spp.	Solanum 9826
Stackhousiaceae		
	<i>Stackhousia viminea</i>	Slender Stackhousia
Thymelaeaceae		
	<i>Pimelea linifolia</i> ssp. <i>linifolia</i>	Slender Rice-flower
Tremandraceae		
	<i>Tetratheca juncea</i>	Tetratheca 7813 (V)
Ulmaceae		
	<i>Trema tomentosa</i> var. <i>viridis</i>	Native Peach
Urticaceae		
	<i>Urtica incisa</i>	Stinging Nettle
Verbenaceae		
	<i>Lantana camara</i>	Lantana
	<i>Verbena bonariensis</i>	Purpletop
Violaceae		
	<i>Viola hederacea</i>	Ivy-leaved Violet
Vitaceae		
	<i>Cissus hypoglauca</i>	Giant Water Vine

Appendix 4: ROTAP Conservation Rating According to Briggs and Leigh (1996)

Conservation Rating According to Briggs and Leigh (1996)

Briggs and Leigh (1996) list over 5,031 species, subspecies and varieties of plants (5% of native vascular flora of Australia) that have been ranked according to their conservation status. While many of these species are contained within the schedules of various state and federal threatened species legislation (eg. TSC Act and *EPBC* Act), and are subject to legislative provisions under those acts, a great many more do not and as a such are extraneous to statutory assessment processes.

The modified list below presents the range of codes that are, in various combinations, applied to each listed plant species.

- 1** Species only known from one collection
- 2** Species with a geographic range of less than 100km in Australia
- 3** Species with a geographic range of more than 100km in Australia
- X** Species presumed extinct; no new collections for at least 50 years
- E** Endangered species at risk of disappearing from the wild state if present land use and other causal factors continue to operate
- V** Vulnerable species at risk of long-term disappearance through continued depletion.
- R** Rare, but not currently considered to be endangered.
- K** Poorly known species that are suspected to be threatened.
- C** Known to be represented within a conserved area.
- a** At least 1,000 plants are known to occur within a conservation reserve(s).
- i** Less than 1,000 plants are known to occur within a conservation reserve(s).
- The reserved population size is unknown.
- t** The total known population is reserved.
- +** The species has a natural occurrence overseas.

Appendix 5: Rare and Threatened Flora paragraphs

Acacia bulgaensis

Acacia bulgaensis is listed as a Rare Or Threatened Australian Plant (ROTAP) with a conservation rating of 2RC (Briggs and Leigh 1995), for codes see Appendix 4). This species is a shrub or small tree to 6 m high that occurs in sclerophyll woodland/forest on sandstone or shale soils (Harden 2002). This species has a distribution from the Putty to Bulga districts on the Central Coast (Tame *et al.* 2001). Records for *Acacia bulgaensis* occur approximately 30 km to the south-west of Branxton and no records occur within the proposed Link (NPWS 2003).

Acacia bulgaensis is not listed on the TSC Act or EPBC Act. As such this species was not considered in an Eight Part Test or under the EPBC Act. Furthermore, the study area is outside the known range of this species and potential habitat is not considered to occur within the proposed Link. This species has not been considered further in this assessment.

Acacia bynoeana

Acacia bynoeana is listed as Endangered on the TSC Act and Vulnerable on the EPBC Act. This species is a small shrub 0.2-1 m high that occurs mainly in heath and dry sclerophyll forest on sandy soils and occurs south of Dora Creek-Morriset area to Berrima and the Illawarra region and west to the Blue Mountains (Harden 2002). This species has not been recorded under the footprint however there is one recent record to the north of Kurri Kurri.

This species has not been recorded under the footprint. Potential habitat for this species is however considered to occur within the proposed Link's alignment by DEC (Deb Stevenson (DEC), *pers. comm.*). As such this species has been considered further in the Eight Part Test.

Bosistoa transversa

Bosistoa transversa is listed as Vulnerable on the TSC Act. This species is a small to medium tree to 22 m high. It occurs north of Tweed River district where it grows in rainforest to an altitude of 300 m (Harden 2002).

This species or its habitat has not been recorded under the footprint and the study area is outside the known range of this species. Therefore, this species has not been considered further in this assessment.

Bothriochloa biloba

Bothriochloa biloba is listed as Vulnerable on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 3V (Briggs and Leigh 1995), for codes see Appendix 4). This species is a perennial grass which flowers in summer and grows in woodland on nutrient poor soils (Harden 1993b).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Callistemon linearifolius

Callistemon linearifolius is listed as Vulnerable on the TSC Act and is listed as a ROTAP with a conservation rating of 2Ri (Briggs and Leigh 1995), for codes see Appendix 4). This species is a shrub about 3-4 m high which produces red ‘bottlebrush’ inflorescences in spring and summer. It occurs chiefly from Georges River to the Hawkesbury River where it grows in dry sclerophyll forest (Harden 2002), open forest, scrubland (Fairley and Moore 2000) or woodland on sandstone. It is found in damp places, usually in gullies (Robinson 1994).

This species has not been recorded under the footprint. Potential habitat for this species is however considered to occur within the proposed Link’s alignment by DEC (Deb Stevenson (DEC), *pers. comm.*). As such this species has been considered further in an Eight Part Test.

Callistemon shiressii

Callistemon shiressii is listed as a ROTAP with a conservation rating of 3R (Briggs and Leigh 1995); for codes see Appendix 4). This species is a shrub or small tree 1.5-12 m high with pale papery bark. This species produces white to pale cream ‘bottlebrush’ flowers in spring. It occurs chiefly from Colo River to Gosford district but is also known to occur in the Howes Valley and Bulga district. It grows on shale ridges, in moist eucalypt forest and rainforest gullies (Harden 2002).

Callistemon shiressii is not listed on the TSC Act or EPBC Act. As such this species was not considered in an Eight Part Test or under the EPBC Act. This species has not been considered further in this assessment.

Cryptostylis hunteriana

Cryptostylis hunteriana is listed as Vulnerable on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 3V (Briggs and Leigh 1995); for codes see Appendix 4). *Cryptostylis hunteriana* is a leafless terrestrial orchid which produces an inflorescence 15-45 cm high in December-February of 5-10 maroon,

black and green flowers. This species typically grows in swamp-heath on sandy soils chiefly in coastal districts (Harden 1993b) but has also been recorded on steep bare hillsides (Bishop 1996).

Despite targeted searches during the flowering period, this species was not recorded under the footprint. However, since habitat for this species occurs within the F3 to Branxton Link footprint an Eight Part Test has been completed for this species.

Cynanchum elegans

Cynanchum elegans is listed as Endangered on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 3Ei (Briggs and Leigh 1995), for codes see Appendix 4). *Cynanchum elegans* is a climber with opposite leaves which grows in rainforest gullies scrub and scree slopes in Gloucester and Wollongong districts (Harden 1992).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment

Darwinia biflora

Darwinia biflora is listed as Vulnerable on both the TSC and EPBC Acts. This species is also listed as a Rare Or Threatened Australian Plant (ROTAP) with a conservation rating of 2Va (Briggs and Leigh 1995); for codes see Appendix 4). *Darwinia biflora* is an erect or spreading shrub to 80 cm high which produces yellow-green flowers (sometimes becoming red) in winter and spring. This species grows in heath or sedgeland on sandstone or in the understorey of woodland on shale-capped ridges (Harden 1991, Robinson 1994, Fairley and Moore 2000) particularly where it intergrades with Hawkesbury sandstone. Canopy often includes *Eucalyptus haemastoma* and *Corymbia gummifera* (NPWS 2000a). It prefers moist shallow depressions (Robinson 1994).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Darwinia peduncularis

Darwinia peduncularis is listed as Vulnerable on the TSC Act and is also listed as a ROTAP with a conservation rating of 3Ri (Briggs and Leigh 1995), for codes see Appendix 4). *Darwinia peduncularis* is a shrub to 1.5 m high which produces purplish-red flowers in winter to spring. It occurs from Hornsby to Hawkesbury River and west to near Glen Davis where it grows in dry sclerophyll forest on sandstone hillsides and ridges (Harden 2002).

This species has not been recorded under the footprint and the study area is considered to be outside the known range of this species. Therefore, this species has not been considered further in this assessment.

Dillwynia tenuifolia

Dillwynia tenuifolia is listed as Vulnerable on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 2Vi (Briggs and Leigh 1995), for codes see Appendix 4).

Dillwynia tenuifolia is an erect shrub up to 1 m high which flowers in spring. It occurs in the Cumberland Plain and Blue Mountains to Howes Valley area where it grows in dry sclerophyll woodland on sandstone, shale or laterite (Robinson 1994, Harden 2002).

This species has not been recorded under the footprint and the study area is considered to be outside the known range of this species. Therefore, this species has not been considered further in this assessment.

Eucalyptus fergusonii* ssp. *dorsiventralis

Eucalyptus fergusonii ssp. *dorsiventralis* is listed as a ROTAP with a conservation rating of 2R (Briggs and Leigh 1995), for codes see Appendix 4). This species is an ironbark to 25 m high with dark grey bark. Recorded from Wollombi Valley to the Wollemi Wilderness and near Milbrodale where it grows in dry sclerophyll forest on sandstone ridges (Harden 2002).

Eucalyptus fergusonii ssp. *dorsiventralis* is not listed on the TSC Act or EPBC Act. As such this species was not considered in an Eight Part Test or under the EPBC Act. Furthermore, this species or its habitat were not recorded under the footprint. This species has not been considered further in this assessment.

Eucalyptus fergusonii* ssp. *fergusonii

Eucalyptus fergusonii ssp. *fergusonii* is listed as a ROTAP with a conservation rating of 3K (Briggs and Leigh 1995), for codes see Appendix 4). This species is an ironbark to 25 m high with dark grey bark. It grows in wet sclerophyll forest or woodland on sandy soil from Bulahdelah to Morriset and west to Widden (Harden 2002).

Eucalyptus fergusonii ssp. *fergusonii* is not listed on the TSC or EPBC Acts. As such this species was not considered in an Eight Part Test or under the EPBC Act. Furthermore, this species or its habitat was not recorded under the footprint. This species has not been considered further in this assessment.

Eucalyptus fracta

Eucalyptus fracta is listed as Vulnerable on the TSC Act. It is a tree or mallee to 8 m high with persistent grey-black ‘ironbark’ on trunk and branches. Branchlets are smooth and whitish with small branchlets slightly glaucous. This species is restricted to shallow soils along the upper escarpment of a steep sandstone range on the northern escarpment of the Broken Back Range, near Cessnock (NSW Scientific Committee 1999a).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Eucalyptus glaucina

Eucalyptus glaucina is listed as Vulnerable on both the TSC and EPBC Act. It is also listed as a ROTAP with a conservation rating of 3Va (Briggs and Leigh 1995), for codes see Appendix 4). *Eucalyptus glaucina* is a tree to 30 m high with smooth white or grey bark shedding in large plated or flakes. It occurs near Casino and from Taree to Broke where it is locally common but very sporadic. Found in grassy woodland on deep, moderately fertile and well watered soil (Harden 2002). Previously recorded within Central Hunter Riparian Forest (mu13) (NPWS 2000e).

This species or its habitat has not been recorded under the footprint. It is recognised that *E. glaucina* can be easily confused with *E. tereticornis* and special care was taken when identifying *E. tereticornis* individuals. This species has not been considered further in this assessment.

Eucalyptus michaeliana

Eucalyptus michaeliana is listed as a ROTAP with a conservation rating of 3Ra (Briggs and Leigh 1995), for codes see Appendix 4). *Eucalyptus michaeliana* is a tree to 30 m high with smooth white or grey or red-brown bark shedding in plates or flakes. It has disjunct populations at Wollombi to St Albans and east of Armidale. It grows in dry sclerophyll woodland on sandy soils where it is locally frequent and occurs as small widely scattered stands (Harden 2002).

Eucalyptus michaeliana is not listed on the TSC Act or EPBC Act. As such this species was not considered in an Eight Part Test or under the EPBC Act. Furthermore, this species was not recorded under the footprint. This species has not been considered further in this assessment.

Eucalyptus parramattensis ssp. decadens

Eucalyptus parramattensis ssp. *decadens* is listed as Vulnerable on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 2V (Briggs and Leigh 1995); for codes see Appendix 4). *Eucalyptus parramattensis* ssp. *decadens* is a small tree to 15 m high with smooth white or grey bark. Occurs from Tomago to Kurri Kurri where it grows in dry sclerophyll woodland on sandy soils, often in low damp sites (Harden 2002).

This species was recorded under the footprint within KSSW (MU 35). An Eight Part Test has been completed for this species.

Eucalyptus prominula

Eucalyptus prominula is listed as a ROTAP with a conservation rating of 2K (Briggs and Leigh 1995); for codes see Appendix 4). *Eucalyptus prominula* is a tree to 25 m high with persistent grey to red-brown stringy bark. It is locally common but highly restricted. It is confined to Bucketty district, west along the Hunter Range and north to the Broke area where it grows in dry sclerophyll forest on shallow sandy soils on steep sandstone slopes (Harden 2002).

Eucalyptus prominula is not listed on the TSC Act or EPBC Act. As such this species was not considered in an Eight Part Test or under the EPBC Act. Furthermore, this species was not recorded under the footprint. This species has not been considered further in this assessment.

Eucalyptus pumila

Eucalyptus pumila is listed as Vulnerable on both TSC and EPBC Act. This species is also listed as a ROTAP with a conservation rating of 2Vi (Briggs and Leigh 1995), for codes see Appendix 4).

Eucalyptus pumila a mallee to 6 m high with smooth grey or grey-brown bark shedding in short ribbons. This mallee is only known from a single stand near Pokolbin where it grows in sclerophyll shrubland on skeletal soil on sloping sandstone (Harden 1991).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Grevillea evansiana

Grevillea evansiana is listed as Vulnerable on the TSC Act and has a ROTAP with a rating of 2V (Briggs and Leigh 1995), for codes see Appendix 4). *Grevillea evansiana* is a low dense spreading shrub, rarely more than 0.5 m high. It produces blackish red or rarely white conflorescences in August-December. This species is restricted to an area

east of Rylstone where it grows in dry sclerophyll forest or woodland and occasionally in swampy heath in sandy soils, usually over Hawkesbury sandstone (Harden 2002).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Grevillea montana

Grevillea montana is listed as a ROTAP with a conservation rating of 2K (Briggs and Leigh 1995); for codes see Appendix 4). *Grevillea montana* is a spreading shrub 0.5-1.5 m high which produces reddish flowers which are often greenish near the base. Flowers are produced mainly in September and October and occur as confluences with 1-4 flowers. It occurs in the southern part of the Hunter Valley from Denman to Kurri Kurri where it grows in open forest in sandy soils over mixed sedimentary substrates (Harden 2002).

This species was recorded under the footprint within KSSW, however, it is not listed on the TSC Act or EPBC Act. As such this species was not considered in an Eight Part Test or under the EPBC Act. This species has not been considered further in this assessment.

Grevillea obtusiflora* ssp. *fecunda

Grevillea obtusiflora ssp. *fecunda* is listed as endangered on the TSC Act and is also listed as a ROTAP with a conservation rating of 2E (Briggs and Leigh 1995), for codes see Appendix 4). *Grevillea obtusiflora* ssp. *fecunda* is a shrub usually 0.2-1 m high but sometimes up to 2 m high and species produces pinkish confluences usually in winter and spring. This species has localised populations in Capertree Valley, south east of Kandos where it grows in sandy loam soils in open low scrub beneath dry sclerophyll forest (Harden 2002).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Grevillea parviflora* ssp. *parviflora

Grevillea parviflora ssp. *parviflora* is listed as Vulnerable on both the TSC and EPBC Acts. *Grevillea parviflora* ssp. *parviflora* is a low shrub less than 1 m high. This species is known to occur from Arcadia to North Maroota and in the Camden-Bargo-Appin area where it grows in sandy or light clay soils usually over thin shales in heath or shrubby woodlands (NSW Scientific Committee 1998a, Harden 2002).

This species has been recorded under the footprint within KSSW. An Eight Part Test has been completed for this species.

Hibbertia elata

Hibbertia elata is listed as a ROTAP with a conservation rating of 3R (Briggs and Leigh 1995); for codes see Appendix 4). *Hibbertia elata* is a diffuse shrub to 1-2 m high which produces yellow flowers in winter to early summer. It occurs in the Mudgee-Rylstone-Merriwa and Wallangarra districts where it grows in shallow soils on rocky slopes (Harden 1990).

Hibbertia elata is not listed on the TSC or EPBC Acts. As such this species was not considered in an Eight Part Test or under the EPBC Act. Furthermore, this species was not recorded under the footprint. This species has not been considered further in this assessment.

Lomandra brevis

Lomandra brevis is listed as a ROTAP with a conservation rating of 2R (Briggs and Leigh 1995); for codes see Appendix 4). *Lomandra brevis* is a perennial tussock with leaves in-rolled 5-30 cm long and an acute apex. It flowers in spring and autumn. Occurs in the Sydney region where it grows in dry sclerophyll forest on sandstone derived soils (Harden 1993b).

Lomandra brevis is not listed on the TSC or EPBC Acts. As such this species was not considered in an Eight Part Test or under the EPBC Act. Furthermore, this species was not recorded under the footprint. This species has not been considered further in this assessment.

Macrozamia flexuosa

Macrozamia flexuosa is listed as a ROTAP with a conservation rating of 2K (Briggs and Leigh 1995); for codes see Appendix 4). *Macrozamia flexuosa* is a cycad with leaves 40-110 cm long and a strongly spirally twisted rachis. It occurs in the southern part of the NC and the extreme north of the CC where it grows in sclerophyll forest on the coast and ranges (Harden 1990).

This species was recorded under the footprint within KSSW, however, it is not listed on the TSC Act or EPBC Act. As such this species was not considered in an Eight Part Test or under the EPBC Act. This species has not been considered further in this assessment.

Melaleuca groveana

Melaleuca groveana is listed as Vulnerable on the TSC Act and is also listed as a ROTAP with a conservation rating of 3R (Briggs and Leigh 1995); for codes see Appendix 4). *Melaleuca groveana* is a shrub or small tree 2-5 (-10) m high, which produces white

inflorescences 2-3 cm long in spring. It is found in coastal region north of Yengo National Park and west to Werikmbe National Park where it grows in higher altitude heath, often in exposed areas (Harden 2002).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Olearia cordata

Olearia cordata is listed as Vulnerable on the TSC Act and as a ROTAP with a conservation rating of 2Ra (Briggs and Leigh 1995); for codes see Appendix 4). *Olearia cordata* is a shrub to 2 m high which produces ‘daisy’ flowers in November-April with yellow disk florets surrounded by deep blue to mauve ray florets. This species occurs chiefly from Wisemans Ferry to Wollombi where it grows in dry sclerophyll forest and open shrubland, on sandstone. (Harden 1992).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Parsonsia dorrigoensis

Parsonsia dorrigoensis is listed as Vulnerable on the TSC Act and is also listed as a ROTAP with a conservation rating of 2Vi (Briggs and Leigh 1995); for codes see Appendix 4). *Parsonsia dorrigoensis* is a climber to 5 m high which produces white-yellow flowers in summer. It is found in sub-tropical and warm-temperate rainforests and wet sclerophyll forest on brown clay soils. Restricted to altitude between 150-800 m. Co-occurring species include *Lophostemon confertus*, *Eucalyptus companulata*, *E. pilularis*, *E. saligna*, *Schizomeria ovata*, *Acmena smithii*, *Trochocarpa laurina* and *Tristaniopsis collina* (NPWS 1999g).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Persoonia hirsuta

Persoonia hirsuta is listed as an Endangered species on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 3Ki (Briggs and Leigh 1995); for codes see Appendix 4). *Persoonia hirsuta* is a spreading to decumbent shrub with moderate to densely hairy young branchlets. Yellow flowers are generally produced in summer. It occurs from Gosford to Royal National Park and in the Putty district from Hill Top to Glen Davis where it grows in woodland to dry sclerophyll forest on sandstone (Harden 2002) or rarely on shale (NSW Scientific Committee 1998c).

This species has not been recorded under the footprint and the study area is outside the known range of this species. Therefore, this species has not been considered further in this assessment.

Persoonia pauciflora

Persoonia pauciflora is listed as Endangered on the TSC Act and Critically Endangered on the EPBC Act.

P. pauciflora is a spreading shrub with terete leaves and yellow flower. It occurs within dry open forest or woodlands on clay soils (Harden 2002). Commonly found within communities dominated by *Eucalyptus maculata*, *E. fibrosa* and *E. crebra* (NPWS 2000b). This species was not recorded within the study area during the field surveys, however potential habitat occurs within the Lower Hunter Spotted Gum Ironbark Forest (Mu 17). An Eight Part Test has been completed for this species.

Prostanthera cineolifera

Prostanthera cineolifera is listed as Vulnerable on both the TSC and EPBC Act. This species is also listed as a ROTAP with a conservation rating of 2K (Briggs and Leigh 1995); for codes see Appendix 4). *Prostanthera cineolifera* is an erect shrub 1-4 m high with strongly aromatic leaves and pale-dark mauve flowers produced in September-October. The taxonomic status and distribution of this species is uncertain. It is thought to occur in sclerophyll forest (Harden 1993b)

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Pterostylis gibbosa

Pterostylis gibbosa is listed as Endangered on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 2E (Briggs and Leigh 1995); for codes see Appendix 4). *Pterostylis gibbosa* is a terrestrial orchid with a rosette of leaves, an inflorescence scape to 45 cm high with 2-7 bright green flowers with transparent patches is produced in August-November. It grows among grass in sclerophyll forest among paper barks near Wollongong (Bishop 1996) with a disjunct population in the Hunter Valley (Harden 1993b).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Tetratheca juncea

Tetratheca juncea is listed as Vulnerable on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 3Vi (Briggs and Leigh 1995); for codes see Appendix 4). *Tetratheca juncea* is a cryptic prostrate shrub with stems to 1 m long leaves reduced to narrow scales. Solitary or paired pink-deep lilac flowers with a black centre are produced in July-December. It grows in sandy or swampy heath and dry sclerophyll forests (Harden 1992, Fairley and Moore 1995). Most populations occur in woodland on poor nutrient soils with good drainage and low moisture levels. Typically found in dense understorey of grasses and canopy species including *Angophora costata*, *Corymbia gummifera*, *Eucalyptus haemastoma* and *E. capitellata* (NPWS 2000d).

This species was recorded within the Kurri Kurri Corridor. This species was found to be locally common within Coastal Plains Smooth-barked Apple Forest (mu 30) with one population of more than 100 plants recorded. An Eight Part Test has been completed for this species.

Velleia perfoliata

Velleia perfoliata is listed as Vulnerable on the TSC Act and is also listed as a ROTAP species with a conservation rating of 2V (Briggs and Leigh 1995); for codes see Appendix 4). *Velleia perfoliata* is a perennial herb with basal leaves 10-12 cm long and 3-4 cm wide. A flowering scape to 50 cm high with yellow flowers is produced in spring. It is found in the Hawkesbury district to the upper Hunter Valley where it grows in heath on shallow sandy soils over sandstone (Harden 1992).

This species or its habitat has not been recorded under the footprint. This species has not been considered further in this assessment.

Zieria involucrata

Zieria involucrata is listed as Vulnerable on both the TSC and EPBC Acts. This species is also listed as a ROTAP with a conservation rating of 2Va (Briggs and Leigh 1995); for codes see Appendix 4). *Zieria involucrata* is a tall erect shrub with dimorphic leaves (one- and three-foliate) covered in stellate hairs. In spring it produces inflorescences of small white flowers. This species occurs chiefly in the Lower Blue Mountains and west to Katoomba district where it grows in moist gullies containing wet sclerophyll forest (Robinson 1994, Harden 2002).

This species or its habitat has not been recorded under the footprint and the study area is outside the known range of this species. Therefore, this species has not been considered further in this assessment.

Appendix 6: Species of Animal Recorded During the Current Surveys

This table details the species of animal recorded during the various targeted surveys (both survey periods) and through opportunistic sightings within the study area.

Family Name	Latin Name	Common Name	TSC Act ^a	EPBC Act ^b	Observation Type ¹ (Number Recorded)						Total Number
					F	K	O	P	T	W	
AMPHIBIANS											
Hylidae	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog								10	10
	<i>Litoria latopalmata</i>	Broad-palmed Frog					1			4	5
	<i>Litoria peronii</i>	Peron's Tree Frog					2			9	11
	<i>Litoria verreauxii</i>	Verreux's Tree Frog								2	2
Myobatrachidae	<i>Crinia signifera</i>	Common Eastern Froglet					1			4	5
	<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog					1				1
	<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog					1				1
	<i>Limnodynastes peronii</i>	Brown-striped Frog								1	1
	<i>Uperoleia laevigata</i>	Smooth Toadlet					1			10	11
INTRODUCED BIRDS											
Columbidae	<i>Streptopelia chinensis</i>	Spotted Turtle-Dove	U				1				1
Sturnidae	<i>Acridotheres tristis</i>	Common Myna	U				1				1
INTRODUCED MAMMALS											
Canidae	<i>Canis familiaris</i>	Dog (feral)	U		2		1				3
	<i>Vulpes vulpes</i>	Fox	U		1		1	4			6
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit	U				2				2
NATIVE BIRDS											
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle					2				2
	<i>Hieraaetus morphnoides</i>	Little Eagle		M			1				1
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck		M			2				2
Ardeidae	<i>Ardea alba</i>	Great Egret					2				2
	<i>Ardea ibis</i>	Cattle Egret		M			1				1
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow					1				1
	<i>Cracticus nigrogularis</i>	Pied Butcherbird					1				1
	<i>Cracticus torquatus</i>	Grey Butcherbird					4			5	9
	<i>Gymnorhina tibicen</i>	Australian Magpie					8			7	15
	<i>Strepera graculina</i>	Pied Currawong					1			5	6
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo					1			1	2
	<i>Cacatua roseicapilla</i>	Galah					4			1	5
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike					13			1	14
	<i>Lalage sueurii</i>	White-winged Triller								1	1
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing		M						1	1
Cinclosomatidae	<i>Psophodes olivaceus</i>	Eastern Whipbird					3			10	13
Climacteridae	<i>Cormobates leucophaeus</i>	White-throated Treecreeper					7				7

Family Name	Latin Name	Common Name	TSC Act ^a	EPBC Act ^b	Observation Type ¹ (Number Recorded)						Total Number
					F	K	O	P	T	W	
Columbidae	<i>Lopholaimus antarcticus</i>	Topknot Pigeon								1	1
	<i>Macropygia amboinensis</i>	Brown Cuckoo-dove					1				1
	<i>Streptopelia chinensis</i>	Spotted Turtle-dove					1				1
Corcoracidae	<i>Corcorax melanorhamphos</i>	White-winged Chough					4				4
Corvidae	<i>Corvus coronoides</i>	Australian Raven					10			17	27
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo					1			1	2
	<i>Cuculus pallidus</i>	Pallid Cuckoo					1				1
	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo					1				1
Dicruridae	<i>Grallina cyanoleuca</i>	Magpie-lark					2				2
	<i>Monarcha melanopsis</i>	Black-faced Monarch		M			1				1
	<i>Rhipidura fuliginosa</i>	Grey Fantail					18			1	19
	<i>Rhipidura leucophrys</i>	Willie Wagtail					5				5
Falconidae	<i>Falco berigora</i>	Brown Falcon		M			1				1
	<i>Falco peregrinus</i>	Peregrine Falcon		M			1				1
	<i>Falco subniger</i>	Black Falcon		M			1				1
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra					4			7	12
	<i>Todiramphus sanctus</i>	Sacred Kingfisher					1				1
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren					17			1	18
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill					8			7	15
	<i>Anthochaera carunculata</i>	Red Wattlebird								2	2
	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater					15				15
	<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater		M			5				5
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater					2			1	3
	<i>Manorina melanocephala</i>	Noisy Miner					3			3	6
	<i>Manorina melanophrys</i>	Bell Miner					3			15	18
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater					7			2	9
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater					1				1
	<i>Melithreptus lunatus</i>	White-naped Honeyeater					4				4
	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater					2				2
	<i>Philemon citreogularis</i>	Little Friarbird					1				1
	<i>Philemon corniculatus</i>	Noisy Friarbird					4			1	5
	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater								1	1
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella					2				2
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush					6			3	8
	<i>Pachycephala olivacea</i>	Olive Whistler	V				1				1

Family Name	Latin Name	Common Name	TSC Act ^a	EPBC Act ^b	Observation Type ¹ (Number Recorded)						Total Number
					F	K	O	P	T	W	
	<i>Pachycephala pectoralis</i>	Golden Whistler					9			2	11
	<i>Pachycephala rufiventris</i>	Rufous Whistler					9			7	16
Pardalotidae	<i>Acanthiza nana</i>	Yellow Thornbill					6				6
	<i>Acanthiza pusilla</i>	Brown Thornbill					8				8
	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill					4				4
	<i>Gerygone mouki</i>	Brown Gerygone					2			1	3
	<i>Pardalotus punctatus</i>	Spotted Pardalote					11			5	16
	<i>Pardalotus striatus</i>	Striated Pardalote					4			1	5
	<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	V				1				1
	<i>Sericornis frontalis</i>	White-browed Scrubwren					3				3
	<i>Smicromis brevirostris</i>	Weebill					4				4
Passeridae	<i>Neochmia temporalis</i>	Red-browed Finch					3				3
	<i>Stagonopleura bella</i>	Beautiful Firetail					1				1
	<i>Taeniopygia bichenovii</i>	Double-barred Finch					1				1
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin					6				6
	<i>Microeca fascinans</i>	Jacky Winter					3				3
	<i>Petroica phoenicea</i>	Flame Robin					2				2
	<i>Petroica rosea</i>	Rose Robin					5				5
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe					1				1
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth					1				1
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	V				30+				30+
Psittacidae	<i>Alisterus scapularis</i>	Australian King-parrot					4			1	5
	<i>Glossopsitta pusilla</i>	Little Lorikeet					2				2
	<i>Platycercus elegans</i>	Crimson Rosella								1	1
	<i>Platycercus eximius</i>	Eastern Rosella					4			1	5
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet					1				1
Scolopacidae	<i>Gallinago hardwickii</i>	Latham's Snipe		M			1				1
Threskiornithidae	<i>Platalea flavipes</i>	Yellow Spoonbill					1				1
	<i>Platalea regia</i>	Royal Spoonbill					1				1
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis					1				1
Tytonidae	<i>Tyto novaehollandiae</i>	Masked Owl	V				1				1
	<i>Tyto tenebricosa</i>	Sooty Owl	V				1			1	2
Zosteropidae	<i>Zosterops lateralis</i>	Silvereeye					6				6
NATIVE MAMMALS											
Dasyuridae	<i>Antechinus</i> sp.	Unidentified Antechinus								1	1
Macropodidae	<i>Macropod</i> sp.	Unidentified macropod								2	2
	<i>Macropus giganteus</i>	Eastern Grey Kangaroo					6				6
	<i>Macropus rufogriseus</i>	Red-necked Wallaby					1				1

Family Name	Latin Name	Common Name	TSC Act ^a	EPBC Act ^b	Observation Type ¹ (Number Recorded)						Total Number
					F	K	O	P	T	W	
	<i>Wallabia bicolor</i>	Swamp Wallaby					2				2
Muridae	<i>Rattus fuscipes</i>	Bush Rat				1			1		2
Peramelidae	<i>Perameles nasuta</i>	Long-nosed Bandicoot				1					1
Petauridae	<i>Petaurus breviceps</i>	Sugar Glider					2		1	2	5
	<i>Petaurus norfolcensis</i>	Squirrel Glider	V						1		1
	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum					1				1
Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum					9				9
REPTILES											
Agamidae	<i>Physignathus lesueurii</i>	Eastern Water Dragon					1				1
Elapidae	<i>Demansia psammophis</i>	Yellow-faced Whip Snake					1				1
	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake					1				1
Varanidae	<i>Varanus varius</i>	Lace Monitor					1				1

Key

a: V = Vulnerable, E1 = Endangered

b: V = Vulnerable, E = Endangered, C = Conservation Concern, M = Migratory

1: F = tracks/scratchings, K = dead, O = observed, P = scat, T = trapped/heard, W = heard.

Appendix 7: Threatened Fauna Paragraphs

Squirrel Glider (*Petaurus australis*)

Potential habitat for this species exists along the length of the Kurri Kurri Corridor, although there have been very few records despite targeted surveys being carried out. The original EIS (Connell Wagner 1995) suggested Squirrel Gliders were likely to occur within the corridor, but extensive fires in January 1994 prior to the survey period prevented detection of the species. The subsequent FIS (Connell Wagner 1997) indicated that this species had been recorded “within mountainous terrain in the east of the study corridor” and again indicated that it may be present in other areas due to the presence of suitable habitat. It was concluded that there was likely to be a significant impact on this species due to the removal of 72 ha of vegetation east of Kurri Kurri. An REF for the Allandale to Illalong Section (Connell Wagner 2000) indicated that a dead Squirrel Glider had been found adjacent to the F3 to Branxton Link where it crosses Camp Road, but subsequent trapping failed to record any further specimens and an Eight Part Test suggested that a significant impact on this species was unlikely. Squirrel Gliders have been recorded in the Tomalpin Employment Zone (Anderson *et al.* 2002), although this area is located outside of the Kurri Kurri Corridor.

As part of this study, a single individual Squirrel Glider was recorded southwest of John Brown Lagoon (Figure 8). A significance assessment determined that it was unlikely that this species would be impacted significantly (Appendix 8).

Koala (*Phascolarctos cinereus*)

There are no records of Koalas within the study corridor, and the nearest record is approximately 5 km away in the Tomalpin Employment Zone. There was also a recent sighting in Cessnock in September 2003 (Deb Stevenson (DEC), *pers. comm.*). However, potential habitat for this species does occur within the Kurri Kurri Corridor. Koala searches during the FIS did not detect any Koalas and neither did searches during the current surveys.

There have been unverified Koala scats recorded in the Kurri Kurri TAFE (EcoPro 1995), although there are no confirmed records for this species and management of the TAFE are unaware of the presence of Koalas (Allan Bowditch, RTA Hunter Client Services, *pers. comm.*).

There have been a number of Koala records from the local community group, Native Animal Trust Fund. The records include local two roadkills, one between Cessnock and Kurri Kurri, and the other on the Richmond Vale side (Annette Rees, Native Animal Trust Fund, *pers comm.* 2003). One sighting has also been recorded near Weston (Annette Rees, Native Animal Trust Fund, *pers comm.* 2003).

Based on the survey results there is unlikely to be a significant population of this species present in the study area and hence a significance assessment has not been completed.

Powerful Owl (*Ninox strenua*)

There is a single record of a Powerful Owl within the study corridor, located within the Coal and Allied Lands northwest of Seahampton (Figure 6). A second record is located just south of North Rothbury, yet this is outside of the Kurri Kurri Corridor. This species has also been recorded within the Tomalpin Employment Zone. There were no records of this species within the study corridor according to the Birds Australia Atlas data. The FIS did not record this species, yet due to the presence of potential habitat, suggested a likely impact (Connell Wagner 1997). This species was considered further in two REF's for the Allandale to Illalong Section (Connell Wagner 1998, 2000), which agreed with the FIS in that there was likely to be a significant impact on this species. This species was not considered further in the Additional Flora and Fauna Assessment (Connell Wagner 2001).

Although this species was not recorded in the current surveys, a significance assessment was completed which determined that a significant impact on this species was unlikely (Appendix 8).

Masked Owl (*Tyto novaehollandiae*)

Masked Owls have previously been recorded in the study corridor in the vicinity of Seahampton and Mount Sugarloaf. One individual was recorded on the Birds Australia Atlas near Hilldale, although this is outside the Kurri Kurri Corridor. The FIS did not record this species and concluded that it was unlikely to be impacted significantly by the proposed Link. This species was not considered further in any subsequent studies associated with the proposed Link (Connell Wagner 1998, 2000, 2001).

A single individual was recorded in the current surveys on the alignment of the proposed Link near Stockrington Road (Figure 8). The Eight Part Test assessment concluded that given the large home-range of this species and absences of suitably sized tree hollows it is unlikely that the proposed Link would have a significant impact on this species (Appendix 8).

Sooty Owl (*Tyto tenebricosa*)

No Atlas of NSW Wildlife or Birds Australia Atlas data records of this species exist within the Kurri Kurri Corridor, although potential habitat is present. This species was not considered in the FIS, although it was considered in the AFFA (Connell Wagner 2001). The AFFA discounted this species as it was not recorded in the vicinity of the proposed corridor (Connell Wagner 2001)

This species recorded in the current surveys on the alignment of the proposed Link near Stockrington Road (Figure 8). The Eight Part Test assessment concluded that given the large home-range of this species and absences of suitably sized tree hollows it is unlikely that the proposed Link would have a significant impact on this species (Appendix 8).

Green and Golden Bell Frog (*Litoria aurea*)

No Green and Golden Bell Frogs (GGBF) have been recorded within the study corridor, the nearest being approximately 3 km north of Seahampton. A herpetological study associated with the FIS (Wells 1995) concluded that suitable habitat for this species existed in the Wallis Creek area, yet no individuals were recorded. The FIS concluded that disturbance to wetlands on the Wallis Creek floodplain during construction may have the potential to impact this species. This species was not considered further in any subsequent studies associated with the proposed Link (Connell Wagner 1998, 2000, 2001).

No GGBF were recorded in the current study in the study area. From discussion with Dr Michael Mahony from the University of Newcastle it appears that he is unaware of any GGBF records from Wallis Creek floodplain but says the species has been recorded from other areas of the catchment. He was not aware of any recent surveys from the area. Dr Andrew Hamer, who has recently finished his PhD on GGBF from Koorogang Island, concurs with Dr Mahony. He also said that despite the lateness of the season he would expect GGBF to be calling during the time of our surveys to take advantage of the wet conditions, particularly as few breeding opportunities occurred during the 2002/2003 summer.

An Eight Part Test assessment concluded that it is unlikely that the proposed Link would have a significant impact on this species (Appendix 8).

Green-thighed Frog (*Litoria brevipalmata*)

There are no known records of the Green-thighed Frog within the study corridor. Suitable habitat for this species was not located within the corridor and the occurrence of this species was considered unlikely (Wells 1995). Fauna searches during the FIS and current surveys did not detect the Green-thighed Frog.

The Green-thighed Frog was recently recorded from Hunter Lowland Redgum Forest and Lower Hunter Spotted Gum Ironbark Forest within the Tomalpin Employment Zone (Harper Somers O'Sullivan 2002), approximately 5 km southwest of the study area. At a regional level the species is known from Ourimbah State Forest, Bloomfield Creek, Porters Creek Wetland, Buttonderry Creek, Wyong, East Erina and Martinsville (Wells 1995).

Details of the preferred habitat for this species are limited but has been described as wet sclerophyll or rainforest (Ehmann 1997; Robinson 1998), open forest (Barker *et al* 1995) and in landforms characterised by pock marked' depressions which form temporary pools for breeding (Harper Somers O'Sullivan 2002). This is one of the few eastern temperate frog species that exhibit "explosive" breeding only once or twice a year, with males congregating near large semi-permanent or temporary pools that form after heavy rainfall events (Lemckert 2002). While the species is known to inhabit areas with varying degrees of disturbance an important microhabitat feature might be the suitability, condition and structure of groundcover vegetation (and leaf litter) for shelter (Lemckert 2002).

Principal areas of potential habitat occur in small sections of highly altered Lower Hunter Spotted Gum-Ironbark Forest immediately east of Wallis Creek and near Branxton, and degraded Hunter Lowland Red Gum Forest near the Allandale Quarry. No other area appeared to provide suitable habitat for this species. The reasons for this include the high topographic relief to the east (and therefore little opportunity for water to pool), vegetation clearing for grazing, agriculture and urban/commercial/industrial development, and unsuitable vegetation eg. Kurri Sand Swamp Woodland or Coastal Plains Scribbly Gum Woodlands. Due to extensive vegetation clearing and intensive grazing the Wallis Creek floodplain was not considered suitable habitat.

Based on the survey results there is unlikely to be suitable habitat for this species within the study area and hence a significance assessment has not been completed.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

No DEC Atlas of NSW Wildlife records exist of Grey-headed Flying Foxes within the study corridor, although this is most likely due to a lack of noting of this species rather than a true absence. This species was not considered in the FIS of the two REF's, since these documents precede the listing of this species on the TSC Act (4 May 2001). However, the supplementary REF (Connell Wagner 2000) mentions numerous Grey-headed Flying Foxes near Camp Road. This species was considered in the AFFA (Connell Wagner 2001) and was recorded at two locations, near Branxton Railway Station and west of the transmission lines at Illalong. This species was also recorded in Area 12 (Coal and Allied Lands) on one occasion during the Tasman EIS (Gunninah Environmental Consultants 2002).

This species was not recorded in the current surveys. An Eight Part Tests assessment suggested that there was unlikely to be a significant impact on this species (Appendix 8).

Pale-headed Snake (*Hoplocephalus bitorquatus*)

There are no known records of the Pale-headed Snake within the study corridor. While the habitats for within the corridor are considered limited (reason are provided below) the occurrence of this species cannot be discounted. Fauna searches during the FIS and current surveys did not detect the Pale-headed Snake or identify areas of prime habitat.

The species has an extensive but discontinuous range extending from north-eastern NSW to north Queensland. It is also known from coastal areas of NSW, although less frequently, and in drier woodland on both sides of the Great Dividing Range.

The Pale-headed Snake is known to use habitats within a range of woodland and forest types, including open forest and woodland in drier areas (eg. western parts of its range) and occasionally rainforest and wet sclerophyll forests within coastal areas. The species is nocturnal, secretive and infrequently encountered in coastal NSW. The species is described as arboreal but the proportion of time spent between arboreal and terrestrial settings is not known. Evidence suggests that the species shelters in tree-hollows and beneath decorticating bark (which may be preferred on dead or senescent trees rather than seasonally shed bark on living trees) and prey includes both terrestrial and arboreal species. It is most commonly recorded on the ground at night, but these sightings are generally rare and the result of accidental encounters (Fitzgerald 1996).

The species may not tolerate vegetation disturbances and has not been found in recently regenerating vegetation or highly disturbed environments, such as heavily logged areas (Fitzgerald 1996). The reasons for this are inconclusive but the loss of shelter sites (eg. tree hollows and fallen logs) changes to understorey vegetation from frequent fires, reduced densities of preferred prey species and increased exposure to predation may be primary causes. Within the study area the Pale-headed Snake may prefer Spotted Gum-Ironbark Forest but for the reasons referred to above this habitat may now be less favourable or even unsuitable for this species.

Based on the survey results there is unlikely to be a significant impact on this species preferred habitat and hence a significance assessment has not been completed.

Regent Honeyeater (*Xanthomyza phrygia*)

No Atlas of NSW Wildlife records of this species exist within the Kurri Kurri Corridor, although potential habitat is present. The Birds Australia Atlas data has no records of this species within the study corridor, although three separate sightings were made near Kitchener in Aberdare State Forest, two sightings approximately two km south of Abermain and one sighting in Spotted Gum forest near Bellbird Colliery. The FIS indicated that this species had been previously observed near Kurri Kurri and North Rothbury and that the proposed Link would have a likely impact on this species. The two subsequent REF's concur with this finding. This species was not considered further in the AFFA.

This species was not recorded in the current surveys, although suitable habitat was assessed. In the Lower Hunter region of NSW, the Regent Honeyeater feeds predominantly on lerp and flowers of the *Corymbia maculata*, preferring mature trees with a DBH of greater than 40 cm (D. Geering (DEC), *pers. comm.*). Although there are relatively good populations of *Corymbia maculata* within the corridor, most are immature, with suitably-sized feed trees only located along creek lines within the Coal and Allied Lands. Potential habitat for the Regent Honeyeater within the corridor is therefore probably only of medium to poor quality, except along creeklines in Spotted Gum–Ironbark woodlands, where it is of high quality. An Eight Part Tests assessment suggested that there was unlikely to be a significant impact on this species (Appendix 8).

Woodland Birds

Potential habitat for five woodland bird species (Brown Treecreeper, Speckled Warbler, Hooded Robin, Diamond Firetail and Grey-crowned Babbler) occurs within the Kurri Kurri Corridor. Two of these species (Speckled Warbler and Grey-crowned Babbler) were recorded during the current surveys on the alignment of the proposed Link near Tuckers Lane and Allandale Quarry. The Bird Australia Atlas data has records of all five species occurring to the west and east of the proposed Link.

Eight part Test concluded that the proposed F3 to Branxton Link is likely to have a significant impact on these species due to fragmentation of habitat (Appendix 8). The isolation and reduction of potential habitat is likely to result in isolate populations and hence place the species at risk of extinction via stochastic events and the loss of genetic viability in the long (Appendix 8)

Swift parrot (*Lathamus discolor*)

No records of the Swift Parrot have been recorded within the Kurri Kurri Corridor. Although records for this species exist within the local area at Sawyers Gully, Bellbird Heights and Ellalong (Connell Wagner 2001).

The FIS indicated that this species was scarce within the local area, with closet record at Seaham. The assessment concluded that this species was unlikely to be affected by the proposed Link. The AFFA concurs with this finding (Connell Wagner 2001).

This species was not recorded in the current surveys, although suitable habitat is present along the length of the Kurri Kurri Corridor. An Eight Part Test assessment for this species concluded that give the nomadic nature of this species and extant of potential habitat within the Kurri Kurri Corridor it is unlikely that the proposed F3 to Branxton Link would have a significant impact on the Swift Parrot (Appendix 8).

Olive Whistler (*Pachycephala olivacea*)

No DEC Atlas of NSW Wildlife records of this species exists within the Kurri Kurri Corridor, although potential habitat is present. The Birds Australia Atlas data has no records of this species within the study corridor, although there are records of this species to the east and west of the Kurri Kurri Corridor.

This species was not considered in the FIS of the two REF's, since these documents precede the listing of this species on the TSC Act (1997). Although it was considered in the Additional Flora and Fauna Assessment (Connell Wagner 2001). The AFFA discounted this species as it was not recorded in the vicinity of the proposed corridor (Connell Wagner 2001).

A single individual was recorded in the current surveys on the alignment of the proposed Link at Allandale Quarry. An Eight Part Test assessment for this species concluded that the proposed Link would isolate populations and hence place the species at risk of extinction via stochastic events and the loss of genetic viability in the long term (Appendix8)

Migratory Birds

Sixty-one migratory species or their habitat have been previously recorded in the local area of the F3 to Branxton Link (Table 9). Of these, fifty-seven species are considered to have potential habitat within the study area and have been considered under the guidelines for significance for the EPBC Act (Appendix 9). Seven of the migratory species were recorded during the current surveys. These species were not considered in the previous FIS or the AFFA (Connell Wagner 2001).

Appendix 8: EP&A Act Eight Part Tests

Endangered Ecological Communities

Kurri Sand Swamp Woodland

Kurri Sand Swamp Woodland (KSSW) is an Endangered Ecological Community (EEC) that was listed on Schedule 1 (Part 3) of the TSC Act on 1 June 2001. KSSW is restricted to the Kurri Kurri - Cessnock area in the Lower Hunter Valley, occurring on soils developed over poorly drained Tertiary sand deposits that blanket Permian sediments.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

NA

In the case of an Endangered Population, whether the life cycle of the species that constitutes the Endangered Population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The region under consideration is the Sydney Basin bioregion. The entire current distribution of KSSW occurs within the boundary of Cessnock LGA. The overall range of the current distribution is restricted to 21 km and generally fits within the pre-1750 distribution indicating that there has been little contraction of the range of the community. The current distribution is however highly fragmented, with 90 fragments ranging in size from 0.6 ha to 391.4 ha. The total current distribution covers 2195 ha, which is 54% of its former distribution.

Approximately 33.7 ha (1.6% of the total current distribution) of KSSW would be removed and 41.4 ha (1.9 %) would be modified through edge-effects. Thus, 3.5 % of the total current distribution of KSSW would be impacted either directly or indirectly. This amounts to 7 % of the KSSW found along the study corridor.

The modification or removal of 3.5 % of the total current distribution of KSSW is considered to be a significant area of known habitat.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link would directly impact ten fragments of KSSW. The proposed Link would dissect two relatively large fragments (59 and 63 ha) and would shave vegetation from the edge of the other eight fragments. Thus, the proposed Link would increase fragmentation and isolation of this community.

Whether critical habitat will be affected.

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

Ten remnant patches of KSSW are situated within the Lower Hunter National Park (under Cessnock LEP zoning 8(a) National Park or State Recreation Area), totalling 182.6 ha or 9% of the extant distribution. Under the Draft Cessnock LEP Amendment No. 60 for the Tomalpin Employment Zone, there is a proposal to rezone a large area of land to the south of Kurri Kurri. Under this proposal a number of changes would occur to the levels of protection for a number of fragments of KSSW, including 111.8 ha of KSSW to be added to the Lower Hunter National Park, making a total of 294.4 ha (14% of the total distribution). A further 311.8 ha will be rezoned 7(b) Habitat Protection Zone. The combination of zones 8(a) and 7(b) will cover 606.2 ha of KSSW, which is 30% of the total current distribution.

The JANIS nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia suggests that 15% of the pre-European distribution should be a minimum target, unless the ecosystem is recognised as vulnerable in which case at least 60% should be reserved. The pre-European distribution of KSSW covered 3816 ha which means that the current and proposed reserve system would account for 15.8% of the pre-European distribution.

It is considered that this community is not adequately represented in conservation reserves given the current and continuing threats to the community.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. The proposed Link requires the Clearing of Native Vegetation.

Whether any threatened species, population or ecological community is at the limit of its known distribution

The proposed Link cuts through the centre of the current and pre-European distribution of KSSW in an east-westerly direction. Furthermore, given the highly localised distribution of this community (stretching over only 21 km), the entire F3 to Branxton Link should be considered to be at or near the limit of the known distribution of this community.

Conclusion

The modification or removal of 3.5 % of the total current distribution of KSSW is considered to be a significant area of known habitat. The vegetation to be impacted is generally considered to be in good condition. KSSW has a highly restricted distribution and is not adequately represented in conservation reserves.

As such it is likely that the proposed Link would have a significant impact on this community.

Hunter Lowland Redgum Forest

Hunter Lowland Redgum Forest (HLRF) is an EEC that was listed on Schedule 1 (Part 3) of the TSC Act on 13 December 2002. HLRF occurs in the Sydney Basin and NSW North Coast bioregions where it is found on gentle slopes arising from depressions and drainage flats on Permian sediments of the Hunter Valley floor (NSW Scientific Committee 2002).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

NA

In the case of an Endangered Population, whether the life cycle of the species that constitutes the Endangered Population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The region under consideration is the Sydney Basin bioregion. The entire current distribution of HLRF occurs between Muswellbrook and the Lower Hunter. The current

distribution is however highly fragmented and the covers 4856 ha, which is 27% of its former distribution (NSW Scientific Committee 2002).

Approximately 16 ha (0.30 % of the total current distribution) of HLRF would be removed and 17 ha (0.35 %) would be modified through edge-effects. Thus, 0.65 % of the total current distribution of HLRF would be impacted either directly or indirectly. This amounts to 4% of the community found along the study corridor.

The modification or removal of 0.65 % of the total current distribution of HLRF is not considered to be a significant area of known habitat.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link would directly impact on four remnant patches of HLRF. The largest of these is within the vicinity of the Allandale Quarry and is a significant remnant in terms of the overall distribution of the community. This remnant also forms a part of a potential ecological corridor to the northeast, and thus, the proposed Link would lead to further fragmentation and isolation of this community.

Whether critical habitat will be affected.

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

Approximately 7 ha of HLRF occurs within Lower Hunter National Park (Bell 2001a). The majority of the remainder occurs on public land (NSW Scientific Committee 2002). Given the lack of information, it is assumed this community is inadequately represented within conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. In addition to clearing and habitat fragmentation, threats to this community include grazing, weed invasion, altered fire frequency and rubbish dumping (NSW Scientific Committee 2002).

Whether any threatened species, population or ecological community is at the limit of its known distribution

The distribution of HLRF occurs between Muswellbrook and the Lower Hunter. The study area is considered to be at or near the limit of distribution of this community.

Conclusion

The modification or removal of 0.65 % of the total current distribution of HLRF is not considered to be a significant area of known habitat. The vegetation to be impacted is generally considered to be in moderate condition. This community is not adequately represented within conservation reserves and is at or near its limit of distribution. The proposed Link would involve the Clearing of Native Vegetation, which is listed as a key threatening process, and would result in the further fragmentation and isolation of this community.

As such it is likely that the proposed Link would have a significant impact on this community.

Lower Hunter Spotted Gum – Ironbark Forest

Lower Hunter Spotted Gum – Ironbark Forest (LHSGIF) is listed as an EEC in Schedule 1 (Part 3) of the TSC Act. It was listed on 18 February 2005. LHSGIF occurs principally on Permian geology in the central to Lower Hunter Valley. The community is strongly associated with, though not restricted to, the yellow podsolic and solodic soils of the Lower Hunter soil landscapes of Aberdare, Branxton and Neath (NSW Scientific Committee 2005). Approximately 26,917 ha of LHSGIF remains, with the canopy of *Corymbia maculata* and *Eucalyptus fibrosa* in largely unmodified condition (NSW Scientific Committee 2005).

The proposed F3 to Branxton cuts diagonally across the lower Hunter Valley in a southeast-northwest direction and impacts on 12 remnant patches of LHSGIF (Figure 3).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

NA

In the case of an Endangered Population, whether the life cycle of the species that constitutes the Endangered Population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

LHSGIF is located in the Sydney Basin bioregion. The distribution of LHSGIF is restricted to a range of approximately 65 km by 35 km and is centred on the Cessnock – Beresfield area in the Central and Lower Hunter Valley (NPWS 2000). It is estimated that the community once covered some 65,000 ha (NSW Scientific Committee 2005). A fragmented core of the community still occurs between Cessnock and Beresfield. Remnants occur within the Local Government Areas of Cessnock, Maitland, Singleton, Lake Macquarie, Newcastle, Port Stephens and Dungog but may also occur elsewhere within the bioregion. Outliers are also present on the eastern escarpment of Pokolbin and Corrabare State Forests on Narrabeen Sandstone.

Approximately 67 ha (0.25 % of the total current distribution) of LHSGIF would be removed and 87.1 ha (0.32 %) would be modified through edge-effects. Thus, 0.57 % of the total current distribution of LHSGIF would be impacted either directly or indirectly.

In relation to the regional distribution of LHSGIF, the area of known habitat to be modified or removed (154.1 ha or 0.57 % of the total current distribution) is not considered to be significant.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link would directly impact 12 remnant patches of LHSGIF. The proposed Link would dissect four of these patches and would shave vegetation from the edges of the other eight. These patches are not interconnecting and do not form part of an ecological corridor. More significant areas of LHSGIF occur well to the north and south of the proposed Link (they are isolated from each other) and the proposed Link's footprint does not impact on either of these areas (Figure 3).

Although remnant patches impacted by the proposed Link have a high number of native species, past disturbances have led to a moderate infestation of weeds, an altered forest structure and a subsequent reduction in ecosystem resilience. These disturbances included; high fire frequency (a predominance of ground-dwelling herbaceous species); land clearance and timber harvesting (even-aged stands of the dominant trees and a lack of large old-growth trees); over-grazing (predominance of unpalatable native grass species such as *Aristida spp.*); and fragmentation (a prevalence of utility easements, roads, tracks and agricultural land uses). For these reasons, the patches of LHSGIF intersecting the proposed Link were generally considered to be in a moderate condition.

It is not anticipated that the proposed Link would exaggerate the existing fragmentation of LHSGIF that falls within the proposed Link's footprint. Furthermore, the proposed

Link is not likely to increase the fragmentation and isolation of LHSIG throughout its range.

Whether critical habitat will be affected.

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

Approximately 1600 ha of LHSIG occurs within Werakata National Park, which represents 6% of the extant distribution. Of an estimated 2,800 ha of the community currently within State Forests, approximately 1,770 ha is excluded from timber harvesting in Forest Management Zone reserves. Within the Hunter Employment Zone (HEZ), 460 ha of Lower Hunter Spotted Gum–Ironbark Forest is estimated to occur within zone 7(b) 'Environmental Protection'. The combination of National Park, State Forest and 7(b) lands will cover 3830 ha of LHSIG, which is 14.5% of the total current distribution.

The JANIS nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia suggests that 15% of the pre-European distribution should be a minimum target, unless the ecosystem is recognised as vulnerable in which case at least 60% should be reserved. The pre-European distribution of LHSIG covered approximately 65,000 ha which means that the current and proposed reserve system would account for 5.9% of the pre-European distribution.

It is considered that this community is not adequately represented in conservation reserves given the current and continuing threats to the community.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. The proposed Link would result in the clearance of native vegetation.

Whether any threatened species, population or ecological community is at the limit of its known distribution

The proposed Link cuts diagonally through the centre of the current and pre-European distribution of LHSIG in a southeast-north westerly direction. However, given the limited distribution of this community (65 km by 35 km), the south-eastern and north-western ends of the proposed Link are considered to be at or near the limit of the known distribution of this community.

Conclusion

The south-eastern and north-western ends of the proposed Link are considered to be at the limit of the known distribution of LHS GIF, the community is not adequately represented in conservation reserves and the proposed Link would result in the clearance of native vegetation which is a key threatening process.

However, a significant area of LHS GIF (in the context of its regional distribution) would not be removed by the proposed F3 to Branxton Link and the remnant patches affected are already moderately disturbed and highly fragmented.

On balance, the future survival of LHS GIF is not considered to be under threat from the proposed Link and therefore it is unlikely to have a significant impact on this community.

River- Flat Eucalypt Forest

In December 2004 River-Flat Eucalypt Forest on Coastal Floodplains was gazetted by the NSW Scientific Committee as an Endangered Ecological Community on Schedule 1 of the TSC Act. Section 8 of the Final Determination for this new EEC listed Central Hunter Riparian Forest, map unit 13 of (NPWS 2004b), as falling within this community. As such, the following Eight Part Test has been conducted for River-Flat Eucalypt Forest on Coastal Floodplains in respect to the vegetation clearance and edge effects on Central Hunter Riparian Forest.

River-Flat Eucalypt Forest on Coastal Floodplains occurs principally on silts, clay loams and sandy loams on alluvial flats, drainage lines and river terraces associated with coastal floodplains (NSW Scientific Committee 2004). River-Flat Eucalypt Forest on Coastal Floodplains generally occurs below 50m elevation but may occur on localised river flats up to 250m elevation. The community varies between regions but dominant tree species generally include *Eucalyptus tereticornis*, *E. amplifolia*, *Angophora floribunda*, *A. subvelutina* and *Casuarina glauca*. In the 1990s, it was estimated that about 2000 ha of this community remained in the lower Hunter (NSW Scientific Committee 2004). This estimate of the extent of the community would be used for the purposes of this assessment, though it is a substantial underestimate of the extent of this community throughout NSW.

The proposed Link would impact on four patches of River-Flat Eucalypt Forest on Coastal Floodplains (Central Hunter Riparian Forest) and result in the removal of 0.6 ha. Approximately 4.2 ha of this community would be indirectly impacted through edge effects. Therefore the total area of River-Flat Eucalypt Forest on Coastal Floodplains impacted by the proposed Link is 4.8 ha.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

NA

In the case of an Endangered Population, whether the life cycle of the species that constitutes the Endangered Population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

River-Flat Eucalypt Forest on Coastal Floodplain is located in the North Coast, Sydney Basin and South East corner bioregions. The distribution of River-Flat Eucalypt Forest on Coastal Floodplain is now highly fragmented throughout this range and the total area of this community remaining is unknown. It is estimated, however, that approximately 2000 ha of this community remains within the lower Hunter.

Approximately 0.6 ha (0.03 % of the total lower Hunter distribution) of River-Flat Eucalypt Forest on Coastal Floodplain would be removed and 4.2 ha (0.21 %) would be modified through edge-effects. Thus, 0.24 % of the total current distribution of River-Flat Eucalypt Forest on Coastal Floodplain would be impacted either directly or indirectly within the lower Hunter.

In relation to the regional distribution of River-Flat Eucalypt Forest on Coastal Floodplain, the area to be modified or removed is much smaller than 0.24 % as the EEC is more expansive than that which is confined to the lower Hunter. Therefore a significant area of known habitat is not likely to be removed by the proposed Link.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed Link would directly impact four remnant patches of River-Flat Eucalypt Forest on Coastal Floodplain (Central Hunter Riparian Forest). These patches are not interconnecting and do not form part of an ecological corridor.

The remnant patches impacted by the proposed Link had a high number of native species, however a number of past disturbances have lead to a moderate infestation of weeds, an altered forest structure and a subsequent reduction in ecosystem resilience. These disturbances included; high fire frequency (a predominance of ground-dwelling herbaceous species); land clearance and timber harvesting (even-aged stands of the

dominant trees and a lack of large old-growth trees); over-grazing (predominance of unpalatable native grass species such as *Aristida spp.*); and fragmentation (a prevalence of utility easements, roads, tracks and agricultural land uses). For these reasons, the patches of River-Flat Eucalypt Forest on Coastal Floodplain intersecting the proposed Link were generally considered to be in a moderate condition.

It is not anticipated that the proposed Link would exaggerate the existing fragmentation of River-Flat Eucalypt Forest on Coastal Floodplain that falls within the development footprint. Furthermore, the proposed Link is not likely to increase the fragmentation and isolation of River-Flat Eucalypt Forest on Coastal Floodplain throughout its range.

Whether critical habitat will be affected

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

It is considered that this community is not adequately represented in conservation reserves given the current and continuing threats to the community (NSW Scientific Committee 2004).

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. The proposed Link would result in the clearance of native vegetation.

Whether any threatened species, population or ecological community is at the limit of its known distribution

Given that River-Flat Eucalypt Forest on Coastal Floodplain is a listed EEC on the North Coast, Sydney Basin and South East Corner bioregions it is not likely that the community is at the known limit of its distribution.

Conclusion

River-Flat Eucalypt Forest on Coastal Floodplain is not likely to be adequately represented in conservation reserves in NSW and clearing of native vegetation is a key threatening process.

However, the area of River-Flat Eucalypt Forest on Coastal Floodplain to be impacted by the proposed Link is not considered to be significant, the proposed Link would not

exaggerate existing fragmentation of the community, critical habitat is not declared for this EEC and it is not likely that the River-Flat Eucalypt Forest on Coastal Floodplain vegetation under the footprint is at the limit of its known distribution.

On balance, the future survival of River-Flat Eucalypt Forest on Coastal Floodplain is not considered to be under threat from the proposed Link and therefore it is not likely to have a significant impact on this EEC.

Flora

Acacia bynoeana

Acacia bynoeana is listed as Endangered on Schedule 1 of the TSC Act, and has a conservation rating of 3V- according to Briggs and Leigh (1995). *Acacia bynoeana* is a low growing prostrate shrub, to 1m high, with leaves that are covered in coarse hairs. The peak flowering period for this species is from November to January (Harden 2002).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

Acacia bynoeana was not recorded within the study area despite conducting two surveys along the F3 to Branxton Link footprint during its flowering period. It is unlikely that *A. bynoeana* would have remained undetected within the study area, and therefore, it is also unlikely that a viable population of this species would be placed at risk of extinction by the proposed Link.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Acacia bynoeana is known to occur in heath and dry sclerophyll forest (Harden 2002). The soil substrate is typically sand or sandy/clay often with ironstone gravels and is usually very infertile and well drained. This species appears to prefer open, sometimes disturbed sites such as trail margins and edges of roadside spoil mounds and recently burnt open patches (NSW Scientific Committee 1999b).

Within the region, potential habitat for *A. bynoeana* also occurs within several vegetation communities. The proposed Link is unlikely to remove individuals of this species and would result in the clearing of a relatively small area of potential habitat. The proposed Link is unlikely to modify or remove a significant area of potential habitat for this species.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Potential habitat for this *A. bynoeana* is restricted to Kurri Sand Swamp Woodland (KSSW). The proposed Link is largely restricted to the margins of KSSW adjacent to power easements. The proposed Link does, however, dissect two medium sized patches of KSSW. *A. bynoeana* was not recorded within the study area despite conducting two surveys along the F3 to Branxton Link footprint during the flowering period. It is unlikely that this species would have remained undetected during the surveys. For this reason, it is unlikely that the proposed Link would fragment an existing important population.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

The species is currently known from 34 locations throughout NSW and the number of individuals within each of the populations is typically 1-5 plants. Only a few sites exist where the populations contain 30-50 individuals. Only a few hundred individuals exist in the wild. *A. bynoeana* does not flower prolifically. Only one record of *A. bynoeana* is found within the Kurri Kurri Corridor.

A. bynoeana has been recorded within several conservation areas including Blue Mountains, Kuringai, Royal and Marramarra National Parks and Castlereagh, Dharawal and Agnes Banks Nature Reserves.

It is unlikely that this species is adequately represented in conservation reserves in the region.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Threatening processes are defined under Schedule 3 of the TSC Act. The proposed Link would include Clearing of Native Vegetation, which is listed as a key threatening process under this legislation. Specifically this species is threatened by clearing, road, trail and powerline maintenance, recreational vehicle use, weed invasion and altered fire regimes. This species is susceptible to catastrophic events and localised extinctions (NPWS 1999a).

Whether any threatened species, population or ecological community is at the limit of its known distribution.

A. bynoeana is endemic to central eastern NSW. It has been recorded from the Hunter district on the Central Coast south to Berrima and Mittagong in the Southern Highlands with most records in the Blue Mountains area. The study area is considered to be at or near the north western limit of the species range

Conclusion

A. bynoeana is not considered likely to occur within the study area as two surveys along the F3 to Branxton Link footprint were undertaken during its known flowering period. The proposed Link is not likely to have a significant impact on this species.

Callistemon linearifolius

Callistemon linearifolius is listed as Vulnerable on Schedule 2 of the TSC Act and has conservation rating of 2Ri- (Briggs and Leigh 1996). *Callistemon linearifolius* is a large shrub to 4 m high. Its leaves are linear-lanceolate with acute tips. The flower spikes have red filaments. It Grows in dry sclerophyll forest on the coast and adjacent ranges, chiefly in the Sydney region from the Georges River to the Hawkesbury River (Harden 2002). One specimen has been previously recorded in the Cessnock district (Figure 4).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction,

Callistemon linearifolius was not recorded within the study area despite targeted surveys for this species. This species has been previously recorded approximately 6 km to the south west of the study area within LHSIGIF. The study area is considered to provide marginal habitat for this species within damp areas and creeklines of LHSIGIF. Since this species was not recorded within the study area despite targeted surveys and the study area is considered to provide only limited marginal habitat it is considered unlikely that this species would occur within the study area. For these reasons it is considered unlikely that a viable population of *C. linearifolius* would be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

An endangered population is defined under the TSC Act as ‘a population specified in Part 2 of Schedule 1’. At the present time, there are no endangered populations of *C. linearifolius* under the Act that are within the study area.

In relation to the regional distribution of habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed,

Callistemon linearifolius has not been recorded within the study area, however, it has been recorded approximately 6 km to the south-west of Kurri Kurri within LHS GIF. Potential habitat for *C. linearifolius* occurs in several vegetation communities within the region. Potential habitat within the study area is considered to occur within damp areas and creek lines within LHS GIF.

Approximately 67 ha (0.25 % of the total current distribution) of LHS GIF would be removed and 87.1 ha (0.32 %) would be modified through edge-effects. Thus, 0.57 % of the total current distribution of LHS GIF would be impacted either directly or indirectly.

The modification or removal of 0.57 % of LHS GIF is not considered to be a significant area of known habitat for this species.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community,

Callistemon linearifolius was not recorded despite targeted surveys and the study area is considered to provide only marginal habitat for this species. The proposed Link generally passes along the edge of areas of potential habitat, however it does pass through some patches of vegetation, which include areas of marginal habitat for this species. The proposed Link would result in further fragmentation of vegetation within the study area. However, since the study area contains only marginal habitat and the nearest record is approximately 6 km from the study area the proposed Link is unlikely to increase the isolation of populations of this species.

Whether critical habitat will be affected,

Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region,

This species is known to occur in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and from Yengo National Park (NSW Scientific Committee 1999c). This species is considered to be inadequately represented within conservation reserves.

Whether the development or activity proposed is of a class of development or activity which is recognised as a threatening process,

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. Specifically this species is threatened by continuing habitat loss due primarily to urban development. This species is also at high risk of local extinctions due to low population numbers (NSW Scientific Committee 1999c). The proposed Link would include clearing native vegetation, however, the vegetation to be cleared is considered to provide only marginal habitat for this species.

Whether any threatened species, population or ecological community is at the limit of its known distribution,

Callistemon linearifolius is known to occur from the Georges River to Hawkesbury River in the Sydney area and north to Nelson Bay. The study area is considered to be at or near the north-western limit of distribution for this species.

Conclusion:

Callistemon linearifolius was not recorded within the study area despite targeted surveys for this species. The study area is considered to provide only marginal habitat. The proposed Link is considered not likely to have a significant impact on this species.

Cryptostylis hunteriana

Cryptostylis hunteriana is listed as vulnerable under TSC Act. It has a conservation rating of 3V (Briggs and Leigh 1995). *Cryptostylis hunteriana* is a terrestrial orchid which typically grows in swamp-heath on sandy soils chiefly in coastal districts (Harden 1993b) but has also been recorded on steep bare hillsides (Bishop 1996). Within the Central Coast bioregion, this species has been recorded within Coastal Plains Smooth-barked Apple Woodland (mu 30) and Coastal Plains Scribbly Gum Woodland (mu 31) (Bell 2001b).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

Despite targeted surveys, *C. hunteriana* was not recorded during the current survey and has not previously been recorded within 10 km of the study site. Within the study area, potential habitat occurs within the Coastal Plains Smooth-barked Apple Woodland (CPSAW), areas of this community should be considered to be potential habitat (Bell 2001b). As such, the proposed Link would require the removal/disturbance of 19.4 ha of potential habitat and a further 21.9 ha would be edge affected. The proposed Link would fragment potential habitat. However, due to small population sizes (Bell 2001b) the

proposed Link is unlikely to increased isolation or disrupt pollinator movements or propagable dispersal.

For the reasons stated above, the proposed Link is not considered likely to disrupt the lifecycle of a viable population of *C. hunteriana*.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

An endangered population is defined under the TSC Act as ‘a population specified in Part 2 of Schedule 1’. At the present time, there are no endangered populations of *C. hunteriana* listed under the Act.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Potential habitat for *C. hunteriana* occurs within CPSAW. All areas of CPSAW should be considered to be potential habitat for this species (Bell 2001b). The proposed Link would require the removal of 19.4 ha of CPSAW and a further 21.9 ha would be edge affected. Within the central coast this species has also been recorded within Coastal Plains Scribbly Gum Woodland (mu31). These two vegetation communities occupy approximately 37,200 ha or 10% of the extant vegetation in the Hunter Valley and Central Coast. The removal of 19.4 ha corresponds to 0.05 % of potential habitat within the Central Coast.

The modification and removal of 0.05 % of potential habitat within is not considered to be a significant area of known habitat.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link would pass through an extensive area of vegetation including several areas of potential habitat for this species. The proposed Link would result in further fragmentation of existing habitat, however, due to small population sizes (Bell 2001b) the proposed Link is unlikely to increase isolation or disrupt pollinator movements or propagable dispersal.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

Cryptostylis hunteriana is known to occur within three conservation reserves within NSW (Gibraltar Range, Kuringai Chase and Ben Boyd National Parks) and two reserves within Victoria (Croajingalong National Park and William Hunter Flora Reserve). This species is not considered to be adequately represented in conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Threatening Processes are defined under Schedule 3 of the TSC Act. The proposed Link would include the Clearing of Native Vegetation, which is listed as a Key Threatening Process.

Other threats to this species in the Central Coast include fragmentation, frequent fire during the flowering season, weed invasion and modification of habitat through nutrient enrichment. Threats to populations in Victoria include drainage of swamps, weed invasion, unscrupulous collection and altered fire regimes (Bell 2001b). The proposed Link would involve increased weed invasion into suitable habitat and fragmentation of potential habitat.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

Cryptostylis hunteriana occurs in coastal regions from Gibraltar Range to Orbost in Victoria. The study site is not at the limit of distribution of this species.

Conclusion:

The proposed Link is unlikely to have a significant impact on this species.

Eucalyptus glaucina

Eucalyptus glaucina is listed as Vulnerable on the TSC Act. It has a conservation rating of 3Va (Briggs and Leigh 1995).

Eucalyptus glaucina is a tree to 30 m high with smooth, white or grey bark, shedding in large plates or flakes. It is very similar to *E. tereticornis* but is distinguished by its glaucous leaves and buds. This species has a locally frequent but sporadic distribution, in grassy woodland on deep, moderately fertile and well-watered soil near Casino and from Taree to Broke (RBG Sydney 1994).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Figure 4 shows that *E. glaucina* has been recorded along the Kurri Kurri Corridor from near the Allandale Quarry and further a field towards Broke. In this area it has been recorded in Central Hunter Riparian Forest (CHRF; (NPWS 2000f) and there is some suggestion that it could be found in Hunter Lowlands Red Gum Forest (HLRF) (pers. obs.). *E. tereticornis* is the dominant species in both communities.

As *E. glaucina* was not recorded during the targeted surveys, it is not likely that the future survival of a viable local population of *E. glaucina* is under threat from the proposed Link.

In the case of an Endangered Population, whether the life cycle of the species that constitutes the Endangered Population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The region under consideration is the Sydney Basin bioregion. Potential habitat for *E. glaucina* occurs locally in Central Hunter Riparian Forest (CHRF) and probably Hunter Lowland Redgum Forest (HLRF). The total current distribution of these communities combined is 6042 ha. The LHCCREMS Study Area represents the eastern limit of both of these vegetation types in the Hunter region. Much of their former extent has been depleted for agriculture.

Approximately 0.6 ha (0.05 % of the total current distribution) of CHRF would be removed and 4.2 ha (0.35 %) would be modified through edge-effects. Thus, 0.40 % of the total current distribution of CHRF would be impacted either directly or indirectly. Additionally, approximately 16 ha (0.30 % of the total current distribution) of HLRF would be removed and 17 ha (0.35 %) would be modified through edge-effects. Thus, 0.65 % of the total current distribution of HLRF would be impacted either directly or indirectly. This amounts to 4% of the community found along the study corridor.

The combined total of CHRF and HLRF to be impacted represents 0.63 % of the total current distribution of these communities. This is not considered to be a significant area of known habitat for *E. glaucina*.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Given the locally frequent but sporadic distribution of *E. glaucina* and its already highly fragmented potential habitat throughout its range, it is unlikely that the proposed Link would increase fragmentation or isolation of this species or its known habitat.

Whether critical habitat will be affected.

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

No data exists as to the level of protection afforded *E. glaucina* in conservation reserves in NSW. It must therefore be assumed that the species is not adequately represented in conservation reserves or similar protected areas.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. The proposed Link requires the Clearing of Native Vegetation.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

Eucalyptus glaucina is known from near Casino and from Taree to Broke. The proposed Link is near to the southern limit of this range.

Conclusion

In the study area, *E. glaucina* is near to southern limit of its range, it is not adequately represented in conservation reserves and native vegetation would be cleared during the construction of the proposed Link, which is a Key Threatening Process. Despite these concerns, no specimens of *E. glaucina* were detected during the extensive field surveys, the proposed Link would not increase the fragmentation of the species and only a small percentage of potential habitat would be removed.

For these reasons, it is not likely that the proposed F3 to Branxton Link would have a significant impact on the future survival of *E. glaucina*.

Eucalyptus parramattensis* ssp. *decadens

Eucalyptus parramattensis ssp. *decadens* is listed as Vulnerable on the TSC Act. This species is found in dry sclerophyll woodland on sandy soils, often in low damp sites (Harden 1991). *E. parramattensis* ssp. *decadens* has a very restricted distribution. It is known from the Tomago area in the east and the Kurri Kurri-Weston area in the west. *E. parramattensis* ssp. *decadens* was recorded under the footprint in KSSW habitat.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Surveys conducted by (O'Sullivan *et al.* 2003) determined that a 2.6 ha patch of KSSW contained 102 adult *Eucalyptus parramattensis* ssp. *decadens* individuals (39 per ha). Based on these figures, the proposed Link would potentially remove 1,314 *Eucalyptus parramattensis* ssp. *decadens* individuals and 33.7 ha of habitat.

The proposed Link would split two relatively large fragments (59 and 63 ha) and would shave vegetation from the edge of the other eight fragments and increase the distance between fragments. Thus, the proposed Link would increase fragmentation and isolation of this community, which is likely to impact the movement of pollinators and propagules. A viable population of this species is likely to be placed at risk of extinction by the proposed Link.

In the case of an Endangered Population, whether the life cycle of the species that constitutes the Endangered Population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The region under consideration is the Sydney Basin bioregion. Potential habitat for this species occurs in the Kurri Kurri, Cessnock and Tomago areas in the Hunter Valley. This species is a dominant canopy species in KSSW (at canopy densities between 0 and 75%) which has a current distribution of 2195 ha.

Approximately 33.7 ha (1.6% of the total current distribution) of KSSW would be removed and 41.4 ha (1.9 %) would be modified through edge-effects. Thus, 3.5 % of the total current distribution of KSSW would be impacted either directly or indirectly. This amounts to 7 % of the KSSW found along the study corridor.

The modification and removal of 3.5 % ha of KSSW is considered to be a significant area of known habitat for *E. parramattensis* ssp. *decadens*.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link would directly impact ten fragments of KSSW, which provides habitat for *E. parramattensis* ssp. *decadens*. The proposed Link would split two relatively large fragments (59 and 63 ha) and would shave vegetation from the edge of the other eight fragments and increase the distance between fragments. Thus, the proposed Link would increase fragmentation and isolation of this species.

Whether critical habitat will be affected.

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

Two known populations of the species occur in the Lower Hunter National Park, with approximately 150 trees present. This species is a dominant canopy species within KSSW. Under Cessnock LEP zoning 8(a) National Park or State Recreation Area, 10 remnant patches of KSSW are situated within the Lower Hunter National Park boundaries, totalling 182.6 ha or 9% of the extant distribution. It is considered that this species is not adequately represented in conservation reserves given the current and continuing threats.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. Native vegetation would be cleared for the proposed Link.

Whether any threatened species, population or ecological community is at the limit of its known distribution

Eucalyptus parramattensis ssp. *decadens* has a very restricted distribution. It is known from the Tomago area in the east and the Kurri Kurri-Weston area in the west. The study area is considered to be at the northern and western limit of the distribution of this species.

The Kurri Kurri-Weston metapopulation occurs within KSSW. The proposed Link cuts through the centre of the current and pre-European distribution of KSSW in an east-westerly direction. Given the highly localised distribution of this community (stretching over only 21 km), the entire F3 to Branxton Link should be considered to be at or near the limit of the known distribution of this community and therefore of this metapopulation.

Conclusion

The modification and removal of 3.5 % ha of KSSW is considered to be a significant area of known habitat for *E. parramattensis* ssp. *decadens*. The proposed Link would also fragment and isolate remaining populations. This species has a restricted distribution and is not adequately represented in conservation reserves.

The proposed Link is likely to have a significant impact on this species.

Grevillea parviflora* ssp. *parviflora

Grevillea parviflora ssp. *parviflora* is listed as Vulnerable on the TSC Act. This species does not have a ROTAP Conservation Risk Code according to (Briggs and Leigh 1995).

Grevillea parviflora ssp. *parviflora* is low open to erect shrub 0.3-1m in height. This species is known to occur within light clayey or sandy soils in woodland and is historically known from the Prospect to Camden and Appin area, with disjunct populations near Putty, Cessnock and Cooranbong (NSW Scientific Committee 1998b). During this study small patches of *G. parviflora* ssp. *parviflora* were recorded from KSSW within the proposed Link.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

The proposed Link would remove *G. parviflora* ssp. *parviflora* individuals and approximately 33.7 ha of potential habitat. The proposed Link would split two relatively large fragments (59 and 63 ha), would shave vegetation from the edge of the other eight fragments and increase the distance between fragments. Thus, the proposed Link would increase fragmentation and isolation of this community, which is likely to impact the movement of pollinators and propagules. A viable population of this species is likely to place at risk of extinction by the proposed Link.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

NA

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Within the Cessnock area, *G. parviflora* ssp. *parviflora* is found within KSSW and within the Sydney region it occurs in communities such as Shale Sandstone Transition Forest.

Approximately 33.7 ha (1.6% of the total current distribution) of KSSW would be removed and 41.4 ha (1.9 %) would be modified through edge-effects. Thus, 3.5 % of the total current distribution of KSSW would be impacted either directly or indirectly.

Many of the communities in which *G. parviflora* ssp. *parviflora* occurs have been depleted in the Sydney Basin bioregion. In addition, the modification and removal of 3.5% of the total current distribution of KSSW is considered to be a significant area of known habitat for this species.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link would directly impact ten fragments of KSSW which provide habitat for *G. parviflora* ssp. *parviflora*. The proposed Link would split two relatively large fragments (59 and 63 ha) and would shave vegetation from the edge of the other eight fragments and increase the distance between fragments. Thus, the proposed Link would increase fragmentation and isolation of this species.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

This species is not known from any conservation reserves (NSW Scientific Committee 1998b). This species is not considered to be adequately represented in conservation reserves in the region.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. The proposed Link requires the Clearing of Native Vegetation.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

This species is known to occur within light clayey or sandy soils in woodland and is historically known from the Prospect to Camden and Appin area, with disjunct populations near Putty, Cessnock and Cooranbong (NSW Scientific Committee 1998b). The study area is likely to be at or near the northern limit of the distribution of this species (NSW Scientific Committee 1998b).

Conclusion

Grevillea parviflora ssp. *parviflora* was recorded within the study area during targeted surveys along the proposed Link. A number of *G. parviflora* ssp. *parviflora* individuals and 3.5 % of known habitat would be disturbed by the proposed Link. The proposed Link would result in an increase in fragmentation and isolation of this species.

It is likely that the proposed Link would have a significant impact on this species.

Persoonia pauciflora

Persoonia pauciflora is listed as Endangered on Schedule 2 of the TSC Act. It has not been assigned a ROTAP conservation code (Briggs and Leigh 1995). *Persoonia pauciflora* was formally recognised as a new species in 1999 (Weston 1999). It is a small spreading shrub to 1.5 m high, with needle-like leaves which are hairy when immature (NPWS 2000b).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

Figure 4 shows that a population of *P. pauciflora* has been recorded approximately three kilometres south of Branxton. In this area it has been recorded in Lower Hunter Spotted Gum Ironbark Forest (LHSGIF) which corresponds to the description of core habitat for this species (NPWS 2000b).

As *P. pauciflora* was not recorded during the targeted surveys, it is not likely that the future survival of a viable local population of *P. pauciflora* is under threat from the proposed Link.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

NA

In relation to the regional distribution of habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The region under consideration is the Sydney Basin bioregion. Potential habitat for *P. pauciflora* occurs locally on silty sandstone soils within LHSGIF. Approximately 67 ha (0.25 % of the total current distribution) of LHSGIF would be removed and 87.1 ha (0.32 %) would be modified through edge-effects. Thus, 0.57 % of the total current distribution of LHSGIF would be impacted either directly or indirectly. This is not considered to be significant area of known habitat.

As the majority of the population of *P. pauciflora* occurs outside the footprint of the proposed Link and a significant amount of potential habitat would not be modified or removed for the proposed Link, it is not likely that a significant area of known habitat species would be impacted by the proposed F3 to Branxton Link.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link would directly impact 12 remnant patches of LHSGIF which is known habitat for *P. pauciflora*. These patches are not interconnecting and do not form part of an ecological corridor. It is not anticipated that the proposed Link would exaggerate the existing fragmentation of LHSGIF that falls within the proposed Link's footprint.

The proposed Link is not likely to increase the fragmentation and isolation of known habitat for *P. pauciflora* throughout its range.

Whether critical habitat will be affected.

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

Persoonia pauciflora is not adequately represented in conservation reserves or similar protected areas (NPWS 2000b).

Whether the development or activity proposed is of a class of development or activity which is recognised as a threatening process.

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. The proposed Link requires the Clearing of Native Vegetation.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

Persoonia pauciflora was not detected within the study area. Known populations of this species occur approximately 3 km to the south of Branxton, which is outside the proposed Link's footprint. Although not directly impacting on the highly localised populations of *P. pauciflora*, the proposed Link is considered to be at or near the limit of the known distribution of this species.

Conclusion

The F3 to Branxton Link is at or near the known limit of the distribution of *Persoonia pauciflora*, the proposed Link requires the Clearing of Native Vegetation which is a threatening process and the species is not considered to be adequately represented in conservation reserves. However, the proposed Link is unlikely to fragment the highly localised population of *P. pauciflora* and no specimens were found under the F3 to Branxton Link footprint during the extensive field surveys.

For these reasons, it is not likely that the proposed Link would have a significant impact on the future survival of *Persoonia pauciflora*.

Rutidosia heterogama

Rutidosia heterogama is listed as Vulnerable on Schedule 2 of the TSC Act and has a conservation significance rating of 2Va (Briggs and Leigh 1995). This species has not been previously assessed as Biosis Research Pty. Ltd. recorded it in the study area after the submission of the initial UAFFA report in September 2003. This species has not been previously recorded within the study area.

Rutidosia heterogama is a perennial daisy with erect glabrous stems to 30 cm high from a woody base. The flowers are yellow and in solitary, terminal heads. Flowering time is autumn. Within its range it is often found along disturbed roadsides (Harden 1993a).

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction,

A population of this species comprising several sub-populations has recently been reported from KSSW and LHSGIF in the lower Hunter (Stevenson 2004). The size of this population has not as yet been established. The species is found in dry sclerophyll forest and woodland as well as sand dunes (Stevenson 2004). It is often associated with disturbed areas. It does not appear to favour particular soil types and it occurs at a range of altitudes (Stevenson 2004). There is very little information available about *R. heterogama* in terms of either its distribution or abundance (Stevenson 2004).

There is also very little information available regarding the phenology and ecology of *R. heterogama*. However, being a herbaceous perennial daisy it is assumed that the species is well adapted to high fire frequency, flowers seasonally and the fruits are wind-blown achenes. The biggest threat to this species is competition from other more aggressive herbaceous perennials (especially weed species which occupy the roadside niche). Only one flower head per stem probably restricts its reproduction. As an Asteraceae (daisies), pollination is probably by air-borne insects whose movements would not be restricted by the proposed Link.

It is not likely that the life cycle of *R. heterogama* would be disrupted such that a viable population of this species would be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

NA

In relation to the regional distribution of habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed,

In the Cessnock district, *R. heterogama* has been recorded from KSSW and LHSGIF (NSW Scientific Committee 2005). KSSW under the footprint is generally considered to be in good condition while LHSGIF is considered to be in a poor to moderate condition. Approximately 33.7 ha (1.6% of the total current distribution) of KSSW would be removed and 41.4 ha (1.9 %) would be modified through edge-effects. Thus, 3.5 % of the total current distribution of KSSW would be impacted either directly or indirectly. In addition, approximately 67 ha (0.25 % of the total current distribution) of LHSGIF would be removed and 87.1 ha (0.32 %) would be modified through edge-effects. Thus, 0.57 % of the total current distribution of LHSGIF would be impacted either directly or indirectly.

Combined, 0.79 % of the total current distribution of KSSW and LHSGIF would be removed or modified for the proposed Link. The modification and removal of a total of 0.79 % of habitat for *R. heterogama* in KSSW and LHSGIF is not considered to be a significant area.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community,

The proposed Link would directly impact ten fragments of KSSW. The proposed Link would dissect two relatively large fragments (59 and 63 ha) and would shave vegetation from the edge of the other eight fragments. Thus, the proposed Link would increase fragmentation and isolation of this community.

The proposed Link would directly impact 12 remnant patches of LHSGIF. The proposed Link would dissect four of these patches and would shave vegetation from the edges of the other eight. These patches are not interconnecting and do not form part of an ecological corridor. More significant areas of LHSGIF occur well to the north and south of the proposed Link (they are isolated from each other) and the proposed Link's footprint does not impact on either of these areas (Figure 3).

It is evident that *R. heterogama* is adapted to disturbed edges and therefore fragmented habitat. In addition, it is assumed that the species is pollinated by insects and dispersed by wind. For these reasons, it is unlikely that the proposed Link would have a detrimental impact on the species in terms of habitat fragmentation and isolation.

Whether critical habitat will be affected,

Critical habitat is declared under the TSC Act. No critical habitat is present within the study area or is likely to be impacted by the proposed Link.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region,

Rutidosia heterogama has been found in Yuraygir, Werakata and Bundjalung National Parks, as well as the Torrington State Conservation Area. In the absence of established population figures, it is assumed that the species is not adequately represented in conservation reserves.

Whether the development or activity proposed is of a class of development or activity which is recognised as a threatening process,

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. The proposed Link requires the Clearing of Native Vegetation.

What other threats are there, if any?

Whether any threatened species, population or ecological community is at the limit of its known distribution,

This species grows mostly in a variety of habitats in coastal districts with disjunct populations from the Maclean to the Hunter Valley and inland to Torrington (Stevenson 2004). It is therefore considered that *R. heterogama* is at or near the southern limit of its range in the vicinity of the proposed Link.

Conclusion

Rutidosia heterogama is at or near the southern limit of its range in the vicinity of the proposed Link, the proposed Link requires the Clearing of Native Vegetation, which is a Key Threatening Process and the species is not adequately represented in conservation reserves. However, the modification and removal of a total of 0.79 % of habitat for *R. heterogama* in KSSW and LHSGIF is not considered to be a significant area. Furthermore, the species has not been previously recorded within the study area and it is unlikely that the proposed Link would have a detrimental impact on the species in terms of habitat fragmentation and isolation. It is unlikely that the life cycle of *R. heterogama* would be disrupted such that a viable population of this species would be placed at risk of extinction.

Therefore it is unlikely that the proposed Link would have a significant impact on *Rutidosia heterogama*.

Tetradlea juncea

Tetradlea juncea is listed as Vulnerable on Schedule 2 of the TSC Act and has a conservation rating of 2VC- (Briggs and Leigh 1995).

Tetradlea juncea is a prostrate shrub with grass-like stems to 1 m long and alternate leaves that are usually reduced to narrow-triangular scales. The flowers are solitary or paired and a deep lilac-pink. Flowering time is July through to December. The species grows in damp heath and in dry sclerophyll forest. It has a range in coastal districts from Bulahdelah to Lake Macquarie and it has also been recorded from Port Jackson to Botany Bay from which it is possibly extinct (Harden 1993a).

Three populations of *Tetradlea juncea* were recorded within the study area.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction,

The three populations within the study area, were recorded as clumps of plants rather than as individuals. Clumps of 2, 33 and 123 were recorded for each of these populations respectively. Populations of over 100 clumps are considered to be highly significant (Lake Macquarie Council and Robert Payne Ecological Surveys and Management 2001). This population estimate is considered to be understated as the species has sporadic flowering, the population was only censused on one occasion and due to time limitations only a subset of the population was counted.

These populations are likely to be entirely removed by the proposed Link, one of which is highly significant. It is therefore considered that a viable population is likely to be removed and placed at risk of extinction by the proposed Link.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

NA

In relation to the regional distribution of habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed,

Habitat for *Tetratheca juncea* includes sandy or swampy heath or dry sclerophyll forest in coastal districts (Harden 1992). Within the study area and local region this species was only recorded within Coastal Plains Smooth-barked Apple Woodland. A total of 19.4 ha of this habitat is likely to be cleared for the proposed Link with a further 21.9 ha being edge affected. This is a total of 41.3 ha or 0.13 % of the total current potential habitat that would be affected by the proposed Link.

One population recorded under the F3 to Branxton Link footprint is considered to be highly significant. This population contained 123 clumps of *Tetratheca juncea*, some of which were white-flowered. The white-flowered variety is also considered to have conservation significance (NPWS 2000c).

For these reasons, the populations of *Tetratheca juncea* recorded within the study area are considered to be significant (especially the larger population) and the area of habitat to be removed or modified is considered to be a significant area.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community,

The proposed Link would pass through an extensive area of vegetation including several areas of potential habitat for this species. The proposed Link would result in further fragmentation of existing habitat. This is likely to result in increased isolation of populations of this species and increased risk of genetic isolation and decline through reduced outcrossing.

Whether critical habitat will be affected,

Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region,

This species is known to occur in Glenrock and Munmorah State Recreation Areas and in Awabakal Nature Reserve on the Central Coast of NSW (Briggs and Leigh 1996). The size of the population within Glenrock State Recreation Area exceeds 1000 plants. The other two populations are known to contain less than 1000 plants (Briggs and Leigh 1996).

This species is considered to be adequately reserved in the south-eastern portion of its distribution but is considered to be inadequately reserved in the vicinity of the study area (north western portion of distribution).

Whether the development or activity proposed is of a class of development or activity which is recognised as a threatening process,

Clearing of Native Vegetation is recognised as a Key Threatening Process under Schedule 3 of the TSC Act. Other recognised threats to this species include high fire frequency, and weed invasion (NPWS 2000d). The proposed Link requires the Clearing of Native Vegetation.

Whether any threatened species, population or ecological community is at the limit of its known distribution,

Tetraloche juncea is known to occur between Bulahdelah and Lake Macquarie. The species has also been recorded from Port Jackson to Botany Bay where it is possibly extinct (Harden 1992) and no further west than the Sugarloaf Range. The study area is considered to be at or near the western limit of the distribution for this species. The three populations are also considered to be at or near the western limit of distribution for this

species (Lake Macquarie Council and Robert Payne Ecological Surveys and Management 2001).

Conclusion:

Due to the presence of a highly significant population under the footprint, it is considered likely that the proposed Link would have a significant impact on this threatened species.

Fauna

Gang-gang Cockatoo (*Callocephalon fimbriatum*)

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

A Preliminary Determination has been made to support a proposal to list the Gang-gang Cockatoo as a vulnerable species in Schedule 2 of the TSC Act (NSW Scientific Committee 2004). The species will be considered further here, in the event that it does become listed as a vulnerable species.

The Gang-gang Cockatoo occurs in a variety of forest and woodland habitats dominated by eucalyptus species. It forages in the canopy of trees on seeds of native and introduced trees, especially eucalypts. Gang-gang Cockatoos nest in tree hollows, preferring live trees (often near water) with hollows between 70-200cm deep and approximately 25cm diameter. These trees often occur in mature sclerophyll forest with a dense shrubby understorey. Although not much is known about the movements of this species, it is known to migrate in response to food availability and seasonal changes.

No Gang-gang Cockatoos were recorded during the current survey. However, numerous observations have been recorded within 10km of the study area between 1982 and 2004. Two records exist within the study area (recorded 1996 and 1998) along the proposed Link, midway between the F3 Interchange and the Buchanan Interchange (DEC Atlas of NSW Wildlife).

The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. The habitat may provide foraging resources; however, due to the paucity of suitably sized hollow-bearing trees for nesting, it is unlikely to provide suitable breeding habitat for this species. It is therefore considered unlikely that the proposed Link would disrupt the life cycle of this species to the extent that a viable local population would be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There are no endangered populations of this species listed under Schedule 1 Part 2 of the TSC Act in the Cessnock or Lake Macquarie LGA's.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The study area occurs within the Sydney Basin bioregion (Thackway and Cresswell 1995). The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. Within the area of the LHCCREMS vegetation mapping, these habitat types have an extant area of 89,642 ha and hence the amount to be removed represents 0.2% of the extant area. Thus in relation to the regional distribution of the species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link is likely to cut through areas of potential habitat for this species. However, given the mobility of this species and lack of suitably-sized tree hollows, it is unlikely that the proposed Link would isolate any areas of known habitat.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared in the Cessnock or Lake Macquarie area or for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

Although the Gang-gang Cockatoo has been recorded at various reserves throughout eastern and central NSW, it is not known whether this species or their habitats are adequately represented in conservation reserves in the region.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes are listed on Schedule 3 of the TSC Act. The proposed Link would include the Clearing of Native Vegetation that is listed as a key threatening process.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. More specifically, in NSW, the Gang-gang Cockatoo is

distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. Isolated records are known from as far north as Coffs Harbour and as far west as Mudgee and the Australian Capital Territory (NPWS 2004a). Within the Hunter region, the Gang-gang Cockatoo is known to occur around Munghorn Gap, Scone, Singleton and Myall Lakes (Higgins 1999).

The study area occurs close to the northern limit of the Gang-gang Cockatoo's known distribution. However, records of the species do exist further north of the proposed Link.

Conclusion

The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. However, within the study corridor these vegetation communities do not represent prime or core habitat for this species due to the paucity of suitably sized hollows-bearing trees. Given the mobility of this species and extent of potential habitat within the local region it is unlikely that the proposed Link would have a significant impact on the Gang-gang Cockatoo.

Green and Golden Bell Frog (*Litoria aurea*)

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

No Green and Golden Bell Frogs (GGBF) have been recorded within the study corridor, the nearest local record occurring approximately 3 km north of Seahampton. A herpetological study associated with the FIS (Wells 1995) concluded that suitable habitat for this species existed in the Wallis Creek area, yet no individuals were recorded. The FIS concluded that disturbance to wetlands on the Wallis Creek floodplain during construction may have the potential to impact this species. This species was not considered further in any subsequent studies associated with the proposed Link (Connell Wagner 1998, 2000, 2001).

From discussion with Dr Michael Mahony from the University of Newcastle it appears that he is unaware of any GGBF records from Wallis Creek floodplain but says the species has been recorded from other areas of the catchment. He was not aware of any recent surveys from the area. Dr Andrew Hamer, who has recently finished his PhD on this species from Kooragang Island, concurs with Dr Mahony. He also said that despite the lateness of the season he would expect GGBF to be calling during the current surveys (Nov 2002) to take advantage of the wet conditions, particularly as few breeding opportunities occurred during the 2002/2003 summer.

Wallis Creek flows north from the Watagan Ranges towards the Hunter River along a broad valley, which is crossed by the proposed Link near its confluence with Surveyors

Creek at Buchanan, which would run in an east-west direction crossing the Wallis Creek floodplain north of John Renshaw Drive. Although the valley and creekline are largely cleared, the creek provides a string of wetlands, including permanent and ephemeral ponds and farm dams. A proposed bridge span of about 200 m over both watercourses at their closest point allowing for a continuous riparian corridor. This design should not greatly detract from the movement and/or dispersal opportunities that already exist. In particular, potential habitat for GGBF would not be excessively disturbed and dispersal of this species, should it occur, across the floodplain is unlikely to be restricted.

It is unlikely that life cycle of the Green and Golden Bell Frog would be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There are no endangered populations of this species listed on the TSC Act 1995.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The study area occurs within the Sydney Basin bioregion (Thackway and Cresswell 1995). The proposed F3 to Branxton Link would remove approximately 5 ha of potential habitat for this species within agricultural riparian habitat associated with the Wallis Creek floodplain. This represents a small proportion of the total area of potential habitat for this species within the Wallis Creek floodplain.

Hence in relation to the regional distribution of the species, it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

There are no known populations within the study area. The proposed F3 to Branxton Link would cross the Wallis Creek floodplain north of John Renshaw Drive. While some components of this species potential habitat (permanent and ephemeral pond, farm dams and surrounding grassland areas) would be directly affect by construction it is considered unlikely that areas of potential habitat north or south of the F3 to Branxton Link would become permanently isolated. Mitigation measures such as the construction of bridges would further reduce any isolation.

Whether critical habitat will be affected.

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. The DEC recommends that such an area should be declared critical habitat, having first consulted with the Scientific Committee. After a period of public exhibition the Minister for the Environment decides whether or not to declare the critical habitat. DEC maintains a register of critical habitat. To date no critical habitat has been declared for the GGBF and the proposed Link would not impact any other critical habitat.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

Most populations of this species are recorded within private land or council reserves (Ehmann, 1997). Only five regional conservation reserves are known to contain populations of this species: Ben Boyd NP, Botany Bay NP (breeding habitat not within park), Hat Head NP (no longer considered present), Jarvis Bay NP, Killalea SRA, Kooragang Island NR (extant), Myall Lakes NP, Nadgee NP, Royal NP (no longer considered present), Seven Mile Beach NP, Towra Point NR (extant), Tyagarah NR (no longer considered present) and Yuraygir NP (extant). Based on current understanding of this species distribution and ecology, it is unlikely, that the GGBF is adequately represented in regional conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes (KTP) are listed on Schedule 3 of the TSC Act, those related to the GGBF are:

- Predation by the Feral Cat (*Felis catus*)
- Predation by the European Red Fox (*Vulpes vulpes*)
- Predation by *Gambusia holbrooki* (eg. Plague Minnow or Mosquito fish)
- Clearing of native vegetation
- Bushrock removal

Additionally, a number of other activities are recognised as contributing to this species decline (Pyke and White 2001).

- Changing land use practices
- Draining and reclamation of coastal wetlands

The proposed Link in its current form is not considered a threatening process

The construction of the proposed Link through the Wallis Creek floodplain is unlikely to further increase these KTPs.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

The GGBFs current distribution is limited to the east coast between Byron Bay in northern NSW and Gippsland Lakes in north-eastern Victoria, however, there are large gaps in its coastal distribution (Morgan and Buttemer 1996). Any local populations of this species would not, therefore, be at the limit of its known distribution.

Conclusion

It is unlikely that the proposed F3 to Branxton Link would have a significant impact on the GGBF. Although the proposed Link would remove a small proportion (est. 5 ha) of potential habitat for this species, this in itself is unlikely to result in a significant impact to any local population within the Wallis Creek floodplain. The provision of mitigation measures is likely to further reduce impacts on this species.

Grey-headed Flying –fox (*Pteropus poliocephalus*)

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

The Grey-headed Flying-fox is a canopy-feeding frugivore, blossom-eater and nectarivore of rainforests, open forests, woodlands, *Melaleuca* swamps and *Banksia* woodlands. The species congregates in large numbers at roosting sites (camps) in habitats that include rainforest patches, *Melaleuca* stands, mangroves, riparian woodland or modified vegetation in urban areas. Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring.

Although this species was not recorded within the current survey or DEC Atlas of NSW Wildlife, it has been previously recorded at two locations within the study area, near Branxton Railway and between Tuckers Lane and Camp Road (Connell Wagner 2000, Gunninah Environmental Consultants 2002). The Grey-headed Flying-fox was observed to be foraging within these areas. This species forages opportunistically, often at distances up to 30 km from camps, and occasionally up to 60–70 km per night (NSW Scientific Committee, 2001). Given the mobility of this species and lack of camps within the study corridor, it is considered unlikely that a viable local population of Grey-headed Flying-fox would be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There are no endangered populations of this species listed under Schedule 1 Part 2 of the TSC Act in the Cessnock and Lake Macquarie LGA's.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The study area occurs within the Sydney Basin bioregion (Thackway and Cresswell 1995). The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. Within the area of the LHCCREMS vegetation mapping, the habitat types have an extant area of 89,642 ha and hence the amount to be removed represents 0.18% of the extant area. Hence in relation to the regional distribution of the species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Although the proposed F3 to Branxton Link would remove approximately 168 ha of vegetation, the Grey-headed Flying-fox forages at a distance of between 60 to 70km in one night. Given that no camp sites were recorded within the Kurri Kurri Corridor and the mobility of this species it is unlikely that the proposed Link would result in further isolate a known population of this species.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared in the Cessnock or Lake Macquarie area or for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

In NSW less than 15% of potentially suitable forest for the Grey-headed Flying-fox occurs in conservation reserves; only 5% of roost sites are similarly reserved (NSW Scientific Committee, 2001)

Therefore, this species is considered inadequately represented in regional conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes are listed on Schedule 3 of the TSC Act. The proposed Link would include the Clearing of Native Vegetation that is listed as a key threatening process.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Grey-headed Flying-fox occurs primarily along the eastern coastal plain from Bundaberg in Queensland, through NSW and south to eastern Victoria. Other movements are made over the Great Dividing Range to the western slopes of NSW and Queensland (NSW Scientific Committee, 2001). The study area is not, therefore, at the known limit of this species distribution.

Conclusions

Given that no camps have been recorded within the Kurri Kurri Corridor and the mobility of this species, it is unlikely that the proposed F3 to Branxton Link would have a significant impact on Grey-headed Flying-fox. Furthermore, the provision of mitigation measures is likely to further reduce impacts on this species.

Olive Whistler (*Pachycephala olivacea*)

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Olive Whistler is considered to be a sedentary bird occurring in woodland and forest with a dense understorey. This species is known to occur singly or groups of two, rarely up to four together (Higgins and Peter 2002).

The Olive Whistler was recorded during the current surveys on the alignment of the proposed Link at Allandale Quarry. It has also been recorded approximately 9km to the east and west of the alignment within the local area (the Birds Australia Atlas).

The proposed Link would remove approximately 168 ha of potential woodland. Given that this species is sedentary it is likely that the proposed Link would isolate populations and hence place the species at risk of extinction via stochastic events and the loss of genetic viability in the long term.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An endangered population is defined under the TSC Act as ‘a population specified in Part 2 of Schedule 1’. At the present time there are no endangered populations of Olive Whistler listed under the TSC Act. No endangered populations would therefore be affected by the proposed Link.

In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. Within the area of the LHCCREMS vegetation mapping, the habitat types have an extant area of 89,642 ha and hence the amount to be removed represents 0.18% of the extant area. Hence in relation to the regional distribution of the species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed Link is likely to fragment the known areas of potential habitat for this species within the Kurri Kurri Corridor. This species is considered to be sedentary and unlikely to traverse tracts of cleared land. Therefore it is likely that the proposed Link would further isolate areas of potential habitat for this species.

Whether critical habitat will be affected

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared in the Cessnock and Lake Macquarie area or for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

It is likely that area suitable potential habitat are well represented in conservation reserves such as Brisbane Waters National Park and Wollemi National park, however it is unlikely that this species is adequately represented in conservation.

Whether the development or activity is of a class of development or activity that is recognised as a threatening process

Threatening processes are defined under Schedule 3 of the TSC Act. The proposed Link would include the Clearing of Native Vegetation that is listed as a key threatening process.

Whether any threatened species, population or ecological community is at the limit of its known distribution

The Olive Whistler has been recorded from south-eastern Queensland to Tasmania. In New South Wales the species occurs east of the Great Dividing Range from Northern Rivers district to the Victorian Border. This species is not considered at the limit of its current distribution.

Conclusion

The Olive Whistler is considered to be a sedentary bird occurring in woodland and forest with a dense understorey. The proposed Link would remove approximately 168 ha of potential woodland. Given that this species is sedentary it is likely that the proposed Link would isolate populations and hence place the species at risk of extinction via stochastic events and the loss of genetic viability in the long term. Therefore the proposed Link would have a significant impact on this species.

Owls - Powerful Owl, Masked Owl and Sooty Owl

Three threatened owl species, Powerful Owl, Sooty owls and Masked Owl have potential habitat within the Kurri Kurri Corridor. All three of these species were recorded during the current survey and are listed as vulnerable on Schedule 2 of the TSC Act.

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Tree hollows are particularly important for all three of the Owl species. Firstly, they provide habitat for hollow-dwelling arboreal marsupials (probably restricted to Common Brush-tail and Common Ring-tail Possums within the study area), which comprise a large proportion of their diet, and secondly, they provide nesting sites for both (Higgins 1999). Large mature trees with hollows at least 0.4 m deep are required for nesting (Gibbons and Lindenmayer 1997). Estimates of the home range of the Sooty and Masked Owl are between 400 and 500 ha (Gibbons and Lindenmayer 1997). The Powerful Owl has a larger home-range of 600 to 1450 ha (Gibbons and Lindenmayer 1997).

The Sooty Owl and Masked Owl were recorded during the current survey on the alignment of the proposed Link near Stockrington Road. The Masked Owl was also previously recorded in the Kurri Kurri Corridor in the vicinity of Seahampton and Mount Sugarloaf and one individual was recorded 5km south of the study area by the Birds Australia Atlas. Although the Powerful Owl was not recorded during the current survey, it has been previously recorded within the study corridor, located within the Coal and Allied Lands northwest of Seahampton.

The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. The habitat may provide foraging resources, however due to the absence of suitably sized hollow-bearing tree for nesting it is unlikely to be prime or core habitat. Additionally, these species would potentially have an increased risk of road-related mortality during the operation phase of the proposed Link, caused when they scavenge for roadkills. Although this could potentially be serious, the implementation of mitigation measures that reduce the risk of roadkills should ensure that scavenging and hence road-related mortality along the proposed Link is minimal. It is unlikely that the species would be disrupted such that a viable local population would be at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An endangered population is defined under the TSC Act as ‘a population specified in Part 2 of Schedule 1’. At the present time there are no endangered populations of the Powerful Owl, Masked Owl and Sooty Owl listed under the TSC Act. No endangered populations would therefore be affected by the proposed Link.

In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

All three Owl species have a large home range, which is in the order of several hundred hectares (Gibbons and Lindenmayer 1997). The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. However within the study corridor these vegetation communities do not represent prime or core habitat for this species due to the absence of significant numbers of suitable hollows-bearing trees. Within the area of the LHCCREMS vegetation mapping, the habitat types have an extant area of 89,642 ha and hence the amount to be removed represents 0.18% of the extant area. Hence in relation to the regional distribution of the species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed Link is likely to cut through area of potential habitat for these species. However, given the large home-range and mobility of these species it is unlikely that the proposed Link would isolate any areas of known habitat.

Whether critical habitat will be affected

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared in the Cessnock and Lake Macquarie area or for these species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

The woodland habitat for these species is likely to be represented within Wollemi National Park, Brisbane Water National Park and Yengo National Park. However it is not known if these species are adequately represented in conservation reserves.

Whether the development or activity is of a class of development or activity that is recognised as a threatening process

Threatening processes are defined under Schedule 3 of the TSC Act. The proposed Link would include the Clearing of Native Vegetation that is listed as a key threatening process.

Whether any threatened species, population or ecological community is at the limit of its known distribution

All three Owl species have been recorded along the eastern coast of Australia from south-eastern Queensland to Victoria. (Debus, 1994). Records are concentrated on the coastward side of the Great Dividing Range but in many places its distribution extends to the inland slopes, mostly within approximately 200km of the coast. These species are not considered to be at the known limit of its distribution.

Conclusion

The three Owl species occupy a large home range, which is in the order of several hundred hectares (Gibbons and Lindenmayer 1997). The proposed F3 to Branxton Link would remove approximately 168 ha of potential habitat for this species. However within the study corridor these vegetation communities do not represent prime or core habitat for this species due to the absence of significant numbers of suitable sized hollows-bearing trees. Given the mobility of these species and extent of potential habitat within the local region it is unlikely that the proposed Link would have a significant impact on the Powerful Owl, Sooty Owl or Masked Owl.

Regent Honeyeater (*Xanthomyza phrygia*)

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

The Regent Honeyeater is considered to be highly mobile species occurring in temperate eucalypt woodlands and open forests (NPWS 1999i, Higgins *et al.* 2001). Most records are from box-ironbark eucalypt forests associations and wet lowland coastal forests (Pizzey 1983, NPWS 1999i).

Although this species has not been recorded within the Kurri Kurri Corridor it has been previously recorded at Aberdare State Forest and Bellbird Colliery. Due to the nomadic nature of this species and the surrounding resources available within the local area it is unlikely that a viable local population is likely to be placed at risk of extinction

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Endangered populations are listed under Schedule 1 Part 2 of the TSC Act. Regent Honeyeater in the Cessnock and Lake Macquarie LGA's are not listed as endangered populations.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The study area occurs within the Sydney Basin bioregion (Thackway and Cresswell 1995). The proposed F3 to Branxton Link would remove approximately 99.2 ha of potential habitat for this species. However within the study corridor these vegetation communities do not represent prime or core habitat for this species as most of the trees are immature with few suitably-sized feed trees. Within the area of the LHCCREMS vegetation mapping, the habitat types have an extant area of 54,463 ha and hence the amount to be removed represents 0.18% of the extant area. Hence in relation to the regional distribution of the species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed Link is likely to cut through potential habitat for this species, however, given the mobility and nomadic nature of this species it is unlikely that it would further isolate a known population of this species.

Whether critical habitat will be affected.

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. The DEC recommends that a particular area should be declared critical habitat, having first consulted with the Scientific Committee. After a period of public exhibition the Minister for the Environment decides whether or not to declare the critical habitat. DEC maintains a register of critical habitat. To date no critical habitat has been declared for the Regent Honeyeater and the proposed Link would not impact any other critical habitat.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

The Regent Honeyeater has been recorded in a number of conservation areas including Wollemi National Park, Brisbane Water National Park and Yengo National Park. (Jones, *et al.* 1997). The preferred habitat of this species is also likely to be well represented in conservation reserves such as Lower Hunter National Park and Watagan National park, but it is however due to the nomadic nature of this species it cannot be conserved adequately within conservation reserves

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes are listed on Schedule 3 of the TSC Act. Clearing of Native Vegetation is listed as a KTP. The proposed F3 to Branxton Link would remove approximately 168 ha of native vegetation of which 99.2 ha is potential habitat for the Regent Honeyeater.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

This species was once distributed along the east coast of NSW to Dalby in Queensland and Kangaroo Island in South Australia, however the distribution is now severely contracted. In NSW individuals range from the coast to the western slopes of the Great Dividing Range.

This species is not considered to be at the limit of its known distribution.

Conclusions

The proposed F3 to Branxton Link is likely to reduce the potential foraging habitat for this species, if present within the Kurri Kurri Corridor. However, given the mobility of this species and the lack of suitably sized feed it is unlikely that the proposed Link would have a significant impact on the Regent Honeyeater.

Squirrel Glider (*Petaurus norfolcensis*)

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

Within the study corridor, records exist for Squirrel Gliders at two locations: near Allandale and to the west of John Brown Lagoon. There is further suggestion that suitable habitat exists in the Coal and Allied lands near Seahampton, but this was not supported by the current habitat and targeted surveys. The Allandale record was dealt with in a separate Eight Part Test (Connell Wagner 2000) in which it was suggested that the area surrounding Allandale where the dead specimen was found does not resemble Squirrel Glider habitat. We concur with this finding and suggest that the area of forest near Allandale does not support a viable population of Squirrel Gliders. The capture of an individual west of John Brown Lagoon does probably constitute part of a viable population. Suitable habitat does exist in the area and local residents report seeing Squirrel/Sugar Gliders along Tuckers Lane. The proposed F3 to Branxton Link would run in an east-west direction approximately 3 km north of the site where the animal was captured. However, John Renshaw Drive already runs north of this point. With suitable mitigation measures implemented during the construction and operations phase, such as controlled clearing of trees with hollows and the provision of gliding poles, it is unlikely that a viable local population would be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Endangered populations are listed under Schedule 1 Part 2 of the TSC Act. Squirrel Gliders in the Cessnock and Lake Macquarie LGA's are not listed as Endangered Populations.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The study area occurs within the Sydney Basin bioregion (Thackway and Cresswell 1995). The proposed F3 to Branxton Link would remove approximately 125 ha of potential habitat for this species (Hunter Lowland Redgum Forest, Coastal Plains Smooth Barked Apple Woodland, Coastal Foothills Spotted Gum-Ironbark Forest and Lower Hunter Spotted Gum – Ironbark Forest). However within the study corridor these vegetation communities do not represent prime or core habitat for this species due to the absence of significant numbers of tree hollows. Within the area of the LHCCREMS vegetation mapping, these four communities have an extant area of 81,695 ha and hence the amount to be removed represents 0.15% of the extant area. Hence in relation to the

regional distribution of the species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Within the study area the only known population is located to the west of John Brown Lagoon. It is highly likely that this population is connected to individuals located within the Hunter Employment Zone, which is located further to the west. The proposed F3 to Branxton Link would be located approximately 3 km north of the site where an individual was captured and the nearest record of this species further north is approximately 15 km north. It is unlikely therefore that the proposed Link would further isolate a known population of this species. Mitigation measures such as the provision of gliding poles would further reduce any isolation.

Whether critical habitat will be affected.

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. The DEC recommends that a particular area should be declared critical habitat, having first consulted with the Scientific Committee. After a period of public exhibition the Minister for the Environment decides whether or not to declare the critical habitat. DEC maintains a register of critical habitat. To date no critical habitat has been declared for the Squirrel Glider and the proposed Link would not impact any other critical habitat.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

Within the region Squirrel Gliders have been recorded in the Blue Mountains National Park and Brisbane Water National Park. It is unclear whether or not it is present in the Lower Hunter National Park, since it has been recorded close to the park boundary, although no records exist within the park. Records do exist within the Hunter Employment Zone and part of this will become reserved due to proposed rezoning. The preferred habitat of this species is likely to be well represented in conservation reserves such as Yengo National Park and Wollemi National park, but it is however unlikely that this species is adequately represented in conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes (KTP) are listed on Schedule 3 of the TSC Act. Clearing of Native Vegetation is listed as a KTP. The proposed F3 to Branxton Link would remove approximately 168 ha of native vegetation of which 125 ha is potential habitat for the

Squirrel Glider. Predation by the European Fox and the feral cat are both listed as KTPs. The construction of the proposed Link through areas of intact vegetation (eg. the Coal and Allied Lands west of Seahampton) is likely to open up areas of previously intact vegetation to increased levels of predation. There is also a preliminary determination to list Removal of dead wood, dead trees and logs as a KTP. It is highly likely that Clearing of Native Vegetation would result in removal of dead trees containing hollows.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Squirrel Glider is distributed along the east coast from western Victoria to north Queensland. It is found inland as far as the Pilliga and Coonabarabran areas of NSW. The study site is therefore not at the limit of the known distribution of the Squirrel Glider.

Assessment Conclusions

Overall it is unlikely that the proposed F3 to Branxton Link would have a significant impact on Squirrel Gliders. Although the proposed Link would increase recognised threatening processes for this species, they are unlikely to result in a significant decrease in population size. The habitat present in the study corridor is not prime for this species, and if present the species is unlikely to be present in high numbers. The provision of mitigation measures is likely to further reduce impacts on this species.

Swift Parrot (*Lathamus discolor*)

In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at risk of extinction.

The Swift Parrot is highly nomadic species that occurs in woodlands and forest in NSW from May to August (Higgins 1999). It migrates in response to food availability and seasonal changes (Higgins 1999). It is often recorded in NSW between May to August and breeds in Tasmania during the warmer seasons (Higgins 1999).

This species was not recorded within the study area, however it has been recorded south of the Kurri Kurri Corridor. The potential habitat for this species within the Kurri Kurri Corridor is unlikely to be core habitat, as most of the trees are immature with few suitably-sized feed trees. Therefore, given the mobility of this species and poor quality of habitat, it is unlikely that a viable local population would be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Endangered populations are listed under Schedule 1 Part 2 of the TSC Act. Swift Parrot in the Cessnock and Lake Macquarie LGA's are not listed as endangered populations.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The study area occurs within the Sydney Basin bioregion (Thackway and Cresswell 1995). The proposed F3 to Branxton Link would remove approximately 99.2 ha of potential habitat for this species. Within the area of the LHCCREMS vegetation mapping, the habitat types have an extant area of 54,463 ha and hence the amount to be removed represents 0.18% of the extant area. Hence in relation to the regional distribution of the species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The Swift Parrot was not recorded within the study area, however this species has been recorded south of the Kurri Kurri Corridor. The proposed F3 to Branxton Link would be located approximately 3 km north of the nearest recorded. It is unlikely therefore that the proposed Link would further isolate a known population of this species.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared in the Cessnock and Lake Macquarie area or for this species (DEC Threatened Species Unit).

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

The preferred habitat of this species is likely to be well represented in conservation reserves such as Brisbane Water National Park and Wollemi National park, but it is however unlikely that this species is adequately represented in conservation (Debbie Saunders, Swift Parrot Project Officer DEC, *pers. com.* 2002).

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes are listed on Schedule 3 of the TSC Act. Clearing of Native Vegetation is listed as a KTP. The proposed F3 to Branxton Link would remove approximately 168 ha of native vegetation of which 99.2 ha is potential habitat for the Swift Parrot.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

This species has been recorded along the south east of Australia from Queensland to Tasmania. In NSW they are mainly recorded east of the Great Divide, in the Central and Southern tablelands and coast regions (Higgins 1999).

This species is not considered to be at the limit of its known distribution.

Conclusions

Although the Swift Parrot was not recorded within the Kurri Kurri Corridor it is likely to use study area on a temporary basis. However, given the nomadic nature of this species and poor quality of habitat within the Kurri Kurri Corridor it is unlikely that the proposed F3 to Branxton Link would have a significant impact on the this species.

Wetland Birds

Potential habitat for five threatened, wetland bird species (Black Bittern *Ixobrychus flavicollis*, Black-necked Stork *Ephippiorhynchus asiaticus*, Comb-crested Jacana *Irediparra gallinacea*, Freckled Duck *Stictonetta naevosa*, Magpie Goose *Anseranas semipalmata* and Painted Snipe *Rostratula benghalensis australis*) occurs within the Kurri Kurri Corridor. None of these species were recorded during the current or previous surveys.

Potential habitat that would be impacted by the proposed Link occurs almost entirely within the Wallis Creek flood plain. The only species previously recorded from within the study corridor include the Comb-crested Jacana and the Black-necked Stork, although the remaining four species have been recorded within a 10 km radius of the study area (DEC Atlas of NSW Wildlife).

The Black Bittern has been previously recorded at one location on Winding Creek near Cardiff, approximately 7 km southeast of the study area (Seahampton).

The Black-necked Stork has been previously recorded in three locations: near Kurri Kurri 2 km southwest of the alignment, the Wallis Creek floodplain 1 km north of the alignment and Hexham Swamps.

The Comb-crested Jacana has been previously recorded in six locations: Wallis Creek floodplain 1 km north of the alignment, Colliery Dam on Wallis Creek 5 km south of the alignment, Wallis Creek 10 km south of the alignment, Wallsend 3 km southwest of the alignment, Lake Macquarie and Hexham Swamps.

The Freckled Duck has been previously located at one location in Hexham Swamps.

The Magpie Goose has been previously recorded at two locations: Blue Gum Creek 4 km north of the alignment and at Hexham Swamps.

The Painted Snipe has been previously recorded at two locations: Blue Gum Creek 4 km north of the alignment and Wallsend 3 km southwest of the alignment.

In the case of a threatened species, whether the life cycle of this species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Although potential wetland habitat exists within the study area for these species, only limited floodplain habitat along Wallis Creek would be impacted by the proposed Link. Additionally, the proposed Link would include a 176 m bridge that would span both Wallis and Surveyors Creek in this section, providing uninterrupted movement at ground level along the floodplain. Therefore, given the small area of limited habitat to be impacted, the maintained connectivity along Wallis Creek floodplain and the mobility of these species, it is unlikely that a viable local population of any of these species would be placed at risk of extinction.

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There are no endangered populations for these wetland bird species listed under Schedule 1 Part 2 of the TSC Act within the Cessnock or Lake Macquarie LGA's. No endangered populations would therefore be affected by the proposed Link.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The proposed Link would remove a very small area of limited potential floodplain habitat for these species along Wallis Creek. In relation to the regional distribution of these species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Although potential wetland habitat exists within the study area for these species, only limited floodplain habitat along Wallis Creek would be impacted by the proposed Link. Additionally, the proposed Link would include a 176 m bridge that would span both Wallis and Surveyors Creek in this section, providing uninterrupted movement at ground level along the floodplain. Due to these reasons and these species high mobility, the proposed Link is unlikely to isolate wetland bird populations or their habitat.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for any of these wetland bird species.

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

Locally, the Black-necked Stork, Comb-crested Jacana, Freckled Duck and Magpie Goose have been recorded in Hexham Swamps (DEC Atlas of NSW Wildlife). However, it is not known if these wetland bird species are adequately represented within conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes (KTP) are listed on Schedule 3 of the TSC Act. A threatening process is defined under the TSC Act as “a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”. Wetland modification, as a result of changes to water flow and degradation of water quality, is recognised as a major threat to most of these wetland bird species. The “alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands” has been listed as a KTP.

The proposed Link has been designed specifically to maintain the existing hydrology of the study area (through careful culvert design and placement) and to preserve existing water quality (through the appropriate management of run-off). Therefore, it is considered unlikely that the proposed Link would result in the modification of adjoining wetland habitats to the detriment of these wetland bird species.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Magpie Goose is considered to be an irregular visitor to southeast Australia and the Black-necked Stork occurs in coastal areas south of Queensland to the Central Coast in NSW. The remaining four species are not at the limit of their known distribution.

Therefore, only the Black-necked Stork can be considered as at the limit of its known distribution, while the Magpie Goose is an irregular visitor to the region.

Conclusion

Although potential wetland habitat exists within the study area for these species, only limited floodplain habitat along Wallis Creek would be impacted by the proposed Link. Additionally, the proposed Link would include a 176 m bridge that would span both Wallis and Surveyors Creek in this section, providing uninterrupted movement at ground level along the floodplain. Therefore, given the small area of limited habitat to be impacted, the maintained connectivity along Wallis Creek floodplain and the mobility of these species, it is unlikely that a viable local population of any of these species would be placed at risk of extinction.

Woodland Birds

Potential habitat for five woodland bird species (Brown Treecreeper, Speckled Warbler, Hooded Robin, Diamond Firetail and Grey-crowned Babbler) occurs within the Kurri Kurri Corridor. Two of these species (Speckled Warbler and Grey-crowned Babbler) were recorded during the current surveys.

In the case of a threatened species, whether the life cycle of this species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The woodland bird species occur in eucalypt woodlands with a grassy understorey, mostly west of the Great Dividing Range with some populations occurring in the drier woodlands in coastal area such as the Hunter Valley. These species are considered sedentary and are often recorded in pairs or small family groups.

All of these species have been previously recorded to the west and east of the proposed Link. Two of these species (Speckled Warbler and Grey-crowned Babbler) were recorded during the current surveys on the alignment of the proposed Link near Tuckers Lane and Allandale Quarry.

The proposed Link would remove approximately 168 ha of potential woodland habitat for these species. Potential habitat within the Allandale Quarry and Tuckers Lane site would be fragmented by the proposed Link. This is likely to isolate populations and hence place

the species at risk of extinction via stochastic events and the loss of genetic viability in the long term (NPWS 2001, NSW Scientific Committee 2001a, b).

In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There are no endangered populations for these woodland species listed under Schedule 1 Part 2 of the TSC Act within the Cessnock and Lake Macquarie LGA's. No endangered populations would therefore be affected by the proposed Link.

In relation to the regional distribution of a habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The proposed Link would remove approximately 168 ha of potential habitat for these species within the local area. Within the area of the LHCCREMS vegetation mapping this habitat type has an extant area of 89,642 ha and hence the amount to be removed represents 0.18% of the extent area. In relation to the regional distribution of these species it is unlikely that a significant area of known habitat would be modified or removed.

Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed F3 to Branxton Link is likely to fragment the potential habitat for the woodland bird species within the Kurri Kurri Corridor. These five woodland species are considered to be sedentary and unlikely to traverse tracts of cleared land, particularly the Grey-crowned Babbler (NPWS 2001, NSW Scientific Committee 2001a, b). The proposed Link would further isolated areas of potential habitat in the Allandale Quarry and Tuckers Lane and is likely to result in isolated woodland bird populations.

Whether critical habitat will be affected.

Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for any of these woodland bird species

Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.

The woodland habitat is likely to be well represented in conservation reserves such as the Lower Hunter National Park, Wollemi National Park and Watagan National Park. However it is not know if these woodland species are adequately represented within conservation reserves.

Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Key Threatening Processes (KTP) are listed on Schedule 3 of the TSC Act. Clearing of Native Vegetation is listed as a KTP. The proposed F3 to Branxton Link would remove approximately 168 ha of native vegetation. Further threats to woodland bird species include fragmentation of habitat causing isolation of populations, degradation of habitat and nest predation are considered to be threats to the potential survival of woodland bird species. The proposed Link is likely to result in the further fragmentation of potential habitat for these species.

Whether any threatened species, population or ecological community is at the limit of its known distribution.

All of the five woodland bird species have been recorded from New England in the north to the Riverina in the south. These species are not considered at the limit of their known distribution.

Conclusion

The proposed Link would remove approximately 168 ha of potential woodland habitat for the five woodland bird species. Potential habitat within the Allandale Quarry and Tuckers Lane site would be fragmented by the proposed Link. This is likely to isolate populations and hence place the species at risk of extinction via stochastic events and the loss of genetic viability in the long (NPWS 2001, NSW Scientific Committee 2001a, b). Therefore the proposed Link is likely to have a significant impact on these species.

Appendix 9: EPBC Act Significance Assessments

Flora

Vulnerable Plant Species

Potential habitat occurs within the study area for seven vulnerable plant species listed on the EPBC Act. Each of these species is listed under the TSC Act and, as such, have had Eight Part Tests conducted in Appendix 8. It is assumed here that assessments using Eight Part Tests under the EP&A Act are comparable to EPBC Assessments of Significance, and as such, species determined likely to be significantly impacted using Eight Part Tests would be determined likely to be significantly impacted using EPBC Assessments of Significance and vice versa. Therefore Assessments of Significance for threatened plant species have not been conducted for the purposes of this report.

Fauna

Endangered Animal Species

Potential habitat occurs within the study site for three Endangered animal species listed on the EPBC Act (Giant Barred Frog, Swift Parrot and Regent Honeyeater). All of these species are listed under the TSC Act. The Giant Barred Frog was previously assessed by Connell Wagner (2001) and the Swift Parrot and Regent Honeyeater in this study (Appendix 8). Therefore Assessments of Significance for these species have not been conducted for the purposes of this report.

Vulnerable Animal Species

Potential habitat occurs within the study site for seven Vulnerable animal species listed on the EPBC Act. For three of these (Red Goshawk, Spotted-tailed Quoll and Brush-tailed Rock-wallaby) the potential habitat is suboptimal and there have been no records of the species within 10 km of the study site. These species have therefore not been considered further as they are unlikely to be impacted. Two species (Green and Golden Bell Frog and Grey-headed Flying-fox) also listed under the TSC Act, have been considered in Appendix 8. The other two species (Heath Frog and Large-eared Pied Bat) were previously assessed by Connell Wagner (2001). Therefore these species have not been considered further.

Migratory Animal Species

Sixty-one migratory species or their habitat have been previously recorded in the local area of the F3 to Branxton Link (Table 9). Of these, fifty-seven species are considered to have potential habitat within the study area and have been considered under the guidelines for significance for the EPBC Act (Table 13).

Table 13: Migratory species with potential habitat along the proposed Link.

Latin Name	Common Name	Significance impact question			Significant Impact
		1	2	3	
Australasian Shoveler	<i>Anas rhynchotis</i>	X	X	X	No
Australian Hobby	<i>Falco longipennis</i>	X	X	X	No
Australian Wood Duck	<i>Chenonetta jubata</i>	X	X	X	No
Banded Lapwing	<i>Vanellus tricolor</i>	X	X	X	No
Black Falcon	<i>Falco subniger</i>	X	X	X	No
Black Kite	<i>Milvus migrans</i>	X	X	X	No
Black Swan	<i>Cygnus atratus</i>	X	X	X	No
Black-faced Monarch	<i>Monarcha melanopsis</i>	X	X	X	No
Black-fronted Dotterel	<i>Elseornis melanops</i>	X	X	X	No
Black-shouldered Kite	<i>Elanus axillaris</i>	X	X	X	No
Black-winged Stilt	<i>Himantopus himantopus</i>	X	X	X	No
Brown Falcon	<i>Falco berigora</i>	X	X	X	No
Brown Goshawk	<i>Accipiter fasciatus</i>	X	X	X	No
Cattle Egret	<i>Ardea ibis</i>	X	X	X	No
Chestnut Teal	<i>Anas castanea</i>	X	X	X	No
Cicadabird	<i>Coracina tenuirostris</i>	X	X	X	No
Clamorous Reed-Warbler	<i>Acrocephalus stentoreus</i>	X	X	X	No
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>	X	X	X	No
Crested Shrike-tit	<i>Falcunculus frontatus</i>	X	X	X	No
Freckled Duck	<i>Stictonetta naevosa</i>	X	X	X	No
Golden-headed Cisticola	<i>Cisticola exilis</i>	X	X	X	No
Grey Falcon	<i>Falco hypoleucos</i>	X	X	X	No
Grey Goshawk	<i>Accipiter novaehollandiae</i>	X	X	X	No
Grey Teal	<i>Anas gracilis</i>	X	X	X	No
Hardhead	<i>Aythya australis</i>	X	X	X	No
Latham's Snipe	<i>Gallinago hardwickii</i>	X	X	X	No
Little Eagle	<i>Hieraaetus morphnoides</i>	X	X	X	No
Little Grassbird	<i>Megalurus gramineus</i>	X	X	X	No
Masked Lapwing	<i>Vanellus miles</i>	X	X	X	No
Musk Duck	<i>Biziura lobata</i>	X	X	X	No
Nankeen Kestrel	<i>Falco cenchroides</i>	X	X	X	No
Osprey	<i>Pandion haliaetus</i>	X	X	X	No
Pacific Baza	<i>Aviceda subcristata</i>	X	X	X	No
Pacific Black Duck	<i>Anas superciliosa</i>	X	X	X	No
Painted Snipe	<i>Rostratula benghalensis</i>	X	X	X	No
Peregrine Falcon	<i>Falco peregrinus</i>	X	X	X	No
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>	X	X	X	No
Plumed Whistling Duck	<i>Dendrocygna eytoni</i>	X	X	X	No
Rainbow Bee-eater	<i>Merops ornatus</i>	X	X	X	No
Red Goshawk	<i>Erythrotriorchis radiatus</i>	X	X	X	No
Red-kneed Dotterel	<i>Erythronyctis cinctus</i>	X	X	X	No
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	X	X	X	No
Regent Honeyeater	<i>Xanthomyza phrygia</i>	X	X	X	No
Rufous Fantail	<i>Rhipidura rufifrons</i>	X	X	X	No
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	X	X	X	No
Scaly Thrush	<i>Zoothera dauma</i>	X	X	X	No
Spectacled Monarch	<i>Monarcha trivirgatus</i>	X	X	X	No
Spotted Harrier	<i>Circus assimilis</i>	X	X	X	No
Swamp Harrier	<i>Circus approximans</i>	X	X	X	No
Swift Parrot	<i>Lathamus discolor</i>	X	X	X	No
Tawny Grassbird	<i>Megalurus timoriensis</i>	X	X	X	No
Wandering Whistling-duck	<i>Dendrocygna arcuata</i>	X	X	X	No
Wedge-tailed Eagle	<i>Aquila audax</i>	X	X	X	No
Whistling Kite	<i>Haliastur sphenurus</i>	X	X	X	No
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	X	X	X	No
White-throated Needletail	<i>Hirundapus caudacutus</i>	X	X	X	No
Yellow-tufted Honeyeater	<i>Lichenostomus melanops</i>	X	X	X	No

X = a negative response to the questions, No = no significant impact

For the purposes of the Act, an area of important habitat for migratory species is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
- habitat utilised by a migratory species which is at the limit of the species range, or
- habitat within an area where the species is declining.

None of the species to be considered are at the edge of their range, the study area does not constitute an area containing a significant proportion of the population and the species are not considered to be declining in the study area. Thus none of the 61 species have been considered under criteria 1 and 2.

Is the action likely to substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species?

Not applicable.

Is the action likely to result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species?

Not applicable.

Is the action likely to seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species?

The proposed F3 to Branxton Link would remove only a relatively small amount of vegetation that cannot be considered habitat for a significant proportion for any population of the 61 species. Thus it is unlikely that an ecologically significant proportion of the population of the 61 migratory species would be affected.

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