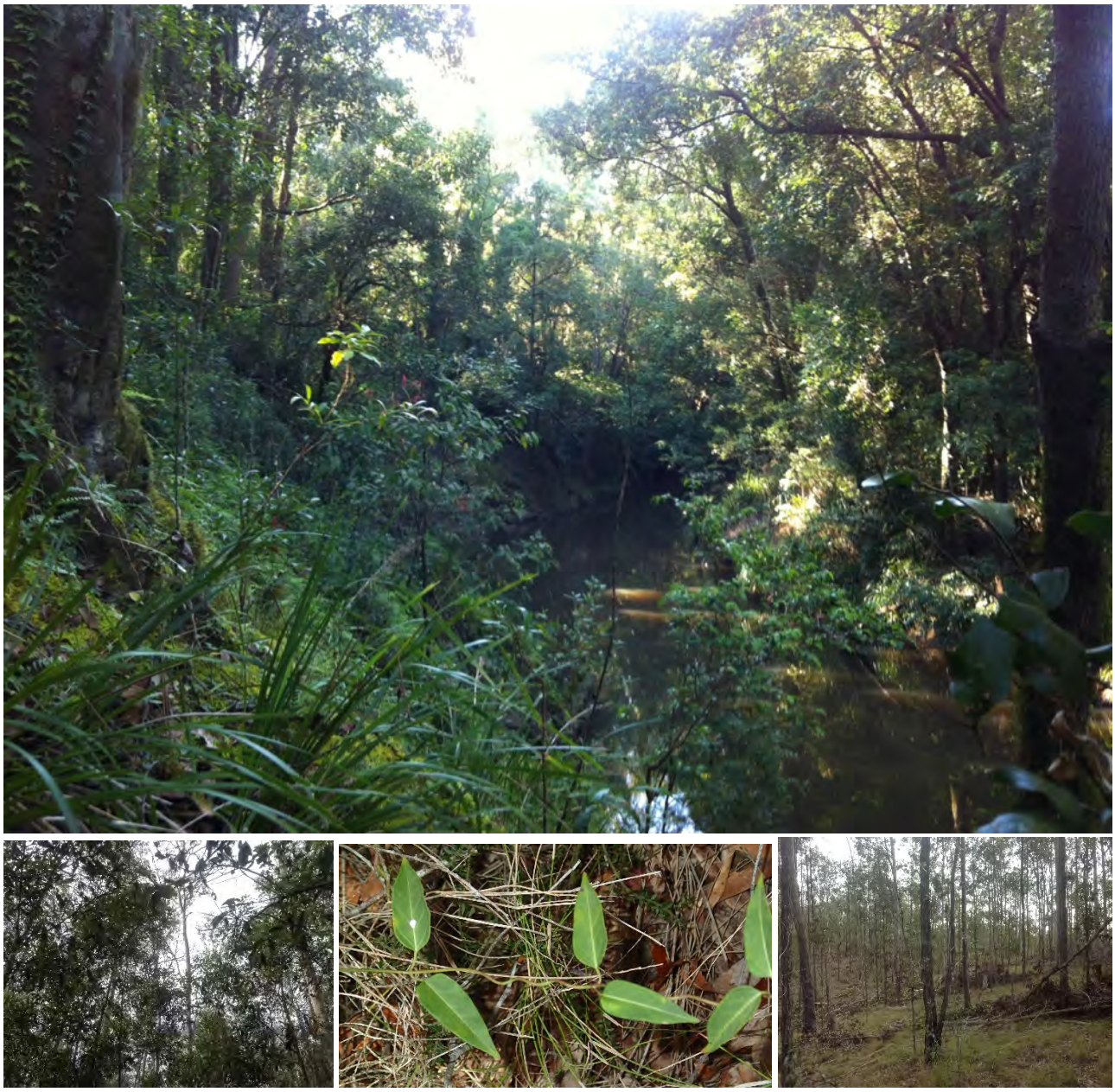

Department of Transport and Main Roads

Bruce Highway Cooroy to Curra (Section D: Woondum to Curra) Detailed Design Job No. 232/10A/7, Invitation No. WBYD-1335

Flora Survey Report for Survey Area Extents

December 2016

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1. Introduction

1.1 Project description

The Department of Transport and Main Roads (TMR) proposes to upgrade and realign 26 km of the existing Bruce Highway, including a bypass to the east of Gympie. This package of works is termed the Bruce Highway Cooroy to Curra (Section D: Woondum to Curra) (herein referred to as 'the project'). The new highway will have a posted speed limit of 110 km/hr and directional separation from Woondum Road to Curra. The project construction area extends for approximately 30 km and will include the acquisition of a project corridor to ultimately accommodate a six lane divided carriageway. Due to the length of the project, the construction phase is likely to be procured under two contracts.

A Southern Contract will extend from the northern tie in to the Bruce Highway Cooroy to Curra (Section C: Traveston to Woondum) project, at Woondum Interchange, to approximately 200 m north of Sandy Creek Road. At approximately 12 km in length, the Southern Contract is termed Contract 1. A Northern Contract of approximately 18 km in length will extend from just north of Sandy Creek Road to Curra termed Contract 2. A locality plan identifying the project area and the separation of the two contracts is provided as Figure 1.

Areas of the proposed works are located within two High Risk Areas identified on the Department of Environment and Heritage Protection's (EHP) Protected Plants Flora Survey Trigger Map, as shown on Figure 1. Section 250 of the *Nature Conservation (Wildlife Management) Regulation 2006* requires a protected plant assessment to be undertaken prior to disturbance of protected plants within a High Risk Area.

1.2 Background

This Flora Survey Report provides updated information and builds upon the works previously completed by Biodiversity Assessment and Management Pty Ltd (BAAM) in 2015 and 2016. In 2015, BAAM completed the *Bruce Highway Upgrade Section D: Baseline Ecological Assessment Woondum Road to Curra* (BAAM, 2015 in Jacobs, 2016) report which provided baseline data on flora species and vegetation communities as well as ground-truthed regional ecosystem (RE) mapping. In 2016, BAAM completed the *Detailed Terrestrial Flora Surveys* report (BAAM, 2016) which provided details of targeted flora surveys for 'endangered', 'vulnerable' or 'near threatened' (EVNT) flora species. Following delivery of BAAM's 2016 report, TMR commissioned GHD to undertake targeted flora surveys for EVNT species in areas not previously surveyed.

1.3 Terminology

For the purposes of this report, the project area is referred to as the extent of disturbance required for the construction of the project. A survey area for the project was established for the purposes of conducting terrestrial flora, terrestrial fauna and aquatic ecology surveys and was defined as the project alignment (as of January 2015) which includes the extent of the cut/fill batters, plus a buffer of approximately 50 m to 100 m around the project area, with some broader areas on surrounding properties, upstream and downstream extents within waterways, or within adjacent habitats. The survey area was selected to gain an appreciation of ecological values that are present within and immediately adjacent to the project area. A locality plan identifying the project area and survey area is provided as Figure 1.

1.4 Purpose of this report

This Flora Survey Report provides the outcomes of the flora surveys undertaken by GHD from 25 to 29 July 2016 and builds upon BAAM's previous works. This Flora Survey Report addresses two flora related components of the project; being the protected plants assessment required under the *Nature Conservation Act 1992* (NC Act) and an assessment of two areas previously identified as closed forest vegetation communities with characteristics of the Lowland Rainforest of Subtropical Australia Threatened Ecological Community (TEC) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The protected plants assessment addresses Section 250 of the *Nature Conservation (Wildlife Management) Regulation 2006* which requires that a flora survey is undertaken within an area identified as a High Risk Area on a Protected Plants Flora Survey Trigger Map or where EVNT flora species are known to occur and appropriate reporting is provided to EHP documenting the outcomes of the survey. In this regard, this report aims to:

- Demonstrate that the flora surveys undertaken for the project meet the principles of the *Flora Survey Guidelines – Protected Plants* ('the Guidelines')
- Present the results of the GHD 2016 flora survey in compilation with BAAM's 2016 *Detailed Terrestrial Flora Surveys* report
- Delineate the extent of EVNT flora species and their area of occupancy within the project area
- Recommend appropriate mitigation measures to minimise impacts to protected plants for the clearing required to accommodate the project.

The protected plants assessment focuses on conservation significant protected plants, i.e. plants listed as EVNT under the *Nature Conservation (Wildlife) Regulation 2006* (NC Wildlife Regulation). Therefore, no detailed discussion on species listed as 'least concern' is provided.

The TEC assessment aims to confirm the presence and extent of the Lowland Rainforest of Subtropical Australia TEC within the project area and survey area.

460,000 465,000 470,000 475,000

7,120,000 7,115,000 7,110,000 7,105,000 7,100,000 7,095,000

CURRA STATE FOREST
Hospital Creek
CURRA
Curra Creek South Branch
Keliher Creek
Corella Creek
CORELLA
NORTH DEEP CREEK
TAMAREE
Tamaree Creek
BRUCE HIGHWAY
CHATSWORTH
ARALUEN
FISHERMANS POCKET
Banks Creek
Deep Creek
VICTORY HEIGHTS
Moody Creek
GYMPIE
Tannery Creek
EAST DEEP CREEK
CEDAR POCKET
Deep Creek
MOTHAR MOUNTAIN
Six Mile Creek
WOONDUM STATE FOREST
WOONDUM
Jackass Creek

GYMPIE
NOOSA HEADS
MOOLOOLABA
BRISBANE

LEGEND

- Town
- Watercourse
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street/Local Road
- Survey Area
- **Project Area**
- Contract 1
- Contract 2
- Protected Areas
- Protected Plants High Risk Area

1:80,000 @ A3

0 0.5 1 2 3

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Department of Transport and Main Roads
Bruce Highway – Cooroy to Curra
(Section D: Woondum to Curra)

Job Number 41-29914
Revision 0
Date 14 Oct 2016

Locality Plan

Figure 1

G:\41\29914\GIS\Maps\MXD\Environmental\41_29914_3019_Overview_A3_Rev0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: GA: Town (2014); TMR: Aerial Imagery (2016), Survey Area (2016); DNRM: Railway, Watercourse (2014), Road (2016). DEHP: Protected Plants High Risk Area (2015). GHD: Project Area (2016) Created by: sc

1.5 Proposed works

Vegetation clearing will be required to facilitate the project. The key elements of the project include:

- 26 km of four lane highway with a posted speed limit of 110 km/hr and directional separation from Woondum Road to Curra
- Acquisition of a project corridor to ultimately accommodate a six lane divided carriageway
- Integration with the Woondum Interchange at the northern extent of Bruce Highway Cooroy to Curra (Section C: Traveston to Woondum) project
- Integration with major interchanges at Penny Road, Gympie Connection Road and the township of Curra
- Construction of multi-span bridges over major waterways including Six Mile Creek, Tannery Creek, Deep Creek, Moody Creek (north and south), Banks Creek, Tamaree Creek, Upper Curra Creek, Keliher Creek, Curra Creek overflow and Curra Creek north
- Construction of a new bridge over the existing North Coast Rail Line
- Construction of new multi-span bridges over existing local road infrastructure, several connections and alteration to the existing local road network
- Acquisition of areas of Woondum State Forest and Curra State Forest for conversion to road reserve or on sale to relevant State government departments
- Waterway diversions of Tannery Creek, Moody Creek (north and south), Banks Creek, Tamaree Creek, Tamaree Creek tributary and Curra Creek anabranch

During the Construction phase of the project, vegetation within the boundaries of the project area (as delineated in Figure 1) may be subject to clearing by the construction contractor. Areas not to be cleared will be delineated as 'no go zones' to retain adjacent vegetation.

1.6 TMR exemption

TMR have a Compliance Management Plan (CMP) in place with EHP for road infrastructure works identified in the TMR document entitled '*Queensland Transport and Road Investment Program 2015-16 to 2018-19*' which details how the clearing of non-remnant vegetation is to be managed with regard to impacts to EVNT flora species. The project is currently listed on the QTRIP for planning purposes only at this stage. The CMP commenced on 22 April 2016 and is able to be used by TMR, its contractors and agents for the taking of EVNT wildlife by clearing under the NC Act. Appendix 2 of the CMP contains the compliance matters and states that the purpose of the CMP is satisfied in relation to the taking of protected plants when carrying out works as follows:

- No clearing of protected plants within a forestry reserve or protected area as defined under the NC Act
- Protected plants comprising EVNT wildlife may only be taken
    - In areas where vegetation has been previously cleared; and
    - The vegetation has not regrown to a state that has reached remnant vegetation status under the *Vegetation Management Act 1999*

As the CMP implies an exemption for clearing EVNT wildlife in non-remnant vegetation outside of a forestry reserve or protected area, there is a requirement to carry out surveys for clearing in High Risk Areas, or obtain clearing permits to take protected plants in non-remnant vegetation.

Nevertheless, while the primary focus of the assessment was on remnant vegetation, the July 2016 flora survey encompassed areas of non-remnant vegetation where there was a reasonable likelihood that habitat for an EVNT species or other protected vegetation association may be present. Additionally, the CMP is for the planning phase of a TMR road project and there is no guarantee the CMP will remain current during project delivery.

1.7 Previous permits

TMR have previously undertaken minor clearing works to support geotechnical investigations and currently hold the following clearing permits issued under the *Nature Conservation Act 1992*:

- Protected Plant Authority: Protected Plant Clearing Permit (permit number WIPA15933015) for the P2 geotechnical investigations was granted on the 26 May 2015
- An amendment to the clearing permit relating to the inclusion of the P3 geotechnical investigations was granted on the 29 May 2015
- A second addendum to the clearing permit relating to the inclusion of the D1 and D2 geotechnical investigations was granted on the 4 April 2016.
- Protected plant authority – amendment for the D3 and D4 geotechnical investigations (permit number WIPA17630516). This permit was supported by an impact management plan which included provisions for an ecologist to be present during clearing works, that no EVNT flora species were to be cleared and that exclusion zones surrounding EVNT flora species were to be in place prior to clearing activities.

A clearing permit has been applied for by TMR to support the D3 and D4 geotechnical investigations.

1.8 Disclaimer

This report has been prepared by GHD for TMR and may only be used and relied on by TMR and EHP and the Commonwealth Department of the Environment and Energy for the purpose agreed between GHD and the TMR as set out in this report. GHD otherwise disclaims responsibility to any person other than TMR arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared. The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by TMR and others who provided information to GHD (including government authorities and consultants engaged by TMR), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points. Investigations undertaken in respect of this report are constrained by the

particular site conditions, such as the presence of large areas of recently burned vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of conservation significant species and/or their supporting habitat) may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Flora survey assessment method

2.1 General

2.1.1 Assessment methodologies

This section of the report is presented in two parts to distinguish between the assessment methodology undertaken for the protected plants assessment under the NC Act and the TEC assessments undertaken for the EPBC Act. While there is considerable overlap in the assessment methodologies for the two assessments, the protected plants assessment requires certain information is provided and site survey is progressed in accordance with the Guideline requirements.

2.1.2 Protected plants assessment

The protected plant assessment included a desktop assessment of existing information (which relies on the previous works and reporting undertaken for the project, including searches of relevant government databases) and a targeted field survey for EVNT species and their extent of occurrence within the project area and survey area.

Details of the people responsible for the flora survey and the methods employed for addressing the requirements of the Guidelines have been included in Sections 2.2 through to 2.4 of this Flora Survey Report.

2.1.3 TEC assessment

An assessment of two polygons of a closed forest vegetation community at Six Mile Creek and Woondum State Forest was undertaken to confirm whether the vegetation communities conform with the key diagnostic criteria and condition thresholds of the Lowland Rainforest of Subtropical Australia TEC. Further details on the methodology adopted have been provided in Section 2.5 of this Flora Survey Report.

2.2 Assessment personnel

This assessment was undertaken by Dr Megan Ward, Peter Moonie and Colin Vaughan with support from Nick Willis, all of whom are professional flora ecologists deemed suitably qualified in accordance with the following requirements identified by the Guidelines:

- A professional qualification or formal training in plant identification and the taxonomy of Queensland flora
- A minimum of five years' experience in undertaking surveys for EVNT species

Megan, Peter, Colin and Nick have previously submitted their *Curricula vitae* to EHP.

Personnel and their relevant experience from BAAM who previously undertook an assessment in 2016 are detailed within the *Detailed Terrestrial Flora Surveys* report (BAAM, 2016) (refer to Appendix A).

No departures from the requirements of the Guidelines were identified with regard to the suitability of the people who undertook the assessment.

2.3 Desktop assessment

A desktop assessment was undertaken to facilitate an informed approach to the field survey. The desktop assessment reviewed existing information for the purposes of identifying target EVNT species for the field assessment and to determine areas with higher potential to

encounter EVNT species. The desktop assessment involved a review of the following information sources:

- **Protected Plants Flora Survey Trigger Map:** EHP's Flora Survey Trigger Map was viewed to determine the extent of High Risk Areas within the project area.
- **Previous reporting:** Flora surveys of the project area and survey area have previously been undertaken in 2011, 2015 and 2016 and are reported in the following:
  - The *Review of Environmental Factors* (Jacobs, 2016)
  - The *Detailed Terrestrial Flora Surveys* report (BAAM, 2016) (refer to Appendix A).

2.4 Protected plants field assessment

2.4.1 Survey timing

The following conservation significant flora species have been assessed by BAAM (2016) as being 'known to occur', 'likely to occur' or having the 'potential to occur' within the survey area:

Known to occur:

- *Macrozamia pauli-guilielmi* (pineapple zamia)

Likely to occur:

- *Marsdenia coronata* (slender milkvine)

Potential to occur:

- *Aponogeton elongatus* subsp. *elongatus*
- *Archidendron lovelliae* (bacon wood)
- *Arthraxon hispidus* (hairy-joint grass)
- *Baloghia marmorata* (jointed baloghia)
- *Floydia praealta* (ball nut)
- *Fontainea rostrata* (deep creek Fontainea)
- *Macadamia integrifolia* (macadamia nut)
- *Macadamia ternifolia* (Maroochy nut)
- *Picris conyzoides* (fleabane hawkweed)
- *Pterostylis chaetophora*
- *Ricinocarpos speciosus*
- *Samadera bidwillii* (quassia)
- *Sophora fraseri* (brush sophora)
- *Symplocos harroldii* (hairy hazelwood)
- *Triunia robusta* (glossy spicebush)
- *Xanthostemon oppositifolius* (southern penda)

The terminology and definitions used in the likelihood of occurrence assessment by BAAM (BAAM, 2016) are described in Table 1.

Table 1 Likelihood of occurrence definition for terrestrial flora (BAAM, 2016)

Likelihood rating	Definition
Known to occur	The species was detected during field assessment, or is known from past surveys in the survey area and is not now considered locally extinct.
Likely to occur	A medium to high probability that the species: • Occurs in the survey area because suitable habitat occurs

Likelihood rating	Definition
	• The survey area is within the known distribution of the species • There are records of the species in the vicinity of the survey area; and • The species is not now considered locally extinct
Potential to occur	Either: (a) there are no past records of the species in the vicinity of the survey area but suitable habitat occurs and there is insufficient information on the distribution of the species (e.g. it is naturally rare and difficult to detect, or there has been insufficient survey effort) to categorise the species as likely or unlikely to occur; or (b) there are past records of the species in the vicinity of the survey area but habitat in the survey area is marginal or spatially limited meaning that the species' presence on the survey area would be transitory at best.
Unlikely to occur	A low probability that the species occurs in the survey area because: • Suitable habitat does not occur • The survey area is outside the known distribution of the species • There are no records of the species in the local region despite adequate survey effort • The species is considered locally extinct; or • The species has not been observed despite sufficient spatial and temporal survey effort for detecting the species

Given that the July 2016 flora surveys were undertaken to target EVNT flora species, a revised likelihood of occurrence assessment was undertaken with a focus on flora species previously recorded within a 10 km search radius of the alignment. In this regard, the defining criteria used for the updated likelihood of occurrence assessment is provided in Table 2.

Table 2 Updated likelihood of occurrence definitions for terrestrial flora

Likelihood rating	Definition
Known to occur	Species has been recorded (directly by TMR commissioned surveys or from database records) within the survey area
Likely to occur	Species has been recorded within 10 km of the survey area and the survey area contains suitable habitat for the species
Potential to occur	The survey area is within the species' current known distribution, but the species has not been recorded within 10 km of the survey area and the survey area contains suitable habitat for the species
Unlikely to occur	The survey area is not within the species' known distribution and/or suitable habitat is not present within the survey area

The results of the updated likelihood of occurrence assessment identified the following species as 'known to occur' and 'likely to occur':

Known to occur:

- *Macrozamia pauli-guilielmi* (pineapple zamia)
- *Marsdenia coronata* (slender milkvine)

Likely to occur:

- *Cossinia australiana* (cossinia)
- *Fontainea rostrata* (deep creek Fontainea)
- *Floydia praealta* (ball nut)
- *Macadamia integrifolia* (macadamia nut)
- *Macadamia ternifolia* (Maroochy nut)
- *Picris conyzoides* (fleabane hawkweed)
- *Samadera bidwillii* (quassia)
- *Symplocos harroldii* (hairy hazelwood)

All of the species assessed as 'known to occur' and the majority of species assessed as 'likely to occur' are long-lived perennial species that can be confidently identified based on vegetative features. BAAM (2016) identified that *Picris conyzoides* is most likely associated with RE 12.3.3 which is described as *Eucalyptus tereticornis* woodland on Quaternary alluvium and is restricted to a small area of land within the northern extent of the project area. No observation of this species was made by BAAM who completed their survey work of RE 12.3.3 over summer months.

BAAM (2016) also identified *Pterostylis chaetophora,* which is a cryptic ground orchid flowering from August to September, as having the 'potential to occur'. Revised desktop searches have indicated that previous records for this species have been located approximately 20 km from the project area and therefore this species is not 'known to occur' or considered to be 'likely to occur' within the survey area.

On the basis of the above, a flora survey at the end of July 2016 was deemed appropriate to maximise the likelihood of encountering all target species (i.e. those reassessed as 'known to occur' and 'likely to occur') and other species assessed as having a lower likelihood of being present (i.e. those species assessed as having the 'potential to occur' including *Pterostylis chaetophora*).

With regard to the timing of the flora survey, no departures from the requirements of the Guidelines were identified.

2.4.2 Flora survey area

The survey area is defined in Section 1.3 of this Flora Survey Report, with the extents of the project area and survey area shown in Figure 1.

Within mapped High Risk Areas, the clearing impact area for the flora surveys was deemed to encompass the area of vegetation within the project area as well as a 100 m buffer area surrounding the project area. The clearing impact area includes areas of both remnant and non-remnant vegetation.

The flora surveys also encompassed vegetation external to mapped High Risk Areas. Section 259, Clause (1) of the *Nature Conservation (Wildlife Management) Regulation 2006* states that a protected plant clearing permit is required for an area other than a High Risk Area if, before a

person starts clearing in an area other than a High Risk Area, the person is, or becomes, aware of the following:

- There are plants that are EVNT wildlife within the area to be cleared
- The plants would be taken by the clearing or there would be clearing within 100 m of the plants.

BAAM (2016) provided mapping of areas of 'known habitat' and 'potential habitat' for EVNT flora species in locations external to High Risk Areas. As these areas had not been previously assessed, survey of these habitats was undertaken in July 2016. Surveyed areas external to High Risk Areas encompassed both remnant vegetation and non-remnant vegetation communities.

It is acknowledged that areas of Curra State Forest had been burnt relatively recently prior to the field survey. However, this limitation was overcome by implementing a habitat suitability approach to the assessment.

No departures from the requirements of the Guidelines were identified as representative meanders across all habitat types present within the clearing impact area were undertaken.

2.4.3 Protected plants survey

The design for the July 2016 survey involved targeted surveys for individuals of *Macrozamia pauli-guilielmi* (pineapple zamia) and *Marsdenia coronata* (slender milkvine) in areas previously identified by BAAM in 2016 as either 'potential habitat' or 'known habitat' for either species. Surveys occurred only in those areas not previously surveyed as part of BAAM's flora survey in 2016. The location of individual plants, or clusters of plants, was recorded with a global positioning system (GPS) unit. The extent of occurrence in the survey area was delineated to allow an estimate of the number of individuals within the localised extent of occurrence to be quantified and extrapolated across that habitat type where the targeted species are present.

As the project area lies within two High Risk Areas and in other areas where EVNT species are 'known to occur' and have 'potential to occur', two survey methodologies were employed. The two flora survey methodologies are discussed in the following sections.

High Risk Areas

Timed meander

The protected plants survey within mapped High Risk Areas was consistent with the timed meander method that is described in the Guidelines. In brief, the timed meander method involves the following steps:

1. Select a starting point within the particular habitat of interest and record the time.
2. Record the identities of the protected plant species observed, and collect specimens for any unknown species (specimens only collected in State forest or protected areas where appropriate permits are held).
3. Traverse the particular habitat in a random manner so as to maximise the coverage of habitat and the encounter rate of different species.
4. Record a list of flora species encountered and note the time every 2 to 5 minutes. If the survey needs to be interrupted, do not include this time in the results.
5. Continue searching until no new species have been recorded for 30 minutes or when the entire area of habitat type is surveyed, whichever happens sooner.

A figure showing the survey effort is included as Appendix B. With regard to the methods of the timed meander, no departures from the requirements of the Guidelines were identified.

Protected plant population survey

In accordance with the Guidelines, when an EVNT plant species has been recorded during a timed meander search, there is a requirement for a more comprehensive assessment to be undertaken. This is required in order to determine the species abundance, distribution and habitat associations, as well as to inform impact management measures. The preferred approach to collect additional data is plot-based assessment.

Following the Queensland Herbarium's methodology (Neldner *et al*., 2012), plots measuring 50 m by 10 m were used to assess identified EVNT plant species. This is the preferred standard quadrat size for determining vegetation structure and composition for the majority of plant communities found in Queensland. With respect to the survey, a plot was established at the location of the *M. coronatas* identified within a High Risk Area and the following information was recorded and described:

- The GPS location of each plot or plots
- The number of individuals of the EVNT species, as well as any other observations such as the age structure (if possible), reproductive state and health
- A description of the vegetation structure, including noting the RE type
- The identities of all flora taxa found in each of the strata comprising the vegetation community
- The landscape attributes including the landform type, soil type, geology, slope, aspect and altitude
- Any specific habitat or micro-habitat features associated with the EVNT species
- The nature and degree of any disturbance to the habitat

No *Macrozamia pauli-guilielmi* (pineapple zamia) additional to those identified by BAAM in 2016 were identified. As BAAM had previously identified *Macrozamia pauli-guilielmi* (pineapple zamia) within a High Risk Area, the information required by the Guidelines was collected by BAAM in 2016 and is presented in their *Detailed Terrestrial Flora Surveys* report (2016).

Areas outside of High Risk Areas

Areas outside of High Risk Areas are not required to be surveyed in accordance with the Guidelines, except where species of conservation significance are known to be present. Nevertheless, the survey methodology employed for areas outside of the mapped High Risk Areas was generally consistent with the timed meander technique described above. Where EVNT flora species were identified outside of High Risk Areas, their location was recorded using handheld GPS units. The field verified RE mapping was relied upon to provide vegetation descriptions of EVNT habitat.

2.4.4 Identification of plant species

All plant species encountered were identified in the field. As a general practice, where field identification is not possible, specimen material is typically collected and later identified with the assistance of diagnostic keys and references. No specimen material was collected from State forests or protected areas during this survey.

BAAM have previously collected specimen material of *M. coronata* from the project area and submitted the collected specimen to the Queensland Herbarium for confirmation, the results of which are presented in their 2016 report.

2.5 Threatened ecological community field assessment

All vegetation communities previously identified by BAAM in 2016 with the potential to conform to the floristic attributes of a TEC were assessed against the key diagnostic characteristics and condition thresholds relevant to the EPBC Act, including the Lowland Rainforest of Subtropical Australia TEC potentially at Six Mile Creek and the area within Woondum State Forest as identified by BAAM in 2016). The extent of any TEC was delineated via an ecologist walking the boundary of the TEC with a handheld GPS unit to confirm the edge of the vegetation community.

2.6 Protected plants assessment data analysis

During the flora surveys, data was captured using the Collector application on iPads to allow for the rapid collection and analysis of information in the field. Following the completion of the flora surveys, the data was analysed in ArcGIS to assist in interpretation.

The extent of occurrence of *M. pauli-guilielmi* and *M. coronata* was calculated based on the methodology provided by the *Threatened Species Scientific Committee Guidelines for assessing the conservation status of native species according to the Environment Protection and Biodiversity Conservation Act 1999 and Environment Protection and Biodiversity Conservation Regulations 2000* (DEE, 2016). The extent of occurrence provided by the Threatened Species Scientific Committee Guidelines is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure of the extent of occurrence excludes discontinuities or disjunctions within the overall distributions of taxa. In order to capture the extent of EVNT flora species' supporting habitat in the extent of occurrence calculations (to align with the Guidelines), a 100 m buffer area was included in the extent of occurrence calculations.

In this regard, the outer boundaries of clusters of *M. pauli-guilielmi* and *M. coronata* individuals were identified and a 100 m buffer area was applied. The outer edge of the buffer area was then used to create the shortest continuous boundary around the clusters of *M. pauli-guilielmi* and *M. coronata.*

3. Protected Plants Assessment Results

3.1 Desktop assessment

3.1.1 Protected Plants Flora Survey Trigger Map

The Protected Plants Flora Survey Trigger Mapping identifies that the project area intersects two High Risk Areas.

3.1.2 Previous field surveys and reporting

BAAM's 2015 *Bruce Highway Upgrade Section D: Baseline Ecological Assessment Woondum Road to Curra* report (BAAM, 2015 in Jacobs, 2016) provides the location and extent of REs within the project area and survey area, as well as baseline information on flora species encountered during the flora survey.

BAAM's 2016 *Detailed Terrestrial Flora Surveys* report (BAAM, 2016) provides the outcomes of the targeted EVNT flora surveys undertaken for the project and identifies that *M. pauli-guilielmi* and *M. coronata* were the only two EVNT flora species encountered during the flora surveys. A detailed discussion on these two species and their supporting habitat is provided in BAAM's *Detailed Terrestrial Flora Surveys* report (BAAM, 2016) included as Appendix A.

3.2 Protected plants assessment flora survey results

3.2.1 General

The July 2016 flora survey confirmed that *M. coronata* and *M. pauli-guilielmi* are present within the survey area. No additional EVNT flora species were identified during the field investigations.

3.2.2 *Macrozamia pauli-guilielmi* (pineapple zamia)

The July 2016 flora survey did not identify any additional *M. pauli-guilielmi* individuals in areas not previously surveyed by BAAM in 2016 (BAAM, 2016). The *M. pauli-guilielmi* previously identified by BAAM are located within a High Risk Area. Refer to BAAM's *Detailed Terrestrial Flora Surveys* (2016) report for a full discussion on the habitat present at the location of each sub-population identified within the survey area.

A total of approximately 48 adults and 167 seedlings of *M. pauli-guilielmi* with an extent of occurrence of 8.31 ha were identified within the project area.

3.2.3 *Marsdenia coronata* (slender milkvine)

The July 2016 flora survey confirmed that *M. coronata* is present in areas previously surveyed by BAAM as well as in areas not previously surveyed. A total of approximately 334 adults and 531 seedlings of *M. coronata* with an extent of occurrence of 69.87 ha were identified within the project area based on the BAAM 2016 and GHD 2016 flora surveys.

The *M. coronata* individuals identified in areas not previously surveyed were identified in a variety of habitat types across the same mapped landform and in areas mapped by BAAM as 'known habitat' and 'potential habitat'. *M. coronata* was associated with habitat types characterised by the following attributes (refer to Plate 1):

- Open forests or woodlands dominated by *Eucalyptus* species
- A low shrub layer was present or juvenile woody species

- Sparse ground cover with bare soil present
- Typically identified on mid to upper slopes

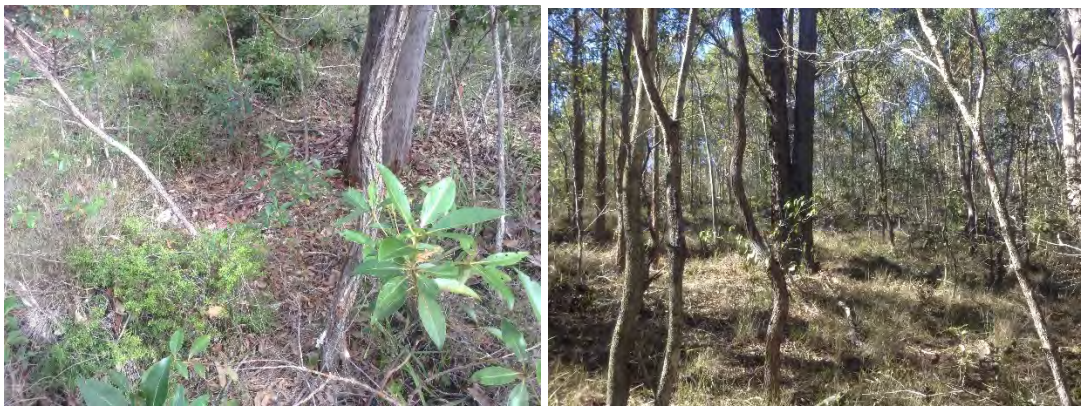

Plate 1 *Marsdenia coronata* habitat within the project area

Table 3 provides the locations of the *M. coronata* individuals identified during the July 2016 flora surveys.

Table 3 *Marsdenia coronata* (slender milkvine) locations with survey area

Location	Habitat type	Number of individuals identified in High Risk Area	Total number of individuals identified
Curra State Forest Lot 700 on FTY1491	12.11.5e	37 adults 4 seedlings*	84 adults 19 seedlings
Lot 3 on MPH23816	12.11.3	4 adults 7 seedlings	4 adults 7 seedlings
Lot 2 on MPH14224	12.11.3	-	23 adults 2 seedlings
Lot 4 on MPH14224	12.11.3	-	3 adults 14 seedlings
	12.11.16	-	10 adults 8 seedlings
Lot 1 on MPH11890	12.11.3	-	10 adults 9 seedlings
Woondum State Forest Lot 983 on FTY1488	12.11.3/12.1 1.14	-	23 adults
	Total	**41 adult 11 seedlings**	**157 adults 59 seedlings**

*Note - For the purposes of this assessment, a seedling is defined as a plant with four leaves or less

A total of 157 adult *M. coronata* individuals and 59 seedlings were identified during the July 2016 flora surveys across six allotments within four different vegetation communities. The vegetation communities within which *M. coronata* were identified are described as follows:

- **RE 12.11.3** (least concern) – *Eucalyptus siderophloia* and *E. propinqua* open forest +/- *E. microcorys*, *Lophostemon confertus*, *Corymbia intermedia*, *E. biturbinata*, *E. acmenoides*, *E. tereticornis*, *E. moluccana*, *Angophora leiocarpa*, *Syncarpia verecunda* with vine forest species and *E. grandis* or *E. saligna* in gullies. *Eucalyptus pilularis* and *E. tindaliae* sometimes present e.g. mid D'Aguilar Range, Conondale Range. Occurs predominantly on hills and ranges of Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.
- **RE 12.11.5e** (least concern) – *Corymbia citriodora* subsp. *variegata* woodland usually including *Eucalyptus siderophloia* or *E. crebra* (sub coastal ranges), *E. propinqua* and *E. acmenoides* or *E. carnea*. Other species that may be present and abundant locally include *Corymbia intermedia*, *C. trachyphloia* subsp. *trachyphloia*, *Eucalyptus tereticornis*, *E. microcorys*, *E. portuensis*, *E. helidonica*, *E. major*, *E. longirostrata*, *E. biturbinata*, *E. moluccana* and *Angophora leiocarpa*. *Lophostemon confertus* often present in gullies and as a sub-canopy or understorey tree. Mixed understorey of grasses, shrubs and ferns. Occurs on hills and ranges of Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.
- **RE 12.11.14** (of concern) – *Eucalyptus crebra, E. tereticornis, Corymbia intermedia* grassy woodland. Other species including *Eucalyptus melanophloia*, *Corymbia clarksoniana*, *C. erythrophloia*, *C. tessellaris, E. siderophloia*, *Angophora* spp. May be present in low densities or in patches. Mid-layer generally sparse but can include low trees such as *Vachellia bidwillii*, *Capparis* spp., *Dodonaea triquetra*, *Alphitonia excelsa* and *Xanthorrhoea* spp. Occurs on mid and lower slopes on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.
- **RE 12.11.16** (endangered) – *Eucalyptus cloeziana* +/- *E. propinqua*, *E. acmenoides*, *E. microcorys* and *E. grandis* open forest. Understory is generally shrubby +/- vine forest species. Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics, especially phyllite of the Kin Kin Beds.

M. coronata was identified during a timed random meander within High Risk Areas mapped over Lot 700 on FTY1491 (Curra State Forest) and Lot 3 on MPH23816. High Risk Areas are not mapped over the other allotments upon which *M. coronata* was identified. In accordance with the Guidelines, plot based assessments were undertaken to quantify the population extent and density in order to quantify the potential impact of the project. Table 4 details the outcomes of the plot based assessments.

Table 4 Outcomes of plot based assessments for *Marsdenia coronata* (slender milkvine) identified within a High Risk Area

Assessment criteria	Outcomes
The GPS location.	The plot based assessments were undertaken where EVNT plant species were identified in each habitat type. The locations of EVNT flora species are provided in Appendix B.
The number of individuals of the EVNT species, as well as any	A total of 65 adult and 51 seedling *M. coronata* individuals were identified within mapped High Risk Areas during the flora surveys undertaken in early 2016 (BAAM) and July 2016. The majority of

Assessment criteria	Outcomes
other observations such as the age structure (if possible), reproductive state and health.	the individuals appeared to be in good health with no obvious signs of stress. One individual appeared unhealthy with wilting leaves and chlorosis evident (i.e. leaf yellowing). No flowers or seed pods were observed during the July 2016 flora surveys. Refer to BAAM's reporting included as Appendix A for a discussion on the individuals identified during the early 2016 flora surveys.
A description of the vegetation structure, noting the RE.	The *M. coronata* individuals were identified in the following habitats: • RE 12.11.3 • RE 12.11.5e These vegetation communities have previously been field verified and conform to the descriptions provided above. BAAM identified *M. coronata* within RE 12.9-10.4, which was field verified as consistent with a *Eucalyptus racemosa* woodland on sedimentary rocks.
The identities of all flora taxa found in each of the strata comprising the vegetation community.	A comprehensive flora species list is provided in BAAM's 2015 *Bruce Highway Upgrade Section D: Baseline Ecological Assessment Woondum Road to Curra* and BAAM's 2016 *Detailed Terrestrial Flora Surveys* (2016) report.
The landscape attributes including the landform type, soil type, geology, slope, aspect and altitude.	*M. coronata* was generally identified on the mid to upper slopes on gently undulating land. All *M. coronata* within the plots were identified on land zone 11. The land zone is described as follows: Metamorphosed rocks, forming ranges, hills and lowlands. Primarily lower Permian and older sedimentary formations which are generally moderately to strongly deformed. Includes low- to high-grade and contact metamorphics such as phyllites, slates, gneisses of indeterminate origin and serpentinite, and interbedded volcanics. Soils are mainly shallow, gravelly Rudosols and Tenosols, with Sodosols and Chromosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.
Any specific habitat or micro-habitat features associated with the EVNT species. Notes must also be included on the nature and degree of any disturbance to the habitat.	*M. coronata* was associated with habitat types characterised by the following attributes: • Open forests or woodlands dominated by *Eucalyptus* species • A low shrub layer was present or juvenile woody species • Sparse ground cover with bare soil present • Typically identified on mid to upper slopes

3.2.4 Extent of occurrence

Extent of occurrence calculations

The extent of occurrence for *M. pauli-guilielmi* and *M. coronata* is shown in Appendix C, with calculations differentiating the extent of occurrence within the survey area and the extent of occurrence within the project area. The clearing impact area defined in Section 2.4.2 of this report was generally the same area as the survey area, comprising the project area plus a 50 m to 100 m buffer. This approach was adopted to minimise the potential of excluding habitat from the extent of occurrence calculations and to accurately quantify the extent of direct impact.

Macrozamia pauli-guilielmi (pineapple zamia)

As identified in BAAM's *Detailed Terrestrial Flora Surveys* (2016) report, *M. pauli-guilielmi* occurs as three distinct sub-populations along approximately 2.8 km of the project area from Chainage (Ch) 159700 m to Ch 156900 m (BAAM, 2016, in Appendix A). No additional *M. pauli-guilielmi* were identified within the survey area during the July 2016 flora surveys.

In this regard, the extent of occurrence provided in Table 5 has been based on the *M. pauli-guilielmi* data provided in BAAM's *Detailed Terrestrial Flora Surveys* (2016) report.

Table 5 Extent of occurrence of *Macrozamia pauli-guilielmi* (pineapple zamia) within the survey area and project area

Sub-population	Map ID (refer to Appendix C)	Location	Extent of occurrence (ha)	
			Survey area	Project area
1	1	Lot 889 on CP864404	3.07	-
2	2	Lot 4 on MPH23906	13.33	6.01
		Lot 1 on MPH23906		
3	3	Lot 700 on FTY1491 Curra State Forest	4.26	2.30
		Total	**20.66**	**8.31**

Based on the results of the survey effort undertaken by BAAM in early 2016, *M. pauli-guilielmi* was identified as having a total extent of occurrence of 8.31 ha within the project area.

Marsdenia coronata (slender milkvine)

The results of the recently completed flora surveys have been combined with data provided by BAAM (2016) to determine the total extent of occurrence of *M. coronata* within the survey area and project area, with the results presented in Table 6.

Table 6 Extent of occurrence of *Marsdenia coronata* (slender milkvine) within the survey area and project area

Site ID (refer to Appendix C)	Location	Extent of occurrence (ha)	
		Survey area	Project area
4	Curra State Forest Lot 700 on FTY1491	33.32	14.78
5		39.23	20.21

Site ID (refer to Appendix C)	Location	Extent of occurrence (ha)	
		Survey area	Project area
8		3.12	1.71
9		3.56	2.17
7	Lot 3 on MPH23816	42.98	26.69
	Lot 2 on MPH23816		
	Lot 1 on MPH23816		
	Lot 1 on MPH30794		
	Lot 4 on MPH23816		
	Lot 10 on RP212322		
	Lot 4 on MPH23906		
	Lot 2 on MPH14224		
	Lot 4 on MPH14224		
	Lot 1 on MPH11890		
	Lot 5 on MPH14224		
	Lot 1 on MPH7001		
6	Woondum State Forest Lot 983 on FTY1488	11.23	4.31
	Total	**133.44**	**69.87**

Based on the results of the survey effort undertaken by BAAM in early 2016 and the GHD surveys in July 2016, *M. coronata* was identified as having a total extent of occurrence of 69.87 ha within the project area.

4. Threatened ecological community field assessment results

4.1 General

The previous flora surveys identified two locations where the vegetation communities were similar to the Lowlands Rainforest of Subtropical Australia TEC. The vegetation communities are located at Six Mile Creek and within Woondum State Forest.

4.2 Six Mile Creek

The riparian vegetation within the survey area along Six Mile Creek was assessed in 2011 and the results are presented in Addendum 1 of BAAM's *Detailed Terrestrial Flora Surveys* (2016) report. The outcomes of the assessment provided in Table A1.2 of BAAM's *Detailed Terrestrial Flora Surveys* (2016) report identified that although the vegetation community meets the key diagnostic characteristics of the Lowland Rainforest of Subtropical Australia TEC, the vegetation community fails to meet the condition thresholds of the Lowland Rainforest of Subtropical Australia TEC due to low species richness (only 20 woody species from Appendix A of the listing advice were identified).

A more extensive survey of the riparian vegetation along Six Mile Creek was undertaken by GHD in July 2016. The assessment was undertaken along Six Mile Creek from the North Coast railway line in the north to where Six Mile Creek intersects the existing Bruce Highway (refer to Appendix E) and comprises an area of approximately 10 ha. During the flora survey, a total of 45 species from Appendix A of the TEC listing advice were identified as present. Appendix E contains a list of species identified during the assessment of the riparian vegetation along Six Mile Creek that are listed in Appendix A of the TEC listing advice.

At intermittent locations within the TEC, the vegetation along Six Mile Creek was observed to be highly impacted by the declared pest species *Macfadyena unguis-cati* (cats claw creeper), while the balance of the TEC within the area surveyed is also impacted by *M. unguis-cati* but to a lesser extent (refer to Plate 2).

Plate 2 TEC impacted by *Macfadyena unguis-cati* (cats claw creeper) along Six Mile Creek

The TEC along Six Mile Creek also contains areas with low density weeds and presents as a closed forest community in good condition (refer to Plate 3).

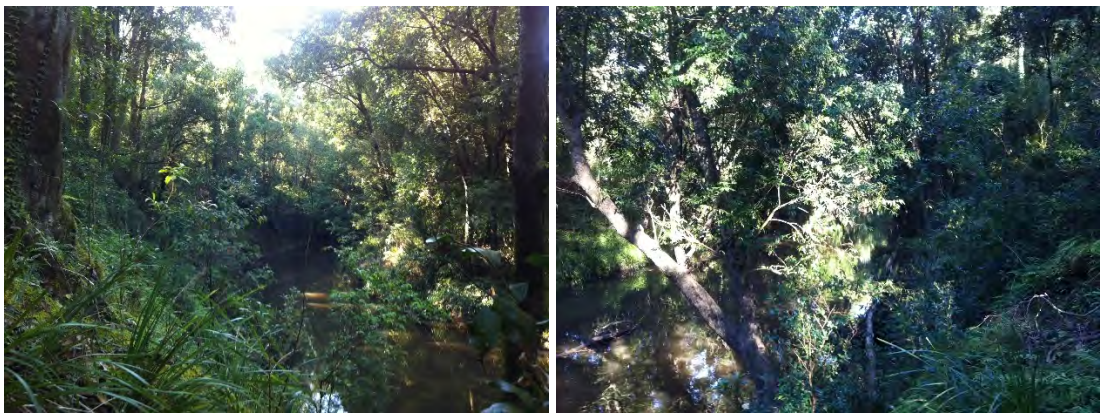

Plate 3 Closed forest community in good condition along Six Mile Creek

The amount of closed forest identified along Six Mile Creek from the existing Bruce Highway to the North Coast railway line has been calculated and is presented in Table 7.

Table 7 Extent of TEC along Six Mile Creek

	Six Mile Creek from Bruce Highway to North Coast railway line (ha)	Within Survey Area (ha)	Within Project Area (ha)
TEC	14.23	4.60	0.82
50 m buffer	29.77	9.14	4.67

An assessment against the key diagnostic characteristics is provided in Table 8 and assessment against the condition thresholds is provided in Table 9.

Table 8 Key diagnostic characteristics of the riparian vegetation along Six Mile Creek

Key diagnostic characteristics	Riparian vegetation along Six Mile Creek	Conformance with characteristics
Distribution of the ecological community is primarily in the NSW North Coast and South Eastern Queensland bioregions.	The vegetation community occurs in the South Eastern Queensland bioregion	Conforms
The ecological community occurs on: soils derived from basalt or alluvium; or enriched rhyolitic soils; or basaltically enriched metasediments	The vegetation community occurs on alluvial soils.	Conforms
The ecological community generally occurs at an altitude less than 300 m above sea level.	Occurs at an altitude of 100 m	Conforms
The ecological community typically occurs in areas with high annual rainfall (>1,300 mm).	Occurs in an area with a mean annual rainfall of 1,126.9 mm (Gympie weather station (40093)).	Conforms – although an average rainfall of less than the key diagnostic characteristic, numerous years have rainfall higher

Key diagnostic characteristics	Riparian vegetation along Six Mile Creek	Conformance with characteristics
		than 1,300 mm.
The ecological community is typically more than 2 km inland from the coast.	Vegetation community occurs approximately 36 km inland from the coast.	Conforms
The structure of the ecological community is typically a tall (20 m – 30 m) closed forest, often with multiple canopy layers.	Vegetation community occurs as a tall closed forest with multiple tree layers.	Conforms
Patches of the ecological community typically have high species richness (at least 30 woody species from Appendix A).	The vegetation community has patches with high species richness, including > 30 woody species from Appendix A of the listing advice.	Conforms

As shown in Table 8, the riparian vegetation along Six Mile Creek conforms to the key diagnostic characteristics of the Lowland Rainforest of Subtropical Australia TEC.

Table 9 Condition thresholds of the riparian vegetation along Six Mile Creek

Condition thresholds		Conformance with condition threshold
Patch type (evidence of remnant vegetation and regeneration status)	Natural remnant evident by the persistence of mature residual trees from Appendix B of the listing advice. AND	Conforms – vegetation is remnant vegetation with persistent mature trees from Appendix B
Patch size (excludes buffer zone)	≥ 0.1 ha AND	Conforms – vegetation community is approximately 10 ha
Canopy cover (over entire patch)	Emergent/canopy/subcanopy cover is ≥ 70% AND	Conforms – projective foliage cover was assessed as greater than 70%
Species richness (over entire patch)	Contains ≥ 40 native woody species from Appendix A AND	Conforms – contains > 40 woody species from Appendix A
Percent of total vegetation cover that is native (use sample plot)	≥ 70% of vegetation is native	Conforms – although the vegetation community contains high density *M. unguis-cati*, total native vegetation cover is greater than 70%

As demonstrated in Table 9, although some areas of the riparian vegetation present within the area surveyed along Six Mile Creek contain high density *M. unguis-cati,* the overall vegetation polygon conforms to the condition thresholds of the Lowland Rainforest of Subtropical Australia TEC.

4.3 Woondum State Forest

An area of rainforest vegetation west of the project area at approximately Ch 136800 m within Woondum State Forest was previously identified as conforming to the key diagnostic characteristics of the Lowland Rainforest of Subtropical Australia TEC; however, upon assessment against the condition thresholds, the vegetation polygon did not conform to the condition thresholds as only 38 woody species from Appendix A of the listing criteria were identified (refer to BAAM's *Detailed Terrestrial Flora Surveys* (2016) report contained in Appendix A for the assessment).

Given that the entirety of the closed forest community polygon was not surveyed and the possibility of an additional two species being present (which would elevate the vegetation community to a TEC and therefore a matter of national environmental significance), a more extensive survey was undertaken in July 2016. The outcome of this assessment identified that a total of 45 species from Appendix A (with greater than 40 woody species) of the listing advice are present within this closed forest vegetation polygon. The location of the closed forest vegetation polygon is shown in Appendix E and comprises an area of approximately 1 ha. Appendix F contains a list of species identified during the assessment of the closed forest vegetation polygon within Woondum State Forest that are listed on Appendix A of the TEC listing advice.

The area of closed forest community identified in Woondum State Forest comprises 1.42 hectares. The areas of the Lowland Rainforest of Subtropical Australia TEC at Woondum State Forest have been calculated with respect to the survey area and project area and are presented in Table 10.

Table 10 Extent of TEC in Woondum State Forest

	Total Extent of TEC in Woondum State Forest	Within Survey Area (ha)	Within Project Area (ha)
TEC	1.42	0.64	0
50 m buffer	3.56	2.27	0.52

As additional species were identified during the July 2016 flora survey, an updated assessment against the key diagnostic characteristics is provided in Table 11 and assessment against the condition thresholds is provided in Table 12.

Table 11 Key diagnostic characteristics of the vegetation polygon within Woondum State Forest

Key diagnostic characteristics	Riparian vegetation along Six Mile Creek	Conformance with characteristics
Distribution of the ecological community is primarily in the NSW North Coast and South Eastern Queensland bioregions.	The vegetation community occurs in the South Eastern Queensland bioregion	Conforms
The ecological community	The vegetation community	Conforms

Key diagnostic characteristics	Riparian vegetation along Six Mile Creek	Conformance with characteristics
occurs on: soils derived from basalt or alluvium; or enriched rhyolitic soils; or basaltically enriched metasediments	occurs on alluvial soils.	
The ecological community generally occurs at an altitude less than 300 m above sea level.	Occurs at an altitude of 100 m	Conforms
The ecological community typically occurs in areas with high annual rainfall (>1,300 mm).	Occurs in an area with a mean annual rainfall of 1,126.9 mm (Gympie weather station 40093).	Conforms
The ecological community is typically more than 2 km inland from the coast.	Vegetation community occurs approximately 36 km inland from the coast.	Conforms
The structure of the ecological community is typically a tall (20 m – 30 m) closed forest, often with multiple canopy layers.	Vegetation community occurs as a tall closed forest with multiple tree layers.	Conforms
Patches of the ecological community typically have high species richness (at least 30 woody species from Appendix A).	The vegetation community has patches with high species richness, including > 30 woody species from Appendix A of the listing advice.	Conforms

As detailed in Table 11, the rainforest community vegetation within Woondum State Forest conforms to the key diagnostic characteristics of the Lowland Rainforest of Subtropical Australia TEC.

Table 12 Condition thresholds of the vegetation polygon within Woondum State Forest

Condition thresholds		Conformance with condition threshold
Patch type (evidence of remnant vegetation and regeneration status)	Natural remnant evident by the persistence of mature residual trees from Appendix B of the listing advice. AND	Conforms – vegetation is remnant vegetation with persistent mature trees from Appendix B
Patch size (excludes buffer	≥ 0.1 ha	Conforms – vegetation community is approximately

Condition thresholds		Conformance with condition threshold
zone)	AND	1 ha
Canopy cover (over entire patch)	Emergent/canopy/subcanopy cover is ≥ 70% AND	Conforms – projective foliage cover was assessed as greater than 70%
Species richness (over entire patch)	Contains ≥ 40 native woody species from Appendix A AND	Conforms – contains > 40 woody species from Appendix A
Percent of total vegetation cover that is native (use sample plot)	≥ 70% of vegetation is native	Conforms – weeds were present only in low densities

As demonstrated in Table 12, the closed forest vegetation present within Woondum State Forest conforms to the key diagnostic characteristics and condition thresholds of the Lowland Rainforest of Subtropical Australia TEC.

The Lowland Rainforest of Subtropical Australia TECs at Six Mile Creek and Woondum State Forest are considered to be matters of national environmental significance and are to be included in the referral documentation submitted to the Commonwealth government under the EPBC Act.

5. Impacts and mitigation

5.1 General

Construction dates for the project are currently unknown as funding for the project has not been formally secured. During the Construction phase of the project, the project area will be made available to the construction contractor to be cleared. In the absence of mitigation measures, this will result in direct impacts to *M. pauli-guilielmi* and *M. coronata*. The anticipated impacts and proposed mitigation measures to these two species are discussed in the following sections. In addition to the species specific mitigation measures developed for the project, the following general management measures will be implemented during the Construction phase of works to minimise impacts to native flora and potential habitat for EVNT flora species:

- Clearing of vegetation will be minimised, as far as practicable by designating a works area which avoids encroachment into adjoining areas of remnant vegetation
- Weed management activities will be undertaken to avoid the spread of weeds in the project area or the introduction of new weed species
- Any existing cleared areas are to be utilised to the greatest extent possible for ancillary activities (e.g. site buildings and stockpiles) and potential impacts managed using appropriate dust, erosion and sediment control
- A project-specific erosion and sediment control plan shall be prepared by the construction contractor for the Construction phase of the project
- Appropriate management of dust and emissions will occur in accordance with strategies identified by the Environmental Management Plan (Construction) to be prepared by the construction contractor
- Rehabilitation and revegetation of exposed surfaces is to be undertaken sequentially during the Construction phase

5.2 Impacts

5.2.1 Protected plants

The Construction phase of the project will require vegetation clearing within the project area which has the potential to result in direct impacts to all *M. pauli-guilielmi* and *M. coronata* identified within this report. Based on the outcomes of the flora surveys undertaken by BAAM in 2016 and GHD in 2016, this would result in a loss of approximately 48 adults and 167 seedlings of *M. pauli-guilielmi* with an extent of occurrence of 8.31 ha within the project area and 334 adults and 531 seedlings of *M. coronata* with an extent of occurrence of 69.87 ha within the project area.

5.2.2 Threatened ecological community

A bridge is proposed over Six Mile Creek which will require the removal of 0.82 ha of the TEC present along the northern bank of Six Mile Creek at this location. A total of 4.67 ha of the TEC 50 m buffer area will be impacted on the southern bank of Six Mile Creek at the location of the bridge crossing.

The highway upgrade works will impact upon the Roadcraft driver training facility currently operating north of Six Mile Creek on Lot 412 on MCH5139, Lot 410 on MCH4680 and Lot 401 on MCH5139. As part of the resumption process, the driver training facility will be relocated within Lot 412 on MCH5139 and Lot 410 on MCH4680.

5.3 Mitigation measures

A number of general mitigation measures have been adopted at the Detailed Design phase of the project to minimise clearing requirements (as detailed in Section 5.1). Mitigation measures to assist in conserving *M. pauli-guilielmi* and *M. coronata* and maximise the potential of these species' survival in the wild involve limiting the extent of clearing and offsetting any residual impact.

In order to achieve a no net-loss of *M. pauli-guilielmi*, all individuals within the project area and individuals whose sub-populations will be fragmented are proposed to be translocated to suitable habitat. This will be completed in accordance with a Translocation Management Plan developed for the project and includes provisions for weed management, replacement of failed treatments, seed dispersal and securing the offset site from future clearing.

In order to achieve a no net-loss of *M. coronata*, a land based offset is being proposed to secure suitable *M. coronata* habitat. A propagation program will be developed in conjunction with a local native plant nursery, with preference given to nurseries that have previously had success in propagating *M. coronata,* and the propagated individuals will be planted at an offset site to be secured from future clearing. Local nurseries have previously had success in propagating *M. coronata* from salvaged individuals and success in planting these individuals in offset sites. The mitigation measures proposed for *M. coronata* will be included in the Impact Management Plan developed for the project which will include provisions for offsetting.

6. Conclusion

Flora assessments of the Bruce Highway Cooroy to Curra (Section D: Woondum to Curra) survey area have been undertaken over a number of surveys to determine the presence of conservation significant flora species that may potentially be impacted by the project. The results of the various flora surveys are presented in this report and in BAAM's *Detailed Terrestrial Flora Surveys* (2016) report included as Appendix A.

This report presents the combined survey effort and results of the flora surveys as well as documenting how the flora surveys achieve compliance with the Guidelines. Table 13 provides a summary of how the flora surveys meet the requirements of the Guidelines.

Table 13 Comparison of flora survey with requirements of the *Flora Survey Guidelines – Protected Plants 2014*

Key requirements of the *Flora Survey Guidelines – Protected Plants*	Limitations of this assessment	Justification
Flora surveys to be co-ordinated and led by a suitably qualified person.	No limitations or deviations were identified with regard to the use of suitably qualified personnel.	The flora survey was co-ordinated and led by suitably qualified persons who all have appropriate qualifications and training together with a minimum of five years' experience in undertaking EVNT flora surveys. For further details of technical lead refer to Section 2.2 of this report and Section 3.2 of Appendix A.
The survey must be conducted at the most appropriate time of year to maximise the chance of detecting the EVNT species.	No limitations with regard to the timing of the flora survey were identified.	The majority of the target species are long-lived perennial species that can be confidently identified based on vegetative features. One species identified by BAAM (2016) as potentially present within the survey area, *Pterostylis chaetophora,* is a cryptic ground orchid which flowers from August to September. A flora survey at the end of July was deemed appropriate to maximise the likelihood of encountering all target species, even though this species was not considered to be likely to occur within the survey area.
The flora survey needs to assess the area to be cleared as well as a buffer area of 100 m around the clearing.	No limitations with regard to the 100 m buffer were identified.	Meanders were completed across all habitat types within the area proposed for clearing together with the surrounding buffer.
The timed meander survey method is the preferred approach for detection of EVNT species.	No limitations with regard to the method of the flora survey were identified.	Timed random meander surveys were undertaken in accordance with the Guidelines in High Risk Areas as well as in areas mapped as 'known habitat' and 'potential habitat'.
If an EVNT plant species is recorded during the survey, a more comprehensive survey is required in order to collect data concerning the EVNT population and its habitat.	Not applicable.	One EVNT species (*M. coronata*) was recorded during the July 2016 flora survey in a High Risk Area while the *M. pauli-guilielmi* was identified by BAAM in a High Risk Area. A plot based assessment was undertaken for the *M. coronata*; with the results presented in Section 3.2.3. The habitat within which the *M. pauli-guilielmi* was identified is presented in BAAM's 2016 report.

7. Works cited

BAAM, 2015. *Bruce Highway Upgrade Section D: Baseline Ecological Assessment Woondum Road to Curra.* Biodiversity Assessment and Management Pty Ltd. Cleveland.

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Appendices