



Penrith Lakes Nepean Pump and Pipeline: Terrestrial and Aquatic Flora and Fauna Impact Assessment

17 March 2006

**Matthew Beitzel
Jennifer Charlton
Sian Wilkins**

**Report for Maunsell
Australia Pty Ltd**

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and Pipeline: Terrestrial and
Aquatic Flora and Fauna
Impact Assessment**

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**Matthew Beitzel
Jennifer Charlton
Sian Wilkins**

Project no: s4173

Ballarat

*449 Doveton Street North, Ballarat VIC 3354
Ph: (03) 5331 7000 Fax: (03) 5331 7033
email: ballarat@biosisresearch.com.au*

Melbourne:

*38 Bertie Street, Port Melbourne VIC 3207
Ph: (03) 9646 9499 Fax: (03) 9646 9242
email: melbourne@biosisresearch.com.au*

Queanbeyan:

*55 Lom Road, Queanbeyan NSW 2620
Ph: (02) 6284 4633 Fax: (02) 6284 4699
email: queanbeyan@biosisresearch.com.au*

Sydney:

*15-17 Henrietta Street, Chippendale NSW 2008
Ph: (02) 9690 2777 Fax: (02) 9690 2577
email: sydney@biosisresearch.com.au*

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ABBREVIATIONS

CAV	Census of Australian Vertebrates
DEC	NSW Department of Environment and Conservation
DEH	Commonwealth Department of the Environment and Heritage
DIPNR	Department of Infrastructure, Planning and Natural Resources (now Department of Natural Resources)
DPI	Department of Primary Industries
EIS	Environmental Impact Statement
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>Fisheries Management Act 1994</i>
KTP	Key Threatening Process
LGA	Local Government Area
LWD	Large Woody Debris
MNES	Matter of National Environmental Significance
NPWS	NSW National Parks and Wildlife Service (now DEC)
ROTAP	Rare or Threatened Australian Plant as listed by Briggs and Leigh (1995)
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TSC Act	<i>Threatened Species Conservation Act 1995</i>
sp.	species (singular)
spp.	species (plural)
ssp.	subspecies
var.	variety

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1.0 SUMMARY

Biosis Research Pty. Ltd. was commissioned by Maunsell Australia Pty Ltd to undertake a terrestrial and aquatic flora and fauna assessment for the proposed Nepean pump and pipeline at Penrith Lakes. The study area comprises the southern sector of the Penrith Lakes Development Corporation (PLDC) Scheme Area and a section of Riparian Vegetation adjacent to the Nepean River, immediately south of the PLDC Scheme boundary.

This report assesses the conservation significance of the study area in terms of threatened species, populations (and their habitats) or ecological communities that occur, or have the potential to occur, in the study area in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act), *Threatened Species Conservation Act 1995* (TSC Act), *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Fisheries Management Act 1994* (FM Act).

An aquatic ecologist, botanist and zoologist from Biosis Research surveyed the proposed pipeline routes on 16 June 2005. Pipeline Route 1 follows the banks of the Nepean River for part of its length. The riparian vegetation adjoining the Nepean River is highly degraded and generally restricted to a strip of trees adjoining the river with an understorey dominated by exotic species and will be impacted by part of Pipeline Route 1. The remainder of Pipeline Route 1 traverses highly degraded vegetation also dominated by exotic species, with some planted native species also present.

Pipeline Routes 2 and 3 both connect to and continue on from Pipeline Route 1, therefore any impacts associated with Pipeline Route 1 are common to all three routes. The majority of the additional area to be impacted by the proposed pipeline routes 2 and 3 is highly degraded vegetation dominated by exotic species. These routes traverse vegetation within the boundaries of and immediately surrounding the quarried area within Penrith Lakes Scheme Area.

Terrestrial Flora

River-flat Eucalypt Forest, an Endangered Ecological Community (EEC) listed under the TSC Act, was recorded adjoining the Nepean River along Pipeline Route 1. An Eight Part Test was conducted for this community and concluded that the proposal would not have a significant impact on the community. No EECs listed under the EPBC Act were recorded in the study area.

No threatened flora species, populations, or their habitats were recorded in the study area. As such, no Eight Part Tests or Assessments of Significance were required for any flora species and a Species Impact Statement or Referral is not required for any flora related issues for the proposed development.

Terrestrial Fauna

Potential habitat occurs along the proposed route options for five threatened fauna species listed under the TSC Act and two threatened and five migratory fauna species listed under the EPBC Act. An additional eight migratory bird species were recorded during the current survey. No Eight Part Tests or Assessments of Significance were carried out as the proposed development is unlikely to cause:

- individual death or injury to significant fauna;
- loss or disturbance of limiting foraging habitat for significant fauna; and/or
- loss or disturbance of limiting breeding habitat for significant fauna.

As no significant impacts are expected to threatened and migratory fauna the route options have not been ranked in order of preference. A Species Impact Statement and/or a Referral to the Federal Minister for the Environment are therefore not required for fauna.

Aquatic Fauna

One threatened aquatic species, Macquarie Perch *Macquaria australasica*, listed under the EPBC and the FM Act, is known to occur in large creeks upstream of the Penrith Weir. An Eight Part Test and Assessment of Significance concluded that there would be no significant impact to this species and therefore a Species Impact Statement and/or Referral is not required.

Mitigation Measures

To reduce the potential impact of the proposal on terrestrial and aquatic flora and fauna, the following mitigation measures are recommended:

Terrestrial Flora and Fauna

- Develop and Implement a Vegetation Management Plan detailing bush regeneration works and weed management strategies.
- Monitor areas to be impacted by the proposal, particularly the riparian vegetation along the Nepean River and tributaries.
- Native species of local provenance should be used for revegetation. Vegetation representing all stratum should be planted during the revegetation process to provide habitat resources for fauna along the length of the pipeline.

- Develop and Implement an Erosion and Sedimentation Control Plan in consultation with the Department of Environment and Conservation.
- Where possible, retain existing trees to maintain current foraging and nesting habitat resources for common fauna, as well as to maintain existing fauna corridors.
- Plant dense waterside vegetation around all existing dams along the chosen route of the pipeline to provide shelter and nesting resources for threatened and migratory fauna.
- Construct temporary access bridges over Peach Tree Creek and Boundary Creek to limit human disturbance on the creek line habitat.

Aquatic Flora and Fauna

- Minimise the impact to the Nepean River and its tributaries through sedimentation control, channel maintenance and rehabilitation.
- Regularly monitor water quality and flows at the Penrith weir and outlet.
- The proposed pumping regime should be further investigated to minimise impacts on downstream flows and fish passage.
- Should drawdown prevent either entry or passage through the fish ladder or the attractant flow within the Nepean River, measures should be implemented to correct this.
- Control measures should be implemented to prevent erosion or sedimentation under high flow and/or flood conditions during construction and rehabilitation of the banks of the Nepean River.
- Where possible, the route of the pipeline should follow existing roads and not cross pits, dams or riparian vegetation.
- Prevent the transport of aquatic weeds (e.g. *Egeria densa*, *Salvinia molesta*, *Elodea canadensis*) through inlet and outlet design and other quarantine methods.
- Consider the establishment of a wetland system at the outlet to assist in improving the water quality provided by the pipeline.
- Organisations which should be consulted regarding the abstraction of water from the Nepean River include Hawkesbury-Nepean CMA and Sydney Catchment Authority.

2.0 INTRODUCTION

2.1 Background

Biosis Research Pty. Ltd. was commissioned by Maunsell Australia Pty Ltd to undertake a terrestrial and aquatic flora and fauna assessment for the proposed Nepean pump and pipeline at Penrith Lakes Development Corporation (PLDC) Scheme Area, described below. This report assesses the conservation significance of the study area in terms of threatened species, populations (and their habitats) or ecological communities that occur, or have the potential to occur, in the study area in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act), *Threatened Species Conservation Act 1995* (TSC Act), *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Fisheries Management Act 1994* (FM Act).

2.1.1 Description and Features of the Study Area

The study area comprises the southern sector of the PLDC Scheme Area (the Scheme) and a section of Riparian Vegetation adjacent to the Nepean River, just south of the Scheme boundary, (Figure 1). The study area lies within the Penrith Local Government Area (LGA) and is managed by the PLDC. The PLDC Scheme Area comprises a rectangular shaped block that is bounded by residential, rural and industrial development to the east, north and south and dense vegetation adjoining Blue Mountains National Park to the west (Figure 1). The Nepean River borders the Scheme to the south and the west and dense areas of vegetation occur at Castlereagh to the north-east.

A large sand and gravel quarrying operation on the Hawkesbury-Nepean River floodplain occurs within the Scheme boundary. There are a number of man-made lakes and dams present that are the result of rehabilitation of past quarrying activities and are used for recreational activities such as rowing and canoeing.

The majority of native vegetation within the study area has been historically cleared. Remaining remnants of native vegetation are mainly restricted to the banks of the Nepean River.

2.1.2 Proposed Development Activity

PLDC propose to construct a pipeline to pump water from Penrith Weir on the Nepean River into existing quarry pits or dams within the Penrith Lakes Scheme, with the aim of extending existing dams and filling new dams. The proposed pipeline flow rates are 0.3- 1.7m³/second, resulting in a flow of approximately ~147 ML/d. Under the existing water license (No 47922) issued in 2000,

pumping is permitted when flow rates exceed 170 ML/d over Penrith Weir. This limit has been set in consideration of downstream extraction requirements and has not taken in to account any environmental flow assessments. Three separate pipeline routes have been proposed, Pipeline Routes 1, 2 and 3 (Figure 2). All three routes start at Penrith Weir and end within the PLDC Scheme boundary. Pipeline Routes 2 and 3 connect to and continue on from Pipeline Route 1, therefore any impacts associated with Pipeline Route 1 are common to all three routes.

Pipeline Route 1 starts immediately south of the Penrith Weir and follows the northern bank of the Nepean River, crossing Peach Tree Creek and Boundary Creek (tributaries of the Nepean River), before heading upslope a steep weedy bank. Route 1 then crosses a cleared area and follows a vehicle track before turning northwards between two tailings dams and discharging into a man made dam called Duck Pond (Figure 2). Three route options (A, B and C) within Pipeline Route 1 have been proposed (Figure 2). For the purpose of this impact assessment, the route option with maximum potential impact has been used for calculating the potential area of impact.

Pipeline Route 2 continues west from Pipeline Route 1 then heads north, through the quarry, generally staying as close as possible to the existing quarry roads, before discharging into a previously extracted area (Figure 2).

Pipeline Route 3 continues from where Pipeline Route 1 intersects with Castlereagh Road and heads in a westerly direction along Castlereagh Road and then north along existing quarry roads to the west of the rowing and warm up lakes, generally staying as close as possible to existing quarry roads, before discharging into an existing man-made dam (Figure 2).

2.2 Aims

The general aim of this report is to undertake a terrestrial and aquatic flora and fauna assessment of the study area and to determine the impact of the proposal on relevant matters of conservation significance.

The specific aims are to:

1. Conduct a literature review and database search for the study;
2. Provide a brief assessment of the habitat values of the study area;
3. Undertake targeted field surveys for threatened terrestrial species, populations (and their habitats) or ecological communities listed under the schedules of the TSC Act, FM Act and/or EPBC Act that are known or likely to occur within the study area;

4. Undertake Section 5A assessments Eight Part Test of Significance for threatened species, populations and ecological communities listed under the TSC Act and/or Assessment of Significance for threatened and migratory species listed under the EPBC Act that are either directly or indirectly impacted by the proposal; and
5. Recommend control measures to minimise the environmental impacts of the proposed development.

3.0 METHODS

The study area was surveyed on the 16th of June 2005. The general condition of the site was assessed and observations made of extant plant and animal species and vegetation communities (as detailed below). During the site visit the weather was sunny with moderate winds.

3.1 Taxonomy

The plant taxonomy (method of classification) used in this report follows Harden (1990, 1992, 1993, 2002) and subsequent advice from the National Herbarium of NSW. In the body of this report plants are referred to by their scientific names only. Common names where available have been included in the Appendices.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by Department of Environment and Heritage (DEH). Names of fish follow the Census of Australian Aquatic Biota (CAAB) maintained by CSIRO and DEH. In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only. Common and scientific names are included in the Appendices.

3.2 Statutory Regulations

Federal and State Acts and Policies that apply to the study area with regard to terrestrial and aquatic flora and fauna are listed below, further information on these regulations are provided in Appendix 1.

- *Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act)
- *Threatened Species Conservation Act 1995* (NSW) (TSC Act) and *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act)
- *Fisheries Management Act 1994* (FM Act)
- *Water Management Act 2000* and *Rivers and Foreshores Improvement Act 1948* (RFI Act)
- State Environmental Planning Policy (SEPP) 19 – Urban Bushland
- NSW DPI Fisheries Habitat Protection Plan 3 Hawkesbury Nepean Catchment
- Sydney Regional Environmental Plan (SREP) 11 Penrith Lakes Scheme

- Sydney Regional Environmental Plan (SREP) 20 – Hawkesbury-Nepean River

3.3 Literature and Database Review

A list of documents used to prepare this report is located in *References*. Database searches were conducted in May 2005. Records of threatened species, populations and communities were obtained from the Department of Environment and Conservation (DEC) Atlas of NSW Wildlife within a 10 km radius of the study area, using the Penrith 1:100 000 map sheets. Records of threatened fish species were obtained from Department of Primary Industries (DPI) Fisheries BioNET for the Hawkesbury-Nepean River system. Records for threatened species, populations and communities listed under the EPBC Act were obtained from the Department of Environment and Heritage (DEH) EPBC Online Database within a 10 km radius of the study area. In addition DPI Fishfiles for the Hawkesbury-Nepean River were checked for potential species of significance occurring within the study area.

3.4 Terrestrial and Aquatic Flora Survey

Flora growing in the study area were surveyed by undertaking a general habitat assessment and targeted searches for threatened species were conducted within likely habitats.

3.4.1 Flora Habitat Assessment

The condition of the vegetation was assessed according to the degree to which it resembled relatively natural, undisturbed vegetation using the following criteria:

- species composition (species richness, degree of weed invasion); and,
- vegetation structure (representation of each of the original layers of vegetation).

The three categories used to evaluate general habitat value were Good, Moderate or Poor, as detailed below:

Good: Containing a high number of indigenous species; no weeds present or weed invasion restricted to edges and track margins; vegetation community contains original layers of vegetation; vegetation layers (ground, shrub, canopy etc) are intact.

Moderate: Containing a moderate number of indigenous species; moderate level of weed invasion; weeds occurring in isolated patches or scattered throughout;

one or more of original layers of vegetation are modified; vegetation layers (ground, shrub, canopy etc) are largely intact.

Poor: Containing a low number of indigenous species; high level of weed invasion; weeds occurring in dense patches or scattered throughout; one or more of the original layers of vegetation are highly modified; one or more original vegetation layers (ground, shrub, canopy etc) are modified or missing.

3.5 Terrestrial Fauna Survey

Fauna using the site were surveyed by undertaking active searching and listening, and recording incidental observations.

3.5.1 Terrestrial Fauna Habitat Assessment

The three categories used to evaluate habitat value were Good, Moderate or Poor, as detailed below:

Good: Ground flora containing a high number of indigenous species; vegetation community structure, ground, log and litter layer intact and undisturbed; a high level of breeding, nesting, feeding and roosting resources available; a high richness and diversity of native fauna species.

Moderate: Ground flora containing a moderate number of indigenous species; vegetation community structure, ground log and litter layer moderately intact and undisturbed; a moderate level of breeding, nesting, feeding and roosting resources available; a moderate richness and diversity of native fauna species.

Poor: Ground flora containing a low number of indigenous species, vegetation community structure, ground log and litter layer disturbed and modified; a low level of breeding, nesting, feeding and roosting resources available; a low richness and diversity of native fauna species.

Other habitat features such the value of the study area as a wildlife corridor, the presence of remnant communities or unusual ecological vegetation community structure were also investigated to assess habitat quality.

3.6 Aquatic Fauna Survey

Aquatic habitats were surveyed by undertaking visual assessment and by recording incidental observations. At each survey site an assessment of the waterway and riparian condition and habitat was undertaken following a modified Ausriwas and Riparian Channel Environment (RCE) assessment (Chessman *et al.* 1997).

3.6.1 Aquatic Habitat Assessment

The aquatic habitats were classified according to the DPI (Fisheries) Fish Habitat Scheme, which assesses the waterway on their potential for fish habitat. The habitat classes are defined as:

- *Class 1 - Major Fish Habitat* Large named permanently flowing stream, creek or river. Threatened species habitat or area of declared "critical habitat" under the threatened species provisions of the FM Act. Aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area;
- *Class 2 - Moderate Fish Habitat* Smaller named permanent or intermittent stream, creek or watercourse. Clearly defined drainage channels with semi-permanent to permanent waters in pools or connected wetland areas. Marine or freshwater aquatic vegetation present. Known fish habitat and/or fish observed inhabiting the area;
- *Class 3 - Minimal Fish Habitat* Named or unnamed watercourse with intermittent flow, with potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). No to minimal defined drainage channel. Semi-permanent pools, ponds, farm dams or wetlands nearby, or form in the watercourse after a rain event. Watercourse interconnects wetlands or stream habitat; and
- *Class 4 - Unlikely Fish Habitat* Named or unnamed watercourse with intermittent flow during rain events only, little or no defined drainage channel, little or no free standing water or pools after rain (e.g. dry gully, shallow floodplain depression with no permanent wetland aquatic flora present). No aquatic or wetland vegetation present.

The waterways class is used to determine the appropriate type of bridge required and whether inclusion of a fishway is required within a development (NSW Fisheries 1999).

3.7 Limitations

This study was by design a habitat assessment and was conducted in accordance with methodology that would be employed for an assessment in accordance with Section 5A of the EP&A Act. Therefore no trapping, spotlighting, fish trapping, electrofishing, water quality testing, call playback or vegetation quadrat sampling techniques were used.

The study area was surveyed in winter and it is possible that some animals and plants were not observed during the survey. However, as the assessment of impact is based on the presence or absence of suitable habitat for threatened flora

and fauna (which is adequate to satisfy the requirements of the EP&A Act), such species are taken into account during the assessment even though they may not be conspicuous during the survey. Such an assessment is considered conservative, in that the presence of habitat for a threatened species, population or ecological community is sufficient to warrant further consideration in the impact assessment process. The assessment does not need to rely on actual records of threatened species.

4.0 RESULTS

A list of the flora and fauna species recorded during the survey are provided in Appendix 2 and Appendix 3 respectively.

4.1 Soil

The soils of the study area are mapped by Hazelton *et al.* (1989) at a 1:100 000 scale as the fluvial derived landscapes Richmond (map unit ri) and Upper Castlereagh (map unit up). Richmond soil landscape is described as Quaternary terraces of the Nepean and Georges Rivers (Hazelton *et al.* 1989). Upper Castlereagh soil landscape is described as terraces of the Nepean and Hawkesbury Rivers (Hazelton *et al.* 1989).

4.2 Vegetation Communities

4.2.1 Pipeline Route 1

Pipeline Route 1 (PR1) follows the bank of the Nepean River, crossing Peach Tree Creek and Boundary Creek, both of which are tributaries of the Nepean River (Figure 2). The vegetation along the Nepean River consisted of trees of *Casuarina cunninghamiana* ssp. *cunninghamiana*, with few scattered shrubs of *Callistemon salignus*. The understorey along the banks of the Nepean River was degraded and dominated by weed species such as *Cyperus eragrostis*, *Eragrostis curvula* *Juncus* sp., *Paspalum urvillei* and *Pennisetum clandestinum*, with scattered natives such as *Persicaria decipiens* on the banks and emergent *Typha domingensis*. Exotic species *Salvinia molesta* was recorded in the water.

Away from the banks of the river, the vegetation was very degraded and dominated by herbaceous weedy species such as *Acetosa sagittata*, *Bidens pilosa*, *Cardiospermum grandiflorum*, *Chlois gayana*, *Eragrostis curvula*, *Ligustrum sinense*, *Ricinus communis*, *Solanum nigrum*, *Tagetes minuta* and *Tradescantia fluminensis*.

At the crossing with Peach Tree Creek the dominant canopy species was *Salix nigra*, which were predominantly dead (probably poisoned as part of the *Salix nigra* Management Plan for the Nepean River).

Scattered exotic trees such as *Erythrina crista-galli* and *Senna pendula* were also present along the banks of the Nepean River.

As PR1 heads up the weedy slope away from the Nepean River and onto the cleared ridgeline, the vegetation was dominated by a dense cover of exotic grasses and herbaceous species such as *Andropogon virginicus*, *Brassica juncea*,

Chloris gayana, *Eragrostis curvula*, *Foeniculum vulgare*, *Setaria gracilis* and *Sida rhombifolia*. At the top of the slope along the cleared ridgeline, there were a number of plantings of species such as *Acacia falcata*, *A. parramattensis*, *Casuarina cunninghamiana*, *Eucalyptus* sp., *Hardenbergia violacea*, *Juncus* sp. and *Lomandra longifolia*. There appeared to be a large number of casualties amongst the plantings, probably due to the lack of rain.

PR1 continues along a vehicle track adjoining plantings of *Bursaria spinosa*, *Corymbia maculata*, *Eucalyptus crebra*, *E. tereticornis*, *Kunzia ambigua*, *Leptospermum polygalifolium*, *Melaleuca decora* and *M. styphelioides*. The understorey beneath these plantings was dominated by the same exotic grasses and herbaceous species as mentioned above, with the addition of the invasive species *Arundo donax* and *Cortaderia selloana*.

PR1 then makes a sharp turn and heads north across a mown grassy area with planted trees such as *Casuarina cunninghamiana*, *Eucalyptus tereticornis* and *Melaleuca armillaris* ssp. *armillaris* and discharges into Duck Pond. The vegetation surrounding Duck Pond was dominated by exotic species such as *Chloris gayana*, *Cynodon dactylon*, *Cyperus eragrostis*, *Eragrostis curvula* and *Paspalum dilatatum*. Native species recorded in and surrounding Duck Pond include *Eleocharis sphacelata*, *Persicaria decipiens* and *Typha* sp.

4.2.2 Pipeline Route 2

Pipeline Route 2 (PR2) connects to and continues on from PR1 (Figure 2). The vegetation along proposed PR2 is highly disturbed and dominated by exotic herbaceous species with some planted trees such as *Acacia parramattensis*, *A. longifolia* and *Eucalyptus* sp. adjoining roads and tracks. The dominant species recorded along PR2 include the exotic species *Cortaderia selloana*, *Eragrostis curvula*, *Melinis repens* and *Ricinus communis*. Native species such as *Phragmites australis* and *Imperata cylindrica* were also present.

The proposed discharge point for PR2 is within a highly disturbed, previously extracted pit. The area was dominated by exotic weeds and grasses with no trees or shrubs present. Earth moving equipment was present at the proposed discharge point at the time of survey.

4.2.3 Pipeline Route 3

Pipeline Route 3 (PR3) connects to and continues on from PR1 (Figure 2). The vegetation along PR3 is highly degraded and dominated by similar exotic herbaceous species as those recorded along PR2. Scattered planted trees of *Casuarina cunninghamiana* and *Eucalyptus tereticornis* were also recorded along the roads.

PR3 passes close to an existing dam whose banks were dominated by exotic herbaceous species. Native species *Bolboschoenus caldwellii* and *Juncus usitatus* were recorded on the banks and *Typha* sp. recorded in the water. An artificial wetland, containing wetland species such as native *Cyperus* sp., had been created for the propagation of macrophytes. It appears that the artificial wetland has not been maintained, as many of the wetland species were dead at the time of survey.

The proposed discharge point for PR3 is within an existing dam.

4.2.4 Pumping Station

PLDC propose to locate the pumping station upslope of PR1 in a mown grassy area adjoining an existing car park, with scattered planted exotic trees. The location of the pumping station is consistent with all pipeline route options.

4.2.5 NPWS (2002) Vegetation Mapping

Vegetation adjoining the banks of the Nepean River, along Pipeline Route 1, has been identified by NPWS (2002b) as Alluvial Woodland and Riparian Forest (Figure 3), both of which are sub-communities of Sydney Coastal River-flat Forest. Until recently Sydney Coastal River-flat Forest was listed as an Endangered Ecological Community under schedule 3 of the TSC Act, but has subsequently been removed from the TSC Act and replaced by a number of listings of communities on floodplains along the NSW east coast, including River-flat Eucalypt Forest and Swamp Oak Floodplain Forest.

The vegetation recorded along the banks of the Nepean River appears to best fit the description of River-flat Eucalypt Forest, with the dominance of *Casuarina cunninghamiana* ssp. *cunninghamiana*. River-flat Eucalypt Forest in the study area is restricted to a thin degraded strip of vegetation adjoining the Nepean River, dominated by *Casuarina cunninghamiana* ssp. *cunninghamiana* in the canopy and exotic herbaceous species in the understorey.

The potential impact of the proposal on this community is no different between the three pipeline route options, as PR1 is consistent to all pipeline route options and is the only option which disturbs the community.

4.3 Flora

Eighty-four vascular plant species were recorded from this area, comprising 38 (45%) locally indigenous species and 46 (55%) exotic species. A list of plant species recorded is provided in Appendix 2.

Five of the species recorded in the study area are declared as noxious weeds in the Penrith LGA: *Alternanthera philoxeroides*, *Ligustrum sinense*, *Cortaderia selloana*, *Salvinia molesta* and *Salix nigra*.

4.3.1 Significant Flora

Twenty-three threatened flora species listed under the TSC Act (Figure 4) and 22 threatened flora species listed under the EPBC Act, or their habitat have been previously recorded within the local area (DEC Atlas of NSW Wildlife and DEH Online EPBC Database). A total of 24 threatened flora species are considered in this report (Table 1).

No significant flora species or their habitats were recorded within the study area (Table 1). As such, Eight Part Tests and Assessments of Significance are not required for any threatened flora.

Table 1: Terrestrial flora listed on the TSC Act or EPBC Act that have the potential to occur in the local area.

Species	Status			Habitat	Habitat present along proposed routes?
	TSC Act ¹	EPBC Act ²	ROTAP ³		
<i>Acacia bynoeana</i>	E1	V	3V	Sandstone ridgetop and Castlereagh Woodlands on sandy clay soil, often with ironstone gravels (NSW Scientific Committee 1999).	No. These communities not recorded in the study area.
<i>Acacia gordonii</i>	E1	E	2K	Grows on sandstone outcrops in dry sclerophyll forest (Harden 1991) and heaths amongst rock platforms (NSW Scientific Committee 1997).	No. These communities not recorded in the study area.
<i>Acacia pubescens</i>	V	V	3Va	Grows in open sclerophyll forest or woodland on clay soils (Harden 1991, Robinson 1994), usually on gravelly clay containing ironstones (NPWS 1999a, Fairley and Moore 2000). This species typically occurs at the integrate between shales and sandstones in Cooks River/ Castlereagh Ironbark Forest, Shale/Gravel Transition Forest or Cumberland Plain Woodland (NPWS 2003).	No. None of these native vegetation communities remain in the study area.
<i>Acrophyllum australe</i>	V	V	2Vi	Restricted to an area between Springwood and Lawson in the Blue Mountains. Usually found near waterfalls where it grows in damp crevices in sandstone, usually near waterfalls (Harden 1990) or under drip ledges below sandstone cliffs (Fairley and Moore 2000).	No. Study area not within species known range.
<i>Allocasuarina glareicola</i>	E1	E	2E	Known only for a few small populations in or near Castlereagh S.F. where it is found in open forest on lateritic soil (Harden 1990, Robinson 1994).	No. No open forest recorded in study area.
<i>Cryptostylis hunteriana</i>	V	V	3V	This species typically grows in swamp-heath on sandy soils chiefly in coastal districts (Harden 1993) but has also been recorded on steep bare hillsides (Bishop 1996).	No. No swamp heath recorded in the study area.
<i>Cynanchum elegans</i>	E1	E	3Ei	Rainforest gullies scrub and scree slopes in Gloucester and Wollongong districts (Harden 1992).	No. Study area not within species known range.

Species	Status			Habitat	Habitat present along proposed routes?
	TSC Act ¹	EPBC Act ²	ROTAP ³		
<i>Dillwynia tenuifolia</i>	V&EP	V	2Vi	Occurs in the Cumberland Plain and Blue Mountains to Howes Valley area where it grows in dry sclerophyll woodland on sandstone, shale or laterite (Harden 2002). Typically it forms large populations within a restricted distribution and specific habitat (Castlereagh Ironbark Forest) (Rymer <i>et al.</i> 2002).	No. Castlereagh Ironbark Forest was not recorded in the study area.
<i>Epacris sparsa</i>	V	V	2Vi	Only known to grow beside Grose River where it is found on in sandy soil among rocks (Harden 1992).	No. Study area not near Grose River.
<i>Eucalyptus benthamii</i>	V	V	2Vi	Restricted but locally abundant, in wet forest on sandy alluvial soils along valley floors (Harden 1991).	No. No wet forest recorded in study area.
<i>Grevillea juniperina</i> ssp. <i>juniperina</i>	V	-	-	It's distribution is centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town (NPWS 2002a). It is found on clay soils in open forest on the Cumberland Plain (Robinson 1994). Grows in moist sites, usually near creeks on acidic soils (Harden 1991).	No. No open forest recorded in the study area.
<i>Haloragodendron lucasii</i>	E1	E	2Ea	Grows in dry sclerophyll forest or low open woodland on sheltered sandstone slopes near creeks in moist sandy loam soil (Harden 1991, NPWS 1999e). Often found below cliff lines with an understorey of ferns and sedges (Fairley and Moore 2000).	No. No dry sclerophyll forest or low open woodland recorded in the study area.
<i>Marsdenia viridiflora</i> ssp. <i>viridiflora</i>	EP	-	-	This species has a wide distribution in subcoastal and southern Queensland but has been recorded rarely in NSW and from a disjunct occurrence near Sydney where it occurs as occurs as very scattered plants in areas of remnant vegetation (NSW Scientific Committee 2003). Grows in woodland and scrub (Harden 1992) and is a characteristic species of Sydney Turpentine Ironbark Forest (NSW Scientific Committee 1998b).	No. None of the communities listed were recorded in the study area.
<i>Melaleuca deanei</i>	V	V	3R	Wet heath on sandstone – coastal districts from Berowra to Nowra (Harden 1991).	No. no wet heath recorded in the study area.
<i>Micromyrtus minutiflora</i>	E1	V	2V	Found on the Cumberland Plain within dry sclerophyll forest (Harden 1992) on old alluviums (Robinson 1994).	No. No dry sclerophyll forest remains in the study area.
<i>Persoonia acerosa</i>	V	V	2V	Found in heath or dry sclerophyll forest on sandstone from central Blue Mountains south to Hilltop (Harden 2002).	No. No heath or dry sclerophyll forest in the study area.
<i>Persoonia hirsuta</i>	E1	E	3Ki	It occurs from Gosford to Royal NP 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 1998a).	No. No woodland or dry sclerophyll forest in study area.
<i>Persoonia nutans</i>	E1	E	2Ei	Grows in Woodland to dry sclerophyll forest on clay soils and old alluviums on the Cumberland Plain (Harden 1991, Robinson 1994). It is restricted to Castlereagh Scribbly Gum Woodlands and in Agnes Banks Woodland (NPWS 2001).	No. No woodland or dry sclerophyll forest in study area.
<i>Pimelea spicata</i>	E1	E	3Ei	In western Sydney, <i>P. spicata</i> grows in Grey Box- Ironbark Woodland with an understorey of	No. Grey Box- Ironbark

Species	Status			Habitat	Habitat present along proposed routes?
	TSC Act ¹	EPBC Act ²	ROTAP ³		
				<i>Bursaria spinosa</i> and <i>Themeda australis</i> (NPWS 2000b).	Woodland was not recorded in the study area.
<i>Pomaderris brunnea</i>	V	V	2V	Open forest confined to the Colo River & upper Nepean River (Harden 1990), on clay & alluvial soils (Fairley and Moore 1995).	No. Study area not near Colo or upper Nepean Rivers..
<i>Pterostylis saxicola</i>	E1	E		Shallow soils over sandstone sheets often near streams – Picnic Point to Picton (Harden 1993). Occurs where vegetation up-slope of potential habitat is shale derived – preference for shale sandstone interface (T. James pers. comm.).	No. No shale/sandstone interface on or near the study area.
<i>Pultenaea glabra</i>	V	V	3Va	Found in dry sclerophyll forest on sandstone in the higher Blue Mountains and Glen Davis area (Harden 1991). Grows above south facing escarpments of the main plateau and sometimes in forest with an open canopy and moist soil (Baker and Corringham 1995).	No. Study area not within species known range.
<i>Pultenaea parviflora</i>	E1	V	2E	<i>P. parviflora</i> is endemic to the Cumberland Plain, with a core distribution from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. <i>P. parviflora</i> may be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays and in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland (NPWS 2002c).	No. None of the listed communities were recorded in the study area.
<i>Zieria involucrata</i>	-	V	2Va	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).	No. Study area not within species known range.

Key: 1) Listed on the TSC Act as Endangered (E1), Extinct (E4), Vulnerable (V) or Endangered Population (EP)
 2) Listed on the EPBC Act as Endangered (E) or Vulnerable (V)
 3) ROTAP= Rare or Threatened Australian Plant (Briggs and Leigh 1995); for description of codes see Appendix 4

Additionally, an endangered population of *Pultenaea villifera* occurs within a 10 km radius of the study area, in the Blue Mountains Local Government Area.

4.4 Terrestrial Fauna Habitats

Fauna habitat types within the study area are ‘River and Riparian Vegetation’, ‘Man-made Dams’, ‘Shrubby Understorey with Scattered Trees’ and ‘Mown Grass with Planted Trees’. These habitat types are described in more detail below.

4.4.1 River and Riparian Vegetation (including tributaries)

This habitat occurs along proposed PR1, which is common to all pipeline route options, from the Penrith Weir at the southern end, then north across two

tributaries (Peach Tree Creek and Boundary Creek) until the proposed path of the pipeline diverts upslope from the banks of the Nepean River.

The Nepean River had floating, fringing and emergent vegetation, such as reeds and grasses, providing habitat resources for common frogs (e.g. Common Eastern Froglet *Crinia signifera*) and water birds (e.g. Dusky Moorhen *Gallinula tenebrosa*). A rocky mound on the bank of the weir could provide possible basking habitat for reptiles (e.g. Eastern Water Skink *Eulamprus quoyii*).

The river was still to slow-flowing along the proposed pipeline route, as was Peach Tree Creek. PR1 crosses Peach Tree Creek close to where it joins the Nepean River. This section of the creek had a large-pebbled bed and weedy vegetation. Boundary Creek (which is also crossed by PR1) occurs slightly further north where the water was fast-flowing on the day of the survey. The water in this creek is primarily tertiary treated sewage effluent from Penrith Sewage Treatment Plant. Due to the varying water flow, water quality and stream structure of the river, Peach Tree Creek and Boundary Creek, these waterways may provide different habitat resources for common fauna.

The riparian vegetation occurring along the Nepean River was dominated by Casuarinas and had a weedy understorey (e.g. *Lantana camera*). The trees and shrubby understorey provide foraging habitat resources for a range of small birds (e.g. Grey Fantail *Rhipidura fuliginosa* and Superb Fairy-wren *Malurus cyaneus*).

Threatened and migratory fauna that have the potential to occur within this habitat type include the Freckled Duck *Stictonetta naevosa*, Painted Snipe *Rostratula benghalensis s. lat*, Large-footed Myotis *Myotis adversus*, White-bellied Sea-Eagle *Haliaeetus leucogaster* and Rufous Fantail *Rhipidura rufifrons*.

River and Riparian Vegetation occurring along part of PR1 was considered to be in poor to moderate condition due to the low number of fauna resources it provides. There were few specific habitat resources (e.g. hollow-bearing trees) for threatened fauna.

4.4.2 Man-Made Dams

Man-made dams occur at the end of Pipeline Routes 1, 2 and 3 and along Pipeline Routes 2 and 3. Tailings Ponds also lie to the west and east of Pipeline Route 1. Dams located at the end of a pipeline route are the termination points for the pipeline, into which the water will flow.

The structure and vegetation varied with each dam; some had steep and bare banks whilst others had patches of vegetation (e.g. reeds and grasses) fringing

and/or emerging from the water, with rocky and/or grassy banks. This habitat type provides resources for frogs and water birds (e.g. Common Eastern Froglet and Little Pied Cormorant *Phalacrocorax melanoleucos*).

Threatened and migratory fauna potentially occurring within the man-made dams include the Freckled Duck, Australian Painted Snipe *Rostratula benghalensis australis*, Latham's Snipe *Gallinago hardwickii*, Australian Wood Duck *Chenonetta jubata*, Pacific Black Duck *Anas superciliosa*, Masked Lapwing *Vanellus miles*, Australasian Shoveler *Anas rhynchotis*, Grey Teal *Anas gracilis* and Hardhead *Aythya australis*. The Duck Pond may also provide potential habitat for the Green and Golden Bell Frog *Litoria aurea*.

The Duck Pond and the existing dams near the macrophyte ponds, Ready Mix dump site and at the end of PR3 were considered to be in moderate condition, with all others considered to be in poor condition. This assessment was based on the relative opportunities provided for fauna such as amount of vegetation cover and foraging habitat.

4.4.3 Shrubby Understorey with Scattered Trees

This habitat type consisted mostly of young Eucalyptus trees with an understorey dominated by weedy grasses and shrubs. This habitat type occurred along PR1 from where the proposed pipeline continues upslope of Nepean River to where the route option diverts north between the western and eastern tailings ponds. This habitat type then continues along PR2 from where it joins PR1 west until the end of the western tailings pond.

Shrubby Understorey with Scattered Trees provided some foraging habitat for common birds (e.g. Zebra Finch *Taeniopygia guttata* and Silvereye *Zosterops lateralis*).

This habitat was considered to be in poor condition providing little foraging and breeding resources for threatened fauna. The majority of trees present were young and thin in diameter with no hollows or substantial branching to provide nesting resources for threatened fauna such as bats and owls.

4.4.4 Mown Grass with Planted Trees

Mown Grass with Planted Trees occurred at the proposed pump site near PR1 and along Castlereagh Road (Pipeline Route 3) to the western edge of Rowing Lake. This habitat type was considered to be in poor condition due to the lack of resources for native animal species. No ground cover or shrubs were present to provide shelter or other resources and although planted trees offered some shelter

for common and introduced birds (e.g. Common Myna *Acridotheres tristis*), they provided little habitat for threatened species.

4.5 Terrestrial Fauna

A detailed fauna survey was not undertaken for this assessment. Fauna using the site were surveyed by undertaking active searching and listening and recording incidental observations. Fauna observed during the current survey are listed in Appendix 3 and include one amphibian, thirty-three birds (two introduced), one reptile and one introduced mammal.

4.5.1 Significant Terrestrial Fauna

Thirty-two threatened animal species listed under the TSC Act (Figure 5) and thirteen threatened and eight migratory animal species listed under the EPBC Act, or their habitat have been previously recorded within the local area (DEC Atlas of NSW Wildlife and DEH Online EPBC Database). A total of fifty-two threatened and migratory fauna are considered in this report (including those listed in Table 2 and eight additional migratory species recorded during the current survey, listed in Appendix 3).

Table 2. Terrestrial fauna listed on the TSC Act or EPBC Act that have the potential to occur in the local area.

Scientific Name	Common Name	TSC Act ¹	EPBC Act ²	Habitat	Potential Habitat?
Amphibians					
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks (Daly 1996, Recsei 1996). Can also occur within shale outcrops within sandstone formations. In the southern part of its range can occur in wet and dry forests, montane sclerophyll woodland and montane riparian woodland (Daly 1996). Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water (Barker <i>et al.</i> 1995).	No
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1	V	Found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes (NPWS 1999d). Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks (White and Pyke 1996, NPWS 1999d).	Yes
<i>Mixophyes balbus</i>	Stuttering Frog	E1	V	This species is usually associated with mountain streams, wet mountain forests and rainforests (Barker <i>et al.</i> 1995). It rarely wanders very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains (Barker <i>et al.</i> 1995).	No
<i>Mixophyes iteratus</i>	Giant Barred Frog	E1	E	Usually found in coastal riverine rainforest and upland areas such as the Border Ranges (Barker <i>et al.</i> 1995).	No
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. These creeks are characterised after rain by a series of shallow pools lined by dense grasses, ferns and low shrubs (Thumm and Mahony 1996, Thumm and Mahoney 1997).	No
Invertebrates					
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E1	-	Most likely restricted to Cumberland Plain, Castlereagh Woodlands and boundaries between River-flat Forest and	No

Scientific Name	Common Name	TSC Act ¹	EPBC Act ²	Habitat	Potential Habitat?
				Cumberland Plain Woodland. It is normally found beneath logs, debris and amongst accumulated leaf and bark particularly at the base of trees. May also use soil cracks for refuge (NPWS 2000a).	
Birds					
<i>Burhinus grallarius</i>	Bush Stone-curlew	E1	-	Lightly timbered open forest and woodland, or partly cleared farmland with remnants of woodland, with a ground cover of short sparse grass and few or no shrubs where fallen branches and leaf litter are present (Marchant and Higgins 1993).	No
<i>Calyptorhynchus lathamii</i>	Glossy Black-cockatoo	V	-	Inhabits forest with low nutrients, characteristically with key <i>Allocasuarina</i> species. Tends to prefer drier forest types (NPWS 1999c) with a middle stratum of <i>Allocasuarina</i> below <i>Eucalyptus</i> or <i>Angophora</i> . Often confined to remnant patches in hills and gullies (Higgins 1999). Breed in hollows stumps or limbs, either living or dead (Higgins 1999).	No
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	This species occurs in eucalypt and cypress woodlands on the hills and tablelands of the Great Dividing Range. They prefer woodlands with a grassy understorey, often on ridges or gullies (Blakers <i>et al.</i> 1984, NSW Scientific Committee 2001). The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. They forage on the ground and in the understorey for arthropods and seeds (Blakers <i>et al.</i> 1984, NSW Scientific Committee 2001). Home ranges vary from 6-12 hectares (NSW Scientific Committee 2001).	No
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams (Pizzey and Knight 1997).	Yes
<i>Grantiella picta</i>	Painted Honeyeater	V	-	Found mainly in dry open woodlands and forests, where it is strongly associated with mistletoe (Higgins <i>et al.</i> 2001). Often found on plains with scattered eucalypts and remnant trees on farmlands.	No
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	-	M	A migratory species that is resident to Australia. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes (English and Predavec 2001).	Yes
<i>Hirundapus</i>	White-throated	-	M	An aerial species found in feeding	No

Scientific Name	Common Name	TSC Act ¹	EPBC Act ²	Habitat	Potential Habitat?
<i>caudacutus</i>	Needletail			concentrations over cities, hilltops and timbered ranges (Pizzey 1983).	
<i>Lathamus discolor</i>	Swift Parrot	E1	EM	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects (Forshaw and Cooper 1981). The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW (Shields and Crome 1992). This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability (Pizzey 1983).	No
<i>Lophoictinia isura</i>	Square-tailed Kite	V	M	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia (Marchant and Higgins 1993). In NSW it is often associated with ridge and gully forests dominated by Woollybutt <i>Eucalyptus longiflora</i> , spotted Gum <i>E. maculata</i> or Peppermint Gum <i>E. elata</i> , <i>E. smithii</i> (NPWS 1999g).	No
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater	V	-	Found mostly in open forests and woodlands dominated by box and ironbark Eucalypts (Higgins <i>et al.</i> 2001). It is rarely recorded east of the Great Dividing Range (Higgins <i>et al.</i> 2001).	No
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland (Pizzey 1983).	No
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies (Pizzey 1983).	No
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Occurs in open woodlands and Eucalypt forests with a ground cover of grasses and understorey of low shrubs (Morris 1980). Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies (Higgins 1999). Nests in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefers to breed in open grassy forests and woodlands, and gullies which are moist (Higgins 1999).	No
<i>Ninox connivens</i>	Barking Owl	V	-	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country (Pizzey 1983).	No
<i>Ninox strenua</i>	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and	No

Scientific Name	Common Name	TSC Act ¹	EPBC Act ²	Habitat	Potential Habitat?
				rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within Red Turpentine in tall open forests and Black She-oak within open forests (Debus and Chafer 1994). Large mature trees with hollows at least 0.5 m deep are required for nesting (Garnett 1992). Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials (Gibbons and Lindenmayer 1997). Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm (Gibbons and Lindenmayer 1997).	
<i>Petroica rodinogaster</i>	Pink Robin	V	-	Found in dense, dank forest/tree fern gullies and disperses in autumn-winter to open forests, woodlands and scrublands (Pizzey and Knight 1997).	No
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Found mainly in open, tall riparian River Red Gum forest or woodland. Often found in farmland including grazing land with patches of remnant vegetation. Breeds in hollow branches of tall Eucalypt trees within 9 km of feeding areas (Higgins 1999).	No
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas (Pizzey 1983).	Yes
<i>Rostratula australis</i>	Australian Painted Snipe	E1	VM	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters (Marchant & Higgins 1993).	Yes
<i>Rostratula benghalensis</i>	Painted Snipe	-	M	Found in the fringes of swamps, dams, sewage farms and marshy areas, generally with a cover of grasses, lignum or open timber (Pizzey and Knight 1997).	Yes
<i>Stictonetta naevosa</i>	Freckled Duck	V	M	The freckled duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits (Simpson and Day 1996).	Yes
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with	No

Scientific Name	Common Name	TSC Act ¹	EPBC Act ²	Habitat	Potential Habitat?
				hollows suitable for nesting and roosting (Higgins 1999). Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometime dead (Higgins 1999). Nest hollows are usually located within dense forests or woodlands (Gibbons and Lindenmayer 1997). Masked owls do prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet (Gibbons and Lindenmayer 1997, Higgins 1999).	
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude <500 m. Nests and roosts in hollows of tall emergent trees, mainly eucalypts (Higgins 1999) often located in gullies (Gibbons and Lindenmayer 1997). Nests have been located in trees 125 to 161 centimetres in diameter (Gibbons and Lindenmayer 1997).	No
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E1	EM	A semi-nomadic species occurring in temperate Eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forests associations and wet lowland coastal forests (Pizzey 1983, NPWS 1999f).	No
Mammals					
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range (Hoye and Dwyer 1995). Can also be found on the edges of rainforests and in wet sclerophyll forests (Churchill 1998). This species roosts in caves and mines in groups of between 3 and 37 individuals (Churchill 1998).	No
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests (Dickman and Read 1992). Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage (Edgar and Belcher 1995).	No
<i>Miniopterus schreibersii</i>	Eastern Bent-wing Bat	V	C	Uses a broad range of habitats including rainforests, wet and dry sclerophyll forests, open woodlands and open grasslands (Churchill 1998). Roosts in caves, but can also use manmade structures such as mines	No

Scientific Name	Common Name	TSC Act ¹	EPBC Act ²	Habitat	Potential Habitat?
				and road culverts (Dwyer 1995, Churchill 1998). Specific caves are used as nursery caves, containing a large number of individuals, which can be used year after year (Dwyer 1995, Churchill 1998).	
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species habits (Allison and Hoyer 1995, Churchill 1998).	No
<i>Myotis adversus</i>	Large-footed Myotis	V	-	Occurs in most habitat types as long as they are near permanent water bodies, including streams, lakes and reservoirs. Commonly roost in caves, but can also roost in tree hollows, under bridges and in mines (Richards 1995, Churchill 1998).	Yes
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	Restricted to tall native forests in regions of high rainfall. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows. Critical elements of habitat include sap-site trees, winter flowering eucalypts, mature trees suitable for den sites and a mosaic of different forest types (NPWS 1999h).	No
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range (Suckling 1995). Requires abundant hollow bearing trees and a mix of Eucalypts, Banksias and Acacias (Quin 1995). There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps (Gibbons and Lindenmayer 1997). Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked (Menkhorst <i>et al.</i> 1988).	No
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, and open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices (Eldridge and Close 1995).	No
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	Occurs in dry sclerophyll open forest with a sparse ground cover of herbs, grasses, shrubs or leaf litter (Soderquist 1995, NPWS 1999b). Individuals may also inhabit heathland, swamps, rainforest and wet sclerophyll forest (NPWS 1999b).	No

Scientific Name	Common Name	TSC Act ¹	EPBC Act ²	Habitat	Potential Habitat?
				Nests and shelters in tree hollows, utilizing many different hollows over a short period of time. Suitable hollows are 25-40 mm wide (NPWS 1999b).	
<i>Phascolarctos cinereus</i>	Koala	V	-	Inhabits Eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall (Reed and Lunney 1990, Reed <i>et al.</i> 1990).	No
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy (Johnston 1995).	No
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost (Tidemann 1995) although some individuals may travel up to 70 km (Augee and Ford 1999).	No
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m (Churchill 1998). In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat (Hoye and Richards 1995). This species roosts in hollow tree trunks and branches (Churchill 1998).	No
Reptiles					
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E1	V	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitat they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer (Webb 1996, Webb and Shine 1998).	No

Key: 1) Listed on the TSC Act as Endangered (E1) or Vulnerable (V).
 2) Listed on the EPBC Act as Endangered (E) or Vulnerable (V) or Conservation Dependant (C) or covered under migratory provisions (M) on the EPBC Act.

No threatened fauna were recorded during the current survey. However, the study area contains potential habitat for five threatened species listed on the TSC Act (Green and Golden Bell Frog, Australian Painted Snipe, Painted Snipe,

Freckled Duck and Large-footed Myotis) and two threatened species listed on the EPBC Act (Green and Golden Bell Frog and Australian Painted Snipe).

Eight migratory fauna not listed in Table 2 were recorded during the current survey (Australasian Shoveler, Australian Wood Duck, Black-shouldered Kite, Brown Falcon, Grey Teal, Hardhead, Masked Lapwing and Pacific Black Duck). These species are generally more common than migratory fauna listed in Table 2. Potential habitat for a further five migratory species (from Table 2) exists within the study area (Freckled Duck, Latham's Snipe, Painted Snipe, Rufous Fantail and White-bellied Sea-Eagle).

In total, sixteen threatened and/or migratory animal species have potential or actual habitat along one or more of the proposed route options. These species are considered further in Section 5 (Impact Assessment).

4.6 Aquatic Habitats

The aquatic habitats of the study area vary from small tributaries to impoundments and major rivers.

4.6.1 Pipeline Route 1

Nepean River above Penrith Weir and Downstream

At the proposed pumping point the Nepean River is a disturbed lowland floodplain river which had low flow at the time of the survey. The Penrith weir is approximately 2m in height and is up to 60m wide. On the eastern side a covered vertical slot fish ladder with an attractant overflow has been constructed (Plate 1). Fish passage through the fish ladder is hindered though its design and detached aquatic vegetation and debris blocking the upstream gate. The Nepean River above Penrith weir is fairly clear, wide and deep behind the weir with a narrow riparian zone on the eastern side and wider zone consisting mainly of *Casuarina* sp. on the western bank. The edges were well held with grass, trees and rock armouring with the substrate being composed of cobbles silt gravel and concrete. Banks, approximately 10m high, border the eastern side of the river.

The vegetation consisted of patches *Typha* sp., *Juncus* sp and *Persicaria* sp. on the banks under a canopy of mature *Casuarina* sp. There were extensive areas of submerged aquatic vegetation dominated by *Vallisneria gigantea* (native) and *Egeria densa* (exotic) directly upstream of the weir which became less dense in deeper areas open to recreation. The floating aquatic weed *Salvinia molesta* (exotic) was present and drifting downstream and native *Lemna* sp. was less common.

Downstream of the weir the river shallows, flowing over bolder and cobble riffles and runs into a meandering section of shallow pools and backwaters (Plate 5.) The river is 15 – 7m wide through the riffles with a depth of approximately 0.3m. The riparian vegetation is denser than above the weir with patches of *Salix* sp. which appear to have been poisoned as part of a control programs.

Downstream of the riffles two tributaries enter from the eastern bank (see below). The banks are high and held by native and exotic trees, grasses and vines. The channel is shallow, braided with vegetated islands and the backwaters infested with *Salvinia molesta* and *Sagittaria platyphylla*.

The Nepean River is classified by the DPI Fish Habitat Scheme as Class 1 Major Fish Habitat, although impacts from the sand extraction and Penrith Sewage Treatment Plant (STP) have affected the flow and quality of habitat of this River.

Peach Tree Creek

The proposed pipeline will cross two tributaries, the first, Peach Tree Creek, drains an area of industrial recreational and residential land between the Nepean River and Penrith. Peach Tree Creek discharges into the Nepean River through a swampy area approximately 6m wide and <0.3m deep with extensive grass cover and dead and regenerating *Salix* sp. The creek has very slow, clear, flow over a cobble silt base and flows within the Nepean's historic banks for some distance. Away from the confluence with the Nepean River the creek becomes narrow <1m and has high banks to a similar level to the Nepean River. The aquatic vegetation consisted of *Vallisneria gigantea* near the confluence and inundated grasses, reeds and filamentous algae (Plate 2).

Peach Tree Creek is classified by the DPI Fish Habitat Scheme as Class 2 Moderate- Minimal Fish Habitat.

Boundary Creek

Boundary Creek converges with the Nepean River approximately 25m downstream of Peach Tree Creek. The high flow observed in this creek was caused by the discharge from the Penrith STP upstream (~25 ML/d median flow, (Bishop 2004). The water was slightly discoloured, had an odour and was observed to have a milky appearance on contact with the Nepean River. The creek was 1-2m wide and 0.3m deep. The creek banks were held with grass and trees and there was some trailing vegetation and algae present.

Boundary Creek is classified by the DPI Fish Habitat Scheme as Class 2-3 Moderate - Minimal Fish Habitat due to the permanent flow and the effects of the STP.

Duck Pond and Penrith lakes

The Duck Pond is a small, well established man-made pond at the proposed termination of PR1. The pond is connected to the main rowing lake in the Penrith lakes system by a pumping facility and pipeline to draw water from it to other lakes (see cover plate). The pond is 60m long by 40m wide, turbid with a gently sloped grassed edge. There are planted trees along the banks approximately 5m from the high water level and patches of *Typha* sp. and *Phragmites australis* occur along the edges. The aquatic vegetation consisted of *Vallisneria gigantea* and *Persicaria decipiens*. There was some indication of the effects of drawdown with dead aquatic vegetation present around the edges of the pond.

4.6.2 Pipeline Route 2

Miscellaneous Pits and Tailings Dams

Within PLDC Scheme Area there are a number of wet swampy areas, tailings ponds and pits associated with the extraction of sand and gravel (primary raw feed). Tailings Pits consist of large flat areas filled with silt sludge from the extraction processes and provide limited swampy habitat for aquatic fauna.

Some of the pits have been smoothed into dams and vary in size for 50m to several hundred meters in width. The dams are constructed after the sand extraction has been completed and are shaped and lined with topsoil from the extraction and will eventually be joined to form part of the expanded Penrith Lakes Scheme. They have steep rocky banks with gravel, cobble and silt substrate with very little riparian vegetation (primarily exotic weeds and *Juncus* sp, *Phragmites australis* and *Typha* sp.). These dams provide some habitat for fish and other aquatic invertebrates however the movement of fish between dams is unlikely. Transport of fish through of eggs/larvae, catastrophic flooding or deliberate translocation are potential means of dispersal into these dams.

4.6.3 Pipeline Route 3

A small, 60m x 40m dam on the south western corner of the rowing lake provides moderate aquatic fauna habitat. There is an existing macrophyte propagation area which consists of a number of shallow plastic lined channels approximately 1.5m wide supporting a large variety of macrophytes. The dam associated with this area is fairly well established however it is affected by sedimentation from the access road. The water is clear and is sourced from road runoff and groundwater (from the sand extraction area passed through the propagation area). *Vallisneria gigantea* and *Typha* sp. dominate the aquatic vegetation of the dam with some *Marsilea* sp. and algae present. Overhanging

vegetation on the western side of the dam was observed and the banks were stabilised with grasses and reeds.

4.7 Aquatic Fauna

There are thirty-nine species of fish that have been recorded in the mid Hawkesbury-Nepean Catchment. Eight native fish species and three alien fish species are known to inhabit the Penrith Lakes System (SKM 2004). Although no fish sampling was undertaken during this survey, small Gudgeons were observed within one of the dams within the PLDC area, however the species of these fish was unknown. The Duck Pond was surveyed as part of the regular Penrith lakes monitoring program by SKM and AWT in 1999 and 2001 (SKM 2004). The majority of the catch was comprised of the alien Mosquito fish *Gambusia holbrooki* with a comparatively large number of Freshwater catfish *Tandanus tandanus* along with smaller numbers of Australian Bass, *Macquaria novemaculeata*, Gudgeon sp., Carp *Cyprinus carpo* and Goldfish *Carassius auratus* (SKM 2004). However, there is a high variability between the sampling years probably due to the different sampling techniques or equipment during this period.

4.7.1 Significant Aquatic Fauna

There are two threatened species of fish listed under the FM Act (Table 3) which have potential to inhabit the local area; the Macquarie Perch *Macquaria australasica* listed as Vulnerable and the Trout Cod *Maccullochella macquariensis* listed as Endangered. Both species are also listed as Endangered under the EPBC Act. In addition one species, the Australian Grayling *Prototroctes maraena*, is listed as Vulnerable under the EPBC Act and is only listed as Protected under the FM Act. However of these species potential habitat is only thought to occur within the study area for the Macquarie Perch.

There are a number of important recreational and migratory aquatic species which are known to occur in the mid Hawkesbury Nepean Catchment. These include the Australian Bass *Macquaria novemaculeata* and the Freshwater Catfish *Tandanus tandanus* both of which are protected from commercial fishing under the FM Act. The Australian Bass is catadroganous (migrates to estuaries to breed) and was introduced into the Penrith Lakes system (SKM 2004). There is currently no opportunity for this species to breed with the Penrith Lakes system.

Two threatened species of Dragonfly are also listed as potentially occurring within the study area. However, field investigations revealed a lack of suitable habitat for these species within the study area.

Table 3 Aquatic fauna listed on the TSC Act or EPBC Act that have the potential to occur in the local area.

Common Name	Scientific Name	FM Act	EPBC Act	Habitat and Distribution	Potential habitat within study area
Invertebrates					
<i>Archaeophya adamsi</i>	Adams emerald dragonfly	V		Cool clear streams with gravely riffles and extensive riparian vegetation	No
<i>Austrocordulia leonardi</i>	Sydney Hawk Dragonfly	E		Deep cool pools on slow flowing rocky rivers with steep sides	No
Fish					
<i>Maccullochella macquariensis</i>	Trout Cod	E	E	Inhabits large rivers and streams in the upper Murray Darling Basin often associated with cover such as LWD rock outcrops, boulders and deep holes	No Known from stocks within Cordeaux Dam
<i>Macquaria australasica</i>	Macquarie Perch	V	E	Cool clean water preferring deep slow flowing pools and lakes. Eastern populations are genetically distinct from western populations. Known from Glenbrook Creek	Yes Potential habitat within the Nepean weir and river
<i>Prototroctes maraena</i>	Australian Grayling	P	V	Clear gravely coastal streams and rivers from the sea to the first barrier, up to 1000m	No Generally found in streams or rivers further south

Key: V = Vulnerable E = Endangered P= Protected

5.0 IMPACT ASSESSMENT

5.1 TSC Act

5.1.1 Significance Guidelines

The Eight Part Test is a statutory mechanism under Section 5A of the EP&A Act for assessing whether a proposed development activity may have a significant impact on threatened species, populations or ecological communities or their habitats. The results of this test are used to determine if a Species Impact Statement is required for each species potentially occurring within the study area.

When a threatened species is known to occur within the vicinity of a study area, however is not recorded during a survey, the presence of potential habitat for this species is used to determine the need to undertake an Eight Part Test. Where there is no potential habitat in the study area for threatened species, there is unlikely to be any impact on these species and therefore Eight Part Tests are not required for these species.

5.1.2 Terrestrial Flora

The study area contains River-flat Eucalypt Forest, which is listed as an Endangered Ecological Community under the TSC Act. An Eight Part Test has been prepared for this community (see Appendix 5). The Eight Part Test concluded that the proposal would not have a significant impact on the community.

Twenty three threatened plant species have previously been recorded within a 10 km radius of the study area (DEC Atlas of NSW Wildlife database, DEH EPBC online database). None of the listed threatened plant species, populations or their habitats were recorded within the study area. As such, no Eight Part Tests are required for flora species and an SIS is not required for any flora species as part of the proposed development.

5.1.3 Terrestrial Fauna

No threatened fauna were recorded during the site visit, however potential habitat does occur for a number of species. Where there is potential habitat (foraging or breeding resources) for a threatened species in the study area, further consideration must be given to the potential impact of the proposed development on these species.

The proposed development may significantly impact threatened species by causing any of the following situations to arise:

- Death or injury of individuals;
- Loss or disturbance of limiting foraging resources; and
- Loss or disturbance of limiting breeding resources.

Limiting resources are specialised habitat components that species are dependent on for their ongoing survival. Such limiting resources are predominantly associated with specialised breeding habitats (such as tree hollows or suitable nest/maternity roost sites) that occur at low densities, with high levels of competition from a range of species. However for some species, limiting resources include specialised foraging habitats that have a restricted distribution (such as Koalas feeding only on specific tree species).

The study area contains potential habitat for five species listed on the TSC Act (and fifteen species on the EPBC Act). Likely impacts of the proposed pipeline on these species have been considered in Table 4 to determine if an Impact Assessment is required.

Table 4: Potential impacts of proposed development on individuals and limiting resources of species with potential habitat.

Common Name	TSC Act	EPBC Act	Death or Injury Likely	Loss of Limiting Foraging Resources	Loss of Limiting Breeding Resources	Impact Assessment Required?
Green and Golden Bell Frog	E1	V	No	No	No	✗
Latham's Snipe	-	M	No	No	No	✗
White-bellied Sea-Eagle	-	M	No	No	No	✗
Rufous Fantail	-	M	No	No	No	✗
Australian Painted Snipe	E1	V	No	No	No	✗
Painted Snipe	V	M	No	No	No	✗
Large-footed Myotis	V	-	No	No	No	✗
Freckled Duck	V	M	No	No	No	✗
Australasian Shoveler	-	M	No	No	No	✗
Australian Wood Duck	-	M	No	No	No	✗
Black-shouldered Kite	-	M	No	No	No	✗
Brown Falcon	-	M	No	No	No	✗
Grey Teal	-	M	No	No	No	✗
Hardhead	-	M	No	No	No	✗
Masked Lapwing	-	M	No	No	No	✗
Pacific Black Duck	-	M	No	No	No	✗

As the proposed development is unlikely to cause:

- Individual death or injury; or

- Loss or disturbance of limiting foraging habitat; and/or
- Loss or disturbance of limiting breeding habitat

for the Green and Golden Bell Frog, Australian Painted Snipe, Painted Snipe, Large-footed Myotis and Freckled Duck, Eight Part Tests have not been prepared for these species and a Species Impact Statement is not recommended.

5.1.4 Aquatic Fauna

No threatened aquatic fauna were observed during this survey. Where there is potential habitat (foraging or breeding resources) for threatened species in the study area then further consideration of the potential impact of the proposed development on these species is required. The Nepean River and Weir provides potential habitat for the Macquarie Perch *Macquaria australasica* which is known to occur in Glenbrook Creek to the south west. An Eight Part Test has been prepared in Appendix 5. The Eight Part Test concluded that the proposal would not have a significant impact on this species.

5.2 EPBC Act

5.2.1 Significance Guidelines

Under the *EPBC Act*, if the proposed development has the potential to have an adverse impact on a threatened species, populations or ecological communities listed on the Act, the proposal must be referred to the Federal Minister for the Environment for further consideration.

Threatened species

For threatened species, an action, will have, or is likely to have a significant impact if it does, will or is likely to:

- Lead to a long-term decrease in the size of an important population of a species, or
- Reduce the area of occupancy of an important population, or
- Fragment an existing habitat critical to the survival of the species, or
- Adversely affect habitat critical to the survival of a species, or
- Disrupt the breeding cycle, or

- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species habitat, or
- Interferes substantially with the recovery of the species.

For the assessment criteria, an important population is defined as one that is necessary for a species long-term survival and recovery, including populations that are:

- Key source populations either for breeding or dispersal,
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

Migratory species

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is 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, or
- Result in invasive species that is harmful to the migratory species becoming established¹ in an area of important habitat of the migratory species, or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat 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

¹ Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.

- 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.

5.2.2 Flora

Twenty-two threatened plant species listed on the EPBC Act have been recorded within 10 km of the study area (DEH online database). None of these threatened plant species or their habitat were recorded within the study area. No endangered ecological communities listed on the EPBC Act were recorded within the study area. Therefore, Assessments of Significance have not been prepared for any flora species and a Referral to the Environment Minister is not recommended for threatened flora and vegetation.

5.2.3 Terrestrial Fauna

Potential and/or actual habitat for two threatened and thirteen migratory terrestrial animal species listed under the EPBC Act is present within the study area. As the proposed development is unlikely to cause individual death or injury or loss/disturbance of limiting foraging and/or breeding habitat for these species (Table 4), Assessments of Significance have not been prepared for these species. A Referral to the Federal Minister for the Environment is not recommended for any terrestrial fauna species.

5.2.4 Aquatic Fauna

One threatened fish species, Macquarie Perch, listed under the EPBC has limited potential habitat within the Penrith Weir. An Assessment of Significance performed for this species concluded that there would be no significant impact (Appendix 6). A Referral to the Federal Minister for the Environment is not recommended for any aquatic fauna species.

5.3 Key Threatening Processes

A Key Threatening Process (KTP) is an impact listed under the FM, TSC or EPBC Acts that could cause a species, population or ecological community to become threatened or is identified as an impact for two or more listed threatened species, population or EECs.

KTPs relevant to the proposal are detailed below.

Clearing of Native Vegetation and Land Clearance

‘Clearing of Native Vegetation’ is listed as a KTP on the TSC Act and ‘Land Clearance’ is listed as a KTP on the EPBC Act. The riparian vegetation along the Nepean River will be impacted by the proposed works, with some clearing required for the installation of the pipeline. The following impacts on biological diversity are listed in the TSC Act Key Threatening Process Declaration for ‘Clearing of Native Vegetation’ and are relevant to the proposal:

- Destruction of habitat (resulting in loss of local populations of individual species);
- Fragmentation of habitat;
- Riparian zone degradation;
- Increased habitat for invasive species;
- Loss of leaf litter layer; and
- Changes to soil biota.

The above listed impacts will be reduced in the long term by the implementation of a Vegetation Management Plan, detailing restoration works. Restoration works will include weed management and re-establishment of native understorey species along the Nepean River and its tributaries. Furthermore, native trees and shrubs should be avoided where possible. Cleared native vegetation should be placed over impacted areas to assist in natural regeneration and prevent erosion. The implementation of a Vegetation Management Plan will minimise impacts to riparian vegetation along the Nepean River and potentially improve the quality of the riparian vegetation in the long term.

Installation and operation of in-stream structures and other mechanisms that alter natural flow regimes of rivers and streams

In-stream structures such as dams and water extraction devices can impact upon the riverine environment causing a wide variety of changes to the habitat, water quality and flow conditions, often creating barriers to fish passage and impacts to the river. The Nepean River is already impacted by historical changes to its water regime. The proposed works will result in the operation of a pumping facility which has the capacity to reduce flows and cause drawdown effect upon the Nepean River. Under an existing licence, the proposed pumping of 1.7 m³/sec (147 ML/day) from the Penrith Weir can be undertaken at flows exceeding 170 ML/day. This may have a significant impact upon the riverine environment downstream of the Penrith weir and cause restrictions and barriers to fish passage.

It has been estimated that flow of >300 ML/day is required to provide adequate fish passage in the Nepean River downstream of the Penrith Weir (Bishop 2004). The Independent Expert Panel for the Hawkesbury-Nepean River recommended an environmental flow regime that provided a flow of 170ML/day over the Penrith Weir > 95% of the time. This would reduce the effects of cyanobacteria and provide improved habitat and fish passage for the lower Nepean River. Currently 170ML/day at the Penrith Weir is exceeded only 61% of the time (WRL 2005).

Management of the pumping should be undertaken to reduce the effects of the abstraction and preserve the natural shape of the flow and not impact on the downstream communities, passage and environmental flow requirements of the river. This would include raising the threshold level of the pumping limit, reduction of the pumping volumes and variation in the pumping volumes. Pumped volumes should be in addition to any environmental flows released for the river.

Degradation of native riparian vegetation along New South Wales water courses

The removal of riparian vegetation is listed on the FM Act as a KTP, including the removal of vegetation in the catchment zones. Riparian vegetation contributes to the River ecosystem by providing: shade; a source of Large Woody Debris (LWD); food for fish; bank stabilisation; and protection from sedimentation and runoff.

A section of riparian vegetation will be removed for the construction of the pipeline along the bank of the Nepean River. Rehabilitation of cleared areas, including revegetation and emergency measures to protect the area from high volume flow events, should be implemented to reduce the potential for erosion and sedimentation.

5.4 General Impacts

5.4.1 Weed Management

A high incidence of weed invasion was observed within the study area. Measures should be taken to minimise spread of weed species during proposed works, including:

- Cleaning vehicles before or after works are completed each day to ensure weed seed is not inadvertently transported around the study area;
- Weed biomass material that is cleared from the direct impact zone should be bagged and removed from the site to be disposed of at appropriate green waste facilities. Any native biomass material should be left onsite

to assist in natural regeneration of the impacted areas; and,

- A Weed Management Plan should be developed and implemented in conjunction with the Vegetation Management Plan.

A number of aquatic weeds are known within the Penrith Weir including the submerged *Egeria densa*, *Elodea canadensis* and floating *Salvinia molesta*. PLDC actively controls macrophyte growth and *Salvinia molesta*, however *E. densa* and *E. canadensis* are not currently known within the Scheme area. Measures should be put in place to prevent the transportation of exotic weeds via the pipeline through the design of the intake structures at the Nepean River and quarantine measures at the output. This may also assist in protecting the water quality of the Penrith Lakes System. Introduced fish known in the Nepean River are also currently found in the Penrith Lakes System. Additional transport of native and alien fish species through the pipeline may increase the species diversity within the Penrith lakes and provide natural recruitment for the fish stocks.

5.4.2 Erosion and Sediment Control

Erosion and sedimentation is of greatest concern in areas where proposed works are in the vicinity of the Nepean River, its tributaries and steep banks. When not controlled, erosion and sedimentation can potentially impact on water quality, aquatic habitats, creek bank stability and riparian vegetation. An Erosion and Sedimentation Control Plan should be developed and implemented in consultation with the DEC and DPI (Fisheries).

5.4.3 Water Quality

Sedimentation and runoff can cause significant degradation in water quality and can affect fish breeding by smothering eggs and nests and by causing fish kills (McDowell 1996). Sedimentation and reduction in water quality are both listed as threatening processes by the Australian Society of Fish Biology (ASFB). Historical sand extraction and associated changes in flow regime have caused significant sedimentation in the Nepean River bordering PLDC. Further changes in the flow regime for the Nepean River through the pumping from the Penrith weir may result in further sedimentation of the Nepean River and impacts to water quality. The proposed pipeline route is within the banks of the Nepean River and runs along side the river for a considerable length. During construction and rehabilitation appropriate sedimentation and erosion controls should be implemented and maintained, particularly to protect against high volume flows.

Water quality within the current Rowing and Warm-up Lakes of the Penrith Lakes Scheme is managed to maintain a standard for primary contact (in accordance with ANZECC (2000) guidelines). The water from the Nepean River

will probably be below the water quality required by Penrith lakes, particularly during initial periods of high flow and during periods of low flow. The quality of water in the Nepean River should, in general, be acceptable for aquatic biota of Penrith lakes however the expansion of the lakes and nutrient levels may result in outbreaks of cyanobacteria or excessive growth of macrophytes. Drastic changes in water quality and temperature should be avoided and further management will be necessary if water quality becomes a problem (clarify – when it drops below what standard). Treatment could include the use of quarantine (lake?/what sort of quarantine)(see Weed Control), wetlands, biological filtration and chemical treatment.

5.4.4 Connectivity and Fragmentation

Clearing of vegetation may result in loss of connectivity within the study area, particularly between the riparian vegetation along Pipeline Route 1 and the remaining vegetation upslope of Nepean River. This fragmentation could act as a barrier to fauna, especially ground-dwelling birds and mammals, reptiles and frogs. However, connectivity between the two vegetation types will remain intact north of where Pipeline Route 1 diverts upslope, thereby providing a movement corridor for fauna and revegetation over the pipeline route will restore connectivity over time.

It is recommended that plant species representative of each vegetation layer (ground cover, understorey and tree canopy) be retained wherever possible or be included in the revegetation process to minimise loss of connectivity within the study area.

6.0 RECOMMENDATIONS

To reduce the potential impact of the proposal on terrestrial and aquatic flora and fauna, the following mitigation measures are recommended.

Terrestrial Flora and Fauna

- Rehabilitate areas of disturbance once the pipeline is installed, particularly the riparian vegetation along the Nepean River and tributaries.
- Develop and implement a Vegetation Management Plan detailing bush regeneration works and weed management strategies. The Vegetation Management Plan should be implemented by qualified bush regenerators and should be consistent with any existing management plans for the area.
- Monitor areas to be impacted by the proposal, particularly the riparian vegetation along the Nepean River and its tributaries.
- Native species of local provenance, collected from within a 5 km radius of the study area should be used for revegetation and landscaping. Appropriate species should be selected based on the native vegetation community present in the area.
- Appropriate sediment and erosion control measures should be implemented, particularly where works are in the vicinity of creeklines and the Nepean River. An Erosion and Sedimentation Control Plan should be developed and implemented in consultation with the DEC and DPI (Fisheries).
- Where possible, retain existing trees to maintain current foraging and nesting habitat resources for common fauna, as well as to maintain existing fauna corridors.
- Vegetation representing ground cover (e.g. grass tussocks), understorey (e.g. low shrubs and trees) and tree canopy (e.g. large trees) be planted during the revegetation process to provide habitat resources for fauna along the length of the pipeline.
- Plant dense waterside vegetation (e.g. reeds) around all existing dams along the chosen route of the pipeline to provide shelter and nesting resources for threatened and migratory fauna.
- Construct temporary access bridges over Peach Tree Creek and Boundary Creek to limit human disturbance on the creek line habitat. These bridges

are for use by the general public and are to allow continued access to the Great River Walk.

Aquatic Flora and Fauna

- Minimise the impact to the Nepean River and its tributaries through sedimentation control, channel maintenance and rehabilitation.
- Regularly monitor water quality and flows at the Penrith weir and outlet.
- The proposed pumping regime should be further investigated to minimise impacts on downstream flows and fish passage.
- Should drawdown prevent either entry or passage through the fish ladder or the attractant flow within the Nepean River, measures should be implemented to correct this.
- Control measures should be implemented to prevent erosion or sedimentation under high flow and/or flood conditions during construction and rehabilitation.
- Where possible, the route of the pipeline should follow existing roads and not cross pits, dams or riparian vegetation.
- Prevent the transport of aquatic weeds (e.g. *Egeria densa*, *Salvinia molesta*, *Elodea canadensis*) through inlet and outlet design and other quarantine methods.
- Consider the establishment of a wetland system at the outlet to assist in improving the water quality provided by the pipeline.

Penrith Lakes Development Corporation has a permit to obtain a licence to divert water from Nepean River within 500 m upstream of Penrith Weir (Deed of Agreement 1987, 1989). Prior to construction, DPI (Fisheries) should be consulted regarding the proposed works including blocking of tributaries for the construction, drawdown effects upon fish passage and development with 40 m of the River. Other organisations which should be consulted regarding the abstraction of water from the Nepean River include the DNR, Hawkesbury-Nepean CMA and Sydney Catchment Authority which under its operating licence must provide a minimum of 50 ML/d over the Penrith weir.

7.0 CONCLUSION

Pipeline Route 1 follows the north-eastern bank of the Nepean River for part of its length. The riparian vegetation along this section of the Nepean River (to be impacted by Pipeline Route 1) is highly degraded, restricted to a strip of trees with an understorey dominated by exotic flora. The remainder of PR1 traverses highly degraded, exotic dominated vegetation, with some planted native species also present.

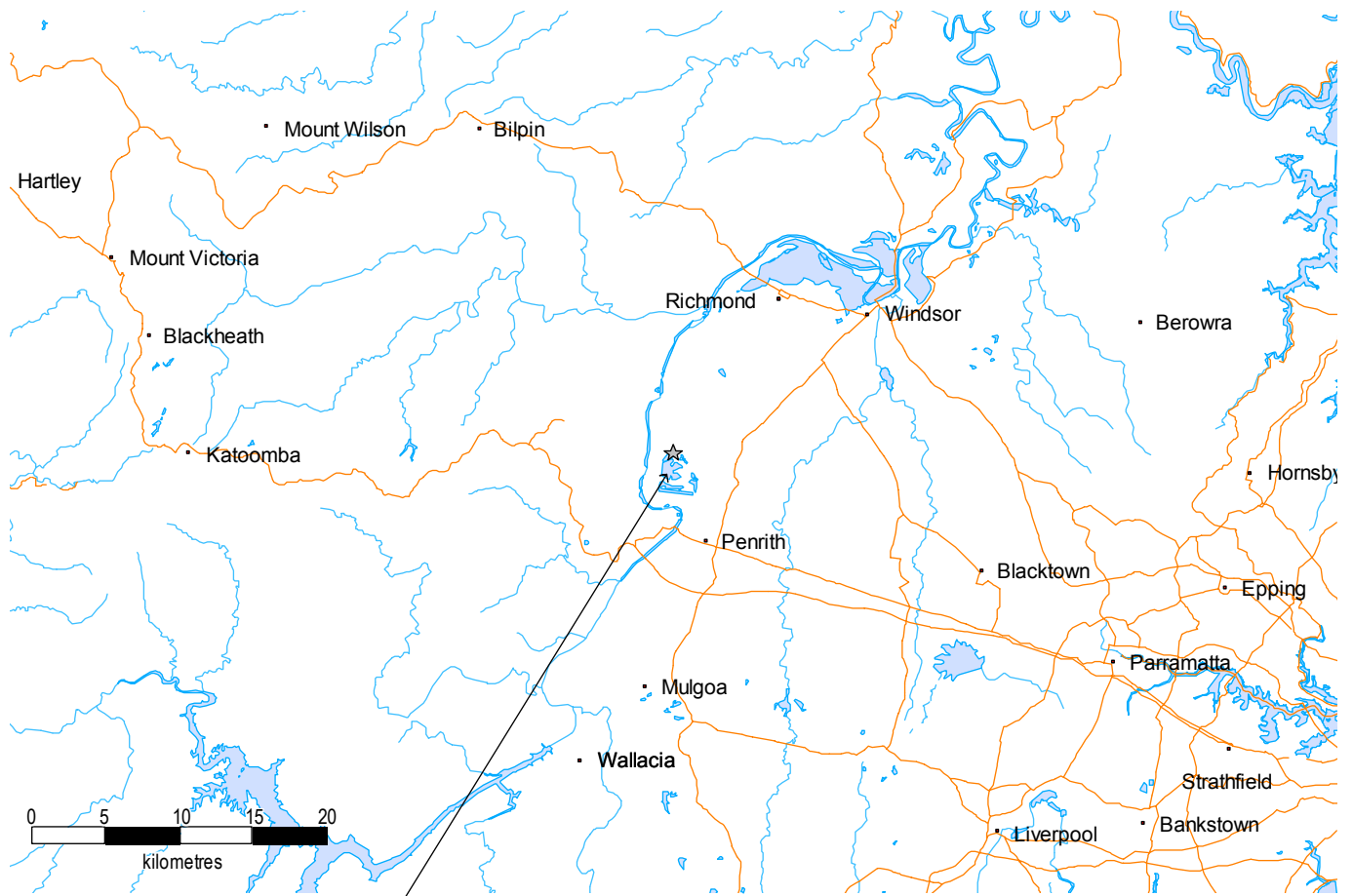
Pipeline Routes 2 and 3 occur within the PLDC Scheme Area. The vegetation within the boundaries of and immediately surrounding the quarried area was observed to be highly degraded, previous clearing and quarrying operations leaving no remnant native vegetation. The majority of the area to be impacted by PR2 and PR3 is highly degraded vegetation dominated by exotic species.

The riparian vegetation in the study area is representative of the Endangered Ecological Community River-flat Eucalypt Forest. An Eight Part Test conducted for this community concluded that the proposal would have no significant impact. No threatened flora species, populations or their habitats were recorded in the study area. Therefore, an SIS or Referral is not required for any threatened flora or vegetation within the study area.

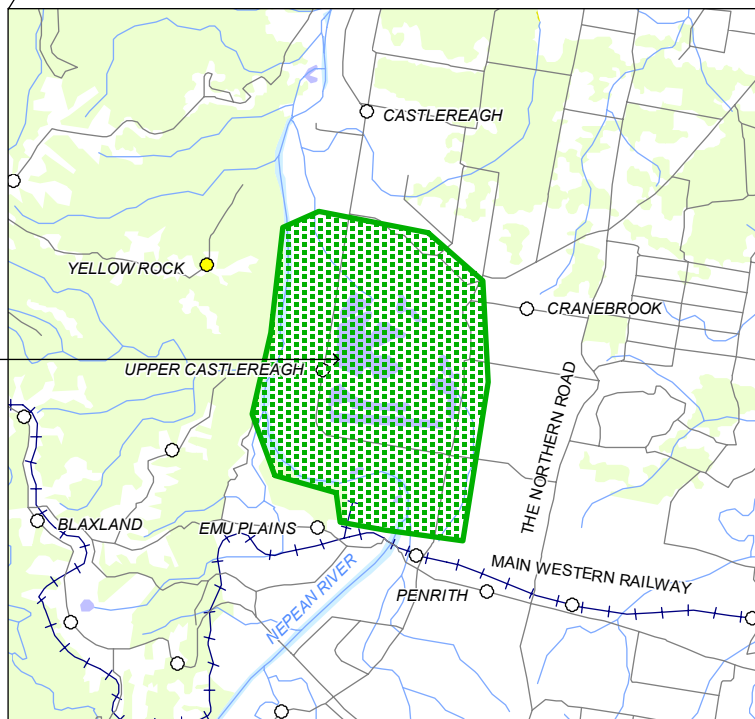
Potential habitat occurs along the proposed route options for five threatened animal species listed on the TSC Act and two threatened and five migratory animal species listed on the EPBC Act. An additional eight migratory species were recorded during the current survey. No Eight Part Tests or Assessments of Significance were carried out as the proposed development is unlikely to cause individual death or injury or loss/disturbance of limited foraging and/or breeding habitat for these species. As no significant impacts are expected to occur for threatened and migratory fauna along any proposed route option for the pipeline, the route options have not been ranked in order of preference. A Species Impact Statement and a Referral to the Federal Minister for the Environment are not recommended for fauna.

The Macquarie Perch, a threatened aquatic species listed on the EPBC and FM Act, has limited potential habitat within the Nepean Weir. An Eight Part Test and Assessment of Significance concluded that there will be no significant impact to the Macquarie Perch as a result of the proposed pump and pipeline. The proposed pumping regime has the potential to significantly impact downstream habitats and fish passage. A review of the flow requirements and pumping rules should be undertaken to protect fish passage and downstream habitats.

FIGURES



Study area



Acknowledgement: Geoscience Australia (1:250000 - SI/56-8).



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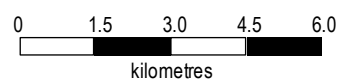
Figure 1: Location of the study area in a regional context.

DATE: 24 June 2005

Checked by: SEW File number: S4173

Location: ... \projects\4000\4100s\4173\Mapping\4173 Fig 1.wor

Scale:





Legend
Proposed pipeline route options

- Route 1 - A
- Route 1 - B
- Route 1 - C
- Route 2
- Route 3

Proposed new lake boundaries

Creeks

INSET

0 50 100 150 metres

Nepean River Weir

INSET

Peach Tree Creek

Legend

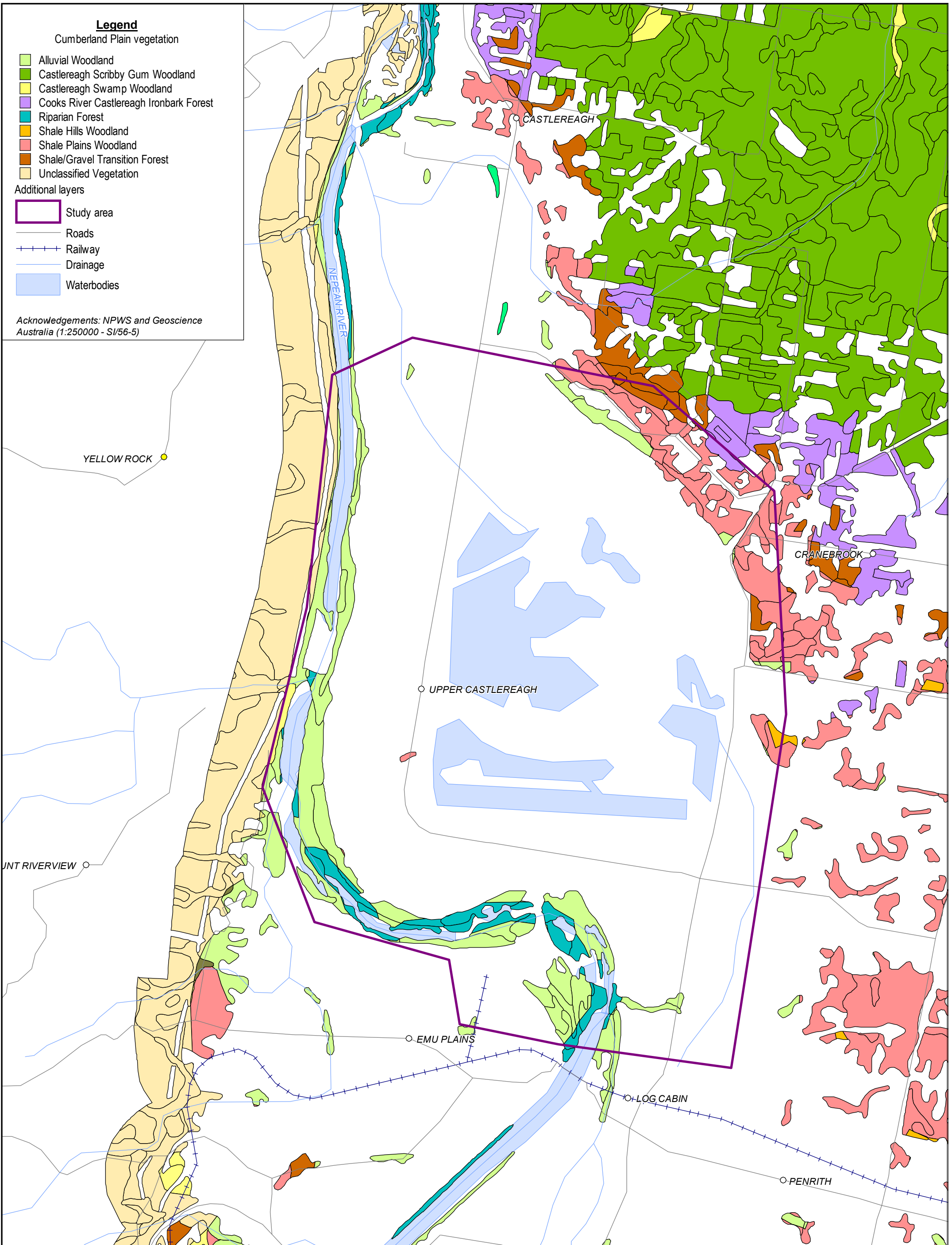
Cumberland Plain vegetation

- Alluvial Woodland
- Castlereagh Scribby Gum Woodland
- Castlereagh Swamp Woodland
- Cooks River Castlereagh Ironbark Forest
- Riparian Forest
- Shale Hills Woodland
- Shale Plains Woodland
- Shale/Gravel Transition Forest
- Unclassified Vegetation

Additional layers

- Study area
- Roads
- Railway
- Drainage
- Waterbodies

Acknowledgements: NPWS and Geoscience Australia (1:250000 - SI/56-5)



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Figure 3: NPWS (2002) vegetation mapping of the study area

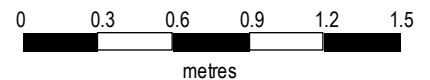
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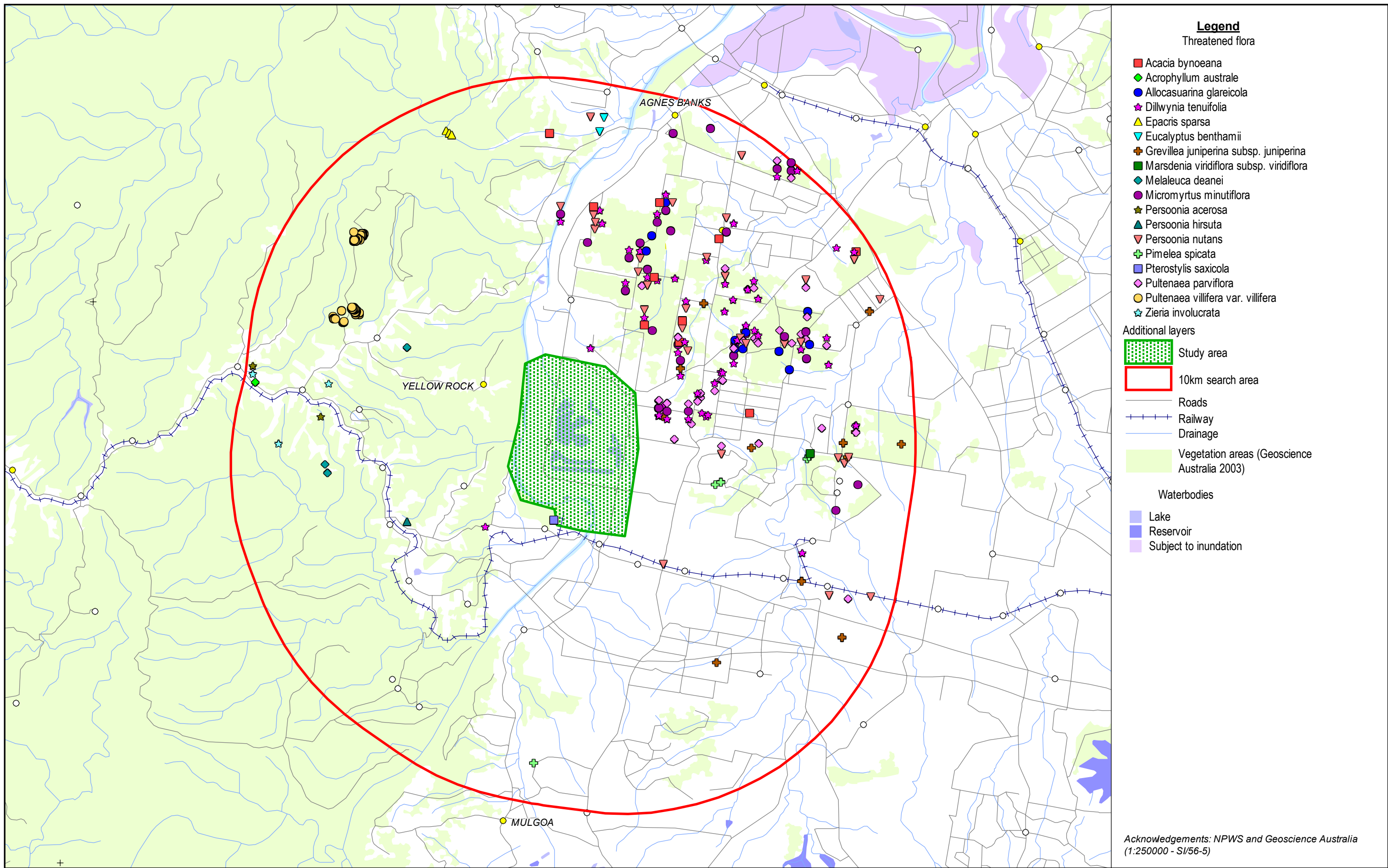
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Scale:





- Legend**
- Threatened flora
- Acacia bynoeana
 - ◆ Acrophyllum australe
 - Allocasuarina glareicola
 - ★ Dillwynia tenuifolia
 - ▲ Epacris sparsa
 - ▼ Eucalyptus benthamii
 - ⊕ Grevillea juniperina subsp. juniperina
 - Marsdenia viridiflora subsp. viridiflora
 - ◆ Melaleuca deanei
 - Micromyrtus minutiflora
 - ★ Persoonia acerosa
 - ▲ Persoonia hirsuta
 - ▼ Persoonia nutans
 - ⊕ Pimelea spicata
 - Pterostylis saxicola
 - ◆ Pultenaea parviflora
 - Pultenaea villifera var. villifera
 - ★ Zieria involucreta
- Additional layers
- ▨ Study area
 - 10km search area
 - Roads
 - - - Railway
 - Drainage
 - Vegetation areas (Geoscience Australia 2003)
- Waterbodies
- Lake
 - Reservoir
 - Subject to inundation

Acknowledgements: NPWS and Geoscience Australia (1:250000 - SI/56-5)

Figure 4: Threatened flora listed on the TSC Act that have been recorded within 10km of the study area

Figure 4: Threatened flora listed on the TSC Act recorded within 10km of the study area



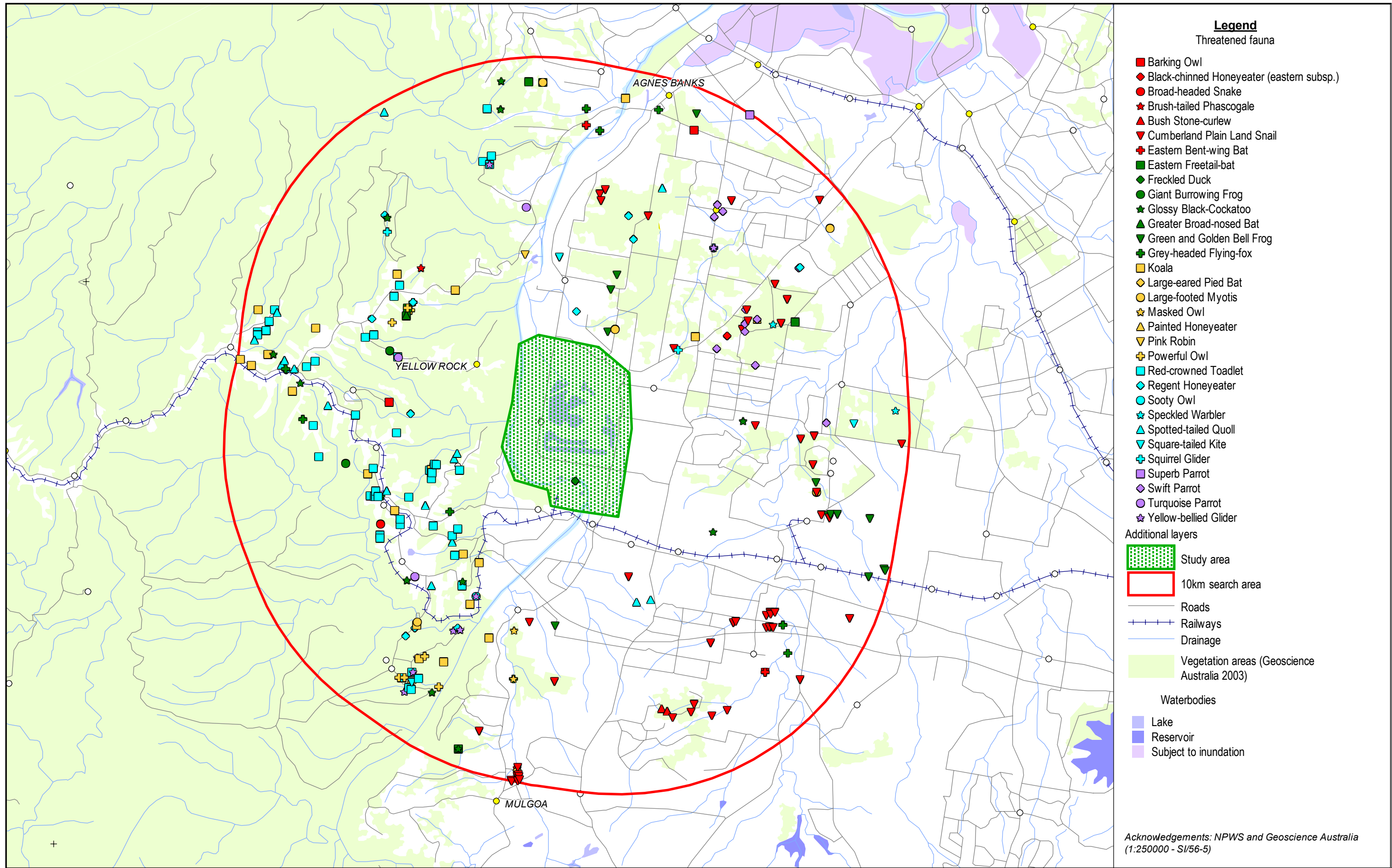


Figure 5: Threatened fauna listed on the TSC Act that have been recorded within 10km of the study area

Figure 5: Threatened fauna listed on the TSC Act, recorded within 10km of the study area

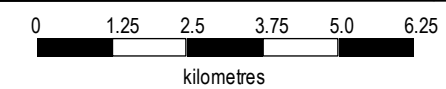
DATE: 24 June 2005

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Location: ...projects\4000\4100s\4173\Mapping\S4173 Fig 5.wor

Scale:



PLATES



Plate 1: Fish ladder (foreground) and overflow of the Penrith Weir



Plate 2: Proposed crossing of Pipeline Route 1 at Peach Tree Creek



Plate 3: Proposed location of pumping station



Plate 4: Planted trees over grassy understorey adjoining banks of Duck Pond, the proposed discharge point of Pipeline Route 1.



Plate 5: Nepean River Downstream of the Penrith Weir

APPENDICES

APPENDIX 1

Statutory Regulations

A.1.1 Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth)

Under the provisions of the EPBC Act any action (activity or development) that requires Commonwealth approval is deemed a controlled action. This is usually the case when an action is likely to have a significant effect on the environment of Commonwealth land or any 'Matter of National Environmental Significance' (MNES) listed below:

- World Heritage areas;
- National Heritage places;
- Wetlands protected by international treaty (Ramsar Convention);
- Nationally listed threatened species and ecological communities;
- Internationally listed migratory species- Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) & Bonn Convention;
- All nuclear actions; and,
- The environment of Commonwealth marine areas.

Where an impact is of potential significance then those affected species or habitats must be referred (Referral) to Department of Environment and Heritage for assessment in accordance with specific criteria outlined in the Guidelines for Significance Assessment. These guidelines provide separate criteria for Extinct, Vulnerable, Endangered and Migratory species against which the significance of the impact can be assessed and whether a referral is required. The purpose of the referral stage is to determine whether a proposed action requires approval under the EPBC Act. If

the Minister determines that an approval is required, the proposed action will proceed through the assessment and approval process.

A referral is a set of information that includes brief descriptions of the proposal, its location and potential impacts on matters of national environmental significance. The EPBC Regulations set out what information must be included in the referral.

If a proposed action has been referred to the Commonwealth Environment Minister and the Minister has decided that the action requires approval, an environmental assessment must be carried out.

The purpose of an environmental assessment is to bring together all the information on the impacts that a proposed action would have on matters protected by the EPBC Act, to ensure that the Minister makes an informed decision on whether or not to approve the action.

If the Commonwealth has signed a bilateral agreement with a State or Territory in which the action is to be carried out, the State or Territory will assess the action under the terms of that agreement. Similarly, the environmental assessment may be carried out by another Commonwealth agency if a ministerial Declaration has been signed with that agency. If no bilateral agreement or Ministerial declaration is in place, the assessment may nonetheless be carried out by a State or Territory under an accredited assessment process. The bilateral agreement between the Commonwealth and New South Wales has not been signed.

If none of these assessment processes is applicable, the Commonwealth will carry

out the assessment using one of the following assessment approaches:

- preliminary documentation;
- public environment report (PER);
- environmental impact statement (EIS); or
- public inquiry.

The proponent, or the person proposing to take the action, will be asked to supply preliminary information on the impacts of the proposed action in order to help the Minister select an appropriate assessment approach.

A.1.2 Threatened Species Conservation Act 1995 (NSW), Fisheries Management Act 1994 (NSW) and Environmental Planning and Assessment Act 1979 (NSW)

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal legislative tool governing land use in NSW. One object of the EP&A Act is to encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats. A second object is to encourage the principles of ecologically sustainable development, including the precautionary principle² as defined under the *Protection of the Environment Administration Act 1991*. The *Threatened Species Conservation Act 1995* protects all threatened plants and animals native to NSW (with the exception of fish and marine plants). It provides for the identification, conservation and recovery

² The precautionary principle states that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

of threatened species and their populations and communities. It also aims to reduce the threats faced by those species. The *Fisheries Management Act 1994* was amended by the *Fisheries Management Amendment Act 1997*, with respect to threatened species conservation and this Act now provides for the protection of all threatened fish and marine vegetation native to NSW waters.

If a planned development or activity will have an impact on a threatened species, this must be taken into account in the development approval process. If the impact is likely to be significant, a Species Impact Statement must be prepared and the Director-General of Department of Environment and Conservation and/or Department of Primary Industries must agree to the development approval. In some cases, the Minister for the Environment will also need to be consulted.

Section 5A of the EP&A Act, Section 94 of the TSC Act and Section 220ZZ of the FM Act lists eight factors (Eight Part Test) which are used to assess the likely impact of a development on a threatened species, population (including their habitats) or Endangered Ecological Community³. Eight Part Test criteria are:

³ The *Threatened Species Conservation Amendment Bill 2002* was assented on 2nd October 2002. This Bill amends the *Threatened Species Conservation Act 1995* and other threatened species legislation. Part of the amendment is the modification of the test applied to determine whether or not an activity is likely to significantly affect threatened species, populations and communities as well as provisions the listing of vulnerable ecological communities. Many of the provisions of the Act were proclaimed on 31st January 2003, while the remainder will be implemented over the next two years. Savings provisions will be prescribed by regulation to ensure that the amendments to the TSC Act and EP&A Act do not affect application and assessment processes that have commenced under the previous legislative regime. Details of the Act and its implementation can be found at <http://www.npws.nsw.gov.au/wildlife/threatened.htm#listing>.

1. 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;
2. 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;
3. 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;
4. 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;
5. Whether critical habitat will be affected;
6. Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region;
7. Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process; and,
8. Whether any threatened species, population or ecological community is at the limit of its known distribution.

An assessment of the results of each test indicates the potential significance of impact. If the application of the Eight Part Tests reveals that a significant effect is likely then:

- The proposal may be modified such that a significant effect on threatened species, populations or ecological communities, or their habitats is unlikely; and/or
- A Species Impact Statement (SIS) must be prepared and the concurrence of the Director-General of Department of Environment and Conservation and/or Department of Primary Industries, or consultation with the Minister for the Environment is required (NPWS 1996).

A.1.3 Water Management Act 2000 and Rivers and Foreshores Improvement Act 1948 (NSW)

The *Water Management Act 2000* (WM Act) provides for the integrated and sustainable management of the State's waters, including those provisions previously included in the *Rivers and Foreshores Improvement Act 1948* (RFI Act). Whilst proclamation commenced most of the provisions of the WM Act on 1 January 2001 (NSW Government Gazette No. 168, December 2000), matters relating to licences and approvals still continue to be dealt with by the RFI Act and the *Water Act 1912*. The Department of Infrastructure, Planning and Natural Resources (DIPNR) is currently developing the administrative procedures to operate the approvals provisions (Chapter 3 Water management implementation, Part 3 Approvals) of the WM Act, however it is not known when these provisions will commence.

While the RFI Act allows the carrying out of works to remove obstructions from and improve rivers and foreshores and to prevent erosion of lands by tidal and non-tidal water, under Part 3A, Section 22B a person must not:

- make an excavation on, in or under protected land (land within 40m from top of bank);
- remove material from protected land;
- do anything which obstructs, or detrimentally affects, the flow of

protected waters, or which is likely to do so unless the person is authorised to do so by a permit.

When assessing developments that require a Part 3A permit, the DIPNR considers whether the proposal is consistent with State Government policy including the NSW State Rivers and Estuaries Policy. Conditions of consent for a Part 3A permit, may as a result, include the establishment of a native vegetation riparian zone along a waterway. Given State Government policy, it is unlikely that a Part 3A permit would be issued for works that degrade watercourses and their environment, as it is DIPNR's aim that:

- an adequate native vegetation riparian zone (minimum 20m) be kept or established on either side of any waterway or wetland,
- on-line or instream water quality structures such as water quality ponds, trash racks and gross pollutant traps are strongly discouraged as they affect the continuity and corridor function of waterways and result in loss of riparian vegetation and habitat, and that
- channelisation, piping and/or relocation of streams and the construction of on-line or instream structures and culverts for waterway road crossing are discouraged.

A.1.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* was amended by the *Fisheries Management Amendment Act 1997*, with respect to threatened species conservation, commercial fisheries management, recreational freshwater fishing, special fisheries trust funds, and charter fishing boats.

This Act provides for the protection of all threatened fish and marine vegetation native to NSW waters. Provisions in Part 7A cover the identification, assessment and proclamations of threatened species, populations and ecological communities and key threatening processes. They also provide for the identification of critical habitat, mandatory impact assessment in the land use planning process and active recovery management.

Under the Fisheries Management Act 1994, a person may be required to provide fish passage, generally through the installation of a fishway, when altering, modifying, or constructing a dam, weir or floodgate. Any proposal that requires construction, modification or alteration of a dam or weir, that requires some approval process by a public authority (including local government) must be referred to DPI Fisheries for determination.

A.1.5 State Environmental Planning Policy 19 Urban Bushland

The principal aims of the State Environmental Planning Policy (SEPP) 19 are to protect and preserve bushland within urban areas. The policy applies to Local Government Areas (LGAs) in the Sydney Region and Lake Macquarie areas but does not apply to areas administered by NSW National Parks and Wildlife Service or State Forests.

Under SEPP 19 the definition of bushland includes the characteristic species that make up the community and its structural form.

'Land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered still representative of the structure and floristics of the natural vegetation'

**A.1.6 NSW DPI Fisheries
Habitat Protection Plan 3
Hawkesbury Nepean
Catchment**

The Fisheries management Act provides for the preparation of habitat protection plans to which the minister and public authorities must regard during the assessment of developments. The plan protects aquatic habitat in the Hawkesbury Nepean Catchment for aquatic fauna and flora. It aims to promote Total Catchment Management, mitigate habitat degradation and assist in the rehabilitation of Hawkesbury-Nepean catchment. It applies to all stages developments and events that may have an impact of fish habitat on all waters and associated habitats within the Hawkesbury-Nepean catchment. Any development should ensure fish habitat conservation through:

- i) the maintenance of natural creek channels and wetlands;
- ii) the preservation of native vegetation possible,
- iii) avoidance of levees, flood gates and drains (except where allowed under SREP 11);
- iv) the preservation of fish passage;
- v) managing stormwater flows (offline gross pollutant traps, sedimentation ponds and artificial wetlands);
- vi) minimise sedimentation and erosion;
- vii) protect water quality
- viii) appropriate monitoring of fish habitats liable to be affected.

**A.1.7 Sydney Regional
Planning Policy 11 Penrith
Lakes Scheme**

The following extract has been adapted from the NSW legislation website (www.legislation.nsw.gov.au).

The aims and objectives of SREP 11 are:

1. To permit the implementation of the Penrith Lakes Scheme.
2. To provide a development control process establishing environmental and technical matters which must be taken into account in implementing the Penrith Lakes Scheme in order to protect the environment,
3. To identify and protect items of the environmental heritage,
4. To identify land which may be rezoned for urban purposes, and
5. To permit interim development in order to prevent the sterilization of land to which this plan applies during implementation of the Penrith Lakes Scheme.

**A.1.8 Sydney Regional
Environmental Plan 20 –
Hawkesbury-Nepean River**

The following extract has been adapted from the NSW legislation website (www.legislation.nsw.gov.au).

This plan applies to certain land in the Greater Metropolitan Region (listed in Part 1 of the Plan), including the Penrith LGA.

This plan does not apply to the land to which *Sydney Regional Environmental Plan No 11—Penrith Lakes Scheme* applies.

The aim of this plan is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.

APPENDIX 2

Flora Results

Family	Scientific name	Common name
Ferns and Fern-like Plants		
Marsileaceae		
	<i>Marsilea</i> spp.	Nardoo
Salviniaceae		
	* <i>Salvinia molesta</i>	Salvinia
Monocotyledons		
Commelinaceae		
	* <i>Tradescantia fluminensis</i>	Wandering Jew
Cyperaceae		
	<i>Bolboschoenus caldwellii</i>	Salt Club-sedge
	* <i>Cyperus eragrostis</i>	Umbrella Sedge
	<i>Eleocharis sphacelata</i>	Tall Spike Rush
Hydrocharitaceae		
	<i>Vallisneria gigantea</i>	Eelweed
Juncaceae		
	<i>Juncus mollis</i>	
	<i>Juncus</i> spp.	
	<i>Juncus usitatus</i>	Billabong Rush
Lomandraceae		
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
Poaceae		
	* <i>Andropogon virginicus</i>	Whisky Grass
	* <i>Arundo donax</i>	Giant Reed
	* <i>Chloris gayana</i>	Rhodes Grass
	* <i>Cortaderia selloana</i>	Pampas Grass
	<i>Cynodon dactylon</i>	Common Couch
	* <i>Eleusine indica</i>	Crowsfoot Grass
	* <i>Eragrostis curvula</i>	African Lovegrass
	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
	* <i>Melinis repens</i>	Red Natal Grass
	* <i>Paspalum dilatatum</i>	Paspalum
	* <i>Paspalum urvillei</i>	Vasey Grass
	* <i>Pennisetum clandestinum</i>	Kikuyu Grass
	<i>Phragmites australis</i>	Common Reed
	* <i>Setaria gracilis</i>	Slender Pigeon Grass
	* <i>Stenotaphrum secundatum</i>	Buffalo Grass
Typhaceae		
	<i>Typha domingensis</i>	Narrow-leaved Cumbungi
	<i>Typha orientalis</i>	Broad-leaved Cumbungi
	<i>Typha</i> spp.	
Dicotyledons		
Alismataceae		
	* <i>Sagittaria platyphylla</i>	Sagittaria
Amaranthaceae		
	* <i>Alternanthera philoxeroides</i>	Alligator Weed
Apiaceae		
	* <i>Foeniculum vulgare</i>	Fennel
Asclepiadaceae		

Family	Scientific name	Common name
	* <i>Araujia hortorum</i>	
Asteraceae		
	* <i>Bidens pilosa</i>	Cobbler's Pegs
	* <i>Cirsium vulgare</i>	Spear Thistle
	* <i>Conyza albida</i>	Tall Fleabane
	* <i>Hypochaeris radicata</i>	Catsear
	* <i>Senecio madagascariensis</i>	Fireweed
	* <i>Sonchus oleraceus</i>	Common Sowthistle
	* <i>Tagetes minuta</i>	Stinking Roger
Brassicaceae		
	* <i>Brassica juncea</i>	Indian Mustard
Casuarinaceae		
	<i>Casuarina cunninghamiana</i> ssp. <i>cunninghamiana</i>	
Euphorbiaceae		
	* <i>Ricinus communis</i>	Castor Oil Plant
Fabaceae (Mimosoideae)		
	<i>Acacia falcata</i>	
	<i>Acacia fimbriata</i>	Fringed Wattle
	<i>Acacia longifolia</i>	Coast/Sallow Wattle
	<i>Acacia parramattensis</i>	Parramatta Wattle
	<i>Acacia</i> spp.	
Fabaceae (Faboideae)		
	* <i>Erythrina crista-galli</i>	Cockspur Coral Tree
	* <i>Genista monspessulana</i>	Montpellier Broom
	<i>Hardenbergia violacea</i>	False Sarsaparilla
	* <i>Lotus suaveolens</i>	Hairy Birds-foot Trefoil
	* <i>Robinia pseudoacacia</i>	Black Locust
Fabaceae (Caesalpinioideae)		
	* <i>Senna pendula</i>	
Fabaceae (Faboideae)		
	* <i>Trifolium repens</i>	White Clover
	* <i>Vicia sativa</i> ssp. <i>sativa</i>	Common Vetch
Gentianaceae		
	* <i>Centaureum tenuiflorum</i>	Slender Centaury
Lauraceae		
	* <i>Cinnamomum camphora</i>	Camphor Laurel
Malvaceae		
	* <i>Sida rhombifolia</i>	Paddy's Lucerne
Meliaceae		
	<i>Melia azedarach</i>	White Cedar
Myrtaceae		
	<i>Angophora</i> spp.	
	<i>Callistemon salignus</i>	Willow Bottlebrush
	<i>Corymbia maculata</i>	Spotted Gum
	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
	<i>Eucalyptus</i> spp.	
	<i>Eucalyptus tereticornis</i>	Forest Red Gum
	<i>Kunzea ambigua</i>	Tick Bush
	<i>Leptospermum polygalifolium</i> ssp. <i>polygalifolium</i>	
	<i>Melaleuca armillaris</i> ssp. <i>armillaris</i>	Giant Honey-myrtle

Family	Scientific name	Common name
	<i>Melaleuca decora</i>	
	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree
Oleaceae		
	* <i>Ligustrum sinense</i>	Small-leaved Privet
Pittosporaceae		
	<i>Bursaria spinosa</i> ssp. <i>spinosa</i>	Sweet Bursaria
Plantaginaceae		
	* <i>Plantago lanceolata</i>	Lamb's Tongues
Polygonaceae		
	* <i>Acetosa sagittata</i>	Rambling Dock
	<i>Persicaria decipiens</i>	Slender Knotweed
	<i>Rumex</i> spp.	
Proteaceae		
	<i>Grevillea robusta</i>	Silky Oak
Salicaceae		
	* <i>Salix nigra</i>	Black Willow
Sapindaceae		
	* <i>Cardiospermum grandiflorum</i>	Balloon Vine
Solanaceae		
	* <i>Solanum mauritianum</i>	Wild Tobacco Bush
	* <i>Solanum nigrum</i>	Black-berry Nightshade
Verbenaceae		
	* <i>Lantana camara</i>	Lantana
	<i>Verbena</i> spp.	

Note: * signifies exotic species

APPENDIX 3

Fauna Results

Common Name	Scientific Name	TSC Act	EPBC Act	Option 1	Option 2	Option 3
Amphibians						
Common Eastern Froglet	<i>Crinia signifera</i>	-	-	W	W	W
Birds						
Australasian Shoveler	<i>Anas rhynchos</i>	-	M	-	O	-
Australian Pelican	<i>Pelecanus conspicillatus</i>	-	-	O	O	O
Australian Raven	<i>Corvus coronoides</i>	-	-	O	-	O
Australian Wood Duck	<i>Chenonetta jubata</i>	-	M	O	-	-
Azure Kingfisher	<i>Alcedo azurea</i>	-	-	O	-	-
Black-shouldered Kite	<i>Elanus axillaris</i>	-	M	O	-	-
Brown Falcon	<i>Falco berigora</i>	-	M	-	-	O
Common Myna	<i>Acridotheres tristis</i>	U	-	O	-	-
Dusky Moorhen	<i>Gallinula tenebrosa</i>	-	-	O	-	-
Eurasian Coot	<i>Fulica atra</i>	-	-	O	-	-
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	-	-	O	-	-
Great Cormorant	<i>Phalacrocorax carbo</i>	-	-	O	-	-
Great Egret	<i>Ardea alba</i>	-	-	O	-	-
Grey Fantail	<i>Rhipidura fuliginosa</i>	-	-	O	-	-
Grey Teal	<i>Anas gracilis</i>	-	M	-	O	-
Hardhead	<i>Aythya australis</i>	-	M	O	-	-
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	-	-	-	-	O
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	-	-	O	-	-
Magpie-lark	<i>Grallina cyanoleuca</i>	-	-	-	-	O
Masked Lapwing	<i>Vanellus miles</i>	-	M	O	-	-
Pacific Black Duck	<i>Anas superciliosa</i>	-	M	O	-	-
Pied Cormorant	<i>Phalacrocorax varius</i>	-	-	-	-	O
Purple Swamphen	<i>Porphyrio porphyrio</i>	-	-	O	-	-
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	U	-	O	-	-
Silvereye	<i>Zosterops lateralis</i>	-	-	O	-	-
Spotted Pardalote	<i>Pardalotus punctatus</i>	-	-	W	-	-
Striated Thornbill	<i>Acanthiza lineata</i>	-	-	W	-	-
Superb Fairy-wren	<i>Malurus cyaneus</i>	-	-	W	-	-
Unidentified Quail	<i>Coturnix sp.</i>	-	-			
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>	-	-	O	-	-
Willie Wagtail	<i>Rhipidura leucophrys</i>	-	-	-	O	-
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	-	-	W	-	-
Zebra Finch	<i>Taeniopygia guttata</i>	-	-	O	-	-
Mammals						
Brown Hare	<i>Lepus capensis</i>	U	-	O	-	-
Reptiles						
Garden/Grass Skink	<i>Lampropholis sp.</i>	-	-	O	-	-

Key

O = Observed; W = Heard; M = Migratory species; U = Introduced species.

APPENDIX 4

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

Eight Part Tests

Vegetation Communities

River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) is listed as an endangered ecological community listed on Schedule 1 (Part 3) of the TSC Act.

RFEF is associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains (NPWS 2004). Alluvial Woodland and Riparian Forest are mapped by NPWS (2003) as occurring in the study area. These vegetation units are sub-communities of RFEF. Impacts of the proposal are likely to be minimal, as the required clearing will be confined to a maximum 10m wide disturbance area, which will be actively regenerated post works. In the vicinity of the Nepean River, three route options (A, B and C) within Pipeline Route 1 have been proposed (Figure 2). For the purposes of the impact assessment, the route option with maximum potential impact has been used for calculations of impact area. The total area to be cleared as part of the proposal is a maximum of approximately 0.26 ha.

- (a) **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.**

Not applicable to endangered ecological communities.

- (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.**

Not applicable to endangered ecological communities.

- (c) **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.**

An approximately 10m wide disturbance area will be cleared through the RFEF in the study area. Based on the NPWS (NPWS 2002b) mapping, this equates to a total of 0.26 ha of RFEF to be cleared for the proposal. This is not a large area of habitat given that there is approximately 1864 ha of the community mapped by NPWS (2002) within a 10 km radius of the study area.

It is recommended that the proposed clearing avoid mature native trees where practicable to prevent erosion and assist in rapid regeneration of the impacted area. Post works, the area cleared will be regenerated.

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

The mapped area of RFEF is currently fragmented by existing tracks and clearings. The RFEF in the study area is restricted to a thin strip of *Casuarina cunninghamiana* adjoining the Nepean River. The approximately 10 m wide impact corridor will temporarily fragment the RFEF, but will not isolate the community from currently interconnecting areas, as the riparian vegetation along the Nepean River is already highly fragmented. Furthermore, the proposal will only fragment the community temporarily, as the cleared areas will be actively regenerated post installation of the pipeline. Bush regeneration works are likely to involve weed control, seeding and possibly planting of local native species in accordance with a Vegetation Management Plan prepared for the site.

(e) Whether critical habitat will be affected.

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the TSC Act, the Director-General maintains a Register of Critical Habitat. To date, no critical habitat has been declared for RFEF (DEH Threatened Species Unit).

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

RFEF is known to occur within conservation reserves including Blue Mountains, Cattai, Dharug, Georges River, Marramarra, Morton, Deua and Wadbilliga National Parks, and Gulguer and Mulgoa Nature Reserves, and these are unevenly distributed throughout the range and unlikely to represent the full diversity of the community (NPWS 2004). It is unlikely that this vegetation community is adequately reserved within the region.

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

Listed Key Threatening Processes (KTP) that may impact RFEF include Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease

transmission by feral pigs; Anthropogenic climate change; High frequency fire; and Removal of dead wood and dead trees (NPWS 2004). The proposal involves 'Clearing of Native Vegetation', which is listed as a Key Threatening Process on the TSC Act. The native vegetation will, however, be actively regenerated post works. The RFEF in the study area is currently in a highly degraded condition.

Additional threats to the RFEF include fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping, anthropogenic climate change and frequent burning (NPWS 2004).

Proposed rehabilitation works post installation of the pipeline are likely to reduce many of the listed threats, including weed invasion and pollution from urban and agricultural runoff.

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

RFEF is known to occur in the North Coast, Sydney Basin and South East Corner Bioregions. The study area is not near the limit of known distribution for the community.

Conclusion

Approximately 0.26 ha of RFEF will be cleared as a result of the proposed works. The proposed works would not have a significant impact on the community given the regional extent of the community and the fact that the area will be regenerated post works in accordance with a Vegetation Management Plan prepared for the site. A Species Impact Statement is not considered necessary.

Fauna

Macquaria australasica

Macquarie Perch

Macquarie Perch *Macquaria australasica* is listed Vulnerable on Schedule 5 of the FM Act. This species is also listed as Endangered on the EPBC Act. Macquarie Perch inhabit the upper reaches of catchments where there are deep pools and riffles with little sediment (McDowall 1996, Allen *et al.* 2002). They undertake an upstream breeding migration in late spring and deposit between 50,000 and 10,000 number small adhesive demersal eggs above riffles and at the tail of pools (Morris and Wooller 2001). Macquarie Perch may have been introduced into the Eastern drainages from the upper Murray Darling Basin. They are known in the upper reaches and dams of the Nepean River, Glenbrook Creek and the Colo River in the Hawkesbury Nepean Catchment and the upper Shoalhaven River (Bruce *et al.* 2001).

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.

Macquarie Perch was not detected during this study. The species is known to occur in Glenbrook Creek approximately 6 km upstream. The Nepean Weir is potential poor quality habitat for the Macquarie Perch. The proposed works will pump water from this weir which may cause drawdown effects which creates barriers to passage and causes some sedimentation. Given the poor quality of habitat directly downstream of the Nepean Weir it is unlikely that this area would support a viable population. While areas of habitat and potentially populations may occur in tributaries downstream it is unlikely that the proposed works will isolate potential breeding and refuge areas.

It is therefore considered that the lifecycle of this species will not be disrupted such that a viable population of this species as 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 currently no endangered populations of this species listed under the FM 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.

The catchment under consideration is the Hawkesbury Nepean Catchment. Macquarie Perch are known to occur in the upper reaches and dams of the Nepean River. They are also known from Glenbrook Creek approximately 6km upstream. It is unlikely that a area of known area of habitat will be impacted

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.

Macquarie Perch are known upstream of the Nepean weir and in the Colo River downstream of the Penrith weir. There are a number of natural and man-made barriers to fish passage within their range and it is unlikely that the proposed works would further isolate known populations of Macquarie Perch within the Hawkesbury-Nepean River System.

Whether critical habitat will be affected.

Critical habitats are areas that are crucial to the survival of particular threatened species, populations and ecological communities. Under the FM Act, a register of critical habitats is maintained. No critical habitat has been declared for this species (DPI Fisheries Scientific Committee).

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

Macquarie Perch are known to occur with National Parks and Catchment reserves with the Hawkesbury Nepean catchment and in their western distribution. However this species is not considered to be adequately represented in conservation reserve in NSW.

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 6 of the FM Act. The proposed development will involve the installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams which is a recognised KTP. It will also involve the removal of a small amount of riparian vegetation which is also listed as a KTP under the FM, TSC and EPBC Acts ('Clearing of Native Vegetation').

Other threats to this species include sedimentation and habitat degradation, barriers to fish passage, thermal pollution from dams, competition by salmonids, overfishing and the EHN Virus. (DPI Fisheries Scientific Committee 1998, Morris and Wooller 2001). The proposed works may increase the barrier to fish movement through the isolation of the fishladder at Penrith Weir.

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

The Macquarie perch eastern population is known to inhabit the Hawkesbury Nepean and Shoalhaven catchments. The study site is at the north eastern limit of distribution of this species.

Conclusion:

The proposed development is unlikely to have a significant impact on this species. A Species Impact Statement is not recommended.

APPENDIX 6

EPBC Assessment of Significance

Endangered Species

Potential habitat occurs within the study site for Macquarie Perch *Macquaria australasica* listed as Endangered on the EPBC Act within the Nepean River Upstream of the Penrith Weir:

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

Macquarie Perch are not known to occur in the Nepean weir and no individuals were observed during this survey. It is unlikely that the proposed action will cause a decrease in the size of a known population.

Is the action likely to reduce the area of occupancy of the species?

Macquarie Perch are not known to occur in the Nepean River at Penrith weir and therefore an area of known habitat will not be reduced by the proposed works

Is the action likely to fragment an existing population into two or more populations?

The Macquarie Perch is known from several tributaries and in the upper catchment of the Hawkesbury Nepean River and the Colo River and it unlikely that the proposed works will further fragment an existing population.

Is the action likely to adversely affect habitat critical to the survival of a species?

There is no critical habitat listed for the Macquarie Perch. The proposed development will not effect riffle or pool habitat within known habitat

Is the action likely to disrupt the breeding cycle of a population?

There are no known breeding populations within or downstream of the weir and the proposed works is unlikely to reduce riffle habitat which is utilised for breeding although riffle habitat downstream of the weir may be effected.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The status of the eastern populations of the Macquarie perch is considered less threatened than the Murray Darling Basin populations although it is still declining. The action may result in a reduction of fish passage in the Nepean River however it is highly unlikely that the Macquarie Perch would find suitably habitat within

the mid and lower Nepean River without significant improvements to the habitat, fish passage and flow regime.

Is the action likely to result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered or critically endangered species/vulnerable habitat?

It is highly unlikely that the proposed action will cause an invasive aquatic species not currently established in the Nepean River to become established. Although a lack of flow may increase the disturbance and abundance of aquatic weeds such as *Salvinia molesta* and *Egeria densa*.

Is the action likely to interfere with the recovery of the species?

An action plan has yet to be developed for the Macquarie perch and fish passage below the weir is highly impacted and however it is highly unlikely that the Macquarie Perch would find suitably habitat within the mid and lower Nepean river without significant improvement to the habitat, fish passage and flow regime

Conclusion

Based on the above assessment, Macquarie Perch are unlikely to be significantly impacted by the activities and as such a Referral under the provisions of the EPBC Act is not recommended for this species.

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