

11 February 2016

Gary Brassington  
Manager Approvals  
Illawarra Coal  
Level 3, Enterprise 1  
Innovation Campus Squires Way  
North Wollongong NSW 2500

Dear Gary

**Targeted surveys for Giant Dragonfly *Petalura gigantea* in Dendrobium Area 3B**  
**Project no. 21661**

After receiving a letter from the Office of Environment and Heritage (OEH) on 14 December 2015, Illawarra Coal was requested to undertake targeted survey for exuviae and adults of the Giant Dragonfly *Petalura gigantea* in all Coastal Upland Swamps (swamps) within Dendrobium Area 3B. These surveys were requested to inform OEH's assessment of the Dendrobium Area 3B Longwalls 14-18 Subsidence Management Plan (SMP) application.

Biosis Pty Ltd (Biosis) was subsequently commissioned by Illawarra Coal to undertake targeted Giant Dragonfly surveys in January 2016. Biosis staff are highly experienced in surveying for this species, having undertaken several years of Giant Dragonfly monitoring throughout the Southern Coalfield. Our knowledge of the species includes identification and determining the sex of exuviae and adults, identification of suitable breeding habitat and the implementation of survey methods for impact assessment and ongoing compliance monitoring purposes.

This report outlines the methods and results of Giant Dragonfly targeted surveys undertaken in January 2016.

## Methods and survey effort

Targeted surveys for the Giant Dragonfly were undertaken between 20 and 27 January 2016, over a period of five days. Attempts were made to survey on days when weather parameters were favourable for flying adults (Table 1). Favourable conditions were characterised as days above 20°C, with maximum sustained wind speeds lower than 15 km/h with no precipitation (Baird 2012). Although there was a light rain shower on one day of surveying (22/01/2016), flying adults were still recorded and the survey effort was deemed valid.

A total of 13 swamps within Dendrobium Area 3B were surveyed for the presence of both exuviae and adults (Figure 1). These swamps included Swamp 01a, 01b, 03, 04, 05, 08, 10, 11, 13, 14, 23, 35a and 35b. Surveys were undertaken by two Biosis zoologists experienced in the identification of the species, with the aim of covering all, or the majority of each swamp. In small swamps (<2.5 hectares), attempts were made to navigate the entirety of the swamp; however in larger swamps (>2.5 hectares), the moist swamp sub-communities of Cyperoid Heath and Tea-Tree Thicket were prioritised (Table 1). These sub-communities

were prioritised as, in Biosis' experience; they have been found to provide the most suitable Giant Dragonfly breeding habitat in swamps of the Cordeaux and Cataract catchment area. This finding is also supported by the characterisations of suitable Giant Dragonfly breeding habitat outlined in Baird (2012). Foraging habitat for adult Giant Dragonfly was also surveyed throughout all swamps and within adjacent woodlands.

**Table 1 Survey effort and weather conditions**

| Swamp     | Date surveyed | Weather conditions (BOM, Mt Annan) | Approximate area of swamp | Survey effort (person hours) |
|-----------|---------------|------------------------------------|---------------------------|------------------------------|
| Swamp 01a | 20/01/2016    | 36.7 °C and 11km/h                 | 7.5 ha *                  | 5.5                          |
| Swamp 01b | 20/01/2016    | 36.7°C and 11 km/h                 | 11.4 ha *                 | 5.5                          |
| Swamp 03  | 25/01/2016    | 23.7°C and 4 km/h                  | 3.5 ha †                  | 4                            |
| Swamp 04  | 25/01/2016    | 23.7°C and 4 km/h                  | 0.8 ha □                  | 3                            |
| Swamp 05  | 20/01/2016    | 36.7°C and 11 km/h                 | 7.5 ha *                  | 5.5                          |
| Swamp 08  | 27/01/2016    | 23.6°C and 9 km/h                  | 1 ha *                    | 4.75                         |
| Swamp 10  | 27/01/2016    | 23.6°C and 9 km/h                  | 1.1 ha †                  | 3.75                         |
| Swamp 11  | 21/01/2016    | 34.5°C and 11 km/h                 | 6.1ha *                   | 6                            |
| Swamp 13  | 22/01/2016    | 25.5°C and 7 km/h. Light showers.  | 2.6 ha *                  | 5                            |
| Swamp 14  | 22/01/2016    | 25.5°C and 7 km/h. Light showers.  | 5.7 ha *                  | 6                            |
| Swamp 23  | 21/01/2016    | 34.5°C and 11 km/h                 | 3.9 ha *                  | 5                            |
| Swamp 35a | 25/01/2016    | 23.7°C and 4 km/h                  | 1.2 ha †                  | 3                            |
| Swamp 35b | 25/01/2016    | 23.7°C and 4 km/h                  | 1.8 ha †                  | 3                            |

\* = Area calculated from current Biosis swamp mapping dataset (Dendrobium\_Swamp\_V5). Biosis swamp mapping is currently under internal review, to be revised as Dendrobium\_Swamp\_V6 in February 2016.

† = Area calculated from NPWS (2003) (woronora\_VISmap\_2387).

□ = Area calculated from Illawarra Coal Mapping (BIC\_Swamps\_Dendrobium\_Area3B)

The survey method included searches for exuviae and adults simultaneously by two zoologists. Surveys for exuviae were conducted by searching ground layer vegetation and shrubs in areas where suitable breeding habitat was identified. Suitable breeding habitat was determined by assessing characteristics such as vegetation sub-community, vegetation composition, soil hydrology and soil composition. Our identification of suitable breeding habitat is based on a thorough literature review, consultation with Dr Ian Baird and our previous experience of confirmed Giant Dragonfly breeding habitat in other areas of the Cordeaux and Cataract catchment area. When an exuviae was observed, its location was noted along with its sex and where it was perched. Surveys for adults, included scanning for flying individuals and searching for perched individuals in all sub-community types visited within swamps and adjacent woodlands. When an adult was observed, its location was noted along with its sex and its behaviour at the time (i.e perched, flying, copulation).

## Results

Of the 13 Coastal Upland Swamps surveyed within Dendrobium Area 3B, Giant Dragonfly were recorded at three swamps including Swamp 01a, Swamp 11 And Swamp 14 (Figure 1). A total of 11 adults and one exuvia were recorded during these targeted surveys (Table 2; Figure 2).

The single exuvia recorded was a female found at Swamp 01a, in an area of Cyperoid Heath (Figure 2a). The presence of this exuvia has confirmed the presence of suitable breeding habitat, despite no adults being recorded.

**Table 2 Giant Dragonfly records within Coastal upland swamps**

| Swamp     | Exuvia     | Adult   | Behaviour notes   | Habitat notes  |
|-----------|------------|---|---|--|
| Swamp 01a | 1 x female |   | -Perched on <i>Lepidosperma limicola</i> , within Cyperoid heath.   | Confirmed breeding habitat and suitable foraging habitat present |
| Swamp 01b |            |   |   | Suitable breeding and foraging habitat present                   |
| Swamp 03  |            |   |   | Suitable foraging and dispersal habitat present                  |
| Swamp 04  |            |   |   | Suitable foraging and dispersal habitat present                  |
| Swamp 05  |            |   |   | Suitable breeding and foraging habitat present                   |
| Swamp 08  |            |   |   | Suitable breeding and foraging habitat present                   |
| Swamp 10  |            |   |   | Suitable foraging and dispersal habitat present                  |
| Swamp 11  |            | 1 x female<br>2 x male  | -Perched on <i>Banksia robur</i><br>-Territorial dispute  | Confirmed foraging habitat and suitable breeding habitat present |
| Swamp 13  |            |   |   | Suitable breeding and foraging habitat present                   |
| Swamp 14  |            | 1 x female<br>3x males<br><br>1 x male<br>1x male<br>1x male<br>1 x unknown sex | -In copulation<br>-attempting copulation with female<br>- perched on <i>B. robur</i><br>- flying<br>- actively foraging<br>- flying | Confirmed foraging habitat and suitable breeding habitat present |
| Swamp 23  |            |   |   | Suitable breeding and foraging habitat present                   |
| Swamp 35a |            |   |   | Suitable foraging and dispersal habitat present                  |
| Swamp 35b |            |   |   | Suitable foraging and dispersal habitat present                  |

A total of three adults were recorded within Swamp 11, including a solitary female and two males engaging in a territorial dispute (Figure 2b). A total of eight adults were recorded within Swamp 14, including three males attempting copulation with a female, several solitary males flying and a solitary male observed actively foraging (catching and eating a flying beetle *Coleopteran sp.*).

All records of exuviae and adults were located in areas recognised as suitable habitat for the species, within either Cyperoid Heath or Tee-tree Thicket. Although exuviae were not recorded within Swamp 11 or Swamp 14; the number of adults recorded, including territorial males and females in copulation, is a strong indicator that the swamp contains suitable breeding habitat and may contain exuviae which were not detected due to seasonal limitations.

## Discussion

In summary, the species was confirmed at three swamps within Dendrobium Area 3B.

The low numbers of exuviae recorded is likely the result of the surveys being undertaken in January, after the emergence season has effectively finished (Baird 2013). Although Giant Dragonfly exuviae can persist in the environment for some time after emergence, the heavy rainfall recorded in the area during late December and early January has dramatically reduced the detectability of exuviae. Heavy rainfall can dislodge exuviae from their perched positions and increases the rate of degradation, making the species more difficult to detect. This was reflected in data collected by Biosis at Giant Dragonfly reference swamps within the Cataract catchment; where exuviae numbers were much lower in the second replicate (early January 2016), compared to the first replicate (early December 2015).

Although surveys were undertaken at the end of the emergence period, Biosis was able to refine the area of suitable breeding habitats throughout Dendrobium Area 3B to the following five swamps: Swamp 01b, 05, 08, 13, 23, along with the previously mentioned Swamps 01a, 11 and 14.

As detailed above, surveys were timed both based on weather conditions and seasonal requirements to ensure the optimal detection of foraging adults. The detection of eight adults in Swamp 14 is high when compared to the number of adults Biosis typically records at reference sites. This indicates that Swamp 14 is likely to provide an important foraging resource for the species. Despite observing breeding behaviour in adults, the importance of Swamp 14 for the oviposition and development of larvae cannot be confirmed due to absence of exuviae (which are used as indicators for successful breeding within a habitat) at the time of survey.

In the regional context of the area, Giant Dragonfly have been previously recorded at six swamps within the Cordeaux catchment (OEH Bionet Atlas, 2016), including Swamp 14 and Swamp 01b within Dendrobium Area 3B. Additionally, Biosis has recorded Giant Dragonfly at nine swamps to the north, throughout the Woronora plateau. Given the spatial distance between swamps within Dendrobium Area 3B and throughout the broader area; Biosis considers that all swamps within Dendrobium Area 3B and peripheral woodland habitats, are also likely to provide foraging and dispersal habitat for the species. However, due to the specific microhabitat features required for breeding success, the species likely uses a smaller sub-set of these swamps for breeding purposes.



Please feel free to contact me if you require additional information

A handwritten signature in black ink, appearing to read "Craig Dunne".

**Craig Dunne**  
Zoologist

## References

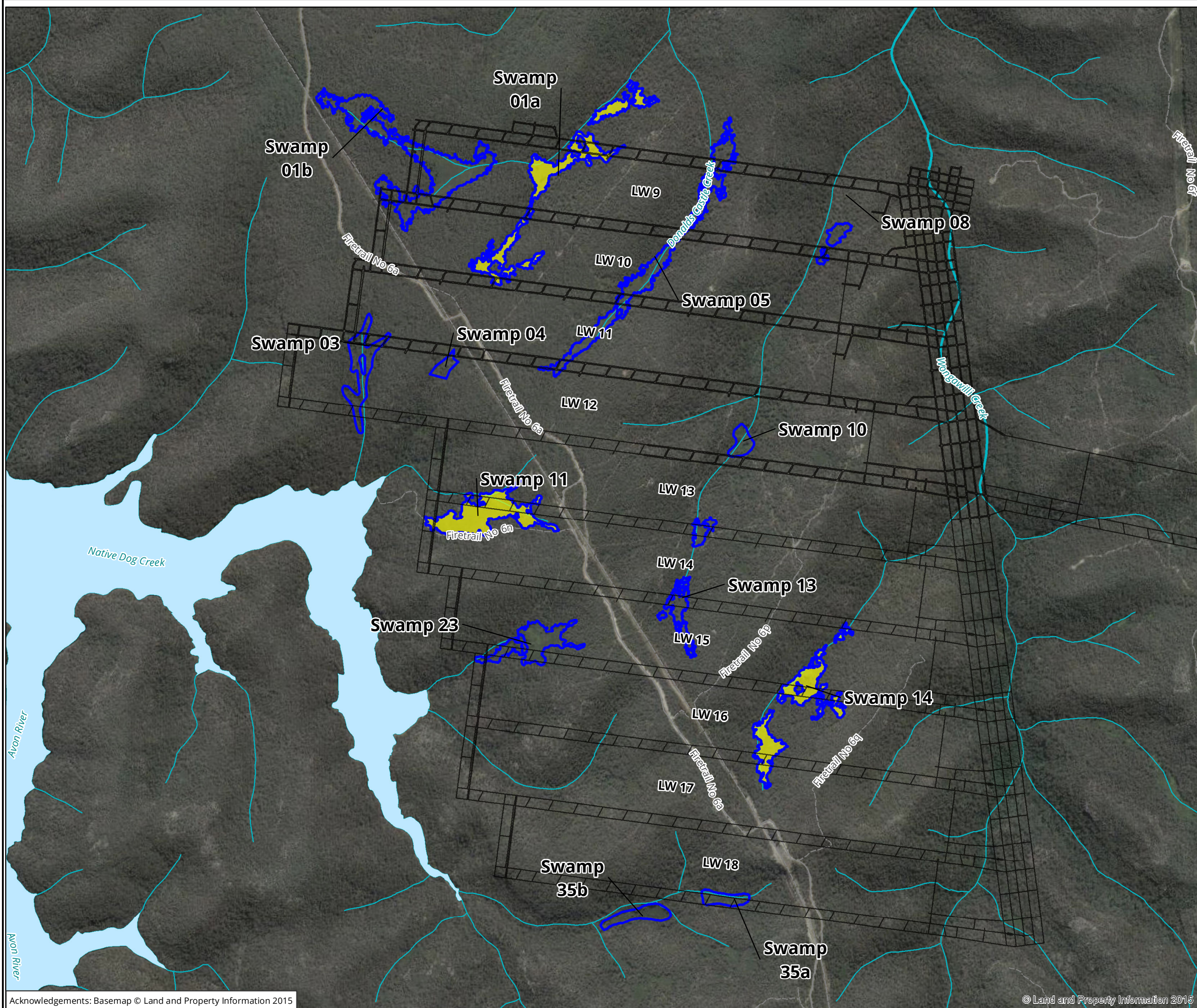
Baird, IRC and Burgin S. 2013. An emergence study of *Petalura gigantea* (Odonata: Petaluridae). *International Journal of Odonatology*. 16:3, 193-211.

Baird, IRC. 2012. *The wetland habitats, biogeography and population dynamics of Petalura gigantean* (Odonata: Petaluridae) in the Blue Mountains of New South Wales, PhD thesis, University of Western Sydney.

NPWS, 2003. *The Native Vegetation of the Woronora, O'Hares and Sydney Metropolitan Catchments*. NSW National Parks and Wildlife Service, Sydney.

NSW Office of Environment and Heritage's Atlas of NSW Wildlife, which holds data from a number of custodians. Data obtained 12/02/2016

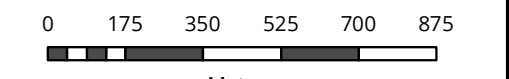




- Legend**
- Study area\*
  - Giant Dragonfly located
  - Dendrobium Area 3B Longwalls

\* Swamp boundaries are defined by using a combination of the following datasets - Biosis detailed swamp mapping (Dendrobium\_Swamp\_V5), Illawarra Coal Mapping (BHP Creek and Swamp Naming), The Native Vegetation of the Woronora, O'Hares and Sydney Metropolitan Catchments (NPWS, 2003) (woronora\_VISmap\_2387).

**Figure 1: Observed records of Giant Dragonfly within Coastal Upland Swamps in Dendrobium Area 3B**



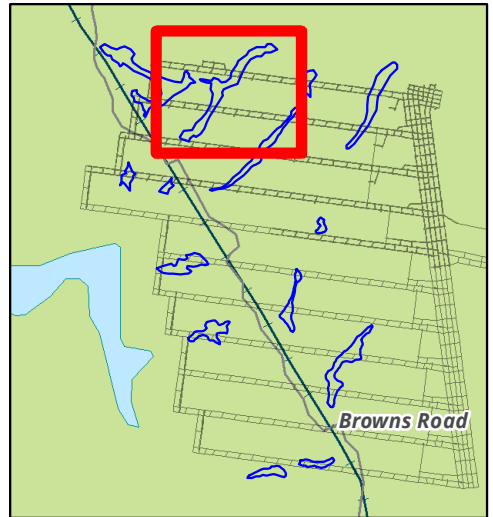
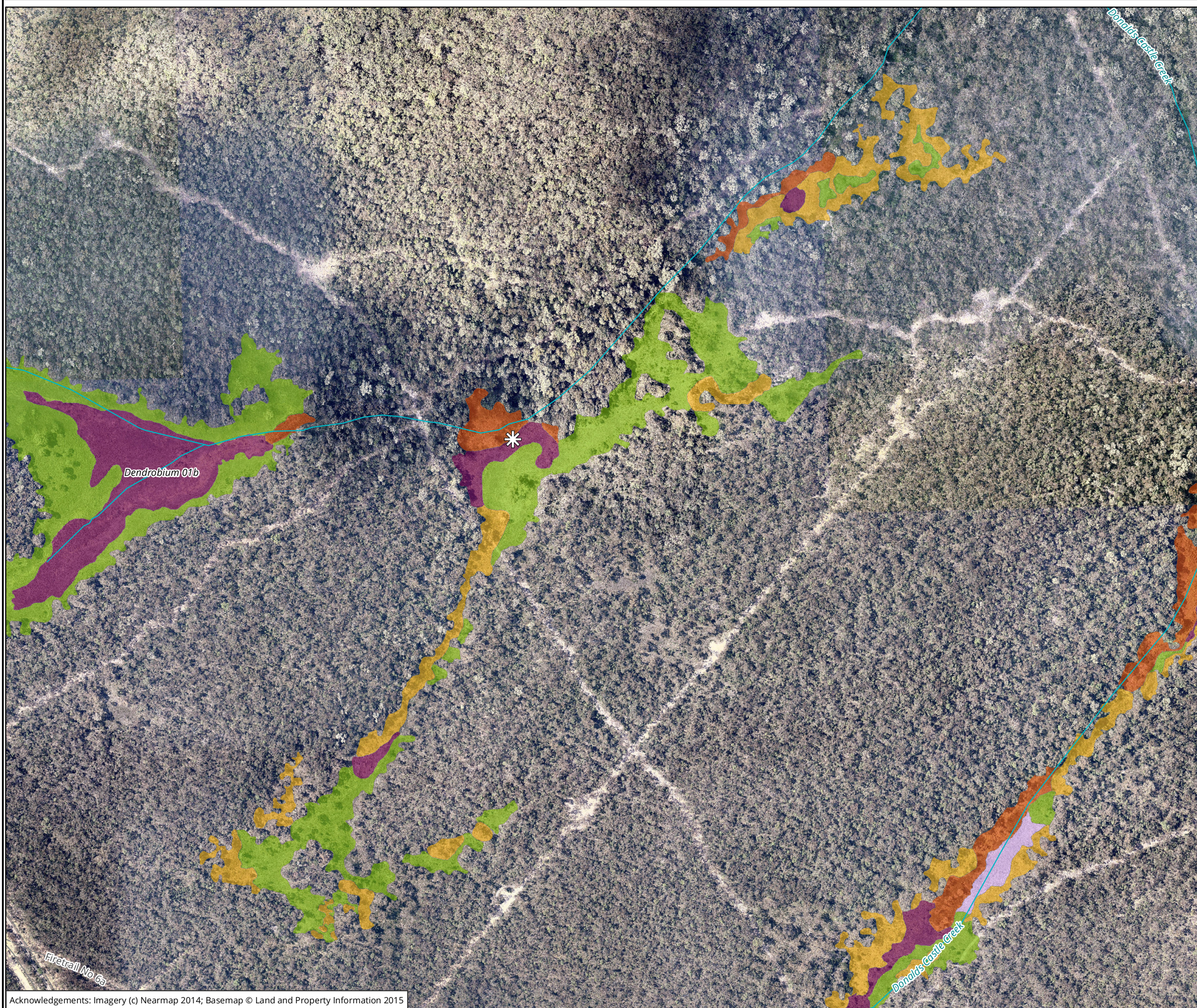
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**Legend**

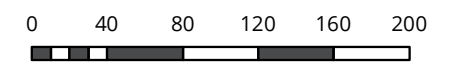
**Giant Dragonfly records (Biosis 2016)**

✱ 1 exuvia located

**LIDAR Swamp Boundaries (Biosis)**

- MU42, Upland Swamps: Banksia Thicket
- MU43, Upland Swamps: Tea-Tree Thicket
- MU44a, Upland Swamps: Sedgeland-Heath Complex (Sedgeland)
- MU44b, Upland Swamps: Sedgeland-Heath Complex (Restioid Heath)
- MU44c, Upland Swamps: Sedgeland-Heath Complex (Cyperoid Heath)

**Figure 2a: Location of Giant Dragonfly records in Swamp 01a**



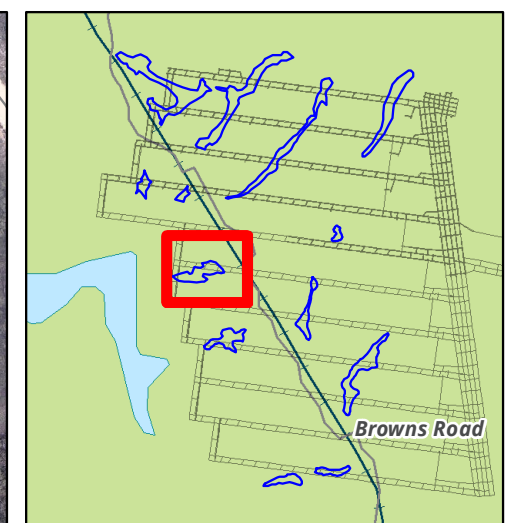
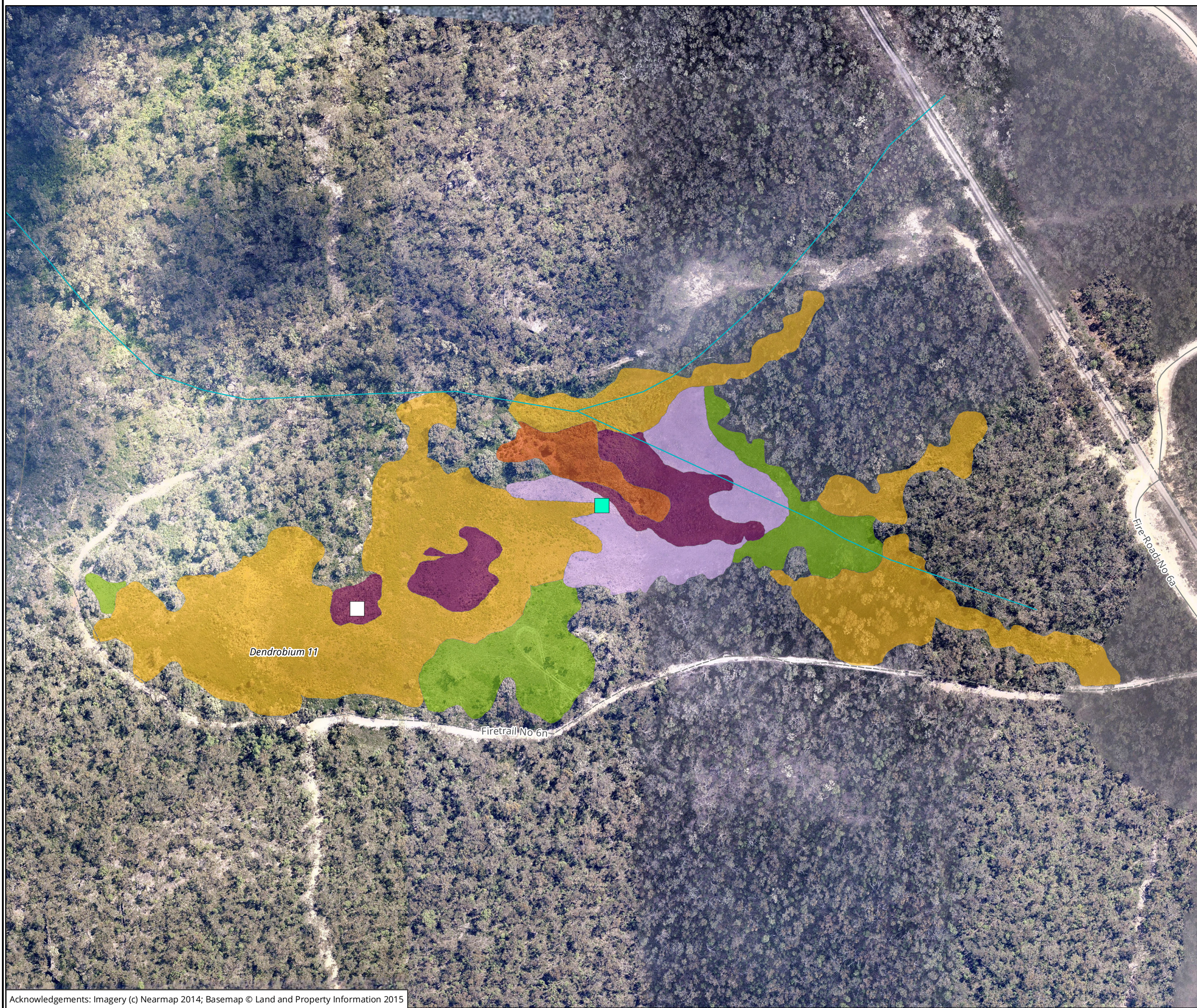
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**Legend**

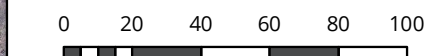
**Giant Dragonfly records (Biosis 2016)**

- 1 adult located
- 2 adults located

**LiDAR Swamp Boundaries (Biosis)**

- MU42, Upland Swamps: Banksia Thicket
- MU43, Upland Swamps: Tea-Tree Thicket
- MU44a, Upland Swamps: Sedgeland-Heath Complex (Sedgeland)
- MU44b, Upland Swamps: Sedgeland-Heath Complex (Restioid Heath)
- MU44c, Upland Swamps: Sedgeland-Heath Complex (Cyperoid Heath)

**Figure 2b: Location of Giant Dragonfly records in Swamp 11**



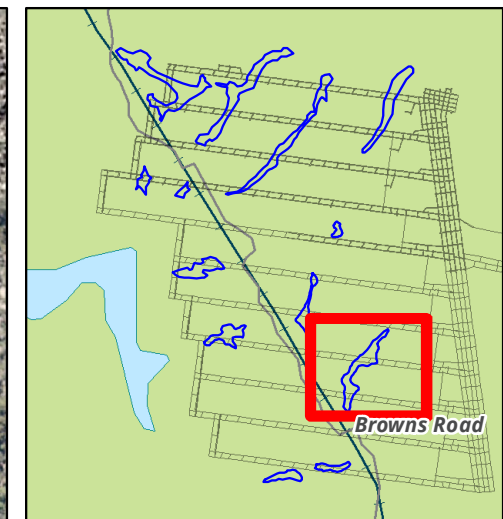
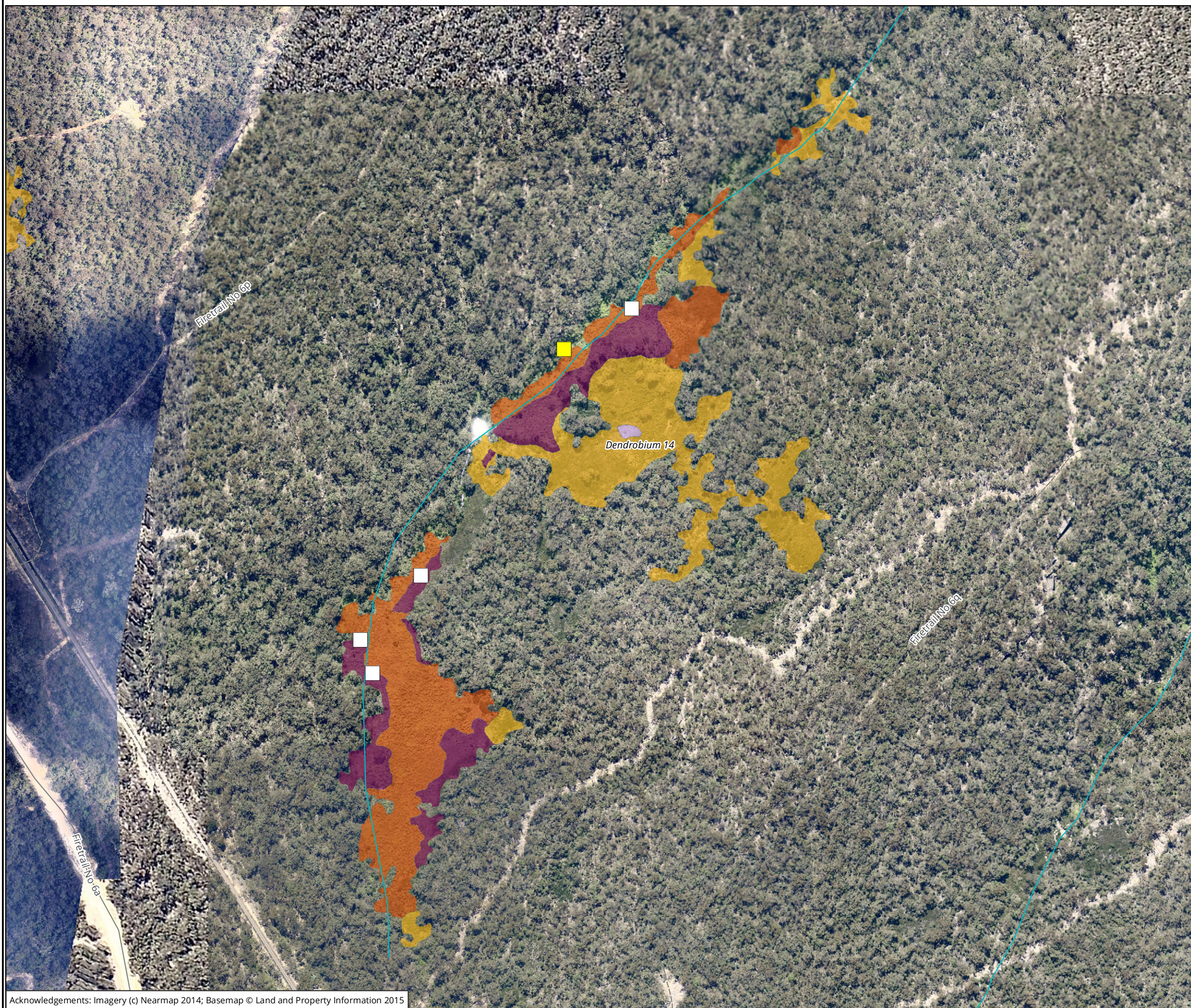
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**Legend**

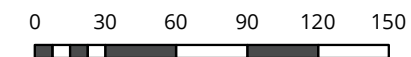
**Giant Dragonfly records (Biosis 2016)**

- 1 adult located
- 4 adults located

**LiDAR Swamp Boundaries (Biosis)**

- MU42, Upland Swamps: Banksia Thicket
- MU43, Upland Swamps: Tea-Tree Thicket
- MU44a, Upland Swamps: Sedgeland-Heath Complex (Sedgeland)
- MU44c, Upland Swamps: Sedgeland-Heath Complex (Cyperoid Heath)

**Figure 2c: Location of Giant Dragonfly records in Swamp 14**



Scale: 1:3,200 @ A3  
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