Roads and Traffic Authority

Pacific Highway Upgrade - Oxley Highway to Kempsey

Flora and Fauna Working Paper

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Appendix D

Methodology

SURVEY METHODOLOGY

Literature review

A literature review was undertaken as part of the desktop assessment process and included the following:

- The Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) website-based EPBC Act Protected Matters Search Tool.
- The NSW Department of Environment and Climate Change (National Parks and Wildlife Service) *Wildlife Atlas* database for threatened species and ecological communities.
- Department of Environment and Climate Change (DECC) Atlas of NSW Wildlife database (as at May 2007) for the Kempsey (9435) and Camden Haven (9434) 1:100,000 map sheets.
- DECC Threatened Species Profile Database for the Macleay Hastings subregion of the Northern Rivers CMA.
- The National Herbarium of NSW *PlantNet* database for threatened and other significant species.
- The Commonwealth Department of Environment and Heritage database for nationally listed threatened species and 'Important Wetlands'.
- Forests NSW database.
- Royal Botanic Gardens (Sydney) and North Coast Regional Botanic Gardens (Coffs Harbour).
- Listings of rare or threatened species in Briggs and Leigh (1996) Rare or Threatened Australian Plants (ROTAP).
- The NSW Fisheries database for threatened and protected aquatic species and ecological communities.
- The Australian Museum *FaunaNet* database for threatened and protected aquatic species.
- New Atlas of Australian Birds (Barrett *et al*., 2003).
- Dr. Vanessa Standing's report on koala sightings recorded in the Advanced Ecological Assessment of the Concept Design: Pacific Highway upgrade–Oxley Hwy to Kempsey Terrestrial Flora and Fauna Final Draft Report March 2008 Ecotone Ecological Consultants Pty Ltd on the Pacific Highway between Port Macquarie and Kempsey.
- Local reports and naturalist groups (for example, bird watchers).

Terrestrial flora

A combination of quadrats, transects and targeted searches for threatened species were used to survey the study area. Vegetation mapping was undertaken using a combination of sampling quadrats and walking transects. Sampling quadrats (400 square metres in size) were placed randomly within each vegetation community and used to collect structural and floristic data. All species present within each quadrat were recorded and a cover abundance ranking assigned to each species. Notes were also taken on the dominant species, soil type and condition, the level of weed invasion and any other signs of disturbance.

Transects

Walking transects were employed to ascertain vegetation community boundaries, record species not observed within sampling quadrats and to search for threatened species within areas of suitable habitat. GPS points were recorded where vegetation boundaries along walking transects where detected, as well as locations of significance for flora including threatened species.

The linear nature of the study area dictated a more continuous traverse along, and to either side of, the proposed alignment centreline, rather than a series of separate and disconnected traverses. Accordingly, a traverse on foot by two observers was conducted involving transects in sections that collectively covered the entire length of the study area. This deviation from the recommended survey guidelines would exceed the minimum suggested survey requirements involving numbers of 100 metre traverses per stratification unit (vegetation community). In general, one transect was examined in sections along the eastern side of the study area centreline, and a second transect was examined along the western side of the centreline. Each transect was not a perfectly straight line within the study area, but took the form of a random meander within each side of the study area (maximum 75 metre width per side) to maximise the area covered. Within each transect the range of floristic variation, vegetation structure, extent of modification, disturbance, weed invasion and condition of the vegetation generally was assessed and recorded. All vascular flora species encountered were recorded in all areas.

Quadrats

The draft flora and fauna survey guidelines (DEC 2004) suggest the following numbers of sample plots (400 square metre quadrats) to be examined per stratification unit (vegetation community):

- 1 quadrat per stratification unit < 2 hectares.
- 2 quadrats per stratification unit of 2 to 50 hectares.
- 3 quadrats per stratification unit of 51-250 hectares.

Broad stratification units were determined prior to the spring and summer surveys based on prior habitat assessment within the study area in combination with a review of information from previous vegetation mapping within the area, aerial photography and topographic maps. No individual stratification unit was found to exceed 250 hectares in total, therefore one, two or three 400 square metre quadrats were examined per vegetation community, depending on the total area each community covered. Quadrat locations were chosen subjectively within each community to include a representative sample of the vegetation of that community. Quadrat configuration was either 20 x 20 metres by default or 40 x 10 metres in narrow communities in gullies and riparian areas. All vascular flora species, habitat and structural vegetation characteristics were recorded from the quadrats.

EEC mapping and verification

Mapping of the Swamp Oak Floodplain Forest Endangered Ecological Community (EEC), Subtropical Coastal Floodplain Forest EEC and Swamp Sclerophyll Forest EEC was verified based on the community description and characteristic species listed in the NSW Scientific Committee (NSW SC) Final Determinations (2004a, 2004b, 2004c), and the results of the vegetation quadrat data.

Targeted rare or threatened flora species surveys

Targeted flora surveys were undertaken throughout the study area in areas for which threatened flora have the potential to occur. The targeted flora surveys included random meander transects within areas for which threatened flora have the potential to occur, and mapping of potential habitat for threatened species.

Although few rare or threatened flora species have, to date, been recorded in or near the study area, more intense targeted random meander surveys were undertaken in areas considered to contain suitable habitat for the threatened flora species determined to be most likely to occur (rated as high or moderate likelihood). In all areas surveyed, the possible presence of any unexpected rare or threatened species in a typical habitat was considered during examination of the transects and quadrats. Although DECCW advised that the species was of no concern, targeted threatened flora surveys included consideration of the possible presence of *Adenostemma lavenia*, since it was one of the Director- General's requirements for the Part 3A assessment.

Photographs

At least one colour photograph was taken of a representative view of each vegetation community. Small samples of any plant species that could not be identified in the field were obtained for further examination and identification. Survey effort for all vegetation field survey work on all field trips for the detailed surveys totalled 154 person hours.

Terrestrial fauna

The broad stratification units determined for flora survey work were refined as a basis for determining fauna survey sites within the study area. Survey sites were chosen so as to provide the best possible sampling of each fauna habitat type within the study area. This included situating traplines within each native vegetation community, ensuring that specific fauna habitat features (for example, water bodies) were adequately surveyed and identifying areas for targeted surveys for specific threatened fauna species. The following field survey methodologies were used:

Habitat assessment

Habitat assessments were carried out using walked traverses of all habitat types throughout the study area to identify potential habitats for fauna, particularly threatened species. Attention was paid to detecting relevant features or resources for native fauna (in particular threatened species) known from the locality (such as hollow-bearing trees, rock outcrops, hollow logs, specific food trees and water features). Scats were collected and identified. Tree hollows were inspected (where possible) for evidence of use by fauna (for example, worn entrances, whitewash).

Traverses included searching for:

- Evidence of native fauna (for example, nesting material, owl white-wash, dreys, evidence of foraging) below mature trees.
- Birds and other diurnally active fauna.
- Trees with bird nests or other potential fauna roosts.
- Burrows, dens and warrens.
- Distinctive scats, tracks, animal remains, feathers, bones, fur, nests, burrows and diggings.

- Evidence of activity such as scratches and diggings.
- Stags and tree-hollows that provide potential roost sites for bats, owls, and other hollow-dependant species.

Experienced field staff identified all scats and bone remains on-site. Potential feed trees for species such as the Swift Parrot (*Lathamus discolor)*, Regent Honeyeater (*Xanthomyza phrygia)* and Koala were also sought and noted during the field surveys.

Live trapping transects

In order to target arboreal mammals, six 'B' Elliott traps (measuring 46 centimetres x 15 centimetres x 15 centimetres) were positioned in trees along a transect. With the aid of a ladder, each trap was mounted on a platform attached to a selected tree at a height of approximately 3 metres. All traps were positioned so as to avoid the morning sun and were covered with a plastic bag to reduce the risk of exposure (due to rain) to any captured animal. Bedding material, usually dry leaves gathered on site, was also provided. Traps were baited with standard peanut butter and rolled oat mixture and candied honey wrapped in paper towel. The tree trunk above the trap was sprayed each day with a honey/water mixture via a spray bottle.

In order to target terrestrial mammals, 25 'A' Elliott traps (measuring 33 centimetres x 10 centimetres x 9 centimetres), four 'B' Elliott traps and two cage traps were set out on the ground along a transect. 'A' Elliott traps were baited with peanut butter and rolled oat balls, 'B ' Elliotts were baited with a mixture of peanut butter, rolled oats and fish, and cage traps were baited with chicken wings. In order to provide shade and shelter, all traps were covered with plastic and shade material and placed in a shady position. Dry bedding material (leaves) was placed in all Elliott traps.

All traps were checked early each morning for captures, with any captured animals identified and immediately released.

Hair tube transects

Hair tube lines targeting arboreal and terrestrial mammals were set out at each of the sites. Each line consisted of twenty small hair tubes and ten hair funnels (Faunatech) set out along a 200-300 metre transect. Each small hairtube was fixed to the trunk of a tree approximately 1.5 to 2 metres off the ground using metal screws and each hair funnel was fixed to the ground using metal pegs. Hair tube lines were set out for periods of five to14 nights. All hair tubes were inspected following retrieval and any hairs found were sent to Barbara Triggs (Dead Finish, Genoa, Victoria) a recognised expert in hair and fur analysis, for identification.

Pitfall traps

Each line of Pitfall Traps consisted of two metal-sided pits with a mesh base (to a depth of approximately 50 centimetres) set along a low mesh fence designed to guide animals into the pits. Loose bark and leaves were added to each pit to provide cover for any captured animals. Each line was left in place and checked every morning and late afternoon for fauna over the survey period.

Diurnal bird census

Diurnal bird surveys were undertaken in the early morning by one observer for a period of at least 20 minutes. All birds positively identified either by direct visual observation or by their characteristic call during this period were recorded.

Koala scat and activity search

Each koala scat survey involved a search for koala scat and other evidence of koala activity at the base of twenty trees closest to the centre of a search quadrat. Potential koala food trees (as listed in SEPP 44) within transects along the side of the highway were searched for koala scats and other evidence of koala activity. During all searches, only trees over 10 centimetres diameter were targeted.

Nocturnal call playback

The playback of pre-recorded calls of threatened nocturnal fauna species (squirrel glider, bush stone-curlew, koala, yellow-bellied glider, powerful owl, masked owl, barking owl, sooty owl and grass owl) within appropriate habitat throughout the survey area and in various areas outside of the study area to determine local occurrence and distribution. Surveys involved an initial listening period of approximately 10 minutes, call playing for five minutes followed by a listening period of two minutes (undertaken separately for each species), and a final listening period of approximately 10 minutes. A general spotlight of the area followed the final listening period. Calls were played through a good quality Sanyo portable cassette tape player connected to a Toa (ER-409) 15 watt megaphone. During all spotlighting surveys nocturnal bird species were also targeted.

Spotlighting

Spotlight searches for nocturnally active mammals and birds were carried out at all designated survey sites as well as opportunistically across the entire study area. Surveys were undertaken throughout the study area in all habitat types present. Surveys targeted all nocturnal arboreal mammal species (for example, koala), nocturnal bird species (e.g. powerful owl) and the larger ground-dwelling mammals potentially occurring within the study area. Whilst small ground-dwelling mammals such as *Antechinus* spp. and rodents were specifically targeted using hair funnels and Elliott traps, all nocturnally active species were searched for during spotlighting. Targeted surveys for arboreal mammals were undertaken to specifically target the threatened yellow-bellied glider (*Petaurus australis),* squirrel glider (*Petaurus norfolcensis)* and koala.

Mammals and nocturnal birds were identified by observation under spotlight or by vocalisations heard whilst spotlighting. Identifications were in accordance with Strahan (1995). Each survey period involved a series of transects conducted on foot at approximately 1 kilometre per hour or from a vehicle travelling at approximately 5 kilometres per hour. Vehicle transects were undertaken in several locations where access was possible since these surveys are able to target a larger area per unit of survey time. Foot transects were undertaken where vehicles were not appropriate, either due to access or density of vegetation.

Herpetofauna

Surveys for frogs and reptiles were carried out at all designated sampling sites as well as opportunistically across the study area. The survey techniques employed targeted all frog and reptile species potentially occurring within the study area, and included:

- Diurnal searches for sheltering or basking frogs and reptiles.
- Listening for frog calls during diurnal and nocturnal census periods.
- Active shelter searches.
- Nocturnal spotlighting.
- Driving transects during wet weather (spotlighting and auditory surveys).

Targeted searches for frogs around dams, streams and other wet areas within the study area were undertaken. Each survey involved identifying any vocal frog species by their unique call as well as a search for frogs under rocks, by the edge of the water, on floating vegetation, in fringing grass or other vegetation, under logs and other debris. Each search was undertaken during the evening, with some searches commencing just before dusk. The length of time spent searching at each site varied between approximately 20-90 minutes depending on the size and nature of the waterbody and surrounding vegetation.

Reptile surveys were undertaken during mid-morning or mid-afternoon when temperatures were suitable for reptile activity. All reptiles positively identified during this period were recorded.

Microchiropteran bat surveys

Anabat surveys

Insectivorous bats were surveyed using ultrasonic call detection. Anabat CFZCAIM detectors were left out overnight or handheld during evening surveys to collect ultrasonic calls of the bat species within the study area. Bats emit ultrasonic calls as a method of navigating and searching for food. These calls are often at a higher frequency than calls audible to the human ear. In order to make the calls audible, bat detectors convert the call to a lower frequency. These calls are recorded and later analysed with a computer package Anabat 6, to identify the species recorded.

Anabats have proved useful for recording species that are difficult to capture. However, owing to variations in call strength and frequency within and between species and the difficulty in identifying short or poor quality calls, the identity of species recorded by a bat detector cannot always be guaranteed. Some bats are difficult to detect due to their quiet calls (for example, *Nyctophilus* sp., *Kerivoula papuensis*) and bats with extremely similar calls are sometimes difficult to differentiate (for example, *Miniopterus schreibersii oceanensis* and *Vespadelus darlingtoni*). Therefore, bat detectors cannot always provide positive species identification.

Targeted bat searches

Active bat searches at potential roosting sites under bridges and within culverts at relevant points along the highway were conducted.

Harp traps

Harp traps were set up within the study area to target insectivorous bats. In order to maximise capture success, suitable harp trap sites were chosen along potential flyways (for example, vehicle tracks) within the study area. Each harp trap left in place for two nights and checked once during the night and early each morning for captures. Bats removed from traps after daybreak were held in cloth bags until the following evening when they were released at the point of capture.

Opportunistic observations

All fauna observed or heard during the field surveys was recorded. Characteristic signs, tracks, trails and other indirect evidence of fauna species from all fauna groups were also recorded.

Aquatic flora

Vegetation community mapping was undertaken in June 2005 in the vicinity of Fernbank Creek (south of the Hastings River) and the floodplain to the south of the Wilson River to identify the presence of any endangered ecological communities. These investigations are summarised in the report RTA Pacific Highway Upgrade: *Oxley Highway to Kempsey Advanced Aquatic Ecological Assessment Report – Floodplain Investigation* (HWR 2005b).

Aquatic fauna

Water quality and habitat assessment.

A habitat assessment and water quality analysis was undertaken at each fish sample site. Habitat values such as algal cover, open sand habitat, emergent and overhanging vegetation, logs and other woody debris, substrate and depth, were recorded for each sample. *In situ* water quality parameters including temperature (ºC), conductivity (µc/cm), turbidity (NTU) and pH were measured using a 90FL-T Field Lab Analyser.

Active sampling

Backpack electrofishing

All electrofishing activities were undertaken in compliance with the electrofishing code of practice using a NIWA Electric Fishing Machine (EFM300). Backpack electrofishing enables a two-person crew to operate in shallow, wadable pools and riffles (to a maximum depth of operator hip height). Electricity is provided from batteries then transferred into the water, as a pulsed DC waveform, via a backpack unit that is carried by the operator, with portable electrodes. Immobilised fish are dip-netted from the water by a second operator. Specimens collected are placed in a bucket of water for recovery. The purpose of the electrofishing is to apply a suitable electrical field to a given body of freshwater in order to attract and induce a temporary state of narcosis in fish within the immediate area. All electrofishing was undertaken at an electrical frequency of 80 hertz and pulse width of 5 milliseconds. The most effective output for fish capture was found to be between 300V to 500V. Where possible, 100 metre transects were electrofished.

Seine Net

A seine net (5 metres x 2 metres, 2 millimetre stretched mesh) was employed to collect small mid-water and benthic fish species. The net was weighted at the bottom and had a series of floats along the headrope. Each seine trawl was standardised to approximately 10 metres. After each trawl, the ends were carefully brought together and the contents of the seine were emptied into a large container where the fish were held for processing.

Habitats sampled include:

- Stands of emergent and submerged vegetation (requiring great care during retrieval to prevent fish escaping).
- Areas adjacent to snags, woody debris and structure.
- Areas underneath overhanging vegetation.
- Open water.

Passive sampling

Fyke nets

Two large mesh single-wing fykes, two small mesh single-wing fykes and two dual-wing fyke nets were deployed, left set overnight for a 12 hour period, sampling the diversity of structural habitat available to fish (for example, open water, amongst or against vegetation and woody material). Large-mesh fyke nets have a central wing (8 metres x 0.65 metres) attached to the first supporting hoop (0.65 metres diameter) with a stretched mesh size of 20 millimetres.

Small-mesh fyke nets have a central wing (8 metres x 0.65 metres) attached to the first supporting hoop (0.65 metres diameter) with a stretched mesh size of 20 millimetres.

Dual-wing fyke nets have two wings (each 2.5 metres x 1.2 metres), with a first supporting hoop (0.65 metres diameter) fitted with a stretched mesh size of 20 millimetres.

Bait Traps

15 bait traps, baited with 'Whiskas Purple' cat food, were deployed and left set over night. Bait traps have a funnelled opening at each end (0.22 metres x 0.22 metres x 0.4 metres, with 2 millimetres stretched mesh) and were set close to emergent vegetation, submerged macrophytes and woody debris to sample fish normally associated with such structures.

Analysis

Univariate

Total species, total abundance, proportion of total native species and proportion of total native abundance were calculated for each water body. The proportion of total catch was calculated to provide a benchmark for the fish communities held within each water body.

Length histograms

The caudal lengths for the first 200 specimens of each species sampled per site were measured. These were used in the body of this report to develop histograms to investigate the size classes of different species held in each waterbody.

Floodplain Investigation

Desktop Assessment

A database search for threatened species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act 1995), the NSW *Fisheries Management Act 1994* (FM Act 1994) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) was carried out.

Field Surveys

Short term or 'snap-shot' flora and fauna surveys can only identify those species present on a site at the time of the sampling survey(s). Consequently, species lists should not be considered to be complete but, rather, representative of the flora of the site. A good flora species list based on a 'snap-shot' survey should represent approximately 80 –90 per cent of the species present on the site.

The methods employed for this report are designed to compile the information about flora species, flora communities and potential fauna habitat. The outcomes of these methods are sufficient to provide an accurate vegetation community map with detailed descriptions of each community, determine the location or potential habitat/location of threatened fauna and flora species, provide discussion about the physical factors and past disturbances affecting the distribution and abundance of flora and fauna species, and quantitatively describe the fauna habitat attributes of the subject site.

Flora 'communities', no matter how they are defined, rarely have sharp boundaries but gradually merge into each other. The boundaries shown on a vegetation map should therefore be viewed as being indicative of the extent of the defined 'communities' rather than being precise edges. Therefore a vegetation map is not a 'photograph' of the vegetation of the site but rather a model of the distribution of plant species designed to demonstrate some inferred ecological relationships between plant species as well as the generalised distribution of major species. Care should therefore be exercised in using the map for any other purpose.

Quadrats

Quadrats are located differently depending upon the aim of the study. Where the study seeks to statistically test hypotheses or compare vegetation communities, the quadrats are located randomly. Where they seek to describe an area of vegetation, systematically placed quadrats on a 200 metre grid are used. Where the study seeks to describe a vegetation unit or fauna habitat attributes and not being used for statistical purposes, quadrats are subjectively placed.

For this study, quadrats were subjectively placed within all major vegetation patches to describe the vegetation and fauna habitat attributes within the investigation areas.

Quadrats are circular in shape with a 12 metre radius (450 square metres) and the following information was recorded.

- All canopy and sub-canopy species are identified and approximate foliage cover recorded.
- All understorey (woody shrub vegetation) species recorded along with dominance, height and approximate counts of each species.
- All groundcovers with approximate order of dominance, approximate foliage cover and height of ground layer collective of all species.

- Proportion of weeds to natives and any other disturbances noted (ie grazing evidence weeds, pasture, slashing evidence, rubbish, etc).
- Fire history information including physical evidence, height and prevalence of any post-fire coloniser species, evidence of fire intensity and frequency such as biodiversity and indicator species.
- A photograph of each quadrat from an area that will best show the structure and composition of the vegetation.
- Record all habitat attributes such as number of hollows, leaf litter, number of fallen logs, rock boulders and outcrops, water availability and soil fertility.

Transects

Transects can be used for a multitude of reasons and can be straight, meandering or haphazard, can be long (1 kilometre+) or short (50 metres), wide (40 metres) or thin (1 metre), run along or transverse environmental gradients and vegetation communities and collect various information depending upon the aims of the study. Information collected along these transects is done at regular intervals (ie 10 or 20 metres) where the data of interest is collected.

For this study, transects were undertaken in all major patches of vegetation to determine the presence of fauna species such as pellet searches for koalas, determine the quality of fauna habitat attributes and delineate vegetation communities.

Transects are generally used by HWR Ecological in surveys for the following reasons:

- Delineating vegetation community boundaries.
- Assessing the condition and diversity of the vegetation.
- Determining the abundance and density of a particular flora species.
- Determining the abundance and location of fauna habitat attributes.