

---

# **UPPER HASTINGS AND FORBES RIVERS WERRIKIMBE NATIONAL PARK**

## **Wild River Assessment**

**Parks and Wildlife Division  
Department of Environment and Conservation  
June 2005**

---

Department of **Environment and Conservation** NSW



Published by:  
Department of Environment and Conservation  
59–61 Goulburn Street  
PO Box A290  
Sydney South 1232  
Phone: (02) 9995 5000 (switchboard)  
Phone: 131 555 (information and publications requests)  
Fax: (02) 9995 5999  
E-mail: [info@environment.nsw.gov.au](mailto:info@environment.nsw.gov.au)  
Website: [www.environment.nsw.gov.au](http://www.environment.nsw.gov.au)

This material may be reproduced for non-commercial and educational use, in whole or in part, provided the meaning is unchanged and the source is acknowledged.

DECC 2008/364  
ISBN 978 1 74122 892 2  
Released by DEC 2005. Web upload to DECC website June 2008

## CONTENTS

|  |    |
|--|----|
| SUMMARY .....  | iv |
| 1 INTRODUCTION .....   | 1  |
| Wild Rivers under the National Parks and Wildlife Act .....                      | 1  |
| Community consultation .....   | 1  |
| 2 ASSESSMENT .....   | 2  |
| 3 RESULTS .....  | 3  |
| Description of the Hastings catchment .....                                      | 3  |
| Description of Upper Hastings and Forbes sub-catchments .....                    | 6  |
| 4 TECHNICAL ASSESSMENT .....   | 10 |
| Biological condition .....   | 10 |
| Geomorphological condition .....   | 13 |
| Hydrological condition .....   | 13 |
| 5 REFERRALS .....  | 14 |
| 6 RECOMMENDATION .....   | 14 |
| 7 REFERENCES .....   | 14 |
| APPENDIX A: RECREATIONAL ZONING CATEGORIES FOR DEC RESERVES .....                | 16 |
| APPENDIX B: DATA SOURCES FOR TECHNICAL ASSESSMENT—CRITERIA FOR WILD RIVERS ..... | 17 |
| APPENDIX C: AQUATIC MACROINVERTEBRATE FAUNA (HASTINGS) .....                     | 18 |
| APPENDIX D: AQUATIC MACROINVERTEBRATE FAUNA (FORBES) .....                       | 20 |

## **SUMMARY**

NSW has recently introduced legislation that enables wild rivers to be formally recognised and protected. Wild rivers are those rivers of which the biology, geomorphology and hydrology are in a substantially unmodified condition. Wild rivers are declared within areas currently reserved and managed for nature conservation purposes to ensure that the high conservation values of these rivers are maintained. Wild rivers can also be used as focal points for a range of protection and rehabilitation works outside reserves.

The Forbes and Upper Hastings rivers fall within the Hastings catchment, located on the Mid North coast of NSW. As is the pattern over much of coastal NSW, clearing has occurred over much of the low floodplains. Forbes and Upper Hastings sub-catchments occur within Werrikimbe National Park and form part of the Central Eastern Rainforest Reserves of Australia (CERRA) World Heritage area. Scattered mining and agricultural activity occurred in the Upper Hastings catchment before its reservation, and two drains, originally installed to drain swamps, remain in the upper catchment.

The Forbes and Upper Hastings rivers have been assessed in terms of their biological, geomorphic and hydrological condition. The biological assessment (AUSRIVAS) indicated that the rivers were suitable for listing as wild rivers. The geomorphic study allocated the highest (most pristine) condition category to the Forbes River. The drains in the upper part of the Upper Hastings sub-catchment are continuing to erode and are likely to have a localised damaging effect on the tributary in which they occur. In terms of hydrology, partial draining of the swamps in the Upper Hastings catchment would increase flows into the Upper Hastings River. The increase in flow is likely to be small compared with the overall flow of the river, and both the Forbes and Upper Hastings are considered to be suitable for declaration as wild rivers.

The Forbes River and all of its tributaries within Wadbilliga National Park are considered to meet the criteria for wild rivers. The Upper Hastings and its tributaries, excluding the disturbed tributary discussed above, are also considered to meet the criteria for wild rivers.

# 1 INTRODUCTION

## Wild Rivers under the National Parks and Wildlife Act

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the declaration of wild rivers.

In order to be considered wild, a river must be in a relatively natural condition. Both the river and the parts of the catchment which affect the river are taken into account:

Wild rivers are those *exhibiting substantially natural flow ... and containing remaining examples, in a condition substantially undisturbed since European occupation of ...*

- a) *the biological, hydrological and geomorphological processes associated with river flow, and*
- b) *the biological, hydrological and geomorphological processes in those parts of the catchment with which the river is intrinsically linked. (s. 61 (4), NPW Act)*

Wild rivers may be declared only on reserves managed by the Department of Environment and Conservation (DEC).

A wild river may be an estuary, a freshwater creek, or a chain of ponds. The Act states that a wild river may be:

any water course or water course network, or any connected network of water bodies, or any part of those, of natural origin, exhibiting substantially natural flow (whether perennial, intermittent or episodic) (s. 61 (4), NPW Act).

Declaration of a wild river is made by notice in the *Government Gazette*.

The Director General of DEC has the power to declare a wild river without an Act of Parliament, but in some cases the concurrence of certain Ministers must first be obtained: if the declaration may affect the functions of the Minister responsible for the *Water Management Act 2000* or, in the case of State Conservation Areas, the Minister responsible for the *Mining Act 1992*, the concurrence of the Minister(s) may need to be obtained (s. 61 (3), NPW Act).

DEC also needs to consider how the river will be managed. A river may not be declared wild unless the declaration is consistent with any Plan of Management that applies to the river's reserve, (s. 61A, NPW Act).

Wild rivers are to be managed in a manner that is consistent with the maintenance and restoration (if necessary) of their wild river values. Aboriginal objects and places associated with the wild river are to be identified, conserved and protected (s. 61 (5) (a) and (b)). Wild river declaration can therefore be used to trigger investigations of Aboriginal objects and places and the development of conservation plans.

The objectives of the NPW Act, such as the conservation of significant natural and cultural features and the fostering of a public appreciation and enjoyment of nature, also apply to wild rivers.

## Community consultation

It is DEC policy to consult the community where the declaration of a wild river will have a substantial effect on the management of that river.

The Forbes and Upper Hastings rivers occur within Werrikimbe National Park. A draft Plan of Management applies to this park, and this plan identifies the Upper Hastings and Forbes rivers as being wild rivers. The Plan of Management was publicly exhibited in 2002. The Plan of Management specifies a management regime that is consistent with the management principles required for wild rivers under the *National Parks and Wildlife Act 1974*.

Under DEC policy, public consultation before the declaration of a wild river is not required where the management of rivers remains unchanged. DEC will not be altering the existing management practices for those sections of the Upper Hastings and Forbes rivers that are declared wild. These areas will continue to be managed in accordance with the exhibited version of the Draft Werrikimbe National Park Plan of Management; therefore, there will be no public consultation before the declaration of this river.

## 2 ASSESSMENT

The NPW Act requires that rivers and relevant parts of their catchments must meet certain standards of biological, geomorphological and hydrological condition in order for them to be declared a wild river. A range of existing information is available on the condition of the Upper Hastings and Forbes rivers and on their catchments. The Upper Hastings and Forbes wild river assessment has drawn from this information and local expertise to assess whether these rivers can be considered wild.

DEC has assessed the Forbes and Upper Hastings rivers in accordance with its *Framework for Wild River Assessment* (Department of Environment and Conservation 2005b). This document outlines DEC's policy in relation to wild river assessment and declaration. The techniques adopted to assess wild rivers measure the current biological and geomorphological condition and compare this with a reference condition.

- For assessment of **biological** health, 'AUSRIVAS' (Davies 2000) analysis is used. This method samples and analyses freshwater invertebrates and uses the presence/absence of groups of invertebrates as a surrogate for biological health.
- For assessment of **geomorphological** condition, River Styles<sup>®</sup> (Brierley and Fryirs 2005) is used. This method measures a range of physical features of a river to determine whether there are unnatural rates of change in the river system.

These methods have been used extensively in NSW. For AUSRIVAS the reference condition is represented by reference sites from all major river systems across NSW; these sites were selected from river reaches thought to be least affected by post-European human activities. Some minor disturbances may still be present at reference sites.

For river **hydrology**, there is no widely available means of estimating a river's natural flow and the degree of flow alteration since European occupation. Stations that measure river flow have been established along some rivers, and from the data obtained from them it is possible to estimate a river's flow regime. These data can be compared with those of models of pre-European flow conditions to determine the degree of alteration. Accurate data on river flow are available only where river-flow monitoring stations have been installed and data on river flow and rainfall in the catchment have been collected over long periods. To determine whether any land-use changes have had an impact on river flow, flow data from before and after major disturbances need to be collected. Such information is rarely available. In cases where data are insufficient the hydrological condition can only be surmised, on the basis of coarse indicators of river flow alteration such as water extraction or the presence or absence of dams and weirs.

The current and historical land-use practices within the relevant parts of the catchment may directly affect the river condition. Current land-use information is used to highlight any management practices that might affect the river or catchment in the future. Disturbances that may have an impact on the biology, hydrology and/or geomorphology of the river include logging, clearing, road works, mining, drainage works, water extraction, frequent or severe fires, intensive recreational activities, grazing, and the presence of certain weeds and feral animals. Sources of information include spatial data sets, maps of vegetation structure, aerial photographs, physical evidence and any documents relating to the history, use and management of the area. In this study, local knowledge has also been used.

The wilderness values of the Forbes and Upper Hastings catchments have been assessed. The wilderness assessment looked at a range of land-use issues to determine the degree to which these catchments were natural; that is, whether they had been substantially undisturbed since European occupation. The wilderness assessment examined factors such as fire history; the presence of roads, powerlines and other infrastructure; the logging, mining, grazing and clearing history; and allocated 'naturalness' classes based on the likely cumulative effect of these disturbances (NSW National Parks and Wildlife Service 2001). Three classes were allocated according to the level of disturbance in any particular area: substantially modified (for areas that had been cleared or extensively modified), modified but recoverable (for areas that had some disturbance but were likely to naturally regenerate within a reasonable period), and substantially unmodified. The wilderness disturbance classes are useful in this study, as they help to provide a more comprehensive picture of catchment condition.

DEC has developed recreational 'zonings' across Werrikimbe National Park to indicate the management intent for each section of the park, including the level of recreational use that is appropriate. The zoning scheme uses a gradation of zones from 1 to 5. Zone 1 allows for a small number of self-reliant visitors who do not require facilities, whereas zone 5 provides for a large number of visitors seeking a range of more intensive recreational activities that rely on facilities. A more detailed description of recreational zonings is provided in Appendix A. These zonings provide a useful indication of the recreational values of the area and the recreation-related impacts that may be operating in the catchment.

The data sources used and experts consulted for the technical assessment are listed in Appendix B.

### **3 RESULTS**

#### **Description of the Hastings catchment**

The Forbes and Upper Hastings rivers fall within the Hastings catchment, located on the Mid North coast of NSW and covering an area of approximately 4500 square kilometres. Approximately 77% of the Hastings catchment is covered by native vegetation, much of this within DEC reserve (25%) or State Forest (20%) on the steeper upper catchment and the coast. Less than 23% of the catchment is covered by crop or pasture, and less than 1% is used for other purposes (Beale *et al.* 2004). Clearing is concentrated on the flatter, coastal plains. The major regional centres of Port Macquarie and Wauchope support a population of approximately 75 000.

The catchment falls within an area where the New England Fold belt overthrusts the Sydney basin, resulting in a complex pattern of ridges and valleys (NSW National Parks and Wildlife Service 2003) that extends eastward to the coast.

The Hastings River, along with the Camden Haven River, forms one of the two major rivers in the catchment. The majority (72%) of rivers in the catchment are considered to be in geomorphologically good condition (Cohen and Brierley 1999). Clearing has commonly occurred on the low floodplains, and erosion has affected the Hastings River trunk (particularly downstream of Long Flat to the confluence of Thone River), the Ellenborough River and the Pappinbarra River. The effects on the rivers include channel widening and the infilling of pools, particularly in agricultural lands and wetlands. Gravel extraction has resulted in instability of the banks along some rivers in the catchment (Cohen and Brierley 1999).

A study conducted in 1999–2000 (Environment Protection Authority 2000) sought to document the concerns of Hastings residents regarding the future of their waterways. Erosion and sedimentation of rivers ranked highly among residents' concerns. Perceived threats to waterways included causeway construction in various places, runoff from council-owned roads, forestry activities, inappropriate land clearing, riverbank erosion, the threat to riparian vegetation, the role of fencing, and controlling cattle access to streams.

Figure 1. The Hastings catchment

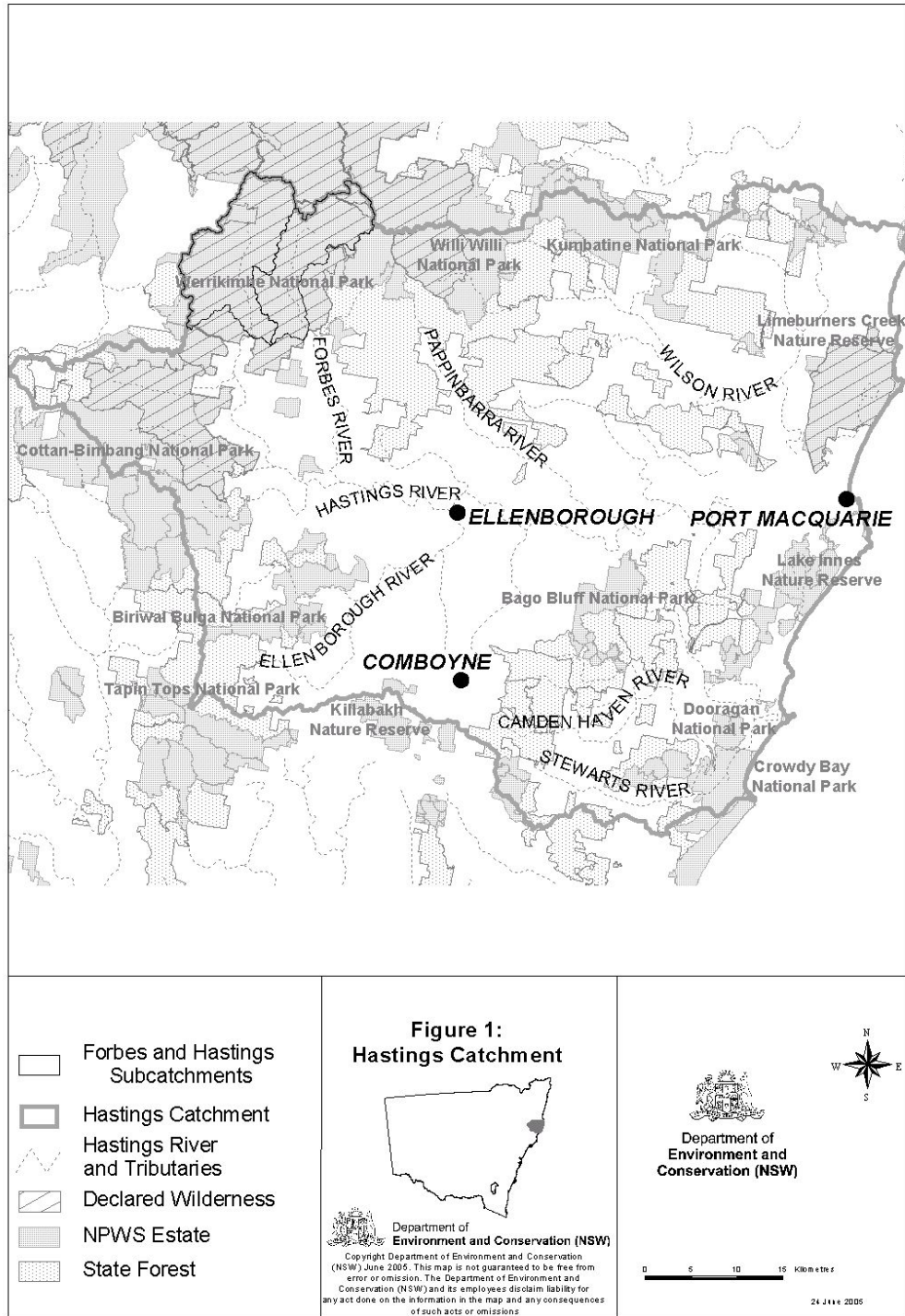
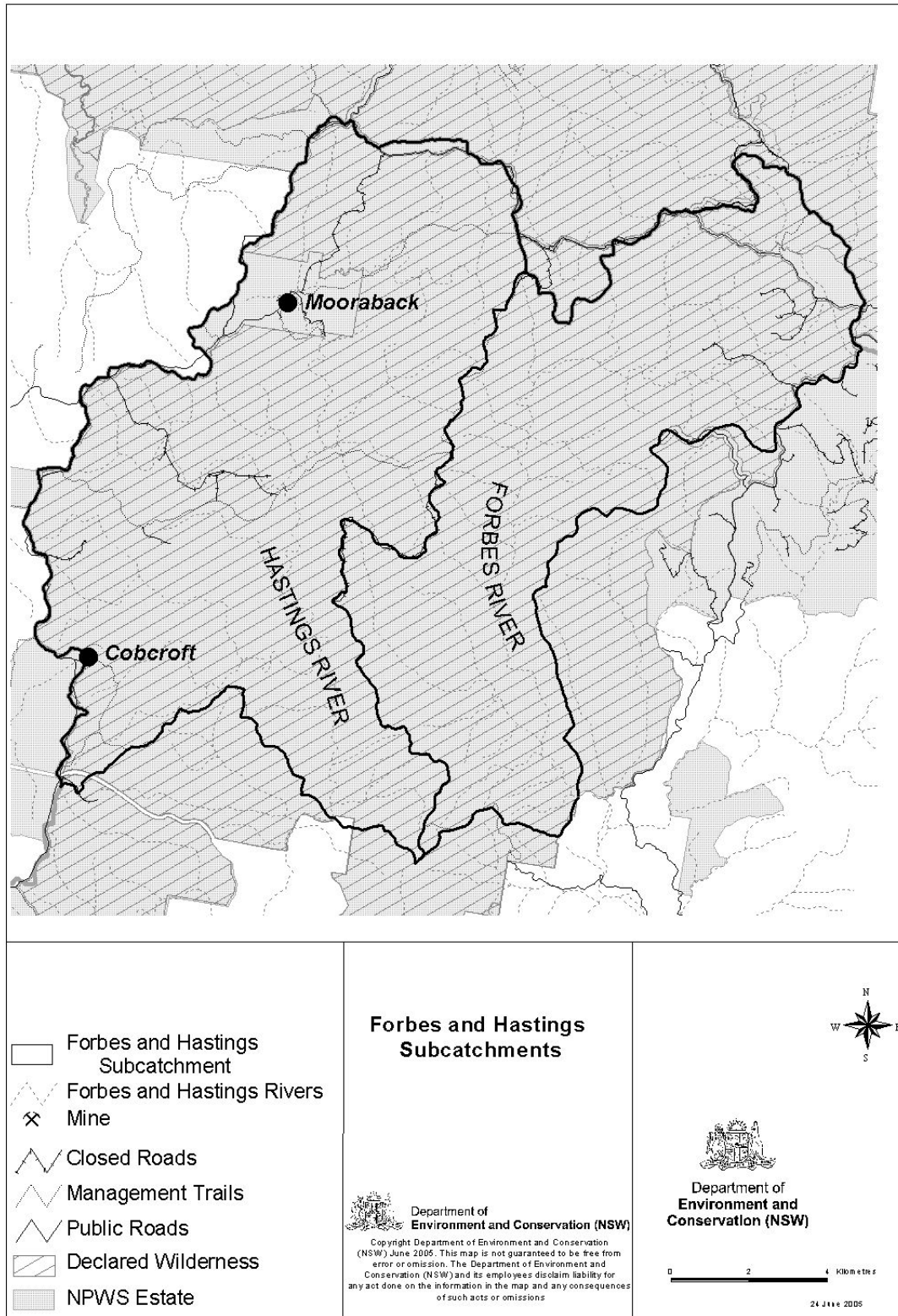




Figure 2. The Forbes and Hastings sub-catchments



The community in Hastings catchment has identified important management issues that are consistent with the declaration of the Forbes and Upper Hastings rivers as wild rivers (Environment Protection Authority 2000). Management issues raised by the community included:

- the need to respect Aboriginal spiritual and cultural values associated with rivers, creeks, wetlands and lakes
- the need to respect traditional Aboriginal management roles in, and uses for, these areas, including as a source of traditional foods
- the need to protect rivers with high conservation values.

## **Description of Upper Hastings and Forbes sub-catchments**

### *Physical features*

The Forbes and Upper Hastings sub-catchments cover 12 700 hectares and 9200 hectares, respectively, and occur in the north-east headwaters of Hastings Catchment (Figure 1). These rivers flow south from the tablelands into deeply dissected gorges within Werrikimbe National Park. The sub-catchments defined in this study are those areas upstream of, and directly influencing, the reserved section of the Upper Hastings and Forbes rivers (Figure 2).

The geology of the park is mainly Devonian metamorphosed sedimentary rocks, intruded by upper Permian igneous rock. The Forbes sub-catchment contains acid volcanic, whereas the Upper Hastings sub-catchment contains sedimentary rocks on the western side, acid volcanics to the east, and leuco-granitic rocks in the south-east. The annual average rainfall in Werrikimbe National Park is 1603 millimetres.

### *Upper Hastings sub-catchment: natural and cultural values*

Werrikimbe National Park (incorporating both the Upper Hastings and the Forbes sub-catchments) is located in the traditional area of the Dungutti Aboriginal people. The park is in the Birpai and Kempsey Local Aboriginal Land Council areas, although Aboriginal peoples living in other land council areas may also have an interest in the management of the park.

The park contains three recorded Aboriginal sites, including one known stone arrangement, stone engravings and surface deposits of stone artefacts. All known sites within the park are recorded in DEC's Aboriginal Heritage Information Management System (AHIMS).

This park is part of the Central Eastern Rainforest Reserves of Australia (CERRA) World Heritage area because of the presence of ancient and isolated rainforest refugia for a variety of plant and animal species.

Most of the Upper Hastings sub-catchment is rainforest and old growth, although some cleared areas that are slowly regenerating exist around the Mooraback camping area. An area of naturally clear swamp, sedgeland and heath is evident in the upper reaches of the Hastings catchment.

Thirty percent of the catchment (3762 hectares) is vegetated with forest ecosystems that are under-represented in the DEC reserve system, including rainforest and Peppermint Forest (NSW National Parks and Wildlife Service 1998b).

Groundwater-dependent ecosystems (moist eucalypt forest, rainforest and riparian forest) comprise 85% of the catchment (Department of Environment and Conservation 2004). These are vegetation types that may be directly dependent on the existing flow regime of the Upper Hastings River. Most of the Upper Hastings sub-catchment is moist eucalypt forest. Rainforest dominates the south-facing slopes, and pockets of riparian forest occur in the southern sections along the river.

Several wetland communities on the New England Tablelands have been listed as endangered ecological communities under the *Threatened Species Conservation Act 1995* (Montane Peatlands and swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions and Upland Wetlands of the drainage divide of the New England Tableland Bioregion). These endangered ecological communities may be present at Racecourse Swamp and/or Bishops Swamp.

Threatened fauna recorded from the Upper Hastings River catchment includes the Hastings River mouse (*Pseudomys oralis*), powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*), glossy black-cockatoo (*Calyptorhynchus lathamii*), spotted-tailed quoll (*Dasyurus maculatus*), eastern false pipistrelle (*Falsistrellus tasmaniensis*), parma wallaby (*Macropus parma*), rufous scrub-bird (*Atrichornis rufescens*), hooded robin (*Melanodryas cucullata*), olive whistler (*Pachycephala oliveacea*), sphagnum frog (*Philoria sphagnicola*) and New England tree frog (*Litoria daviesae*) (Department of Environment and Conservation 2005a).

Threatened flora recorded from the catchment includes *Callitris oblonga* subsp. *parva*, *Philothea myoporoides* subsp. *obovatifolia*, *Thesium australe*, and *Euphrasia ciliolata* (Department of Environment and Conservation 2005a).

**Recreational values.** Two visitation nodes are maintained in the Upper Hastings catchment, at Mooraback and Cobcroft (see Figure 2). Mooraback is a basic campsite with five sites and a pit toilet, whereas Cobcroft is a small day-use facility with a toilet and picnic table. Both sites have short walks of approximately 1.5 hours duration, supplemented by longer walks along management trails. These longer walks take visitors through areas of Warm Temperate rainforest in areas of old-growth forest. It is estimated that this western side of Werrikimbe receives fewer than 10 000 visitors a year.

The Upper Hastings River—particularly the Upper, Middle and Lower Falls—are well known to experienced bushwalkers as an area for challenging off-track bushwalks.

#### *Upper Hastings sub-catchment: land-use history*

**Degree of naturalness.** In 1999–2000 DEC undertook a wilderness assessment of Werrikimbe National Park (NSW National Parks and Wildlife Service 2001). As a part of this assessment the Forbes and Upper Hastings sub-catchments were assessed for their natural values—that is, the degree to which they have been modified since European occupation (see Section 2). Under this assessment the majority of the Upper Hastings sub-catchment was found to be substantially unmodified by European activities. An area of approximately 600 hectares on the north-west side of the sub-catchment was excluded from wilderness. Disturbances on this site (evident from 1997 aerial photos and listed in the draft Plan of Management) include drains, causeways, erosion along gullies and dirt trails. Supplementary plantings were undertaken in the early 1980s to enhance the recovery of these cleared areas, and research has been undertaken on rehabilitating the high-altitude swamps that were drained as part of previous grazing practices.

It is likely that the full complement of original ecological communities is present within the catchment.

**Trails.** Fenwicks Road, Cobcroft Road and Cedar Creek Road/Racecourse Trail form a continuous public access road along the western and northern boundaries of the study area. These roads weave in and out of the park and the catchment. Mooraback Road provides access to the camping area and field study centre at Mooraback. This route comprises a section of the Bicentennial National Trail, which is routinely used by horseriders and walkers.

A series of trails south and west of the Mooraback area are used for essential management purposes only, such as fire suppression and weed and pest control. These trails are closed to public access by locked gates.

**Fire history 1993–2005.** Significant wildfires occurred in the north-west and south-east sections of the study area in 2002–03. The whole of the northern half was burnt in 1993–94.

Prescribed burns within the last 10 years affected the Mooraback area (burned in 1998–99) and the Werrikimbe Trail and Cobcroft Trail areas (burned in 1993–94).

**Recreational zoning.** The southern half of the study area below Werrikimbe Trail is zoned 1 for maximum environmental protection. (See Section 2 for an explanation of recreation zoning.) The Mooraback area is zoned 3, consistent with the presence of a camping and picnic area, and the remaining northern section is zone 2 because of the presence of management trails.

**Mining history.** Paddy's Prospect, a historic manganese oxide mine, has been recorded on a ridge just south of Werrikimbe Trail. Evidence of the mine can be seen during ground inspections, but the mine site is slowly being overtaken by the forest. The mine was only a small-scale operation and was mined by hand. No evidence of the mine is visible from aerial photos. Other historic manganese mines within the sub-catchment are Red Hill and Black Jewel on the western side of the river. All three mines are located within the declared Werrikimbe Wilderness area, restricting public vehicle access.

**Infrastructure.** Two swamp drains are located on the river in the northern-most section of the catchment along Bishops Swamp and Racecourse Swamp, which is the head of the Hastings River. The drains are over 100 years old and would have originally been shallow trenches probably dug with a double mouldboard plough. The Bishops Swamp drain has eroded to form a gully 3 to 4 metres deep and about 15 to 20 metres across for about 500 metres down the centre of the swamp. The drain at Racecourse has not eroded to the same extent and in the upper section has not suffered any widening or deepening since its original placement (Mitchell 2004). Racecourse swamp suffers some damage from feral pigs and illegal 4WDs. There are plans to install bollards to restrict illegal vehicle access to the swamp.

The old stockmen's hut at Mooraback has recently been refurbished as a field study centre. Other infrastructure around Mooraback consists of numerous old fencelines, the remains of at least three other huts and the stockyards. On Werrikimbe Trail through the middle of the park five bridges have recently been constructed to replace deteriorated wooden structures and thus maintain management access along this trail.

The drains at Bishops Swamp and Racecourse Swamp would have reduced the original size of these swamps. Bishops Swamp is intact and in good condition, albeit over a reduced area.

#### *Upper Hastings sub-catchment: threatening processes*

The Upper Hastings sub-catchment is entirely reserved, with the primary management objective being to 'preserve and protect the unique or outstanding scenery or natural phenomena'. The majority of the sub-catchment has been declared wilderness, the highest form of protection within the DEC reserve system.

The part of the Mooraback area that is not wilderness is used for moderate recreational use. Any major upgrading of facilities or other activities in this area will be subject to environmental assessment, including consideration of the impact of the activity on the Upper Hastings River, as is standard practice throughout DEC reserves.

The majority of the sub-catchment is free of pests and weeds. The Mooraback and Bishops Swamp areas are prone to weed infestations owing to their history of grazing. Mooraback currently contains weeping willows (*Salix babylonica*), which are transported by streams and reproduce vegetatively. Infestations of blackberry (*Rubus fruticosus*), are subject to annual control programs. Weed control in these areas is ongoing, and although control programs succeed in restricting the problem, blackberry is unlikely to be eliminated.

Many exotic trees were planted in the Mooraback area in the years before dedication of the park. Some of these trees may be historically significant, whereas others, such as hawthorn (*Crataegus monogyna*), have the potential to spread throughout the park. DEC will determine the best management option for these trees through a separate Conservation Management Plan for Mooraback.

Introduced animal species in the park include feral pigs (*Sus scrofa*), European red foxes (*Vulpes vulpes*), cats (*Felis catus*) and mosquito fish (*Gambusia holbrooki*). There are no practical solutions to the control of mosquito fish at this stage. Feral pigs are a declared noxious animal in NSW and are of particular concern in the Upper Mooraback and Lower Mooraback section of the park. The impact of pigs on the conservation values of the park is substantial, with locally extensive areas of ground disturbance encouraging invasion by weeds and initiating soil erosion. Pig control is being undertaken in accordance with the Werrikimbe National Park Plan of Management.

Annual trapping and shooting programs are undertaken for the control of pigs, as are 1080 baiting and trapping for wild dogs. Werrikimbe is one of the 'dingo conservation areas' listed under Pest Control Order 2 of the Rural Lands Protection Act.

*Phytophthora cinnamomi* root fungus, which causes dieback in a range of plant species, has been recorded in the park. A walking track in the Hastings area has recently been closed in an attempt to minimise the spread of this disease.

#### *Forbes sub-catchment: natural and cultural values*

Approximately 60% of the study area comprises groundwater-dependent ecosystems (rainforest, moist eucalypt forest or riparian forest), most of which occur in the upper part of the catchment (Department of Environment and Conservation 2004).

Forest types in the study area that are not adequately represented in the DEC reserve system include Rainforest and Stringy-bark-Mallee Forest and cover approximately 60% of the catchment (NSW National Parks and Wildlife Service 1998b).

Threatened fauna recorded in the Forbes River sub-catchment includes *Assa darlingtoni*, *Mixophes balbus*, *Mixophes iteratus*, *Philoria sphagnicola*, *Litoria daviesae* and *Litoria booroolongensis*. Species listed on the Japan – Australia or China – Australia Migratory Bird (protection) Agreements (JAMBA and CAMBA) and recorded in the sub-catchment include the white-throated needletail (*Hirundapus caudacutus*), Japanese snipe (*Gallinago hardwickii*) and white egret (*Egretta alba*).

#### *Forbes sub-catchment: land-use history*

**Degree of naturalness.** The wilderness assessment for this area mapped the majority of the catchment as substantially unmodified, with the exception of approximately 350 hectares of modified but recoverable terrain and 100 hectares of substantially modified terrain, both of which occur within the upper catchment (NSW National Parks and Wildlife Service 2001). Half of the area classed as substantially modified (in the north-east of the sub-catchment) contains two day-use picnic areas and the Brushy Mountain Camping Area. Much of the remainder of the substantially modified area has been logged and contains a high proportion (50% to 70%) of young regrowth trees. In the area classed as modified recoverable some substantial damage has occurred though severe fire and dieback. Some canopy gaps and other evidence of older logging are also evident.

**Mining.** No mines have been recorded in the Forbes sub-catchment.

**Fire history 1993–2005.** Significant wildfires occurred within the southern-most section in 2002–03 (approximately 20% of the study area), and in 1993–04 the northern 30% of the study area was burned.

In 1990–91 a prescribed burn was undertaken on the ridge forming the northern border of the study area.

**Trails.** A few roads are present in the study area, mostly confined to the upper parts of the catchment. A public access trail bisects the northern section of the catchment boundary just above the main arm of the Forbes River. This trail is surfaced with local (natural) materials. Public access roads also fringe the north-west boundary (natural surface) and south-east boundary (gravel surface) of the upper catchment.

To the south of the public access road are a number of shorter management trails surfaced with natural materials. These management trails are closed to public access and are used infrequently by DEC, for essential management purposes.

**Infrastructure.** A lookout is located at the northern tip of the Spokes trail. A trig station is located in the south-west section of the catchment.

#### *Forbes sub-catchment: threatening processes*

The area is entirely reserved, with the primary management objective being to 'preserve and protect the unique or outstanding scenery or natural phenomena'. The majority of the sub-catchment is managed for wilderness values and is afforded the highest form of protection within the DEC reserve system. Few threatening processes are operating in the Forbes sub-catchment.

The majority of the Forbes study area has a recreational zoning of 1 for maximum environmental protection. Brushy Mountain camping area, Grassy Tree day-use area and Spokes and Scrub Bird walking tracks are located in the Racecourse Trail area in the north-east of the study area (Figure 3). Brushy Mountain camping area covers less than 1 hectare. The canopy has been retained but the understorey is cleared. Brushy Mountain Camping Area is zoned 4 (facilities provided), whereas the remaining recreational features are zoned 3. The camping area contains a shelter shed, pit toilets, pit garbage and some park furniture.

Plateau Beech camping occurs on north Plateau Road on the eastern edge of the Forbes sub-catchment (Figure 3). The camping area occupies just over half a hectare. The associated Plateau Beech Walking Track falls mostly outside the catchment. These features are recreational zone 3, and facilities here are similar to those at Brushy Mountain Camping Area. Canopy gaps are more extensive here than in Brushy Mountain Camping Area, but replanting of some of the site is proposed. Because of the small, localised nature of these facilities any associated disturbances to the Forbes River are considered unlikely.

The majority of the Forbes study area is free of weeds. Introduced animal species in the park, including in the Forbes sub-catchment, are discussed under the Upper Hastings River section above.

*Phytophthora* has been detected in the Forbes catchment. A systematic survey will be required to determine its extent.

## **4 TECHNICAL ASSESSMENT**

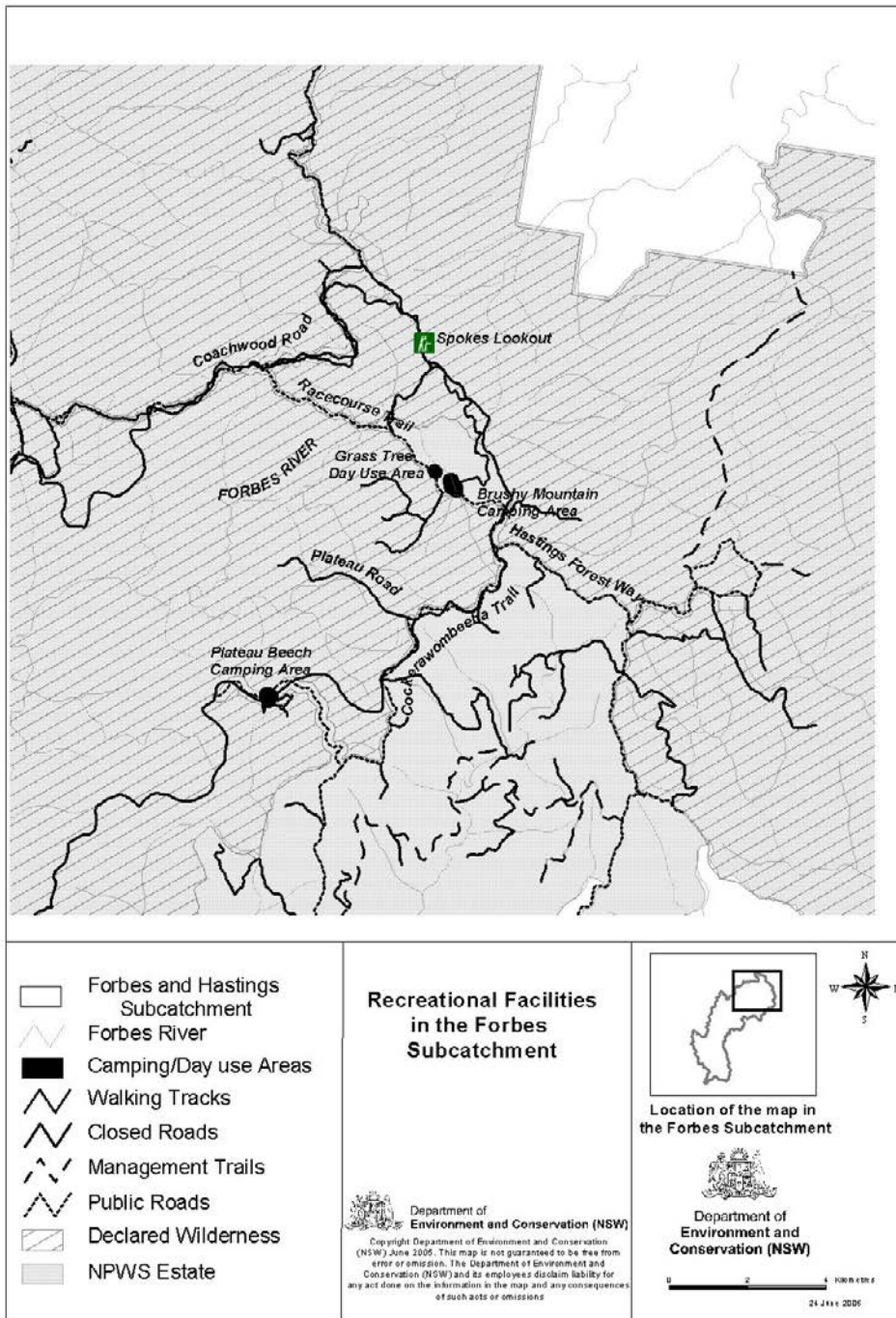
### **Biological condition**

#### *Upper Hastings River*

The two sites sampled in the Upper Hastings catchment were Bishops Creek and the Upper Hastings River at Werrikimbe Trail. A rich macroinvertebrate fauna was present, with 60 aquatic taxa (identified mostly to family level) collected at the two sites (Appendix C).

Only a single AUSRIVAS edge sample was collected from Bishops Creek. This sample was rich (31 taxa, Appendix C) and gave a high AUSRIVAS score of 1.03.

Figure 3. Recreational facilities in the Forbes sub-catchment





The Upper Hastings River at Werrikimbe Trail was sampled on three occasions (April and October 1999 and April 1996). Both riffle and edge samples were collected on all three occasions. This site had a rich aquatic invertebrate fauna (50 taxa, Appendix C). The AUSRIVAS scores for this site were also high (average observed to expected ratio O/E = 1.04, minimum O/E 0.86 and maximum O/E = 1.26).

There were significant fires in 2002–03 in the north-west and south-east, and there were prescribed burns in the Mooraback and Werrikimbe trail areas.

The impacts of fire on freshwater invertebrates are poorly understood. Data on this issue are limited, although the studies that have been done to date (including studies in Bishops Creek and Royal National Park after fires in 1998 and 1994 respectively) indicate that the effects may be temporary. Observed effects included a dramatic increase in sediment load in streams and subsequent loss of habitat, but invertebrate populations appear to recover from these effects once the sediment flushes out. Consequently it is likely that the invertebrate populations have recovered from any effects of the 2002–03 fires described above under *Upper Hastings sub-catchment: land-use history*.

The area immediately downstream from the Bishops Swamp drain may have more depauperate invertebrate fauna and macrophyte diversity owing to the effects of sediment, but this effect is likely to be localised. There would be no effect upstream where the Bishops Creek samples were taken.

These results suggest that the effects of past logging activities and other disturbances have been too small to have a measurable impact on the aquatic fauna of the Upper Hastings River and its tributaries. Both the high AUSRIVAS scores and high aquatic biodiversity support the view that the Upper Hastings River is suitable for listing as a wild river.

#### *Forbes River*

Three sites were sampled in this area. These were an unnamed rainforest stream on South Plateau Road, Cockerawombeeba Creek at Rimau Road and Forbes River near Racecourse Trail. The aquatic macroinvertebrate fauna in this area was found to be very rich, comprising 69 taxa (identified mostly to family level) (Appendix D).

The unnamed rainforest stream was sampled in October 1994 and 1995 and April 1995 and 1996. This site produced relatively poor AUSRIVAS results, especially for the single-season assessments (average O/E = 0.86, minimum O/E = 0.6, maximum O/E = 0.96). This was not consistent with the richness of the fauna (48 taxa, Appendix D). This could be explained by some of the attributes of this stream. Because it is in a steep valley with a tall rainforest canopy, the high shading is likely to preclude aquatic plants and algae. The substratum is primarily large boulder with little suitable habitat. The water quality was excellent. This and the health of the catchment explain the richness of the cumulative fauna. The poor AUSRIVAS scores from some samples are likely to reflect the sparsity of macroinvertebrate habitat, rather than any threat to the health of the creek.

Cockerawombeeba Creek was also a rainforest stream but was much more open than the one mentioned above. It was also less steep and had cobbles and small boulders and therefore had much more extensive, high-quality macroinvertebrate habitat. The AUSRIVAS scores at this site were mostly high (average O/E = 0.96, minimum O/E = 0.72 and maximum O/E = 1.14). The aquatic fauna of this site was rich (46 taxa, Appendix D).

The Forbes River at the Racecourse Trail was sampled on five occasions (April 1995, 1996, October 1995, 1998 and May 1998). The AUSRIVAS scores were mostly high (average O/E = 0.90 and maximum O/E = 1.14), although two relatively low scores were observed (minimum O/E = 0.62). The fauna at the site was rich (49 taxa, Appendix D).

These results suggest that the effects of past logging activities and other disturbances have been too small to have a measurable impact on the aquatic fauna of the Forbes River and its tributaries. Both the high AUSRIVAS scores and high aquatic biodiversity support the view that the Forbes River is suitable for listing as a wild river.



## Geomorphological condition

A River Styles<sup>®</sup> assessment has been conducted over the Hastings catchment (Cohen and Brierley 1999). The River Styles<sup>®</sup> of both the Upper Hastings and Forbes River within the national park were consecutively (from upstream moving downstream within park) Bedrock River – Alternating Bedrock Stream – Bedrock River. Both rivers were classed as conservation reaches, which was the highest condition category given in this study.

### *Upper Hastings River*

Impacts on river geomorphology from fire can occur as a result of logs falling across creeks and removal of riparian vegetation and subsequent bank erosion. These impacts could be measured only by an intensive survey of the river along the section where fire has occurred, and such a survey is not feasible.

Ongoing geomorphic effects of the drains at Bishops Swamp and Racecourse Swamp could include the shrinking of the river channel owing to the effects of sand slugs and subsequent infilling of floodplain pockets. Floodplain pockets are currently present along the Hastings but may have been more extensive before the installation of drains. The Bishops Swamp drain is actively eroding, but erosion on the Racecourse Swamp is more minor, and the upper section of the drain is no wider than a plough blade.

The geomorphologic assessment did not detect any sediment slug within the Upper Hastings River, indicating that the effect of the drains on the remainder of the catchment may be minor. For these reasons it is considered that the Upper Hastings River may be declared a wild river with the exception of the Mooraback/Bishops Creek Swamp area, which will be excluded.

### *Forbes River*

Clearing in this catchment is limited to a small area in the upper catchment that is now used as a camping area. There are no additional factors that might alter the favourable condition report given in the River Styles<sup>®</sup> assessment.

## Hydrological condition

### *Upper Hastings River*

There is a flow-monitoring gauge at the bottom of the Upper Hastings River, but data exist only for 1984 onwards. Any changes to hydrology that may have occurred as a result of land use before this time cannot be detected. Although the drains—particularly by the shrinking of Bishops Swamp—would increase the flow of water into the Upper Hastings, the effect is likely to be small proportional to the overall flow of the river, since the areas drained are small and within the upper catchment.

No water-extraction licences have been issued for this sub-catchment and no weirs are present.

### *Forbes River*

Gauge information is available for this river from 1955 onwards, but no study has been done to determine whether there have been any unnatural alterations in flow from this time to the present.

There have been three licences issued downstream of the Forbes sub-catchment and south of the park. The total entitlement for these licences is 87 megalitres a year—a small amount compared with the river's flow.

The proportion of the catchment that has been modified is relatively small, and there are no factors in the land-use history to indicate that the natural hydrology of the sub-catchment would have been substantially disturbed.

## 5 REFERRALS

As stated in *Wild Rivers under the National Parks and Wildlife Act* in Section 1 above, in some cases DEC requires the concurrence of certain Ministers before a river can be declared wild. Concurrence is required where the declaration may affect the functions of the Minister responsible for the *Water Management Act 2000* or, in the case of State Conservation Areas, the Minister responsible for the *Mining Act 1992* (s. 61 (3), NPW Act).

Those parts of the Upper Hastings and Forbes sub-catchments under investigation in this report comprise the headwaters of these rivers and fall entirely within National Park. The declaration of these rivers will therefore have implications for DEC only, and the concurrence of the Ministers responsible for the *Water Management Act 2000* and the *Mining Act 1992* is not required.

## 6 RECOMMENDATION

The Upper Hastings and all its tributaries within Werrikimbe National Park are considered to meet the criteria for wild rivers as listed in the *National Parks and Wildlife Act 1974*, excluding the part of the catchment known as Mooraback and Bishops Swamp. All of Forbes River and its tributaries within Werrikimbe National Park are considered to meet the criteria for wild rivers as listed in the *National Parks and Wildlife Act 1974*.

The above-described rivers are recommended for declaration as wild rivers.

## 7 REFERENCES

- Beale G, Miller M, Barnett P, Summerell G, Gilmore R and Hoey D (2004) *NSW Coastal Salinity Audit*. Report for the NSW Department of Infrastructure, Planning and Natural Resources, Sydney.
- Brierley GJ and Fryirs K (2005) *Geomorphology and River Management: Application of the River Styles Framework*. Blackwell Publications, Sydney.
- Cohen T and Brierley G (1999) *River Styles in the Hastings Basin, Mid North Coast, NSW*. Report completed for the NSW Department of Land and Water Conservation. Unpublished.
- Davies PE (2000) *Development of the National River Bioassessment System (AUSRIVAS) in Australia*. pp. 113–124 in JF Wright, DW Sutcliffe and MT Furse (eds), *Assessing the Biological Quality of Freshwaters: RIVPACS and other Techniques*. Freshwater Biological Association, Cumbria, UK.
- Department of Environment and Conservation (2004) *Groundwater Dependent Ecosystems* (May 2004 draft report for the Coastal Sands Aquifer Pilot Macro Water Sharing Plan Interagency Group). Department of Environment and Conservation, Environmental Protection and Regulation Division, North East Branch, Coffs Harbour.
- Department of Environment and Conservation (2005a) *Atlas of New South Wales Wildlife* database. Department of Environment and Conservation, Hurstville.
- Department of Environment and Conservation (2005b) *Framework for Wild River Assessment*. Unpublished report.
- Department of the Environment and Heritage (2003) *Australian River Assessment System (AusRivAS) National River Health Database*. Australian Government, Canberra. ANZCW0501009864
- Environment Protection Authority (2000). *Guidelines for Water Quality and River Flow Interim Environmental Objectives, Camden Haven and Hastings River Catchments*. Environment Protection Authority, Sydney.
- Mitchell B (2004) *Mooraback Pastoral Station in Werrikimbe National Park: A History*. Report for the National Parks and Wildlife Service, Hurstville.
- NSW National Parks and Wildlife Service (1998a) *Bioregional Strategy for NSW Landscape Layer*. Spatial data set. Department of Environment and Conservation, Hurstville.

NSW National Parks and Wildlife Service (1998b) *Lower North East Forest Ecosystem Layer*. Spatial data set. Department of Environment and Conservation, Coffs Harbour.

NSW National Parks and Wildlife Service (2001) *Northern Wilderness Assessment Report – 2001*. NSW National Parks and Wildlife Service (Northern Directorate), Coffs Harbour.

NSW National Parks and Wildlife Service (2003) *The Bioregions of NSW: their Biodiversity, Conservation and History*. NSW National Parks and Wildlife Service, Hurstville.

## APPENDIX A: RECREATIONAL ZONING CATEGORIES FOR DEC RESERVES

*(Excerpt from NSW National Parks and Wildlife Service (2003) Draft Recreation Planning Framework for NSW National Parks. Unpublished)*

In **zone 1** a visitor can expect opportunities to experience solitude in a large and wild natural area requiring a high degree of self-reliance.

In **zone 2** a visitor can expect to experience solitude in a natural area. Visitors in this zone will be largely self-reliant, with facilities provided only where essential for public safety and environmental protection.

In **zone 3** a visitor can expect various opportunities for nature appreciation and minor social interaction in a natural setting, but with some human disturbance.

In **zone 4** a visitor can expect a natural setting, in which facilities and good access (all weather 2WD) are provided, with a moderate level of social interaction. The provision of visitor facilities and interpretation is a major feature of the zone.

In **zone 5** the visitor can expect what is perceived to be a relatively natural setting, with the provision of significant visitor facilities for large numbers of visitors; a high level of social interaction may be evident. Visitors will rely on the facilities provided. The facilities, setting and social interaction will be major attractions for the visitors to this zone.

## APPENDIX B: DATA SOURCES FOR TECHNICAL ASSESSMENT— CRITERIA FOR WILD RIVERS

|                         | <b>Biological condition</b>  | <b>Geomorphological condition</b>  | <b>Hydrological condition</b>   |
|-------------------------|--|--|---|
| <b>Data sources</b>     | Department of the Environment and Heritage (2003) <i>Australian River Assessment System (AusRivAS) National River Health Database</i> . Australian Government, Canberra. ANZCW0501009864 | Cohen T and Brierley G (1999) <i>River Styles in the Hastings Basin, Mid North Coast, NSW</i> . Report completed for the NSW Department of Land and Water Conservation. Unpublished. | Department of Infrastructure, Planning and Natural Resources, water-extraction licence data.  |
| <b>Technical advice</b> | Eren Turak, Research Scientist, Policy and Science, Department of Environment and Conservation.<br><br>Graeme White, Department of Primary Industries.                                   | David Outhet, Research Scientist, Department of Infrastructure, Planning and Natural Resources.  | Paul Simpson, Senior Natural Resource Officer, Water Management Division, Department of Infrastructure, Planning and Natural Resources. |

## APPENDIX C: AQUATIC MACROINVERTEBRATE FAUNA (HASTINGS)

| Taxon           | Bishops<br>Creek | Hastings River |
|-----------------|------------------|----------------|
| Aeshnidae       |                  | X              |
| Amphipoda       | X                |                |
| Amphipterygidae |                  | X              |
| Ancylidae       |                  | X              |
| Atriplectididae | X                |                |
| Atyidae         | X                | X              |
| Baetidae        |                  | X              |
| Caenidae        | X                | X              |
| Calamoceratidae |                  | X              |
| Calocidae       |                  | X              |
| Ceinidae        |                  | X              |
| Ceratopogonidae | X                |                |
| Chironominae    | X                | X              |
| Collembola      | X                |                |
| Conoesucidae    |                  | X              |
| Corbiculidae    | X                |                |
| Corduliidae     | X                |                |
| Corixidae       | X                | X              |
| Corydalidae     |                  | X              |
| Diamesinae      |                  | X              |
| Dixidae         |                  | X              |
| Ecnomidae       |                  | X              |
| Elmidae         | X                | X              |
| Eustheniidae    |                  | X              |
| Gerridae        |                  | X              |
| Glossosomatidae |                  | X              |
| Gomphidae       | X                |                |
| Gripopterygidae | X                | X              |
| Gyrinidae       | X                | X              |
| Hebridae        |                  | X              |
| Helicopsychidae |                  | X              |
| Hydracarina     |                  | X              |
| Hydraenidae     | X                | X              |
| Hydrobiidae     |                  | X              |

| <b>Taxon</b>      | <b>Bishops<br/>Creek</b> | <b>Hastings River</b> |
|-------------------|--------------------------|-----------------------|
| Hydrobiosidae     | X                        | X                     |
| Hydrophilidae     | X                        | X                     |
| Hydropsychidae    |                          | X                     |
| Leptoceridae      | X                        | X                     |
| Leptophlebiidae   | X                        | X                     |
| Libellulidae      |                          | X                     |
| Megapodagrionidae |                          | X                     |
| Notonectidae      | X                        | X                     |
| Odontoceridae     |                          | X                     |
| Oligochaeta       | X                        | X                     |
| Oniscigastridae   | X                        |                       |
| Orthocladiinae    | X                        | X                     |
| Ostracoda         | X                        |                       |
| Perthiidae        |                          | X                     |
| Philopotamidae    |                          | X                     |
| Phreatoicidae     | X                        |                       |
| Polycentropodidae | X                        | X                     |
| Psephenidae       |                          | X                     |
| Scirtidae         |                          | X                     |
| Simuliidae        | X                        | X                     |
| Staphylinidae     |                          | X                     |
| Synlestidae       | X                        | X                     |
| Tanypodinae       | X                        | X                     |
| Tasimiidae        |                          | X                     |
| Tipulidae         | X                        | X                     |
| Veliidae          | X                        | X                     |

## APPENDIX D: AQUATIC MACROINVERTEBRATE FAUNA (FORBES)

| Taxon           | Unnamed               |                                |
|-----------------|-----------------------|--------------------------------|
|                 | Cockerawombeeba Creek | rainforest stream Forbes River |
| Aeshnidae       | X                     | X                              |
| Amphipterygidae |                       | X                              |
| Ancylidae       | X                     | X                              |
| Antipodoeciidae |                       | X                              |
| Austroperlidae  | X                     | X                              |
| Baetidae        | X                     | X                              |
| Blephariceridae | X                     | X                              |
| Caenidae        | X                     | X                              |
| Calamoceratidae | X                     | X                              |
| Calocidae       | X                     | X                              |
| Ceratopogonidae | X                     | X                              |
| Chironominae    | X                     | X                              |
| Coluburiscidae  |                       | X                              |
| Conoesucidae    | X                     | X                              |
| Corbiculidae    | X                     |                                |
| Corduliidae     |                       | X                              |
| Corixidae       |                       | X                              |
| Corydalidae     |                       | X                              |
| Diamesinae      |                       | X                              |
| Dixidae         | X                     | X                              |
| Dugesiidae      |                       | X                              |
| Dytiscidae      | X                     | X                              |
| Ecnomidae       | X                     | X                              |
| Elmidae         | X                     | X                              |
| Empididae       |                       | X                              |
| Ephemerellidae  | X                     |                                |
| Eustheniidae    | X                     | X                              |
| Gelastocoridae  | X                     |                                |
| Gerridae        | X                     | X                              |
| Glossosomatidae | X                     | X                              |
| Gripopterygidae | X                     | X                              |
| Gyrinidae       | X                     | X                              |
| Helicopsychidae | X                     | X                              |



| <b>Taxon</b>      | <b>Cockerawombeeba Creek</b> | <b>Unnamed rainforest stream</b> | <b>Forbes River</b> |
|-------------------|------------------------------|----------------------------------|---------------------|
| Hydracarina       | X                            | X                                | X                   |
| Hydraenidae       | X                            | X                                | X                   |
| Hydrobiosidae     | X                            | X                                | X                   |
| Hydrometridae     |                              |                                  | X                   |
| Hydropsychidae    | X                            | X                                | X                   |
| Hydroptilidae     | X                            | X                                | X                   |
| Leptoceridae      | X                            | X                                | X                   |
| Leptophlebiidae   | X                            | X                                | X                   |
| Lestidae          |                              |                                  | X                   |
| Mesoveliidae      |                              | X                                |                     |
| Nannochoristidae  |                              | X                                |                     |
| Neurorthidae      | X                            | X                                | X                   |
| Notonectidae      |                              |                                  | X                   |
| Notonemouridae    | X                            | X                                | X                   |
| Odontoceridae     | X                            | X                                | X                   |
| Oligochaeta       | X                            |                                  | X                   |
| Oniscigastridae   |                              |                                  | X                   |
| Orthoclaadiinae   | X                            | X                                | X                   |
| Osmylidae         |                              | X                                |                     |
| Parastacidae      |                              |                                  | X                   |
| Philopotamidae    | X                            | X                                | X                   |
| Philorheithridae  | X                            |                                  |                     |
| Podonominae       | X                            | X                                | X                   |
| Polycentropodidae |                              | X                                | X                   |
| Psephenidae       | X                            | X                                | X                   |
| Psychodidae       |                              | X                                |                     |
| Ptilodactylidae   | X                            | X                                | X                   |
| Scirtidae         | X                            |                                  | X                   |
| Simuliidae        | X                            | X                                | X                   |
| Staphylinidae     |                              | X                                |                     |
| Synlestidae       |                              |                                  | X                   |
| Tanypodinae       | X                            | X                                | X                   |
| Tasimiidae        |                              | X                                | X                   |
| Thaumaleidae      |                              | X                                |                     |
| Tipulidae         | X                            |                                  | X                   |
| Veliidae          | X                            | X                                | X                   |