

Roads and Traffic Authority

Pacific Highway Upgrade -
Oxley Highway to Kempsey
Flora and Fauna Working Paper

September 2010

GHD Pty Ltd
ABN 39 008 488 373
Level 3, GHD Tower
24 Honeysuckle Drive
NEWCASTLE NSW 2300
Phone: +61 2 4979 9999
Fax: +61 2 4979 9988
Email: ntlmail@ghd.com

2. Methods

The field surveys and assessment undertaken for this working paper were designed to build on the information obtained during detailed terrestrial and aquatic ecological surveys and assessments undertaken throughout the route development, preferred route selection and concept design phases for the Proposal.

The assessment included updated literature reviews and both terrestrial and aquatic flora and fauna field surveys. Field survey techniques and survey effort were guided by *DECC's Draft Threatened Biodiversity Survey and Assessment Guidelines* (DEC 2004).

2.1 Definitions of relevant areas

For the purposes of this report the following areas are defined:

- The 'study locality' is the area within 10 kilometres of the centreline of the Proposal covering an area of 60 kilometres x 20 kilometres.
- The 'study area' consists of a strip of land 150 metres wide along the length of the Proposal with two wider areas at the southern end of the study area from Fernbank Creek to Cairncross State Forest and further through Cairncross State Forest to Haydons Wharf Road. It also includes all roundabouts, on- and off-ramps and interchanges.
- The 'Proposal boundary' refers to the area of land that would be acquired for the Proposal.
- The 'Proposal footprint' refers to the area where direct impacts would occur, and includes the carriageways, service and access roads plus an allowance for clearing.

2.2 Literature review

2.2.1 Database searches

In order to determine those rare and threatened flora and fauna species, both terrestrial and aquatic, and endangered ecological communities (EECs) known to occur within the study locality, a review of available data was undertaken.

Data reviewed includes the following:

- The Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) website-based EPBC Act Protected Matters Search Tool (as at July 2009).
- The NSW Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife database (as at July 2009) for the Kempsey (9435) and Camden Haven (9434) 1:100,000 map sheets.
- DECCW Threatened Species Profile Database for the Macleay Hastings subregion of the Northern Rivers Catchment Management Authority.
- The National Herbarium of NSW PlantNet database for threatened and other significant species.
- Forests NSW database.
- Royal Botanic Gardens (Sydney) and North Coast Regional Botanic Gardens (Coffs Harbour) records.

- Listings of rare or threatened species in Briggs and Leigh (1996) *Rare or Threatened Australian Plants*.
- The former NSW Fisheries threatened species profiles which describes threatened and protected aquatic species and ecological communities listed on the FM Act.
- NSW Bionet database for threatened terrestrial and aquatic flora and fauna.
- The Australian Museum FaunaNet database for threatened and protected aquatic species.
- *The New Atlas of Australian Birds* (Barrett et al. 2003).

Fauna records from the Atlas of NSW Wildlife are listed in **Appendix A**. The species listed in the tables have been previously sighted in the area of the Proposal. The records have been separated based on the buffers (distance from the area) where the sightings have occurred. Results for the EPBC Protected Matters Search Tool are included in **Appendix B**. Results from other database searches are presented in **Appendix C**.

2.2.2 Flora and fauna reports and mapping

The following flora and fauna reports and mapping were also reviewed in the preparation of this working paper:

- Dr. Vanessa Standing's report on koala sightings on the Pacific Highway between Port Macquarie and Kempsey.
- Department of Industry and Investment (DII) (2010) mapping of estuarine habitats in NSW.
- National Parks and Wildlife Service 2005 key habitats and corridors in northeast NSW.
- DECCW (2009) draft Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region.

2.2.3 Identification of subject species for assessment

The rare and threatened flora and fauna species lists for the locality compiled from the database searches and literature reviews were then refined to include those rare and threatened flora and fauna previously recorded in the study area and those likely to occur within the study area, based on distance from the site, habitat suitability and distribution ranges (see **Appendix E**). Fauna recorded within the study locality that were immediately excluded from assessment on the basis of clearly unsuitable habitat within the study area included ocean going seabirds, shorebirds, whales, marine turtles and the dugong. All terrestrial threatened fauna species known to occur in the NSW North Coast Bioregion were considered however some species, for example the brush-tailed rock-wallaby, were discarded as the habitat within the study area is unsuitable. The resultant final list of species was then used to guide the techniques applied in the targeted field surveys and in identifying subject species for the impact assessment.

2.2.4 Identification of matters of national environmental significance

The DEWHA website-based EPBC Act Protected Matters Search Tool was interrogated (as at July 2009) to identify any matters of national environmental significance of relevance to the Proposal. The EPBC Act Protected Matters search report is provided in **Appendix B**. The likelihood of identified threatened and migratory species occurring in the study area was assessed based on distance from the site, habitat suitability and distribution ranges (see **Appendix E**).

2.3 Field investigations

Following the literature review, field investigations were undertaken to assess the potential impacts of the Proposal on threatened species, populations and endangered ecological communities and their habitats and to assist in identifying the most appropriate impact mitigation and environmental management measures to avoid or minimise the potential for significant adverse impacts.

The component field investigations undertaken to assess the Proposal are described below and summarised in **Table 2-1**. A detailed description of survey techniques is provided in **Appendix D** and survey sites are indicated in **Figure 2** and **Figure 3**.

Table 2-1 Field surveys conducted to assess potential impacts of the Proposal

Survey type and surveyor	Survey area	Dates	Survey techniques
Floodplain investigations (HWR)	Fernbank Creek and Telegraph Point floodplains	14,16-17 June 2005	Vegetation quadrats and transects Habitat assessment
Riparian surveys (HWR)	Wilson River	18-19 October 2005	Vegetation quadrats and transects Habitat assessment
Flora and fauna assessment – spring surveys (Ecotone)	150m corridor encompassing the preferred route and buffer area	18-23 September 2006	Vegetation quadrats and transects Terrestrial fauna surveys Habitat assessment
Flora and fauna assessment – summer surveys (Ecotone)	150m corridor encompassing the preferred route and buffer area	11-17 March 2007	Vegetation quadrats and transects Terrestrial fauna surveys Habitat assessment
Supplementary flora and fauna assessment (GHD)	Proposed infrastructure sites outside the 150m corridor surveyed by Ecotone	19-24 November 2007	Vegetation quadrats and transects Terrestrial fauna surveys Habitat assessment
Supplementary targeted koala survey (Ecotone)	Maria Bridge: transects along the median strip between Maria River and Stumpy Creek	6-7 March 2007	Koala scat searches
Supplementary targeted microbat surveys (Ecotone)	Bridges, culverts and drainage pipes within study area	12-15 November 2007	Inspections of potential roost sites for insectivorous microbats
Aquatic surveys (GHD)	Pipers, Smiths, Fernbank and Cooperabung Creeks and Maria River	4-9 March 2007	Fish sampling (active and passive) Habitat assessment Water quality analysis
Marine vegetation surveys – targeting mangroves, seagrass and seaweeds (GHD)	Proposed crossing locations along Hastings and Wilson rivers	4-9 March 2007	Vegetation quadrats and transects

A summary of the overall survey effort is provided in **Section 2.3.6**.

It should be noted that access was not granted to survey two properties between Cairncross State Forest and the Wilson River. Therefore it was not possible to carry out proper surveys in these properties, except for remotely viewing the vegetation in each property from other properties and inferring the vegetation types from adjoining properties and aerial photographs.

Even though access was not available, it was possible to view the vegetation closely enough to ascertain the vegetation community types and hence whether they constituted EECs or not with the assistance of aerial photograph interpretation.

One of these properties is well vegetated with swamp forest, some of which is regenerating, and the other was predominantly cleared for cattle grazing. The area of these properties not surveyed that falls within the Proposal footprint is 5.8 hectares and 14.9 hectares respectively. These properties would be surveyed for the presence of threatened flora and fauna and endangered ecological communities prior to construction works commencing.

2.3.1 Terrestrial flora surveys

Comprehensive flora field surveys were undertaken over the study area during three separate field trips on 18 to 23 September 2006 (spring surveys) (Ecotone), 11 to 17 February 2007 (summer surveys) (Ecotone) and from 19 to 24 November 2007 (GHD).

Since it was determined that there were no threatened flora species potentially occurring in the study area that were only likely to be seasonally detectable, the areas surveyed during each field trip were not determined by particular flora species. Instead, the order of survey was determined by the relative accessibility of areas. Areas that were easily accessible were generally surveyed during the spring surveys, including state forests, nature reserves and some private properties. Areas that required particular pre-arrangements for access or properties where access was not initially granted were generally surveyed during the summer surveys.

Generally, the priority was to survey areas considered likely to contain significant vegetation communities as a first priority, followed by the remainder of vegetated areas in a systematic manner, and finally the cleared or semi-cleared areas as the lowest priority. To avoid duplication, areas within the study area that had been comprehensively surveyed during the route options assessment process were not re-surveyed.

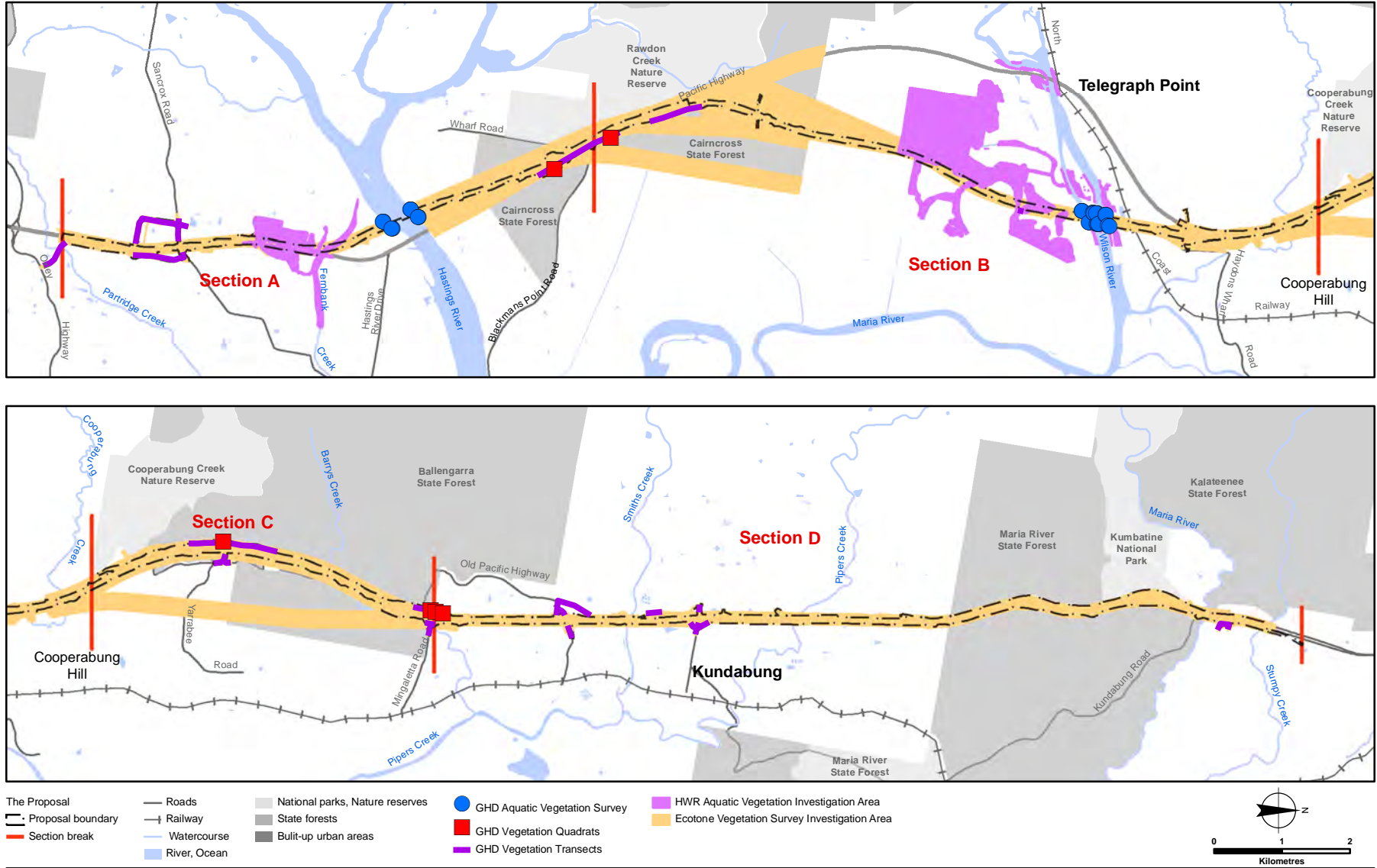
Flora survey techniques

A number of techniques were used during terrestrial flora surveys within the study area to target threatened flora species and to verify vegetation communities, in particular EECs. Full descriptions of methods used are provided in **Appendix D**. Quadrat and transect locations are illustrated in **Figure 2**.

Flora survey methodologies used included:

- Transects.
- Quadrats: 20 metres x 20 metres or 40 metres x 10 metres in narrow communities in gullies and riparian areas.
- GPS recording of vegetation community boundaries.
- EEC mapping and verification.
- Targeted rare or threatened flora species surveys.
- Photographing sites and vegetation communities.

Figure 2 Flora survey site locations



2.3.2 Terrestrial fauna

Fauna field surveys were undertaken within the study area during two separate field trips on 18 to 23 September 2006 (spring surveys), and 11 to 17 February 2007 (summer surveys). Supplementary koala scat searches were conducted on 6 and 7 March 2007. Supplementary field investigations were undertaken by GHD between 19 and 24 November 2007 in order to cover additional areas of the Proposal (for example, roundabouts, on- and off-ramps, and new service and access roads) that fell outside the 150 metre corridor surveyed by Ecotone Ecological Consultants (GHD 2007b).

Additional surveys investigating potential roost sites for insectivorous bats at bridges, culverts and drainage pipes within the study area were undertaken in March and November of 2007. Surveys at Maria River bridge were carried out on 6 March 2007 and surveys of bridges at Fernbank Creek, Cooperabung Creek, Barrys Creek, Smiths Creek, Pipers Creek, Stumpy Creek and thirteen culverts and drainage pipes were carried out between 12 and 15 November 2007. During the supplementary survey at Maria River bridge, an additional koala scat search was also undertaken along the median strip between Maria River and Stumpy Creek, with no evidence of koalas recorded.

The timing of the field surveys in spring and summer was chosen so that the maximum number of predicted threatened species would be encountered. For instance, spring is the best time for most frog, reptile and bat species as activity and breeding is on the increase. Spring and summer surveys are essential for summer migratory birds and it is the breeding season for the koala, with males calling during this period. The lack of winter surveys may have missed some species, such as the swift parrot and regent honeyeater, however the nomadic nature and inconsistent visitation to the study area much reduces the chance of recording these species. The low activity of frogs, reptiles and bats and the lack of summer migrant birds significantly reduces the productivity of winter surveys.

Survey site selection

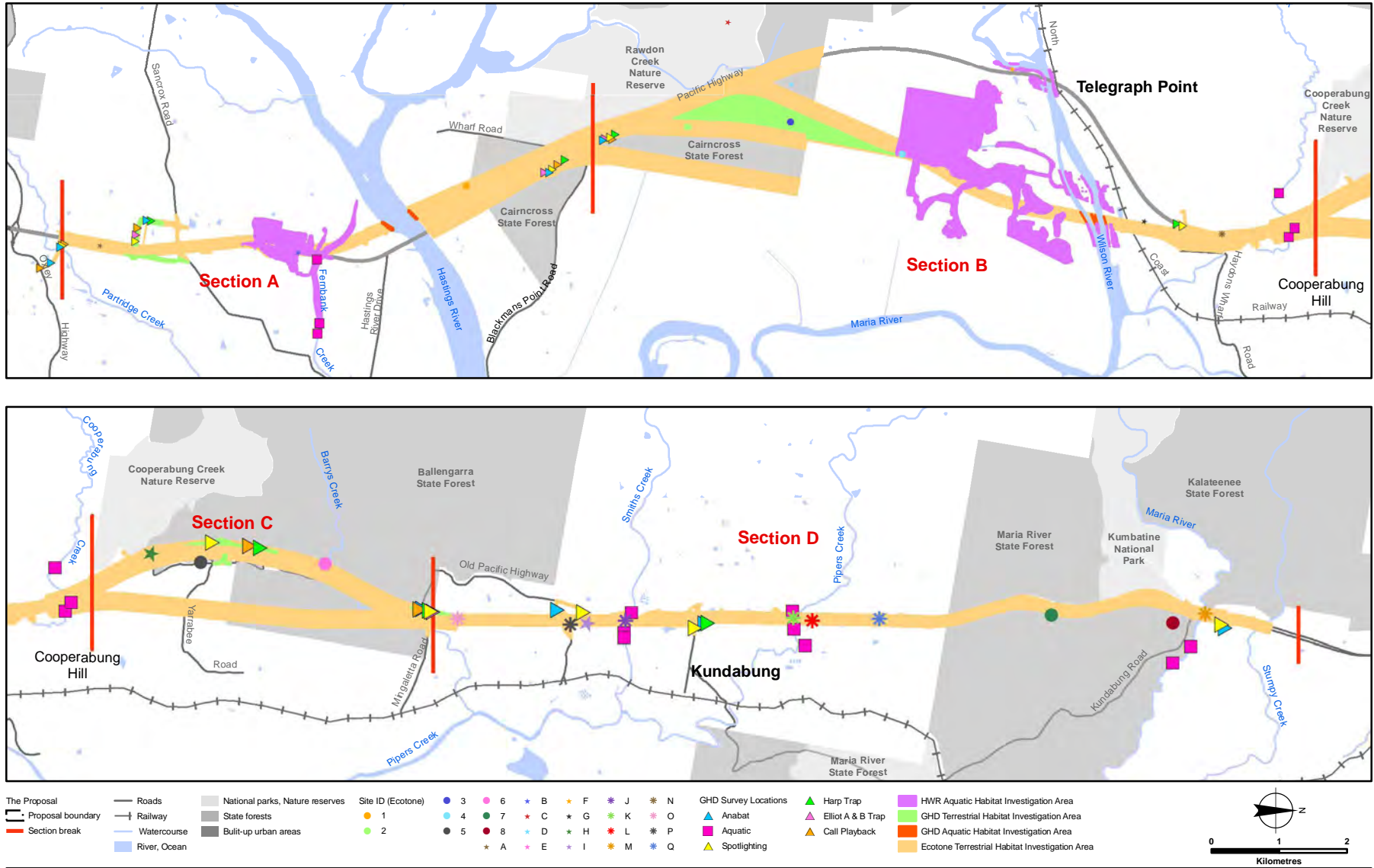
The broad stratification units determined for flora survey work were refined as a basis for determining fauna survey sites within the study area. Survey sites were chosen so as to provide the best possible sampling of each fauna habitat type within the study area. This included situating traplines within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

Eight main sites (Sites 1 to 8) were used for base sampling surveys, with additional surveys carried out at 17 supplementary sites (Sites A to Q). Further sites were located where on- and off-ramps and roundabouts would impact on vegetation. The locations of these sites are indicated in **Figure 3**.

Fauna survey techniques

A variety of techniques were used during fauna surveys within the study area to target threatened fauna species. Survey techniques are outlined below and detailed descriptions of methods used are in **Appendix D**.

Figure 3 Fauna survey site locations



Fauna survey techniques used:

- Habitat assessment, including tree hollow counts and 'potential koala habitat' assessments.
- Arboreal and terrestrial live trapping transects using Elliot 'A' and 'B' traps and cage traps.
- Arboreal and terrestrial hair tube transects using small hair tubes and larger hair funnels.
- Pitfall traps.
- Diurnal bird census, involving observation and call identification.
- Koala scat searches under food trees.
- Nocturnal mammal, bird and frog call playback.
- Spotlighting (walked transects and stag watches).
- Diurnal reptile searches in areas of suitable habitat.
- Nocturnal frog searches in areas of suitable habitat.
- Ultrasonic bat call detection.
- Harp trapping for bats along potential flyways.
- Inspections of artificial roost sites (bridges, culverts and pipelines) for insectivorous bats.
- Opportunistic observations.

2.3.3 Fauna habitat assessment

Preliminary fauna habitat assessment survey work was undertaken by Ecotone for the route options assessment stage in November 2005 (Ecotone Ecological Consultants 2006a).

A thorough fauna habitat assessment was conducted within the study area over two separate field trips on 18 to 23 September 2006 (spring surveys) and 11 to 17 February 2007 (summer surveys). The aim was to document the relative quality of fauna habitat along the Proposal, with a particular focus on identifying habitat features for threatened fauna. Areas that were easily accessible were generally surveyed during the spring surveys, including state forests, nature reserves and some private properties. Areas that required particular pre-arrangements for access in the remainder of private properties or in properties where access was not initially granted were generally surveyed during the summer surveys. Generally, the priority was to survey areas considered likely to represent threatened fauna habitat, thus survey work concentrated mainly on areas of natural vegetation, with cleared or semi-cleared areas given a lower priority.

The fauna habitat survey was undertaken in conjunction with the vegetation mapping survey and consisted of a traverse on foot by two observers involving transects in sections that collectively covered the entire length of the study area. 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 to maximise the area covered.

In association with the vegetation mapping, information about specific fauna habitat attributes was recorded for each section of the study area. The approximate boundaries of each area of similar fauna habitat were recorded in the field using a hand-held GPS. Opportunistic observations of fauna species, particularly threatened or locally significant species, including searches for indirect evidence such as scats and owl pellets, were carried out in conjunction with the field habitat assessment.

Data analysis

The GPS information obtained in the field was downloaded into MapInfo and superimposed onto the layers containing the aerial photograph and proposed alignment. The GPS points for vegetation boundaries were used in combination with visual assessment of changes in vegetation types from the aerial photograph to produce a vegetation map of the investigation area.

Fauna habitat attributes recorded in the field were applied to the vegetation community mapping mentioned above using MapInfo and the potential for threatened species to occur was estimated. This was difficult for most species, as either they are mobile species that could occur in a variety of habitats along the route options or the species is known to utilise several of the available habitats. Fauna habitat attributes recorded were as follows:

- Vegetation type (dominant tree species and height also recorded).
- Estimated shrub and ground cover.
- Presence of tree hollows.
- Presence of waterbodies and wet areas.
- Presence of fallen timber and rock outcrops.
- Disturbance regimes.
- Links to identified fauna corridors and/or adjoining forested lands.
- The potential habitat for threatened species.

Fauna habitats were assessed by examining characteristics such as native vegetation, ground and litter layers, breeding, nesting, feeding and roosting resources and evidence of fauna presence. The following criteria were used to evaluate habitat values:

- High: Fauna habitat components are usually all present (for example, old-growth trees, fallen timber, shrub stratum, groundcover, feeding and roosting resources etc) and habitat linkages to other remnant ecosystems in the landscape are intact.
- Medium: Some fauna habitat components are often missing (for example, old-growth trees, fallen timber, shrub stratum), although linkages with other remnant habitats in the landscape are usually intact, although often degraded.
- Low: Many fauna habitat elements in low quality remnants have been lost, including old-growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive past clearing.

Freshwater wetland areas were difficult to classify using the same criteria and have been given a medium ranking, as while they do provide habitat for a range of species, all of these areas experience some level of ongoing disturbance due to grazing by cattle.

2.3.4 Aquatic fish surveys

Aquatic assessments were undertaken in accordance with the NSW Fisheries document *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation 1999* (DPI 1999). A combination of active and passive sampling techniques was used to target fish and assess habitat types.

Field sampling occurred between 4 March and 9 March 2007. Five watercourses that would be intersected by the Proposal were selected for sampling: Fernbank Creek, Cooperabung Creek, Smiths Creek, Pipers Creek and Maria River. Fishing was carried out under the conditions set by the NSW Fisheries scientific permit (P06/0110-1.0). All fish were identified to species level and counted, weighed and measured before being returned to the water, with the exception of *Gambusia holbrooki* which were euthanased in benzocain solution. Locations of the fish sampling sites are included in **Figure 3**.

The following field survey methodologies were used:

- Water quality analysis (temperature, conductivity, turbidity and pH).
- Habitat assessment, involving documentation of habitat attributes.
- Backpack electrofishing.
- Seine nets.
- Fyke nets.
- Bait traps.

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. The caudal lengths for the first 200 specimens of each species sampled per site were measured to investigate the size classes of different species held in each waterbody.

The results of the water quality analysis and habitat assessment were used to determine the suitability of sampled watercourses for threatened fish species, including the Oxleyan pygmy perch (*Nannopeca oxleyana*) and eastern freshwater cod (*Maccullochella ikei*).

An aquatic habitat assessment for Stumpy Creek would be undertaken prior to construction.

2.3.5 Surveys of protected marine species

Seagrasses

The Hastings and Wilson river crossing points and approximately 100 metres either side of the crossing points were surveyed for the presence of seagrass and threatened seaweeds. Notes were taken on the dominant species, sediment type and condition, levels of weed invasion (if applicable) and any other signs of disturbance. The results of these targeted surveys were mapped and included the location and extent of seagrass beds within the study area.

Mangroves

Surveys of mangrove forests at the proposed crossings of the Hastings and Wilson rivers (incorporating Dalhunny Island) and approximately 100 metres either side of the crossing points were undertaken to determine species assemblage and plant densities. Counts of plants were undertaken in 20 square metre quadrats on the northern and southern side of the Hastings and Wilson rivers and on Dalhunny Island.

2.3.6 Summary of survey effort

A summary of the survey methods and effort and targeted species and groups is provided in **Table 2-2**.

Table 2-2 Survey methods and effort

Targeted species / groups	Methodology	Surveyor Date	Survey hours	Surveyor Date	Survey hours
General reptiles and frogs	Hand searches, spotlight, auditory surveys	GHD 19-24 Nov 2007	7.22 hours	Ecotone 18-23 Sept 2006 11-17 Feb 2007	6 hours
Targeted frog survey	Spotlight, auditory survey & call playback	GHD 19-24 Nov 2007	13.6 hours	Ecotone 18-23 Sept 2006 11-17 Feb 2007	14 hours
Diurnal birds	Observation and call identification	GHD 19-24 Nov 2007	22 hours	Ecotone 18-23 Sept 2006 11-17 Feb 2007	11 x 20 minute two hectare transects
Nocturnal birds (and mammals for Ecotone surveys)	Call playback and call identification	GHD 19-24 Nov 2007	10 hours	Ecotone 18-23 Sept 2006 11-17 Feb 2007	27.5 hours
Mammals and nocturnal birds	Spotlight surveys	GHD 19-24 Nov 2007	22 hours	Ecotone 18-23 Sept 2006 11-17 Feb 2007	43 hours
Arboreal mammals, microbats and nocturnal birds	Stag watch	GHD 10-13 Nov 2007 16-19 Dec 2007	13.15 hours	-	-
Small mammals	Ground-trapping - Elliott A traps	GHD 19-24 Nov 2007	320 trap nights	Ecotone 11-17 Feb 2007	775 trap nights
Medium-sized mammals	Ground-trapping - Cage traps (and Elliott B traps for Ecotone surveys)	GHD 19-24 Nov 2007	80 trap nights	Ecotone 11-17 Feb 2007	Elliott B – 124 trap nights Cages – 62 trap nights
Arboreal mammals	Tree-trapping – Elliott B Traps	GHD 19-24 Nov 2007	160 trap nights	Ecotone 11-17 Feb 2007	192 trap nights

Targeted species / groups	Methodology	Surveyor Date	Survey hours	Surveyor Date	Survey hours
Koala scat searches	Searches under food trees	GHD 19-24 Nov 2007	10 hours	Ecotone 18-23 Sept 2006 11-17 Feb 2007 6-7 March 2007	22 searches (20 trees)
Microbats	Anabat II ultrasonic call recording	GHD 19-23 Nov 2007	30 hours	Ecotone 18-23 Sept 2006 11-17 Feb 2007	17 unit nights
Microbats	Harp traps	GHD 19-23 Nov 2007	11 trap nights	Ecotone 18-23 Sept 2006 11-17 Feb 2007	16 trap nights
Microbats – bridge and culvert targeted surveys	Stag watch Ultrasonic call recording Searching potential roost sites	Ecotone 6 March 2007 12-15 Nov 2007	Stag watch – 2 hours Ultrasonic call recording – 6 unit nights Searching potential roost sites – 30 hours	-	-
Small-large mammals	Faunatech hair funnels (and small PVC pipe hair tubes for Ecotone surveys)	GHD 23 Nov – 7 Dec 2007	1120 trap nights	Ecotone 18-23 Sept 2006	Small PVC pipe (arboreal) – 760 trap nights Funnels (ground) – 380 trap nights
Reptiles, frogs and small mammals	Pitfall traps	GHD 19-23 Nov 2007	24 trap nights	Ecotone 11-16 Feb 2007	24 trap nights
Tree-hollow counts	Walked traverse of Proposal	GHD 19-23 Nov 2007	25 hours	-	-
Fish	Backpack electrofishing, Seine Nets, Fyke Nets, Bait traps, Habitat assessment	GHD 4-9 March '07	5 sites, 6 days	-	-
Vegetation survey, mapping EECs, targeted threatened flora survey and fauna habitat assessments	Quadrats/ transects	GHD 19-23 Nov 2007	80 hours	Ecotone 14 Dec 2004 9-12 Nov 2005 18-23 Sept 2006 11-17 Feb 2007 HWR Ecological 14, 16, and 17 June 2005 18-19 Oct 2005	154 hours 40 hours

2.4 Groundwater dependent ecological communities

Vegetated groundwater dependent ecological communities and their degree of dependence on groundwater were inferred from the floristics and structure of the vegetation, known correlations with groundwater systems, and their position in the landscape. Rivers and streams are assumed to be groundwater dependent.

THIS PAGE IS INTENTIONALLY BLANK