Inland Rail North Star to NSW/QLD Border

Appendix B – Terrestrial Biodiversity Technical Report

Australian Rail Track Corporation

Reference: 2700

Document Number:
2-0001-270-EAP-10-RP-0401

Revision: 10

Document control record

Document prepared by:

Future Freight Joint Venture
Level 8, 540 Wickham Street
Fortitude Valley QLD 4006
PO Box 1307
Fortitude Valley QLD 4006
Australia

T +61 7 3553 2000
F +61 7 3553 2050

A person using Future Freight Joint Venture documents or data accepts the risk of:

a) Using the documents or data in electronic form without requesting and checking them for accuracy against the original hard copy version.

b) Using the documents or data for any purpose not agreed to in writing by Future Freight Joint Venture.

Document control						
Report title		Appendix B – Terrestrial Biodiversity Technical Report				
Document ID		2-0001-270-EAP-10-RP-0401		**Project number**		2700
Projectwise Link		**pw:\\designshare.au.aurecon.info:PWZ_DS_AUDC1_P_01\Documents\FFJV Inland Rail Phase 2\5 Environment_EIS Documents\270 NS2B\2-0001-270-EAP-10-RP-0401**				
Client		Australian Rail Track Corporation				
Client contact				**Client reference**		
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
0	2 April 2020	Final Issue	S Glauert O Robertson	C Schell		R Dela Pena
1	1 May 2020	Assessment clarification	S Glauert O Robertson	C Schell		R Dela Pena
2	27 July 2020	Revised Final Issue	S Glauert O Robertson	C Schell		R Dela Pena
3	24 August 2020	Revised Final Issue	S Glauert O Robertson	C Schell		R Dela Pena
4	19 March 2021	Revised Final Issue	S Glauert B Taylor	D Adshead		R Dela Pena
5	13 May 2021	Revised Final Issue	S Glauert	D Adshead		R Dela Pena
6	31 May 2021	Revised Final Issue	S Glauert L Stephen	D Adshead		R Dela Pena
7	16 July 2021	Revised Final Issue	S Glauert	D Adshead		R Dela Pena
8	24 August 2021	Revised Final Issue	S Glauert	D Adshead		R Dela Pena
9	18 October 2021	Revised Final Issue	S Glauert	D Adshead		R Dela Pena
10	20 October 2021	Revised Final Issue	S Glauert L Stephen	D Adshead		R Dela Pena
Current revision		**10**				

Contents

1 Introduction 1

1.1 Overview 1

1.1.1 Inland Rail and the proposal 1
1.1.2 Purpose and scope of this report 1
1.1.3 Commonwealth matters (EPBC Act) 2
1.1.4 Structure of this report 3

1.2 The proposal 4

1.2.1 Key features of the proposal 4
1.2.2 Permanent footprint 21
1.2.3 Temporary construction footprint 21
1.2.4 New track 21
1.2.5 Borrow pits 22
1.2.6 Crossing loop 22
1.2.7 Bridges 23
1.2.8 Macintyre River viaduct 23
1.2.9 Culverts 23
1.2.10 Road rail interfaces 24
1.2.11 Road realignments 24
1.2.12 Earthworks 25
1.2.13 Fencing and signage 25

1.3 Construction overview 25

1.3.1 Site establishment and enabling works 26
1.3.2 Main construction works 27
1.3.3 Earthworks 27
1.3.4 Track work 28
1.3.5 Drainage works – culverts 28
1.3.6 Drainage works – track drainage 28
1.3.7 Bridge works 29
1.3.8 Road works 29
1.3.9 Testing and commissioning 30
1.3.10 Reinstatement 30

1.4 Operation 30

1.4.1 Maintenance of the proposal 31

2 Legislative context 32

2.1 Commonwealth and State legislation 32

3 Methods 38

3.1 Overview of assessment methodologies 38

3.1.1 Biodiversity Assessment Method 38
3.1.2 Cumulative impact assessment 42

3.2 Desktop assessment 50

3.2.1 Database review and background research 50
3.2.2 Directory of Important Wetlands 51
3.2.3 Groundwater dependent ecosystems 51
3.2.4 Landscape features and context 51

3.3 Consultation with government agencies 52

3.4 Terrestrial flora surveys 54
3.4.1 Mapping and identification of Plant Community Types and Managed land 54
3.4.2 Identification of vegetation zones for minimum plot requirements 56
3.4.3 Assessing the patch size for a vegetation zone 56
3.4.4 Vegetation integrity plots (site condition) 57
3.4.5 Vegetation integrity survey plots 57
3.4.6 Targeted flora survey methods 59
3.4.7 Threatened ecological community assessment 59
3.4.8 Threatened flora survey planning 75
3.5 Terrestrial fauna surveys 76
3.5.1 Overview 76
3.5.2 Fauna habitat assessments 77
3.5.3 Targeted surveys 78
3.5.4 Fauna survey methods 85
3.6 Survey effort, weather and limitations 86
3.6.1 Survey effort and timing 86
3.6.2 Weather 87
3.7 Species polygon mapping for threatened species 105
3.8 Permits to conduct works 105
3.9 Quality assurance/quality control 105
3.10 Nomenclature 106
3.10.1 Flora 106
3.10.2 Fauna 106
3.11 Assumptions and limitations 106
3.12 Personnel - Accredited Assessors under the Biodiversity Assessment Method 107

4 Landscape context 109
4.1 Land use, Bioregions and Sub-regions 109
4.2 Vegetation - threatened ecological communities 110
4.3 Soils and geology 111
4.3.1 Alignment segments 111
4.3.2 Borrow pits 112
4.4 Other matters of state environmental significance 113
4.4.1 Protected areas 113
4.4.2 Critical habitat 113
4.4.3 Results of aquatic ecology desktop assessment 113
4.4.4 Threatened aquatic species and communities 114
4.4.5 Wetlands of International Importance 114
4.4.6 Waterfront Land 114
4.4.7 Groundwater dependent ecosystems 114

5 Native vegetation 116
5.1 Overview 116
5.1.1 Flora species observed 116
5.2 Plant Community Types 116
5.2.1 Vegetation profiles 141
5.2.2 Number of Biodiversity Assessment Methodology plots required for assessment 155
5.2.3 Threatened ecological communities (BC Act) 157
5.2.4 Managed land 157
5.2.5 Weeds – high threat exotics 158

6 Threatened species 160
6.1 Ecosystem – credit species 160
6.1.1 Predicted species 160
6.1.2 Observed species 165
6.2 Species – credit species 179
6.2.1 Threatened species predicted to occur under the BAM 179
6.2.2 Observed species 179
6.2.3 Candidate threatened species (species credit entries) 181
6.2.4 Species habitat polygons 196
6.3 Threatened flora survey records 203
6.4 Threatened fauna survey records 203
6.5 Pest fauna species survey records 204

7 Matters of national environmental significance 205
7.1 Threatened ecological communities 205
7.2 Threatened species 206
7.2.1 Threatened flora 206
7.2.2 Threatened fauna 208
7.2.3 Other matters of national environmental significance 211

8 Potential impacts and impact mitigation 212
8.1 Introduction 212
8.2 Proposal activities 212
8.3 Nature of impacts 214
8.3.1 Habitat loss and degradation from vegetation clearing/removal 214
8.3.2 Fauna species injury or mortality 214
8.3.3 Reduction in biological viability of soil to support plant growth due to soil compaction 215
8.3.4 Displacement of flora and fauna species from invasion of weed and pest species 216
8.3.5 Reduction in the connectivity of biodiversity corridors 217
8.3.6 Edge effects 217
8.3.7 Habitat fragmentation 218
8.3.8 Barrier effects 218
8.3.9 Noise, dust and light impacts 219
8.3.10 Increase in litter (waste) 219
8.3.11 Erosion and sedimentation 220
8.3.12 Changes to hydrology and flooding 220
8.3.13 Disturbance to specialists breeding and foraging habitat 222
8.3.14 Trampling of threatened species 223
8.3.15 Fallen timber and bush rock collection or removal 223
8.3.16 Fertiliser drift 223
8.3.17 Increased bushfire risk 224
8.4 Potential impact to fauna species-credit species which have been identified within the subject land 224
8.4.1 Squirrel glider 224
8.4.2 Koala 225
8.4.3 Pale-headed Snake 225
8.5 Groundwater dependent ecosystems 226
8.6 Impact mitigation 226
8.6.1 Avoidance options 226
8.6.2 Design considerations 229

8.6.3 Mitigation measures 230

9 Impact assessment under Biodiversity Assessment Methodology 236

9.1 Impact assessment 236

9.1.1 Impacts not triggering further assessment 236

9.1.2 Plant Community Types and threatened species requiring offset 237

9.2 Serious and irreversible impacts 246

9.2.1 Threatened Ecological Community 247

9.3 Prescribed biodiversity impacts 253

9.4 Key threatening processes 257

10 Significant Impact Assessment – Matters of National Environmental Significance 261

10.1 Introduction 261

10.2 Significant Impact Assessment 261

10.2.1 Magnitude of impacts 261

10.2.2 Sensitivity 262

10.2.3 Significance of impact 263

10.3 Summary of impacts on matters of national environmental significance assessed under Biodiversity Assessment Methodology 264

10.4 Identification of ecological values and MNES receptors and initial impact assessment 267

10.4.1 Ecological values 267

10.4.2 Ecological receptors 267

10.5 Quantification of the magnitude of potential environmental impact to identified matters of national environmental significance 268

10.6 Initial significance of potential impacts 268

10.7 Significant Impact Assessment – MNES Guidelines 272

10.7.1 Vulnerable species 276

10.7.2 Endangered and critically endangered ecological communities 291

11 Cumulative impact assessment 296

12 Biodiversity offsets 311

12.1 Biodiversity credit report 311

13 Evaluation and conclusion 321

14 References 324

Appendices

Appendix A

Flora and Supplementary Site Maps

Appendix B

Flora data

Appendix C

EPBC and BC – TEC criteria and thresholds

Appendix D

Fauna data

Appendix E

Desktop search results

Appendix F

Fauna maps

Appendix G

BAM credits - species profiles

Appendix H

Biodiversity Assessment Method Credit Reports

Figures

Figure 1.1a-p Site map
Figure 1.2 Construction staging
Figure 1.3 Indicative construction timing
Figure 3.1 Biodiversity Assessment Method approach
Figure 3.2 Cumulative impact projects
Figure 3.3 Standard plot layout to be used for site assessment
Figure 3.4a-o Location of PCTs and BAM plots
Figure 3.5a-n Location of targeted fauna assessments
Figure 5.1a-u Location of PCTs and vegetation zones
Figure 6.1a-m Location of ecosystem-credit species within the study area
Figure 6.2 Location of species-credit species within the study area

Tables

Table 1.1 Key features of the proposal
Table 1.2 Proposed bridges
Table 1.3 Summary of proposed road works
Table 2.1 Legislation, policies, standards and guidelines relevant to the proposal
Table 3.1 Assessment methodologies with corresponding legislation and relevant ecological receptors
Table 3.2 Checklist indicating compliance with Biodiversity Assessment Method and location of information
Table 3.3 Projects to be included in cumulative assessment
Table 3.4 Assessment matrix
Table 3.5 Impact significance
Table 3.6 Proposal related assessments and reports
Table 3.7 Consultation with government agencies
Table 3.8 Base shapefile to begin categorisation of land
Table 3.9 Attributes measured to assess composition, structure and function
Table 3.10 Required number of survey plots per vegetation zone
Table 3.11 Targeted threatened flora species during January 2021 surveys
Table 3.12 Targeted species survey methodology, location and effort
Table 3.13 Daily and monthly temperature and rainfall observations during survey
Table 3.14 Qualifications and experience of person involved with preparation of the report
Table 4.1 Landscape features
Table 4.2 Plant Community Types and analogous TECs (BC Act) identified from the State Vegetation Type Map
Table 4.3 Soil classification and potential qualitative risk of borrow pits
Table 4.4 Summary of terrestrial groundwater dependent ecosystems
Table 5.1 Plant community types and TECs, broad condition classes (PCTs) and area of impact
Table 5.2 Plant Community Type area and number of BAM plots required within the alignment segments
Table 5.3 Plant Community Type area and number of BAM plots required within each Borrow pit
Table 5.4 Hight Threat Exotic species identified within the subject land

Table 6.1 Ecosystem-credit species predicted to occur under BAM C within the subject land
Table 6.2 Ecosystem Credit Species exclusions based on habitat assumptions
Table 6.3 Species-credit species predicted to occur by BAM C within the subject land
Table 6.4 Species credit species PCT exclusions following targeted survey
Table 6.5 Species Credit Species exclusions based on habitat assumptions
Table 6.6 Polygon mapping for Species Credit Species and their related PCT zones within the alignment segments
Table 6.7 Polygon mapping for Species Credit Species and their related PCT zones within the Borrow pits
Table 6.8 Species-credit species recorded or assumed present within the subject land
Table 6.9 Threatened and migratory species observed within the study area and adjacent area
Table 6.10 Threatened and migratory species observed within the study area and adjacent area
Table 7.1 Threatened ecological communities (EPBC Act) identified within the Proposal
Table 7.2 Threatened flora species listed under the EPBC Act identified from database searches
Table 7.3 Threatened fauna species listed under the EPBC Act identified from database searches
Table 8.1 Description of proposal related activities associated with construction, commissioning and reinstatement and operation phases
Table 8.2 Flood impact objectives and outcomes
Table 8.3 Reductions in disturbance area – EIS and post EIS
Table 8.4 Initial mitigations of relevance to terrestrial ecology
Table 8.5 Proposed additional mitigation measures
Table 9.1 Plant Community Types requiring offset and the total ecosystem credits required within the Rail Alignment segments
Table 9.2 Plant Community Types requiring offset and the total ecosystem credits required within Borrow pits
Table 9.3 BAM plots which were not used with the BAM-C and reason
Table 9.4 Locations where benchmark data was used within the BAM-C
Table 9.5 Species-credit species requiring offset for works within the alignment segments and the number of species credits required
Table 9.6 Species-credit species requiring offset for works within borrow pits - species credits required and impact area (ha)
Table 9.7 Scattered paddock tree assessment results
Table 9.8 PCT area in each IBRA, IBRA subregion, 1000 ha and 10 000 ha radius as required under the BAM
Table 9.9 The area and condition of the TEC to be impacted
Table 9.10 PCT area in each IBRA, IBRA subregion, 1,000 ha and 10,000 ha radius as required under the BAM
Table 9.11 Prescribed biodiversity impacts on native vegetation
Table 9.12 Prescribed biodiversity impacts on threatened species
Table 9.13 Key threatening processes and their applicability to the proposal
Table 10.1 Criteria for magnitude
Table 10.2 Timeframes for duration terms
Table 10.3 Sensitivity criteria for ecological receptors within the subject land
Table 10.4 Significance assessment matrix
Table 10.5 Significance classifications
Table 10.6 Like-for-like offsets within the Biodiversity Assessment Method
Table 10.7 EPBC Act listed ecological receptors assessed by the Significant Impact Assessment Methodology
Table 10.8 Estimation of potential magnitude of disturbance for each of the ecological receptors identified for the proposal
Table 10.9 Initial significance impact assessment of the proposal upon identified MNES
Table 10.10 MNES listed in the SEARS and summary recommendation
Table 10.11 MNES listed in the PMST (Appendix E) and select other species, and summary recommendation

Table 10.12 Summary of the results of the significant impact assessment for matters of national environmental significance fauna species
Table 10.13 Assessment against the significant impact criteria: Murray cod
Table 10.14 Assessment against the significant impact criteria: Belson's Panic (*Homopholis belsonii*)
Table 10.15 Assessment against the significant impact criteria: Bluegrass (*Dichanthium setosum*)
Table 10.16 Assessment against the significant impact criteria: Five-clawed worm-skink (*Anomalopus mackayi*)
Table 10.17 Koala assessment tool
Table 10.18 Assessment against the significant impact criteria: Koala (*Phascolarctos cinereus*)
Table 10.19 Assessment against the significant impact criteria: Brigalow (*Acacia harpophylla* dominant and co dominant)
Table 10.20 Assessment against the significant impact criteria: Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland
Table 11.1 Magnitude rating and justification of cumulative impacts within the cumulative impact assessment area
Table 11.2 Significance assessment of cumulative impacts within the cumulative impact area
Table 12.1 Summary of all credits generated within the project segments
Table 12.2 All credits generated within the project Greenfield alignment segment
Table 12.3 All credits generated within the project Brownfield alignment segment
Table 12.4 All credits generated within the project Early works alignment segment
Table 12.5 All credits generated within the project Borrow pits segment

Abbreviations

Abbreviation	Explanation
AEP	Annual exceedance probability
AOI	Area of Influence
ARTC	Australian Rail Track Corporation Limited
AUSRIVAS	Australian River Assessment System
BAM	Biodiversity Assessment Method
BAM C	Biodiversity Assessment Method Calculator
BBS	Brigalow Belt South
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BCAR	Biodiversity Certificate Assessment Report
BCSD	Biodiversity, Conservation and Science Division (formerly OEH)
BOS	Biodiversity Offsets Scheme
BVT	Biometric Vegetation Type
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
Ch	Chainage
CMA	Catchment Management Authority Area
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height
DIWA	Directory of Important Wetlands in Australia
DNG	Derived Native Grassland
DotE	Commonwealth Department of the Environment (superseded)
DotEE	Commonwealth Department of the Environment and Energy (formerly DotE) (superseded)
DPI	Department of Primary Industries (DPI)
DPIE	Department of Planning, Industry and Environment (formerly OEH)
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (superseded)
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FFJV	Future Freight Joint Venture
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystems
GIS	Geographical Information System
ha	hectares
HTE	High Threat Exotic
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometres
km/hr	kilometres/hour
KMA	Koala Management Area

Abbreviation	Explanation
KTP	Key threatening process
LGA	Local Government Area
m	metre
MNES	Matters of National Environmental Significance
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NS2B	North Star to Border Project
NSW	New South Wales
NSW EES	New South Wales Environment, Energy and Science Group
NV Act	*Native Vegetation Act 2003* (NSW) (Repealed, superseded by the LLS Act and SEPP)
OEH	NSW Office of Environment and Heritage (Currently BCSD)
PCT	Plant Community Type
PMST	Protected Matters Search Tool
RDP	Rapid Data Points
SAII	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SMP	Site Management Plan
SSD	State Significant Development
SSI	State Significant Infrastructure
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995* (NSW) (Repealed, superseded by the BC Act)
TSPD	Threatened Species Profile Database
TSR	Travelling Stock Route
VEC	Vulnerable Ecological Community
VIS	Vegetation Information System
WoNS	Weed of National Significance

Glossary

Term	Explanation
Adverse impact	Adverse impacts are defined as those impacts that result in an unwanted and unanticipated result of taking a particular action. In an environmental context, an adverse impact means any change in the physical or biological conditions of the natural environment that results in a detrimental effect upon flora, fauna, air, water, minerals, or other natural characteristic of the area.
Assessment area	Includes the subject land and the area of land within the 1,500 m buffer zone surrounding the subject land (or 500 m buffer zone for linear proposals) that is determined as per Subsection 3.1.2 of the BAM.
BAM calculator (BAM C)	An online application of the BAM which uses the rules and calculations outlined in the BAM, and allows the used to apply the BAM at a site and observer the results of the assessment. Refer https://www.lmbc.nsw.gov.au/bamcalc.
Biodiversity	Biodiversity is the variety of all living things; the different plants, animals, micro-organisms, the genetic information they contain and the ecosystems they form.
Biodiversity assessment method (BAM)	A prescribed method for assessing vegetation community health and structure as outlined in Section 6 of the BC Act 2016, that provides a consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site, guidance on how a proponent can avoid and minimise potential biodiversity impacts, and the number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity.
Biodiversity Conservation Act 2016 status	The BC Act categorises threatened species and threatened ecological communities within NSW under one of four criteria: **Vulnerable** ■ Face a very high risk of extinction in NSW in the medium-term future **Endangered** ■ Face a very high risk of extinction in Australia in the near future **Critically endangered** ■ Facing an extremely high risk of extinction in Australia in the immediate future **Presumed extinct** ■ There is no reasonable doubt that the last member of the species in Australia has died
Bioregion	A bioregion as defined in An Interim Biographic Regionalisation of Australia (IBRA) (Thackway and Cresswell 1995).
Critical habitat	The whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community. Critical habitat is listed under the FM Act and/or the EPBC Act
Cumulative impacts	When numerous projects occur within a region they can cause cumulative impacts. Cumulative impacts: ■ May differ from those of an individual project when considered in isolation ■ May be positive or negative ■ Have a severity and duration that depends on the spatial and temporal overlap of projects occurring in a region.
Development footprint	The area of land that is directly impacted by a proposed development, including access roads and areas used to store construction materials. The term development footprint is also taken to include clearing footprint, except where the reference is to a small area development or a major project development.
Development site	An area of land that is subject to a proposed development under the EP&A Act. The term development site is also taken to include clearing site, except where the reference is to a small area development or a major project development.
Direct impacts	Impacts that result from a direct interaction between integral proposal activities and the ecological receptor (e.g. land clearing resulting in vegetation and habitat loss)
Ecological community	An ecological community is a naturally occurring group of native plants, animals and other organisms living in a unique habitat.
Ecological receptor	An ecological receptor is a feature, area or structure or grouping of the aforementioned that may be affected by direct or indirect changes to the environment.

Term	Explanation
Ecosystem credit	A measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT, and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values as a biodiversity stewardship site.
EPBC Act conservation status	Under the EPBC Act, listed species and threatened ecological communities are assigned a conservation status of extinct in the wild, critically endangered, endangered or vulnerable. Migratory species are also listed as Migratory. Definitions of these terms under the Act are as follows: **Extinct in the wild** ■ It is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range or, ■ It has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a timeframe appropriate to its lifecycle and form **Critically endangered** ■ It is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria **Endangered** ■ It is not critically endangered, and ■ It is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria **Vulnerable** ■ It is not critically endangered or endangered, and ■ It is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria **Migratory** Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. Examples of migratory species are species of birds (e.g. albatrosses and petrels), mammals (e.g. whales) or reptiles. Listed migratory species are those listed in the: ■ Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) ■ China-Australia Migratory Bird Agreement (CAMBA) ■ Japan-Australia Migratory Bird Agreement (JAMBA) ■ Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
Exempt land	Category 1 exempt land is land which is not subject to assessment under the LLS Act as per the Native vegetation regulatory map: method statement. OEH 2017a
Habitat	An area or areas permanently, periodically or occasionally occupied by a species, population or ecological community, including any and all biotic and abiotic features of the area or areas occupied
High constraint area	An area that support a relatively high number of ecological receptors and/or receptors with relatively high sensitivity, that is at risk from the proposal activity.
High threat exotic	A weed species which has been designated under NSW legislation (Biosecurity Act 2015) as high risk for input into the BAM C.
IBRA subregion	Are more localised and homogenous geomorphological units in each IBRA bioregion. This report covers IBRA subregions.
Indirect impacts	Impacts that are not a direct result of proposal activities but tend to occur away from the original impact area via a complex pathway (e.g. soil disturbance during construction promoting weed and/or pest invasion that reduces habitat quality). In accordance with the EPBC Act, indirect impacts may include the following: ■ Downstream or downwind impacts, such as impact on wetlands or ocean reefs from sediment, fertilisers or chemical which are washed or discharged into river systems ■ Upstream impacts such as impacts associated with the extraction of raw materials and other inputs which are used to undertake the action ■ Facilitated impacts which result from further actions (including actions by third parties) which are made possible or facilitated by the action.

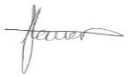
Term	Explanation
Key Threatening Process	A process or event which adversely affects threatened species, populations of a species or ecological community or it may cause species, populations of a species or ecological communities to become threatened i.e. invasion of weeds or cane toads.
Linear-shaped development	Development that is generally narrow and extends across the landscape.
Managed land	Managed land is land which meets the definition of Category 1 exempt land, but has not yet been mapped by the DIPE. This is land which is not subject to assessment under the LLS Act as per the Native vegetation regulatory map: method statement. OEH 2017a
Microchiropteran bats	This report uses the term Microchiropteran bats (microbats) to refer to small mostly insectivorous bats that use echolocation to navigate and find food. The microbats constitute the suborder Microchiroptera within the order Chiroptera.
Migratory	Species listed as migratory under the EPBC Act. Refer to definitions of EPBC Act conservation status, for meaning of migratory under the Act
Native vegetation (BC Act)	Native vegetation means any of the following types of plants native to New South Wales: ■ Trees (including any sapling or shrub or any scrub) ■ Understorey plants ■ Groundcover (being any type of herbaceous vegetation) ■ Plants occurring in a wetland. Native vegetation extends to any plant (both living and dead) that is endemic to NSW regardless of it's location.
Negative impact	An impact that is considered to result in an unfavourable or adverse change to an ecological receptor.
Patch	A patch is an area of native vegetation within the subject land that: a) Occurs on the subject land, and b) Includes native vegetation that has a gap of less than 100 m from the next area of moderate to good condition native vegetation (≤ 30 m for non-woody ecosystems). Where vegetation does not meet this requirement (e.g. low-quality vegetation) a patch is not recorded. A patch may extend onto neighbouring land that is not part of the subject land. It is used as a filter to predict if threatened species are likely to occur or use habitat within the subject land.
Permanent impact	The impact will last longer than 21 years
Plant community type (BC Act)	Is a vegetation classification system which classify plant community types on the basis of inherent attributes and characteristics of the vegetation structure, growth form and plant species. It is not restricted to a geographical region or vegetation condition
Prescribed impact	As defined by the Biodiversity assessment method (BAM), 'prescribed impact' means the prescribed impacts identified in clause 6.1 of the BC Regulation. Prescribed impacts can be direct or indirect impacts.
Proposal	The amount and area of works being proposed to occur
Segmented	In this report the term 'segmented' (also segment) has been used as a proxy for 'staged', in the context of credits and offset obligations
Serious and irreversible impact (SAII)	The BC Regulation defines a SAII as: An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because: ■ It will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline ■ It will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size ■ It is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution ■ The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable (refer BAM).

Term	Explanation
Significant impact	In accordance with the EPBC Act, a significant impact is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.
Spatial extent	The scale of potential impacts used to determine the magnitude of impacts and defined by three qualitative categories i.e. widespread, regional and local
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Species Profile Database.
Species polygon	The area of the subject land within which a species is considered to be present is mapped and forms the species polygon for that species under the BAM
Study area	The area of land within a 500 m buffer of the linear disturbance footprint of the alignment (greenfield, brownfield and early works segments), and 1,500 m buffer around the disturbance footprint of the borrow pits. Study area has the same meaning as 'assessment area' referenced in the BAM.
Subject land	A term used in the BAM to define the disturbance footprint subject to assessment
Threatened ecological community	Threatened ecological communities (TECs), which include endangered ecological communities, are defined and listed under both the *NSW Biodiversity Conservation Act 2016* and EPBC Act 1999. In both cases the plant community types (PCTs) and TECs are different classifications that have been developed independently of each other.
Threatened species (NSW)	In NSW a species in considered threatened if a) there is a reduction in its populations size b) it has a restricted geographical distribution or c) there are few mature individuals. A species may be listed under the BC Act 2016 as: ▪ Vulnerable ▪ Endangered ▪ Critically endangered, or ▪ Presumed extinct. How threatened a species is in NSW depends on: ▪ The extent of its population reduction ▪ The size of its geographical distribution, or ▪ The number of mature individuals. Populations of a species and ecological communities can also be listed as threatened. Species and ecological communities listed under the EPBC Act are also recognised as threatened species in NSW.
Vegetation zone	Areas of the same PCT with the same broad condition state, mapped in accordance with Subsection 5.3.1 of the BAM.
Wetland	Wetlands are defined in NSW as areas of land covered or saturated with water. Wetlands can be covered with fresh, brackish or salt water that's generally still or slow moving. The water can also sit just below the surface. Many wetlands in inland NSW can be dry for 10 years or longer before being flooded after heavy rainfall and then stay wet for several years. This allows wetland plants and animals to regenerate and reproduce.

Executive summary

This report has been prepared by the following accredited assessor shown in Table 1.

Table 1 Accredited assessor

Person	BAM accreditation	Signature	Date
Sarah Glauert	BAAS17097		20 October 2021

This Terrestrial Biodiversity Technical Report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued 8 August 2018 (Application number SSI-9371). The structure and content of the report has been specifically designed to meet the requirements of the *Biodiversity Conservation Act 2016* (NSW) (BC Act) and has been prepared in accordance with the minimum requirements of the Biodiversity Assessment Method (BAM) so as to satisfy the requirements of a Biodiversity Development Assessment Report (BDAR). For ecological receptors outside of the jurisdiction of the BC Act, assessment pathways are consistent with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (terrestrial threatened flora and fauna species and threatened ecological communities) and other relevant regulatory provisions (refer Section 7). The purpose of this report is to gain primary approvals to allow the proposal to proceed.

To meet the certification requirements under Section 6.15 of the BC Act, this report has been prepared on the basis of the requirements of (and information provided under) the BAM, as current on the date this report was finalised on 19 March 2021. All sections of this report which relate specifically to the BAM and works associated with the proposal EIS have been completed or overseen by one or more of the following BAM accredited assessors:

- Sarah Glauert (BAM Assessor No. BAAS17097) (Primary assessor)
- Ben Roberts (BAM Assessor No. BAAS17023)
- Andrew Craig (BAM Assessor No. BAAS19022)
- Oliver Robertson (BAM Assessor No BAAS20007).

Other ecological consultants from the FFJV have undertaken work under the supervision of the BAM accredited assessors.

Table 2 Checklist indicating compliance with Biodiversity Assessment Method and location of information

BDAR reporting requirement as per Appendix 10 of the BAM	Location within this document
Introduction including operational and construction footprint	Section 1, Section 1.2.2 and Section 1.2.3
Site Map	Figure 1.1
Location Map	Figure 1.1
Identification of landscape features including IBRA bioregion and subregion identification	Section 4.1 and Appendix A
Native vegetation including class, type, area, and species relied on for PCT identification, TEC status, percent cleared value of PCT	Section 5, Section 5.2, Section 5.2.1, and Section 5.2.3
Map of PCTs, PCT zones, Patch size (to> 100ha) and plot locations	Figure 3.4 and Appendix A Map C.3
Map of TECs	Appendix A Map C.5
Field Plot data sheets	Appendix A and supplied to DPIE
Description of survey effort	Section 3.6, Appendix A, Appendix B, Appendix D and Appendix F
Vegetation integrity scores	Section 9 and Table 9.4
Candidate species	Section 6.2.3

BDAR reporting requirement as per Appendix 10 of the BAM	Location within this document
Table of ecosystem credit species and associated PCTs	Section 6.1 and Table 6.1
Justification for any exclusions of ecosystem credit species	Section 6.1 and Table 6.2
Table of species credit species, biodiversity risk rating and associated PCTs	Section 6.2 and Table 6.3
Justification for any exclusions of species credit species	Section 6.2, Table 6.4 and Table 6.5
Species credit species polygon maps	Section 6.2.4, Appendix A and Appendix F
Targeted survey effort	Section 3.6, Table 3.11, Table 3.12 and Appendix F
Table of species habitat features and abundance on site	Table 6.8
Demonstration of efforts to avoid and minimise impacts upon biodiversity values	Section 8
Table of measures to be implemented before, during and after construction	Table 8.4 and Table 8.5
Map of final project footprint including construction and operation segments	Figure 1.1
Identification of SAII	Section 9.2
Map of any SAII	Appendix A Map C.7 (flora) and Appendix F Map D.2 (fauna)
Identification of impacts requiring offset, impacts not requiring offset and areas not requiring assessment	Section 9.1.2
Map of impacts requiring offset	Appendix A Map C.6
Map of areas not requiring offset	Appendix A Map C.6
Map of area not requiring assessment	Appendix A Map C.6
Impact summary	Section 9 and Section 12
Overall summary table of ecosystem, species and scattered paddock tree credits required	Table 12.1
Summary table by each project segment of PCTs, scattered trees and threatened species requiring offset and the number of credits required	Table 12.2 to Table 12.5
Table of credit classes and matching credit profile	Table 9.4 and Table 9.5

ARTC propose to construct the North Star to Border (NS2B) section of Inland Rail ('the proposal'), which is a key component of the wider Inland Rail network between Melbourne and Brisbane. Key features of the proposal include 25 km of new track within the existing, non-operational Boggabilla rail corridor, approximately 5 km of new track within a greenfield rail corridor, one crossing loop, one maintenance siding and three associated turn outs. It will also involve the construction of 39 culvert locations and 11 bridge crossings, 63 rail crossing locations, and ancillary works. Ancillary facilities will include borrow pits and laydown areas temporarily required during the construction phase. The design response to key environmental features has been developed in line with engineering constraints for a feasible rail design. The rail design is based on avoiding and minimising environmental and social impacts, minimising disturbance to existing infrastructure and meeting engineering design criteria.

The subject land is situated within the New England North West region of NSW and traverses the Brigalow Belt South bioregion defined by the Interim Biogeographic Regionalisation for Australia (IBRA). The subject land has been significantly modified by agricultural land use, where the clearing of native vegetation has been extensive. Current dominant land cover types include exotic pasture grasslands, irrigated and dryland crops, and fallow fields. Large tracts of remnant vegetation are rare within the subject land, with the majority of remaining native vegetation occurring in small fragments, often in a highly degraded state. Some connectivity is provided by riparian vegetation along drainage lines.

Scope of this report

This BDAR presents the biodiversity data (flora and fauna) obtained between October 2018 and March 2021 and the outcomes of its associated assessment in accordance with State and Federal requirements. For completeness, the data contained within the BDAR submitted in support of the Environmental Impact Statement (EIS) (ARTC 2020) on 26 August 2020 has been retained within this version of the BDAR.

As a result of feedback obtained during the public exhibition and Departmental consideration of the EIS submitted BDAR, additional works have been completed between September 2020 and March 2021 including:

- Completion of flora and fauna surveys in September/October 2020 to provide field verification of species that had been assumed present within the EIS submitted BDAR in August 2020. These species are listed in Table 3.

Table 3 Flora species assessed in September/October 2020

Scientific name	Common name	BC Act status	EPBC Act status
Cyperus conicus	-	Endangered	-
Desmodium campylocaulon	Creeping tick-trefoil	Endangered	-
Dichanthium setosum	Bluegrass	Vulnerable	Vulnerable
Digitaria porrecta	Finger panic grass	Endangered	-
Homopholis belsoniii	Belson's panic	Endangered	Vulnerable
Lepidium aschersonii	Spiny peppercress	Vulnerable	Vulnerable
Lepidium monoplocoides	Winged peppercress	Endangered	Endangered
Phyllanthus maderaspatensis	-	Endangered	-
Platyzoma microphyllum	Braid fern	Endangered	-
Polygala linariifolia	Native milkwort	Endangered	-
Pomaderris queenslandica	Scant pomaderris	Endangered	-
Swainsona sericea	Silky Swainson-pea	Vulnerable	-
Tylophora linearis	-	Vulnerable	Endangered

- Completion of fauna surveys in February and again in March 2021 to provide field verification of species that had been assumed present (refer Table 4).

Table 4 Fauna species assessed in February and March 2021

Scientific name	Common name	BC Act status	EPBC Act status
Cercartetus nanus	Eastern pygmy possum	Vulnerable	-
Hoplocephalus bitorquatus	Pale-headed snake	Vulnerable	-
Jalmenus eubulus	Pale imperial hairstreak	Critically Endangered	-
Setirostris eleryi	Bristle-faced free-tailed bat	Endangered	-

- Optimisation of disturbance areas, in particular areas allocated for laydown areas and borrow pits. The purpose of this optimisation process is, as far as practical, to avoid disturbance of ecologically valuable ecological communities and demonstrate the proposal's commitment to the hierarchy of mitigations

Assumed presence has been selectively adopted in some locations where land access was not agreed with the property owner. Maps of areas not accessed are located within this report.

The information within the report is provided in segments to allow for offsetting to be delivered in a staged manner prior to impacts occurring. Works have been divided into the following segments:

- Brownfield alignment – this segment is approximately 25 km of new track within the existing, non-operational Boggabilla rail corridor from North Star north to approximately 3.8 km south of the Bruxner Way-Tucka Tucka Road intersection. North of this point it becomes the Greenfield segment to Queensland – New South Wales border on the Macintyre River.
- Greenfield alignment – this segment is approximately 5 km of new track within a greenfield rail corridor south-west from the Macintyre River to the Bruxner Way and new access tracks required to be retained during the project operation.
- Early works alignment – this segment is comprised of areas used during construction such as laydown areas, temporary accommodation and setup areas, and
- Borrow pits, with each potential borrow pit assigned a number (for example Borrow Pit 1) and impacts for each borrow pit considered discretely should it be required as part of the works.

These segments will be established initially as a larger temporary construction footprint which will be reduced to a smaller permanent footprint once operational.

All potential borrow pits have been included in this report though it is envisioned that not all borrow pits will be used. Therefore, not all credits within this report are expected to be required to be retired. This report has followed the precautionary principle and assumed the largest potential impact will occur (i.e. worst-case scenario). The location of each of these segments within the project area is provided in Figure 1.1 in Section 1.

The subject land provides habitat for seven TECs and 84 threatened species listed under the BC Act, including four TECs and 41 threatened species listed under the EPBC Act, as well as areas identified by the NSW Government as important environmental values. Species or communities that were listed after the proposal's controlled action decision (refer Section 1.1.3) are not required to be assessed within this report. This includes the Poplar box grassy woodland on alluvial plains TEC and the Grey falcon (*Falco hypoleucos*).

The proposal assessment framework has been designed to provide an objective approach to identifying the proposal's environmental constraints and potential impacts to ecological receptors.

Table 3 outlines the maximum possible impact areas associated with the project and credits required under BAM for BC Act listed ecological receptors, summarised into segments for offset purposes. The ecosystem and species credits identified in the table below are required for BC Act listed ecological receptors. Some of these ecological receptors are also listed under the EPBC Act. A detailed summary of the individual ecosystem and species credits associated with each segment is provided in Section 12.

It is important to note that not all borrow pits are likely to be activated for the project. However, in line with the precautionary principle and in order to show all possible impacts and cumulative effects this report assumes all borrow pits will be used throughout the development of this project.

Table 3 **Area of impact, impacted PCTs and Biodiversity Assessment Methodology summary credits required for each segment of the proposal**

Segments	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	PCTs impacted	Ecosystem credits	Species credits	Scattered tree credits
Alignment Greenfield (total)	38.04	1.64	39.68	36, 52, 192, 244, 247, 628	1,354	7,746	1
Alignment Brownfield	165.57	26.47	192.04	27,35,36,52, 53, 55, 56, 98, 244, 247, 628	4,297	7,671	-
Alignment Early works	54.89	59.03	113.92	27, 35, 36, 53, 56, 192, 628	1,398	1,962	-

Segments	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	PCTs impacted	Ecosystem credits	Species credits	Scattered tree credits
Borrow Pit 1	6.17	0.64	6.81	35, 147	152	375	-
Borrow Pit 2	13.57	1.27	14.84	35, 418	195	606	-
Borrow Pit 4	0	8.56	8.56	56	0	0	-
Borrow Pit 5	12.4	19.9	32.3	192	193	743	-
Borrow Pit 7	0.13	15.68	15.81	56	2	2	5
Borrow Pit 8	21.1	6.17	27.27	56	787	1572	-
Borrow Pit 9	7.9	4.7	12.6	418	137	368	-
Borrow Pit 13	0.57	11.04	11.61	98	12	0	-
Borrow Pit 25	3	19.6	22.6	418	40	32	-
Total	**323.3**	**174.7**	**498**	**27, 35, 36, 52, 53, 55, 56, 98, 147, 192, 244, 247, 418, 628**	**8,567**	**21,077**	**6**

Multiple terrestrial ecological receptors were identified within the subject land, and these were assessed under different methodologies dependent upon how they are regulated:

- Threatened species, TECs, and plant community types regulated under the BC Act were assessed under the BAM
- Threatened species and TECs regulated under the EPBC Act (including ecological receptors also regulated under the BC Act) were assessed in accordance with the SIAM, which considered ecological receptor sensitivity and the magnitude of potential related impacts upon the specific ecological receptor.

Informed by the outcomes of the desktop and field assessments, identification of potential impacts from proposal activities upon the receptors was undertaken as mentioned above.

Prescribed biodiversity impacts considered in accordance with the BC Regulation include the potential impacts on threatened species or ecological communities, connectivity of habitat, movement of threatened species to maintain their lifecycle, impacts on water quality and hydrology and potential vehicle strikes.

The construction and operation of the proposal has the potential to impact on receptors via the following mechanisms (predominantly associated with the construction phase):

- Habitat loss and degradation from vegetation clearing/removal
- Fauna species injury or mortality
- Reduction in biological viability of soil to support growth due to soil compaction
- Displacement of flora and fauna species by invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light impacts
- Increase in litter (waste)
- Erosion and sedimentation
- Disturbance to specialists breeding and foraging habitat
- Trampling of threatened species

- Fallen timber and bush rock collection and removal
- Fertiliser drift
- Increased fire risk.

Impact assessment under the BAM identified potential serious and irreversible impacts (SAII) for one Plant Community Type (PCT) as listed below:

- PCT 35 – Brigalow – Belah open forest/woodland known to occur – 17.51 ha.

Potential cumulative impacts of the proposal include:

- Habitat loss and degradation from vegetation clearing/removal
- Fauna species injury or mortality
- Reduction in biological viability of soil to support growth due to soil compaction
- Displacement of flora and fauna species by invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light impacts
- Increase in litter (waste)
- Erosion and sedimentation
- Flooding and hydrology changes
- Disturbance to specialists breeding and foraging habitat
- Trampling of threatened species
- Fallen timber and bush rock collection and removal
- Fertiliser drift
- Increased fire risk.

The significance of the predicted cumulative impacts as a result of the proposal and other similar projects are likely to be highest on the following ecological receptors:

- Threatened Ecological Communities listed under the EPBC Act and/or BC Act (6 TECs)
- Threatened flora and fauna listed under the EPBC Act and/or BC Act (85 species)
- The Great Artesian Basin protected under the EPBC Act.

There is the potential for some proposal activities to have an irreversible and/or permanent impact upon some ecological receptors, even after the implementation of all mitigation measures.

During the detailed design (post-EIS approval phase) of the proposal, sensitive ecological receptors identified during the EIS will be subject to further investigation to assess where impacts to these receptors may be reduced (through design refinement), and to confirm the final magnitude of the significant adverse residual impacts upon the identified ecological receptors. Reductions in impacts may require a BDAR modification to amend offset calculations under the BAM. The specific mitigation measures will then be applied to ensure that the significance ratings of any potential impacts are classified as low as reasonably practicable through mitigation and the unavoidable residual adverse impacts are offset. Specific mitigation measures include:

- Disturbance footprints are limited to that required to construct and operate the works
- Design is developed to minimise impacts to waterways, riparian vegetation and in-stream flora and habitats

- Fauna crossing opportunities will be co-located with waterway crossing structures to maintain habitat connectivity across the landscape
- Watercourse crossing structures (including culverts and bridges) are designed in accordance with design considerations for fish friendly waterway crossings within Australia
- Construction areas including compounds, stockpiles, fuel storage, laydown areas and staff parking should be defined outside the tree protection zone
- The total number of borrow pits required for the proposal will be revised from the total number of borrow `pits assessed in the BDAR. Where possible borrow pits will be preferentially selected/located to minimise biodiversity impacts.

As a result of the proposal, a total of up to 8,567 ecosystem, 6 scattered paddock tree and 21,077 species credits may require offsetting in accordance with the BAM guidelines a summary is provided in Table 4. Full details of each ecosystem and species credit required, broken down by segment, is provided in Section 12.

Table 4 Summary of credits required for each project segment

Segment	Ecosystem credits	Species credits	Scattered tree credits	Total credits
Greenfield	1,354	7,746	1	9,101
Brownfield	4,297	7,671	-	11,968
Early works	1,398	1,962	-	3,360
Borrow pits	1,518	3,698	5	5,221

In addition, offsets may also be required for ecological receptors listed under the EPBC Act that are predicted to be subject to significant residual impacts following the application of mitigation measures. Offsets under the EPBC Act will be amended following the detailed design phase.

A bilateral agreement has been signed between the Australian Government and NSW which means that offset obligations can be calculated in BAM credits for EPBC Act receptors also listed under the BC Act, however it is still the prerogative of the Australian Government not to accept the specific application of the offset. The Commonwealth Minister or a delegate will determine this on a case by case basis. Credits for species-credit species can compound for habitats that support multiple species-credit species and require offsets for each species. Alternatively, the significant adverse residual impacts to dual listed receptors may be offset under the EPBC Act.

1 Introduction

1.1 Overview

1.1.1 Inland Rail and the proposal

The Australian Government has committed to delivering Inland Rail, an interstate freight rail corridor between Melbourne and Brisbane, via central-west New South Wales and Toowoomba in Queensland. Inland Rail is a significant piece of nation transport infrastructure. It will enhance Australia's existing rail network and serve the interstate freight market.

The Inland Rail route, which is approximately 1,700 kilometres (km) long, will involve:

- Using the existing interstate rail corridor through Victoria and southern NSW
- Upgrading approximately 400 km of existing corridor, mainly in western NSW
- Providing approximately 600 km of new corridor in northern NSW and southeast QLD
- Inland Rail has been divided into 13 sections, seven of which are located in NSW.

The Australian Rail Track Corporation (ARTC) (the proponent) was created in 1997 after the Australian and State governments agreed to the formation of a 'one stop shop' for all operators seeking access to the national interstate rail network. The proponent is seeking approval to construct and operate the North Star to NSW/QLD border section of Inland Rail (the proposal). The proposal is a key component of the wider Inland Rail network between Melbourne and Brisbane.

Subject to approval of the proposal, construction of the proposal is planned to occur between 2021 and 2027. The proposal will be managed and maintained by ARTC; however, train services will be provided by a variety of operators. Train services are not expected to commence until all 13 sections of the Inland Rail Program are complete, which is planned to be in 2027.

The proposal will be trafficked by an estimated 14 trains per day in 2027, increasing to an estimated 21 trains per day in 2040. Annual freight tonnages will increase in parallel, from approximately 12 million tonnes per year in 2027 to 20 million tonnes per year in 2040.

1.1.2 Purpose and scope of this report

The purpose of this report is to meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs) issued 8 August 2018 (Application number SSI-9371) and suitably inform the EIS in order to obtain primary project approvals.

This technical report has been prepared to address the SEARs that are associated with biodiversity. The structure and content of the report has been specifically designed to meet the requirements of the *Biodiversity Conservation Act 2016* (NSW) (BC Act) and provide sufficient information to satisfy the requirements of the Biodiversity Assessment Method (BAM) (Department of Planning, Industry and Environment (DPIE)(2017) and BDAR (refer Sections 1-6 and Section 9), whist still assessing matters of national environmental significance (MNES) in accordance with the EPBC Act, and relevant guidelines (refer Section 10). Only MNES that are listed in the SEARs as EPBC Act controlling provisions are considered in this report (i.e. listed threatened species and communities). Key Threatening Processes and their applicability to the project are discussed in Section 9.4. The report will also address offset requirements and inform the feasibility of the proposal accordingly. Further details on the assessment approach are provided in Section 3.1. The assessment of aquatic ecological receptors is contained in a separate Aquatic Biodiversity Technical Report (refer EIS Chapter 11: Biodiversity and EIS Appendix S: Aquatic Biodiversity Technical Report).

The specific components of the BDAR and their location within the report is detailed in Table 3.2. The assessment of MNES ecological receptors is contained within Section 7, including desktop results, significant impact assessment and provision of disturbance areas that constitute a significant adverse residual impact upon habitat for MNES. Cumulative impact to ecological receptors regulated under the BC Act and the EPBC Act are combined (refer Section 8).

1.1.3 Commonwealth matters (EPBC Act)

The proposal has been referred (EPBC number: 2018/8222) to the Department of Agriculture, Water and the Environment (DAWE) and was determined to be a controlled action by the department on 12 June 2018. DAWE considers that the proposed action has the potential to significantly impact MNES and must therefore assess the significance of any potential impacts on MNES threatened species and communities. The proposal was listed under the following relevant controlling provisions:

- Listed threatened species and communities (sections 18 and 18A).

Based on advice received within the SEARs subsequent to the referral, assessments of significance were undertaken for the following MNES:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC
- Weeping myall woodland TEC
- White box-Yellow box-Blakely's red gum grassy woodland and derived native grassland (TEC)
- Natural grasslands on basalt and fine textured alluvial plains of northern New South Wales and southern Queensland (TEC)
- Coolibah-Black box woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions (TEC)
- *Cadellia pentastylis* (Ooline)
- *Homopholis belsonii* (Belson's panic)
- *Tylophora linearis* (Slender tylophora)
- Koala (*Phascolarctos cinereus*)
- Squatter pigeon (southern) (*Geophaps scripta scripta*)
- Painted honeyeater (*Grantiella picta*)
- Murray cod (*Maccullochella peelii*)
- Large-eared pied bat (*Chalinolobus dwyeri*)
- Corben's long-eared bat (*Nyctophilus corbeni*)
- *Dichanthium setosum* (Bluegrass)
- Five clawed worm skink (*Anomalopus mackayi*)
- Adorned delma (*Delma torquata*)
- Dunmall's snake (*Furina dunmalli*).

It is noted that fauna species listed as Migratory under the EPBC Act were not identified as a controlling provision for the proposal by DAWE. Therefore, the potential impacts from the proposal on species listed as Migratory and not assessed under the BAM, are not further assessed within this document.

The bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment (the assessment bilateral agreement) is relevant to the proposal. The assessment bilateral agreement allows the Commonwealth Minister for the Environment to rely on specified environmental impact assessment processes of the State of New South Wales in assessing actions under the EPBC Act. The BC Act includes a biodiversity impact assessment and offset regime, including the Biodiversity Offsets Scheme. Under the bilateral agreement with DAWE, the majority of species listed under both the BC Act and EPBC Act have been assessed for significant residual impacts and the requirement for Biodiversity Offsets solely under the assessment processes within the BC Act.

The remaining species including those listed only under the EPBC Act have been assessed under the requirements of the EPBC Act Environmental Offsets Policy (2012) including assessment under the MNES Significant Impact Guidelines 1.1 (Dote 2013). This includes the following species:

- Ooline (*Cadellia pentatstylis*)
- Austral toadflax (*Thesium australe*)
- Red goshawk (*Erythrotriorchis radiatus*)
- Curlew sandpiper (*Calidris ferruginea*)
- Dunmall's snake (*Furina dunmalli*)
- Murray cod (*Maccullochella peelii*).

Species or communities that have been listed under the EPBC Act after the controlled action decision for the proposal are not required to be assessed within this report. For the purposes of this assessment this includes the following:

- Poplar box grassy woodland on alluvial plains TEC (listed as Endangered on 4 July 2019)
- Grey falcon (*Falco hypoleucos*) (listed as Vulnerable on 9 July 2020).

1.1.4 Structure of this report

This report complies with the requirements of a BDAR and assess all potential impacts associated with the project. In order to facilitate timely retirement of offset liabilities the analysis of impact areas has been segmented and reported in the following groupings:

- Brownfield alignment – a segment of new track and associated infrastructure (such as culverts and signalling) with the existing non-operational Bobbabilla rail corridor. This brownfield segment extends approximately 25 km from North Star north to approximately 3.8 km south of the Bruxner Way-Tucka Tucka Road intersection. North of this point it becomes a greenfield segment to Queensland – New South Wales border on the Macintyre River.
- Greenfield alignment – this segment is approximately 5 km of new track within a new greenfield rail corridor south-west from the Macintyre River to the Bruxner Way. This segment also includes new access tracks required to be retained during the project's operation.
- Early works alignment – this segment is comprised of specific areas used during construction such as laydown areas, temporary accommodation and setup areas
- Borrow pits, with each potential borrow pit numbered and its credits considered discretely, as not all borrow pits may be required as part of the works.

The location of each of these areas is shown in Figure 1.1 and with associated PCTs in Figure 3.4 . The segmentation of the BDAR in this manner will allow for project offset liabilities to be retired in the order for which they are to be impacted. It is anticipated that early works which are associated with the early works segment of the project will be conducted in the earliest phase, and the brownfield segment will follow this. Borrow pits will be activated progressively as required, although it is likely that not all borrow pits will be required for the development of this project. It is anticipated the greenfield section is the final segment activated.

1.2 The proposal

1.2.1 Key features of the proposal

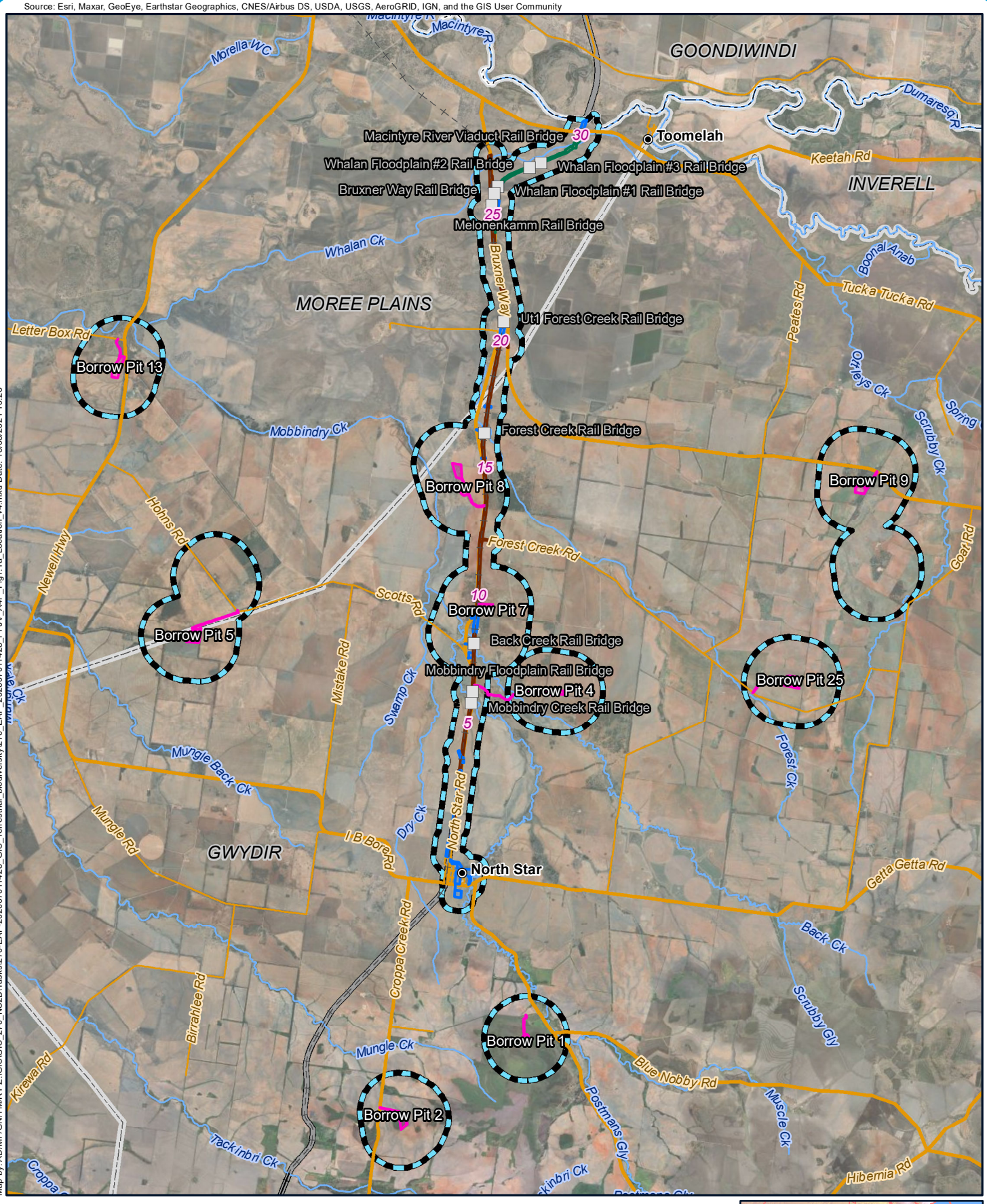
The proposal will occur between North Star and the NSW/QLD border. Between North Star and a greenfield deviation around Whalan Creek, the proposal is within the existing brownfield non-operational rail corridor and will consist of approximately 25 km of upgraded track. Between Whalan Creek and the NSW/QLD border, the proposal will occur within a greenfield rail corridor and consist of 5 km of new track.

The proposal consists of a permanent project footprint containing the key features listed in Table 1.1. The temporary construction phase of the proposal will cover a larger footprint and also includes laydown areas, temporary access tracks, borrow pits, a mobile concrete batching plant and a construction camp.

In order to facilitate the staged retirement of credit liabilities the subject land is divided into the brownfield, greenfield, borrow pit and early works segments as shown in Figure 1.1. Additional supplementary site maps, showing the IBRA regions and sub-regions, NSW (Mitchell) landscapes and land use for the study area, are provided in Appendix A.

Table 1.1 Key features of the proposal

Aspect	Description
New track	▪ Approximately 25 km of new track within the existing brownfield non-operational Boggabilla rail corridor ▪ Approximately 5 km of new track within a greenfield rail corridor.
Crossing loop and turnouts	▪ One crossing loop, designed to accommodate trains up to 1,800 m long ▪ Turnouts will be provided on either end of the crossing loop to allow trains to be guided from one track to another.
Bridges	▪ Eleven new bridges ▪ This includes an approximately 1.8 km long viaduct over the Macintyre River and Whalan Creek, which are major watercourses. The viaduct is located in both NSW and QLD; therefore, it will be assessed under *the NSW Environmental Planning and Assessment Act 1979* (EP&A Act) by this Terrestrial Biodiversity Technical Report, and under the *State Development and Public Works Organisation Act 1971* by the NSW/QLD border to Gowrie EIS. Approval from both States is required before construction of the viaduct can commence.
Drainage	▪ Reinforced concrete pipe culverts and reinforced concrete box culverts. Scour protection measures will be installed as required around culverts to avoid erosion where required. ▪ Embankment and catch drains adjacent to the proposed alignment to divert surface runoff the nearest bridge or culvert location.
Level crossings	▪ New and existing level crossings ▪ Signalling and communications infrastructure.
Ancillary works	▪ Ancillary infrastructure including signalling and communications infrastructure, signage, fencing and utilities.
Borrow pits	▪ Ten potential borrow pits, new and existing with estimated potential material quantities ranging from <112,000 m^3 to 3,600,000 m^3



Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1a: Site map

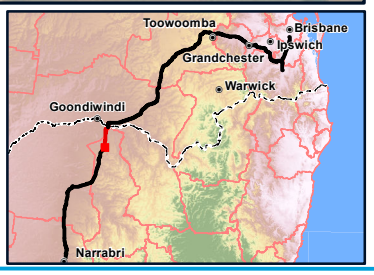
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Localities
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

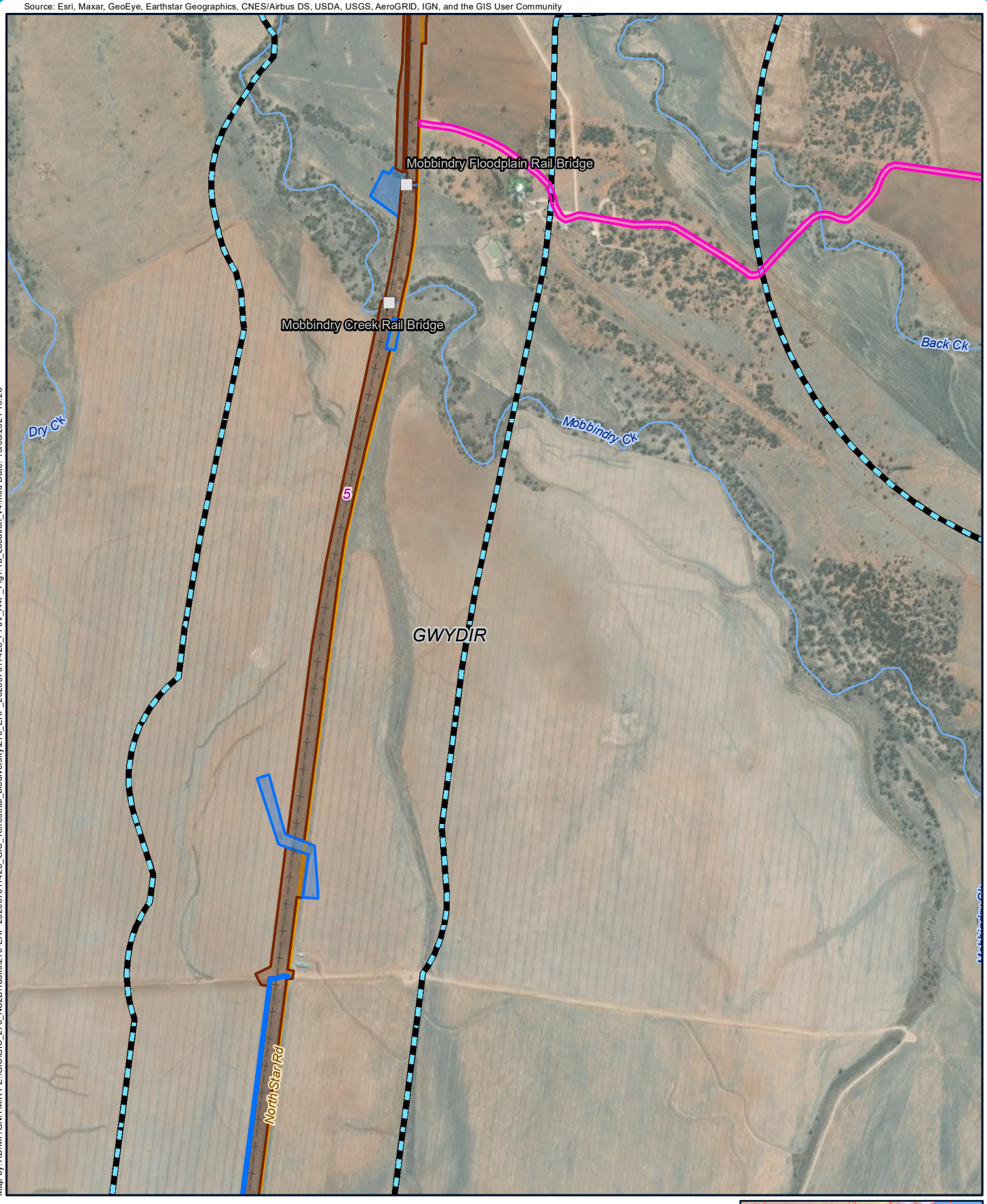
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

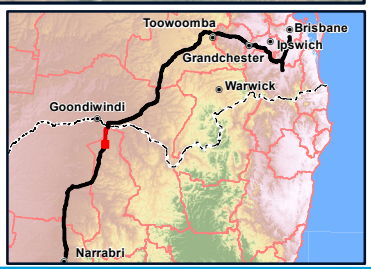
North Star to NSW/QLD border

Figure 1.1b: Site map



Legend

- Bridges
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

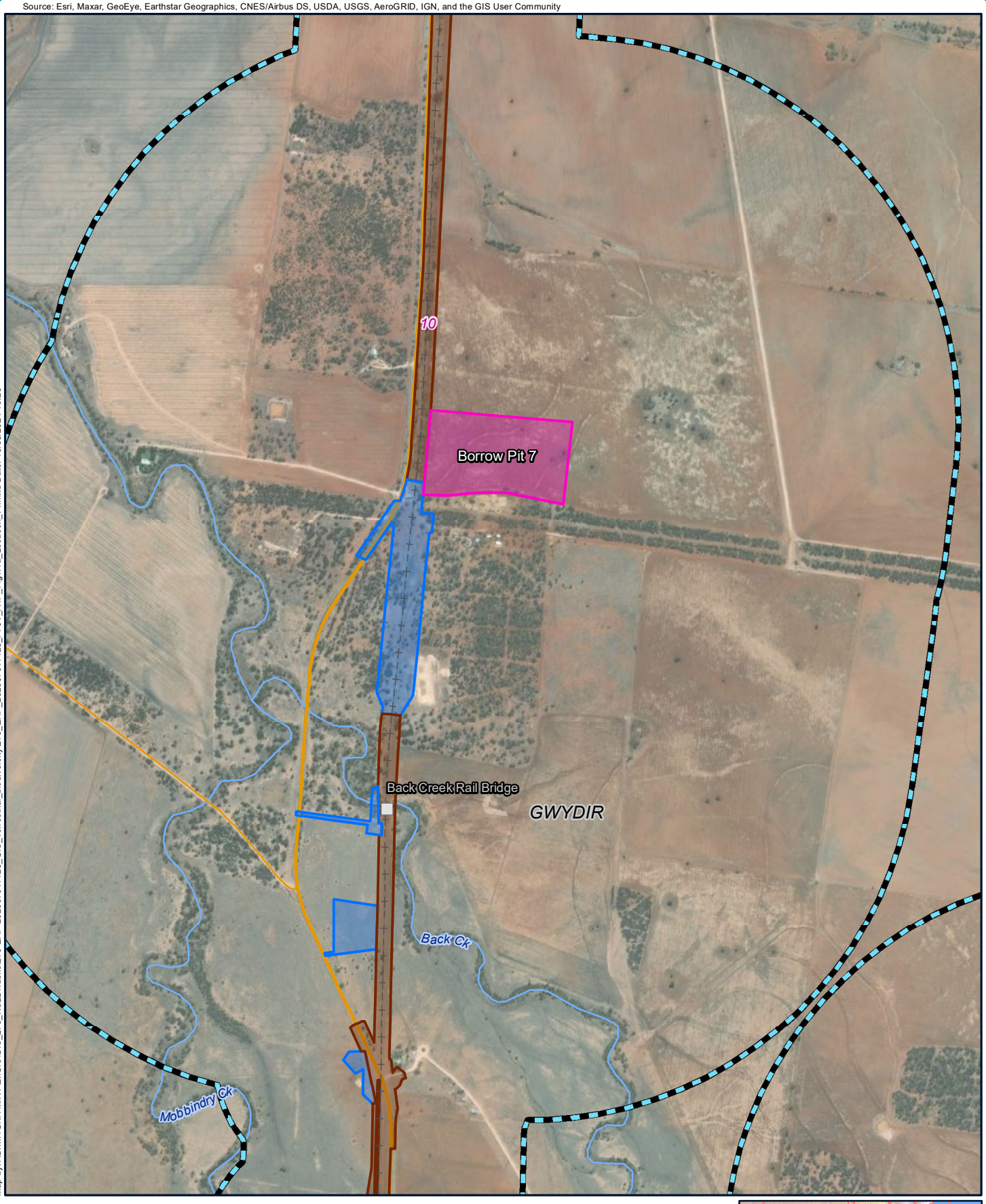
Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1c: Site map

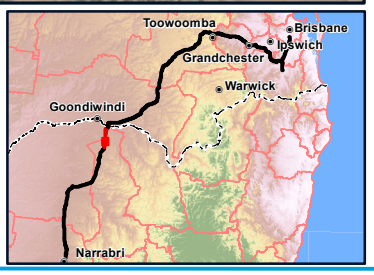
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Bridges
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

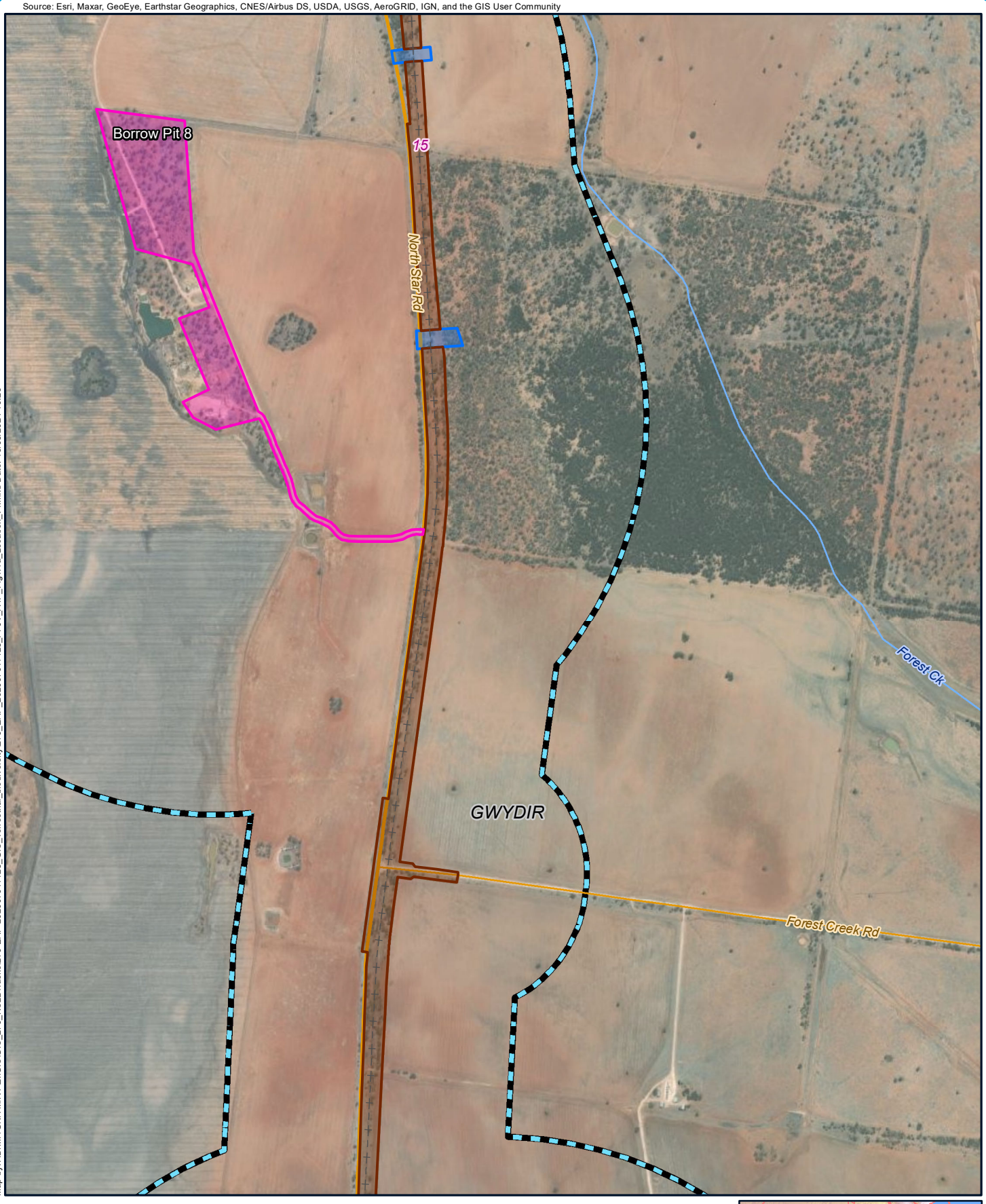
Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1d: Site map

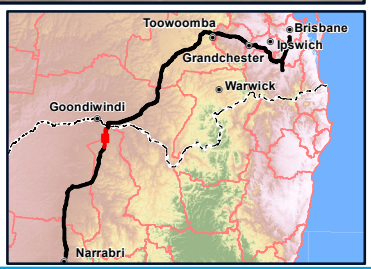
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

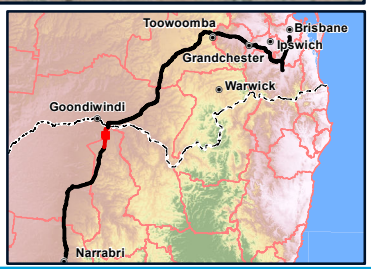
Figure 1.1e: Site map



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Bridges
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

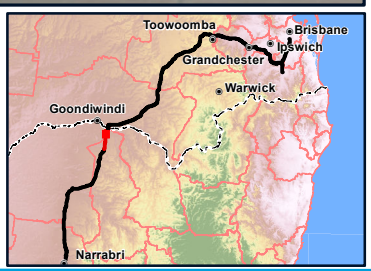
Figure 1.1f: Site map



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Bridges
- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

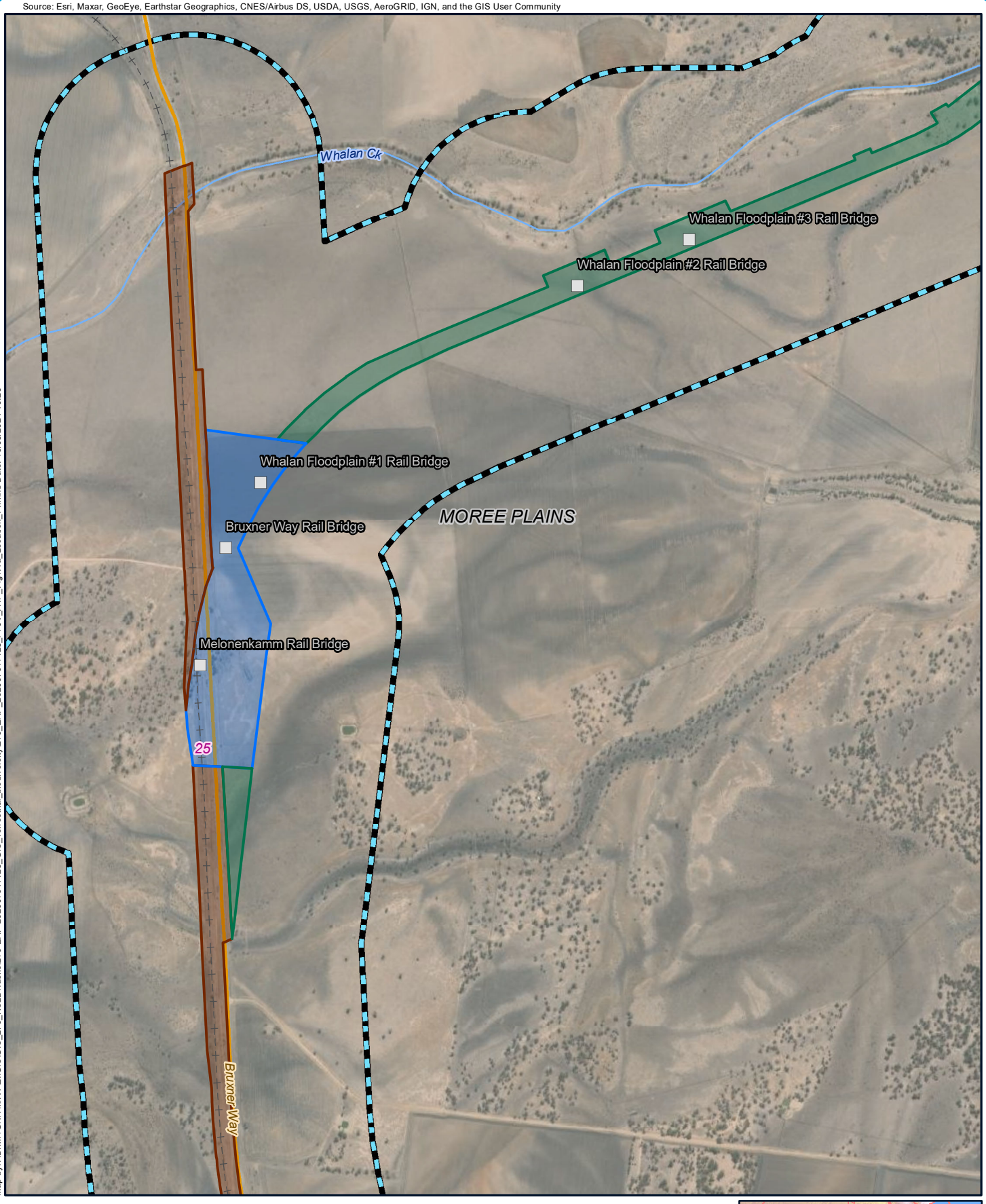
Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1g: Site map

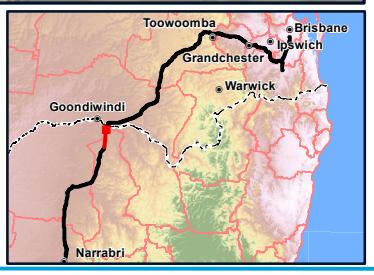
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Bridges
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1h: Site map

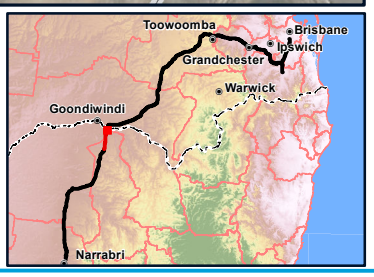
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Bridges
- Major roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

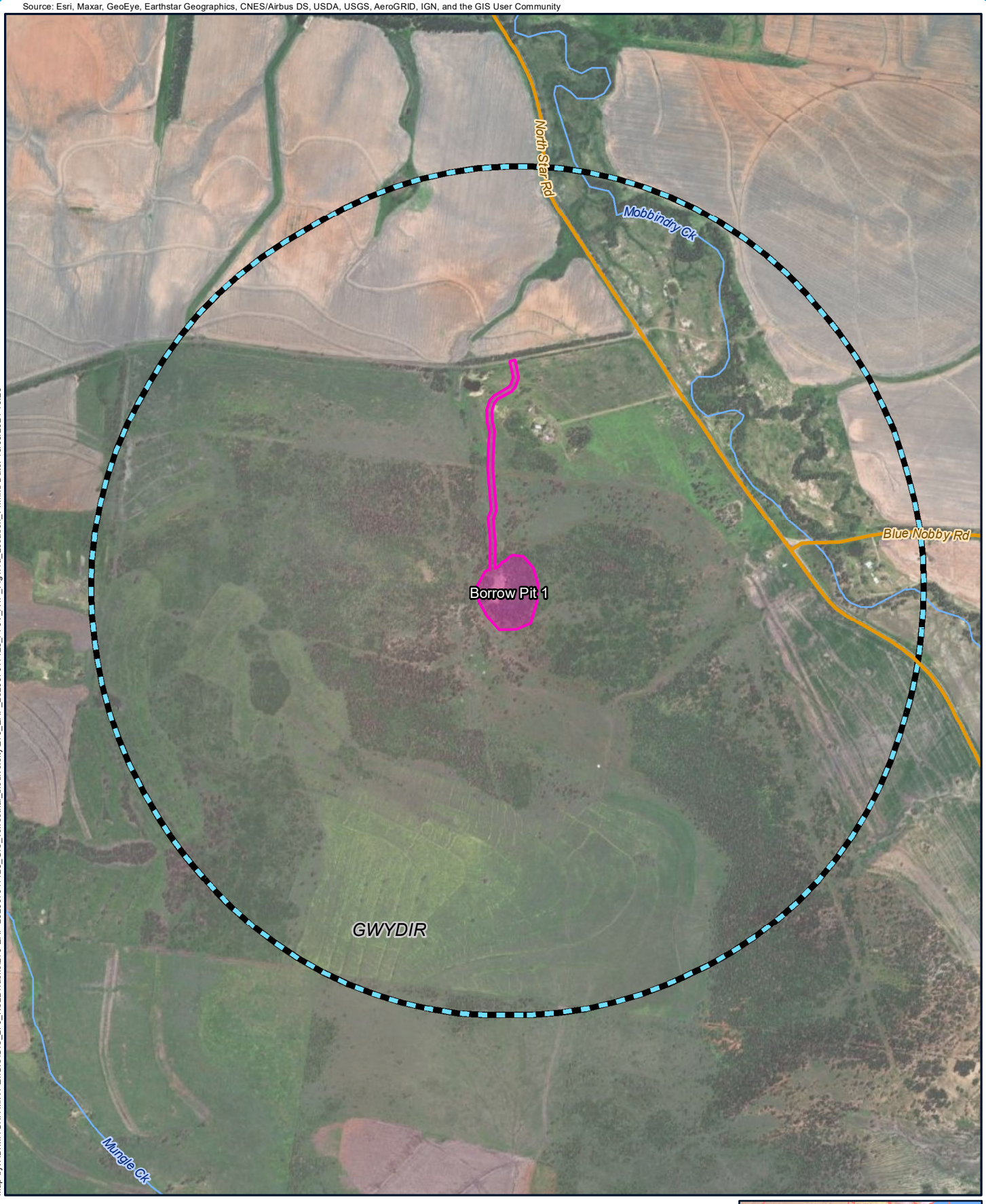
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

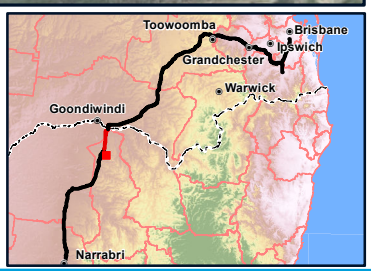
North Star to NSW/QLD border

Figure 1.1i: Site map



Legend

- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

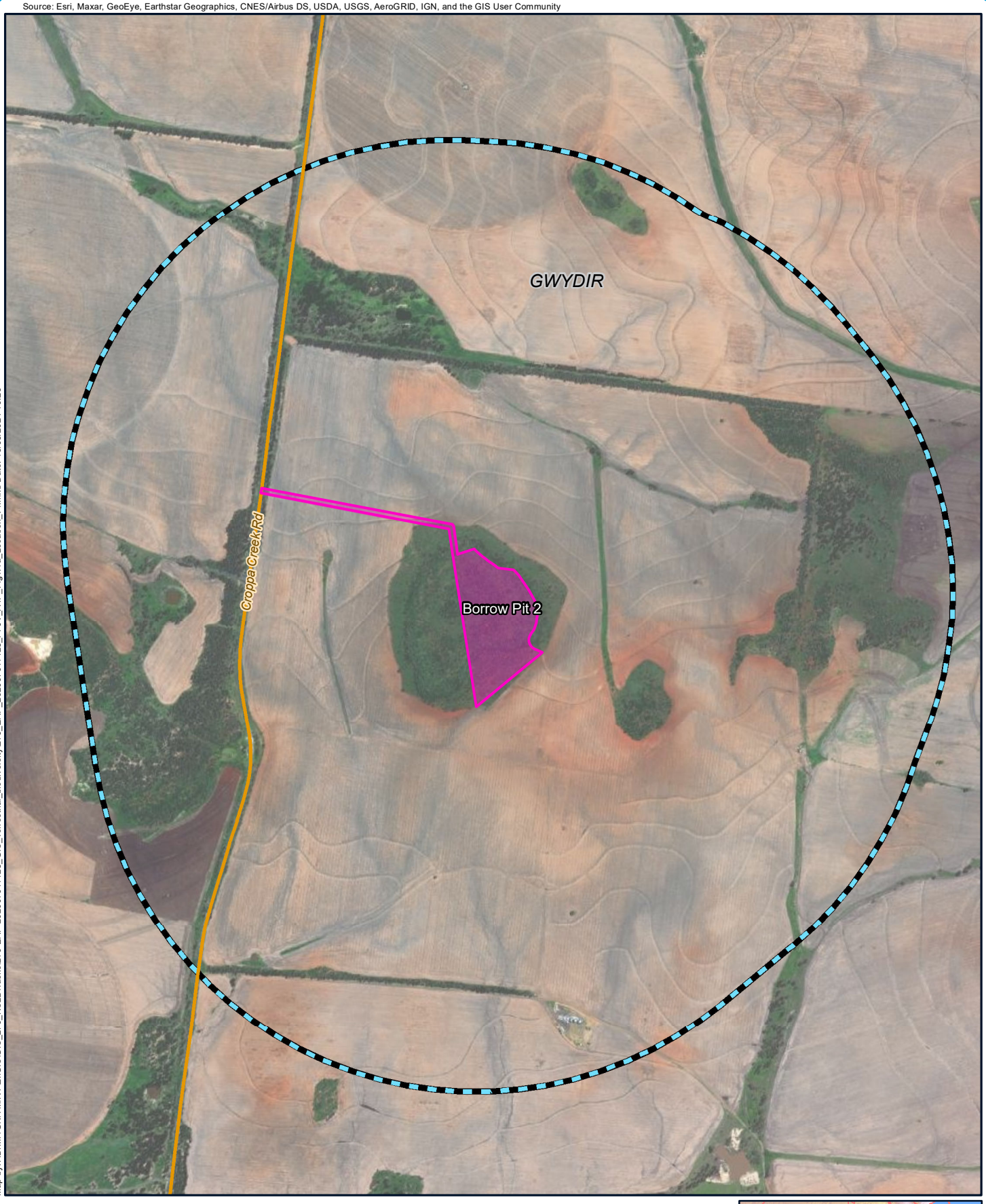
Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1j: Site map

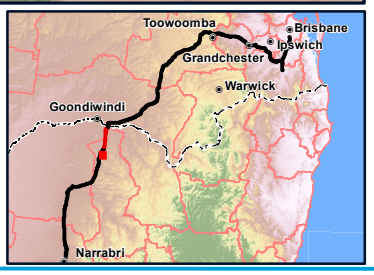
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Major roads
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

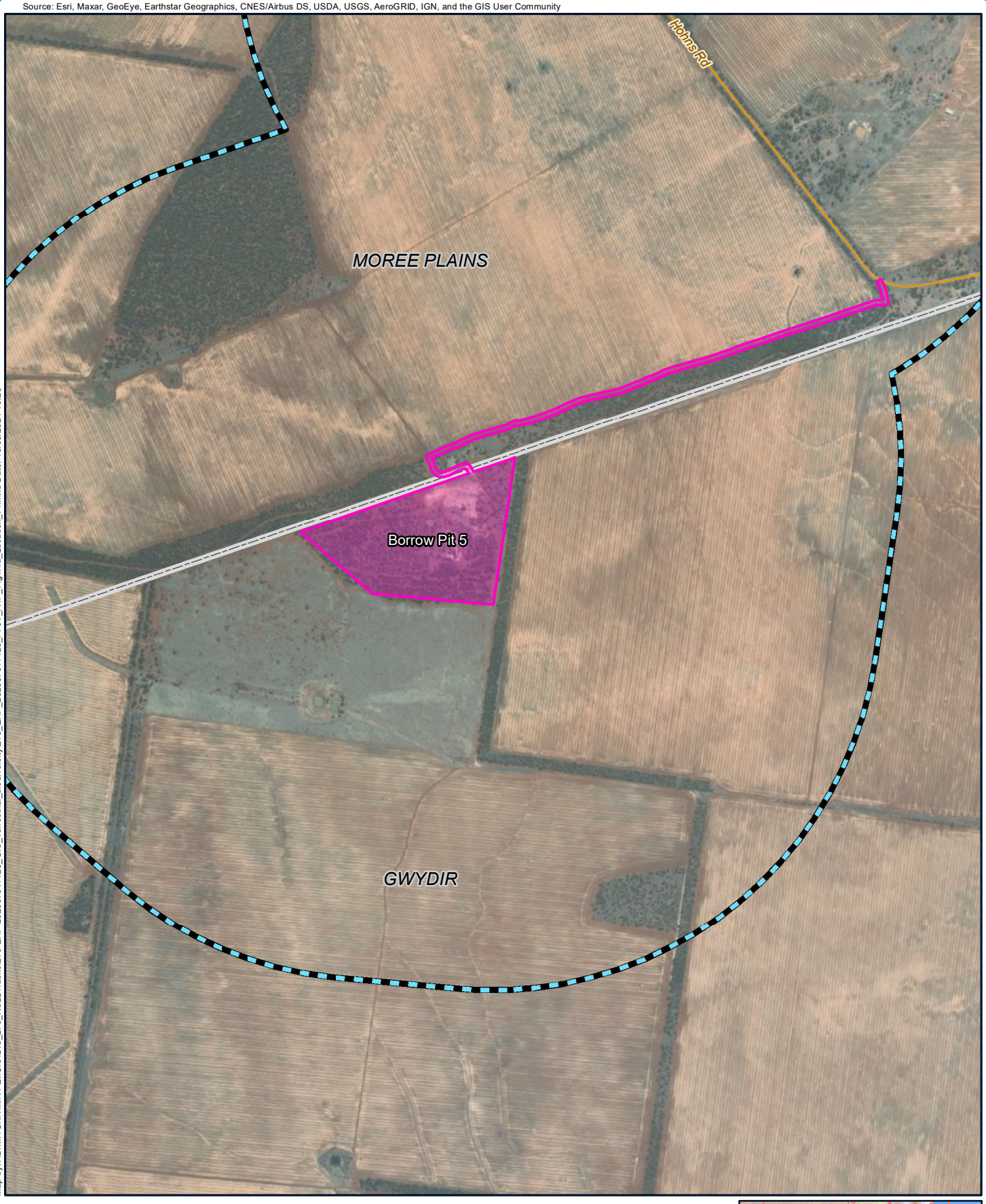
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

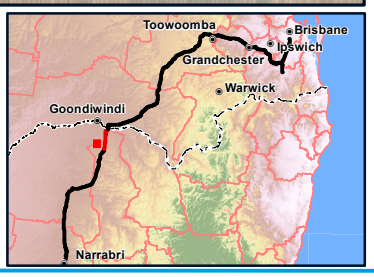
North Star to NSW/QLD border

Figure 1.1k: Site map



Legend

- Minor roads
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

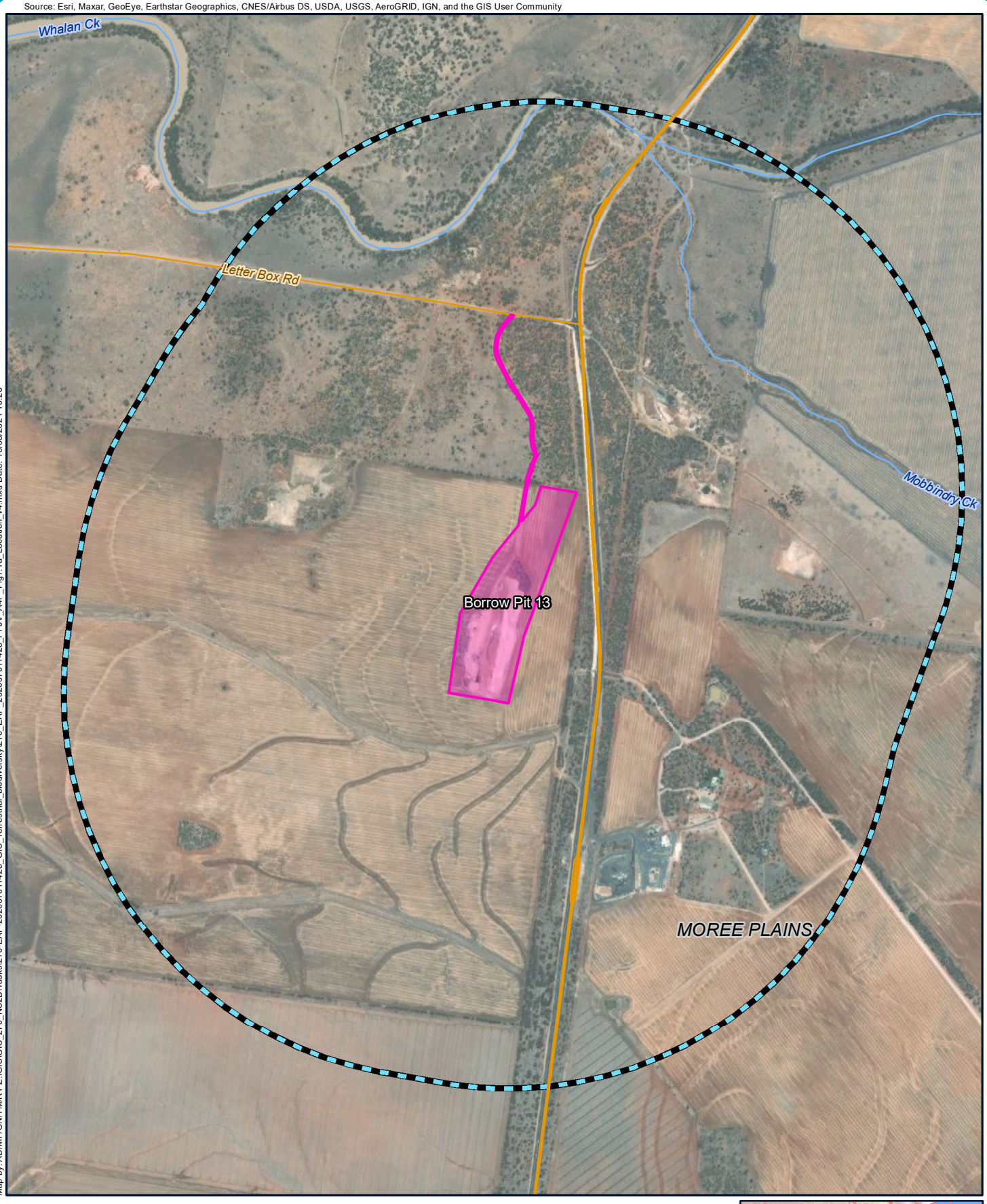
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

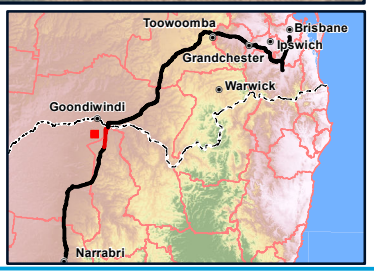
North Star to NSW/QLD border

Figure 1.1l: Site map



Legend

- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

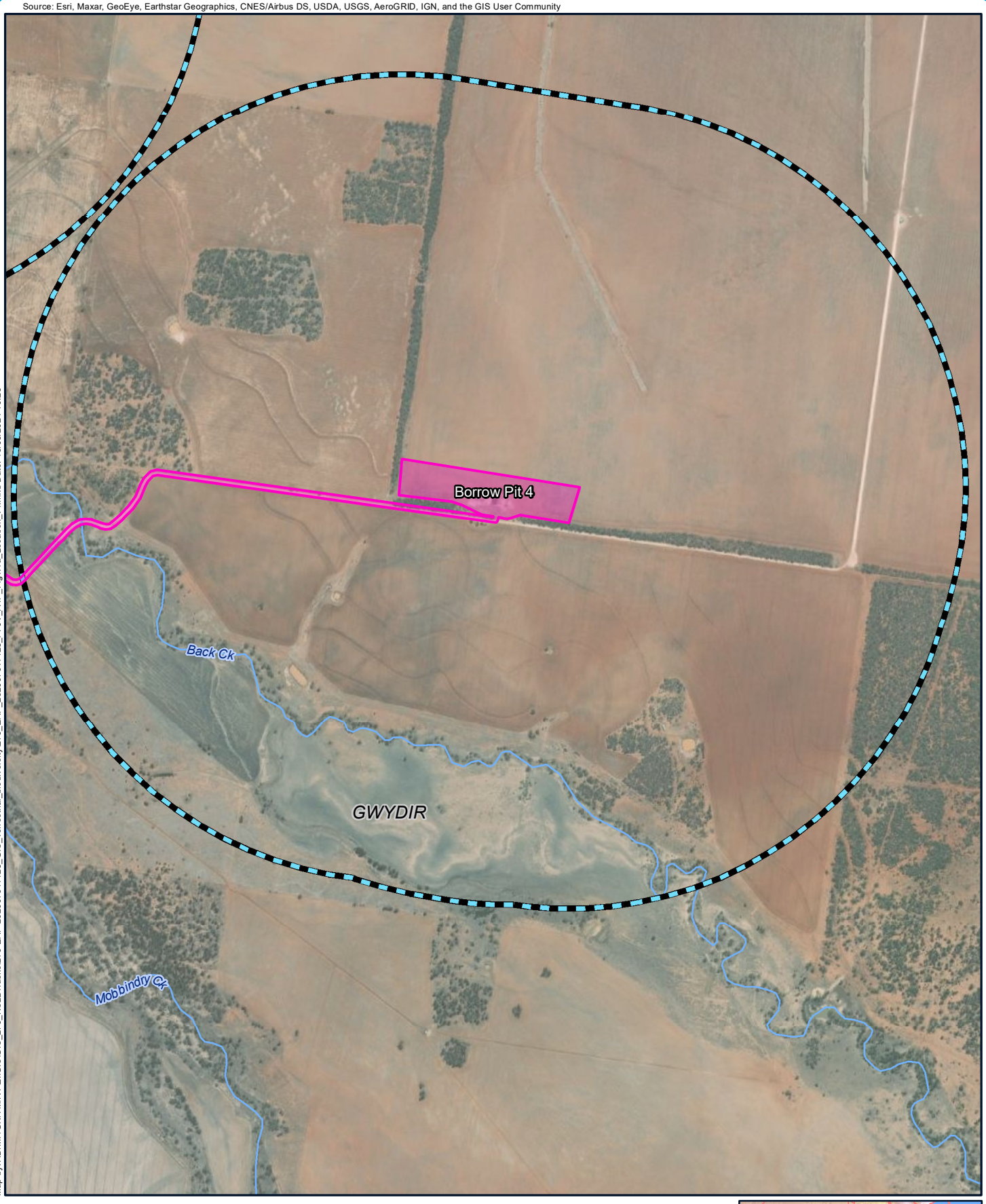
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

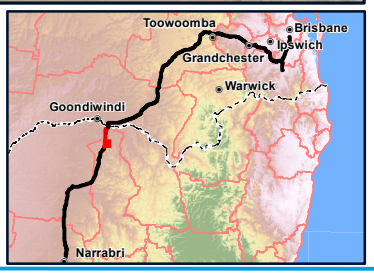
Figure 1.1m: Site map



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

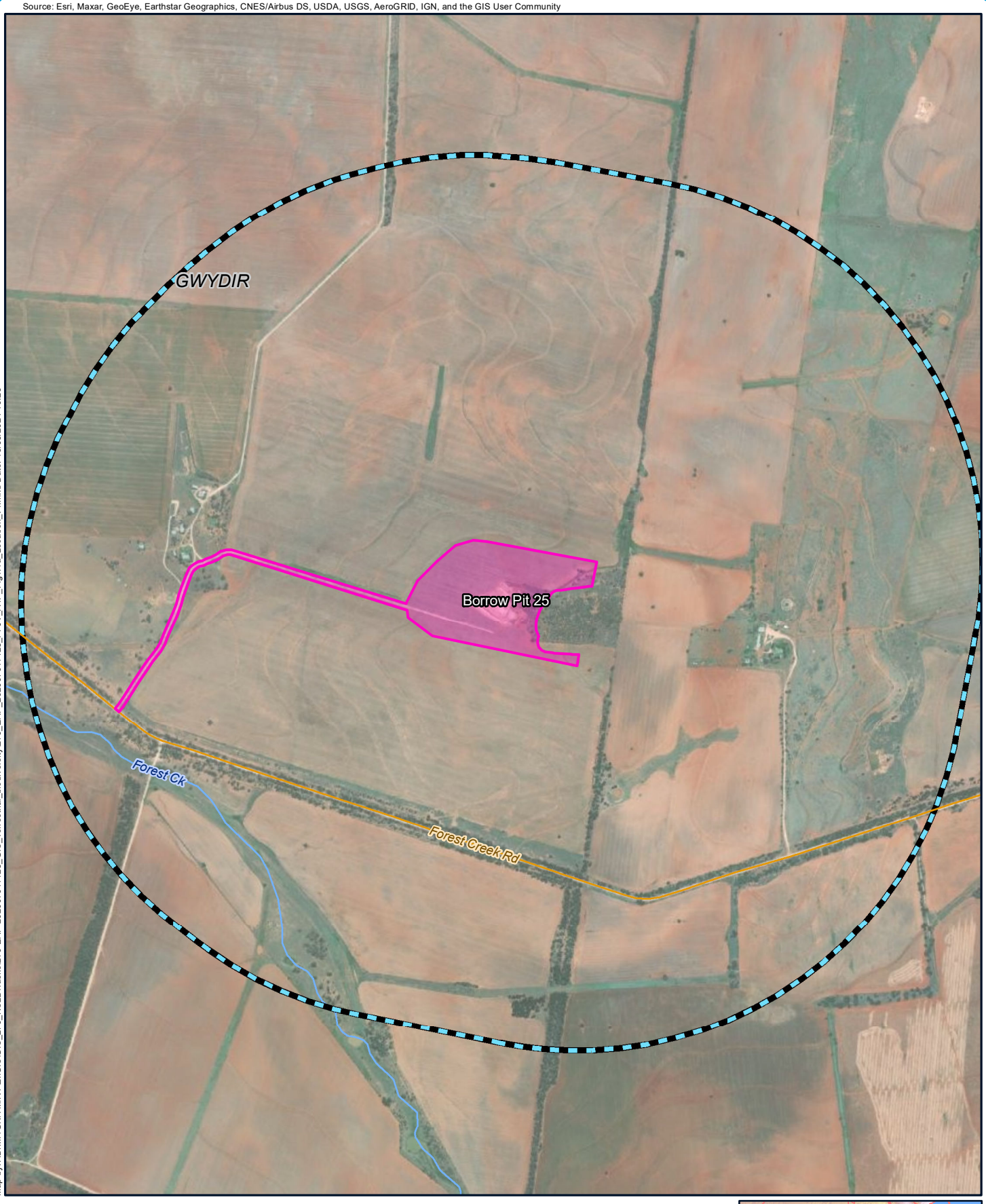
Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1n: Site map

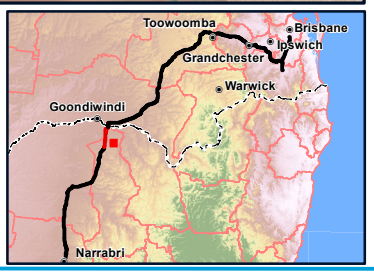
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

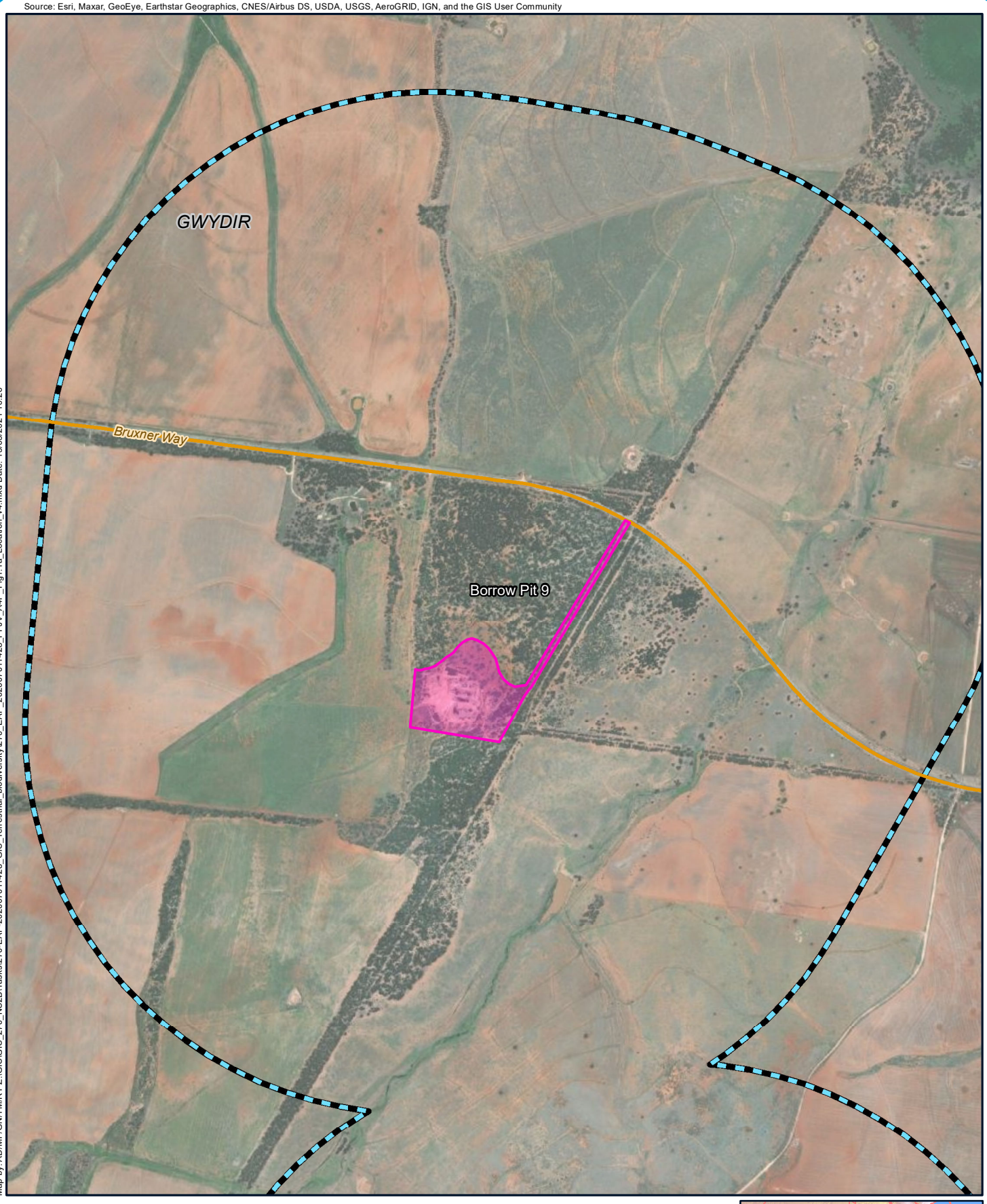
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

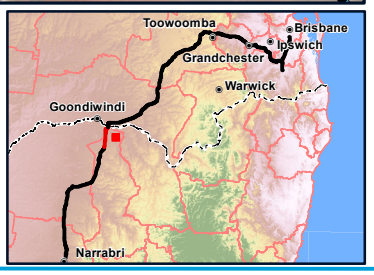
Figure 1.1o: Site map



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig1.1a_Location_v4.mxd Date: 13/05/2021 10:26

Legend

- Major roads
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Local Government Areas



A4 scale: 1:20,000

0 200 400m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 1.1p: Site map

1.2.2 Permanent footprint

The proposal is in accordance with the following parameters:

- Generally, aligns with the existing non-operational Boggabilla rail corridor between North Star (Chainage (Ch) 0.9 km) and the greenfield deviation (Ch 25.7 km)
- A strip of land at least 10 m wide has been allowed on either side of the earthworks footprint to accommodate track-side infrastructure such as fencing and drainage structures.
  - Encompasses the ultimate footprint of:
    - New track and associated earthworks
    - Bridge and drainage structures, including scour protection around culverts
    - Level crossings
    - Road realignments
    - Possible upgrades to adjacent roads and infrastructure
    - Rail maintenance access road, including access points, passing bays and turnarounds
    - Fencing and signage.

The width of the permanent footprint varies along the proposed alignment depending on the shape and size of the features listed above. A minimum width of 40 m has been adopted for the permanent footprint; however, the width of the permanent footprint increases to approximately 200 m in the vicinity of the Bruxner Way realignment to allow for realignment.

Within this footprint buffer zones will be established to reduce potential indirect impacts and avoid sensitive areas, such as 40 m buffer zones around sensitive Brigalow vegetation communities, and exclusions areas around retained habitat trees in accordance with tree protection zone as defined in AS4970-2009 Protection of trees on development sites and other sensitive locations. Mitigation measures to be applied during design, pre-construction, construction and operation are detailed in Section 8.6.3.

1.2.3 Temporary construction footprint

The temporary construction footprint incorporates areas which are outside of the of permanent footprint but are required for construction including:

- Laydown areas
- Access tracks
- Workers accommodation camp at North Star
- Borrow pits.

These additional areas are temporary as they are only required during the construction phase of the proposal. The additional areas comprise of approximately 112 hectares (ha) and do not form part of the permanent footprint. The impacts relating to the laydown areas, access tracks and workers camp are reported as part of the early works alignment for the project area. The impacts relating to the borrow pits and associated access tracks is been reported individually with further detail provided in Section 1.2.5.

1.2.4 New track

Track within the existing non-operational Boggabilla rail corridor is considered unsuitable for reuse due to its' alignment. Therefore, the proposal consists of:

- Approximately 25 km of new, single line, standard gauge track within the existing non-operational Boggabilla rail corridor, between North Star (Ch 0.9 km) and the greenfield deviation (Ch 25.7 km)

- Approximately 5 km of new, single line, standard gauge track within a greenfield rail corridor, between the greenfield deviation (Ch 25.7 km) and the NSW/QLD border (Ch 30.6 km).

Key features of the new track include:

- Single line – trains travelling in both directions share the same track
- Standard gauge – gauge refers to how far apart the rails on a railway track are spaced. Standard gauge indicates that the rails will be spaced 1.435 metres (m) apart
- Greenfield rail corridor – this is a section of new track within a new rail corridor.

The track structure will consist of rails, fasteners, rail pads and concrete sleepers, which are laid on a trackbed of ballast. Collectively, these elements are referred to as 'permanent way'. The new track is designed to support 21 tonne axle load intermodal (i.e. container) trains up to 1,800 m long and 6.5 m high. Tonne axle load refers to the total weight felt by the track due to passing trains. Depending on the tonne axle load, train speeds will vary between 80 kilometres/hour (km/hr) and 115 km/hr.

1.2.5 Borrow pits

Borrow pits are required during the construction phase of the proposal and are needed to supply fill material, including general fill and rock ballast. A total of eleven borrow pits, new and existing were investigated for potential use. Each borrow pit has an estimated potential material quantity ranging from <112,000 m^3 to 3,600,000 m^3. The borrow pits are located up to 14.5 km from the permanent footprint. The total number of required borrow pits will be revised during the detailed design phase. The impacts relating to the borrow pits and access tracks required for the borrow pits have been reported individually for each potential borrow pit area i.e. Borrow pit 1 or Borrow pit 8. Buffer zones are incorporated into borrow pit footprints to remove the potential for indirect impacts on sensitive vegetation communities (refer Section 8.6.1), including an additional 40 m buffer for PCT 35 Brigalow – Belah open forest/woodland.

1.2.6 Crossing loop

The proposal includes one crossing loop, known as the Boonal crossing loop. As the proposal is for single line track, the Boonal crossing loop will allow trains travelling in opposite directions to pass each other.

The Boonal crossing loop is an approximately 2.2 km section of single line, standard gauge track, running roughly parallel to the main track. The optimised location of the crossing loop is between Ch 22.7 km and Ch 24.9 km. During the feasibility design phase, the location of the crossing loop was chosen on account of following factors:

- Preliminary operational modelling undertaken by ARTC for the wider Inland Rail Program demonstrated that installing a crossing loop in this location would minimise train travel times in both directions
- Placing the crossing loop in this location minimises construction works as it is a relatively straight section of track, clear of structures and level crossings.

The Boonal crossing loop is able to accommodate trains up to 1,800 m long. It is connected to the main track at both ends via low-speed (80 km/hr) turn outs.

A one-ended, single line, standard gauge siding will be incorporated into the Boonal crossing loop for maintenance purposes. It is approximately 500 m long and will be connected to the southern end of the Boonal crossing loop via a low-speed (40 km/hr) turn out. Connecting to the southern end is preferred over the northern end due to the straighter, flatter alignment, and lower embankment heights.

1.2.7 Bridges

Bridges are required so that water, vehicles, and in some cases, stock and pedestrians may cross the proposed rail corridor. Two types of bridges are proposed:

- Rail over water
- Rail over road.

The type of bridge proposed depends on a range of factors, including the local topography, road usership, rail and road alignments at the crossing point, and access requirements. Bridges have been provided at all major watercourse crossings along the proposed alignment to minimise impacts to the local riverine system, and to avoid having to divert watercourses.

A total of 11 new bridges are proposed. An approximately length for each bridge is included in Table 1.2.

Table 1.2 Proposed bridges

Chainage of the southern-most end of the bridge (km)	Bridge	Approximate bridge length
Ch 5.7	Mobbindry Creek Rail Bridge	112 m
Ch 6.1	Mobbindry Floodplain Rail Bridge	182 m
Ch 8.1	Back Creek Rail Bridge	70 m
Ch 16.3	Forest Creek Rail Bridge	154 m
Ch 20.7	UT1 Forest Creek Rail Bridge	136 m
Ch 25.2	Melonenkamm Rail Bridge	160 m
Ch 25.7	Bruxner Way Rail Bridge	114 m
Ch 26.0	Whalan Floodplain #1 Rail	183 m
Ch 27.5	Whalan Floodplain #2 Rail	126 m
Ch 28.0	Whalan Floodplain #3 Rail	126 m
Ch 29.3	Macintyre River Viaduct	1,750 m

1.2.8 Macintyre River viaduct

The viaduct crossing the Macintyre River includes an approximately 1.8 km long viaduct that crosses Whalan Creek, Tucka Tucka Road and the Macintyre River. Approximately 1.2 km of the viaduct is located in NSW, while the remaining 0.6 km is located in Queensland, where the NSW/QLD border is defined by the centre point of the Macintyre River.

During the feasibility design phase, the design of the Macintyre River viaduct was informed by geotechnical and flooding studies. Initially, three separate bridge structures were proposed over Whalan Creek, Tucka Tucka Road, and the Macintyre River. However, an iterative flood assessment of the design has resulted in a single viaduct structure that minimises upstream flooding impacts.

1.2.9 Culverts

Culverts are structures that allow water, whether in a watercourse or drainage line, to pass under the proposed alignment. During the feasibility design phase, proposed designs and locations for culverts were developed based on:

- Addressing hydrologic, hydraulic and geotechnical constraints associated with the proposal
- Minimising potential flooding impacts by:
  - Locating culverts at low points along the proposed alignment in order to prevent upstream water ponding
  - Ensuring that the inside base of culverts is level with the natural surface

- Designing culverts to withstand a 100-year flood event (i.e. 1% annual exceedance probability (AEP))
- Maintaining existing patterns of flow across the floodplain so as not to divert or concentrate flows.

Culverts associated with the proposal will be a mix of reinforced concrete pipe culverts and reinforced concrete box culverts. Scour protection measures will be installed as required around culverts, on disturbed stream banks, and around waterfront land (defined as the bed of any river, lake or estuary and the land within 40 m of the river banks, lake shore or estuary mean high water mark (*Water Management Act 2000*)) to prevent erosion.

A total of 48 culvert locations were identified during the feasibility design phase. The number of culverts and their locations will be further refined during the detailed design phase in order to minimise potential impacts, especially flooding impacts.

1.2.10 Road rail interfaces

Road rail interfaces are points at which the proposed alignment intersects a road. Treatments for road rail interfaces can be categorised as grade separated crossings, level crossings or closures:

- **Grade separated crossings** – road and rail cross each other at different heights so that traffic flow is not affected. Grade separations are either road over rail, or rail over road.
- **Level crossings** – road and rail cross each other at the same level. Level crossings have either passive or active controls to guide road users:
  - **Passive** – have static warning signs (e.g. stop and give way signs) that are visible on approach. This signage is unchanging with no mechanical aspects or light devices.
  - **Active** – have static warning signs as well as flashing lights and automatic boom gates.
- **Closure** – existing road rail interfaces may be closed, consolidated into fewer crossing points, relocated or diverted to where there is lower operational demand. Closures will only occur where the impact of diversions or consolidations is considered acceptable, or the existing location is not considered safe and cannot reasonably be made safe.

There are no existing signalling or communications systems within the proposed alignment. New signalling and communications infrastructure will be installed at the crossing loop and active level crossings, enabling active controls to tie into the wider Inland Rail network.

In the future, ARTC's Advanced Train Management System is proposed to manage signalling and communications for the wider Inland Rail network. Communication (voice and data) will occur between Network Control Centres and locomotives operating on the Inland Rail network.

1.2.11 Road realignments

The proposal involves a minor realignment of Bruxner Way. Bruxner Way is a main road pursuant to the *Roads Act 1993*. It is a two lane, two-way road with a posted speed limit of 100 km/hr.

In order to achieve flood immunity, the elevation of the proposal must be significantly higher than Bruxner Way at the point where the proposal intersects Bruxner Way. Therefore, a rail over road grade separation with a minimum vertical clearance of 5.4 m is proposed at the point of intersection.

At the point where the proposal intersects the existing Bruxner Way, the skew angle is approximately 75 degrees. Maintaining this skew angle would involve constructing a bridge with excessively long, non-standard spans.

A more practical skew angle is 45 degrees. To achieve a 45-degree skew angle, it is proposed to realign Bruxner Way to the east, and then back to the existing Bruxner Way on a slight curve.

As part of the reconfiguration, the elevation of Bruxner Way will be maintained or slightly increased. This will maintain or improve flood immunity at this location.

1.2.12 Earthworks

The proposed alignment traverses the Macintyre River floodplain for approximately 14 km. To achieve flood immunity, the majority of the proposal is elevated on a fill embankment. The embankment height is typically less than 2 m; however, around the realigned Bruxner Way and in the lead up to the Macintyre River Viaduct, the embankment height increases to approximately 7.5 m.

Embankments have been designed and constructed to minimise erosion during flood events. The steepness of embankments will be minimised as much as possible to encourage vegetation growth, which will further prevent erosion.

No significant cuttings (i.e. > 10 m deep) are proposed. However, where practicable, materials won from excavations and cuttings will be assessed for re-use as embankment fill. If unsuitable for reuse, this material may be formed into permanent spoil mounds within the rail corridor. Features of the spoil mounds include:

- Located as close as possible to the source of excavated material
- Maximum height of 2 m
- Option to be located on both sides of the track
- Stabilisation as required
- Gaps in the spoil mounds will be provided to allow water to drain away from the track.

The exact location, sizing and design of spoil mounds will be determined during the detailed design phase, with consideration given to the results of hydraulic modelling and sight distances. Mounds would not be located in areas where they would impact on flooding or drainage, or in areas where they will impact extant vegetation communities or wildlife habitat (i.e. they will be located in cleared areas).

1.2.13 Fencing and signage

The purpose of fencing is to protect the proposed alignment from trespass and prevent stock on adjoining properties from accessing the rail corridor. Standard rural fencing, consistent with the existing rural landscape, is proposed between the rail corridor and adjoining properties, generally located at the corridor boundary.

Fencing will generally be provided around culverts. Gates will be installed for accessing culverts for inspection and maintenance.

Fencing extents will continue to bridge abutments. However, to avoid locating fencing in major watercourses and floodplains, the rail corridor will not be fenced underneath bridges. In specific cases, fencing will be provided across waterways to prevent stock on adjoining private properties from accessing the rail corridor.

Signage is also proposed, especially at level crossings.

1.3 Construction overview

The following sections provide an overview of activities that will occur within each stage of the construction of the proposal. A detailed summary is provided in EIS Chapter 7: Construction of the proposal. Figure 1.2 provides an overview of how the construction phase will be staged for the proposal. The construction activities are conventional in nature. However, in some locations, certain activities may be modified to account for site-specific environmental and/or engineering constraints.

Construction activities are not necessarily presented in order. Some activities may occur concurrently or in a different order due to environmental and/or engineering constraints. The final construction activities, sites and sequencing will be determined during the detailed design phase, taking into account the construction contractor's chosen methodologies and relevant conditions of approval.

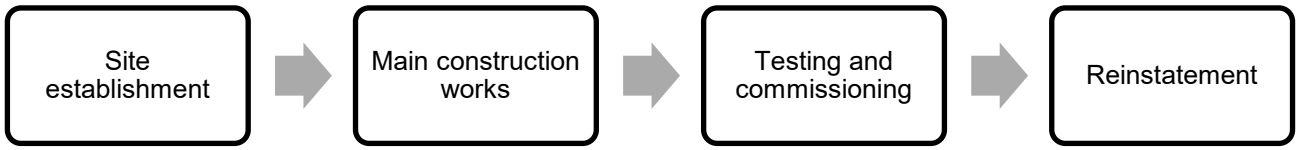


Figure 1.2 Construction staging

During the detailed design phase (2020 to 2021), the proposal will be further refined to minimise impacts. All future refinements will be constrained to the maximum parameters and impacts identified in this EIS. In this way, construction and operation (occurring after 2027) of the proposal will be within the parameters and impacts approved through the EIS.

Construction is expected to occur between 2021 and 2025. It is anticipated that earthworks, bridge works and drainage works will progress on multiple fronts. However, track work will progress on one front, from south to north. An indicative construction program for the proposal is shown in Figure 1.3.

Construction stage	2020				2021				2022				2023				2024			
Design and approvals																				
Site establishment																				
Road works																				
Earthworks																				
Bridge works																				
Drainage works																				
Track works																				
Testing, commissioning, reinstatement																				

Figure 1.3 Indicative construction timing

The construction program in Figure 1.3 is indicative only. It may be subject to change during the detailed design and construction phases as a result of:

- Weather conditions
- Changes to construction methods and materials
- Unexpected finds, such as threatened species or cultural heritage values
- Community interest in the proposal or issues that need to be addressed.

If the duration and timing of construction were to change, work will be rescheduled, taking into account site-specific environmental and/or engineering constraints. The schedule of environmental controls, including traffic management and noise controls, would also be adjusted.

1.3.1 Site establishment and enabling works

Site establishment and enabling works will occur in advance of the main construction works. This includes, but is not limited to, the following low impact work:

- Survey work including carrying out general alignment surveys, installing survey controls (such as global positioning system), installing repeater stations, carrying out surveys of existing and future utilities and infrastructure, archaeological monitoring and road dilapidation surveys
- Investigations including investigative drilling and excavation
- Treatment of contaminated sites
- Establishing construction of ancillary facilities (including minor clearing and relocation of vegetation) such as laydown areas, the construction camp, access tracks, water supply infrastructure, utility diversions and adjustments
- Erection of prefabricated site offices and portable amenities
- Delivering and stockpiling construction materials

- Installing mitigation measures including erosion and sediment controls, temporary exclusion fencing around sensitive areas and at-property acoustic treatments
- Some property adjustment works including installing property fencing
- Archaeological testing and salvaging indigenous artefacts
- Demolition and/or maintenance of existing structures needed to facilitate construction of the proposal. Existing bridges and culverts within the non-operational Boggabilla rail corridor are considered unsuitable for reuse as part of the proposal. They will be demolished and relocated clear of works or offsite.

1.3.2 Main construction works

Following site establishment activities, the main construction works will commence, primarily consisting of earthworks, track works, drainage works, bridge works and road works. The final construction activities, sites and sequencing will be determined during the detailed design phase, taking into account the construction contractor's chosen methodologies. The final methodologies will allow for:

- Site-specific environmental and engineering constraints
- Maintaining sufficient water flow
- In the event of flooding, critical plant and equipment can be quickly evacuated to higher ground.

A Construction Environmental Management Plan will be prepared to manage key environmental and public amenity risks arising from the main construction works.

1.3.3 Earthworks

The anticipated construction methodology for earthworks is as follows:

- Clearing and grubbing will occur progressively during the construction phase in order to minimise soil exposure where practicable (preceded by pre-construction ecology and heritage surveys). Protective measures will be in place in downstream areas to prevent erosion and sedimentation
- Stripping topsoil and stockpiling it for later use
- Excavation of cuttings, including stockpiling cutting material that is unsuitable for reuse. Topsoil stripping and excavations will occur progressively during the construction phase in order to minimise soil exposure. Surplus material that is unsuitable for re-use as fill material may be used to rehabilitate disturbed areas, or it may be formed into permanent spoil mounds within the rail corridor. Spoil mounds will be neatly formed to prevent erosion and sedimentation. They will not be located in areas where they would impact on flooding or drainage
- Hauling embankment materials (general fill, structural fill and capping) from borrow pits and local quarries to embankment locations and/or stockpiling areas
- Construction of embankments and stabilising of batter slopes. The embankment foundation will be inspected and tested as it is exposed. Depending on the condition of the foundation, it will either be compacted, dug out and replaced, or treated in situ (e.g. with lime) to ensure the subgrade meets the design requirements

Within the construction footprint, some sections of track within the existing non-operational Boggabilla rail corridor are raised on embankments. There may be an opportunity to reuse these existing embankments for the proposal, resulting in material and time savings. The anticipated methodology for reusing existing embankments is as follows:

- Removing track, sleepers and ballast from the existing embankment
- Clearing, grubbing and topsoil stripping
- Inspecting the consistency and strength of the existing embankment. If the consistency and strength are acceptable, the embankment may be reused for the proposal. In some cases, the embankment material may need to be blended with other material prior to reuse.

1.3.4 Track work

Existing bridges and culverts within the non-operational Boggabilla rail corridor are considered unsuitable for reuse as part of the proposal. Therefore, in advance of track work, bridges and culverts within the Boggabilla rail corridor must be demolished and relocated clear of work or offsite.

There are two widely accepted options for constructing new sections of rail track: using a track laying machine, or using an excavator with octopus attachments. During the feasibility design phase, an excavator with octopus attachments was identified as the preferred option. This option can pick up to six sleepers at once and spread them to the correct spacing.

An indicative construction methodology for track work is as follows:

- Placing the bottom layer of ballast
- Laying the sleepers at the required spacing
- Placing the rail - a rail handling yard is proposed near North Star (Ch 0.2 km). Rails delivered in short lengths (13.7 m to 27.5 m) can be welded into longer lengths within the rail handling yard.
- Clipping and welding of the rail
- Placing the top layer of ballast
- Tamping and profiling the ballast under and around the sleepers
- Rail adjustments and stressing.

Turnouts for the crossing loop will be constructed in-situ to avoid having to lift the switch and panels.

1.3.5 Drainage works – culverts

Culverts associated with the proposal will be a mix of reinforced concrete pipe culverts and reinforced concrete box culverts. Culvert installation will generally involve the following activities:

- Temporarily damming or diverting any water flows including sediment control structures
- Excavating to the required depth
- Placing and compacting the culvert bedding material
- Placing the pre-cast culvert structures, including the headwalls and aprons, on the bedding material and fastening them together
- Placing compacted backfill around and over the culvert
- Placing scour protection around the culvert
- Track works over the top of the culvert
- Restoring and revegetating disturbed areas.

Once installed, either side of culverts will be backfilled with support material for the culvert. Scour protection measures may also be installed upstream and downstream of culverts, on disturbed stream banks and around waterfront land to avoid erosion. The placement of scour protection measures will minimise obstructions to fish passage.

1.3.6 Drainage works – track drainage

Embankment and catch drains will be constructed along the proposed alignment, generally involving:

- Preparing survey control points for planned excavations
- Excavating material from the drain location
- Trimming and compacting the base and sides of the drain
- Lining the drain to prevent erosion (if required).

1.3.7 Bridge works

A total of 11 new bridges are proposed (refer Table 1.2), including an approximately 1.8 km long viaduct that crosses Whalan Creek, Tucka Tucka Road and the Macintyre River. The anticipated methodology for bridge construction works is as follows:

- Establishing bridge laydown areas
- Protective measures will be installed in downstream areas to prevent erosion and sedimentation of watercourses. The placement of protective measures will minimise obstructions to fish passage.
- Establishing working platforms for piling rigs and cranes
- Constructing substructure components, including piles, pile caps, piers, headstocks and abutments
- Lifting pre-cast concrete girders and deck components into place
- As all bridges are less than 20 m high, cranes will be used to lift the pre-cast components into place
- Earthworks needed to connect the main track to either end of the bridge
- Installing scour protection
- Placing ballast, sleepers and rail on top of the bridge
- Installing permanent fencing and signage
- Restoring and revegetating disturbed areas.

1.3.8 Road works

Construction works will be undertaken on the six roads listed in Table 1.3 to accommodate level crossings and rail over road bridges. During construction, road drainage will be installed such that the existing flood immunity of these roads will be maintained.

Table 1.3 Summary of proposed road works

Chainage (km)	Road	Infrastructure proposed	Description of proposed works
Ch 7.1	North Star Road	Level crossing	The vertical alignment will be amended to suit the rail level at this location. Access to the adjacent private properties will be re-configured to suit the level crossing and provide safe access across the corridor and to North Star Road.
Ch 12.2	Forest Creek Road	Level crossing	The vertical alignment will be amended to suit the rail level at this location. Safety upgrades are also proposed to bring the intersection with North Star Road up to the current Austroads standard.
Ch 19.9	North Star Road	Level crossing	The vertical alignment will be amended to suit the rail level at this location. Access to the adjacent private properties will be re-configured to suit the level crossing and provide safe access across the corridor, North Star Road and the TSR to the north.
Ch 25.6	Bruxner Way	Bruxner Way rail bridge	Realignment of Bruxner Way is required to accommodate the Bruxner Way rail bridge. Bruxner Way will be realigned to the east and then back to the existing Bruxner Way on a slight curve.
Ch 30.1	Tucka Tucka Road	Macintyre River viaduct	No changes to the existing Tucka Tucka Road alignment are proposed; however minor pavement works may be required to accommodate the Macintyre River viaduct.

The anticipated methodology for road works is as follows:

- Implementing traffic management measures
- Earthworks to establish the road formation. This may involve topsoil stripping, excavating, placing fill, compaction and/or subgrade treatment.
- Installation of culverts, headwalls and aprons
- Placing a select layer of earthworks materials on top of the road formation
- Placing and compacting the pavement layer (road base/gravel) over the select layer. This pavement layer may need to be sealed with bitumen.
- Once paving is completed, road furniture such as guard fencing, guide posts and traffic signs will be installed and lines would be marked on the road. Around active level crossings, flashing lights and boom barriers will also be installed.

1.3.9 Testing and commissioning

Testing and commissioning of the proposal will ensure that all infrastructure and systems have been designed, installed and operated according to the proponent's requirements.

1.3.10 Reinstatement

All temporary construction sites, including laydown areas, access tracks and borrow pits, will be rehabilitated having regard to their pre-construction condition and any arrangements with affected landowners. Reinstatement activities will occur progressively during the construction phase, usually involving the following activities:

- Demobilising laydown areas and associated facilities
- Removing all materials, waste and redundant structures from construction sites
- Decommissioning temporary fencing and access tracks that will not be used during the operation phase
- Installing permanent fencing
- Restoring disturbed areas, including erosion sediment control and revegetation where required.

A Reinstatement and Rehabilitation Plan and an Erosion and Sediment Control Plan will be prepared to guide the approach to reinstatement following the completion of construction.

1.4 Operation

The proposal will form part of the rail network managed and maintained by ARTC. Train services will be provided by a variety of operators. Trains will be a mix of grain, bulk freight and other general transport trains.

Inland Rail as a whole will be operational once all 13 sections are complete, which is currently estimated to be in 2027.

The proposal will involve operation of a single rail track with crossing loops, to accommodate double stacked freight trains up to 1,800 m long and 6.5 m high. Train speeds will vary according to axle loads and track geometry and will range from 80 to 115 km/hr. It is estimated that the proposal will run an annual average of about 32 train services per day in both directions (northbound and southbound) in 2027. This is then likely to increase to up to 47 per day in both directions in 2040 with current proposed infrastructure.

1.4.1 Maintenance of the proposal

During the operational phase standard maintenance activities will be undertaken, including:

- Bridge and culvert inspections
- Sleeper replacement
- Rail welding and grinding
- Ballast dropping and cleaning
- Track tamping and reconditioning
- Signalling systems and equipment maintenance.

2 Legislative context

2.1 Commonwealth and State legislation

This section describes the legislative, policy and management framework for the proposal, including:

- Legislative framework which applies to the assessment of ecological receptors applicable to the proposal at the Commonwealth and State levels, providing the statutory context for which the assessment has been undertaken
- Statutory approvals required as a result of potential impacts to terrestrial and aquatic ecology
- The approach to environmental offsets for significant residual impacts on BC Act listed ecological receptors and MNES.

An overview of the Commonwealth and State legislation that is relevant to environmental aspects of the proposal, is presented in Table 2.1.

Table 2.1 Legislation, policies, standards and guidelines relevant to the proposal

Legislation, policy or guideline	Intent and relevance to the proposal	Relevant report section
Commonwealth legislation		
Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act)	The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance (MNES). There are nine MNES to which the EPBC Act applies, these are: ■ World heritage properties ■ National heritage places ■ Wetlands of international importance ■ Listed threatened species and ecological communities ■ Migratory species ■ Commonwealth marine areas ■ Great Barrier Reef Marine Park ■ Nuclear actions ■ A water resource, in relation to coal seam gas and large coal mining development. The proposal has been referred (EPBC number: 2018/8222) to the Department of Agriculture, Water and the Environment (DAWE) and was determined to be a controlled action by the department on 12 June 2018. DAWE considers that the proposed action has the potential to significantly impact MNES and must therefore assess the significance of any potential impacts on MNES threatened species and communities. The EPBC Act controlling provisions for the proposed action are: ■ Listed threatened species and communities (section 18 and 18A). All MNES protected under the triggered controlling provisions are potentially relevant. The department considers that the proposed action has the potential to significantly impact the following: ■ Brigalow (*Acacia harpophylla* dominant and co-dominant) – endangered ■ Coolibah – Black box woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions – endangered ■ Natural grasslands on basalt and fine-textured alluvial plans of northern New South Wales and southern Queensland – critically endangered ■ Weeping myall woodlands – endangered ■ White box-Yellow box-Blakely's red gum grassy woodland and derived native grassland – critically endangered ■ Squatter pigeon (southern) (*Geophaps scripta scripta*) – vulnerable ■ Painted honeyeater (*Grantiella picta*) – vulnerable ■ Murray cod (*Maccullochella peelii*) – vulnerable ■ Large-eared pied bat (*Chalinolobus dwyeri*) – vulnerable ■ Corben's long-eared bat (*Nyctophilus corbeni*) – vulnerable	Refer Sections 7 and 10. Aquatic species refer to the EIS Appendix S: Aquatic Biodiversity Technical Report

Legislation, policy or guideline	Intent and relevance to the proposal	Relevant report section
	■ Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (*Phascolarctos cinereus*) – vulnerable ■ *Cadellia pentastylis* (Ooline) – vulnerable ■ *Dichanthium setosum* (Bluegrass) – vulnerable ■ *Homopholis belsonii* (Belson's panic) – vulnerable ■ *Tylophora linearis* (Slender tylophora*)* – endangered ■ Five-clawed worm-skink (*Anomalopus mackayi*) – vulnerable ■ Adorned delma (*Delma torquata*) – vulnerable ■ Dunmall's snake (*Furina dunmalli*) – vulnerable Note that this may not be a complete list and it is the responsibility of the proponent to ensure any protected matters under this controlling provision are assessed for the Commonwealth decision-maker's consideration. Migratory species are not a controlling provision for the proposal. The Bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment (the assessment bilateral agreement) is relevant to the proposal. The assessment bilateral agreement allows the Commonwealth Minister for the Environment to rely on specified environmental impact assessment processes of the State of New South Wales in assessing action under the EPBC Act. While offset obligations can be calculated in BAM credits for EPBC Act projects, the Commonwealth Minister or a delegate will approve this on a case by case basis. It has been noted in the SEARs that – "*A number of offsets options under the NSW Biodiversity Conservation Act 2016 will be acceptable for EPBC Act approval purposes. It is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action i.e. 'like for like'. Like-for-like includes protection of native vegetation that is the same EEC or habitat being impacted, or funding to provide a direct benefit to the matter being impacted i.e. threat abatement, breeding and propagation programs or other relevant conservation measures*".	
EPBC Act Environmental Offsets Policy (2012)	This policy outlines the Australian Government's approach to the use of environmental offsets under the EPBC Act. The Offsets assessment guide, which accompanies this policy, has been developed in order to give effect to the requirements of this policy, utilising a balance sheet approach to measure impacts and offsets. It applies where the impacted protected matter is a threatened species or ecological community. The policy applies to both project-by-project assessments and approvals under Parts 8 and 9 of the EPBC Act and to strategic assessments under Part 10 of the EPBC Act. Proposed new strategic assessments may consider alternative metrics other than the Offset assessment guide (e.g. if a jurisdiction has developed a metric tailored to their needs) provided the principles of this policy are met. This will be considered on a case by case basis. The offset principles of this policy are: 1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action; 2. Be built around direct offsets but may include other compensatory measures; 3. Be in proportion to the level of statutory protection that applies to the protected matter; 4. Be of a size and scale proportionate to the residual impacts on the protected matter; 5. Effectively account for and manage the risks of the offset not succeeding;	Refer Sections 10 and 12

Legislation, policy or guideline	Intent and relevance to the proposal	Relevant report section
	6. Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action); 7. Be efficient, effective, timely, transparent, scientifically robust and reasonable; 8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced. In assessing the suitability of an offset, government decision-making will be: 9. Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty; 10. Conducted in a consistent and transparent manner.	
State legislation, policies and guidelines (NSW)		
Environmental Planning and Assessment Act 1979 (EP&A Act)	The EP&A Act provides a statuary basis for planning and environmental assessment in NSW. The EP&A Act provides a framework for environmental planning and development approvals and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the proposal approval process. The objective of this Act that are relevant to biodiversity are as follows: ■ To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment ■ To protect the environment, including the conservation of native animals and plants (including threatened species), ecological communities and their habitats. The proposal is subject to assessment under Division 5.2 of the EP&A Act as it is State Significant Infrastructure. This report forms part of the assessment under the Act.	Refer Section 3.2
Biodiversity Conservation Act 2016 (BC Act)	The BC Act came into effect on the 25 August 2017 and repealed the *Threatened Species Conservation Act 1995* (TSC Act), the *Native Vegetation Act 2003* (NV Act) and components of the *National Parks and Wildlife Act 1974* (NPW Act) The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development (described in *the Protection of the Environment Administration Act 1991*) and Section 516A of the EPBC Act), and in particular: ■ To conserve biodiversity at bioregional and State scales, and ■ To maintain the diversity and quality of ecosystems and enhance their capacity to adapt to change and provide for the needs of future generations, and ■ To improve, share and use knowledge, including local and traditional Aboriginal ecological knowledge, about biodiversity conservation, and ■ To support biodiversity conservation in the context of a changing climate, and ■ To support collating and sharing data, and monitoring and reporting on the status of biodiversity and the effectiveness of conservation actions, and	Refer Sections 3, and 9

Legislation, policy or guideline	Intent and relevance to the proposal	Relevant report section
	■ To assess the extinction risk of species and ecological communities, and identify key threatening processes, through an independent and rigorous scientific process, and ■ To regulate human interactions with wildlife by applying a risk-based approach, and ■ To support conservation and threat abatement action to slow the rate of biodiversity loss and conserve threatened species and ecological communities in nature, and ■ To support and guide prioritised and strategic investment in biodiversity conservation, and ■ To encourage and enable landholders to enter into voluntary agreements over land for the conservation of biodiversity, and ■ To establish a framework to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity, and ■ To establish a scientific method for assessing the likely impacts on biodiversity values of proposed development and land use change, for calculating measures to offset those impacts and for assessing improvements in biodiversity values, and ■ To establish market-based conservation mechanisms through which the biodiversity impacts of development and land use change can be offset at landscape and site scales, ■ To support public consultation and participation in biodiversity conservation and decision-making about biodiversity conservation, and ■ To make expert advice and knowledge available to assist the Minister in the administration of this Act. From 25 August 2017, provisions in the TSC Act dealing with assessment of impacts on threatened species, populations and ecological communities were repealed and replaced by provisions in the BC Act. The BC Act requirements for impact assessment are significantly different as they introduce the Biodiversity Offsets Scheme (BOS).	
Biodiversity Conservation Regulation 2017 (BC Regulation)	Provides further regulation under the BC Act, particularly related to: ■ The protection of native animals and plants ■ The declaration of areas of outstanding biodiversity value ■ The listing criteria for threatened species and ecological communities, ■ Private land conservation agreements ■ The biodiversity offsets scheme established by the Act and the Biodiversity Stewardship Payments Fund under the scheme ■ Biodiversity assessments and approvals under the Environmental Planning and Assessment Act 1979 ■ The biodiversity certification of land ■ Public consultation ■ The Biodiversity Conservation Trust ■ Regulatory compliance mechanisms ■ The retention, destruction or disposal of seized animals, plants or other things under the Act ■ Criminal proceedings ■ Other matters.	Refer Sections 3.2.1, 9 and 12

Legislation, policy or guideline	Intent and relevance to the proposal	Relevant report section
Local Land Services Act 2013 (LLS Act)	The LLS Act provides a governance framework and statutory corporation (Local Land Services) responsible for the delivery and management of local land services in the social, economic and environmental interests of the state. The LLS Act defines Category 1 – Exempt Land. Exempt or Category 1 lands are areas which are exempt from assessment under the BAM and include areas used for sporting grounds, quarries, perennial and seasonal horticulture and irrigated cropping. Category 1 land mapping has not been released for the area of NSW in which the project is located therefore in agreement with BCSD an agreed mapping methodology has been developed for use within this assessment, areas which meet the definition of Category 1 land are labelled as Managed land in this report. Details of this assessment are located in Section 3	Refer Section 9.1.1
Biosecurity Act 2015	Under the *Biosecurity Act,* all native and non-native plants are regulated with a general biosecurity duty "*to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.*" Declared weeds are known to occur within the proposal area and will be considered in weed mitigation measures.	Refer Sections 5.2.5, 6.5 and 8.3.4
Biodiversity Assessment Method (BAM)	The BAM is the assessment manual (DPIE 2017, DPIE 2020b) that outlines how an accredited person assesses impacts on biodiversity at development sites and stewardship sites. It is a regulatory document that provides: ■ A consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site, ■ Guidance on how a proponent can avoid and minimise potential biodiversity impacts, and ■ The number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity. An accredited assessor must apply the BAM. The assessor documents the results of the biodiversity assessment in a Biodiversity Development Assessment Report (BDAR). The BDAR identifies how the proponent proposes to avoid and minimise impacts, any potential impact that could be characterised as serious and irreversible according to specified principles and the offset obligation required to offset the likely biodiversity impacts of the development or clearing proposal, expressed in biodiversity credits. Vegetation assessments and biodiversity assessments contained in this report have been completed by an accredited assessor.	Refer Sections 3,4,5,6 and 9

3 Methods

3.1 Overview of assessment methodologies

The assessment of biodiversity components for the proposal listed under the BC Act was undertaken using the BAM (refer Table 3.1). Where an ecological receptor was not assessed under the BAM, different assessment pathways were applied to according to the relevant legislation such as EPBC and FM Acts, as required for compliance with the SEARs. All ecological receptors assessed under the FM Act are covered in the EIS Appendix S: Aquatic Biodiversity Technical Report.

All ecological receptors regulated under the BC Act, impact significance was assessed using methodologies prescribed by the BAM (as required under the *Biodiversity Conservation Act 2016*) (refer Section 3.1.1), and for ecological receptors regulated under the EPBC, assessments were undertaken in accordance with a Significant Impact Assessment Methodology (SIAM) (refer Section 10).

An ecological receptor is a feature, area or structure that may be affected by direct or indirect changes to the environment, including ecological receptors identified by the SEARS such as threatened species and ecological communities. Sections 3.1.1 and 10.1 describe the BAM and SIAM methodologies in more detail. All identified ecological receptors were assessed for cumulative impacts (refer Section 3.1.2).

Table 3.1 Assessment methodologies with corresponding legislation and relevant ecological receptors

Assessment methodology	Legislation associated with ecological receptor	Ecological receptor
Biodiversity Assessment Method (BAM) (refer Section 3.1.1)	*Biodiversity Conservation Act 2016* (BC Act)	Threatened flora and fauna
		Habitat for threatened species
		BC Act listed TECs
		Native vegetation
SIAM using magnitude and sensitivity (refer Section 10.1)	*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	Threatened flora and fauna (EPBC Act)
		EPBC Act listed TECs
Cumulative impact assessment (refer Section 3.1.2)	BC Act and EPBC Act	Threatened flora and fauna
		Habitat for threatened species
		TECs
		Native vegetation

3.1.1 Biodiversity Assessment Method

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land in order to:

- Identify areas of managed land which does not require further assessment
- Identify the biodiversity values on land subject to proposed development, clearing, or land in a biodiversity certification assessment area, or land proposed as a biodiversity stewardship site
- Determine the impacts of proposed development, or clearing or biodiversity certification on biodiversity values
- Quantify and describe the biodiversity credits required to offset the residual impacts of proposed development or clearing or conferral of biodiversity certification on biodiversity values
- Quantify and describe the biodiversity credits that can be created at a biodiversity stewardship site from the improvement in biodiversity values from management actions undertaken at the site.

Where required under NSW legislation, the BAM is used to assess terrestrial biodiversity values on a proposed development site or proposed clearing site or land proposed for biodiversity certification. It must also be used to assess the biodiversity values on land proposed to be secured under a biodiversity stewardship agreement. The terms development, development footprint and development site are also taken to include clearing, clearing footprint and clearing site respectively, except where the reference is to a small area development or a major project development. The BAM defines the 'subject land' as the land subject to a development, which is the construction footprint needed to construct and operate the proposal. For the purposes of this assessment and following the precautionary principle, impacts to the maximum disturbance area within the subject land, including proposed borrow pits, temporary and permanent disturbance, were assessed. This information is provided in the form a BDAR as per Appendix 10 of the BAM (refer Table 3.2).

The assessment requirements set out in the BAM enable the survey and assessment effort to be scaled depending on the level of risk posed by the impact of the development, the availability and quality of existing information such as native vegetation maps, and the area of land that is being assessed.

Table 3.2 Checklist indicating compliance with Biodiversity Assessment Method and location of information

BDAR reporting requirement as per Appendix 10 of the BAM	Location within this document
Introduction including operational and construction footprint	Section 1.2.1 and Section 1.3
Site Map	Figure 1.1
Location Map	Figure 1.1
Identification of landscape features including IBRA bioregion and subregion identification	Section 4.1 and Appendix A
Native vegetation including class, type, area, and species relied on for PCT identification, TEC status, percent cleared value of PCT	Section 5.2
Map of PCTs, PCT zones, Patch size (to> 100ha) and plot locations	Figure 3.5 and Appendix A Map A.3
Map of TECs	Appendix A Map A.5
Field Plot data sheets	Appendix B and supplied to DPIE
Description of survey effort	Section 3.4, Section 3.5 and Appendix A, Appendix B, Appendix D and Appendix F
Vegetation integrity scores	Section 9 and Table 9.4
Candidate species	Section 6.1, 6.2 and Table 6.3
Table of ecosystem credit species and associated PCTs	Section 6.1 and Table 6.1
Justification for any exclusions of ecosystem credit species	Section 6.1, Table 6.2 and Appendix G
Table of species credit species, biodiversity risk rating and associated PCTs,	Section 6.2 and Table 6.3
Justification for any exclusions of species credit species	Section 6.2, Table 6.2and Appendix G
Species credit species polygon maps	Section 6.2.4, Appendix A and Appendix F
Targeted survey effort	Section 3.3, Table 3.12 and Appendix D
Table of species habitat features and abundance on site	Appendix D
Demonstration of efforts to avoid and minimise impacts upon biodiversity values	Section 8.6
Table of measures to be implemented before, during and after construction	Table 8.4 and Table 8.5
Map of final project footprint including segmentation	Figure 1.1
Identification of SAII	Section 9.2
Map of any SAII	Appendix A Map A.8 (flora) and Appendix F Map D.2 (fauna)
Identification of impacts requiring offset, impacts not requiring offset and areas not requiring assessment	Section 9.1.2

BDAR reporting requirement as per Appendix 10 of the BAM	Location within this document
Map of impacts requiring offset	Appendix A Map A.7
Map of areas not requiring offset	Appendix A Map A.6
Map of area not requiring assessment	Appendix A Map A.4
Impact summary	Section 9, Section 10 and Section 11
Table of PCTs requiring offset and the number of ecosystem credits required	Table 9.5 and Table 9.6
Table of threatened species requiring offset and the number of species credits required	Table 6.5 and Table 6.7
Table of scattered paddock tree credits required	Table 9.7
Table of credit classes and matching credit profile	Table 6.1, Table 6.2 and Table 9.7

Impacts of development, clearing or certification on biodiversity values, or gains in biodiversity values at biodiversity stewardship sites are measured in biodiversity credits. There are two broad categories of classes of biodiversity credit for the purposes of measuring impact or gain – *ecosystem credits* and *species credits*. The BAM will step through the credit class category that is created or required for certain kinds of impact or gain. Each credit is assigned attributes to determine whether a particular credit within a class is 'like' another credit in the same class for the purpose of applying the like for like rules and variation rules set out in the BC Regulation. A class of credits is formed where the biodiversity credit shares the same attributes. Ecosystem credits have seven shared attributes. For species credits, the only shared attribute is the name of the threatened species. Attributes are considered when determining suitable like-for-like offset credits.

The BAM incorporates three distinct stages (refer Figure 3.1):

- **Stage 1: Assessment of Biodiversity Values** - involves a desktop and fieldwork-based assessment of biodiversity values within and adjacent to the subject land, staged as follows:
  - Desktop review – initially completed October 2018 and reconfirmed February 2021
  - Landscape features and site context – initially completed 2019 and reconfirmed February 2021
  - Habitat suitability – initially completed 2019 and reconfirmed February 2021
  - Field Validation – completed in multiple stages between October 2018 and March 2021.
- **Stage 2: Impact Assessment** - involves the assessment of proposed impacts on biodiversity values identified in Stage 1. Impact assessment follows the mitigation hierarchy of avoid, minimise then mitigate, and was staged as follows:
  - Avoidance and minimisation of impacts – Alignment selection completed for the EIS (ARTC 2020). Optimisation and reduction of borrow pit, laydown, temporary access completed December 2020 to April 2021
  - Assessment of impacts and mitigation measures – Initially completed August 2020. Revisited April 2021
  - Thresholds for the assessment and offsetting – Initially completed August 2020. Revised April 2021.
  - Documentation of Impact Assessment – August 2020. Revised 2021 to incorporate additional targeted survey results from September 2020 to March 2021
- **Stage 3 Improving Bio-diversity values** – occurs during the detailed design phase following submission of the EIS and is not contemplated as part of this BDAR

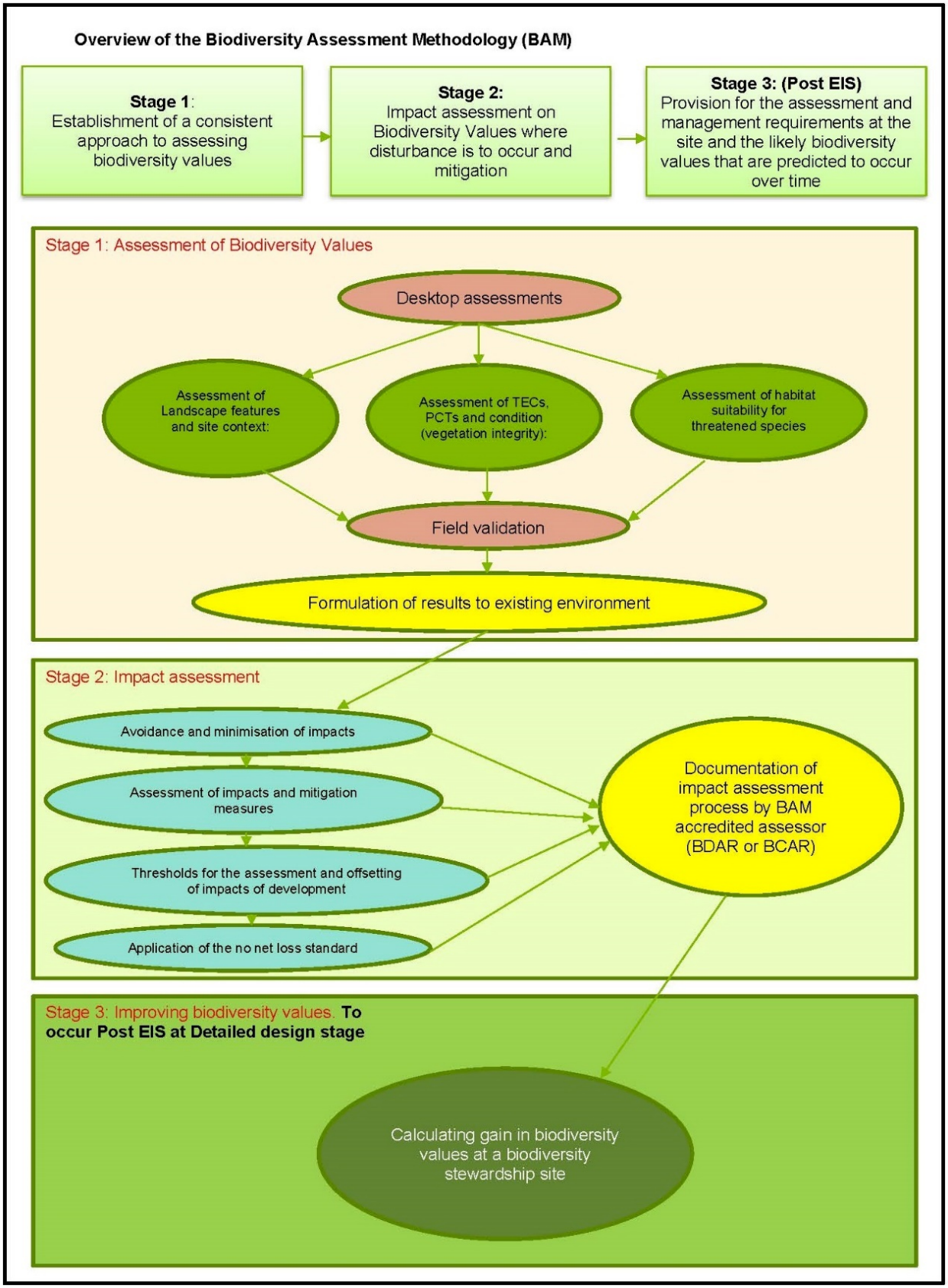


Figure 3.1 **Biodiversity Assessment Method approach**

Under the BAM the proponent must describe the area within the disturbance footprint plus a 500 m buffer when describing a linear alignment such as the proposed greenfield, brownfield and early works alignment segments of the proposed rail line. For non-linear infrastructure or development a 1,500 m buffer is required such as for the proposed borrow pit areas for this proposal. For the purposes of this report the disturbance footprint plus the required buffer areas required for the BAM assessment are hereon referred to as the study area. As it is envisaged that not all borrow pits will be utilised and that those which are, will be commissioned at different stages of the project, each borrow pit has been assessed as a separate 'project' to ensure the correct number of BAM plots and targeted surveys have occurred. This has allowed for both cumulative impacts to be assessed over the North Star to Border brownfield, greenfield and early works segments of the rail alignment, as well targeted assessment of the localised impacts associated with each borrow pit.

As the potential borrow pits have been assessed individually, they have a 1,500 m assessment buffer, where Borrow Pit 7 intersects with the alignment the assessment has included a 500 m buffer for the alignment and a 1,500 m buffer for the borrow pit. The assessment for the alignment was conducted separately to that of Borrow Pit 7 and as such has separate BAM plots associated with it. This will make any offsets associated only with Borrow Pit 7 or the alignment easier to separate should Borrow Pit 7 not/be only partially utilised for the project.

3.1.2 Cumulative impact assessment

When numerous projects occur in a region they can cause cumulative impacts. Cumulative impacts:

- May differ from those of an individual project when considered in isolation
- May be positive or negative
- Have a severity and duration that depends on the spatial and temporal overlap of projects occurring in a region.

This cumulative impact assessment only deals with:

- Projects that have been approved but where construction has not commenced
- Projects that have commenced construction
- Projects that have only recently been completed
- Projects that are currently being assessed as State significant infrastructure within Gwydir, Moree Plains and Inverell local government areas or Coordinated Projects in Goondiwindi local government area.

For the purpose of this assessment, the cumulative impact assessment area is defined as the spatial area of influence which is determined by each of the environmental and social issues being assessed for the proposal. The area of influence (AOI) considered in the assessment included state significant infrastructure projects within 300 km.

This cumulative impact assessment has been prepared in accordance with the SEARs, which requires:

> *'An assessment of the cumulative impacts of the project considering other projects that have been approved but where construction has not commenced, projects that have commenced construction, and projects that have recently been completed*.'

3.1.2.1 Project selection

Projects included in the cumulative impact assessment are:

- **Projects outside the overall Inland Rail Program of works.** Only state significant infrastructure projects under Division 5.2 of the EP&A Act, and other 'strategic' projects in the public domain as being planned, constructed or operated at the time the SEARs were issued, have been included in the cumulative impact assessment. Where additional projects worthy of inclusion were identified, the Secretary of the NSW Department of Planning and Environment was consulted for a determination on whether or not to include the project.
- **Inland Rail projects immediately adjacent to the proposal**. This included the Narrabri to North Star and the NSW/QLD Border to Gowrie projects of Inland Rail.

Projects that were excluded from the cumulative impact assessment are:

- Existing projects within the proposal subject land.
- Proposed projects that have not been developed to the point that their environmental assessment process has been made public.

Based on the above criteria, the projects that have been included in the cumulative impact assessment are summarised in Table 3.3. The location of each project is shown in Figure 3.2.

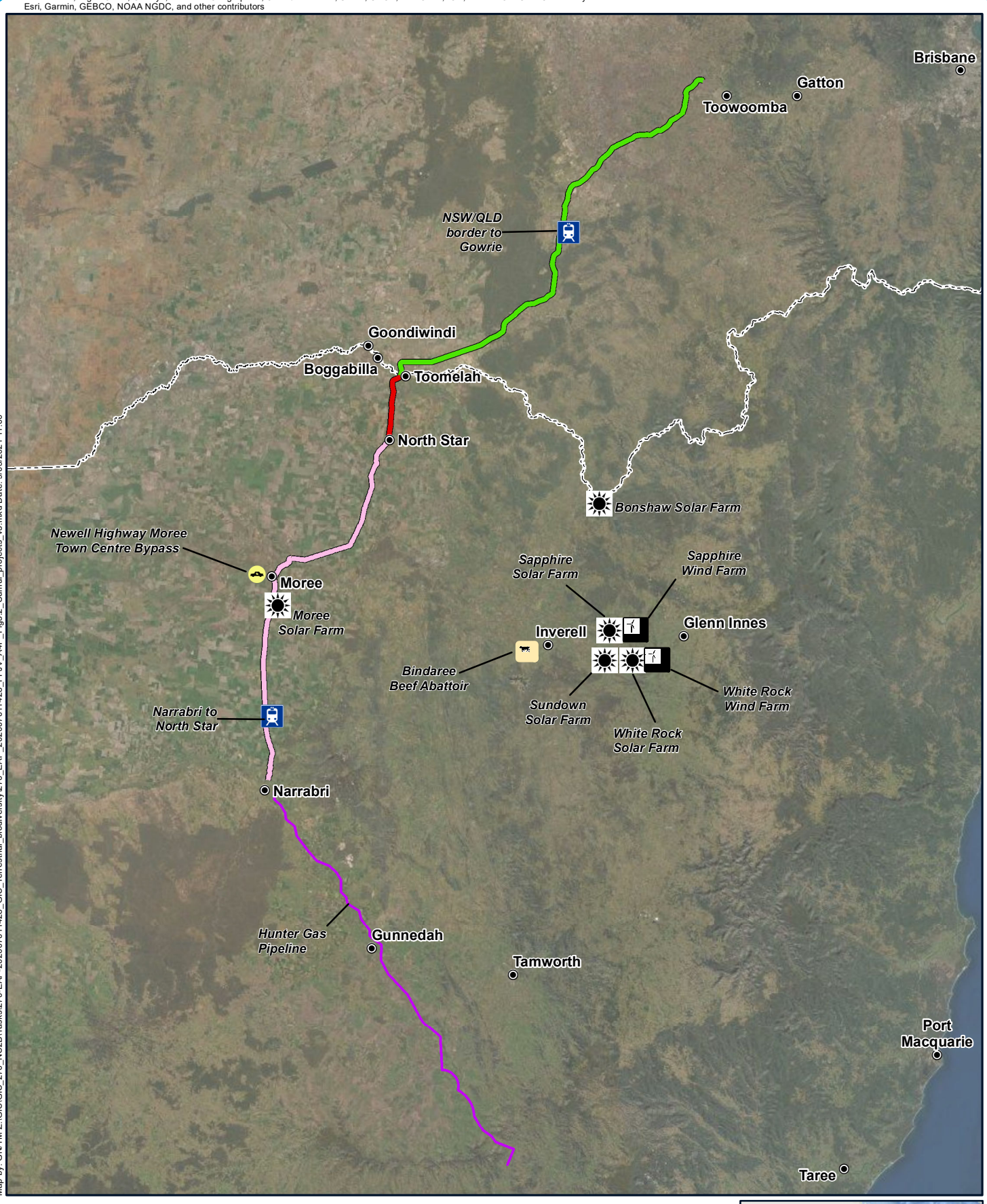
Table 3.3 Projects to be included in cumulative assessment

Project and proponent	Location	Description	EIS status	Construction dates	Construction jobs	Operation years	Operation jobs	Selection criteria	Relationship to the proposal	Distance from the proposal (km)
Border to Gowrie – Inland Rail (ARTC)	NSW/QLD Border to Gowrie	Approximately 146 km of new dual gauge track and 78 km of upgraded track from the NSW/QLD border, near Yelarbon, to Gowrie Junction, north west of Toowoomba in QLD	Project referred to Commonwealth Minister for the Environment	2021 to 2025	1,600	-	TBA	b)	Potential overlap on construction commencement for Border to Gowrie and finalisation of North Star to Border	0 (adjacent)
Narrabri to North Star – Inland Rail (ARTC)	Narrabri (NSW) to the village of North Star in NSW	An upgrade to approximately 188 km of track within the existing rail corridor and construction of approximately 1.6 km of new rail corridor	Proponent reviewing submissions	Mid 2018 to 2020	TBA	-	TBA	b)	Potential overlap of finalisation of Narrabri to North Star and commencement of North Star to Border construction	0 (adjacent)
Moree Solar Farm	10 km south of Moree, off the Newell Highway in Northern NSW	Construction of a 56 Mwac/ 70.1 MWdc single axis tracking solar PV facility. Construction works currently involve the installation of the framing system which consists of the BladePiles and the NexTracker tracking systems, the JA Solar photovoltaic modules, the DC and AC wiring of the electrical equipment, the 22/66 kV on-site substation and the 66 kV transmission line	Approved by the NSW Major Projects Office on 17/07/2011	2018 to 2022	1,050	-	10 – 12	c)	Potential increase of traffic on the Newell Highway. Construction of Moree Solar Farm is scheduled around the peak visitation to Moree in autumn	79

Project and proponent	Location	Description	EIS status	Construction dates	Construction jobs	Operation years	Operation jobs	Selection criteria	Relationship to the proposal	Distance from the proposal (km)
Newell Highway Moree Town Centre Bypass	Moree	Construction of a 4.4 km two-lane bypass of the Moree town centre	Approved by the NSW Major Projects Office on 20 July 2004. Latest modification 8 approved 7 July 2010	-	-	-	-	c)	Potential increase of traffic on the Newell Highway	72
Bindaree Beef Abattoir – Rendering Plant and Bio-digester Plant	Bindaree Beef Abattoir, Inverell	The proposed project involves the installation of a wastewater treatment system (bio-digester) and new render plant facility to reduce odour and carbon emissions at its existing abattoir site. The bio-digester generates a bio-gas from waste and waste water which would then be reused at the site	Approved by the NSW Major Projects Office on 10 December 2014	12 months construction. Start date unknown	60	-	-	c)	Potential conflict or demand for construction resources if projects overlap. Increase of traffic volumes on the Gwydir and Newell Highway	104
Queensland -Hunter Gas Pipeline	Wallumbilla to Newcastle	420 km gas pipeline from the Narrabri Gas Project to Newcastle via, Gunnedah, Quirindi, Scone, Muswellbrook, Singleton and Maitland	Project determined under Part 3A – now transitioned to SSI	From approval, approximately 8 months of construction	600	-	150	c)	If construction occurs at the same time, there is potential for increase in traffic using similar routes and demand for construction resources and personnel	156
White Rock Solar Farm	20 km south-west of Glen Innes, 40 km east of Inverell NSW	Establishment of a 20-megawatt solar farm and associated infrastructure	Approved by the NSW Major Projects Office 14 June 2016	Construction forecast to take 6 months	50	25	TBA	c)	Potential increase in road traffic on the Gwydir Highway and the Newell highway	137

Project and proponent	Location	Description	EIS status	Construction dates	Construction jobs	Operation years	Operation jobs	Selection criteria	Relationship to the proposal	Distance from the proposal (km)
White Rock Wind Farm	20 km south-west of Glen Innes, 40 km east of Inverell NSW	Stage 2 of White Rock Wind Farm upgrades will consist of up to 48 turbines, producing up to 202 MW of clean renewable electricity	Approved by Major Projects Office on 10 July 2012	Late 2018	100	30	20	c)	Potential increase in road traffic on the Gwydir Highway and the Newell highway	142
Sundown Solar Farm	South of Gwydir Hwy, 30 km east of Inverell (NSW)	The project consists of a large-scale solar photovoltaic generation facility, including battery storage and associated infrastructure, with an estimated maximum capacity of up to 600 MW, enough to power over 250,000 homes	SEARs issued by Major Projects Office	2019 to 2023	-	-	-	c)	Potential increase in road traffic on the Gwydir Highway and the Newell highway	133
Bonshaw Solar Farm	Bruxner Way, 16 km south of Bonshaw and 66 km north of Inverell (NSW)	GAIA Australia is proposing to develop a large scale solar photovoltaic generation facility and associated infrastructure with a capacity of 500 MW	SEARs issued by Major Projects Office	Mid 2019 to 2021	-	25	-	c)	Potential increase of traffic on the Bruxner Way. North Star to Border alignment crossed the Bruxner Way. Deconfliction at construction times may be required.	86
Sapphire Solar Farm	Project in the Kings Plains, Wellingrove and Sapphire areas, approximately 28 km east of Inverell and 18 km west of Glen Innes.	A 200 MW hybrid solar and battery power facility	Approved by the NSW Major Projects Office on 16 August 2018	2019 to 2020	200	25	150	c)	Potential increase of traffic on the Gwydir and Newell Highway	124

Project and proponent	Location	Description	EIS status	Construction dates	Construction jobs	Operation years	Operation jobs	Selection criteria	Relationship to the proposal	Distance from the proposal (km)
Sapphire Wind Farm	Project in the Kings Plains, Wellingrove and Sapphire areas, approximately 28 km east of Inverell and 18 km west of Glen Innes.	Construction of a 238 to 425 MW capacity wind farm (between 125 and 159 turbines)	Approved by the NSW Major Projects Office on 26 June 2013	TBA	-	-	-	c)	Potential increase of traffic on the Gwydir and Newell Highway	119



Legend

- Localities
- North Star to NSW/QLD border alignment
- NSW/QLD border to Gowrie alignment
- Narrabri to North Star alignment
- Hunter gas pipeline
- NSW/QLD border



A4 scale: 1:2,300,000

0 20 40 60 80 100km

Future Freight
Integrating Community, Environment and Engineering

Date: 9/03/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.2:
Cumulative impact projects

3.1.2.2 Approach

The approach used to identify and assess potential cumulative impacts of this proposal provided within this technical report is summarised below.

- A review of the potential impacts identified within the EIS assessments
  - The environment at the time of the EIS SEAR is the baseline, prior impacts from past land use has not be considered
- A register of assessable projects has been collated with timelines to demonstrate the temporal relationship between projects. This has included:
  - Identification of projects outside of the Inland Rail Program
    - Only 'state significant' or 'strategic' projects that are in the public domain as being planned, constructed or operated at the time of the EIS SEARs have been considered
  - The Inland Rail projects immediately adjacent to the project within the assessment
    - For this Project, the Narrabri to North Star Inland Rail Project and Border to Gowrie Inland rail Project have been considered
- Identification and mapping of the assessable projects and the areas of influence of the aspect being considered
  - Current operational projects and commercial or agricultural operations that are in the areas of influence around the Project are accounted for in the corresponding technical baseline studies (e.g. air, noise, social, economic, etc.)
- Where there is a potential overlap in impacts (either spatially or temporally), a cumulative impact assessment has been undertaken to determine the nature of the cumulative impact. This includes:
  - Where possible the assessment method has been quantitative in nature, but qualitative assessment has also been undertaken
  - Where quantitative assessment is possible, the significance of impact should be assessed in comparison to the same criteria or guidelines as adopted by the relevant technical impact assessments
  - Where the impacts are expressed qualitatively, the probability, duration, and magnitude/intensity of the impacts should be considered as well as the sensitivity and value of the receiving environmental conditions.

The significance of the impact has been determined by using professional judgement to select the most appropriate relevance factor for each aspect in Table 3.4 and summing the relevance factors. The sum of the relevance factors determines the impact significance and consequence which are summarised in Table 3.5.

Table 3.4 Assessment matrix

Aspect	Relevance factor		
	Low	Medium	High
Probability of impact	1	2	3
Duration of impact	1	2	3
Magnitude/Intensity of impact	1	2	3
Sensitivity of receiving environment	1	2	3

Table 3.5 Impact significance

Impact significance	Sum of relevant factors	Consequence
Low	1 to 6	Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.
Medium	7 to 9	Mitigation measures likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
High	10 to 12	Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

3.2 Desktop assessment

3.2.1 Database review and background research

Existing information on the terrestrial biodiversity of the subject land was obtained from a range of sources, including databases, aerial photographs and maps.

Previous documents and reports relevant to the subject land were reviewed, including regional and sub-regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys, and relevant ecological database searches.

Aerial imagery for the subject land was reviewed to identify land use patterns, extent of vegetation, relevant landscape/catchment matters and possible issues for the area.

As a matter of best practice, the desktop information listed below was reviewed. The review of literature included a desktop mapping (10 km buffer – referred to as the search area) and analysis exercise that examined available data for the subject land. Data sets, documents and other resources analysed included:

- NSW Environment, Energy and Science (EES) BioNet Wildlife Atlas threatened species records (accessed 24 February 2021)
- EPBC Act Protected Matters Search Tool (accessed 24 February 2021)
- Commonwealth, NSW and local legislation and planning instruments
- Ramsar and Directory of Important Wetlands in Australia (DIWA) wetlands, and drainage mapping
- State Vegetation Type Map
- Secretary's Environmental Assessment Requirements (SEARs)
- Any relevant previous ecological assessments conducted for the site or adjacent areas.

Details of the existing literature and previous study reports which have been reviewed for the desktop assessment are summarised in Table 3.6. The reports informed recent records of threatened species which may not have been updated on government databases at the time of database searches.

Table 3.6 Proposal related assessments and reports

Document title	Reference	Major findings
North Star to NSW/QLD Border Project Study Area Selection Report	ARTC 2018	▪ Alternative alignment options considered through Multi-Criteria Analysis (MCA) ▪ Preferred study area identified in May 2017 workshop Study area up to 2 km wide to allow for future alignment changes following Phase 2 Feasibility Assessment
Melbourne to Brisbane Inland Rail, 2016 Phase 1 Continuity Alignment Report, North Star to Yelarbon	WSP/PB 2017	▪ MCU comparison of east and west possible alignments ▪ Confirmation of North Star to Border investigation area (west) Investigation area includes two possible alignments to cross the Macintyre River

Document title	Reference	Major findings
Melbourne to Brisbane Inland Rail, 2016 Phase 2 Preparatory Alignment Assessment Report, North Star to Yelarbon	WSP/PB 2017a	▪ 6 km wide study area within the west option created to investigate possible Macintyre River crossing locations River crossing study area reduced to 2 km to allow further refinement
Narrabri to North Star Project, Environmental Impact Statement. Technical Report 2: Biodiversity Assessment Report	ARTC 2017	A Biodiversity Assessment Report identified the following offset requirements for the N2NS project: ▪ 18,826 ecosystem credits required for eight TECs ▪ 364 species credits for *Digitaria porrecta* (Finger panic grass) ▪ 2,607 species credits for *Desmodium campylocaulon* (Creeping tick-trefoil) ▪ 1,898 species credits for *Homopholis belsonii* (Belson's panic) ▪ 1,632 species credits for Koala (*Phasolarctos cinereus*)

3.2.2 Directory of Important Wetlands

The Directory of Important Wetlands in Australia (DIWA) identifies important wetland such as Ramsar sites. Additional detailing of inland wetlands includes permanent rivers and streams, seasonal and irregular rivers and streams, riverine floodplains, permanent freshwater lakes, seasonal/intermittent freshwater lakes and freshwater swamp forest and others.

3.2.3 Groundwater dependent ecosystems

An assessment of potential groundwater dependent ecosystems (GDEs) was undertaken via review of the following data sources:

- Relevant NSW Water Sharing Plans (which include scheduled listings of high priority GDEs
- Bureau of Meteorology Groundwater Dependent Ecosystems Atlas.

The Bureau of Meteorology Groundwater Dependent Ecosystems Atlas was accessed to assess potential GDEs within or near the proposal site. An approximate 2 km radius around the alignment centreline was reviewed for potential GDEs as a conservative approach to assess potential impacts on ecological receptors. Detailed figures of potential GDE locations are provided elsewhere within the technical report for Groundwater (refer EIS Chapter 14: Groundwater).

3.2.4 Landscape features and context

3.2.4.1 Identifying landscape features

As per Section 4.2 of the BAM, landscape features within the subject land and the 500 m (greenfield, brownfield and early works segments of the alignment) or 1,500 m (borrow pit) buffer areas were determined through reviewing aerial photography and relevant GIS layers. Landscape features that were reviewed included:

- NSW Interim Biogeographic Regions of Australia (IBRA region and sub-region) – version 7
- NSW (Mitchell) landscapes
- Rivers, streams and estuaries
- Wetlands within, adjacent to and downstream of the sites
- Connectivity of areas of habitat including areas identified as priority investment areas, flyways for migratory species

- Any relevant previous ecological assessments conducted for the site or adjacent areas
- Areas of geological significance and soil hazard features
- Areas of Outstanding Biodiversity Value
- Percent native vegetation cover
- Cleared areas.

3.2.4.2 Determining the site context

Determining the 'site context' is calculated by assessing the percent native vegetation cover and patch size in accordance with Subsections 4.3.2 and 5.3.2 of the BAM guidelines (OEH 2020b).

3.2.4.3 Percent native vegetation cover

Percent native vegetation cover is calculated by estimating the amount of native vegetation (both woody and non-woody vegetation inclusive of regrowth of species native to NSW) that remains within the buffer of the subject land and subject land itself. In accordance with Section 4.3.2.2 of the BAM, native over-storey vegetation was used to determine percent cover in woody vegetation types.

To determine native over-storey percent cover, vegetation zones containing a broad vegetation condition of high and medium were used as a proxy of vegetation containing native over-storey within the subject land. Three non-woody vegetation types occur within the subject land these include Lignum Swamp, a small Ephemeral Wetland and Native Grasslands.

3.3 Consultation with government agencies

Throughout the assessment process open communication has been conducted with both state and federal assessment agencies. A table of major communications and meetings is shown below.

Table 3.7 Consultation with government agencies

Date	Issue raised	Agency/Staff	ARTC/FFJV staff	Outcome
3 March 2020	Assessing EPBC listed entities using BAM and Adverse Impacts Assessment Methodology (since removed)	DAWE S Zafrin A Dunbar K Dunstal	Ben Lippett Sarah Glauert Chris Schell	Approval to use the information from the BAM targeted surveys to inform Adverse Impacts Assessment Methodology for assessment of EPBC listed entities
June 2020	BCSD requested that BCSD and P&A Group should meet with the proponent and their BAM accredited assessors to seek clarity on the assessment methodology used in the Biodiversity Technical Report.	BCSD Renee Shepherd	Sarah Glauert Ben Lippett Steve Robertson Ron Dela Pena	Complete – meetings occurred on 18 and 25 June 2020. Table 1 added to the Executive Summary stating where the minimum BDAR requirements are addressed throughout the BDAR.
13 September 2020	Survey timing for the Pine donkey orchid following prolonged drought	BCSD Renee Shepherd	Sarah Glauert	Timing is suitable to conduct survey for Pine donkey orchid as it is flowering in other areas

Date	Issue raised	Agency/Staff	ARTC/FFJV staff	Outcome
17 December 2020	EPBC listed Poplar Box grassy woodland	BCSD Renee Shepherd Ben Ellis	Sarah Glauert Steve Robertson Ron Dela Pena	Confirmation email that the EPBC listing of Poplar Box woodland does not need to be considered as it occurred after the Controlled Action decision was made
18 December 2020	Category 1 vegetation	BCSD Renee Shepherd Ben Ellis	Sarah Glauert Roisin Feeney Ron Dela Pena	Confirmation of approved methodology for mapping of Category 1 land
1 February 2021	Bristle faced free-tailed bat	BCSD Renee Shepherd	L Fisher Sarah Glauert	Confirmation of proposed bat survey methodology
4 February 2021	Belson's panic & Eastern pygmy possum	BCSD Renee Shepherd Ben Ellis	Sarah Glauert Roisin Feeney Ron Dela Pena	Mapping advice on Belon's panic and further survey requirements for Eastern pygmy possum
12 February 2021	Pale imperial hairstreak survey methodology	BCSD Renee Shepherd T Mazzer	Sarah Glauert Roisin Feeney D Fleming. Ben Lippett	Updated survey methodology requirements for Pale Imperial Hairstreak
15 February 2021	Pale Imperial Hair Streak survey methodology	BCSD Renee Shepherd T Mazzer	Sarah Glauert Roisin Feeney D Fleming Ben Lippett	Updated survey methodology requirements for Pale Imperial Hairstreak
22 February 2021	Request for approval for the delivery of an Addendum to this BDAR to cover findings of Pale imperial hairstreak and Pale-headed snake surveys	BCSD Renee Shepherd Ben Ellis	Sarah Glauert Steve Robertson Ron Dela Pena Roisin Feeney D Fleming. Ben Lippett	Approval granted to provide an Addendum to this report to cover findings of final of Pale imperial hairstreak and Pale-headed snake surveys
7 April 2021	Discussion on BDAR delivery and incorporation of addendum	BCSD Renee Shepherd	Roisin Feeney Ben Lippett Wayne Window Alexander Scott Steve Robertson Ron Dela Pena	Timing of BDAR discussed. Advice that a consolidated BDAR would be preferred rather than addendum if timing worked
13 April 2021	Data set discrepancy discussion and understanding of Department data validation protocols	BCSD Ben Ellis Renee Shepherd	Ron Dela Pena Steve Robertson Liam Stephen Wayne Window Ina Weinheimer Michael Fleming	Understanding of BCD data requirements and BDAR review protocols

3.4 Terrestrial flora surveys

3.4.1 Mapping and identification of Plant Community Types and Managed land

Initial surveys to confirm and map PCTs were undertaken using a rapid vegetation assessment (Rapid Data Points (RDPs)) process. The results of this survey were compared with the NSW Vegetation Information System (VIS) to determine accuracy of existing mapping. Vegetation communities and potential TECs were compared with detailed descriptions of PCTs and TECs available from the NSW EES website (www.environment.nsw.gov.au). The results of this assessment were used to validate vegetation mapping and refine community boundaries. At each rapid site, the dominant canopy, midstorey and groundcover species; structural cover condition; vegetation structure; PCT; priority or environmental weed species and cover; opportunistic threatened species counts; soil texture; fire history; vegetation condition; landform element and pattern; notes; photo number; surveyor; and date was recorded.

Each of the vegetation communities described within the subject land were aligned with an equivalent PCT and TEC (where appropriate) as detailed in the BioNet Vegetation Classification database (OEH 2018b). For each vegetation community described, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCTs were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details. Three PCTs which are dominated by *Eucalyptus populnea* (Poplar Box) (56, 244 and 628), were further delineated using soil mapping and aerial imagery. Information on the soil composition for each PCT is located within Section 5.2.1.

An assessment of Managed land was achieved though ground truthing between 2018 and 2021, a review of historical aerial images and a review of the NSW Land use mapping (OEH 2017a) for areas mapped as cropping, quarries or recreation and culture as detailed in Sections 3.2 and Figure 7 of the Native vegetation regulatory map: method statement (OEH 2017a). All areas of managed land have been the target of at least one round of on ground assessment, though not all areas were able to be accessed throughout the whole of the assessment period (2018 – 2021) due to land access issues which developed later in targeted assessment stages (2020 -2021).

The following layers were used to determine Managed land:

- 2017 Landuse map (OEH)
- State Vegetation type map – Border Rivers Gwydir /Namoi
- Field verified PCT mapping
- Category 2 - sensitive regulated and Category 2 - vulnerable regulated land from the Native Vegetation Regulatory map.

A map layer was then generated showing Category 1 lands as Managed land Roads and Tracks.

Table 3.8 Base shapefile to begin categorisation of land

Category	Description and source dataset	Assessment method
Excluded land	LLS Act does not apply	BAM
Managed Land – land use 3, 4 and most of 5 (as per figure 7 of the NVR method statement)	2017 ALUM land use map	No BAM assessment required
Category 2 – sensitive regulated land	LLS Act applies. Data from NVR Map	BAM
Category 2 – vulnerable regulated land	LLS Act applies. Data from NVR Map	BAM

The layers were then further interrogated and first step of the categorisation was then split as follows

1. All Category 2 (sensitive regulated) and Category 2 (vulnerable regulated land) was included in the area to be assessed under the BAM. PCTs and vegetation zones were assigned to these areas as per the Stage 1 and 2 methods for the project.

2. The 2017 State vegetation type map was reviewed in conjunction with aerial photography, satellite imagery, site mapping of PCTs conducted in nearby areas for the project and on site photographs to assist with assigning PCTs to these areas.
3. The 2017 Landuse map was reviewed in conjunction with aerial photography, satellite imagery, regional vegetation mapping, SVTM and mapping of PCTs conducted in nearby areas for the project and on site photographs.
4. Land uses in categories 3, 4 and most of 5 (as per Figure 7 and Table 2 of the NVR method statement- such as perennial and seasonal horticulture and irrigated cropping) would be identified as Managed land. No further classification of this category required. Data sources will be identified in the attribute layer and a description and reason given for classification.
5. Where spatial layers are displaying conflicting results e.g. land use 3, 4 or 5 (potentially Category 1) and aerial imagery or PCT mapping (Category 2) then Category 2 was assigned. Within the attribute table of the categorisation layer, a description would be made of the conflicting data set. Where ARTC have accessed the conflicting vegetation, a PCT would be assigned and provided in the description notes. This conflicting vegetation would be assessed in accordance with the BAM. This approach is in accordance with section 2.3.3 (responding to uncertainty) of the NVR method statement.

Output mapping will be made to be in line with the rules of the NVR method statement (refer Table 1 of the NVR method statement):

- Managed land – exempt land
- Category 2 – regulated land
- Category 2 – vulnerable regulated land
- Category 2 – sensitive regulated land
- Excluded land where the LLS Act does not apply

Each RDP was also assessed for broad condition against one of five condition classes. These condition classes included:

- **Managed land:** Land which fits the description of Category 1 land. Assessed against the *Native vegetation regulatory map: method statement* (OEH 2017a) to assess those areas to determine their fit as 'Category 1 land' (i.e. land that was cleared of native vegetation as at 1 January 1990, or land that was lawfully cleared between 1 January 1990 and 25 August 2017). This included review of historical aerial imagery from prior to 1 January 1990 against those areas which have been historically and are currently cropped within and adjacent to the footprint. This also includes managed land such as playing fields and quarries as described in method above.
- **Scattered paddock trees:** Areas within the subject land with canopy species present only and that meet the BAM scattered tree streamline assessment criteria (Appendix 1 of BAM) (i.e. cropped paddocks with canopy trees only)
- **Low:** Native vegetation that predominantly has one vegetation stratum present in accordance with the most appropriate PCT but occasionally has a second strata present when considered in a broader landscape context (i.e. ground layer vegetation equivalent to the subject PCT with occasional or no canopy trees present only)
- **Medium:** Native vegetation with one vegetation strata absent in accordance with the most appropriate PCT and, ≤50% cover of exotic vegetation
- **High:** Intact native vegetation with all vegetation strata present in accordance with the most appropriate PCT, ≤25% cover of high threat exotic weeds.

A total of 114 rapid vegetation assessments were undertaken over eight days between 21 August and 27 August 2018, and on 19 June 2019. A further 64 areas that were unable to be accessed during these times were analysed using aerial imagery interpretation. The information from these assessments was then used to refine the number of BAM plots required. Areas which were not accessible during the RDP process were available for the targeted BAM surveys which followed this process.

Final mapping of PCT locations and conditions was produced following the completion of field surveys in 2021. The lead ecologist then spent several days working with the GIS team working to provide accurate mapping delineation at a scale of between 1:250 and 1:1000. Where differences occur between mapped PCTs and the underlying imagery, this is due to the currency of the available aerial imagery. Most differences can be seen if the provided shapefiles are used over recent aerial/satellite imagery, any further differences are based on ground truthing which may not be easily identifiable at the mapping scale provided. The updated PCT mapping is shown in Appendix A.

3.4.2 Identification of vegetation zones for minimum plot requirements

A vegetation zone is classified as 'a relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state' (OEH 2018b). Following RDP and broad condition assessments, vegetation zones were mapped and established for the subject land.

Vegetation zones were mapped such that:

- Each PCT that was assessed as having a different broad condition was considered as its own separate vegetation zone
- Each vegetation zone was described to accurately reflect significant and distinct differences in condition:
  - High – an area which contains all major functional vegetation tiers: ground layer, understory/shrub layer and canopy trees
  - Medium – an area which contains two of the three functional vegetations tiers generally ground layer/grasses and canopy trees with little or not shrub layer or regeneration of canopy layer
  - Low – an area which has been cleared of over 95% of canopy trees and contains little or no functional shrub layer in terms of species habitat values. In general the area contains only grasses and shrubs under <50 cm high with less than 1 tree per ha.
- The area of each vegetation zone was calculated in hectares
- One separate vegetation zone was required for PCT 418 low at Borrow Pit 9 which had a Vegetation Integrity (VI) score of 5.9. All other VI's within the alignment segments and borrow pits were above 20.
- Scattered paddock tree areas.

3.4.3 Assessing the patch size for a vegetation zone

A patch is an area of native vegetation within the subject land that:

- Occurs on the subject land, and
- Includes native vegetation that has a gap of less than 100 m from the next area of *moderate* to *high* condition native vegetation (≤ 30 m for non-woody ecosystems). Where vegetation does not meet this requirement (e.g. low-quality vegetation) a patch is not recorded.

A patch may extend onto neighbouring land that is not part of the subject land. It is used as a filter to predict if threatened species are likely to occur or potentially use habitat within the subject land.

Patches are classified into one of four size classes including:

- < 5 ha
- 5 ha to 24 ha
- 25 to 100 ha
- > 100 ha.

A total of 25 patches were identified within the subject land and these are shown in Appendix C.

3.4.4 Vegetation integrity plots (site condition)

In addition to the rapid vegetation assessments, field surveys were undertaken by experienced and accredited botanists to comply with the BAM. The required minimum number of vegetation condition (integrity) plot/transects were undertaken in accordance with the BAM guidelines. Based on desktop assessment, a minimum of 145 plots were required for assessment. It is noted that in some locations, due to refinement of the study area since the assessment was completed, some original BAM plots now fall outside the modified study area. Where appropriate these original BAM plots outside the subject land were retained where they are part of a contiguous PCT extending into the subject land.

Full vegetation integrity and PCT identification data at each plot/transect was collected during surveys conducted between:

- 1 October to 9 October 2018
- 31 October to 6 November 2018
- 18 June to 24 June 2019
- 1 July 2019 to 7 July 2019
- 20 January 2021 to 28 January 2021.

Verification or changes of PCT mapping was conducted by comparison of existing mapping with ground truthed field observations. This included confirmation of the dominant vegetation species at each strata level where such stratification occurred, or through field observation of surrounding plant community types and landscape features where the PCT was not immediately obvious. Recordings were also made of any signs of historical disturbance which may have contributed to changes in the PCT or difficulty in distinguishing between PCTs such as the selective removal of timber for fenceposts.

Assessments included the measurement of composition, structure and function as listed in Table 3.9 for each vegetation zone against the benchmark data for the relevant PCT.

Table 3.9 Attributes measured to assess composition, structure and function

Growth form groups used to assess composition and structure	Attributes used to assess function
▪ Tree ▪ Shrub ▪ Grass and grass like ▪ Forb ▪ Fern ▪ Other	▪ Number of large trees ▪ Tree regeneration ▪ Tree stem size class ▪ Total length of fallen logs ▪ Litter cover ▪ High threat exotic vegetation cover ▪ Hollow bearing trees

3.4.5 Vegetation integrity survey plots

The minimum number of vegetation plots/transects sampled for each vegetation zone followed the guidelines as shown in Table 3.10 and Figure 3.3.

Table 3.10 Required number of survey plots per vegetation zone

Vegetation zone area (ha)	Minimum number of plots/transects
< 2	1 plot/transect
> 2 to 5	2 plots/transects
> 5 to 20	3 plots/transects
> 20 to 50	4 plots/transects
> 50 to 100	5 plots/transects
> 100 to 250	6 plots/transects

Vegetation zone area (ha)	Minimum number of plots/transects
> 250 to 1,000	7 plots/transects; more plots may be needed if the condition of the vegetation is variable across the zone
>1,000	8 plots/transects; more plots may be needed if the condition of the vegetation is variable across the zone

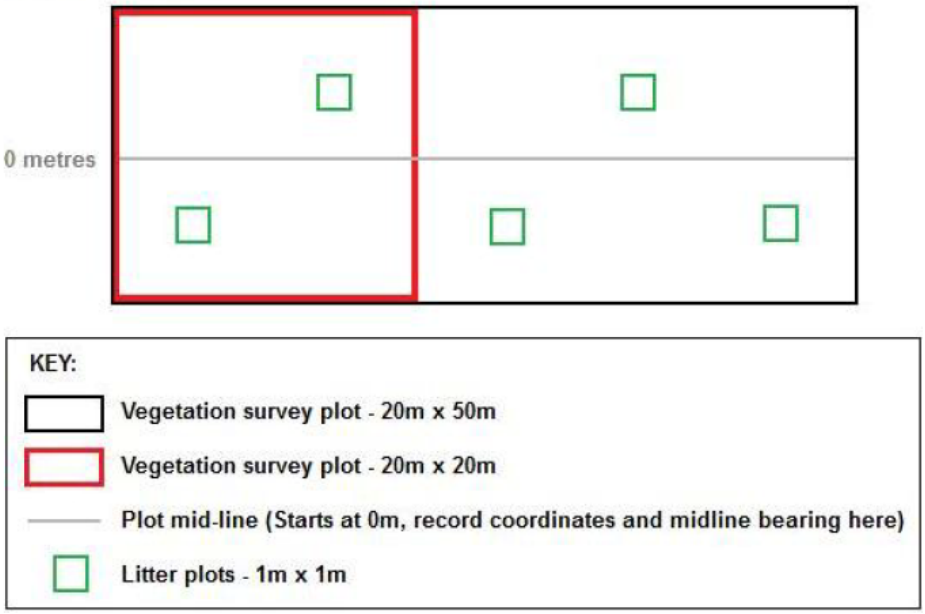


Figure 3.3 Standard plot layout to be used for site assessment

Source: BAM Operation Manual (DPIE 2020b)

Within each plot, the following elements were measured:

- Composition

  Vegetation composition was measured within a 20 x 20 m plot centred along a 50 m transect (or for linear zones, as a 10 x 40 m plot). All native and exotic plant species were recorded to genus and species (where possible) within the plot and assigned a growth form, according to the definitions within the BAM guidelines (DPIE 2020b). The three most dominant native species (i.e. those that contributed most to the cover of each growth form) were identified.

- Structure

  Vegetation structure was measured within the same 20 x 20 m plot as per composition. The percent foliage cover for each growth form group of all living material was recorded to the nearest 0.1% for those species with < 10% cover, to the nearest 1% for species with > 0.9 to 10% cover and to the nearest 5% for species with 10 to 100% cover. Non-native plant species were divided into two groups, either exotic or high threat exotic and each assigned a percent foliage cover.

- Function

  Function was assessed within a 20 x 50 m plot centred along a 50 m transect (or for linear zones, as a 10 x 100 m plot). The number of large trees, their stem size class, the level of tree regeneration and length of fallen logs were recorded.

  The diameter at breast height (DBH) was recorded for each tree and categorised into one of the following size classes: < 5, 5 to 9, 10 to 19, 20 to 29, 30 to 49, 50 to 79 and +80 cm. Comparison with the benchmark DBH size determined if a tree was considered to be large. Regeneration potential was assessed based on the presence or absence of living trees with stems <5 cm DBH.

  Logs were considered for assessment if they were greater than 10 cm in diameter, were dead and entirely or in part on the ground. Logs were measured to the nearest 0.5 m.

Litter cover was assessed within five 1 x 1 m plots spaced equidistant apart centred along a 50 m transect (or for linear zones, along a 100 m transect). Litter was considered to include leaves, seeds, twigs, branchlets and branches (< 10 cm in diameter) and plant material that is detached from a living plant. This was measured to the nearest 5%.

The number of trees with hollows was also recorded within the 20 x 50 m plot.

The vegetation integrity score was calculated using the information collected above and as per the equations set out in the BAM guidelines (DPIE 2020b).

3.4.6 Targeted flora survey methods

Two targeted survey methods were applied from 2018 to 2021 when searching for threatened flora species. Both methods have been approved by BCSD and are detailed as follows:

- Meandering transects

  Meandering transects as described in NSW Threatened Biodiversity Survey and Assessment (OEH 2008) guidelines were undertaken through vegetation units across the subject land adjacent to BAM plots. These transects were targeting threatened and otherwise significant species and endangered populations in suitable habitat. Meandering transects enabled sampling across a much larger area than systematic plots alone, allowing the survey to achieve a combination of detailed observation and broader application. A minimum of 30 minutes was spent searching for threatened flora within the plots and surrounding landscape. After 30 minutes searches were stopped when no new species were recorded for a period of five minutes. Records along the transects supplemented floristic sampling carried out as part of the transect/plots, however the data was in the form of presence records, rather than the semi-quantitative cover abundance scores.

  The location of the BAM plots conducted as part of the field works is shown in Figure 3.4 with greater detail located in Appendix A and E.

- Targeted surveys

  Multiple rounds of targeted parallel field traverse surveys have been conducted at 5 and 10 m distances for specific species. In vegetation that was dense a 5 m traverse was implemented whilst in vegetation that was more open a 10 m traverse was implemented. A total of over 656 hours of targeted transects have been completed. Details on each species and the survey effort for that species is located in Appendix G.

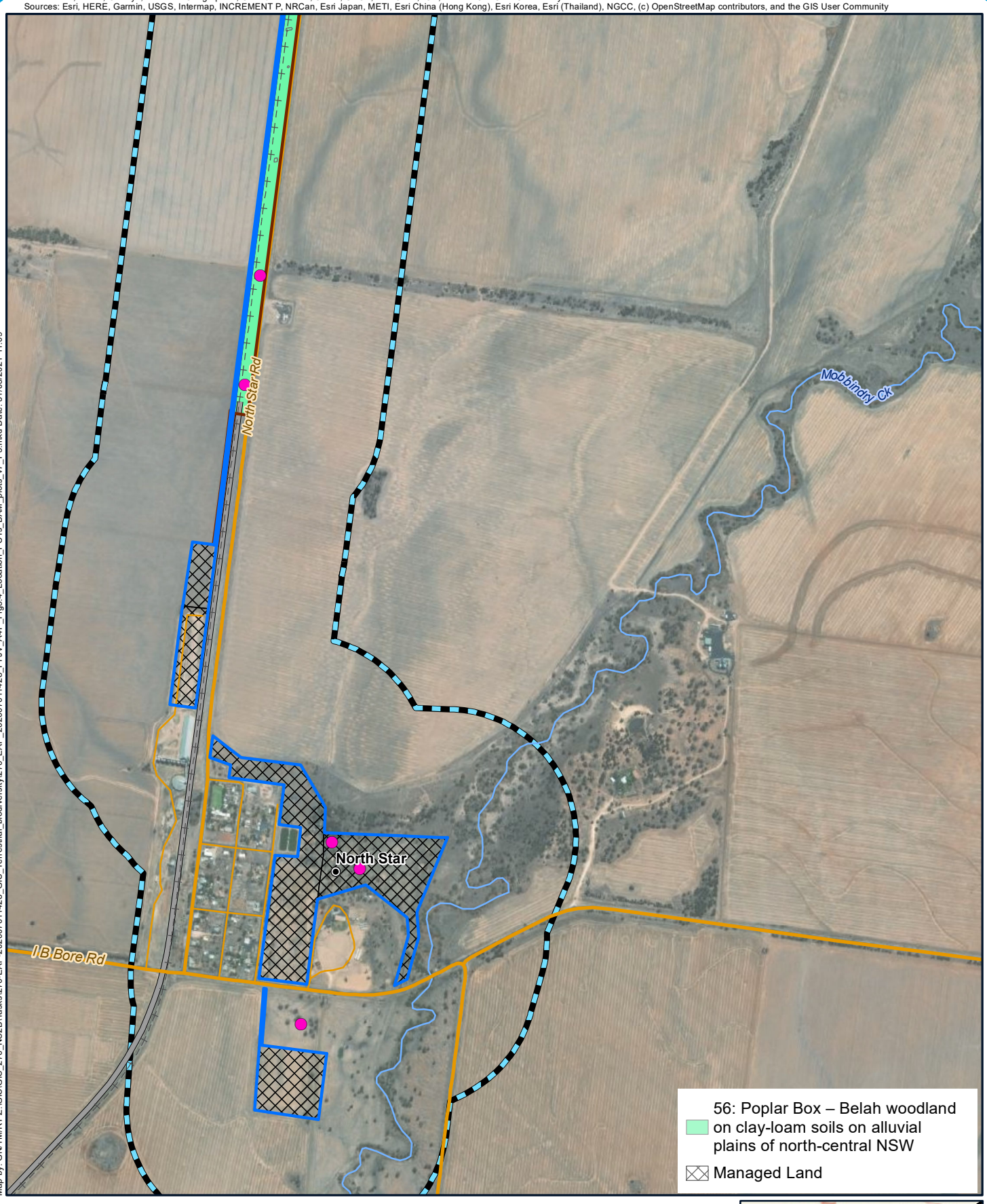
  Given the suitable rainfall and weather conditions during the 2020/21 survey period, the results of the targeted flora surveys are considered sufficient to determine species-credit species to be absent.

3.4.7 Threatened ecological community assessment

The Protected Matters Search Tool (PMST) identified six EPBC listed TECs within a 10 km buffer of the subject land. These include:

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Coolibah – Black box woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions
- Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
- Weeping myall woodlands
- White box-Yellow box-Blakely's red gum grassy woodland and derived native grassland.

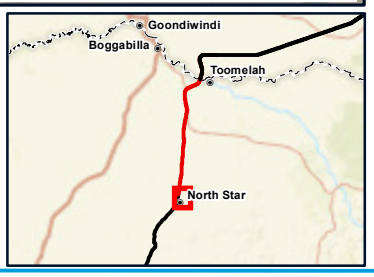
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- Localities
- BAM plot used in BAM-C
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

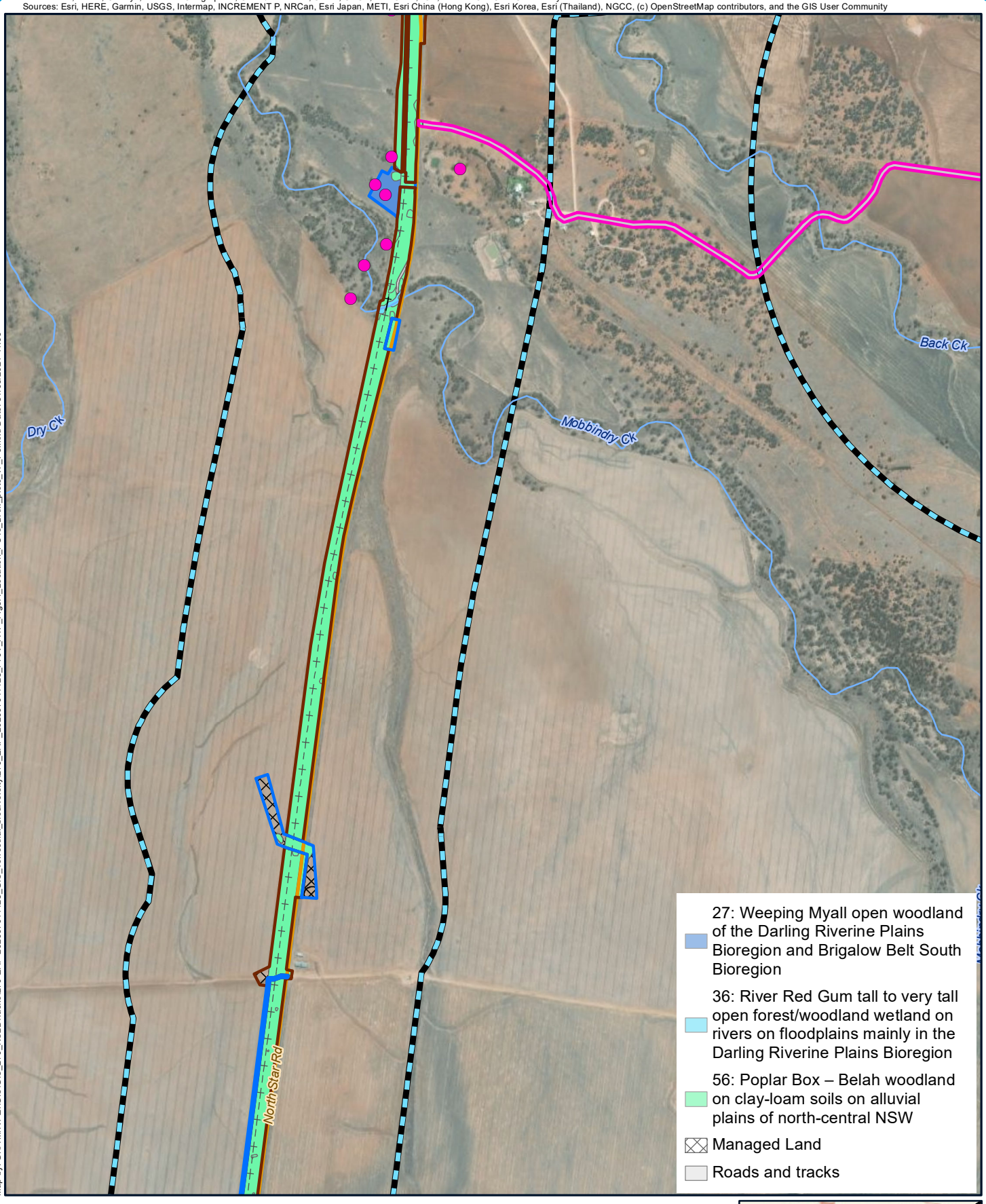
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4a:
Location of PCTs and BAM plots

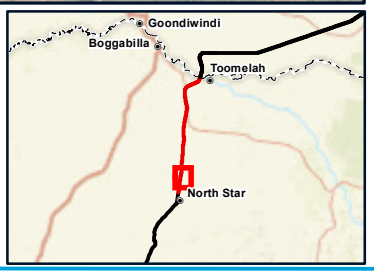
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot used in BAM-C
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

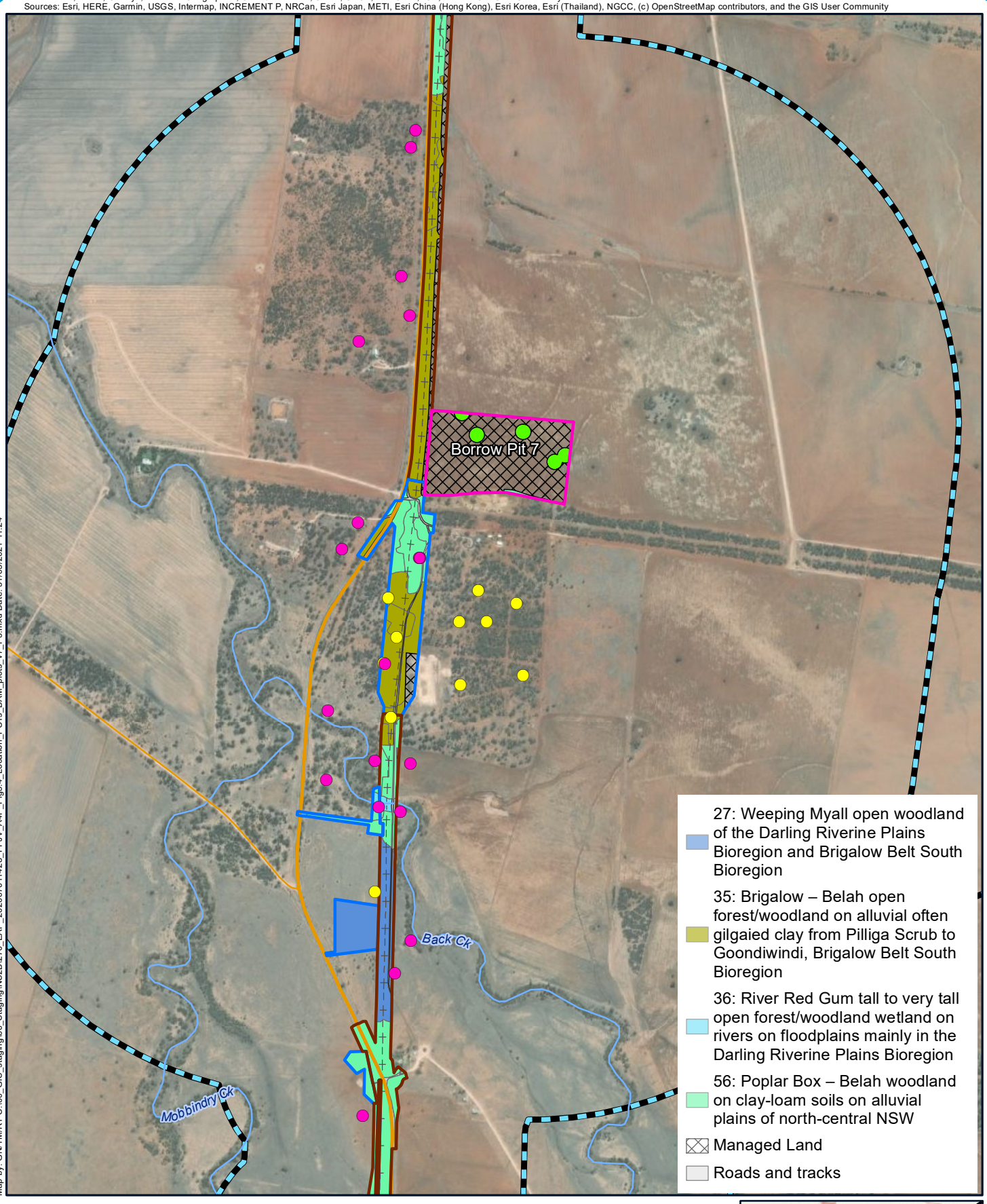
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4b:
Location of PCTs and BAM plots

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

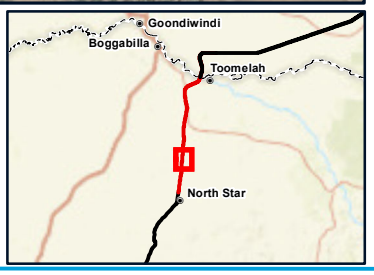
Managed Land

Roads and tracks

Map by: GN/TM/RY C:\00_GIS_staging\00_Staging\NS2B\270_EAP_20200701428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:24

Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Scattered paddock trees
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000
0 0.25 0.5km

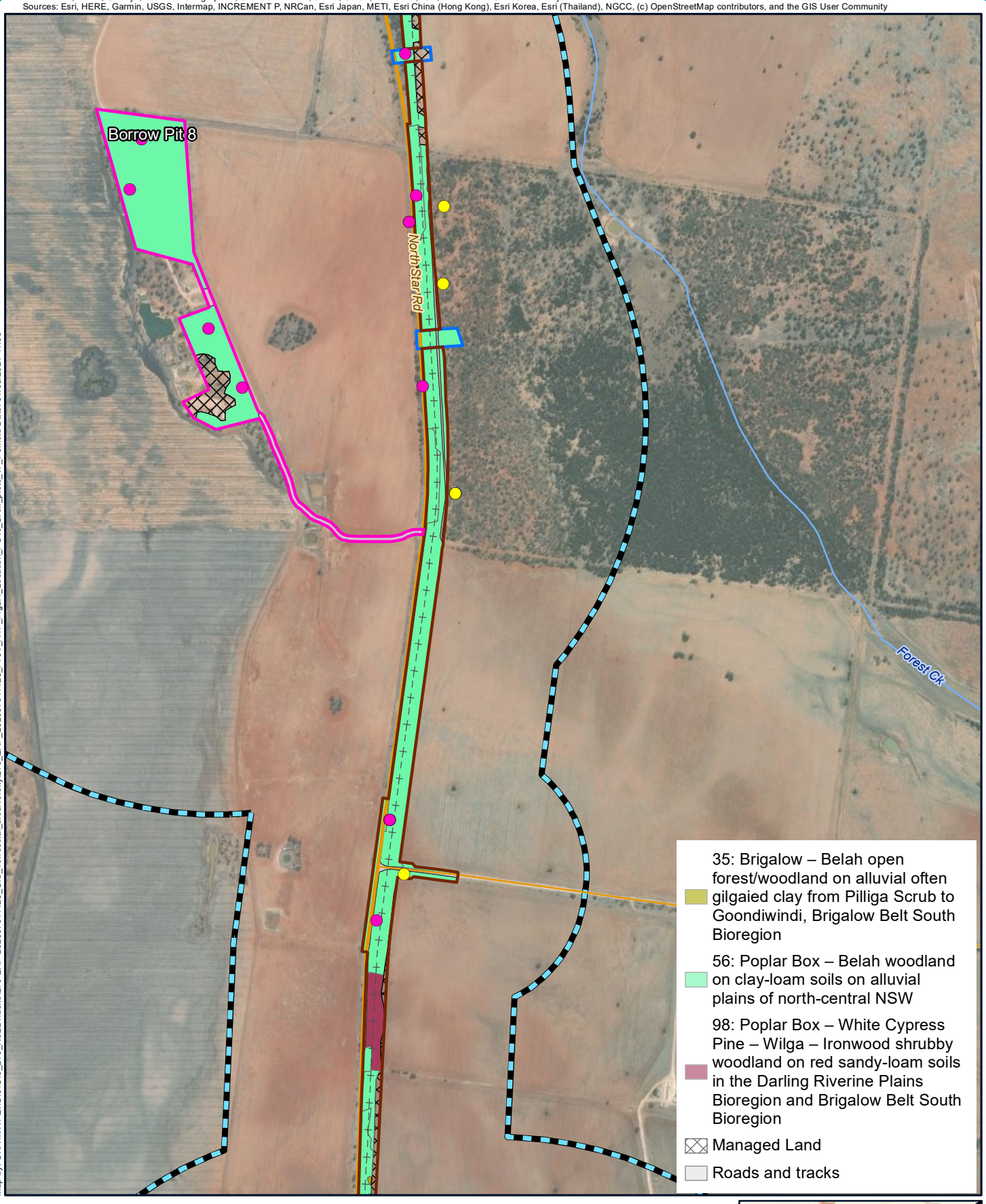
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 5
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4c:
Location of PCTs and BAM plots

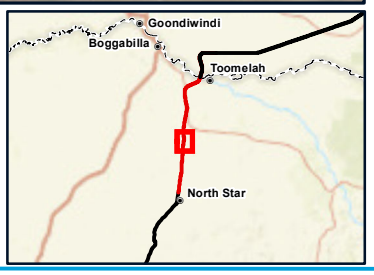
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 5

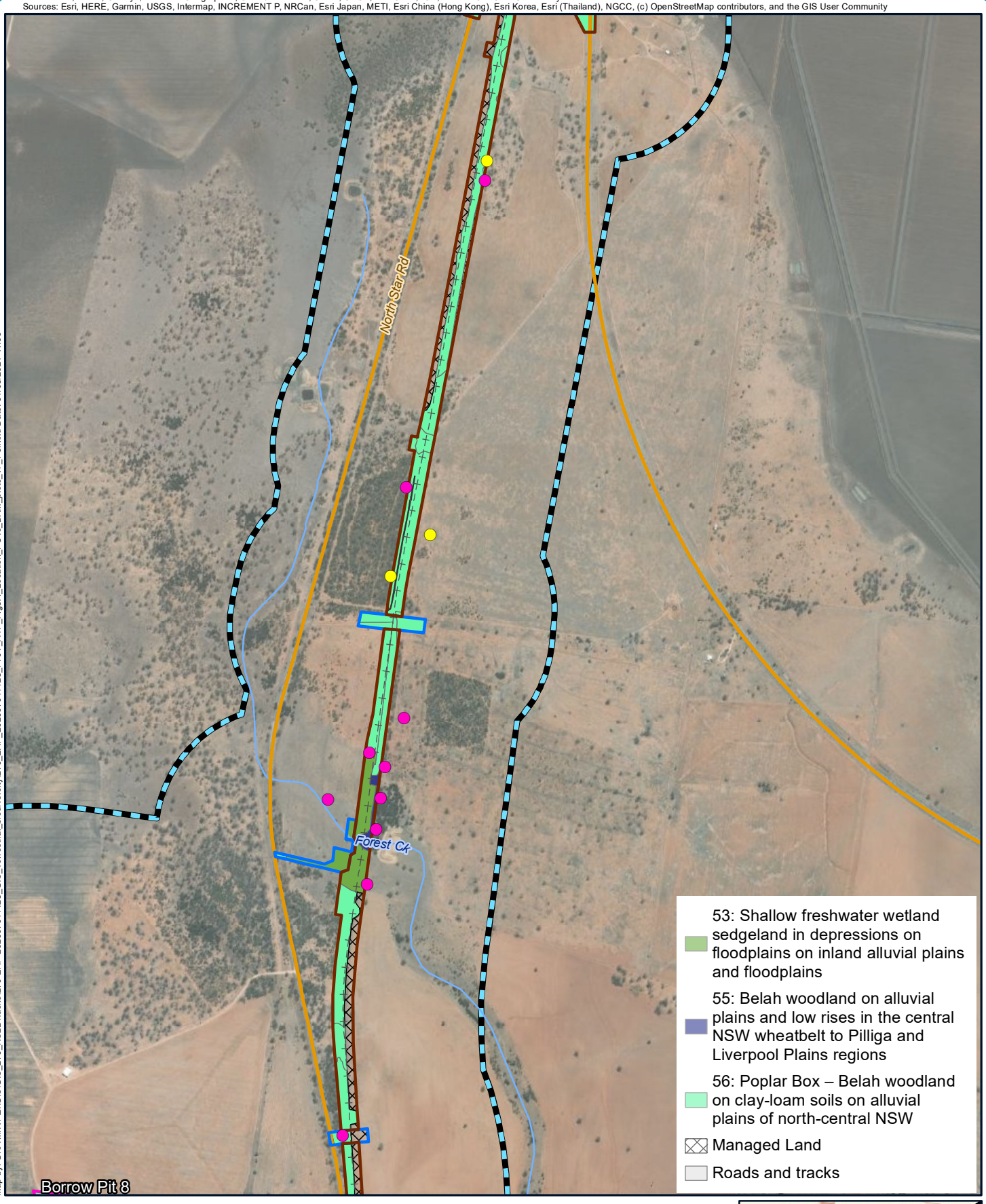
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4d:
Location of PCTs and BAM plots

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09



Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

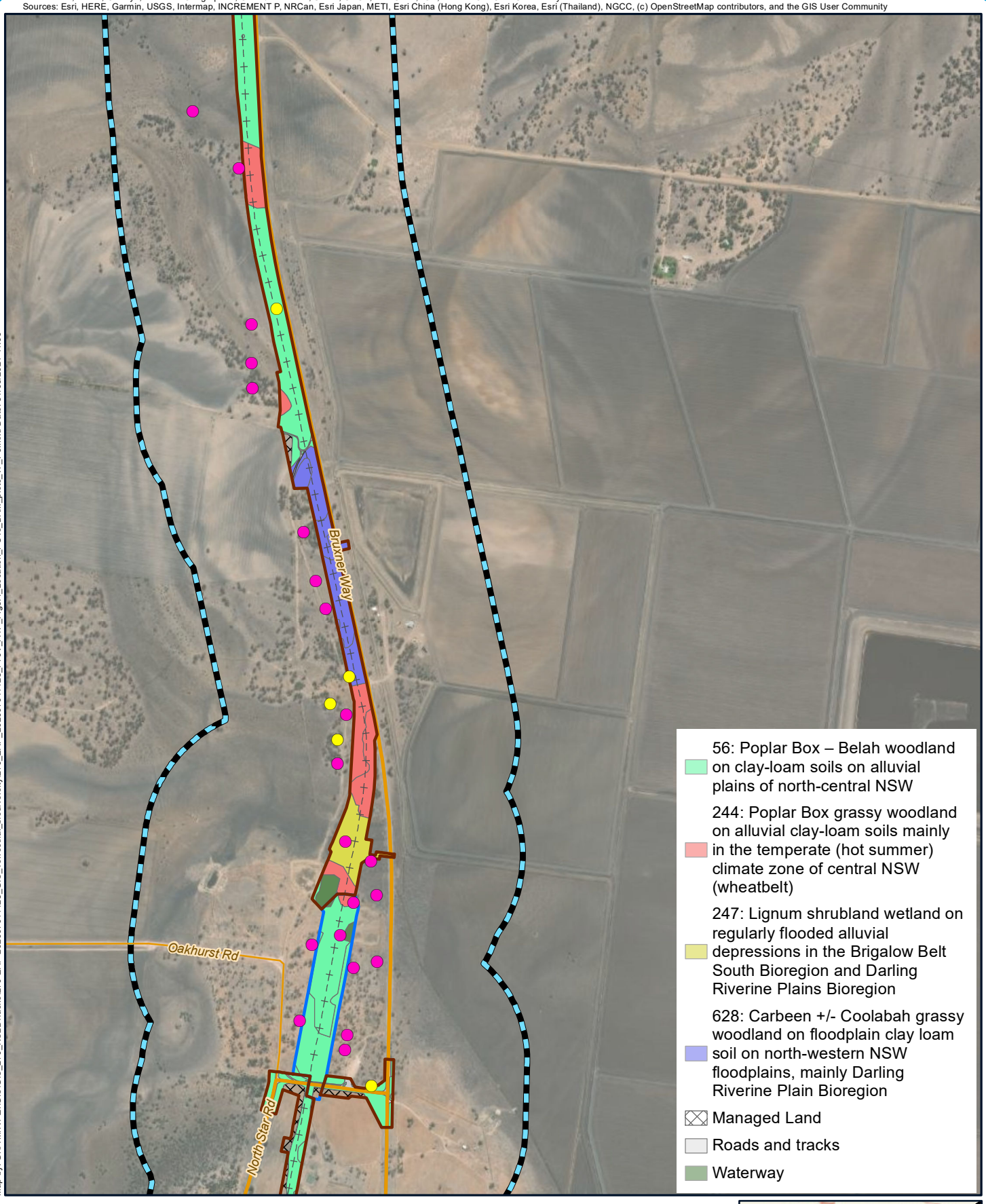
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4e:
Location of PCTs and BAM plots

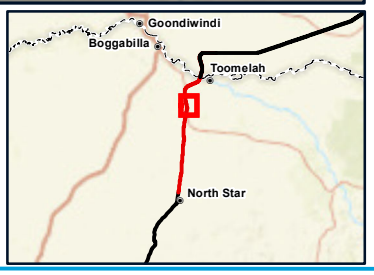
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000
0 0.25 0.5km

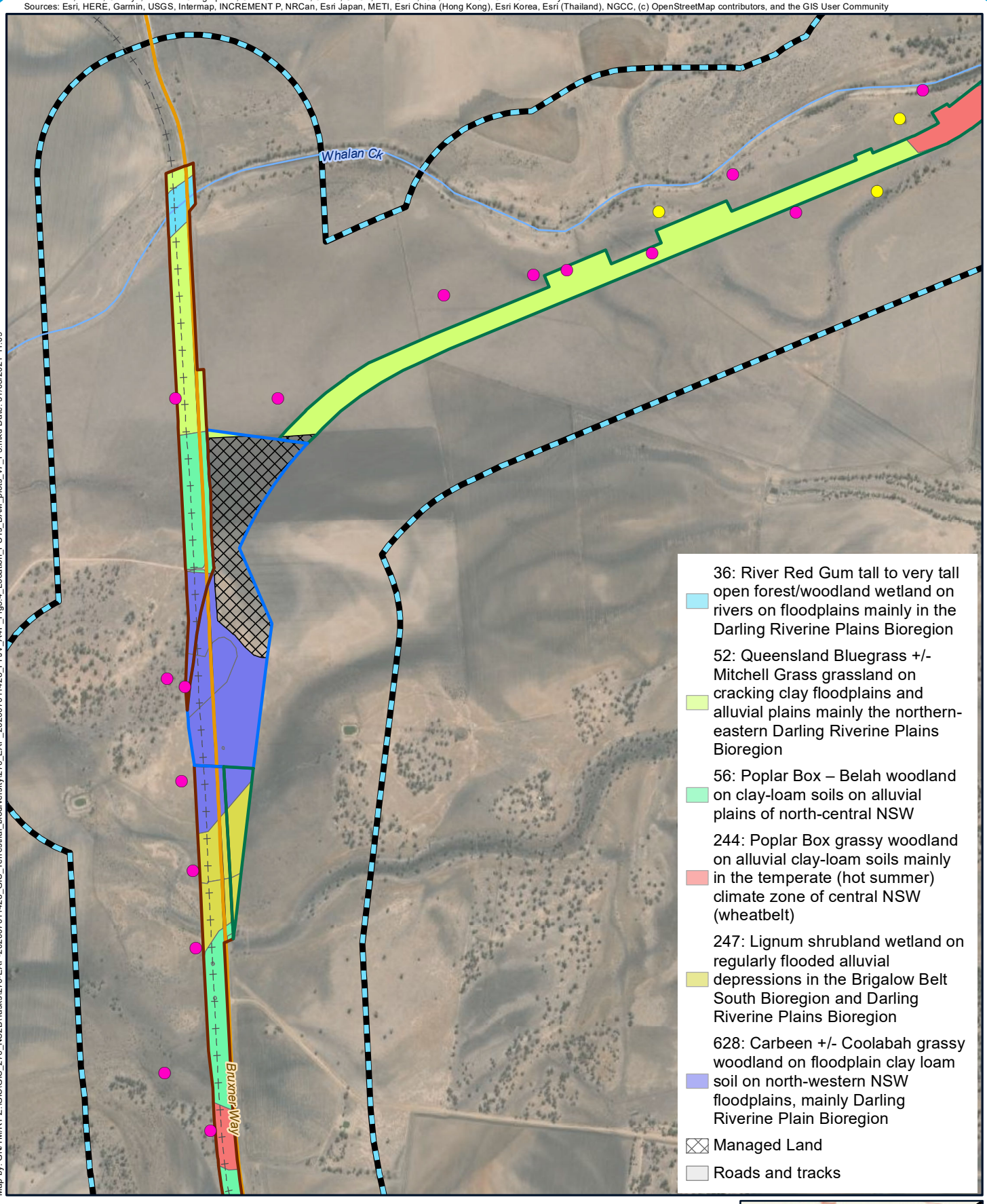
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 5
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4f:
Location of PCTs and BAM plots

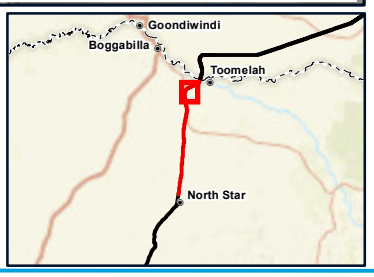
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

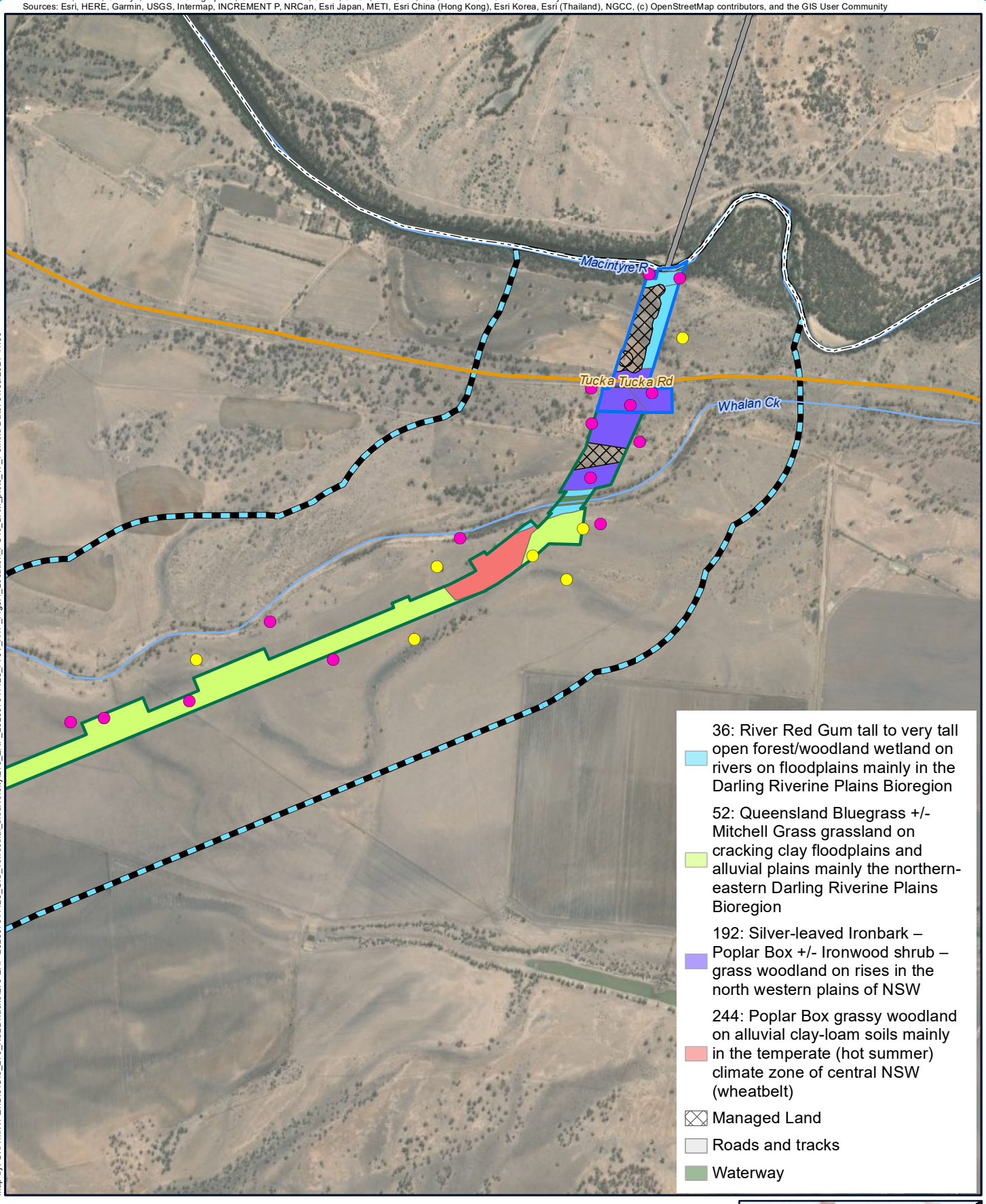
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4g:
Location of PCTs and BAM plots

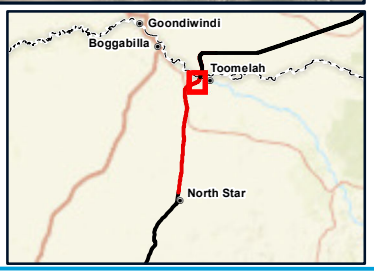
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000
0 0.25 0.5km

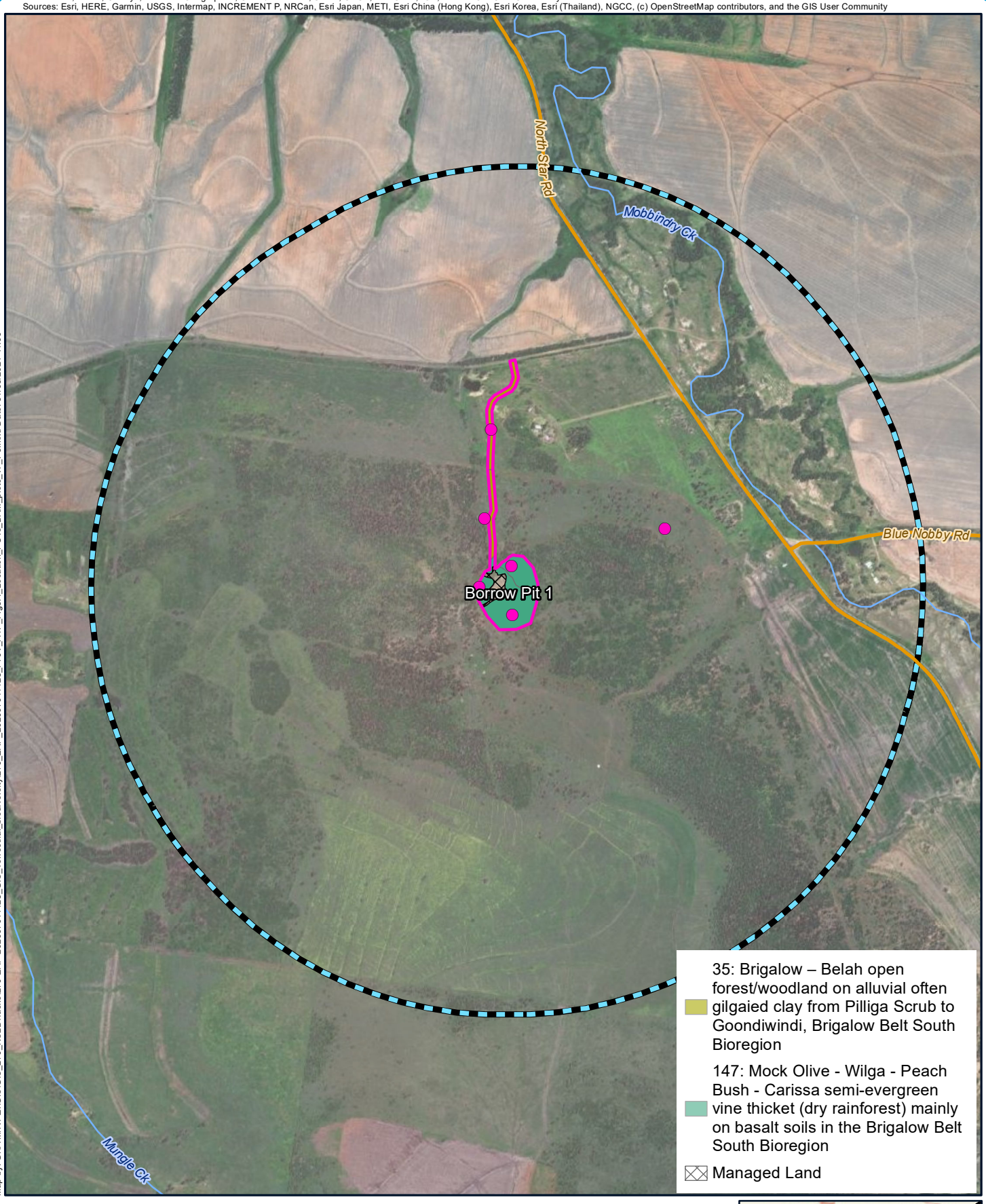
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 5
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4h:
Location of PCTs and BAM plots

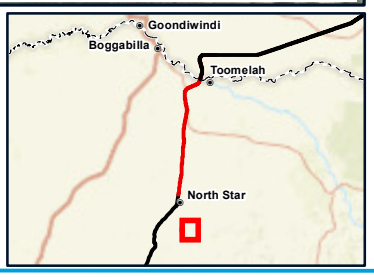
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot used in BAM-C
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

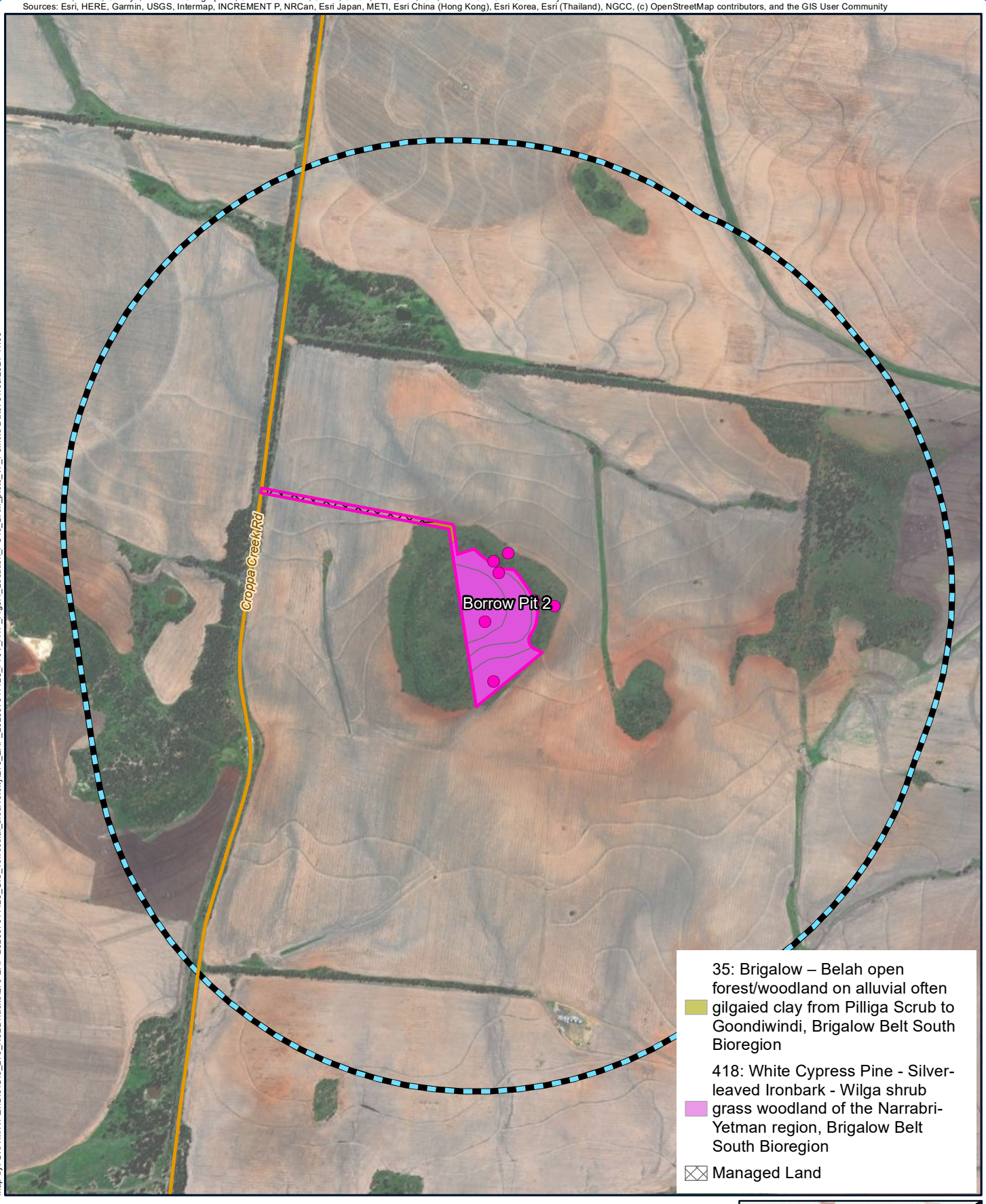
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4i:
Location of PCTs and BAM plots

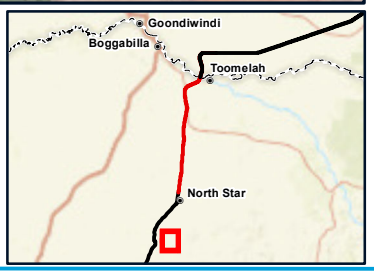
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot used in BAM-C
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

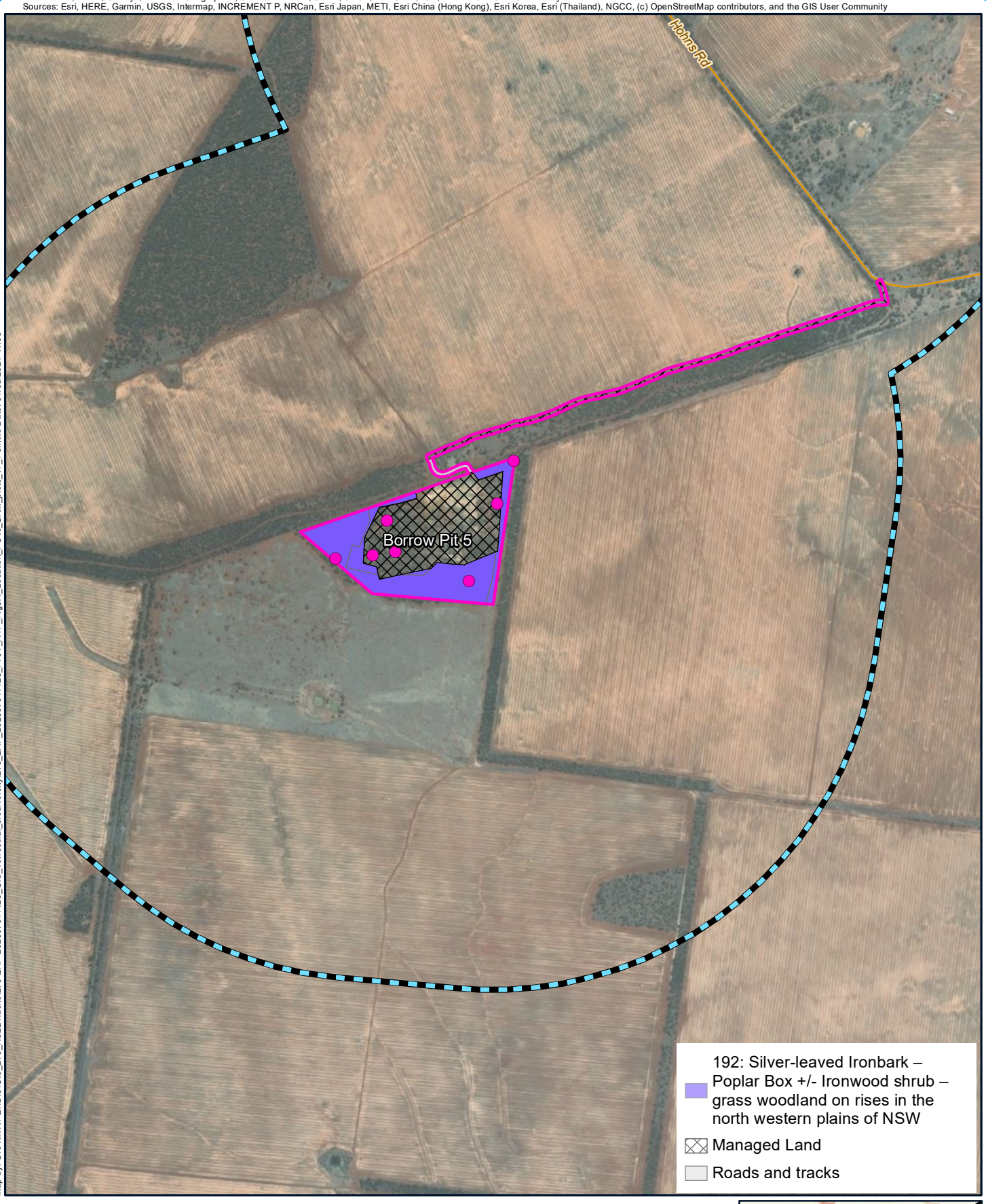
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4j:
Location of PCTs and BAM plots

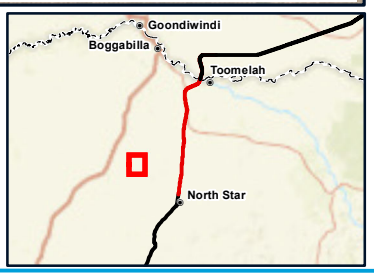
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot used in BAM-C
- Minor roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

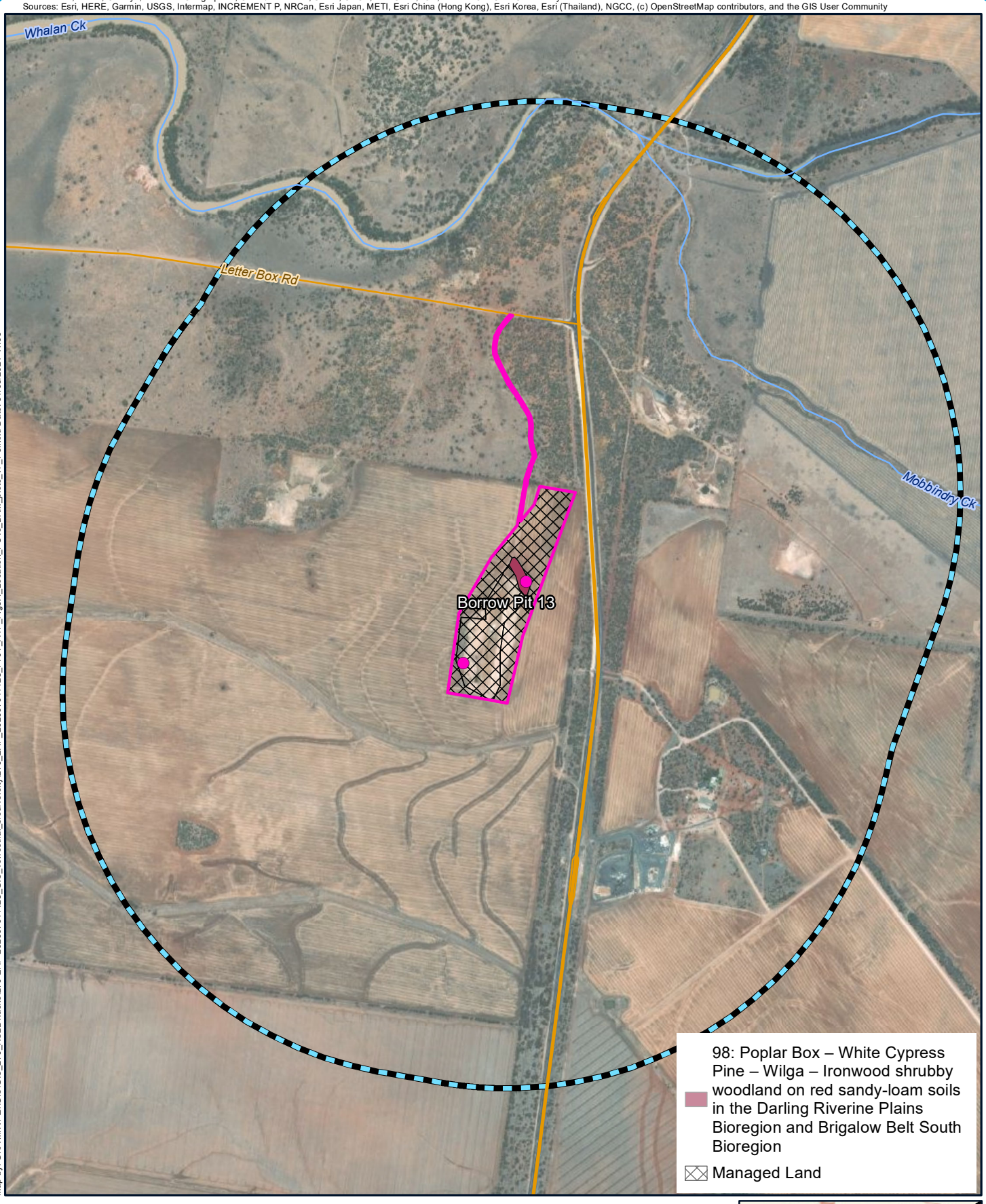
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4k:
Location of PCTs and BAM plots

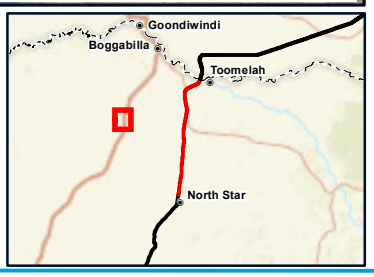
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot used in BAM-C
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

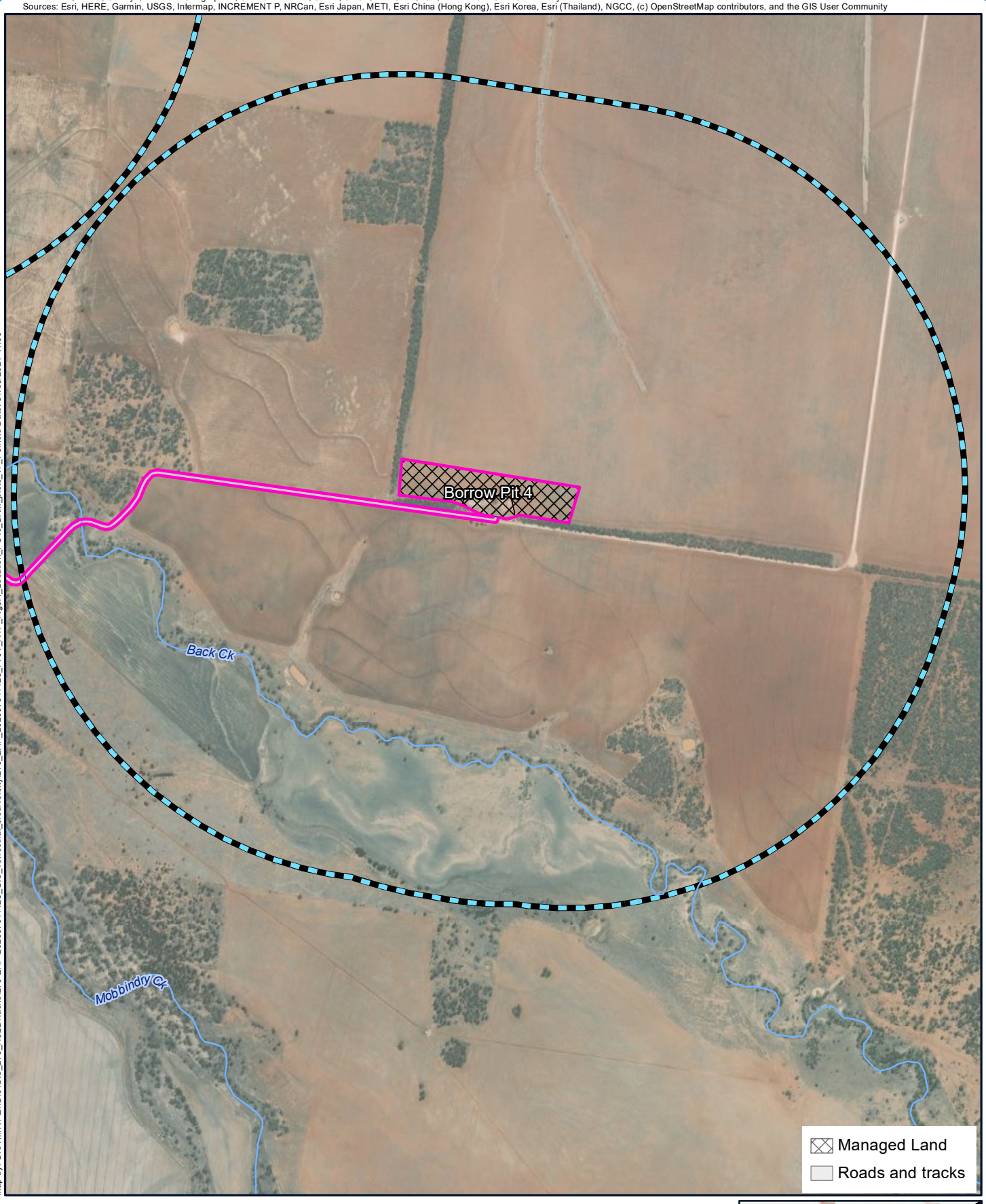
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4l:
Location of PCTs and BAM plots

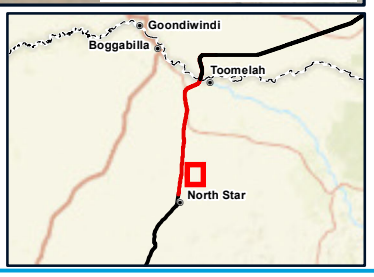
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 5

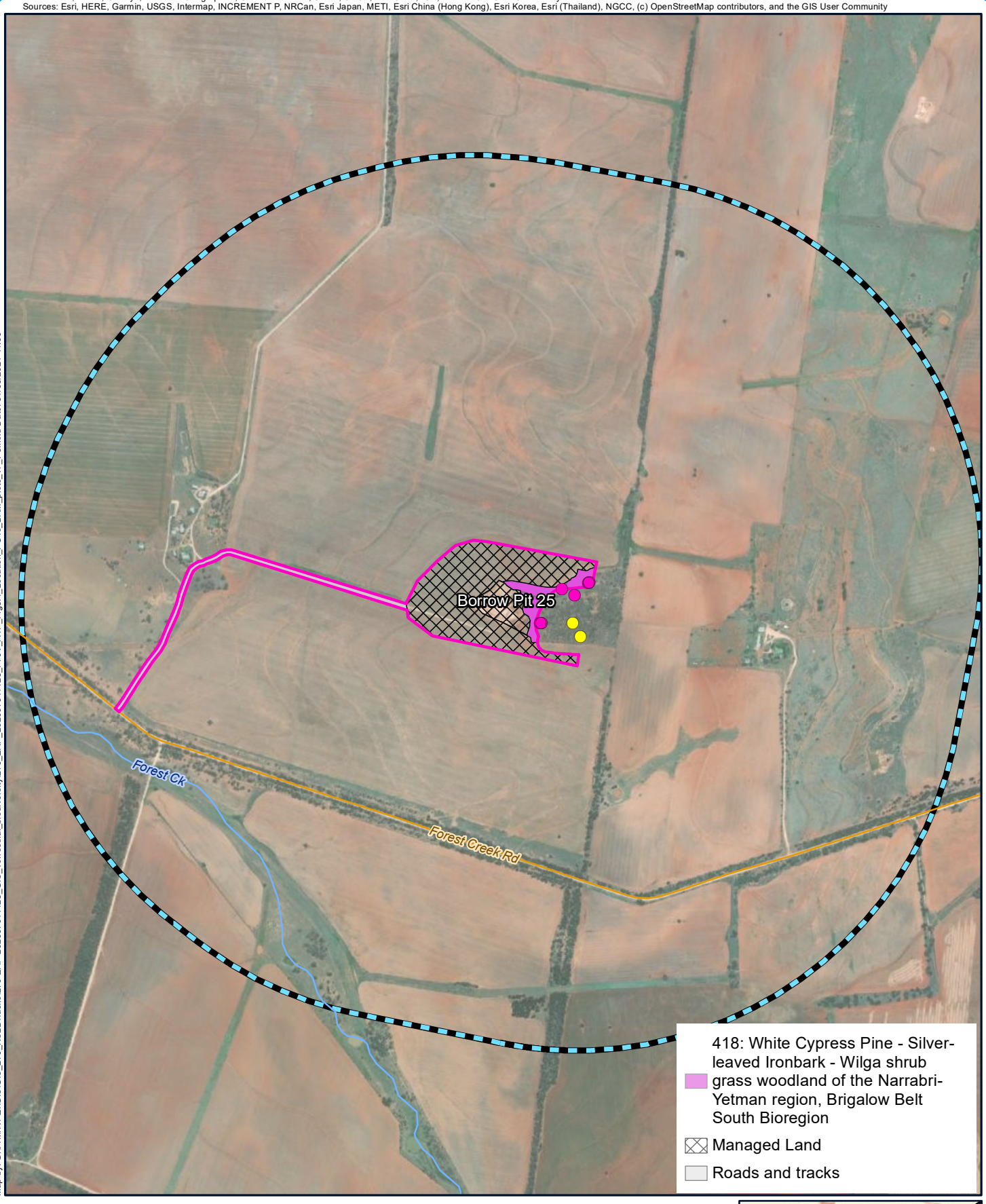
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4m:
Location of PCTs and BAM plots

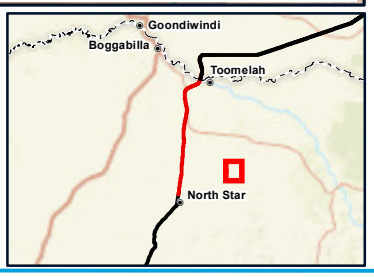
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09



Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

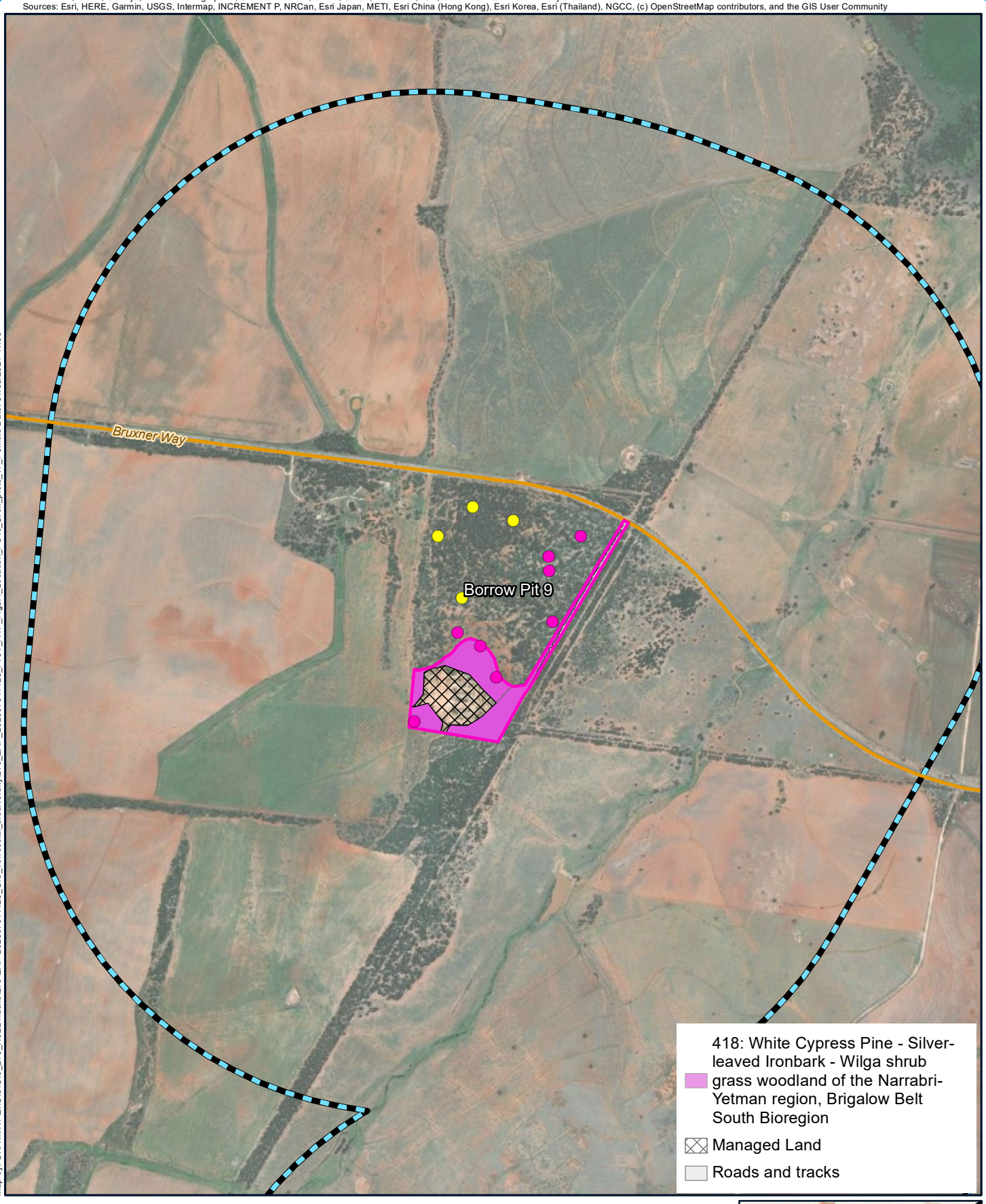
Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4n:
Location of PCTs and BAM plots

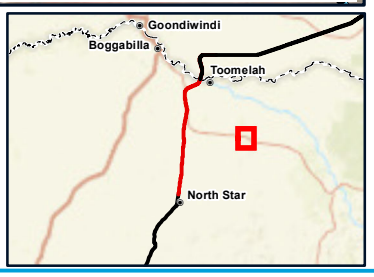
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.4_Location_PCTs_BAM_plots_v7_P3.mxd Date: 31/05/2021 11:09

Legend

- BAM plot not used in BAM-C
- BAM plot used in BAM-C
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.25 0.5km

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 5

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.4o:
Location of PCTs and BAM plots

TEC assessments were conducted within vegetation zones within the subject land to compare key diagnostic criteria and condition thresholds to determine the presence of the BC and EPBC Act listed TECs. These diagnostic criteria and condition thresholds can be found in Appendix C. The assessment of TECs was informed by the PMST database search results of the terrestrial ecology desktop assessment (refer Appendix E).

With regard to the natural grasslands TEC potentially present in the study area (*Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland*), site assessments were completed as per the EPBC Act thresholds. However, extended drought conditions were present at the time of the site assessments, impacting the condition of these areas substantially. Initial detailed assessment of species diversity and composition indicated that several plots were within the benchmark conditions for the TEC while some were lacking indicator species present in plots nearby. Follow up site assessments under more favourable conditions in early 2021 confirmed the grassland TEC as present. Further consideration of this grassland TEC is provided in Appendix C.

The Poplar box grassy woodland on alluvial plains TEC was listed on 4 July 2019, after the Controlled Action decision was made and the SEARS was released, and therefore on advice received from DPIE (17/12/2020) it is not considered further in this report.

3.4.8 Threatened flora survey planning

Prior to Stage Two of the BAM impact assessment commencing (refer Figure 3.1), a preliminary assessment using the Biodiversity Assessment Method Calculator (BAM C) and broad PCT mapping is completed, to provide a list of species-credit flora species that may require consideration for survey. Species identified as Ecosystem-credit species are predicted by landscape attributes and are not required to undergo specific targeted surveys.

The *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft* (TBSA Guidelines) *(*DEC 2004) and *Commonwealth Threatened Species Survey and Assessment Guidelines* (various, DoEE 2010) were considered when undertaking the initial threatened species surveys in the subject land in 2018. This methodology was acceptable at the time of the assessment. Recent assessments (September 2020 and January 2021) have applied the methods described in the *NSW survey guide for the Biodiversity Assessment Method: surveying threatened plants and their habitats* (DPIE 2020c)

Targeted surveys for the species-credit flora species included targeted on-ground searches in suitable habitat throughout the subject land. Searches for these species were undertaken as meandering transects (refer Section 3.7) as described in Section 5.2.7 of the TBSA Guidelines. This involved walking in suitable habitat within the subject land, including the borrow pit sites searching for targeted species. Initial surveys of vegetation communities were undertaken during drought conditions. As such, these conditions were not adequate in providing optimate conditions for detecting threatened flora species. As a result, all threatened species credit species were initially assumed to be present, with the exception of *Sida rohlenae* (Shrub sida) and *Acacia jucunda* (Yetman wattle). These two species were excluded as eight other species of Sida were recorded during those survey times and the subject land is considered to be outside of the range of Yetman wattle (refer Table 6.5).

Later surveys (22 to 30 September 2020 and 19 to 2 February 2021) were carried out in post drought conditions using the parallel field traverse method described in DPIE (2020c) using multiple parallel 5 to 10 metre transects within the subject land. The subject land had experienced sufficient rainfall throughout spring and into summer providing sufficient conditions for detecting threatened flora. The September 2020 surveys targeted the Pine Donkey Orchid (*Diuris tricolor*) the Slender Darling Pea (*Swainsona murrayana*) and Silky swainson-pea (*Swainsona sericea*), whilst the January 2021 surveys targeted a number of threatened flora species within their associated PCTs, so at most only a total of five species were surveyed for at any one time. Table 3.11 provides a list of targeted species for the summer 2021 surveys, and their associated PCTs. Approval was given by DPIE (December 8 2020) to survey for six threatened species in PCT56 where two of those species were *Lepidium* spp. and thus similar in structure this allowed for one round of targeted plant transect surveys to occur in PCT56 in January 2021 rather than two.

Table 3.11 Targeted threatened flora species during January 2021 surveys

Common name	Scientific name	PCT Association
Braid fern	*Platyzoma microphyllum*	53, 247
Native milkwort	*Polygala linariifolia*	192, 418
Belson's panic	*Homopholis belsonii*	27, 35, 55, 56, 147, 244
Bluegrass	*Dichanthium setosum*	27, 35, 52, 55, 56, 418, 628
Finger panic grass	*Digitaria porrecta*	27, 35, 52, 55, 56, 244, 628
Creeping Tick-trefoil	*Desmodium campylocaulon*	35, 52
Phyllanthus maderaspatensis	*Phyllanthus maderaspatensis*	36, 247
Winged peppercress	*Lepidium monoplocoides*	56, 244, 247, 628
Cyperus conicus	*Cyperus conicus*	55, 56
Silky swanson-pea	*Swainsona sericea*	27, 98, 244, 418, 628
Scant pomaderris	*Pomaderris queenslandica*	147
Tylophora linearis	*Tylophora linearis*	147
Spiny peppercress	*Lepidium aschersonii*	35, 53, 55, 56,

Terrestrial flora field surveys included the following methodologies:

- Surveys to confirm and map PCTs and TECs to confirm accuracy with the NSW *Vegetation Information System* was undertaken using a rapid vegetation assessment (Rapid Data Points). At each rapid site, the dominant canopy, midstorey and groundcover species; structural cover condition; vegetation structure; PCT; priority or environmental weed species and cover; opportunistic threatened species counts; soil texture; fire history; vegetation condition; landform element and pattern; notes; photo number; surveyor; and date was recorded.
- Vegetation integrity assessment (site condition) plots were undertaken in accordance with the BAM based desktop assessments to enable field validation of PCTs. Within each plot information relating to composition, structure and function was recorded, in addition to meandering transects to search for threatened flora species.

TEC assessments were conducted within vegetation zones within the subject land to compare key diagnostic criteria and condition thresholds to determine the presence of the EPBC Act listed TECs. The natural grasslands TEC potentially present in the study area (*Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland*) was assessed as per the EPBC Act thresholds. However, extended drought conditions were present at the time of the site assessments, impacting the condition of these areas substantially and making detailed assessments not feasible. Follow up site assessments under more favourable conditions in early 2021 confirmed the grassland TEC as present.

3.5 Terrestrial fauna surveys

3.5.1 Overview

In order to assess potential fauna survey requirements, a preliminary assessment using the BAM Calculator and broad PCT mapping was undertaken by a BAM accredited assessor. This process provides a list of species-credit fauna species that may require survey in accordance with the BAM requirements. In accordance with the BAM, species identified as ecosystem-credit species are predicted by landscape attributes and are therefore not required to undergo targeted surveys due to their cryptic nature. Some species may be both ecosystem-credit (foraging) and species-credit (breeding sites) species.

The *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft* (DEC 2004) and Commonwealth Threatened Species Survey and Assessment Guidelines (various, DoEE 2010) were considered when undertaking the threatened species surveys for the project.

The baseline sampling of vertebrate fauna species was undertaken between 23 and 30 October 2019 using the following methods:

- Fauna habitat assessments
- Active searches
- Microchiropteran bat call detection
- Camera traps
- Visual and auditory identification surveys of birds
- Spotlighting
- Call playback
- Incidental observations.

Further surveys were undertaken between 3 February and 20 February 2021. These surveys targeted selected threatened fauna species and included the following methods:

- Active searches
- Harp trapping and microchiropteran bat call detection x64 trap nights
- Baited camera traps
- Visual and auditory identification surveys of birds
- Spotlighting searches
- Incidental observations.

These methods are further described below, and the survey effort for each species is presented in Table 3.12, Appendix F and Appendix G.

3.5.2 Fauna habitat assessments

Early stage habitat assessments were completed within the alignment segments and proposed borrow pits in August 2018 to characterise the fauna habitat within the subject land, within areas of medium to high condition. Fauna habitat assessments were conducted to aid understanding of potential habitat use within the subject land and, while not filling all of the BAM survey requirements for species credit species, the results were used to inform targeted survey efforts which occurred in October 2019 and January to March 2021. These surveys included all the alignment segments, and all borrow pits. The targeted surveys provide an indication of likely fauna utilisation, and suitability for fauna species, including listed fauna and species-credit species. Habitat attributes recorded during the assessment include:

- Vegetation structure and dominant species, including a description of canopy, shrub and ground layer structure and composition
- Presence and abundance of tree hollows and stags
- Presence and abundance of woody debris such as habitat logs and ground timber
- Presence and abundance of rocky habitat such as surface rocks, boulders, crevices, overhangs and caves
- Proximity to water (both permanent and ephemeral)
- Other disturbances such as grazing pressure, clearing, thinning or fire
- Any other significant habitat features present.

The habitat assessments included searches for signs of animal activity, such as tracks, scats, scratches, bones, fur, feathers, nests, foraging holes and diggings. In particular, scats deemed as potentially belonging to a species-credit species such as Koala were collected and sent to a scat analysis specialist (Barbara Triggs) for detailed analysis. Scat samples are analysed by removing hairs, which are then measured and examined under an optical microscope in whole mount, using 100x magnifications, in order to observe the hair profile, the structure of the medulla and the pigment distribution. The hairs were then cross-sectioned using the methods of Brunner & Coman (1974). The cross-sections were then examined under 100x magnification and the sections compared with others from the reference collection.

3.5.3 Targeted surveys

Targeted fauna surveys for species listed as suitable for spring survey occurred in October 2019 and Summer of 2021, this included nesting raptors and several mammals. Targeted surveys for several late summer/post rainfall fauna species were carried out in January/March 20121. A full list of the species targeted during the spring surveys and the general location of surveys are outlined in Table 3.12. Further detail of the survey effort including number or nights/days, locations and specific PCTs is located in Appendix D and Appendix F.

Table 3.12 Targeted species survey methodology, location and effort

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort	Approved survey method followed
Birds					
Australasian bustard (*Ardeotis australis*)	Habitat survey	35 (9 sites) 52, 244 (2 sites per PCT) 53, 55, 98, 192 and 628 (1 site per PCT) 56 (4 sites) 418 (3 sites)	October 2019	25 x habitat assessments	Surveyed all year round (as per NSW BioNet guidelines) for signs of nests/mounds and tracks. Flushing surveys of individuals by foot and vehicle.
	Flushing survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	
Barking owl (*Ninox connivens*)	Habitat survey	35 (7 sites) 36, 55 and 628 (1 site per PCT) 56 (5 sites) 98, 244 and 418 (2 sites per PCT)	October 2019	21 x habitat assessments	Breeding survey May to December. Broadcast searches are conducted for owl nests, roosts and pellets and nocturnal call playback and spotlight surveys specifically target the Barking Owl as per guidelines from Draft NSW Recovery Plan for Barking Owl.
	Pellet survey			42 person-hours	
	Spotlighting and call playback			210 person-hours	
Black-breasted buzzard (*Hamirostra melanosternon*)	Habitat survey	36, 55 and 98 (1 site per PCT) 56 (2 sites)	October 2019	5 x habitat assessments	Breeding survey September to November. Searches are conducted as per general raptor EPBC guidelines, searches for nests/roosts with paddock trees and retained vegetation. Active searches for soaring birds to detect over suitable habitat. Any incidental sighting during driving or walking also recorded. Detection by sightings, calls or signs of occupancy (EPBC Survey guidelines for Australia's threatened birds 2010)
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort	Approved survey method followed
Bush stone-curlew (*Burhinus grallarius*)	Spotlighting and call playback	35 (5 sites) 36, 192 and 628 (1 site per PCT)	October 2019	33 person-hours	Survey all year. Surveyed during breeding season to increase detectability, but also surveyed for using call playbacks and active night spotlighting.
	Flushing survey	52, 98, 244 and 418 (2 sites per PCT) 56 (4 sites)	Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	
Cotton pygmy goose (*Nettapus coromandelianus*)	Habitat survey	53 (1 site)	October 2019	1 x habitat assessment	Temporary wetland habitat surveyed in summer/early autumn after summer rains and deep permanent wetlands at end of dry season e.g. August to October when temporary wetlands have dried out (as per NSW BioNet guidelines)
Glossy black cockatoo (*Calyptorhynchus lathami*)	Habitat survey	35 (2 sites) 55, 244 and 628 (1 site per PCT) 56 (4 sites)	October 2019	9 x habitat assessments	Breeding survey April to August. Detected through area searches or transects on foot through areas of Casuarina/Allocasuarina in search of sign of recent feeding, which consists of chewed cones Surveyed during the first or last two hours of daylight when they are most active. Surveyed for signs of breeding on site as follows; (a) begging birds of any age or sex; or (b) lone adult males identified during the breeding season (April to August); or (c) an occupied nest. (EPBC Survey guidelines for Australia's threatened birds 2010, NSW BioNet database guidelines)
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	
Little eagle (*Hieraaetus morphnoides*)	Habitat survey	35, 56 (5 sites per PCT) 98 (2 sites per PCT) 244 and 628 (1 site per PCT).	October 2019	10 x habitat assessments	Breeding survey August to October. Searches are conducted as per general raptor EPBC guidelines, searches for nests/roosts with paddock trees and retained vegetation. Active searches for soaring birds to detect over suitable habitat. Any incidental sighting during driving or walking also recorded. Detection by sightings, calls or signs of occupancy (EPBC Survey guidelines for Australia's threatened birds 2010)
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	
	Active nest search	Above PCTs and; 147 (1 site) 418 (2 sites)	October 2019	9 person-hours	

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort	Approved survey method followed
Major Mitchell's cockatoo (*Lophochroa leadbeateri*)	Habitat survey Diurnal survey	192 and 628 (1 site per PCT) 244 (2 sites)	October 2019 Throughout all survey periods (2018, 2019 and 2020)	4 x habitat assessments Incidental driving and walking transects across all survey periods	Survey for signs of breeding from Aug to November, and search for foraging individuals all year round. All incidental observations recorded. (NSW BioNet database guidelines)
Masked owl (*Tyto novaehollandiae*)	Habitat survey Spotlighting and call playback	35 (3 sites) 36, 55, 98 and 628 (1 site per PCT) 56 (5 sites)	October 2019	12 x habitat assessments 120 person-hours	Breeding survey May to August. Broadcast searches are conducted for owl nests, roosts and pellets around stags or paddock trees as well as nocturnal call playback and spotlight surveys specifically targeting the Masked Owl (EPBC Survey guidelines for Australia's threatened birds 2010)
Red-tailed black cockatoo (*Calyptorhynchus banksii samueli*)	Habitat survey Diurnal survey	35 (2 sites) 55, 244 and 628 (1 site per PCT) 56 (4 sites)	October 2019 Throughout all survey periods (2018, 2019 and 2020)	9 x habitat assessments Incidental driving and walking transects across all survey periods	Surveys for breeding (May – December) will be identified by the presence of suitable habitat AND 1. presence of nest OR; 2. pairs exhibiting courtship behaviour; OR 3. observing/hearing begging juveniles. Surveys conducted all year round for incidental observations. (NSW BioNet database guidelines)
Square-tailed kite (*Lophoictinia isura*)	Habitat survey Diurnal survey	35 (7 sites) 36, 55 and 192 (1 site per PCT) 56 (5 sites) 98 and 418 (2 sites per PCT)	October 2019 Throughout all survey periods (2018, 2019 and 2020)	19 x habitat assessments Incidental driving and walking transects across all survey periods	Breeding survey September to January. Searches are conducted as per general raptor EPBC guidelines, searches for nests/roosts with paddock trees and retained vegetation. Active searches for soaring birds to detect over suitable habitat. Any incidental sighting during driving or walking also recorded. Detection by sightings, calls or signs of occupancy (EPBC Survey guidelines for Australia's threatened birds 2010)
Squatter pigeon (southern) (*Geophaps scripta scripta*)	Incidental daylight surveys	35 (9 sites) 36, 147, 192 and 628 (1 site per PCT) 52, 98 and 244 (2 sites per PCT) 56 and 418 (3 sites)	Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	Surveyed all year round in suitable habitat using flushing surveys (EPBC Survey guidelines for Australia's threatened birds 2010)

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort	Approved survey method followed
Superb parrot (*Polytelis swainsonii*)	Habitat survey	36 and 192 (1 site per PCT) 52 (2 sites)	October 2019	4 x habitat assessments	Breeding survey September to November. Surveyed during day when active and conspicuous. Incidental observations recorded (EPBC Survey guidelines for Australia's threatened birds 2010)
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	
Swift parrot (*Lathamus discolor*)	Habitat survey	35 and 418 (1 site per PCT)	October 2019	2 x habitat assessments	Area searches of suitable habitat, in the early morning and afternoon when birds are most active and vocal. Detection by sighting or call. Slow-moving vehicle transects, detecting loud, distinctive 'clinking' call that can be heard over noise of engine. Targeted surveys of patches of heavily flowering eucalypts. Surveys on the conducted between March and July. (EPBC Survey guidelines for Australia's threatened birds 2010)
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	
White-bellied sea-eagle (*Haliaeetus leucogaster*)	Habitat survey	35 (7 sites) 36, 98, 192 and 628 (1 site per PCT) 56 (5 sites) 244 and 418 (2 sites)	October 2019	20 x habitat assessments	Breeding survey July to December. Searches are conducted as per general raptor EPBC guidelines, searches for nests/roosts with paddock trees and retained vegetation. Active searches for soaring birds to detect over suitable habitat. Any incidental sighting during driving or walking also recorded. Detection by sightings, calls or signs of occupancy (EPBC Survey guidelines for Australia's threatened birds 2010)
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	
Mammals					
Bristle-faced free-tailed bat (*Setirostris eleryi*)	Anabat call detector	35, 36, 55, 98, 192, 244 and 628 (1 site per PCT) 56 (2 sites)	October 2019	18 x detector nights	Anabat dectector left at site for multiple day in suitable habitat during Oct to Mar. EPBC Survey guidelines for Australia's threatened bats 2010)
	Harp trapping	35, 36, 56 and 244 (1 site per PCT)	February 2021	64 x trap nights	Breeding survey October to March. Traps are placed in vegetation corridors, near water to catch bats with fishing line into catch bags. Left full night and check in morning. ('Species credit' threatened bats and their habitats. NSW guide for the BAM (DPIE 2017) and EPBC Survey guidelines for Australia's threatened bats 2010)

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort	Approved survey method followed
Eastern bent-wing bat (*Miniopterus orianae oceanensis*)	Anabat call detector	147 (1 site) 35 and 418 (2 sites per PCT)	October 2019	10 x detector nights	Breeding survey December to February. NO breeding habitat present. Anabat dectector left at site for multiple day in suitable habitat. ('Species credit' threatened bats and their habitats. NSW guide for the BAM (DPIE 2020b) and EPBC Survey guidelines for Australia's threatened bats 2010)
Eastern cave bat (*Vespadelus troughtoni*)	Anabat call detector	35 and 56 (2 sites per PCT) 147, 192 and 418 (1 site per PCT).	October 2019	14 x detector nights	Breeding survey November to January. Not within 2km of breeding habitat. Anabat dectector left at site for multiple day in suitable habitat during summer months ('Species credit' threatened bats and their habitats. NSW guide for the BAM (DPIE 2020b) and EPBC Survey guidelines for Australia's threatened bats 2010).
Eastern pygmy possum (*Cercartetus nanus*)	Spotlighting	244 and 418 (1 site per PCT)	February 2021	13 person-hours	Survey window October to March. Active spotlighting searches conducted in suitable habitat from October through to March. (NSW BioNet database guidelines and advice from BCSD Officer in Charge of the species)
	Camera traps			92 x trap nights	Set camera traps in suitable habitat from October through to March. (NSW BioNet database guidelines)
Grey-headed flying-fox (*Pteropus poliocephalus*)	Habitat survey	35 (6 sites) 56 (3 sites) 418 (2 sites)	October 2019	11 x habitat assessments	Surveyed for unrecorded day roosts all year. NO roosts recorded. Both the ground and foliage should be examined for flying fox scats. Roosts surveyed for animals exiting at dusk. ('Species credit' threatened bats and their habitats. NSW guide for the BAM (DPIE 2020b, EPBC Survey guidelines for Australia's threatened bats 2010)
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods	Conduct walking transects (100 m apart) looking for feeding and flying bats. Night time audio recordings made at selected sites or fruiting food plants observed within the project area. (EPBC Survey guidelines for Australia's threatened bats 2010)

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort	Approved survey method followed
Koala (*Phascolarctos cinereus*)	Spotlighting and call playback	36 (1 site)	October 2018	2 x persons for 3 nights	Survey all year. surveys and call playback conducted in suitable habitat. Initial listening for 15mins followed by spotlight search and then call play back and further listening for response and further spotlight. Surveyed twice on two separate nights at a minimum. (EPBC Survey guidelines for Australia's threatened mammals 2010)
	Scat search, spotlighting and call playback	35 (9 sites) 36, 55, 192, 244 and 628 (1 site per PCT) 56 (5 sites) 98 (2 sites) 418 (3 sites)	October 2019	25 person-hours Scat sent to B.Triggs for analysis	Active search on ground around trees for scats, where scats are detected, the location is marked with flagging tape with a GPS device. (EPBC Survey guidelines for Australia's threatened mammals 2010)
	Spotlighting	244 and 628 (1 site per PCT)	February-March 2021	8 person-hours	Spotlight conducted in suitable habitat. (EPBC Survey guidelines for Australia's threatened mammals 2010)
Large-eared pied bat *Chalinolobus dwyeri*	Anabat call detector	147 (1 site)	October 2019	10 x detector nights	Anabat dectector left at site for multiple day in suitable habitat during Oct to Mar. EPBC Survey guidelines for Australia's threatened bats 2010)
	Harp trapping (completed with Bristle-faced free-tailed bat *(Setirostris eleryi)* survey)	35, 36, 56 and 244 (1 site per PCT)	February 2021	64 x trap nights (four separate locations within study area less than 10 km apart)	Breeding survey October to March. Traps are placed in vegetation corridors, near water to catch bats with fishing line into catch bags. Left full night and check in morning. ('Species credit' threatened bats and their habitats. NSW guide for the BAM (DPIE 2017) and EPBC Survey guidelines for Australia's threatened bats 2010)
Rufous bettong (*Aepyprymnus rufescens*)	Habitat survey	35 and 55 (1 site per PCT)	October 2019	2 x habitat assessments	Survey window all year. Species surveyed by baited camera traps using universal bait in suitable habitat (open woodland with thick grass where possible (NSW BioNet database guidelines, EPBC Survey guidelines for Australia's threatened mammals 2010)
	Camera traps			12 x trap nights	

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort	Approved survey method followed
Squirrel glider (*Petaurus norfolcensis*)	Habitat survey	35 and 418 (2 sites per PCT)	October 2019	6 x habitat assessments	Survey window all year. Species surveyed by camera traps placed in potential habitat trees. Stag watching occurred just after dusk observing hollow-bearing trees for approximately 40 mins. (EPBC Survey guidelines for Australia's threatened mammals 2010)
	Spotlighting and stag watching	36 and 192 (1 site per PCT)		8 person-hours	
	Camera traps	192 (1 site)		4 x trap nights	
Reptiles					
Border thick-tailed gecko *(Uvidicolus sphyrurus)*	Habitat survey	192 (1) 418 (2 sites)	October 2019	3 x habitat assessments	Survey November to March. Survey should be undertaken on warm humid nights with good insect activity, or search by day under rocks, bark, logs, or in logs. (NSW BioNet database guidelines)
	Spotlighting	192 (1 site) 418 (2 sites)	October 2019 February-March 2021	14 person hours	
Dunmalls snake *(Furina dunmalli)*	Habitat survey	35 (2 sites)	October 2019	2 x habitat assessments	Targeted water-inundated gilgais, wetlands, riparian habitats and the surrounding environment (e.g., roads) and large logs between dusk and early morning hours. Spotlight surveys on warm, humid evenings. Surveys over a minimum of 1.5 person hours per hectare for habitats of average complexity and over a minimum of 3 nights. (EPBC Draft Referral guidelines for the nationally listed Brigalow Belt reptiles)
	Spotlighting	35 (2 sites)	February-March 2021	17 person hours	
Pale-headed snake (*Hoplocephalus bitorquatus*)	Habitat survey	35 (1 site) 56 (2 sites)	October 2019	3 x habitat assessments	Searched in suitable habitat from November to March after 1-2 days of rainfall or humid nights. (NSW BioNet database guidelines)
	Spotlighting	36, 56, 192, 244, 628 and 418 (1 site per PCT)	February-March 2021	82 person-hours	
Zigzag velvet gecko (*Amalosia rhombifer*)	Habitat survey	35 (2 sites) 418 (2 sites)	October 2019	4 x habitat assessments	Searched in suitable habitat on warm, humid nights with good insect activity, September to April. (NSW BioNet database guidelines)
	Spotlighting	35 (2 sites) 418 (2 sites)	February-March 2021	28 person hours	
Insects					
Pale imperial hairstreak (*Jalmenus eubulus*)	Habitat survey	35 (3 sites) 418 (1 site)	October 2019	4 x habitat assessments	Three times survey effort at minimum, surveyed 2 weeks apart in suitable habitat. Searching leaves of juvenile Brigalow below 2m for caterpillars, pupae and butterflies. 1 hour per ha for sites under 10ha and 11/ hour per ha for sites over 10 ha (DPIE pers comms 2021 T. Mazzer and email Appendix D)
	Active search	35 (9 sites)	February-March 2021	95 person hours	

3.5.4 Fauna survey methods

3.5.4.1 Active searches

Active searches were undertaken for reptiles, amphibians, small mammals, invertebrates and cryptic or ground-dwelling bird species and scats. This included scanning the trees and ground, searching beneath microhabitat such as rocks, fallen timber and peeling bark, digging through leaf litter and soil at tree bases and flushing birds from areas with a dense or grassy ground cover. Active searches were undertaken for a minimum of one hour within suitable microhabitat at each habitat assessment site (i.e. across the broad range of habitat types throughout the subject land). Active searches were undertaken for the Pale imperial hairstreak where suitable habitat (i.e. juvenile brigalow) occurs for the species within the subject land. Branches, leaves and stems were check for the presence of ants, larvae and pupa. Ants tending to larvae and pupa provided the best indication of the presence of these early life stages. Active searches were conducted for the adult butterflies wherever brigalow was present checking the canopy of larger brigalow trees. Pale imperial hairstreak surveys were undertaken across three phases as per the approved BCSD methodology in February and March 2021.

3.5.4.2 Microchiropteran bat call detection

Microchiropteran bat echolocation calls were recorded using Anabat recorders and Song Meter ultrasonic bat call detectors (Song Meters), configured to record Microchiropteran species potentially occurring in the area. Detection was conducted across the subject land between dusk and dawn across the broad range of habitat types. Where possible, detection units were positioned in natural flyways, favourable for Microchiropteran bat detection. Eight units were deployed over separate locations in October 2018 and October 2019 for a combined 39 survey nights (refer Figure 3.5). Call data from both the Song Meters and Anabat recorders was forwarded to Balance! Environmental for analysis. Further information on the approaches implemented is provided in Appendix D.

3.5.4.3 Harp trapping

Harp trapping was carried out in January and February 2021 targeting Bristle-faced free-tailed bat (*Setirostris eleryi*). In line with the NSW methodology four trap sites each containing four harp nets were deployed for four nights giving a total of 64 trap nights. The location of the traps and images of their setup is shown in Appendix D.

3.5.4.4 Camera traps

Camera traps were deployed in strategic positions within the alignment segments and borrow pits to record visitation by nocturnal and diurnal animals. Strategic locations included fauna corridors and watering points such as dams and creek lines. Honey-oat mix (some with added almond oil) was used as an attractant where natural lures (e.g. water) were not present. 27 cameras were set at 13 locations for a combined 156 trap nights (refer Appendix D and Appendix F). Depending on the target animals' traps were set at either <50 cm above ground (such as Rufous bettong (*Aepyprymnus* rufescens)) or >150 cm for arboreal animals (such as Squirrel glider (*Petaurus norfolcensis*) and Eastern pygmy-possum (*Cercartetus nanus*)). Further information on the approaches implemented is provided in Appendix D and G.

3.5.4.5 Visual and auditory identification surveys of birds

Roaming/meandering bird surveys were undertaken using both visual and auditory identification both within the alignment segments and borrow pits. Surveys commenced at dawn and continued for at least 20 minutes. Surveys were conducted at each habitat assessment site and during transit between sites. At least 20 minutes was spent at each survey site, with each site being sampled at least three times on separate mornings, sampling approximately 1 ha each time. A total of 75 surveys were carried out across the study area during the 2018 and 2019 surveys.

3.5.4.6 Spotlighting

To locate nocturnal fauna, spotlighting on foot using head torches and hand-held spotlights was undertaken over three nights at each survey location. Each survey continued for 20 minutes. In addition, spotlighting from the passenger window of a slow-moving vehicle (generally 5 to 10 km per hour) was undertaken along farm tracks, targeting larger ground and arboreal mammals and nocturnal birds. A total of 85 surveys were carried out across the study area during the 2018 and 2019 surveys.

Additional surveys for Pale-headed snake were conducted in February and March 2021, with a minimum of two-night surveys at each potential location for a minimum of 20 minutes at each site. Suitable habitat for this species included large trees along and nearby watercourses with hollows and decorticating bark, particularly at the base of the trunk. Microhabitat features and the surrounding terrestrial environment was actively searched for this species.

3.5.4.7 Call playback

Call playback for nocturnal bird species and koala was undertaken three times at each targeted location following spotlight surveys (refer Appendix D and Appendix F). Call playback targeted a range of species depending on habitat type present. Calls were played for several minutes, followed by a period of listening for responses, scanning the night sky for silhouettes, and spotlighting adjacent vegetation for perched owls and ground dwelling species.

3.5.4.8 Incidental observations

All fauna observed incidentally within or in close proximity (up to 4 km) to the subject land were recorded, including those seen while travelling along roads and tracks. Fauna identified at dams and wetlands were also recorded.

3.6 Survey effort, weather and limitations

3.6.1 Survey effort and timing

Following the desktop assessment, ecological survey sites identified as containing features of interest and located within or directly adjacent to the study area were selected. Specifically, the following features were used to identify areas of interest:

- Areas containing a representative example of a distinct vegetation community (i.e. areas contained within mapped PCTs, regrowth vegetation, and managed land areas)
- Areas containing landscape features that were considered likely to support threatened species when viewed from aerial photography (i.e. gilgai areas and wetlands)
- Areas known or predicted to support threatened species
- Areas identified as containing or potentially containing BC Act and EPBC Act listed TECs
- Areas that have not been subject to previous biodiversity investigations.

The location of terrestrial survey sites is shown in Figure 3.5. Further detail of the survey effort including number or nights/days, locations and specific PCTs is located in Appendix D and Appendix F.

A representative sampling approach was employed as part of the field sampling methodology in line with the BAM guidelines. Seasonal sampling (i.e. Spring (mid-September to mid-December) and Autumn (late February to April)) is recommended for taxa within this region. A number of surveys have been carried out for the proposal comprising the following:

- BAM plot surveys have occurred at the following times: 1 October to 9 October 2018; 31 October to 6 November 2018; 18 June to 24 June 2019; 1 July to 7 July 2019; 2 February 2021. These surveys were conducted in accordance with the methodology described in Section 3.4.1 and included targeted searches for species credit species flora which had specified survey months that coincided with the BAM plot survey.
- Targeted fauna surveys for suitable species credit species occurred between 23 October to 30 October 2019. This survey included searches for species with no specified survey months, species which had October as one of the specified survey months and a detailed assessment of fauna habitat including the size and height of tree hollows at each location in order to determine if suitable breeding habitat was present for other species credit species.
- Targeted flora surveys for species credit species with specified survey months occurred between 22 September to 30 September 2020. Species targeted included Pine donkey orchid (*Diuris tricolor*), Silky Swainsona (*Swainsona sericea*) and Slender darling pea (*Swainsona murrayana*). Parallel field traverses were undertaken in 10 m transects searching for threatened flora for the survey (as described in Section 3.4.8).
- Targeted flora and fauna surveys for species credit species with specified survey months/weather conditions occurred between 19 January to March 2021. Species targeted included several grass species, two species of *Lepidium* and searches for the Pale imperial hairstreak (*Jalmenus eubulus*). Parallel 10 m transect searches for threatened flora used for the survey. Survey for the Pale imperial hairstreak (*Jalmenus eubulus*) followed the methodology outlined in Appendix F and included three rounds of visual assessment of juvenile brigalow which was identified as potentially being habitat for the species (although not optimal habitat).
- Targeted fauna surveys for species credit species with specified survey months/weather conditions occurred in February 2021 and in March 2021. Species targeted included Pale-headed snake (*Hoplocephalus bitorquatus*), Bristle-faced free-tailed bat (*Setirostris eleryi*), Eastern pygmy possum (*Cercartetus nanus*), Border thick-tailed gecko (*Uvidicolus sphyrurus*) and Zigzag velvet gecko (*Amalosia rhombifer*).

All rounds of required targeted surveys have been completed in accordance with the BAM and agency requirements.

3.6.2 Weather

The daily temperature as recorded at Texas Post Office (station number 041100) is closest to the survey area and daily rainfall as recorded at New Kildonan (station 041507) at the time of surveys are detailed in Table 3.13 and Figure 3.5.

Table 3.13 Daily and monthly temperature and rainfall observations during survey

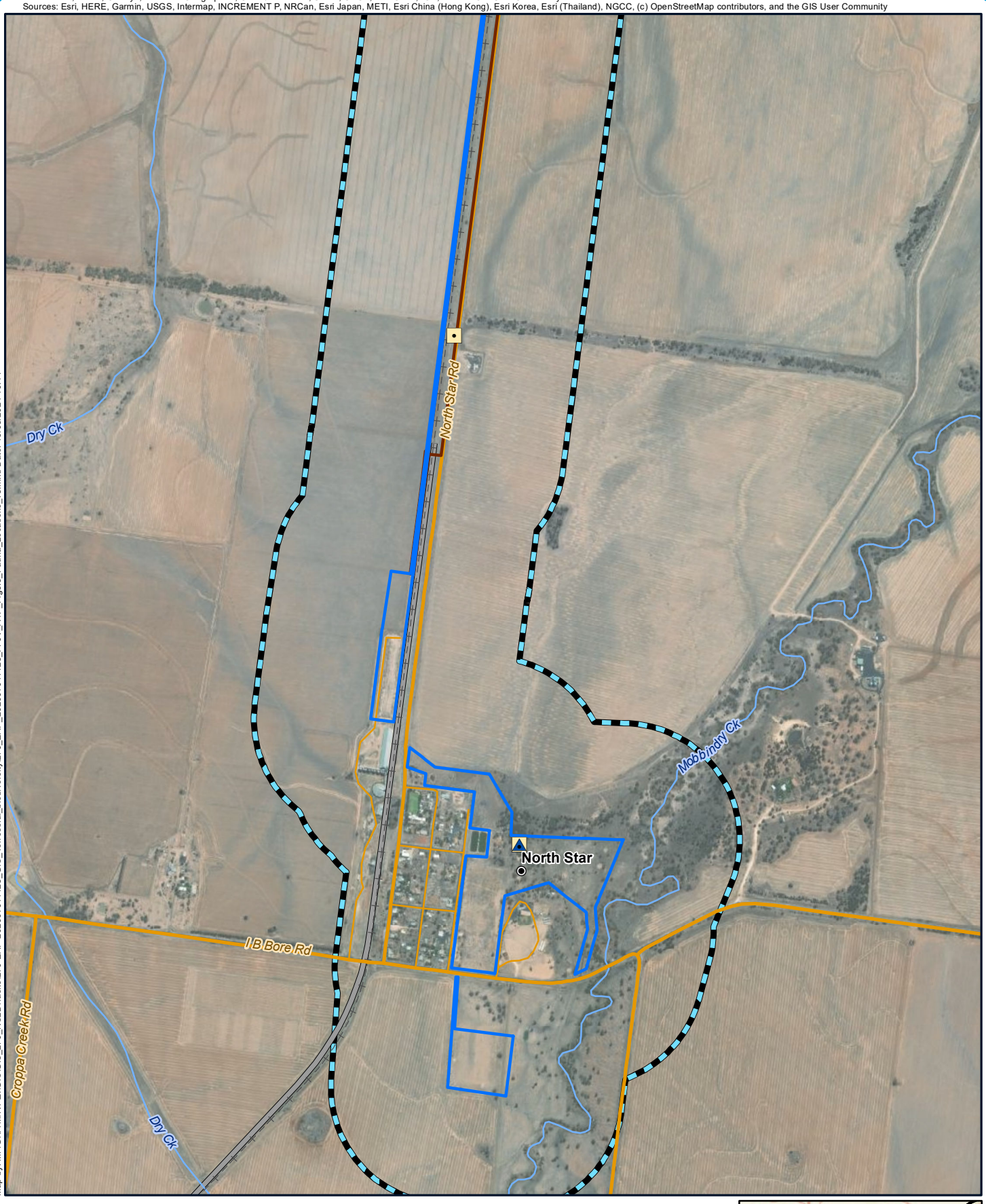
Date	Minimum temperature	Maximum temperature	Rainfall (mm)
1 October 2018	8.47	26.5	0
2 October 2018	8.1	28.0	0
3 October 2018	9.5	29.8	0
4 October 2018	13.1	25.2	0
5 October 2018	15.7	18.9	8
6 October 2018	14.3	25.7	6.6
7 October 2018	11.1	26.8	0.6

Date	Minimum temperature	Maximum temperature	Rainfall (mm)
8 October 2018	12.4	28.2	0
9 October 2018	13.5	30.5	0
10 October 2018	12.2	32.2	0
30 October 2018	13.1	29.7	0.2
31 October 2018	14.4	32.0	0
Monthly mean (temp.)/total (rain) October 2018	**13.9**	**28.6**	**103.4**
1 November 2018	15.2	35.	0
2 November 2018	16.8	32.6	0
3 November 2018	19.0	34.5	0
4 November 2018	18.2	37.2	0.8
5 November 2018	15.8	39.2	0
6 November 2018	23.6	40.7	0
Monthly mean (temp.)/total (rain) November 2018	**15.7**	**31.6**	**59**
20 June 2019	2.2	19.5	0
21 June 2019	-0.5	16.0	0
22 June 2019	-1.8	17.7	0
23 June 2019	-0.5	18.5	0
Monthly mean (temp.)/total (rain) June 2019	**5.5**	**20.2**	**15.4**
3 July 2019	6.4	24.0	0
4 July 2019	6.6	23.1	0
5 July 2019	10.9	22.0	0
6 July 2019	11.0	21.7	0
Monthly mean (temp.)/total (rain) July 2019	**3.8**	**21.2**	**4**
23 October 2019	13.0	31.2	0
24 October 2019	13.1	32.1	0
25 October 2019	17.1	32.2	0
26 October 2019	18.1	34.5	0
27 October 2019	14.6	33.1	0
28 October 2019	12.5	32.2	0
29 October 2019	13.9	32.0	0
30 October 2019	17.2	28.0	0
Monthly mean (temp.)/total (rain) October 2019	**13.1**	**30.6**	**23.6**
22 September 2020	17.5	27.7	2.6
23 September 2020	8.8	27.0	0.2
24 September 2020	6.0	24.2	0
25 September 2020	5.2	29.0	0
26 September 2020	6.0	19.5	0
27 September 2020	1.3	22.0	0

Date	Minimum temperature	Maximum temperature	Rainfall (mm)
28 September 2020	5.5	25.1	0
29 September 2020	6.4	25.5	0
30 September 2020	9.9	21.7	0.2
Monthly mean (temp.)/total (rain) September 2020	**9.1**	**26.0**	**7.2**
19 January 2021	18.1	33.2	9.4
20 January 2021	18.3	32.2	0.2
21 January 2021	17.2	30.3	0
22 January 2021	19.0	30.2	7.4
23 January 2021	16.9	33.3	1.6
24 January 2021	15.9	33.3	0
25 January 2021	17.9	34.3	0
26 January 2021	18.4	35.3	0
27 January 2021	19.7	37.9	0
28 January 2021	20.2	33.6	0.4
29 January 2021	17.5	33.5	0
30 January 2021	18.1	35.0	0
31 January 2021	18.7	36.2	0
Monthly mean (temp.)/total (rain) January 2021	**18.3**	**32.3**	**42.8**
1 February 2021	17.7	32.4	0
2 February 2021	17.1	33.0	0
3 February 2021	17.9	34.1	0
4 February 2021	16.1	35.5	0
5 February 2021	18.5	35.0	5.2
6 February 2021	19.0	32.1	6.4
7 February 2021	20.6	34.0	13.8
8 February 2021	20.3	35.5	4.6
9 February 2021	20.2	33.1	15.6
10 February 2021	17.6	32.9	0
11 February 2021	15.8	33.5	15.4
12 February 2021	19.0	32.9	34.2
13 February 2021	22.5	32.0	0
14 February 2021	20.6	32.3	5.2
15 February 2021	17.5	32.8	0
16 February 2021	17.5	32.5	0
17 February 2021	15.7	31.5	0
18 February 2021	17.8	32.2	11.6
19 February 2021	17.6	33.5	0
20 February 2021	17.2	34.6	0
Monthly mean (temp.)/total (rain) February 2021	**18.4**	**33.7**	**150.6**

Date	Minimum temperature	Maximum temperature	Rainfall (mm)
1 March 2021	23.5	33.5	0
2 March 2021	18.5	35	0
3 March 2021	18.5	32.5	0
4 March 2021	18.4	30.6	0
5 March 2021	16.1	32.5	0
6 March 2021	16.1	32.5	0
7 March 2021	17.2	33	0
8 March 2021	20	30.5	0
9 March 2021	17.9	31.8	29.2
10 March 2021	19.8	33	0
11 March 2021	19.9	30	1.2
12 March 2021	18.8	30.4	0
13 March 2021	19.7	32.5	0
14 March 2021	20	31.5	0
Monthly mean (temp.)/total (rain) March 2021	**17.6**	**29.3**	**79.0**

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Localities
- Dawn survey/Spotlighting
- Fauna habitat assessment
- Existing rail (non-operational)
- Adjoining alignments
- Watercourses
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:22,000

0 110 220 330 440 550m

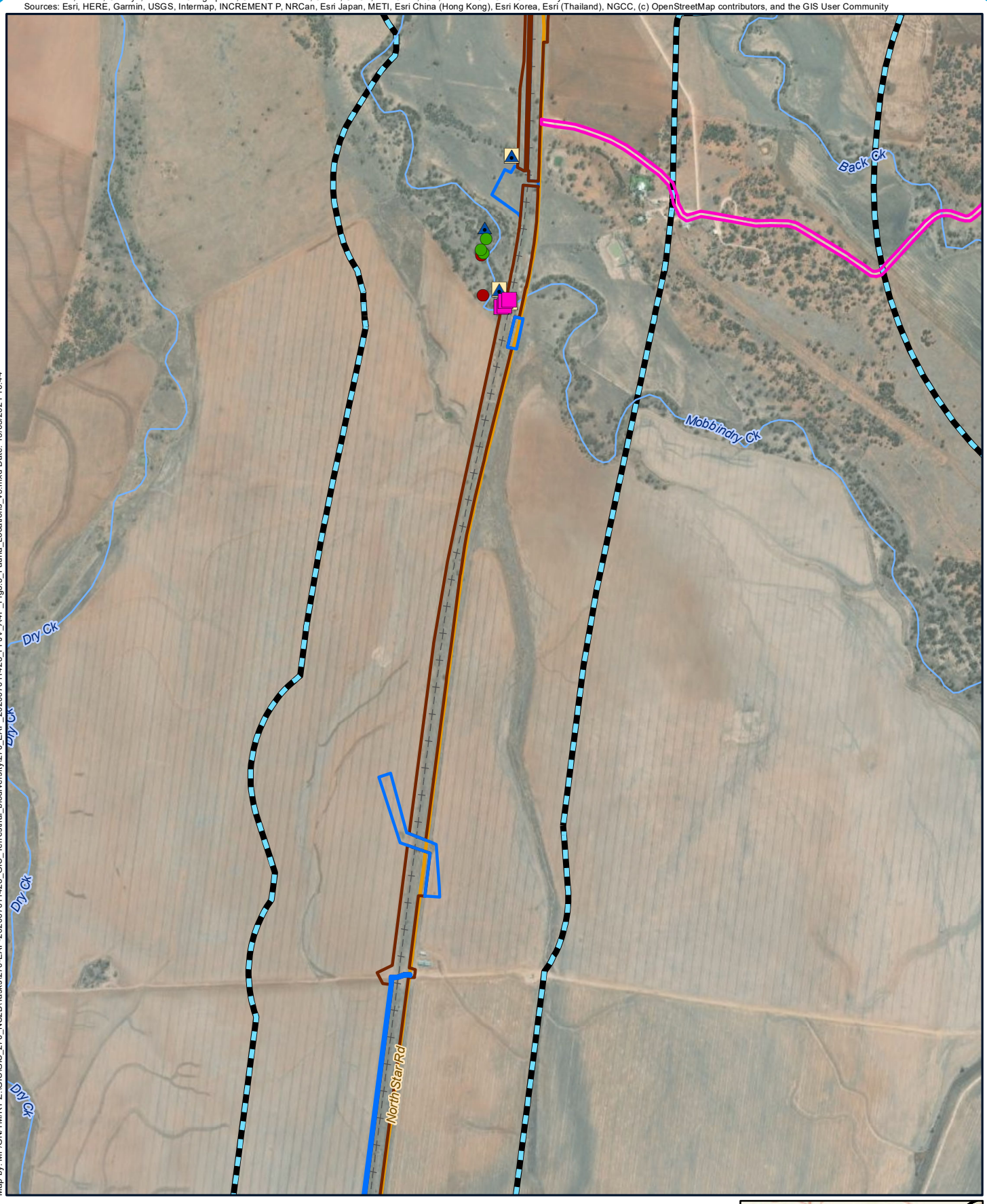
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5a:
Location of targeted fauna assessments

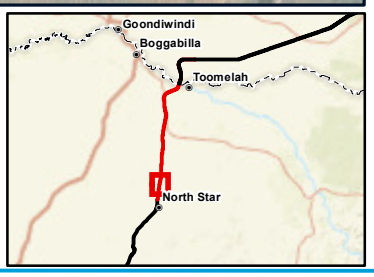
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Harp trap
- Fauna habitat assessment
- Existing rail (operational)
- Existing rail (non-operational)
- Watercourses
- Major roads
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 100 200 300 400 500m

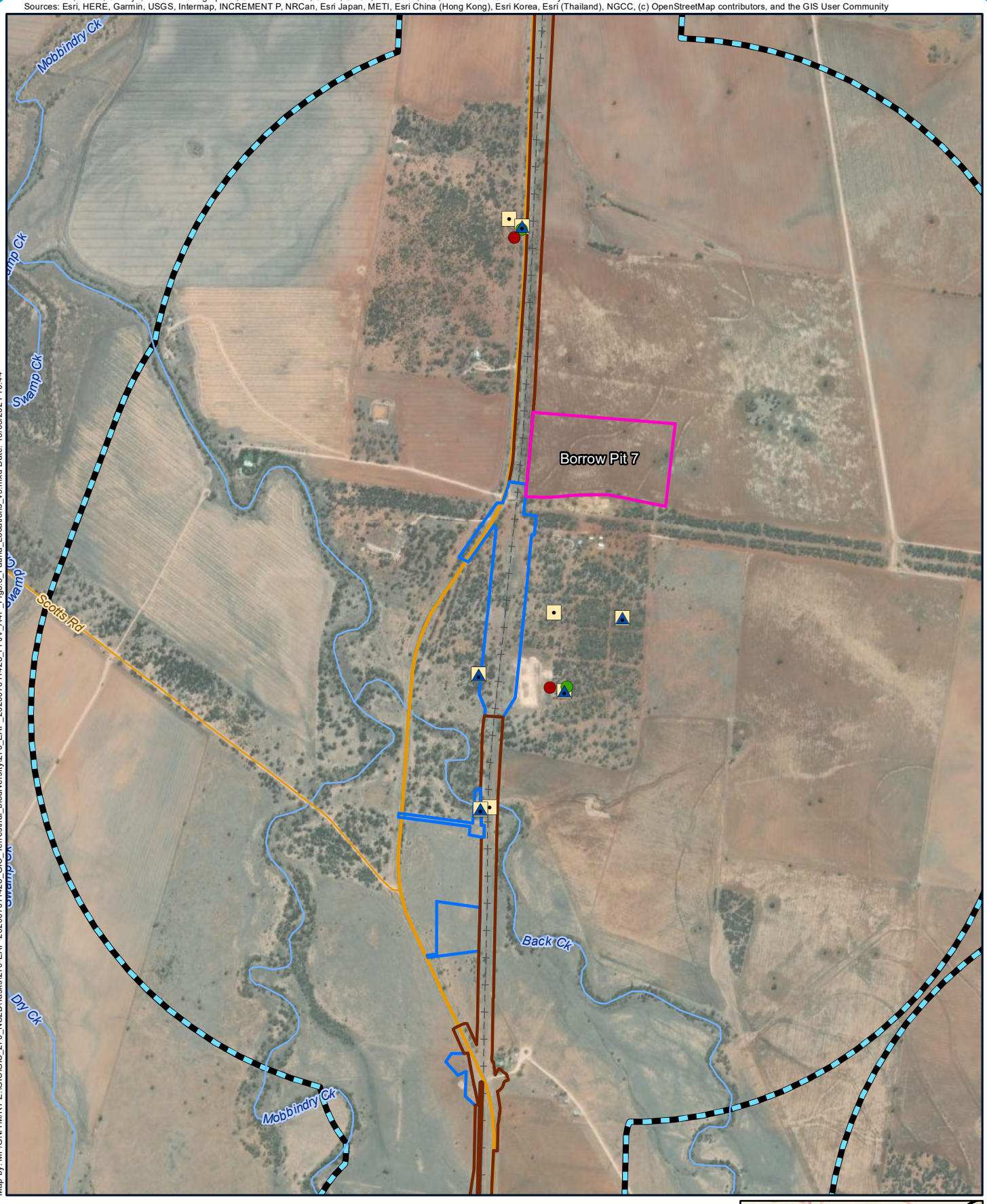
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5b:
Location of targeted fauna assessments

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Microchiropteran bat call detection
- Camera trap
- Fauna habitat assessment
- Existing rail (non-operational)
- Watercourses
- Major roads
- Minor roads

- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)

A4 scale: 1:20,000

0 100 200 300 400 500m



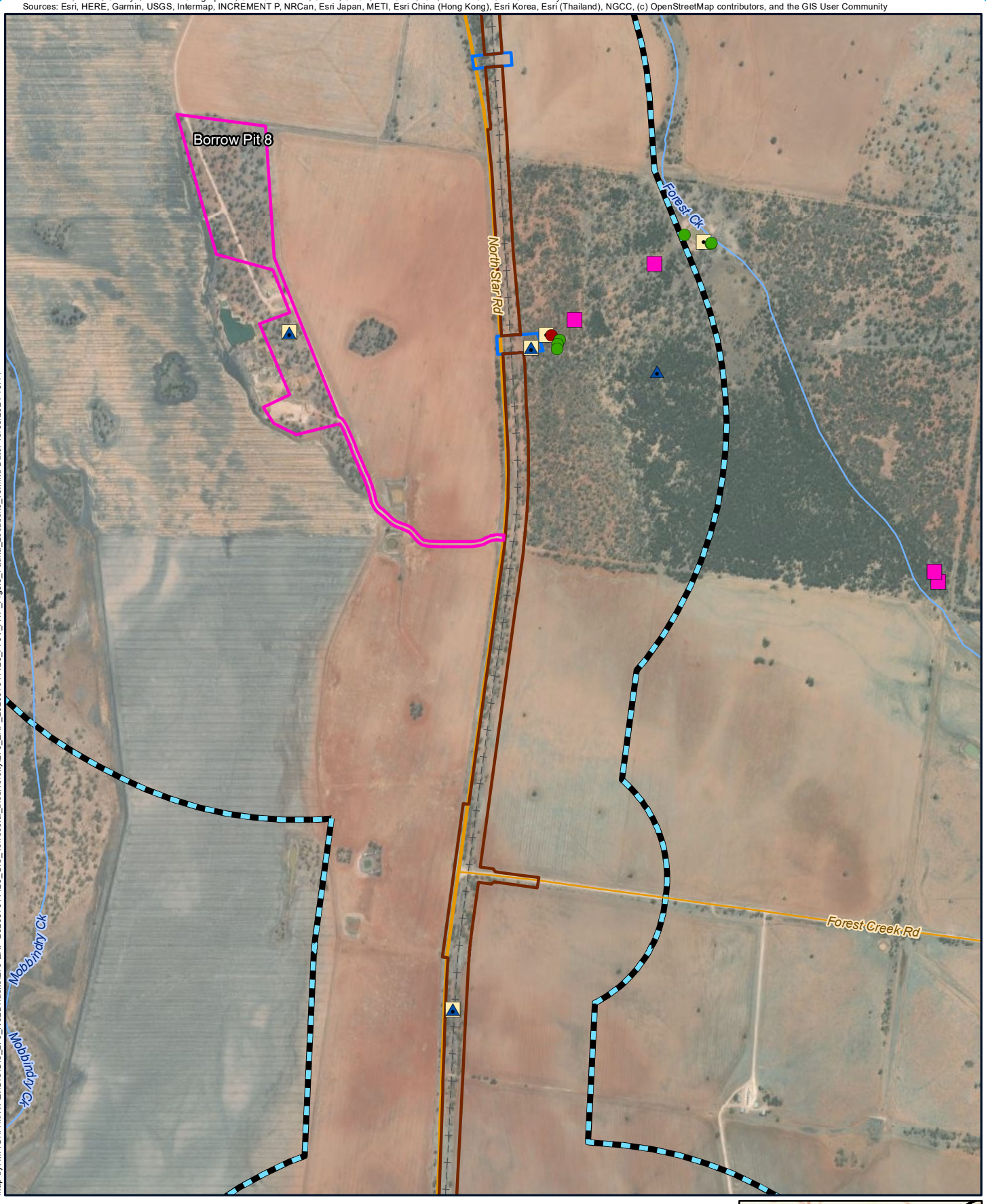
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5c:
Location of targeted fauna assessments

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Harp trap
- Fauna habitat assessment
- Existing rail (non-operational)
- Watercourses
- Major roads
- Minor roads
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 100 200 300 400 500m

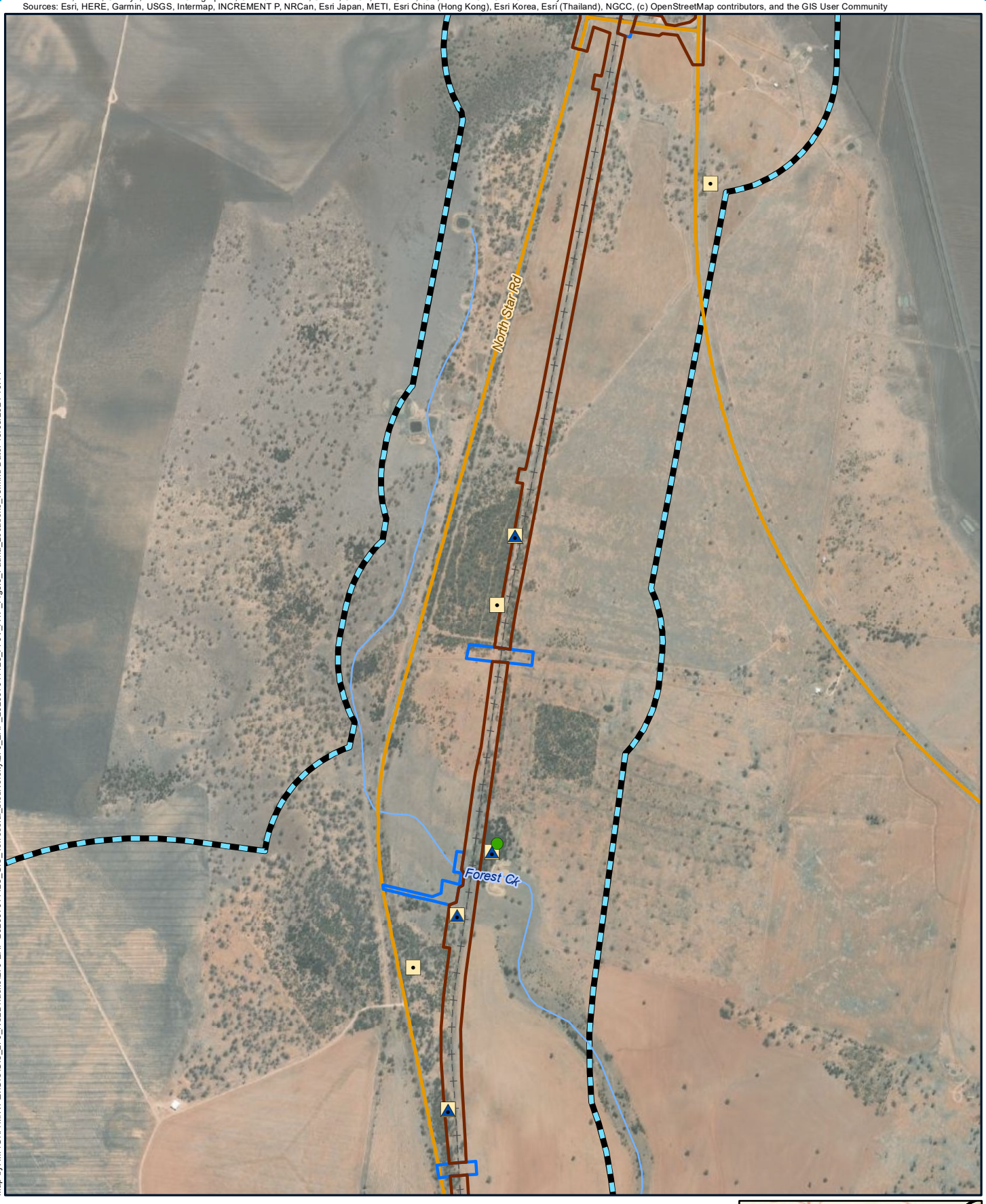
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5d:
Location of targeted fauna assessments

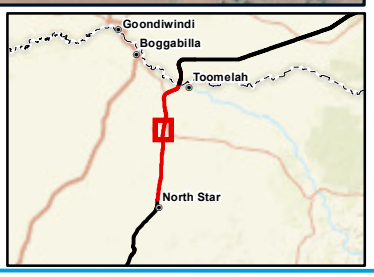
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Camera trap
- Fauna habitat assessment
- Existing rail (non-operational)
- Watercourses
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 100 200 300 400 500m

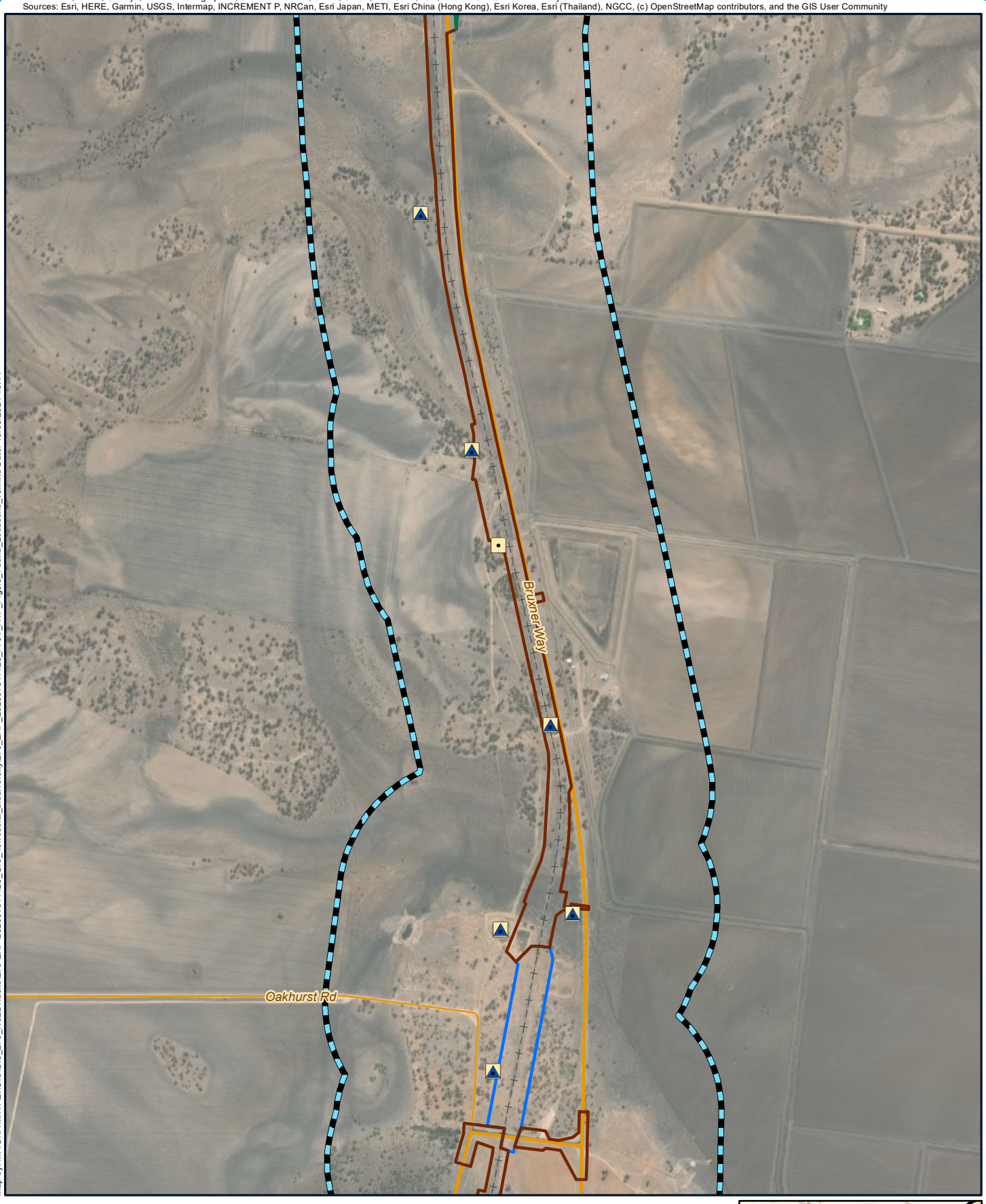
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5e:
Location of targeted fauna assessments

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Fauna habitat assessment
- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 100 200 300 400 500m

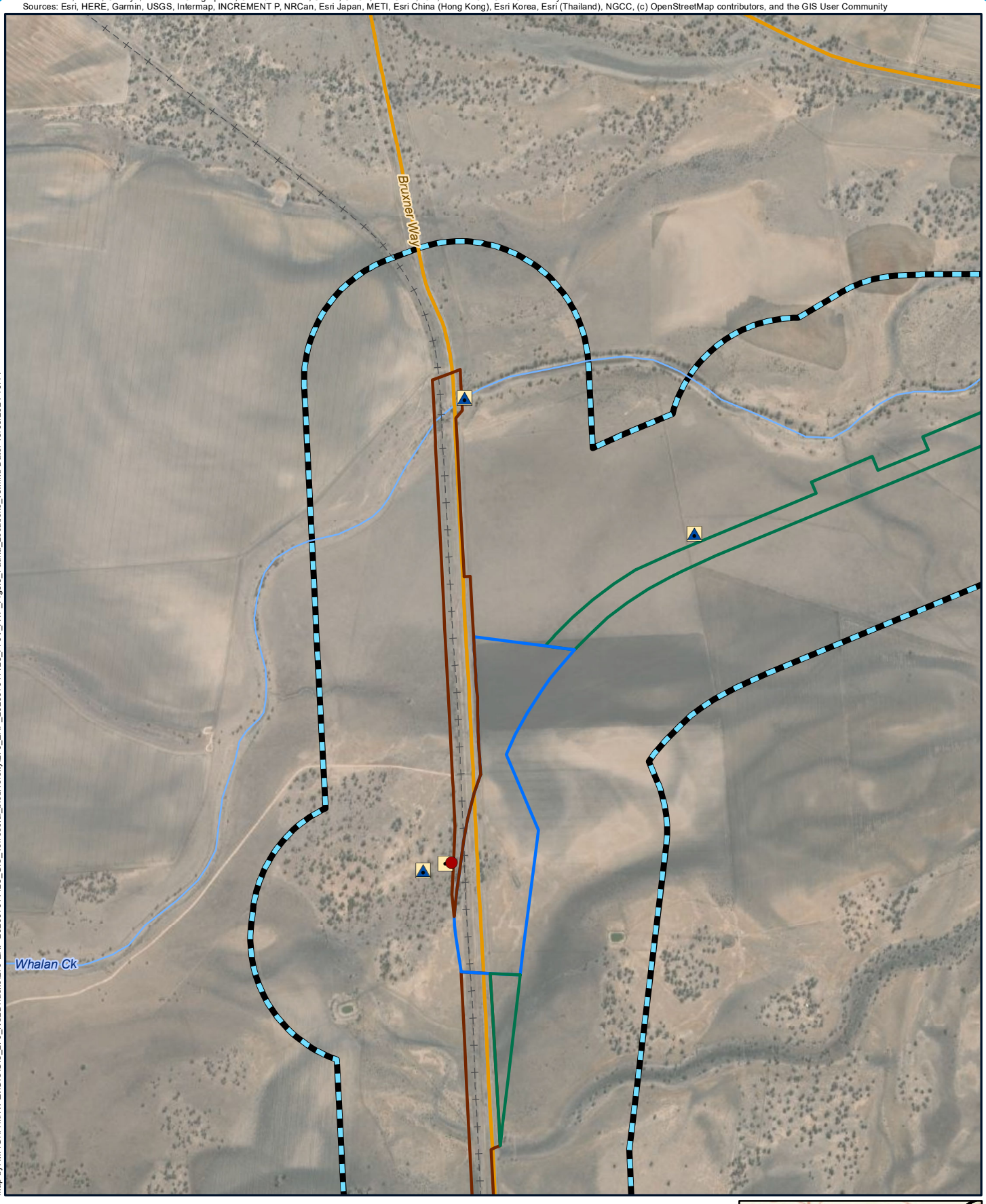
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5f:
Location of targeted fauna assessments

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Fauna habitat assessment
- Existing rail (non-operational)
- Watercourses
- Major roads
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 100 200 300 400 500m

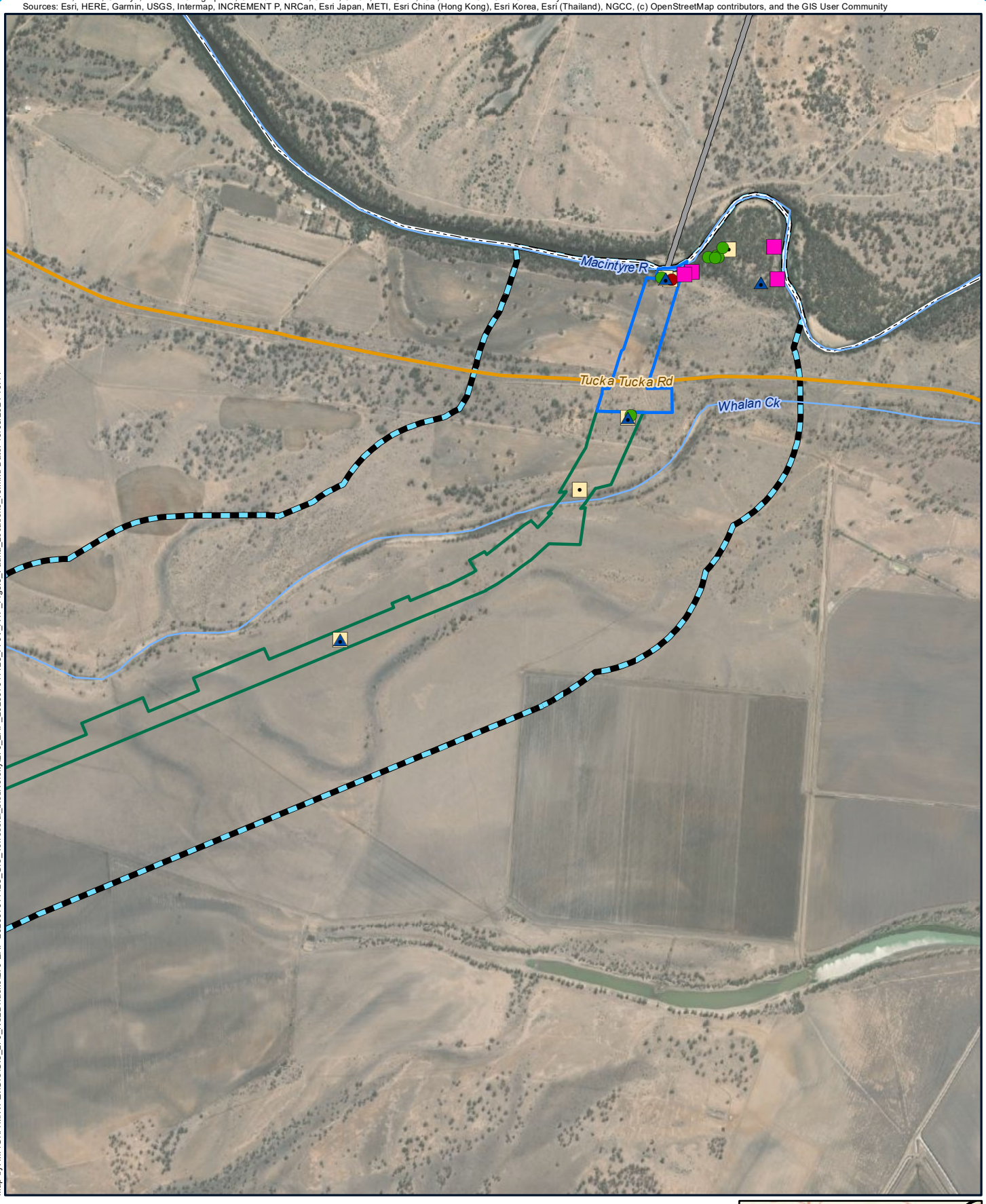
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5g:
Location of targeted fauna assessments

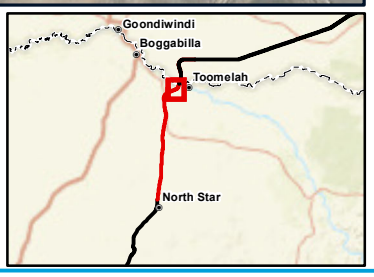
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Camera trap
- Harp trap
- Fauna habitat assessment
- NSW/QLD border
- Watercourses
- Major roads
- Study area
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 100 200 300 400 500m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5h:
Location of targeted fauna assessments

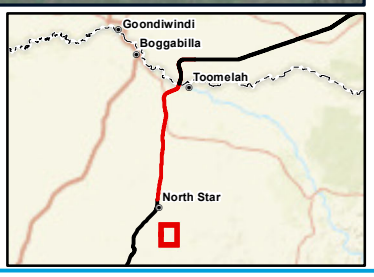
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Microchiropteran bat call detection
- Watercourses
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:10,000

0 50 100 150 200 250m

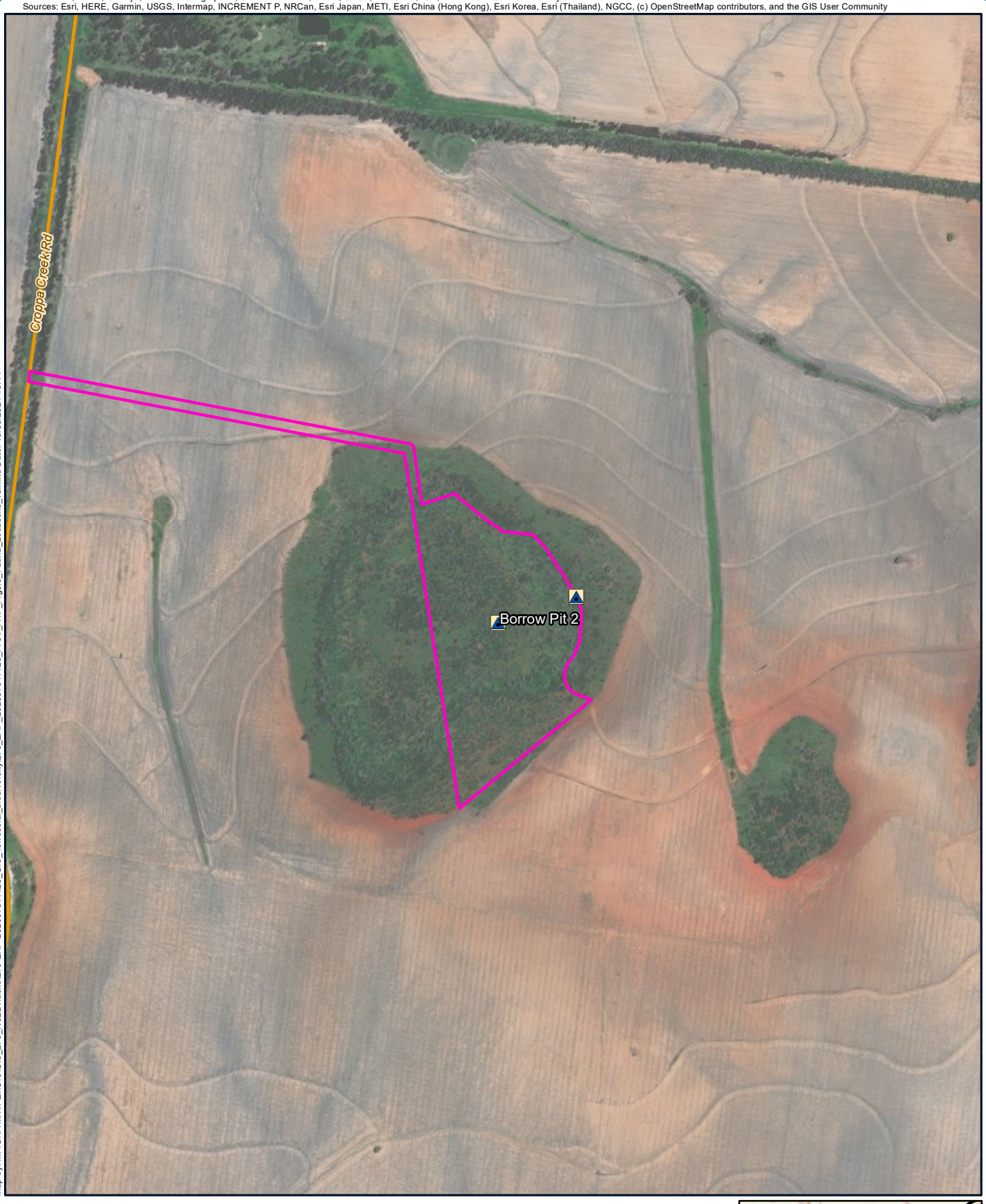
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5i:
Location of targeted fauna assessments

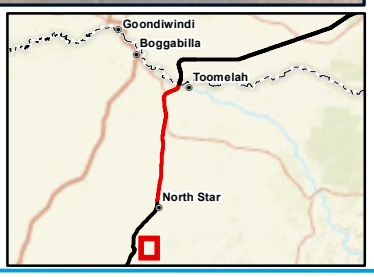
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5j:
Location of targeted fauna assessments

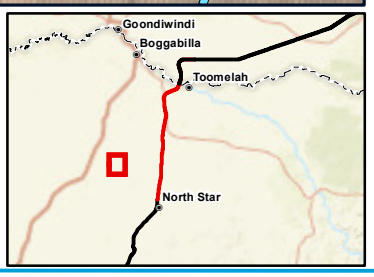
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Camera trap
- Minor roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:15,000

0 75 150 225 300 375m

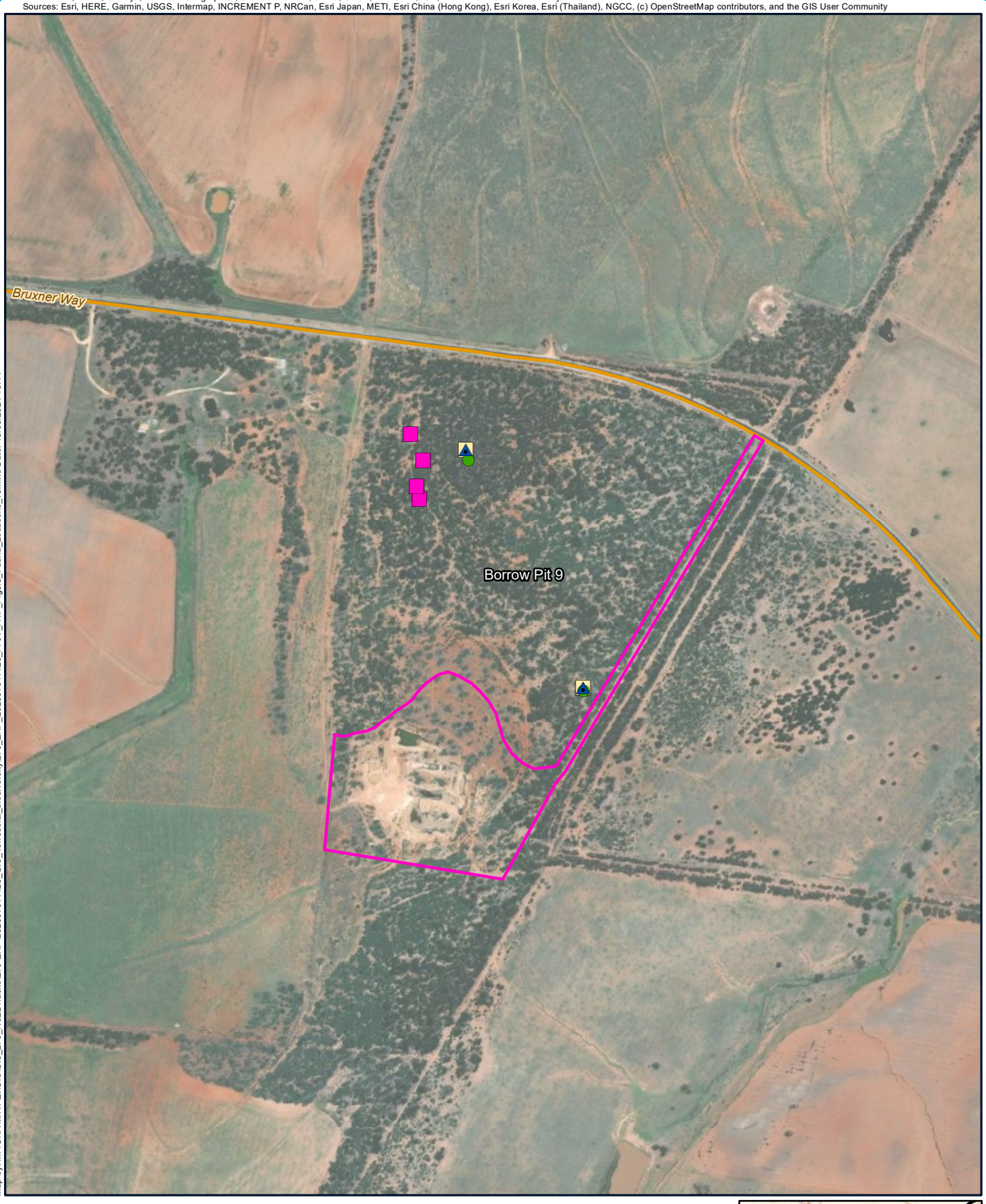
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5k:
Location of targeted fauna assessments

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Camera trap
- Harp trap
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5l:
Location of targeted fauna assessments

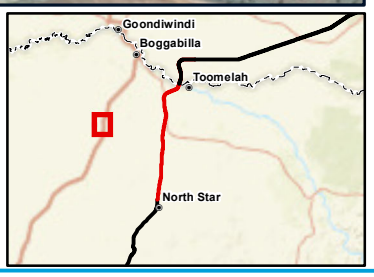
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Watercourses
- Major roads
- Minor roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5m:
Location of targeted fauna assessments

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig3.5_Fauna_Locations_v5.mxd Date: 13/05/2021 10:44

Legend

- Dawn survey/Spotlighting
- Camera trap
- Watercourses
- Minor roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 3.5n:
Location of targeted fauna assessments

3.7 Species polygon mapping for threatened species

Species polygon mapping was undertaken upon completion of the spring vegetation survey in 2018 to identify and map areas having the potential to provide habitat for species-credit species listed under the provisions of the BC Act in accordance with the BAM. This allowed for targeted survey efforts to be planned in suitable PCTs within the timeframes stipulated by the threatened species database.

The first round of targeted fauna and detailed habitat assessments at 46 locations within the alignment segments and borrow pits were conducted in October 2019 and induced dawn, dusk and daytime surveys with recording of habitat features at each location. The results from this survey effort further refined the species polygons based on absence or presence for targeted species or based on the presence of suitable hollow bearing trees for some non-target species i.e. higher than 5 m and greater than 15 cm for Glossy black-cockatoo.

This mapping was again refined in March 2021 following completion of all targeted flora surveys, and additional targeted fauna surveys such as harp trapping for Bristle-faced free-tailed bat. Where flora presence was guided by soil and PCT conditions all of the PCT polygon was mapped as habitat, where individual plants occurred i.e. one grass plant, then a buffer of 100 m was placed around that plant to determine the area of habitat for that species in that location. This mapping decision is based on the information within the BioNet database which refers to the colonisation ability of both grass species to 'Disperse beyond the adult plant but within the population'. Species polygon mapping has been developed in line with the NSW requirements (as per DPIE 2020c).

Where areas which have not been able to be accessed for targeted flora and fauna survey in 2020/21 as shown in Appendix A, all threated species associated with PTCs within those areas have been assumed to be present as per BAM requirements.

For any threatened species not surveyed for as part of targeted efforts but identified within the SEARS and for any MNES species not covered under the BAM, predictive habitat modelling was undertaken as outlined in Section 10.

3.8 Permits to conduct works

The biodiversity field surveys reported in this document were conducted under the provisions of Aurecon's Scientific Licence (SL101374), Scientific collection permit (Fisheries) (P14/0025-1.4) and Animal Research Authority for ecological surveys within non-protected areas of New South Wales. Flora samples were collected under AECOM's scientific licence SL100659 and Aurecon's scientific licence SL101374 issued by the DPIE.

3.9 Quality assurance/quality control

Quality control/assurance in relation to field results occurred through the following processes:

- BAM related work under the supervision of the BAM accredited assessors (refer Section 3.12)
- Scats that were collected in the field were sent to Barbara Triggs, scat analysis specialist, for species confirmation (third party verification)
- Any threatened fauna species had to be sighted/confirmed by both members of the field team to produce a confirmed record. Where applicable/possible, proof (e.g. photograph, scat or other evidence) was collected.

The BAM accreditation of people preparing this report, and the qualifications and experience of any other people relied on in preparing the report is summarised in Table 3.14.

Table 3.14 Qualifications and experience of person involved with preparation of the report

Person	BAM accreditation	Qualifications	Experience
Sarah Glauert	BAAS17097	BSc Conservation Biology	13 years field ecology and consulting in NSW and Queensland
Ben Roberts	BAAS18042	BSc Arts, G Dip Science	14 years ecological consulting
Dr Helen Vickers	-	BSc Science (Honours), PhD	12 years ecological consulting
Andrew Craig	BAAS19022	BSc Science	20 years field ecology
Greg Ford	-	BSc App Science, G Dip Res Mgt	25 years research, field ecology
Brett Taylor	-	BSc Science, Eco and Cons Biol	12 years ecological consulting, 14 years field ecology
Kirsty Raines	-	BSc Science, M.A Env Sci and Mgt	2 years ecological consulting and field ecology in NSW
Andy Dalton	-	BSc Science	6 years field ecology
Nick Heard	-	BSc Ecology	9 years field ecology
Dr Oliver Robertson	BAAS20007	BSc Science (Honours), PhD	7 years field ecology and ecological consulting, 10 years research
Dominic Adshead	-	BSc Science (Forestry)	25 years field ecology and consulting in NSW
Liam Stephen	-	BSc Science (Honours)	1 year field ecology

3.10 Nomenclature

3.10.1 Flora

All vascular plants recorded or collected within plots were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Royal Botanic Gardens Sydney 2018).

3.10.2 Fauna

The sources of nomenclature for the fauna sections of this report follow those used in the OEH threatened biodiversity profiles.

3.11 Assumptions and limitations

The following assumptions and limitations are applicable to this technical report:

- Drought and Intense Drought conditions affecting NSW, in particular within the Moree Plains and Gwydir Shires within which the subject land falls, resulted in limited floral material being available for identification purposes and limited the diversity and cover of vegetation observed during initial surveys in 2018 and 2019. Potentially, this could lead to an underestimation of the presence of native flora species and cover. In turn this may have impacted the ability to accurately initially determine threatened species presence and the presence of some TECs such as Natural grasslands on basalt and fine-textured alluvial plains. It is the assessors understanding that DPIE have recently conducted updated BAM plot surveys in some areas to inform/update condition scores to accurately reflect drought conditions. A review of the BioNet Vegetation Classification database for several of the PCTs indicated that the results from the surveys were reasonable in terms of expected flora diversity for high, medium and low condition PCTs as mapped and that it was the percent cover which was most likely to have been impacted by the drought.

- Flora species that are difficult to identify during dry conditions, such as grasses, were assumed to be present where suitable habitat occurs following initial surveys in 2018 and 2019. This approach is consistent with the precautionary principle. Later targeted surveys for these species were carried out in September 2020 and January/February 2021 following substantial rains in the area.
- A number of plots located in the northern section of the subject land had four rather than five leaf litter sub- plots recorded. Where this occurred rather than use an 'average' of the benchmark value, the percentage cover was determined by dividing the sum of the sub-plots by four.
- All potential borrow pits have been included in this report though it is envisioned that not all borrow pits will be used. Therefore, not all credits will need to be retired. This report has followed the precautionary principle and assumed the largest potential impact will occur (i.e. worst-case scenario).
- Access to parts of the greenfield northern rail alignment from Bruxner Way to Whalan Creek was not possible and a number of species were assumed to be present in this section.
- Where due to changes in the layout of the alignment insufficient numbers of plots had been completed the benchmark data for that PCT was used. If an area had been mapped as 'Low' due to the absence of trees within that zone the tree data for that PCT was not included within the Benchmark information. Information of which areas have had benchmark data used is below
- Due to the amount of time between the original submission of the BDAR for public exhibition on 26 August 2020, updates to some species and PCT associations have occurred within the BAM C. These updates account for any differences noted between the number of ecosystem credits associated with specific MNES species located in Table 10.6. between the two versions of the report.

Benchmark Data Used Brigalow Belt South	Number of plots	Alignment segment mapping location
PCT 628	2	CB 628 Greenfield Low
PCT 628	1	CB 628 Brownfield Low
PCT 35	1	NB 35 Greenfield High
PCT 35	1	NB 35 Brownfield Low
PCT 35	1	NO 35Brownfield High
PCT 56	2	NB 56 Early works Low
PCT244	2	CB 244 Brownfield Low
PCT247	2	CB 247 Brownfield Low
PCT27	1	NB 27 Early works Low

3.12 Personnel - Accredited Assessors under the Biodiversity Assessment Method

To meet the certification requirements under Section 6.15 of the BC Act, this report has been prepared on the basis of the requirements of (and information provided under) the BAM, as current on the date this report was finalised on 19 March 2021. All sections of this report which relate specifically to the BAM and works associated with the proposal EIS have been completed or overseen by one or more of the following BAM accredited assessors:

- Sarah Glauert (BAM Assessor No. BAAS17097) (Primary assessor)
- Ben Roberts (BAM Assessor No. BAAS17023)
- Andrew Craig (BAM Assessor No. BAAS19022).
- Oliver Robertson (BAM Assessor No BAAS20007).

Other ecological consultants from the FFJV have undertaken work under the supervision of the BAM accredited assessors.

The outcomes of impact assessments undertaken under the BAM are typically presented in the form of a BDAR or a Biodiversity Certification Assessment Report (BCAR) which also presents the findings of Stage 1 (refer Figure 3.1). For the purposes of this Terrestrial Biodiversity Technical Report, this document will contain sufficient information to satisfy the requirements of a BDAR. The BDAR has been segmented with separate assessments for the greenfield, brownfield and early works areas associated with the alignment. The early works areas include the associated laydown areas, access tracks and camp. Separate assessments have been conducted for each potential borrow pit. It is anticipated that not all borrow Pits will be required for the project. The impacts assessed in the BDAR are of a concept design using a conservative maximum footprint. During the detailed design phase it is anticipated that impacts will be revised and reduced. Specific methodologies associated with the assessment of impacts and their associated significance are detailed in Section 9 of the BAM (DPIE 2017).

The sections of this Terrestrial Biodiversity Technical Report that constitute a BDAR are hereby certified as BAM compliant as of the 16 July 2021.

4 Landscape context

The following sections detail the landscape context (as required under the BAM), as well as other relevant results of the terrestrial ecology desktop study. Search result outputs from the PMST and NSW EES Bionet Atlas databases are provided in Appendix E.

4.1 Land use, Bioregions and Sub-regions

As outlined in Section 3.2.4 of the BAM, landscape features have been identified within a 500 m buffer from the boundary of the construction footprint (including the temporary and permanent disturbance footprints) along the greenfield, brownfield and early works segments of the alignment and 1,500 m surrounding the borrow pits. The subject land traverses different IBRA Bioregions and Sub-regions, NSW (Mitchell) landscape areas, various stream orders and connective features. Landscape features applicable to the subject land are described in Table 4.1. Maps showing IBRA regions, subregions, NSW (Mitchell) landscapes and land uses within the subject land are provided in Appendix A.

Table 4.1 Landscape features

Landscape feature	Brigalow Belt South IBRA Northern Basalts	Brigalow Belt South IBRA Northern Outwash	Darling Riverine Plains IBRA Castlereagh-Barwon
Combined alignment segments (greenfield, brownfield and early works)			
Subject land	167 ha	116 ha	113 ha
Native vegetation extent (500 m buffer)	426 ha	135 ha	497 ha
Percent native vegetation cover (500 m buffer)	33%	20%	47%
Mitchell landscapes	▪ Croppa Clay Plains ▪ Macintyre Alluvial Plains	▪ Croppa Creek Channels and Floodplains ▪ Croppa Clay Plains ▪ Macintyre Alluvial Plains	▪ Barwon Channels and Floodplains ▪ Macintyre Alluvial Plains ▪ Croppa Clay Plains ▪ Macintyre Alluvial Plains
IBRA Bioregion	Brigalow Belt South	Brigalow Belt South	Darling Riverine Plains
IBRA Sub-region	Northern Basalts	Northern Outwash	Castlereagh-Barwon
Rivers, streams, estuaries (Strahler order)	▪ Forest Creek ▪ (3rd order stream)	▪ Mobbindry Creek ▪ (3rd order stream) ▪ Back Creek ▪ (3rd order stream)	▪ Whalan Creek ▪ (2nd order stream) ▪ Macintyre River ▪ (6th order stream)
Wetlands	None	None	▪ Water reservoir associated with a cotton crop ▪ Floodplain wetland associated with Macintyre River
Connecting features	▪ Forest Creek	▪ Mobbindry Creek ▪ Back Creek	▪ Whalan Creek ▪ Macintyre River
Areas of geological significance and soil hazard features	Great Artesian Basin	Great Artesian Basin	Great Artesian Basin
Areas of outstanding biodiversity value	None	None	None

Landscape feature	Brigalow Belt South IBRA Northern Basalts	Brigalow Belt South IBRA Northern Outwash	Darling Riverine Plains IBRA Castlereagh-Barwon
Combined borrow pits			
Subject land	45 ha	14 ha	None
Native vegetation extent (1,500 m buffer)	620.60 ha	1320.43 ha	None
Percent native vegetation cover (500 m buffer)	34%	19%	31%
Mitchell landscapes	▪ Croppa Clay Plains ▪ Macintyre Alluvial Plains ▪ Yallaroi Basalts	▪ Croppa Clay Plains ▪ Macintyre Alluvial Plains	▪ Macintyre Alluvial Plains ▪ Barwon Channels and Floodplains- ▪ Croppa Clay Plains ▪ Macintyre Alluvial Plains
IBRA Bioregion	Brigalow Belt South	Brigalow Belt South	Darling Riverine Plains-
IBRA Sub-region	Northern Basalts	Northern Outwash	-Castlereagh-Barwon
Rivers, streams, estuaries (Strahler order)	▪ Forest Creek ▪ 3rd order stream	▪ Back Creek ▪ 3rd order stream (Borrow pit 7)	▪ -Macintyre River ▪ Whalan Creek ▪ 2nd order stream ▪ 6th order stream
Wetlands	None	None	▪ Water reservoir associated with a cotton crop ▪ Floodplain wetland associated with Macintyre River
Connecting features	▪ Forrest Creek	▪ Mobbinbry Creek ▪ Back Creek	▪ Whalan Creek ▪ Macintyre River
Areas of geological significance and soil hazard features	Great Artesian Basin	Great Artesian Basin	Great Artesian Basin-
Areas of outstanding biodiversity value	None	None	-

4.2 Vegetation - threatened ecological communities

Following a review of the BioNet Vegetation Classification database and the existing PCT mapping eight PCTs were identified as having six analogous or partly analogous TECs listed under the BC Act (refer Table 4.2). Detailed assessment of these PCTs against the TECs is located in Appendix A.

Table 4.2 Plant Community Types and analogous TECs (BC Act) identified from the State Vegetation Type Map

PCTs	Analogous TEC (BC Act)
PCT 27 Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion **PCT 55** Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions

PCTs	Analogous TEC (BC Act)
PCT 35 Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion **PCT 56** Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW **PCT 244** Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions
PCT 36 River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion ***Partly analogous*** **PCT 53** Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains **PCT 244** Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt) **PCT 247** Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	Artesian Springs Ecological Community in the Great Artesian Basin
PCT 147 Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion **PCT 55** Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	Semi-evergreen vine thickets of the Brigalow Belt South and Nandewar Bioregions
PCT 56 Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW **PCT 628** Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions
PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregion

4.3 Soils and geology

4.3.1 Alignment segments

The proposed alignment is characterised by a general decline in gradient from south to north. The highest elevation occurs at North Star (approximately 260 m AHD). The elevation gradually descends from the highlands into the low ridges of the NSW/Queensland border, with the point of lowest elevation occurring as the corridor passes over Whalan Creek at 223 m AHD.

Soil profiles were examined along the proposed greenfield, brownfield and early works alignment segments. The road crossing of Back Creek, on the western side of the road, is associated with minor sheet, rill and gully erosion with stable scald erosion. Streambank erosion is evident on site, however no salting was found. The railway crossing on the western side of North Star Road (located south of Scotts Road) is also associated with minor sheet erosion with stable scald erosion, however no salting was evident.

Soil erosion data from the NSW Central West region, which encompasses the all segments of the proposed alignment, revealed 25 per cent of soil monitoring units reporting sheet erosion as an issue, followed by 4 per cent gully erosion and 4 per cent for wind erosion. However, given that data from Metcalfe & Bui (2016) was broad-scale and has been categorised as ‘limited’ in confidence, indicates that actual erosion risk in proximity to the proposed alignment may vary from the study results.

None of the boreholes drilled as part of the geotechnical investigation for this proposal encountered rock between the depths of 20 and 40 m. The main geological unit under the proposal is the Kumbarilla Beds, which is a sedimentary sequence of terrestrial origin (sandstone, siltstone and mudstone). It is not known to be acid producing.

None of the younger sediments (Quaternary alluvium and Quaternary sand/soil) have the potential to be acid forming. The geology of the alignment indicates a strong dominant presence of alluvium deposits which are associated with sediments deposited through the transportation of channelled stream water. The main form of alluvium deposit in the Moree Plains and Gwydir region is likely to consist of prairie soils, black earths and grey clays which have developed on finer-grained sediment. Alluvium deposits in the region will potentially result in deposits of sand, silt or silty clay on low ridges along floodplains (DSITIA 2012). Studies of soil distribution and physical properties indicate that parent material strongly influences soil development in an area.

4.3.2 Borrow pits

The EIS for the project (ARTC 2020) identified eleven borrow pits with the potential to provide general and/or structural fill, with a maximum amount of extracted material during construction estimated to be 1,500,000 m^3. Borrow pit location IDs (refer Figure 1.1) and the corresponding soil types, potential qualitative contamination, soil erosion and salinity risk is detailed in Table 4.3. The location of potential borrow pits is based on the likely availability of suitable material. Several of the proposed borrow pits are located directly adjacent to existing borrow pits and also within close proximity to the alignment. The two potential borrow pits to the south of North Star (Borrow Pit 1 and Borrow Pit 2) are located on rocky outcrops which have not been developed for farming activities due to the amount of surface rock and the quality of the underlying soils. This is typical of the region, where most existing borrow pits are located on rocky outcrops and stony rises that are unsuitable for agriculture. Potential borrow pit sites were initially proposed based on minimising impacts to existing agricultural land-use and distance to the rail alignment. The presence of existing borrow sites was also considered. The final selection of borrow sites considered biodiversity impacts. Following detailed investigation and consultation with the biodiversity and engineering teams the final number of borrow pits has been reduced to eight and the total areas of these pits has also been reduced. This has been achieved to reduce the potential impacts on listed vegetation communities and species. Borrow pits that have been removed from further consideration are greyed out and italicised in the table below.

Table 4.3 Soil classification and potential qualitative risk of borrow pits

Borrow pit ID	Soil type mapping	Surrounding land uses	Soil erosion risk	Salinity risk
4	Chromosols	Existing borrow pit, cropping pasture	Medium – soil type known to be susceptible to structural decline	Low - Found in well drained sites, moderate water holding capacity
5	Vertosols	Existing borrow pit, scattered vegetation, cropping pastures	Low – soil type is rich in clay and has high plasticity. Difficult to cultivate. Known shrink-swell phenomena (cracks when dry and expands when wet). Typically low sodicity.	Low – High water holding capacity. Typically low salinity.
7	Chromosols	Existing borrow pit, scattered vegetation, cropping pastures, house	Medium – soil type known to be susceptible to structural decline	Low - Found in well drained sites, moderate water holding capacity
8	Ferrosols, Dermosols and Chromosols	Existing borrow pit, cropping pasture	Low – soil type is rich in clay and has high plasticity. Difficult to cultivate. Known shrink-swell phenomena (cracks when dry and expands when wet). Typically low sodicity.	Low – High water holding capacity. Typically low salinity, can have localised salinity hazard.
9	Chromosols	Existing borrow pit, dense vegetation, cropping pastures	Medium – soil type known to be susceptible to structural decline	Low - Found in well drained sites, moderate water holding capacity

Borrow pit ID	Soil type mapping	Surrounding land uses	Soil erosion risk	Salinity risk
11 (removed)	*Chromosols*	*Existing borrow pit, dense vegetation, suspected residential rubbish disposal, housing*	*Medium – soil type known to be susceptible to structural decline*	*Low - Found in well drained sites, moderate water holding capacity*
13	Vertosols	Existing borrow pit, cropping pastures, scattered vegetation	Low – soil type is rich in clay and has high plasticity. Difficult to cultivate. Known shrink-swell phenomena (cracks when dry and expands when wet). Typically low sodicity.	Low – High water holding capacity. Typically low salinity.
25	Chromosols	Existing borrow pit, cropping pastures, vegetation, house	Medium – soil type known to be susceptible to structural decline	Low - Found in well drained sites, moderate water holding capacity
26 (removed)	*Chromosols*	*Existing borrow pit, vegetation, cropping pastures*	*Medium – soil type known to be susceptible to structural decline*	*Low - Found in well drained sites, moderate water holding capacity*
2	Vertosols & Dermosols	Cropping pastures, scattered vegetation	Medium – localised sheet erosion hazard	Low - Found in well drained sites, moderate water holding capacity
1	Vertosols & Dermosols	Existing borrow pit, native vegetation and grazing	Medium – localised sheet erosion hazard	Low - Found in well drained sites, moderate water holding capacity

4.4 Other matters of state environmental significance

4.4.1 Protected areas

No protected areas (including land and water) managed by DPIE and/or DPI Fisheries under the National Parks and Wildlife Act 1974 and the Marine Estate Management Act 2014 have been identified within the study area. No biobank sites, private conservation lands and other lands identified as offsets have been identified within the study area.

4.4.2 Critical habitat

A single area of critical habitat under Division 3 of the FM Act (1994) has been registered. This is Grey-nurse Shark Critical Habitat which is a marine environment and is not relevant to the proposal.

4.4.3 Results of aquatic ecology desktop assessment

The subject land falls within the Border Rivers Catchment which comprise the catchments of the Dumaresq, Severn and Macintyre Rivers. The proposed rail corridor and borrow pits fall within the Macintyre River sub-catchment and transect several creeks. A detailed assessment can be found in the EIS Appendix S: Aquatic Biodiversity Technical Report.

4.4.4 Threatened aquatic species and communities

No fish records occur within the rail corridor identified in a search of the BioNet database (refer Section 4.4.3). The only threatened aquatic species identified by the PMST was the Murray cod (*Macullochella peelii*) which is listed as vulnerable (EPBC Act). The Macintyre River provides suitable habitat for Murray cod. All other waterways surveyed are unlikely to support Murray cod due to a lack of key fish habitat, including but not limited to semi-permanence of aquatic refuges. No aquatic communities were identified in the PMST report. Further detail on aquatic habitat values is provided in EIS Appendix S: Aquatic Biodiversity Technical Report. An assessment of the potential for the proposal to significantly impact Murray cod is provided in EIS Appendix S: Aquatic Biodiversity Technical Report.

4.4.5 Wetlands of International Importance

There are no Wetlands of International Importance (Ramsar wetlands) within, or adjacent to (i.e. within 10 km) of the proposal. The following Ramsar wetlands are located within north-western NSW but more than 100 km from the proposal:

- Gwydir Wetlands
- Little Liangothlin Nature Reserve Ramsar Site
- Narran Lake Nature Reserve Ramsar Site
- Macquarie Marshes Ramsar Site.

The following Ramsar wetlands, identified in the EPBC Act Protected Matters Report (Appendix E), are located more than 1,000 km from the proposal:

- Banrock Station Ramsar site (>1,100 km to the south-west in South Australia)
- Riverland Ramsar site (>1,000 km to the south-west in South Australia)
- Coorong and Lakes Alexandria and Albert (>1,200 km to the south-west in South Australia).

A wetland complex consisting of Morella watercourse, Pungbougal Lagoon and Boobera Lagoon are part of a remnant channel of the Macintyre River south of Goondiwindi. This wetland complex is listed as a site of national importance in the Directory of Important Wetlands in Australia (an inventory of nationally important wetlands maintained by Environment Australia). It is not located within the proposal site, with the watercourse system at a minimum of 8 km downstream from the proposal site, and hydraulically connected only during flood events.

4.4.6 Waterfront Land

Under the NSW *Water Management Act 2000* 'waterfront land' is defined as the bed of a river and the land within 40 m of the river bank. Within the proposal area, all watercourses and associated tributaries and adjacent lands are classed as 'waterfront land' (including the Macintyre River and adjacent lands). Under the Act this may be classed as a 'controlled activity' requiring development approval. The Guidelines for controlled activities on waterfront land (DPI 2012) provide a framework for development activities within the riparian corridor. However, the proposal has been classed as 'state significant infrastructure' and is exempt from requiring a controlled activity approval. As such, 'waterfront land' associated with the proposal is not referred to further in this report.

4.4.7 Groundwater dependent ecosystems

4.4.7.1 Terrestrial groundwater dependent ecosystems

Moderate to high potential terrestrial GDEs are mapped within the 2 km radius groundwater search area for GDEs; these are summarised in Table 4.4. Mapping of potential GDEs is presented in EIS Chapter 14: Groundwater.

Table 4.4 Summary of terrestrial groundwater dependent ecosystems

PCT	GDE Category	Aquatic GDE description
PCT36	High	High potential terrestrial GDEs within the floodplains of Mobbindry Creek, Back Creek, Whalan Creek and, Macintyre River. This GDE is characterised by Red River Gums and open tall forest associated with flood plains. The alignment intersects this feature with a short section of cut and fill proposed.
PCT53	High	High potential terrestrial GDEs within the area mapped as PCT53 which is an ephemeral wetland.
PCT247	High	High potential terrestrial GDE within the areas mapped as lignum swamp

4.4.7.2 Subterranean groundwater dependent ecosystems

No known or potential subterranean GDEs have been mapped within the Bureau of Meteorology GDE Atlas within the GDE groundwater search area.

5 Native vegetation

5.1 Overview

This section provides a description of the existing flora values of the subject land based on the results of the field assessments. The results presented in this section detail the plant community types, existing flora and fauna species (including weeds and pests), habitats, and TECs observed within the study area.

5.1.1 Flora species observed

A total of 341 flora species were observed within the subject land. Of those 285 (83 per cent) were native and 56 (17 per cent) were non-native. A full list of the flora species recorded within the subject land is located in Appendix E. Of the non-native species, 34 (61 per cent) are recorded as Naturalised on PlantNET, 15 (27 per cent) are listed as High Threat Exotics (HTE) and four (7 per cent) do not appear on the PlantNET records for NSW. One HTE was recorded outside of the subject land but has the potential to invade within a short timeframe. Two species-credit flora species were observed within the subject land.

5.2 Plant Community Types

Surveys of the subject land identified 14 PCTs across three broad condition states, equating to 29 distinct vegetation types which are listed in Table 5.1 and shown in Figure 5.1. The percent cleared value in the vegetation community profiles is sourced from the BioNet Vegetation Classification database.

These PCTs were aligned with communities described as part of the NSW VIS Classification Database (OEH 2016c). The PCTs were then categorised into 21 vegetation zones across the three segments of the alignment and 25 vegetation zones within the Borrow pits, based on condition and location within the IBRA subregions.

The composition of the PCTs including location within IBRA sub-regions and vegetation quality (High, Medium, Low) are outlined in Section 5.2.1 and a flora species list for all plots surveyed is included in Appendix E.

Table 5.1 Plant community types and TECs, broad condition classes (PCTs) and area of impact

PCT ID	Plant community types	BC Act threatened ecological communities	Condition classes	Area of impact alignment segments[#] (ha)	Area of impact Borrow pits (ha)	Analogous TEC under the EPBC Act
PCT 27	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions - **present**	Medium Low	0.02 4	N/A	Weeping Myall Woodland - **present**
PCT 35	Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions - **present**	High	11.17		Brigalow (*Acacia harpophylla* dominant and co-dominant) - **present**
			Medium	N/A	0.67 (BP1)	
			Low	4.1	0.95 (BP1) 0.67 (BP2)	
PCT 36	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	Artesian Springs Ecological Community in the Great Artesian Basin - **absent**	High	1.17	N/A	The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin - **absent**
			Medium	4.27	N/A	
PCT 52	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	N/A	Medium	33.50	N/A	Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland - **present**
PCT 53	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains	N/A	Medium	4.20	N/A	N/A

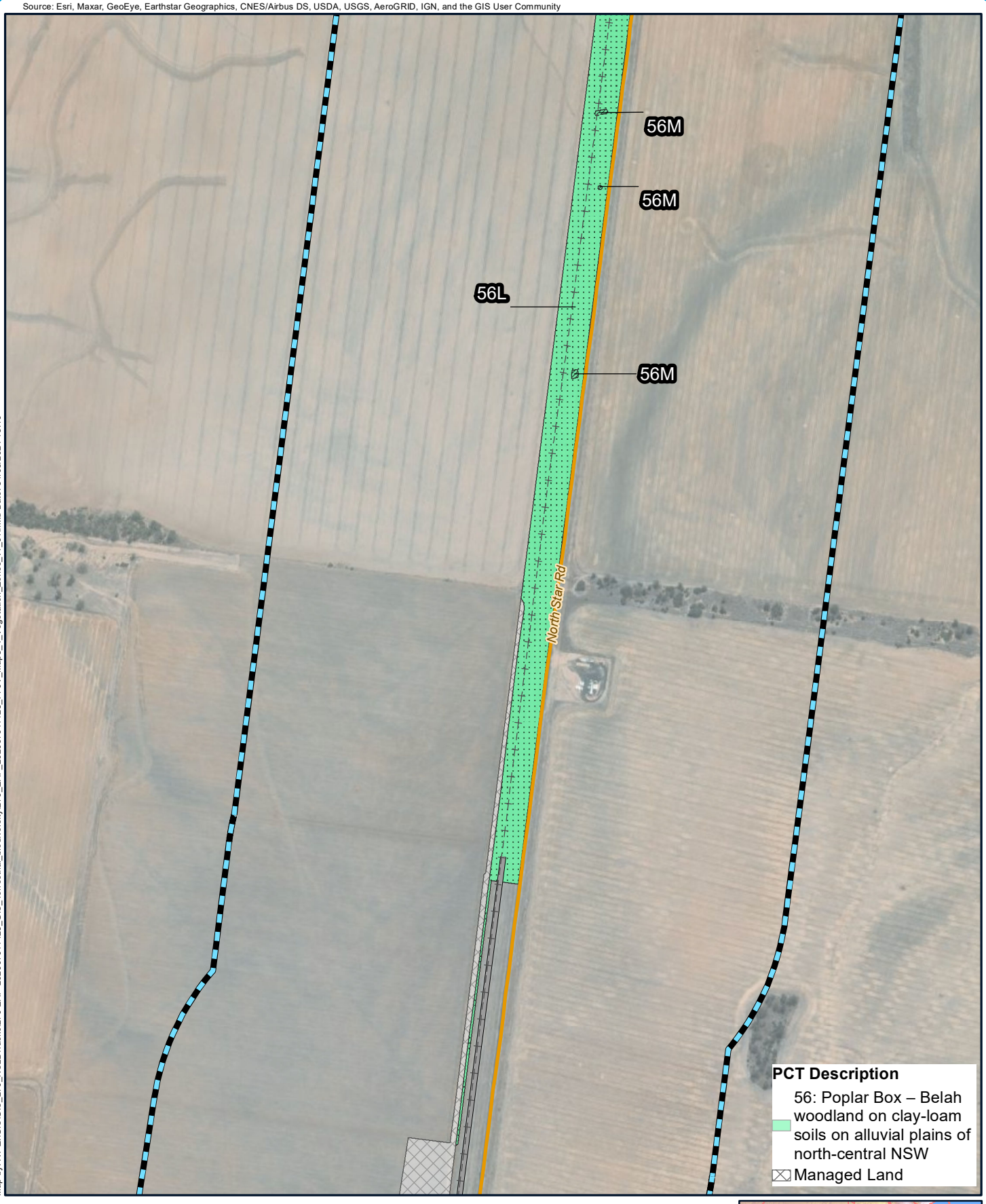
PCT ID	Plant community types	BC Act threatened ecological communities	Condition classes	Area of impact alignment segments[#] (ha)	Area of impact Borrow pits (ha)	Analogous TEC under the EPBC Act
PCT 55	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregion - **absent** Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions - **absent** Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions - **absent**	High	0.64	N/A	Coolibah-Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions - **absent** Weeping Myall Woodland - **absent** Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions - **absent**
PCT 56	Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions - **absent** Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions - **absent**	High	36.37	0.13 (BP7)	Brigalow (*Acacia harpophylla* dominant and co-dominant) - **absent**
			Medium	9.16	21.14 (BP8)	
			Low	87.50	0.77 (BP7)	
PCT 98	Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	N/A	High	2.2	0.57 (BP13)	N/A
PCT 147	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion	Semi-evergreen vine thickets of the Brigalow Belt South and Nandewar Bioregions - **present**	High	N/A	1.2 (BP1)	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions - **present**
			Medium	N/A	3.4 (BP1)	
PCT 192	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW	N/A	High	N/A	9.09 (BP5)	N/A
			Medium	4.30	1.35 (BP5)	
			Low	3.10	1.86 (BP5)	

PCT ID	Plant community types	BC Act threatened ecological communities	Condition classes	Area of impact alignment segments[#] (ha)	Area of impact Borrow pits (ha)	Analogous TEC under the EPBC Act
PCT 244	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions - **absent**	Medium	7.4	N/A	Brigalow (*Acacia harpophylla* dominant and co-dominant) - **absent** Poplar Box Grassy Woodland on Alluvial Plains - **present**
			Low	3.7	N/A	
PCT 247	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	N/A	Medium	6.2	N/A	N/A
			Low	4.5	N/A	
PCT 418	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion	N/A	High	N/A	6.09 (BP2) 3.95 (BP9)	N/A
			Medium	N/A	6.67 (BP2) 2.99 (BP9) 1.52 (BP25)	
			Low	N/A	1.05 (BP9) 0.76 (BP25)	
PCT 628	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions - **present**	Medium	6.0	N/A	N/A
			Low	20.4	N/A	

Table note:

The alignment consists of the greenfield, brownfield and early works segments

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PCT Description

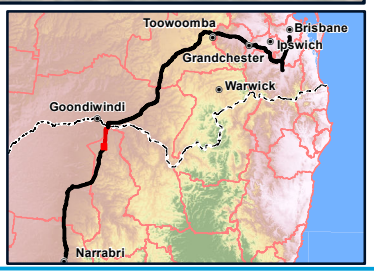
56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Managed Land

Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Legend

- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Study area
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

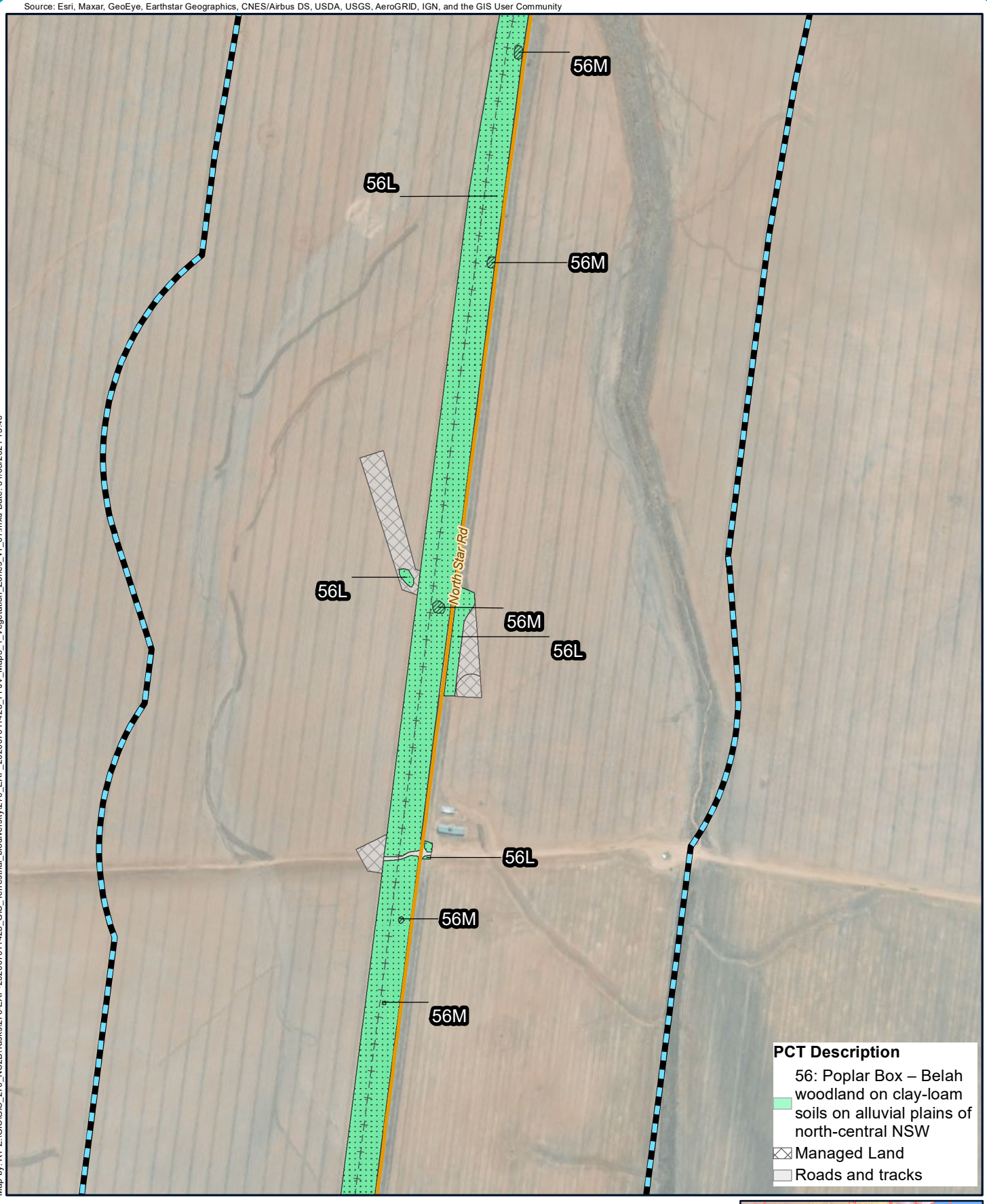
Future Freight
Integrating Community, Environment and Engineering

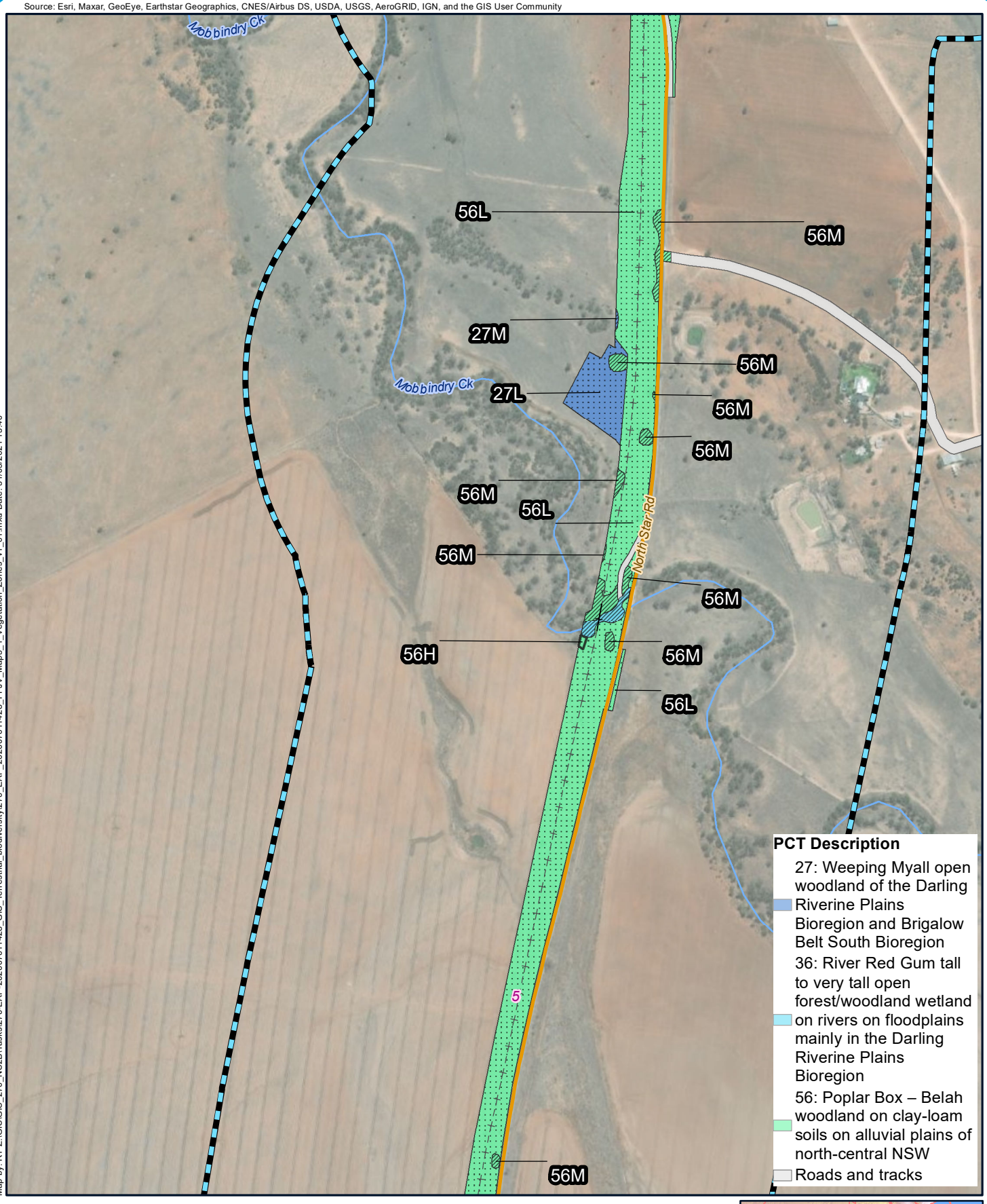
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

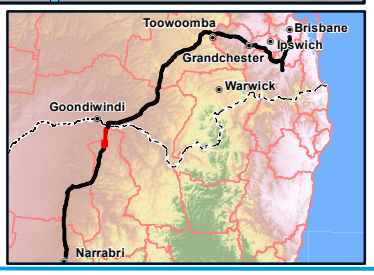
Figure 5.1.a: Vegetation zones


Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
56M
56L
56M
North Star Rd
56L
56M
56L
56L
56M
56M
PCT Description
56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
Managed Land
Roads and tracks
Legend
Existing rail (non-operational)
Major roads
Study area
Medium
Low
None
Toowoomba
Brisbane
Ipswich
Grandchester
Warwick
Goondiwindi
Narrabri
A4 scale: 1:10,000
0 50 100 150 200 250m
Future Freight
Integrating Community, Environment and Engineering
Date: 31/05/2021 Version: 1
Coordinate System: GDA 1994 MGA Zone 56
North Star to NSW/QLD border
Figure 5.1.b:
Vegetation zones
Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40



Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

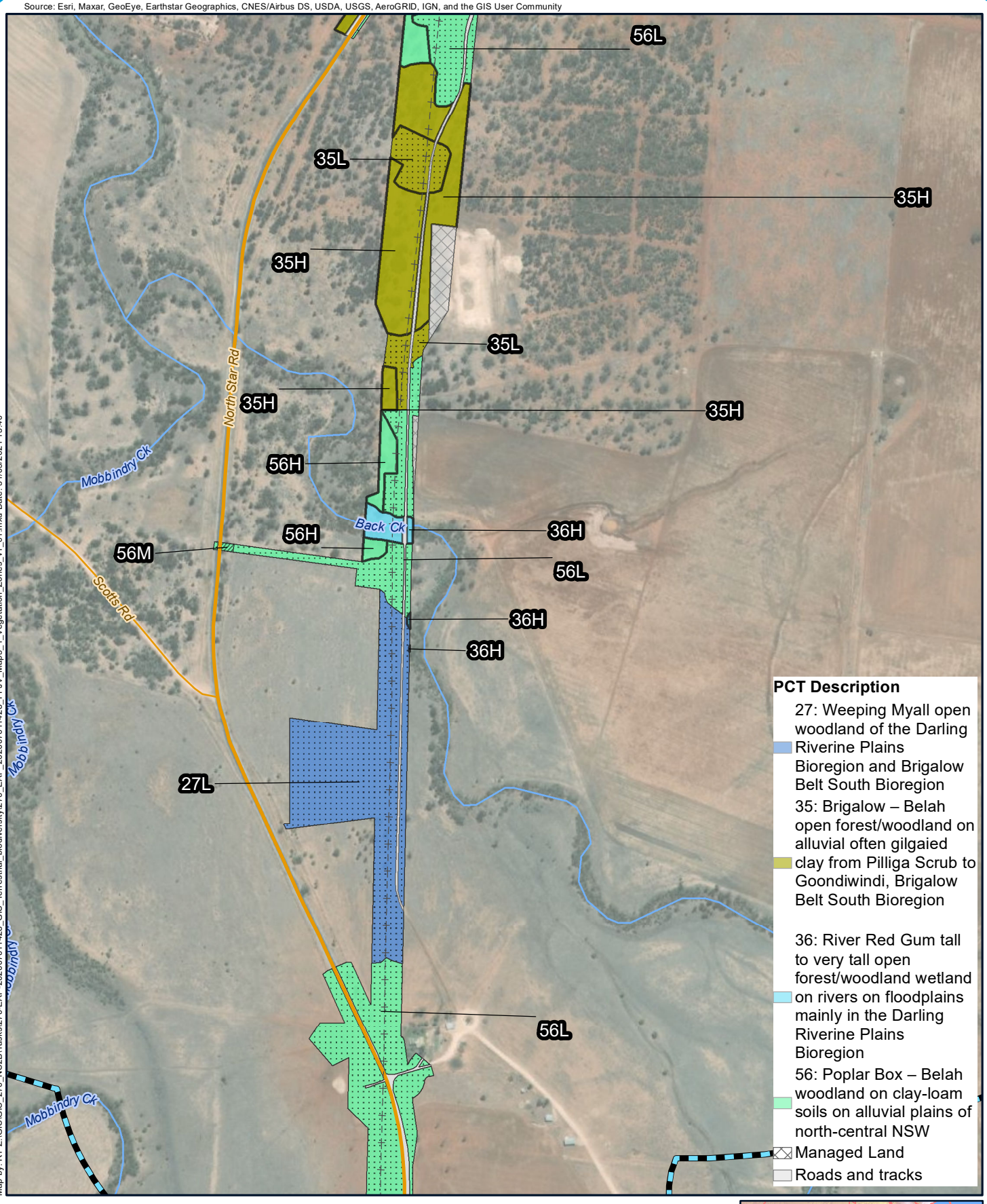
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

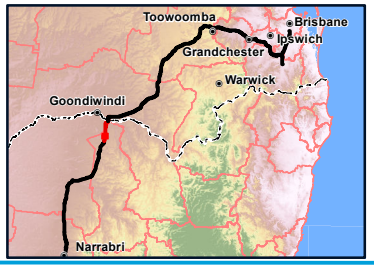
North Star to NSW/QLD border

Figure 5.1.c: Vegetation zones



Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

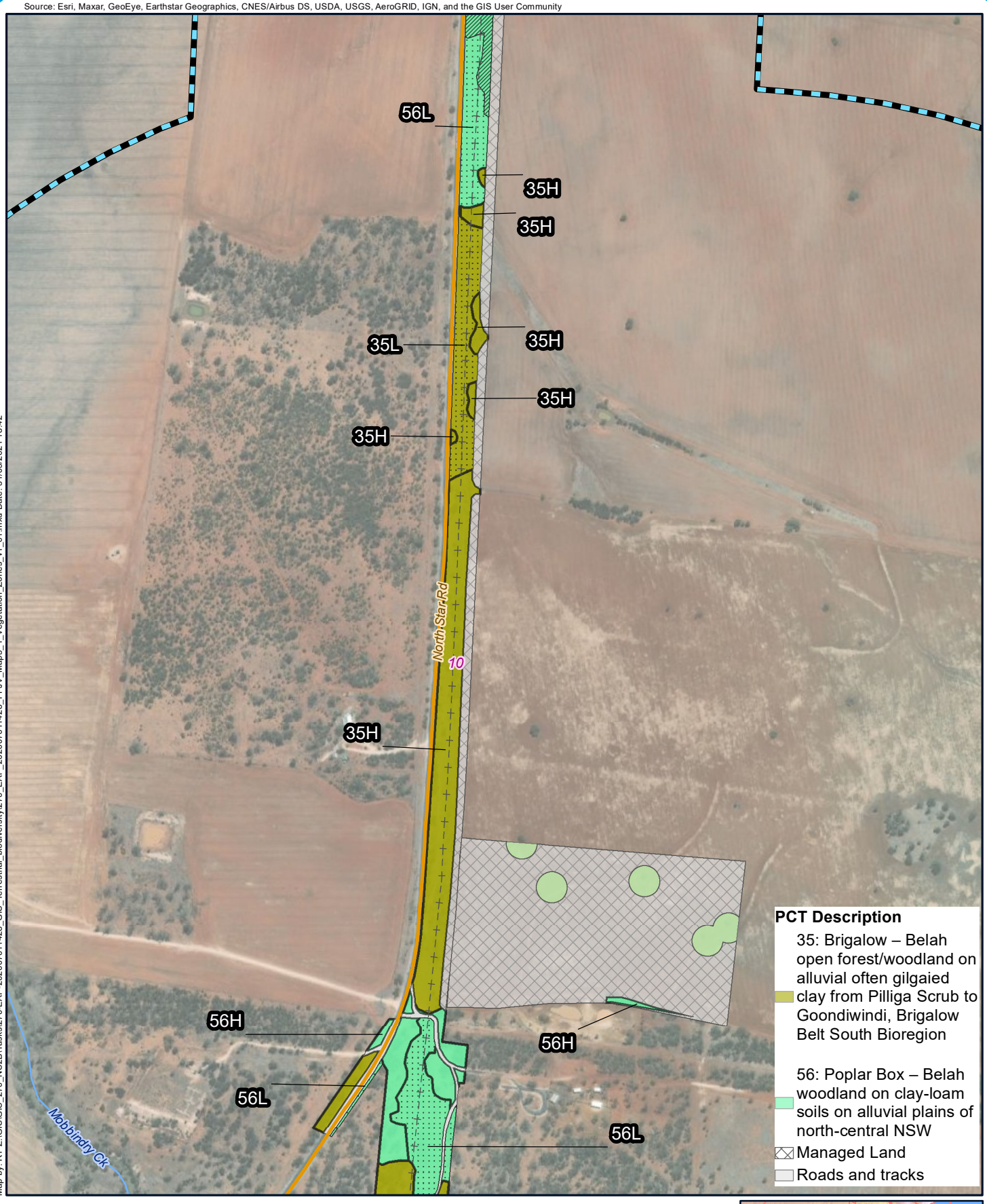
Future Freight
Integrating Community, Environment and Engineering

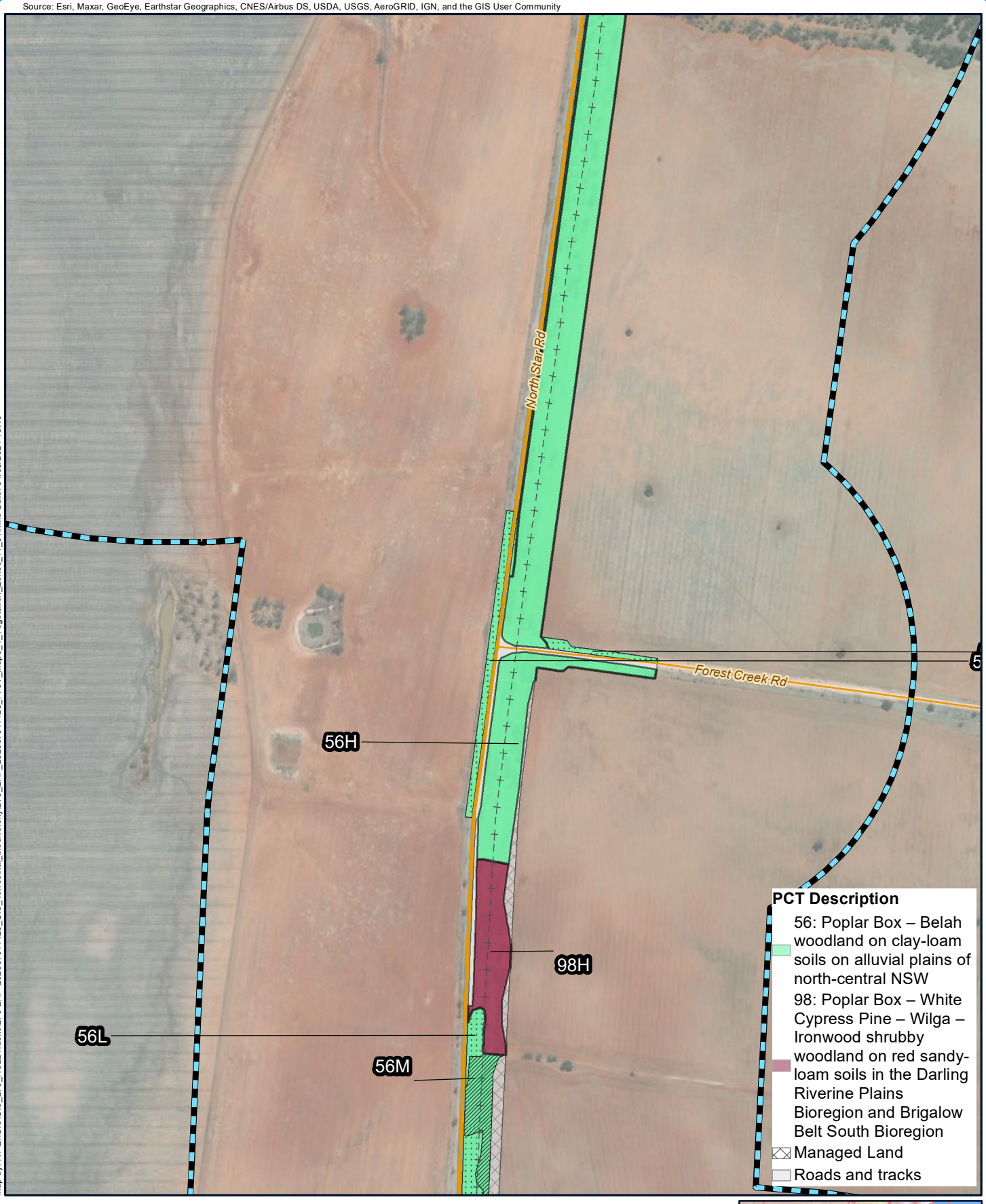
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

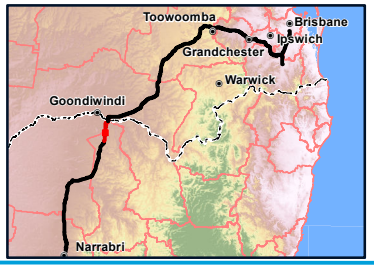
Figure 5.1.d: Vegetation zones


Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
56L
35H
35H
35L
35H
35H
35H
North Star Rd
10
35H
56H
56H
56L
56L
Mobbindry Ck
PCT Description
35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
Managed Land
Roads and tracks
Legend
Scattered paddock trees
Existing rail (non-operational)
Major roads
Watercourses
Study area
High
Medium
Low
None
Toowoomba
Brisbane
Ipswich
Grandchester
Warwick
Goondiwindi
Narrabri
A4 scale: 1:10,000
0 50 100 150 200 250m
Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 18:42
Future Freight
Integrating Community, Environment and Engineering
Date: 31/05/2021 Version: 1
Coordinate System: GDA 1994 MGA Zone 56
North Star to NSW/QLD border
Figure 5.1.e:
Vegetation zones



Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

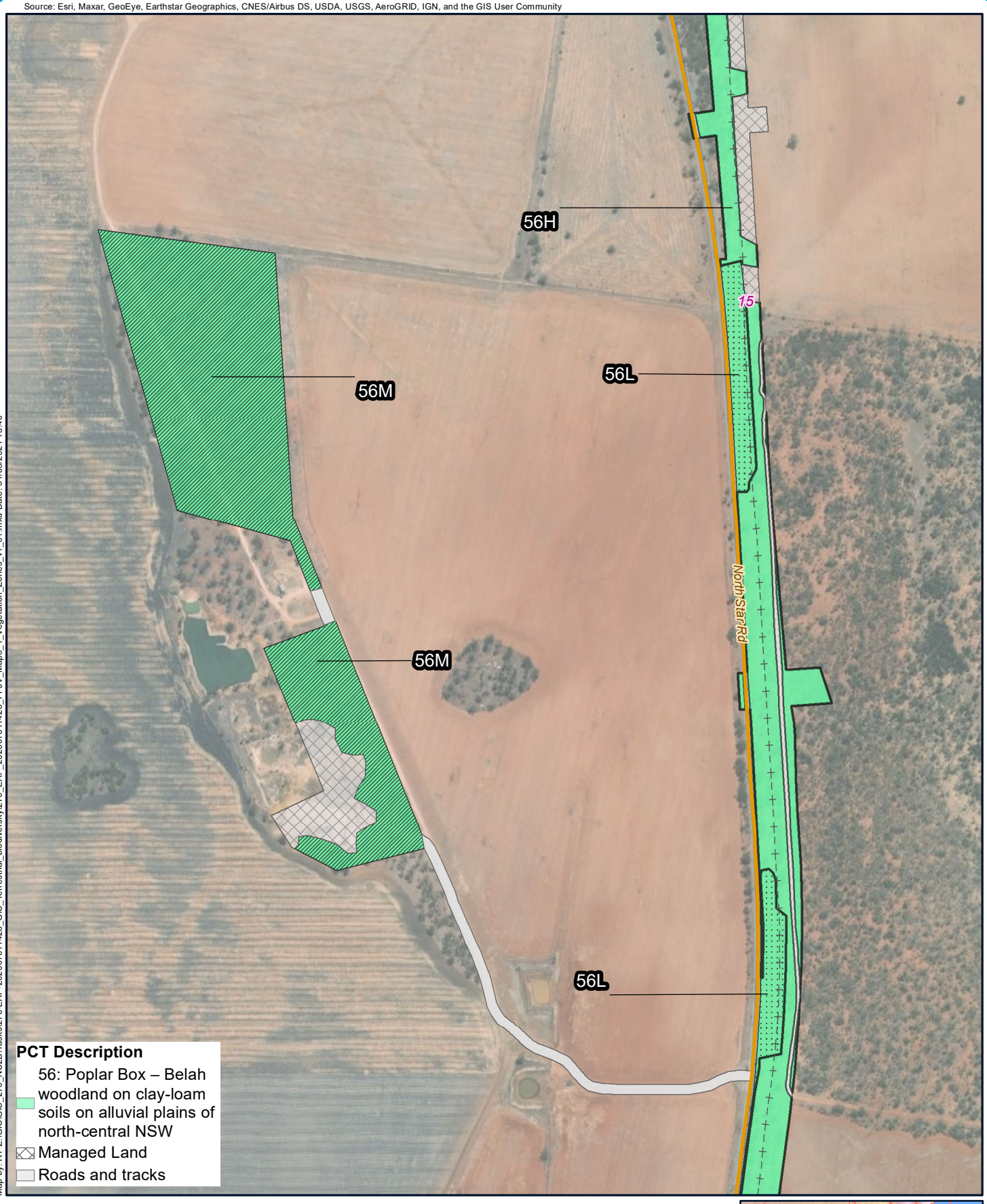
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

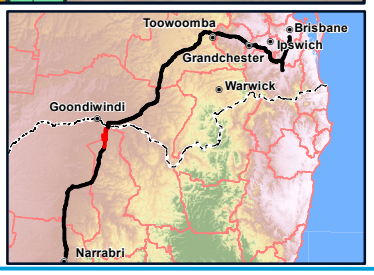
North Star to NSW/QLD border

Figure 5.1.f: Vegetation zones



Legend

- Existing rail (non-operational)
- Major roads
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

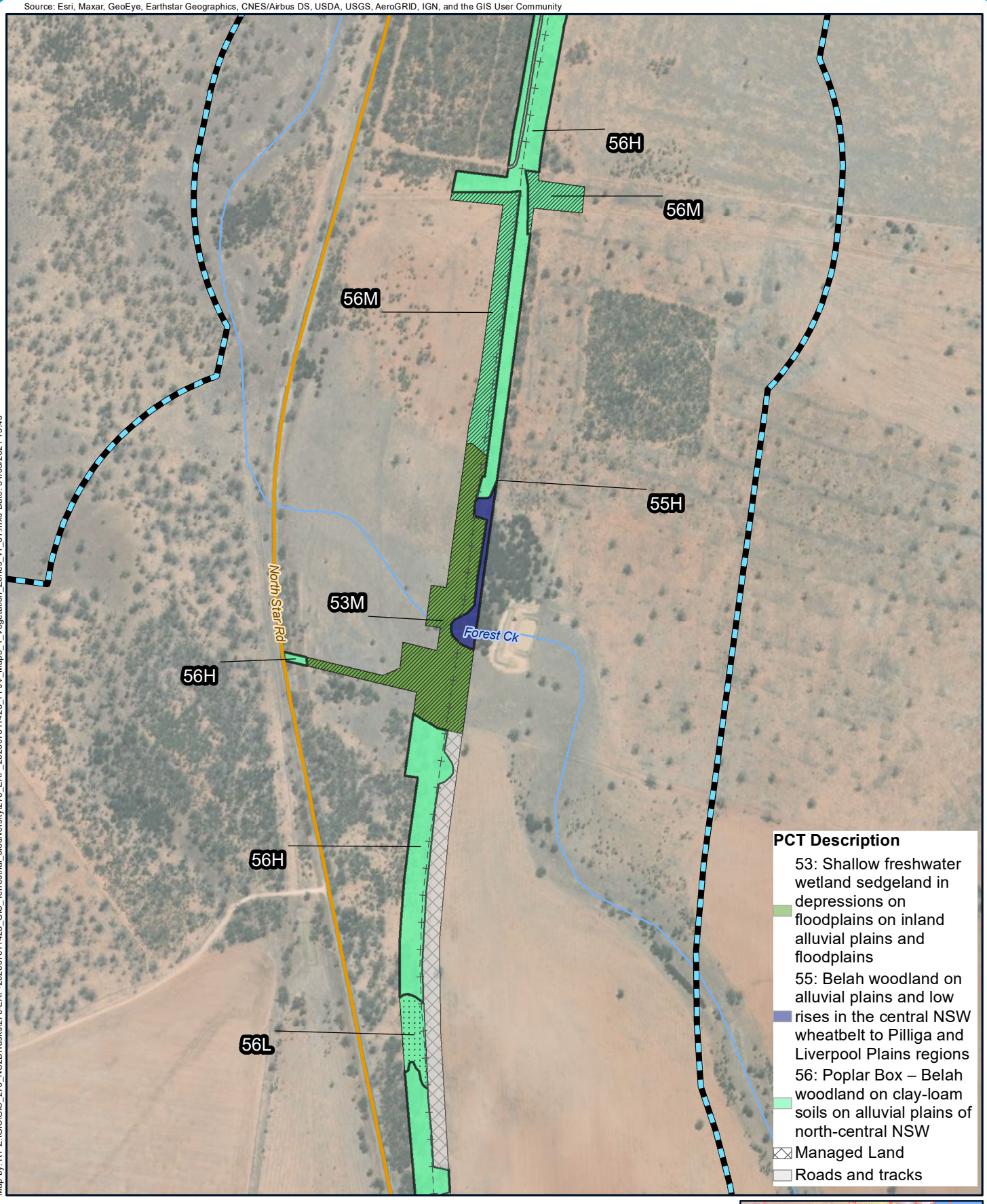
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

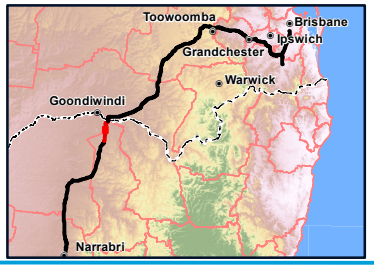
Figure 5.1.g: Vegetation zones



Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

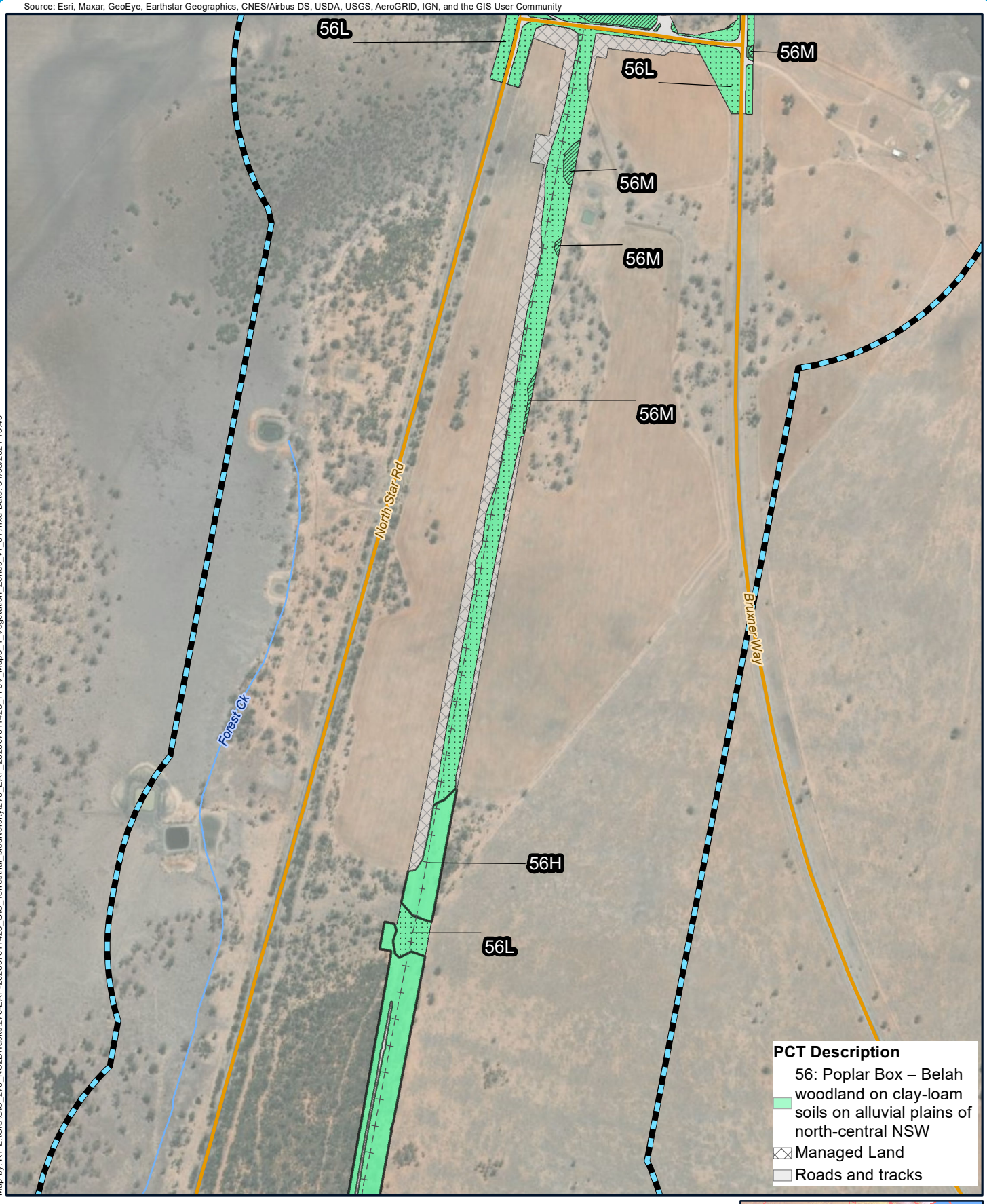
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

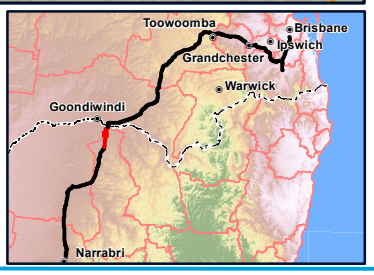
North Star to NSW/QLD border

Figure 5.1.h: Vegetation zones



Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

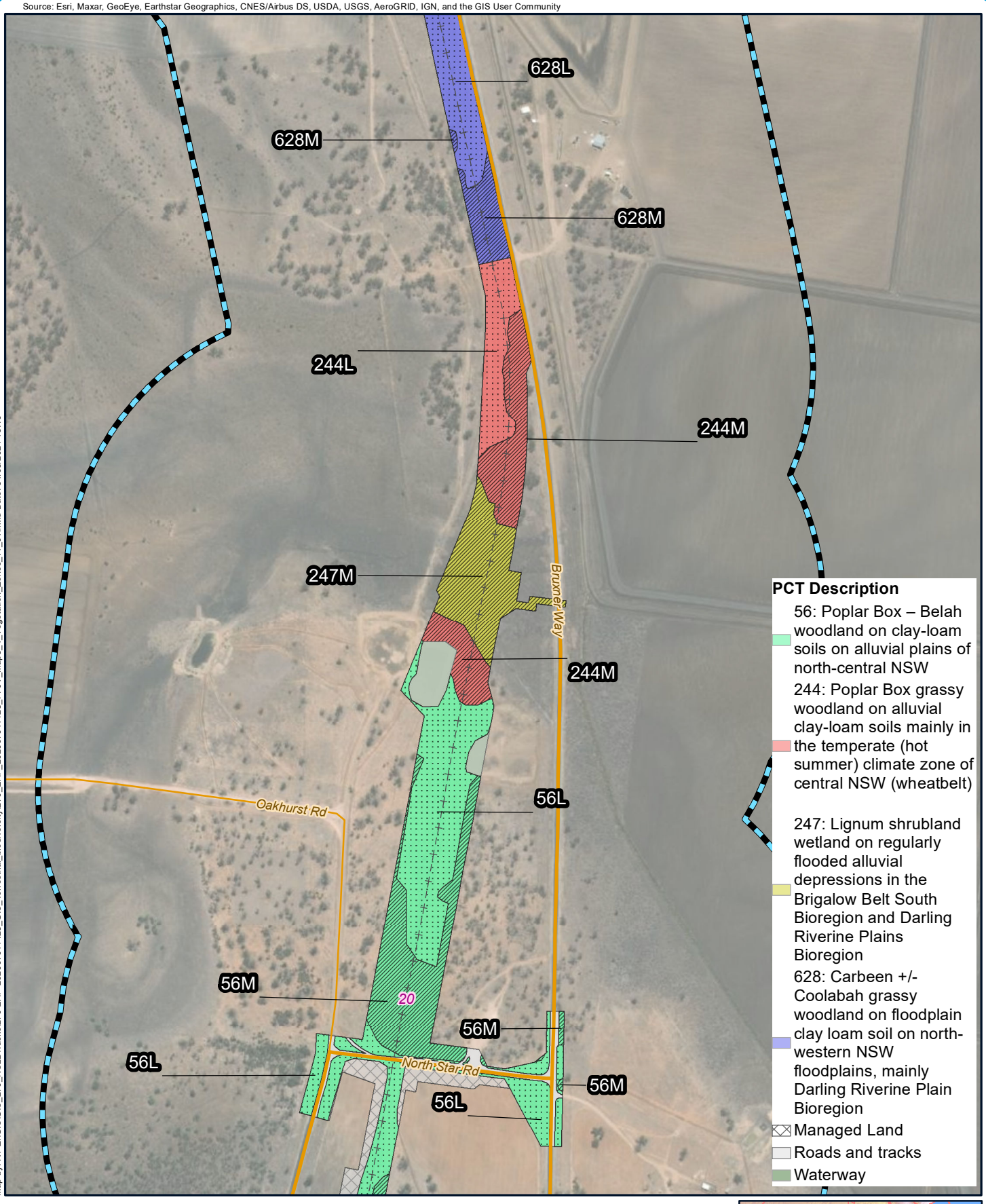
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.i: Vegetation zones

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

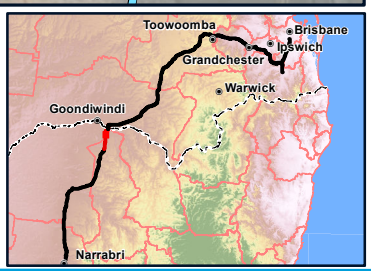


PCT Description

- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- 244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- 247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
- 628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
- Managed Land
- Roads and tracks
- Waterway

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

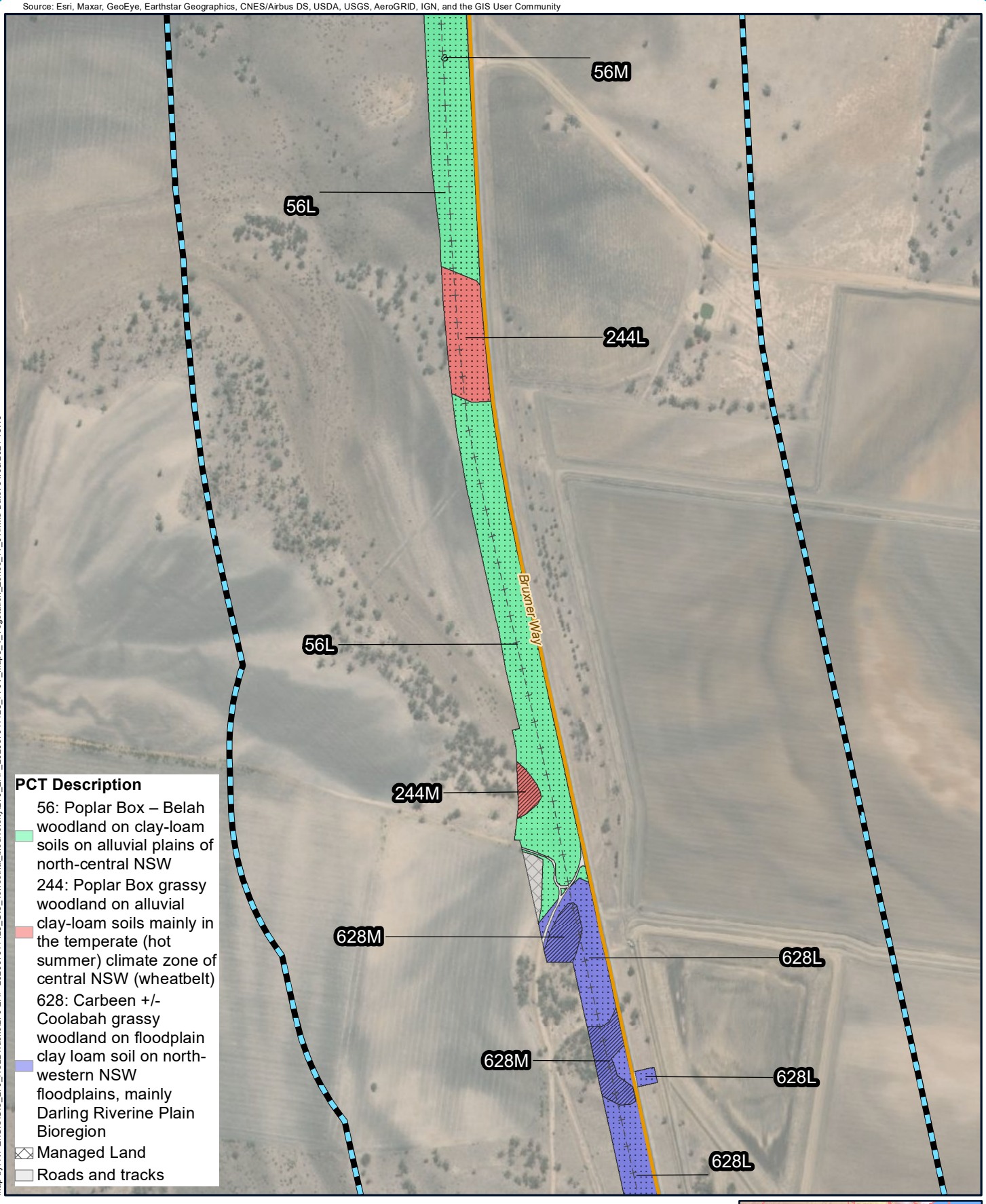
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.k: Vegetation zones

Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

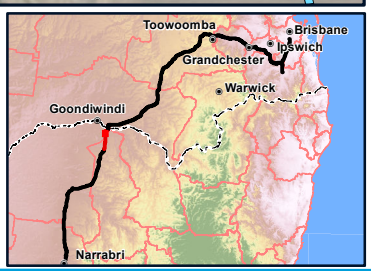


PCT Description

- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- 244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- 628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
- Managed Land
- Roads and tracks

Legend

- Existing rail (non-operational)
- Major roads
- Study area
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

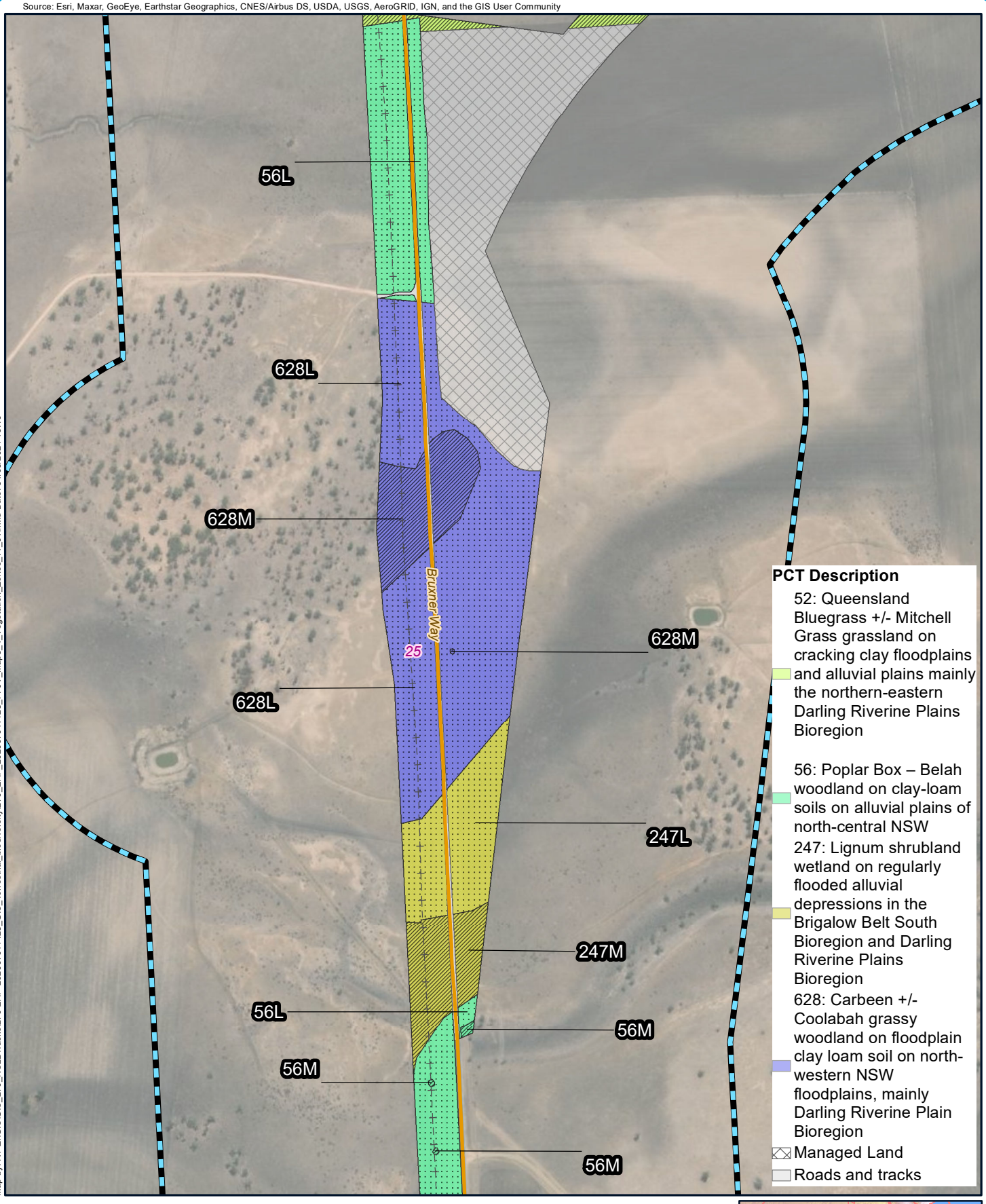
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

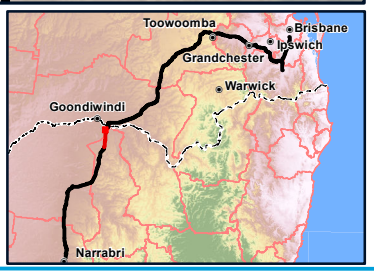
Figure 5.1.I: Vegetation zones

Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40



Legend

- Existing rail (non-operational)
- Major roads
- Study area
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

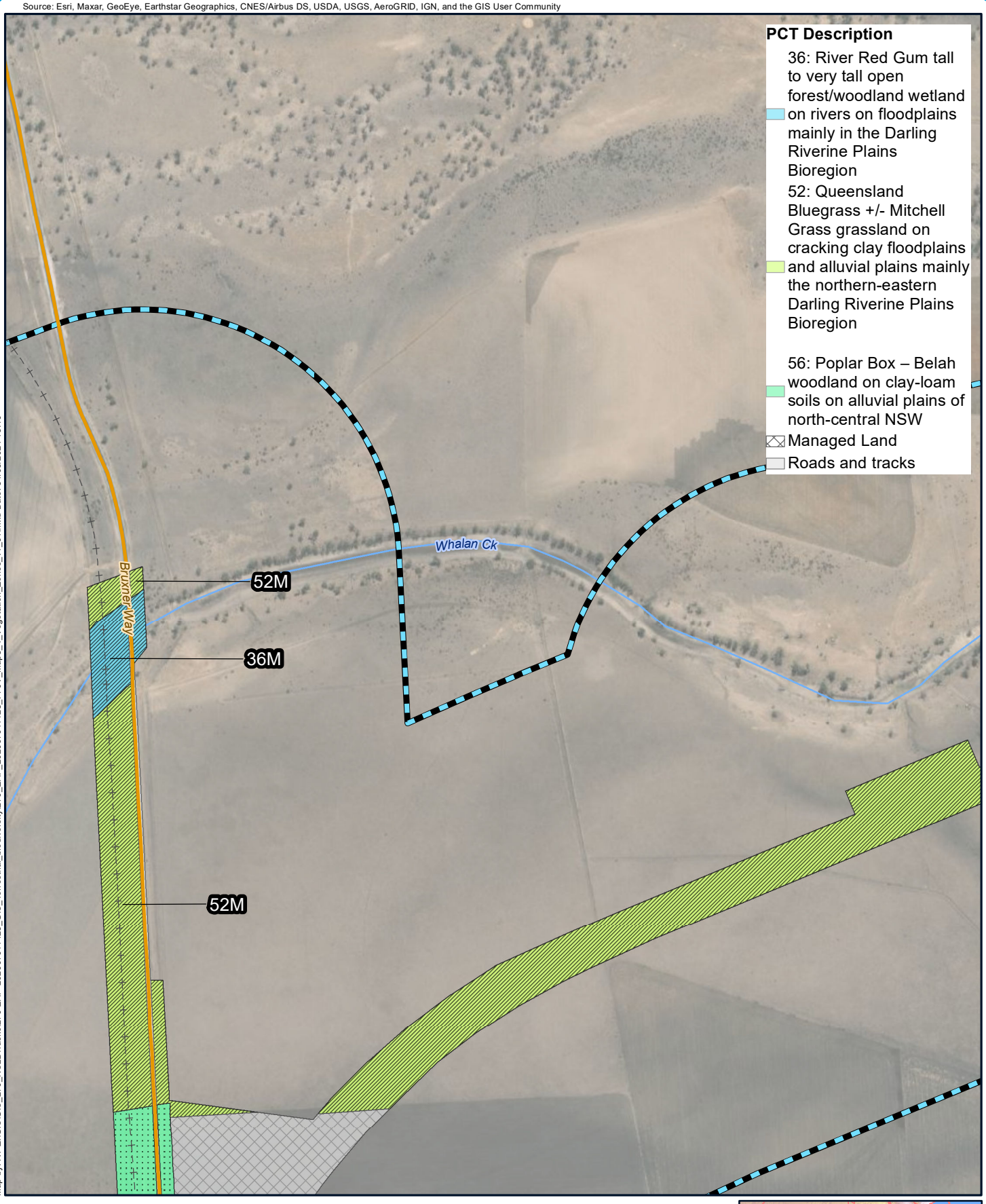
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.m: Vegetation zones

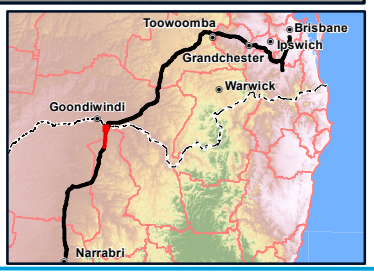
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

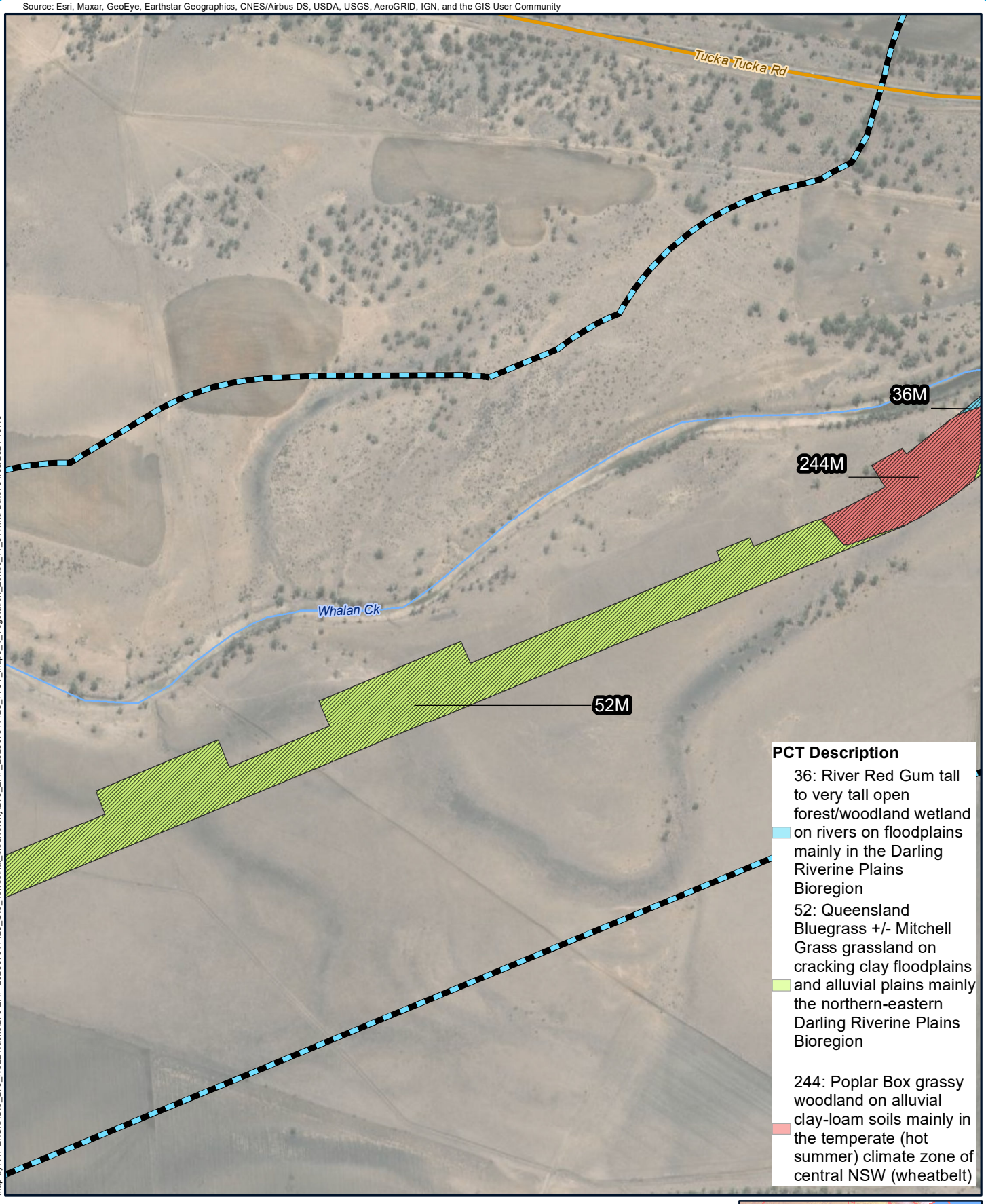
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.n: Vegetation zones

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PCT Description

36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

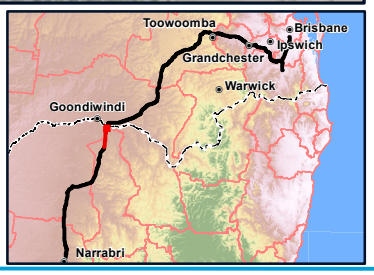
52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Legend

- Major roads
- Watercourses
- Study area
- Medium



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

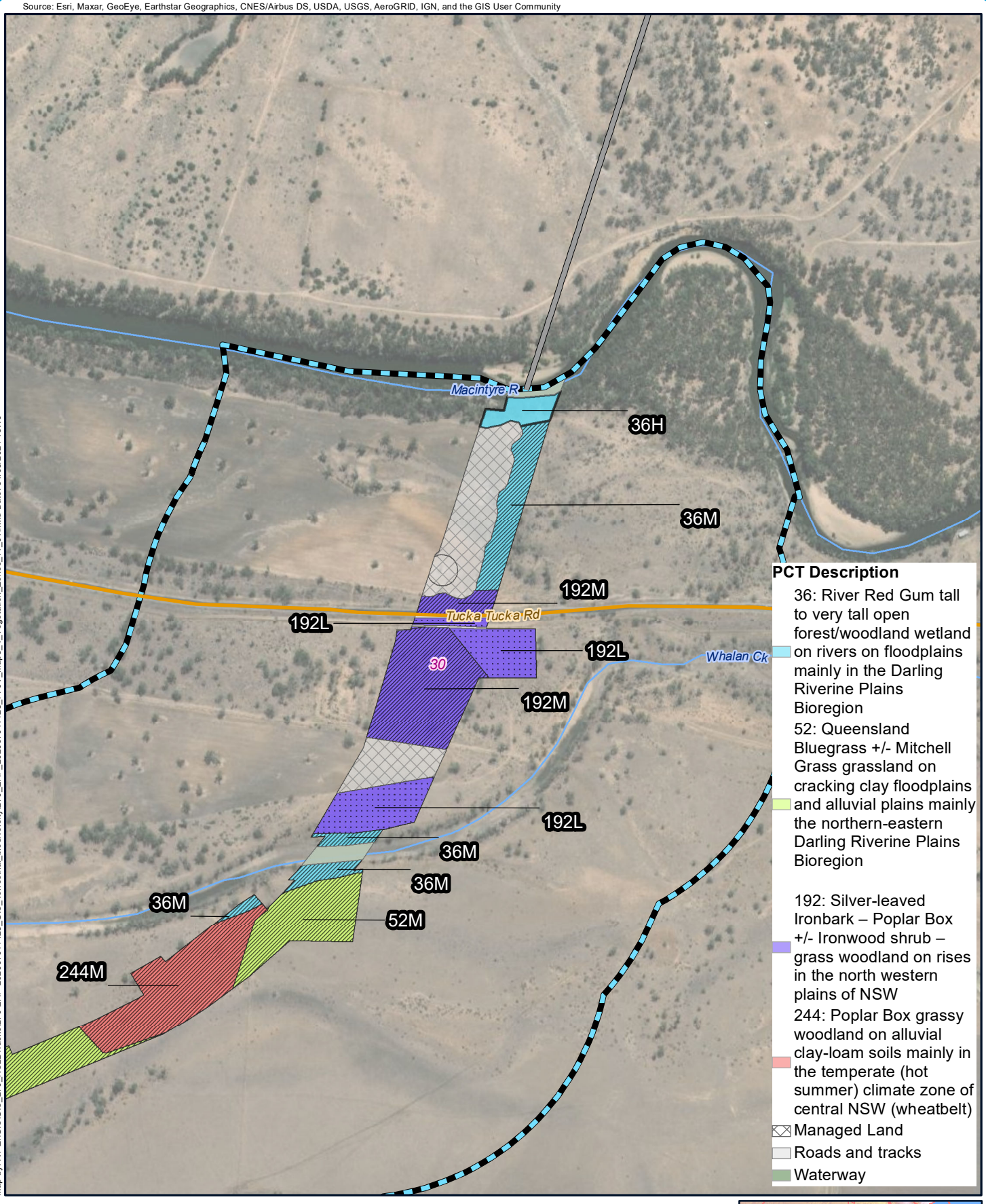
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.o: Vegetation zones

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

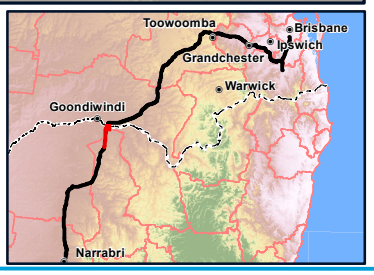


PCT Description

- 36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
- 52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
- 192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
- 244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- Managed Land
- Roads and tracks
- Waterway

Legend

- Major roads
- Watercourses
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

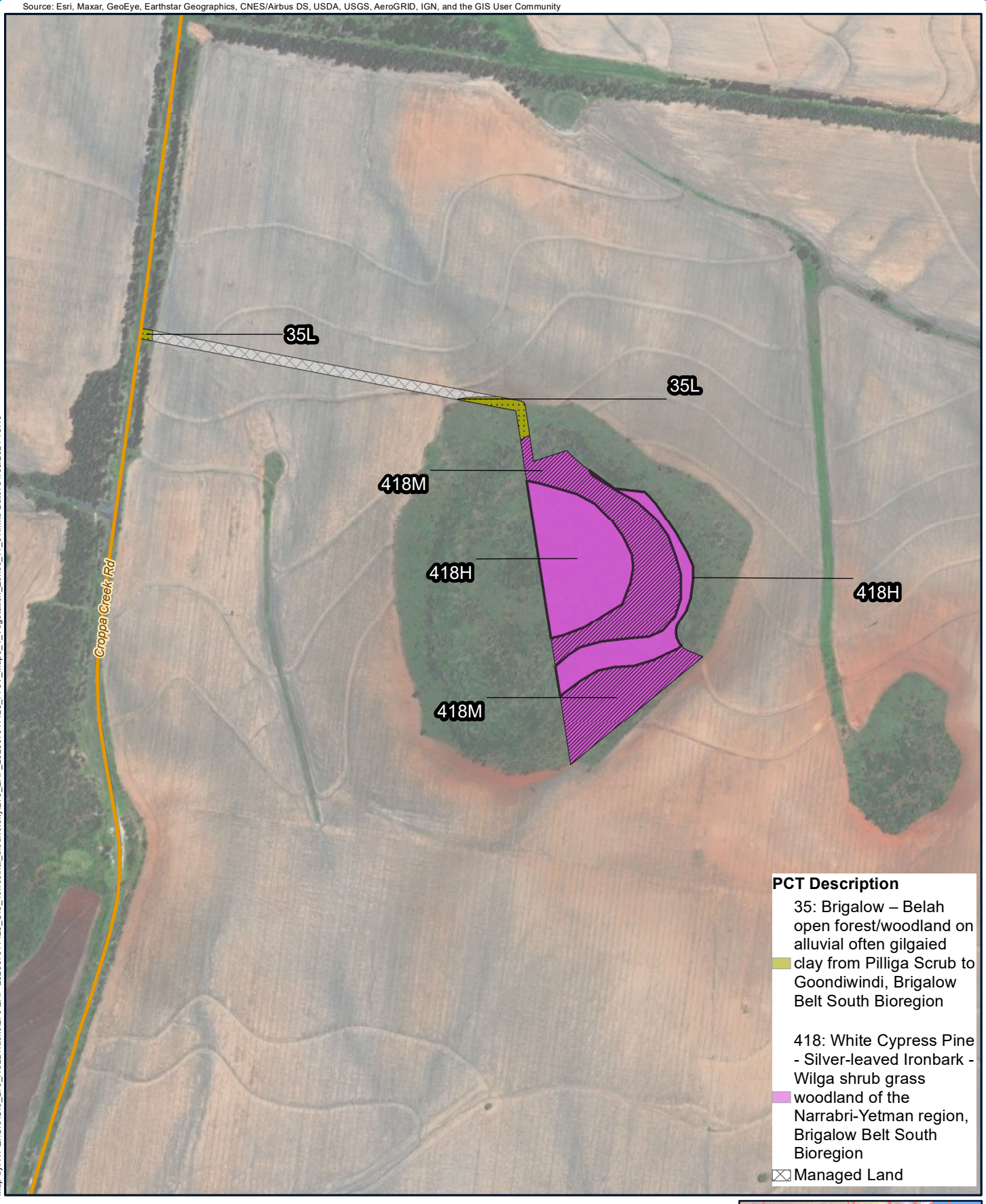
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.p: Vegetation zones

Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



PCT Description

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

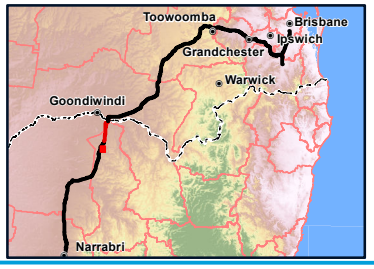
418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Managed Land

Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Legend

- Major roads
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

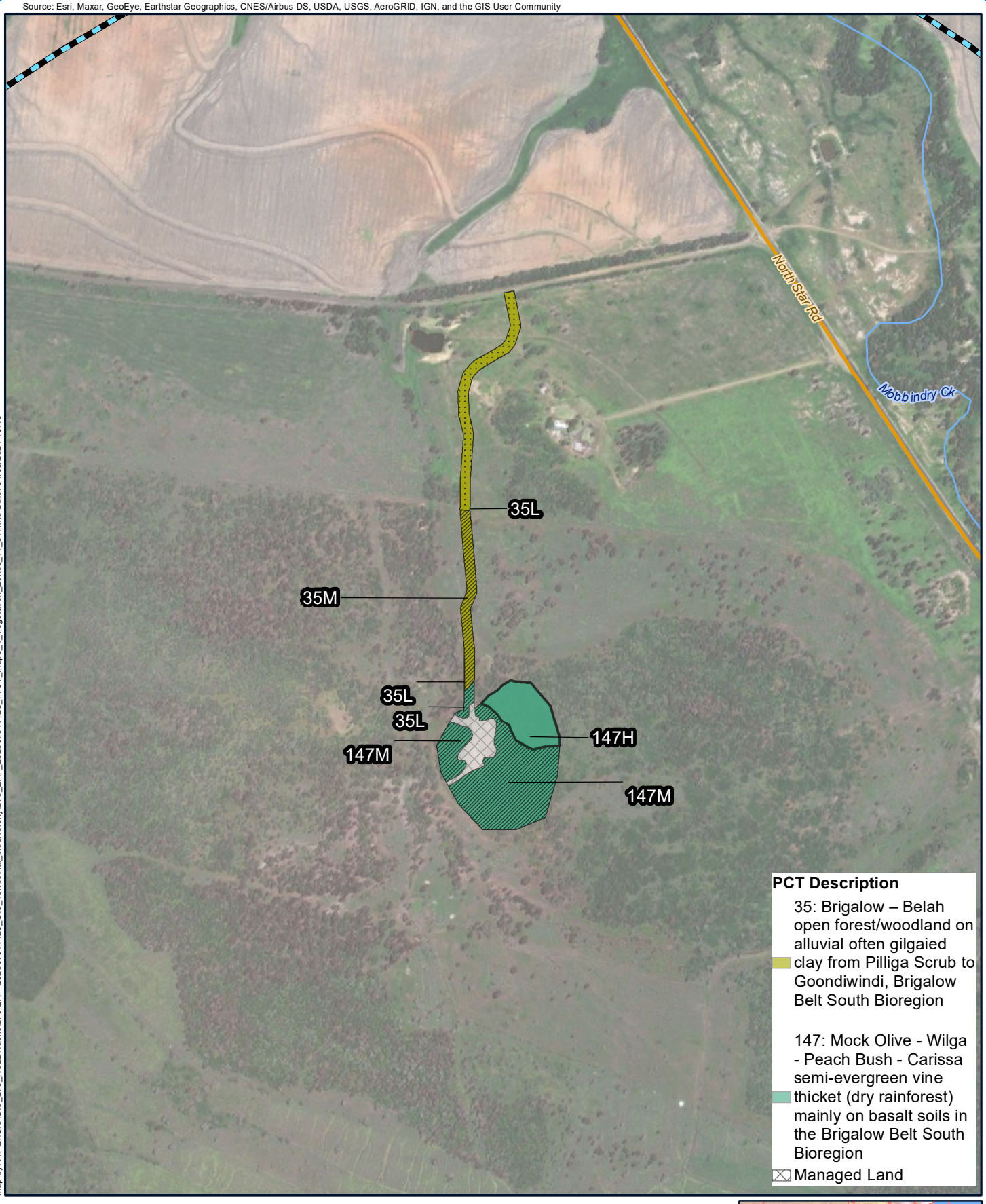
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

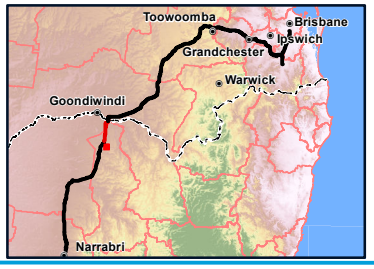
North Star to NSW/QLD border

Figure 5.1.q: Vegetation zones



Legend

- Major roads
- Watercourses
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

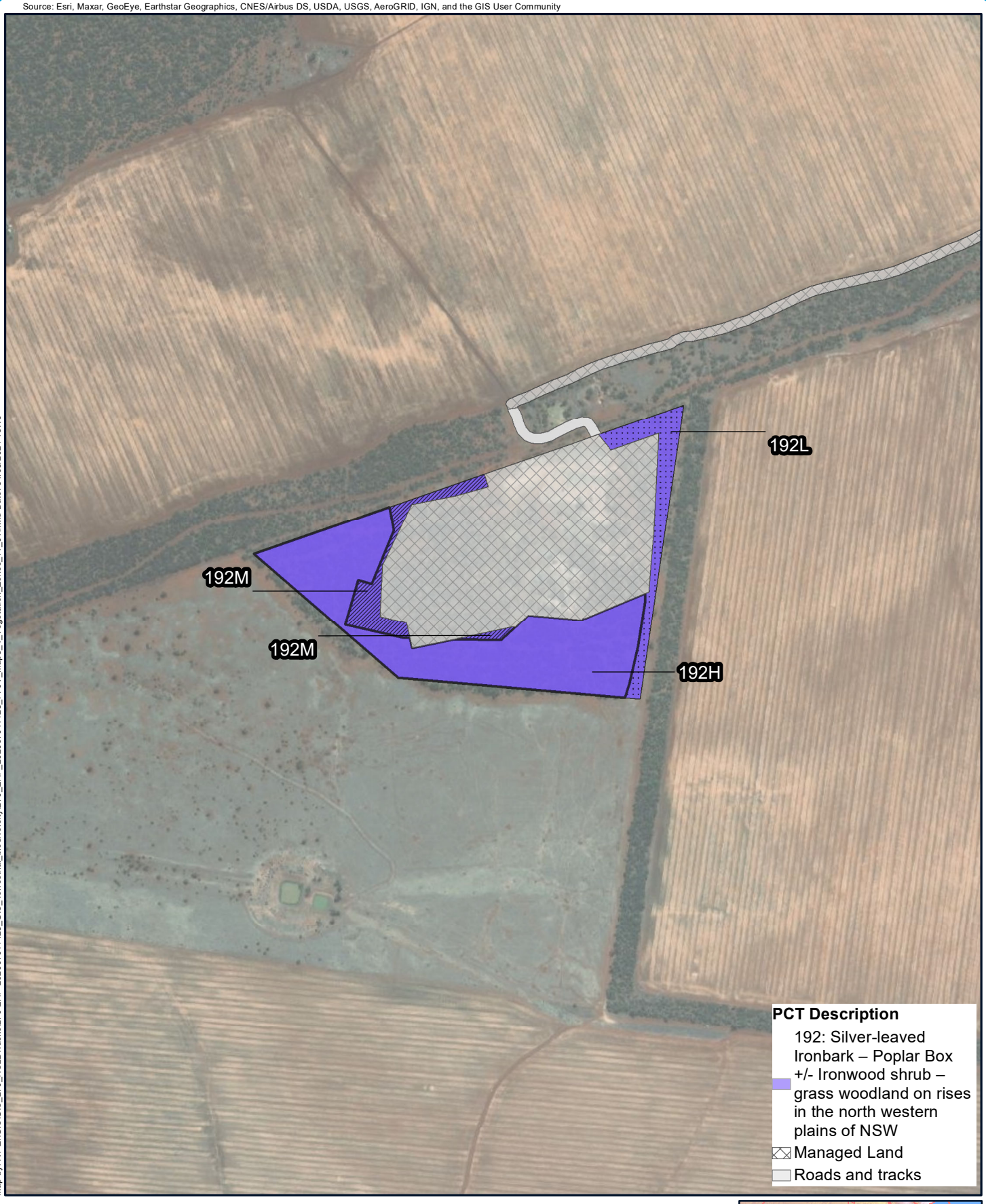
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

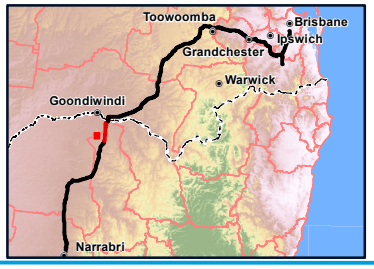
Figure 5.1.r: Vegetation zones



Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Legend

- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

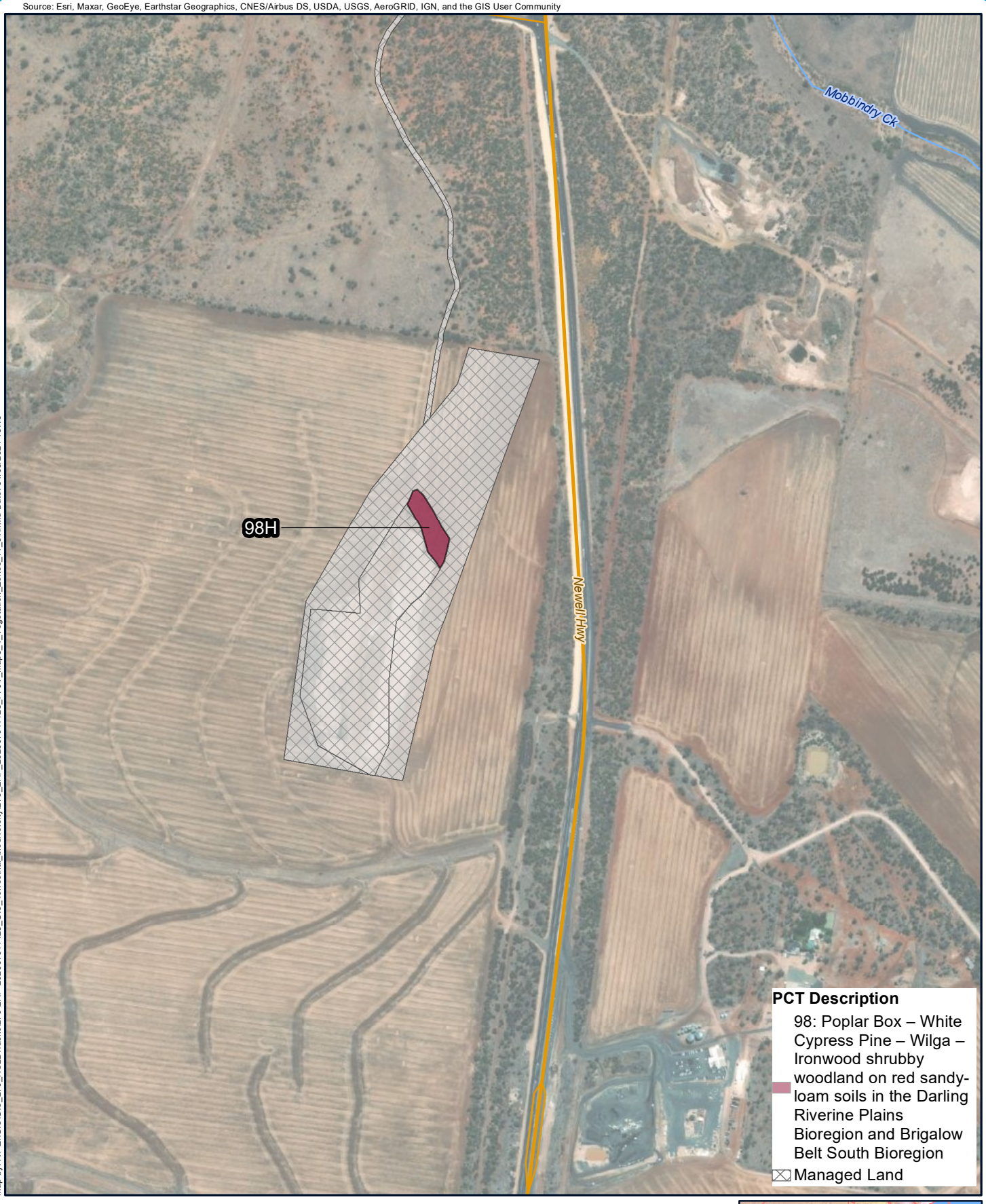
Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.s: Vegetation zones

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



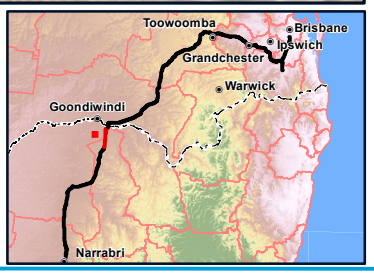
PCT Description

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Managed Land

Legend

- Major roads
- Minor roads
- Watercourses
- Study area
- High
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

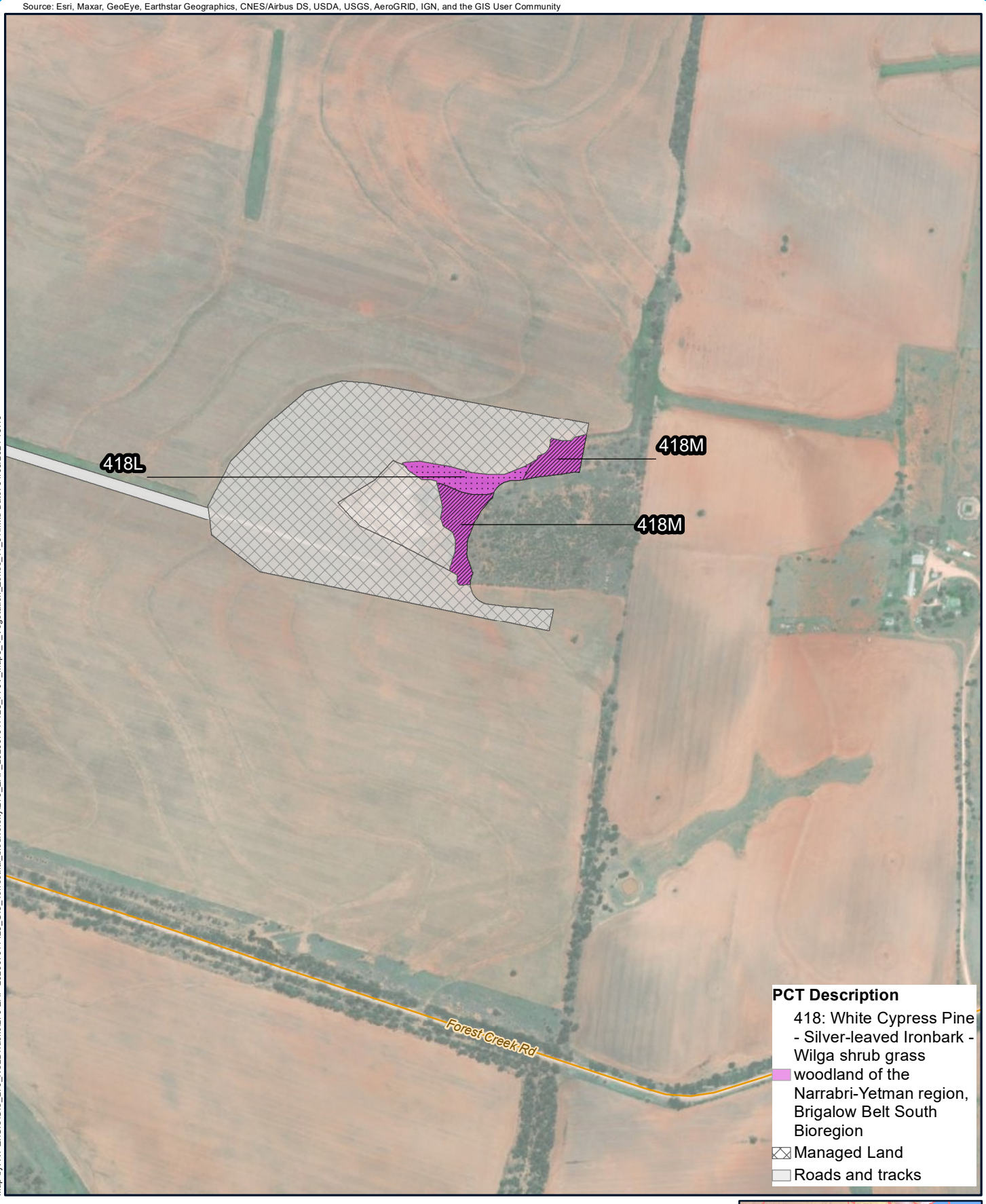
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.t: Vegetation zones

Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



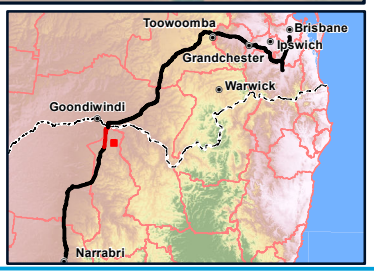
Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_Map5_1_Vegetation_Zones_v1_01.mxd Date: 31/05/2021 15:40

PCT Description

- 418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
- Managed Land
- Roads and tracks

Legend

- Minor roads
- Study area
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

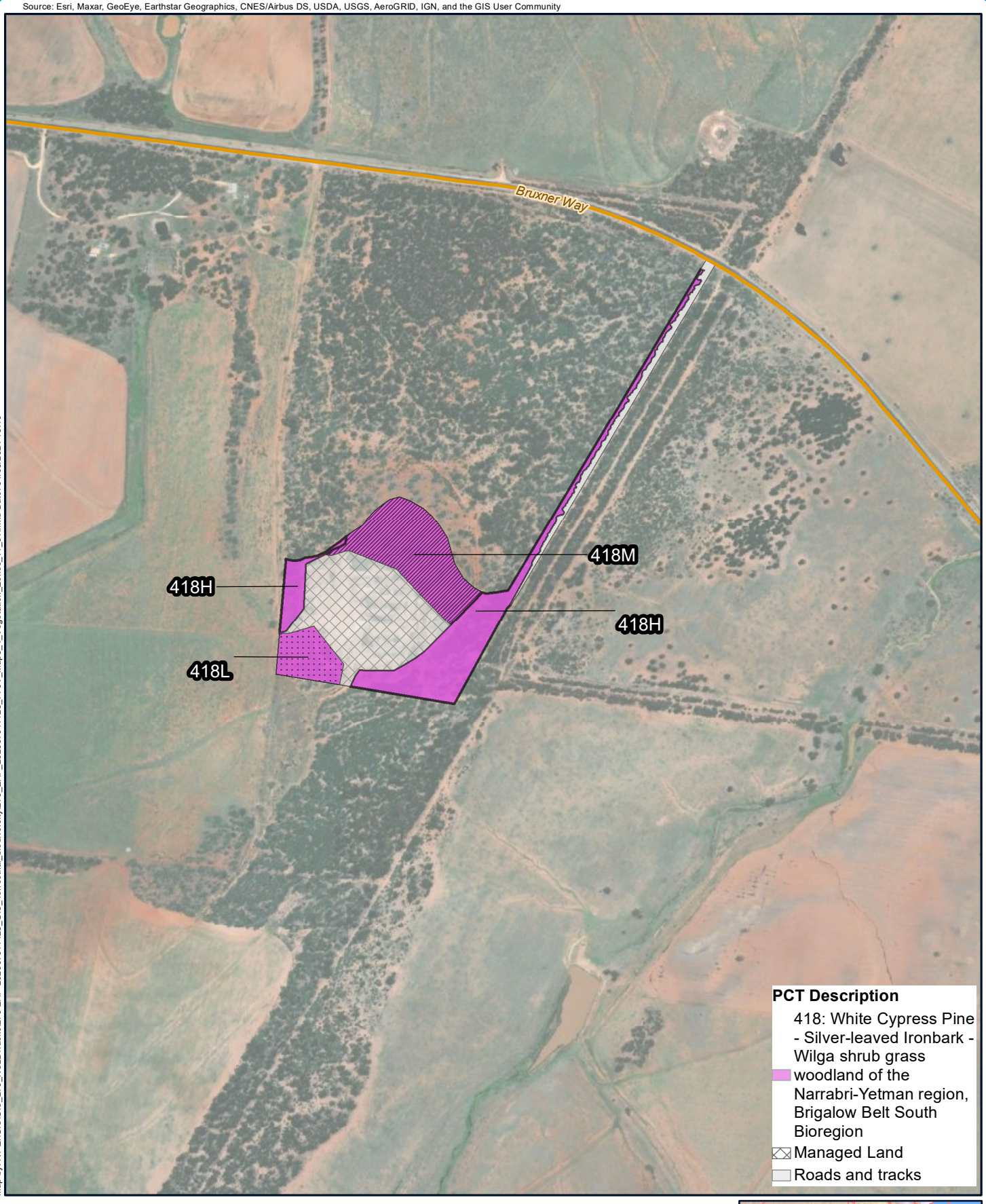
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

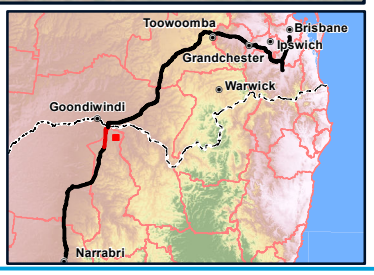
North Star to NSW/QLD border

Figure 5.1.u: Vegetation zones



Legend

- Major roads
- Study area
- High
- Medium
- Low
- None



A4 scale: 1:10,000

0 50 100 150 200 250m

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 5.1.v: Vegetation zones

5.2.1 Vegetation profiles

5.2.1.1 PCT 27 Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion – Medium

PCT Name	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	
Condition	Medium - Low	
PCT number	27	
IBRA region	Brigalow Belt South	
IBRA sub-region	Northern Outwash	
Formation	Semi-arid Woodlands (Grassy sub-formation)	
Class	Riverine Plain Woodlands	
Percent Cleared	86	
General site description used to identify PCT	Small areas of Weeping Myall woodland occur within the subject land and have been modified by past grazing. The woodland contains a mid to low intact canopy of Weeping Myall, *Acacia pendula,* with a grazed grassy understory containing occurrences of forbs including *Einadia nutans subsp. Nutans*, *Atriplex leptocarpa* and grasses *Enteropogon acicularis, Aristida leptopoda and Aristida jerichoensis.* The area is not currently covered by state PVT mapping but meets the EPBC condition descriptions and is mapped at PCT27 Medium condition due to the obvious level of recent disturbance. The area is surrounded by grassland which contains both native and exotic species. The surrounding area is mapped as Low PCT27 as this is the most likely historical PCT based on the location in the landscape, soil type and surrounding vegetation.	
Benchmark floristic description	Mid-high and low woodland to open woodland to about 10 m high dominated by Drooping Myall often with Belah (*Casuarina cristata*) and Wild Orange (*Capparis mitchellii*). Poplar Box (*Eucalyptus populnea* subsp. *bimbil*), Western Rosewood (*Alectryon oleifolius*), Whitewood (*Atalaya hemiglauca*) or Black Box (*Eucalyptus largiflorens*) may also occur. Shrubs are sparse and include Wilga (*Geijera parviflora*), *Rhagodia spinescens*, *Capparis lasiantha*, *Acacia oswaldii, Acacia salicina, Myoporum montanum* and *Pimelea neo-anglica*. Small shrubs include species of copperburrs including *Sclerolaena brachyptera*, *Sclerolaena muricata* var. *muricata* and *Sclerolaena stelligera*. Other small shrubs include *Maireana aphylla*, *Atriplex stipitata*, *Leiocarpa panaetioides* and *Enchylaena tomentosa*. The ground cover may be dense after rain but normally is mid-dense to sparse. It contains many species of grasses and forbs. Forbs include *Einadia nutans* subsp. *nutans*, *Leiocarpa tomentosa*, *Marsilea hirsuta*, *Solanum esuriale*, *Daucus glochidiatus*, *Goodenia fascicularis*, *Oxalis perennans*, *Eryngium paludosum* and *Craspedia variabilis*. The most common grass species are *Monachather paradoxus*, *Chloris truncata*, *Enteropogon acicularis*, *Astrebla lappacea*, *Astrebla pectinata*, *Walwhalleya proluta*, *Dichanthium sericeum* subsp. *sericeum*, *Sporobolus caroli*, *Austrodanthonia setacea* and *Aristida leptopoda*. Occurs on grey to brown cracking clay, black earth or clay loam soils that are sometimes gilgaied, on flats or undulating rises on broad alluvial plains or outer floodplains that rarely flood. Mainly occurs in the Darling Riverine Plains and Brigalow Belt South Bioregions with some outliers beyond these regions. It is estimated that > 75 per cent has been cleared due to its occurrence on arable alluvial soils. Some remnants are in good condition where they are not continuously or heavily grazed such as on roadsides or in travelling stock reserves. May have contained more of a chenopod understorey prior to European settlement in some places.	
BC Act status	This PCT is consistent with the Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions - Endangered. Detailed analysis is located in Appendix C	
EPBC Act status	This PCT is consistent with Weeping Myall Woodland TEC - Endangered. Detailed analysis against the listing is located in Appendix C	

5.2.1.2 PCT 35 Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion – High – Low

PCT Name	Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion	
Condition	High – Medium - Low	
PCT number	35	
IBRA Region	Brigalow Belt South	
IBRA Sub-region	Northern Basalts Northern Outwash	
Formation	Semi-arid Woodlands (Grassy sub-formation)	
Class	Brigalow Clay Plain Woodlands	
Percent Cleared	90	
General site description used to identify PCT	This community is dominated by Brigalow *Acacia harpophylla* and is often co-dominated by Poplar Box and Belah *Casuarina cristata*. In the central part of the subject land Brigalow dominated vegetation is associated with slightly elevated red clays; however, this is not considered a constraining feature of the community. Remnants of Brigalow occur across the subject land, with much of the community regularly grazed and varying in condition and age. Where there is little or no regeneration of Brigalow the community is mapped as Low condition. Where there is scattered Brigalow with either mature trees or regeneration, the community is mapped as Medium condition. Where this community contains mature trees with reasonably intact understory vegetation it is mapped as High condition. Many of the areas identified are currently mapped as Brigalow communities on the State Vegetation Map, however this mapping does overestimate the distribution of the PCT in some areas. There is no PCT35 mapped on the SVT map at Borrow pit 2 however the site inspection identified a small ring of low quality PCT35 containing a few remnant trees, as well as a soil type associated with Brigalow at the base of the hill. Therefore this area is included in the mapping and reporting.	
Benchmark floristic description	Open forest or woodland up to 25 m high dominated by Brigalow (*Acacia harpophylla*) often with pockets of Belah (*Casuarina cristata*) on less gilgaied clays. Poplar Box (*Eucalyptus populnea* subsp. *bimbil*) and Pilliga Box (*Eucalyptus pilligaensis*) occur on better drained sandier soils. A sparse shrub layer is usually present including *Geijera parviflora*, *Eremophila desertii, Apophyllum anomalum, Enchylaena tomentosa, Pittosporum angustifolium, Capparis mitchellii, Eremophila mitchellii, Citrus glauca, Rhagodia spinescens, Maireana decalvans* and *Sclerolaena* spp. The ground cover is often very bare or covered with leaf litter with a very sparse to sparse cover of grasses such as *Sporobolus caroli*, *Austrodanthonia setacea*, *Austrostipa ramosissima, Sporobolus creber, Enteropogon ramosus, Diplachne parviflora, Setaria paspalidioides, Panicum queenslandicum* var. *queenslandicum, Paspalidium caespitosum* and *Chloris truncata*. Forb species include *Einadia nutans* subsp. *eremaea*, *Einadia hastata*, *Tetragonia moorei*, *Zygophyllum apiculatum*, *Brachyscome multifida* var. *multifida, Alternanthera* sp. A, *Vittadinia sulcata*, *Vittadinia pterochaeta*, *Plantago varia*, *Abutilon oxycarpum* and *Wahlenbergia communis*. Sedges include *Cyperus gracilis*, *Carex inversa* and *Eleocharis pusilla*. Nardoo fern (*Marsilea drummondii*) is often common. Weeds include *Opuntia aurantiaca*, *Opuntia stricta* var. *stricta* and *Rapistrum rugosum*. Occurs on heavy, gilgaied, grey or brown cracking clay or clayey loam soils over mainly sedimentary strata on flats or gentle rises on alluvial plains or undulating peneplains mainly in the Northern Outwash sub-region in the Brigalow Belt South Bioregion, in the dry subtropical and temperate (hot summer) climatic zones with a rainfall from 500 to 700 mm per annum. Mainly distributed south and west of Narrabri and north-east of Moree with small patches in the Pilliga forest. Outliers also occur in the Darling Riverine Plains Bioregion, on the Liverpool Plains and Mt Misery in the upper Hunter Valley. The endangered peppercress *Lepidium aschersonii* occurs in areas near Narrabri along with populations of Black Striped Wallaby (*Macropus dorsalis*), which is endangered in NSW. This is an Endangered community with less than 10 per cent or the pre-clearing extent remaining.	
BC Act status	This PCT is consistent with the Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions- Endangered. Detailed analysis is provided in Appendix C	

PCT Name	Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
EPBC Act status	Medium and High quality occurrences of this PCT are consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC - endangered. Detailed analysis against the listing is located in Appendix C

5.2.1.3 PCT 36 River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion – High – Medium – Low

PCT Name	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	
Condition	High – Medium	
PCT number	36	
IBRA region	Brigalow Belt South Darling Riverine Plains	
IBRA sub-region	Northern Outwash Castlereagh-Barwon	
Formation	Forested Wetlands	
Class	Inland Riverine Forests	
Percent cleared	53	
General site description used to identify PCT	PCT 36 is characterised by the presence of River Red Gum (*Eucalyptus camaldulensis*) which is present across various size classes. This community is located along the margins of major creeks, rivers and ox-bow lakes throughout the subject land. This community has been subject to historical grazing and subsequently contains a sparse array of shrubs including Wilga *Geijera parviflora* and Warrior Bush (*Apophyllum anomalum*) along with a dense ground layer of *Atriplex* spp., *Sclerolaena* spp., *Aristida* spp., *and Enteropogon* spp. The vegetation on the banks of the Macintyre River is in good condition with some level of weed infestation however, the vegetation in other parts is heavily disturbed through grazing and historical clearing activities. Areas which only contain remnant mature River Red Gum with limited regeneration and a highly disturbed understory are mapped as Medium condition. Areas which contain River Red Gums with signs of regeneration and good quality understory structure are mapped as High condition. The project mapping correlates with State Vegetation Type mapping with one exception where the SVT map shows PCT39 and we have mapped it as PCT36, based on a lack of Coolabah and River Coobah (associated with PCT 39) within the area and only River Red Gum being present.	
Benchmark floristic description	Very tall or tall open forest or woodland up to 30 m high lining major watercourses dominated by River Red Gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*) sometimes with Black Box (*Eucalyptus largiflorens*) or Coolabah (*Eucalyptus coolabah*) with southern areas containing Yellow Box (*Eucalyptus melliodora*). Shrubs may be absent or if present are sparse including Cooba (*Acacia salicina*), River Cooba (*Acacia stenophylla*) and Lignum (*Duma florulenta*). The ground cover may be dense after rain or flooding and is dominated by native grass species including *Austrostipa ramosissima, Austrostipa verticillata, Austrodanthonia caespitosa*, Warrego Summer Grass (*Paspalidium jubiflorum*), Umbrella Cane Grass (*Leptochloa digitata*), Native Millet (*Panicum decompositum*) and Couch (*Cynodon dactylon*). Sedge species include *Cyperus gymnocaulos*, *Eleocharis pallens* and *Eleocharis plana*. Rushes such as *Juncus radula* may be present. The fern Nardoo (*Marsilea drummondii*) is common in poorly drained sites. A range of forbs include *Pratia concolor*, *Centipeda cunninghamii, Rumex brownii*, *Haloragis glauca, Boerhavia dominii, Swainsona galegifolia, Alternanthera denticulata* and *Goodenia fascicularis*. Occurs on Quaternary alluvial grey cracking clay, loamy clays and sometimes sandy loam soils in the riparian zone of rivers (banks, levees, benches), ox-bow lakes and depressions on adjacent floodplains. A widely distributed community with large floristic variation depending on flooding regimes. Distributed on the floodplains of major rivers and creeks of central-northern western NSW, mainly in the Darling Riverine Plains Bioregion extending into adjoining bioregions.	
BC Act status	Not considered analogous to BC Act TECs, Artesian Springs Ecological Community in the Great Artesian Basin– not listed under the BC Act. There were no springs evident within the subject land, even during drought conditions (refer Appendix C).	

PCT Name	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
EPBC Act status	Not considered analogous to EPBC Act TECs (The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin) – not listed under the EPBC Act

5.2.1.4 PCT 52 Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

PCT Name	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
Condition	Medium
PCT number	52
IBRA region	Darling Riverine Plains
IBRA sub-region	Castlereagh-Barwon
Formation	Grassland
Class	Semi-arid floodplain grassland
Percent cleared	70
General site description used to identify PCT	Mixed tussock grassland on alluvial grey clays on alluvial plains in northern section of the Darling Riverine Plains Bioregion and western section of the Brigalow Belt South Bioregion. This area is mapped as PCT 257 Candidate Native Grasslands and has been confirmed to be native grasslands during survey, so is relegated to PCT 52 which most closely aligns with the existing plant community. The most common species present at this location include *Astrebla spp*, *Enteropogon spp*, *Chloris truncata*, *Digitaria divaricatisim,Solanum esuriale, Sclerolaena murica, and Marsilea drummondii* Due to drought conditions the precautionary principal has been followed and all grasslands within this northern section which are not currently being 'actively farmed', as viewable on satellite imagery, and have been mapped as PCT 52.
Benchmark floristic description	Mixed tussock grassland dominated by Queensland Bluegrass (*Dichanthium sericeum*), Cup Grass (*Eriochloa crebra*), Windmill Grass (*Chloris truncata*) and after summer rains Mitchell Grass (*Astrebla elymoides*, *A squarrosa* or *A. pectinata*). Other common grass species include Native Millet (*Panicum decompositum*), *Aristida leptopoda*, *Digitaria divaricatisim*, Curly Windmill Grass (*Enteropogon acicularis*) and *Sporobolus* spp., *Monachather paradoxus* and *Austrostipa aristiglumis*. Forbs include *Solanum esuriale*, *Oxalis chnoodes*, *Hibiscus trionum*, *Alternanthera denticulata*, *Leiocarpa brevicompta*, *Pycnosorus globosus*, *Vittadinia pterochaeta*, *Plantago debilis* and *Einadia polygonoides*. A sparse shrub cover may be present including the tall shrub *Vachellia* (*Acacia*) *farnesiana* and the low shrubs Roly Poly (*Sclerolaena muricata* sens lat.), Galvanized Burr (*Sclerolaena birchii*) and *Maireana decalvans*. Sedges include *Cyperus bifax*, *Carex inversa* and *Eleocharis plana*. The aquatic fern Nardoo (*Marsilea drummondii*) is common. Occurs on grey cracking clay, brown clay, or black earth soils. Distributed on periodically flooded floodplains of major rivers including the Barwon and Gwydir Rivers extending into Queensland. Occurs mainly on alluvial grey clays on alluvial plains in the eastern section of the Darling Riverine Plains Bioregion and western section of the Brigalow Belt South Bioregion including south of Yetman. Small patches occur as far south as Warren on the Bogan and Macquarie River floodplains. Large areas would have occurred around Moree but they have mostly been cleared and cropped. This community has affinities to grasslands further west including Mitchell Grasslands on the Darling and Culgoa River floodplains (ID43). It also grades into a Windmill Grass-dominated grassland on brown clay (ID49). Further clearing would render this community as critically endangered and as of 2005 it is very poorly represented in protected areas.
BC Act status	Not considered analogous to BC Act TECs – not listed under the BC Act
EPBC Act status	This PCT is analogous with the Critically Endangered TEC: Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland. Detailed analysis against the listing is located in Appendix C



5.2.1.5 PCT 53 Shallow freshwater wetland sedgeland in depressions and floodplains on inland alluvial plains and floodplains

PCT Name	Shallow freshwater wetland sedgeland in depressions and floodplains on inland alluvial plains and floodplains	
Condition	Medium	
PCT number	53	
IBRA region	Brigalow Belt South	
IBRA sub-region	Northern Basalts	
Formation	Freshwater Wetland	
Class	Inland Floodplain Swamp	
Percent cleared	67	
General site description used to identify PCT	During drought periods very limited vegetation is present however following rain the underlying vegetation community is identifiable (as shown above). The species composition varies across the wide distribution of this community and levels of or time since inundation. Many plant species are ephemeral but are generally *Eleocharis spp*, Nardoo (*Marsilea drummondii)*, *Paspalidium spp* and *Cyperus spp*. Some of the area covered by this PCT is mapped on the PVT mapping as non-native which if viewed during dry times or on satellite imagery is understandable, however a site visit following rain allowed accurate PCT mapping of this area.	
Benchmark floristic description	Low to mid-high sedgeland/grassland dominated by spike rushes including *Eleocharis pallens, Eleocharis acuta, Eleocharis plana* and *Cyperus* spp., along with ferns Nardoo (*Marsilea drummondii*) and *Marsilea costulifera*, the rushes Juncus subsecundus, *Juncus aridicola*, the grasses Native Millet (*Panicum decompositum*), Warrego Grass (*Paspalidium jubiflorum*), Umbrella Canegrass (*Leptochloa digitata*) and Rats Tail Grass (S*porobolus mitchellii*). Forb species include *Rumex* spp., Alternanthera spp., *Haloragis aspera, Mimulus gracilis, Pratea concolor, Boerhavia dominii* and *Ranunculus* spp. A taller sedge/shrub layer may be present composed of the tall sedge *Cyperus exaltatus*, and the shrubs Lignum (*Muehlenbeckia florulenta*), *Eremophila bignoniifolia* and River Cooba (*Acacia stenophylla*). Weed species include Lippia (*Phyla canescens*) and Bathurst Burr (*Xanthium spinosum*). Scattered trees of River Red Gum (*Eucalyptus camaldulensis*) and Belah (*Casuarina cristata*) occur in some locations. Occurs on grey and brown clays including gilgais on low lying flats or depressions on floodplains or on sandplains that regularly flood or fill from local runoff after rain. Distributed throughout the floodplains of the inland plains, particularly in the Darling Riverine Plains Bioregion with small areas in other bioregions. Grades into box woodlands on the plains and River Red Gum along the rivers. Similar to ID241 which has a dominant cover of *Acacia stenophylla*. Threatened by drainage, less frequent flooding regimes, clearing for crops and invasion of Lippia (*Phyla canescens*).	
BC Act status	Not considered analogous to BC Act TECs – not listed under the BC Act	
EPBC Act status	Not considered analogous to EPBC Act TECs – not listed under the EPBC Act	

5.2.1.6 PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions – High

PCT Name	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	
Condition	High	
PCT number	55	
IBRA region	Brigalow Belt South	
IBRA sub-region	Northern Basalts	
Formation	Semi-arid Woodlands (Grassy sub-formation)	
Class	North-west Floodplain Woodlands	
Percent cleared	83	
General site description used to identify PCT	This PCT is dominated by Belah (*Casuarina cristata*) and lacks other canopy, shrub or ground layer species. It was concluded on site that the current expanse of this community is greater than its original extent due to the influence of altered drainage patterns. It is considered likely that the existing rail line acts as a drainage barrier which results in surface water flows pooling upstream of the rail line, in the area dominated by Belah. The current extent of this community was likely originally occupied by PCT 56 Poplar Box woodland. This vegetation community is directly adjacent to the newly mapped PCT 53 and is in line with the existing STV mapping.	
Benchmark floristic description	Tall woodland of about 12 m high, dominated by Belah (*Casuarina cristata*). Other tree species include Black Box (*Eucalyptus largiflorens*) and Coolabah (*Eucalyptus coolabah*) in depressions and on higher ground Western Grey Box (*Eucalyptus microcarpa*) and Poplar Box (*Eucalyptus populnea* subsp. *bimbil*). Weeping Myall (*Acacia pendula*) may be present as an associate but not as a dominant species. Tall shrubs include Wilga (*Geijera parviflora*), Western Rosewood (*Alectryon oleifolius*), Budda (*Eremophila mitchellii*), Warrior Bush (*Apophyllum anomalum*), Wild Orange (*Capparis mitchellii*) and Supplejack (*Ventilago viminalis*). Shrubs include Western Boobialla (*Myoporum montanum*), Thorny Rhagodia (*Rhagodia spinescens*), *Maireana enchylaenoides*, Spotted Fuchsia Bush (*Eremophila maculata*) and *Eremophila deserti*. Lignum (*Duma florulenta*) may be present in frequently flooded areas. Ground cover includes the low shrubs such as Ruby Saltbush (*Enchylaena tomentosa*), many species of copperburrs including Galvanized Burr (*Sclerolaena birchii*), *Sclerolaena divaricata*, grasses such as Curly Windmill Grass (*Enteropogon acicularis*), wallaby grasses including *Monachather paradoxus* and *Austrodanthonia setacea*, *Austrostipa scabra, Austrodanthonia fulva, Austrostipa aristiglumis, Austrostipa verticillata, Aristida leptopoda, Paspalidium gracile, Sporobolus caroli* and *Panicum queenslandicum*. Forbs include *Einadia nutans*, *Oxalis chnoodes, Vittadinia cuneifolia, Boerhavia dominii, Goodenia fascicularis* and *Solanum esuriale*. Sedges such as *Eleocharis pallens*, rushes such as *Juncus radula* and Nardoo (*Marsilea drummondii*) occur in depressions. Common weed species include *Rapistrum rugosum, Carthamus lanatus* and *Medicago polymorpha*. Occurs on alluvial brown or grey clay soils that may be gilgaied on floodplains and alluvial plains and on black loam soils derived from basalt. Often lines intermittent drainage lines or on flats. Distributed in the northern and central wheatbelt of NSW mainly in the Darling Riverine Plains and Brigalow Belt South Bioregions but extending south into the NSW South-western Slopes Bioregion. Mostly cleared and a declining community	
BC Act Status	Not considered analogous to BC Act TECs – not listed under the BC Act	
EPBC Act Status	Not considered analogous to EPBC Act TECs – not listed under the EPBC Act	

5.2.1.7 PCT 56 Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW – High

PCT Name	Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
Condition	High – Medium – Low
PCT number	56
IBRA region	Brigalow Belt South
IBRA sub-region	Northern Basalts Northern Outwash Castlereagh-Barwon
Formation	Grassy Woodlands
Class	Floodplain Transition Woodlands
Percent cleared	78
General site description used to identify PCT	Poplar Box – Belah woodland is the most common community within the subject land which includes ~37 per cent of native vegetation. The community is dominated by Poplar Box (*Eucalyptus populnea*) and occasionally contains co-dominate species from adjoining communities including Belah and Brigalow. The community contains a diverse shrub layer including Geijera, *Eremophila* spp., *Pittosporum* spp., Ironwood *Acacia excelsa,* Whitewood *Atalaya hemiglauca,* Warrior Bush and *Capparis* spp. The ground layer consists of a variety of small saltbush's, herbs and grass species. The majority of this community has been subject to past disturbance, generally from grazing and in some cases contains high threat exotic weeds including Harissa cactus, *Harissa* spp. and Tiger pear *Opuntia* spp.. The vegetation occurs on the soil type Mungle (mgh) which covers large areas of the project. For the most part this PCT aligns with the existing SVT mapping, changes may have occurred based of fine scale site assessment of community structure or review of soil mapping. This community has been mapped on soil types Mungle and Turrah within the subject land.
Benchmark floristic description	Tall to mid-high woodland dominated by Poplar Box (*Eucalyptus populnea* subsp. *bimbil*) and Belah (*Casuarina cristata*) commonly with the small tree Western Rosewood (*Alectryon oleifolius*). Tall shrubs are sparse and include Wilga (*Geijera parviflora*), Warrior Bush (*Apophyllum anomalum*), *Capparis* spp., *Citrus glauca* and Thorny Rhagodia (*Rhagodia spinescens*). Low shrubs include Galvanized Burr (*Sclerolaena birchii*), Black Roly Poly (*Sclerolaena muricata*), other copperburrs, *Maireana coronata, Maireana decalvans* and *Enchylaena tomentosa*. The ground cover is sparse during dry times but mid-dense after rain and includes grasses such as *Chloris truncata*, *Enteropogon acicularis* and *Austrostipa scabra* subsp. *scabra*. Forb species include *Einadia nutans* subsp. *nutans, Oxalis chnoodes*, *Bulbine alata, Erodium crinitum, Wahlenbergia fluminalis* and *Brachyscome heterodonta*. Generally occurring on pink to brown loamy sand or light clay in the transition zone between the floodplain and the peneplain in the central and northern plains of the NSW wheatbelt in the temperate (no dry season – hot summer) and dry subtropical climate zones with annual precipitation between 300 and 550 mm.
BC Act status	Not considered analogous to BC Act TECs – not listed under the EPBC Act
EPBC Act status	This PCT is considered analogous with the vegetation community *Poplar Box Grassy Woodland on Alluvial Plains* which was listed as Endangered in July 2019. This TEC was not listed at the time of the proposal's controlled action decision and as such no further assessment is required.



5.2.1.8 PCT 98 Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion – High

PCT Name	Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	
Condition	High - Low	
PCT number	98	
IBRA region	Darling Riverine Plains	
IBRA sub-region	Northern Basalts Northern Outwash	
Formation	Semi-arid Woodlands (Shrubby sub-formation)	
Class	Western Peneplain Woodlands	
Percent cleared	40	
General site description used to identify PCT	A single occurrence of this community is located within the alignment and another is found at Borrow Pit 13. This community is similar in composition to PCT 56 except with the addition of White Cypress Pine (*Callitris glaucophylla*). The SVT mapping currently shows both sites as PCT35 which is not consistent with the existing vegetation community as there was no brigalow present or directly adjacent to the area. Therefore, the project has mapped this area as PCT 98. PCT 98 was chosen rather than PCT 56 due to the presence of White Cypress Pine as co-dominant in both locations and the underlying soil type of the red sandy loam, which is clearly visible onsite on aerial imagery, especially at Borrow pit 13.	
Benchmark floristic description	Mid-high woodland dominated by Poplar Box (*Eucalyptus populnea* subsp. *bimbil*) with White Cypress Pine (*Callitris glaucophylla*). Whitewood (*Atalaya hemiglauca*), Quinine Tree (*Alstonia constricta*), Ironwood (*Acacia excelsa*), Western Rosewood (*Alectryon oleifolius* subsp. *canescens*) and Supplejack (*Ventilago viminalis*) may be present as small trees. A diverse, mid-dense to sparse stratum of small trees and tall shrubs includes *Geijera parviflora*, *Eremophila mitchellii, Apophyllum anomalum, Eremophila sturtii, Dodonaea viscosa* subsp. *angustissima, Chenopodium curvispicatum*, *Myoporum montanum, Acacia aneura* and *Hakea leucoptera* subsp. *leucoptera*. Low shrub species include *Rhagodia spinescens*, *Chenopodium desertorum* subsp. *microphyllum, Enchylaena tomentosa, Pimelea pauciflora, Sclerolaena tricuspis, Sclerolaena deserticola* and *Sclerolaena birchii*. The ground cover is generally sparse and is dominated by grasses such as Box Grass (*Paspalidium constrictum*), wiregrass (*Aristida* spp.), *Austrostipa scabra* subsp. *scabra*, Curly Windmill Grass (*Enteropogon acicularis*) and *Eragrostis* spp. Forb species include *Einadia nutans* subsp. *eremaea*, *Sida cunninghamii*, *Rhodanthe moschata, Wahlenbergia stricta* subsp. *alterna, Bulbine semibarbata, Boerhavia dominii, Xerochrysum bracteata, Pimelea trichostachya* and *Nicotiana simulans*. Occurs on red and red-brown sandy loam and light clay loam soils or gravelly ridges on low rises and flats on stagnant alluvial plains and stony rises in the temperate (no dry season hot summer) and semi-arid climate (hot) zones mainly in the north-western sections of the Darling Riverine Plain and BBS Bioregions and eastern section of the Mulga Lands Bioregion.	
BC Act Status	Not considered analogous to BC Act TECs – not listed under the BC Act	
EPBC Act Status	Not considered analogous to EPBC Act TECs – not listed under the EPBC Act	

5.2.1.9 PCT 147 Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion – High - Medium

PCT Name	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion	
Condition	High - Medium	
PCT number	147	
IBRA region	Darling Riverine Plains	
IBRA sub-region	Northern Basalts	
Formation	Rainforests	
Class	Western Vine Thickets	
Percent cleared	83	
General site description used to identify PCT	The site at Borrow Pit 1 consists of mid-high to low closed known as "semi-evergreen vine thicket" dominated by rich diversity of low trees and shrubs to about 6 m high. Species on site included *Ehretia membranifolia,Geijera parvifolia, Notelaea microcarpa, Capparis spp, Jasminum lineare, Carisa ovata* and *Pittosporum spinescens*. Very few trees emergent trees are present. It occurs on dark brown to black loam soils on a basalt hill. The area is currently mapped on SVT mapping as PCT378 which contains Belah and Wilga +/- White Box with PCT 147 mapped adjacent. While one Belah was present within the plots the site assessment determined, based of floristic composition, PCT 147 was a closer match the existing vegetation. This was confirmed by a review of the soil mapping which noted that the soil type present, Black Hill (bhw), typically supports PCT147, while PCT378 usually occurs on clay loam soils on slopes or flats. This PCT is listed as an Endangered Ecological Community under both the NSW BC Act and the Commonwealth EPBC Act.	
Benchmark floristic description	Mid-high to low closed or open forest known as "semi-evergreen vine thicket" dominated by rich diversity of low trees and shrubs to about 6 m high. Low trees include Mock olive (*Notelaea microcarpa var. microcarpa*), Wilga (*Geijera parviflora*), Peach Bush (*Ehretia membranifolia*) along with *Elaeodendron australe var. integrifolia, Ventilago viminalis, Psydrax oleiofolia, Alectryon subdentatus* and *Alstonia constricta*. Some tree species are facultatively deciduous. Emergent trees to 15 m high are often present including White Box (*Eucalyptus albens*), Silver-leaved Ironbark *(Eucalyptus melanophloia*), White Cypress Pine *(Callitris glaucophylla*) and Belah (*Casuarina cristata*). The shrubs layer may be mid-dense or dense and includes *Carissa ovata, Beyeria viscosa, Spartothamnella juncea, Solanum parvifolium, Rhagodia parabolica, Olearia elliptica, Senna coronilloides, Indigofera adesmiifolia, Indigofera brevidens, Breynia cernua, Solanum semiarmatum, Cassinia laevis, Myoporum montanum, Capparis lasiantha, Pimelea neo-anglica* and *Phyllanthus subcrenulatus*. Vines are common and include Wonga Vine (*Pandorea pandorana*), *Parsonsia eucalyptophylla, Clematis microphylla var. microphylla, Cayratia clematidea* and *Jasminum lineare*. Mistletoes include *Lysiana exocarpi, Lysiana subfalcata* and *Amyema miraculosum*. The ground cover is mid-dense in open areas or sparse under dense tree or shrub canopies. Common grass species include *Austrostipa verticillata, Leptochloa asthenes, Poa sieberiana var. hirtilli, Elymus scaber Panicum queenslandicum var. queenslandicum, Chloris ventriculosa, Austrodanthonia bipartita, Paspalidium gracile* and *Cymbopogon refractus*. The sub-shrub *Desmodium brachypodum* is often abundant. Forbs include *Boerhavia dominii* and *Dichondra sp*. Sedges such as *Carex inversa* may be present along with the rock fern *Cheilanthes sieberi subsp. sieberi*.	
BC Act Status	This PCT is consistent with Semi-evergreen vine thicket in the Brigalow Belt South and Nandewar Bioregions TEC - Endangered. Detailed analysis is located in Appendix C	
EPBC Act Status	This PCT is consistent with Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC - Endangered. Detailed analysis against the listing is located in Appendix C	

5.2.1.10 PCT 192 Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW – Medium – Low

PCT Name	Silver-leaved ironbark – Poplar box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW	
Condition	High - Medium – Low	
PCT number	192	
IBRA region	Darling Riverine Plains	
IBRA sub-region	Northern Outwash Castlereagh-Barwon	
Formation	Semi-arid Woodlands (Shrubby sub-formation)	
Class	Subtropical Semi-arid Woodlands	
Percent cleared	33	
General site description used to identify PCT	This PCT is generally located at the northern end of the subject land and within Borrow Pit 5. The community is characterised by the co-dominance of Poplar Box and Silver-leaved Ironbark (*Eucalyptus melanophloia*). White Cypress Pine was not observed within this community; however it may have been historically removed from these areas due to its preference as a building and fencing material. Some areas containing this community have been heavily grazed and generally consist of canopy trees and a ground layer consisting of chenopod shrubs and grass species. The vegetation in the northern section of the subject land is currently mapped as PCT 56 and PCT 71, neither of which are consistent with the dominant tree layer of Poplar Box and Silver-leaved Ironbark. Borrow Pit 5 is currently mapped as PCT 35 which is not consistent with the findings of the site assessment which do not report the presence of any Brigalow but do show Poplar Box and Silver-leaved Ironbark at both sites.	
Benchmark floristic description	Mid-high to tall open woodland or woodland dominated by Poplar Box (*Eucalyptus populnea* subsp. *bimbil*) and Silver-leaved Ironbark (*Eucalyptus melanophloia*). White Cypress Pine (*Callitris glaucophylla*) or Ironwood (*Acacia excelsa*) may be present. The understorey contains a sparse stratum of small trees and shrubs such as Wilga (*Geijera parviflora*), Wild Orange (*Capparis mitchellii*), Budda (*Eremophila mitchellii*), Western Rosewood (*Alectryon oleifolius* subsp. *canescens*), Leopardwood (*Flindersia maculosa*) and Thorny Saltbush (*Rhagodia spinescens*). Mulga (*Acacia aneura*) may be present. Small shrubs include species of Copperburr (*Sclerolaena* spp.). The ground cover may be sparse or mid-dense depending on rainfall and includes Curly Windmill Grass (*Enteropogon acicularis*), Amphipogon caricinus var. caricinus, *Monachather paradoxus*, Box Grass (*Paspalidium constrictum*), Kangaroo Grass (*Themeda australis*), spear grass (*Austrostipa scabra* subsp. *scabra*) and a number of wire grass species (*Aristida* spp.). Occurs on red or grey, sandy or stony loams or light clays on low rises or low hills above the floodplains. In NSW it is distributed near the Queensland/NSW border across the northern wheatbelt and eastern section of the northern part of the Western Division including the dry subtropical, and part of the temperate (hot summer) and semi-arid (hot) climate zones. It extends into Queensland. It has mainly been cleared for grazing in the Central Division. Merges with Silver-leaved Ironbark – White Cypress Pine on alluvium (ID227), Coolabah, Belah, Brigalow and other Poplar Box communities.	
BC Act Status	Not considered analogous to BC Act TECs – not listed under the BC Act	
EPBC Act Status	Not considered analogous to EPBC Act TECs – not listed under the EPBC Act	

5.2.1.11 PCT 244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt) – High – Medium – Low

PCT Name	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	
Condition	High – Medium – Low	
PCT number	244	
IBRA region	Brigalow Belt South Darling Riverine Plains	
IBRA sub-region	Northern Basalts Castlereagh-Barwon	
Formation	Grassy Woodlands	
Class	Floodplain Transition Woodlands	
Percent cleared	73	
General site description used to identify PCT	This community contains similar structural characteristics and species composition to PCT 56 Poplar Box woodland. It occurs on clay-loam soils on flats on alluvial plain and stagnant alluvial plain landscapes. This is a widespread community with significant variation across its range, and it often grades into PCT 56. The area within the Norther Basalts and Castlereagh-Barwon IBRA sub-regions are mapped as a grade from PCT56 higher on the landscape into PCT244 in the slightly lower area, with darker soils which most closely aligns with the PCT description. This PCT has been mapped on soil types Booncarroll within the subject land.	
Benchmark floristic description	Mid-high to tall woodland or open woodland, averaging 13 m high, dominated by Poplar Box (*Eucalyptus populnea* subsp. *bimbil*). The small trees Belah (*Casuarina cristata*) or Western Rosewood (*Alectryon oleifolius* subsp. *canescens*) may be present but not co-dominant. The shrub layer is absent or sparse with some thickets in places. Tall shrub species include Wilga (*Geijera parviflora*), Warrior Bush (*Apophyllum anomalum*) and Budda (*Eremophila mitchellii*). Low shrubs include *Maireana microphylla*, *Maireana decalvans* and Thorny Saltbush (*Rhagodia spinescens*). The ground cover is mid-dense to sparse and contains low shrubs such as *Sclerolaena birchii* and *Sclerolaena muricata* and a range of grass species including *Austrodanthonia setacea*, *Enteropogon acicularis*, *Austrostipa scabra* subsp. *scabra*, *Elymus scaber* var. *scaber, Eragrostis parvifolia, Chloris truncata, Austrodanthonia fulva* and *Sporobolus caroli*. Forb species include *Calotis cuneifolia, Sida corrugata, Vittadinia dissecta* var. hirta, *Dichondra repens*, *Rostellularia adscendens* subsp. *adscendens*, *Oxalis perennans* and *Rumex brownii*. Sedges such as *Eleocharis plana* and *Carex inversa*, rushes (*Juncus* spp.) and Nardoo (*Marsilea drummondii*) grow in slight depressions. Weed species may be common including *Medicago* spp., *Trifolium* spp., *Hypochaeris radicata* and *Rapistrum rugosum*.	
BC Act status	Not considered analogous to BC Act TECs – not listed under the BC Act	
EPBC Act status	This PCT is considered analogous with the vegetation community *Poplar Box Grassy Woodland on Alluvial Plains* which was listed as Endangered in July 2019. This TEC was not listed at the time of the proposal's controlled action decision and as such no further assessment is required.	

5.2.1.12 PCT 247 Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion – High – Medium

PCT Name	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion	
Condition	Medium - Low	
PCT number	247	
IBRA region	Darling Riverine Plains	
IBRA sub-region	Castlereagh-Barwon	
Formation	Freshwater Wetlands	
Class	Inland Floodplain Shrublands	
Percent cleared	63	
General site description used to identify PCT	This community is located in the northern part of the subject land, within the Darling Riverine Plains bioregion. Lignum (*Duma florulenta*) shrubland wetlands are located in broad, low-lying landscapes that are subject to seasonal wetting or flooding. The community is dominated by Lignum. The ground covers species were either dormant or had died off at the time of assessment due to the prolonged dry conditions. Observable ground cover species consisted of *Eleocharis pusilla, Carex inversa*, *Cyperus* spp.*, Juncus* spp. and Nardoo, *Marsilea drummondii*. The PVT mapping for the area indicates historical PCT241 which contains River Coobah swamp wetlands and PCT 211, slender Saltbush – samphire – copper burr low open shrubland wetland, as there was no evidence of clearing of River Coobah or saltbush-samphire communities within the surrounding areas and there were areas of dense lignum present so it was determined that PCT 247 was the most likely fit for the vegetation community at this site.	
Benchmark floristic description	Tall shrubland or open shrubland usually to 2 m high dominated by Lignum (*Duma florulenta*). Other shrub species that may be present include *Eremophila bignoniiflora, Eremophila maculata, Rhagodia spinescens* and *Chenopodium nitrariaceum*. Scattered trees may be present with less than 10 per cent canopy cover including River Red Gum (*Eucalyptus camaldulensis*), Black Box (*Eucalyptus largiflorens*) and Coolabah (*Eucalyptus coolabah*). The ground cover may be dense after rains or inundation but very sparse during drought. The scrambler *Einadia nutans* subsp. *nutans* may be present along with copperburr shrubs such as *Sclerolaena muricata* and *Sclerolaena divaricata*. Grass species include Warrego Summer Grass (*Paspalidium jubiflorum*), Native Millet (*Panicum decompositum*), Windmill Grass (*Chloris truncata*), Curly Windmill Grass (*Enteropogon acicularis*) and Rats Tail Grass (*Sporobolus mitchellii*). Forbs include *Persicaria hydropiper*, *Alternanthera denticulata, Eclipta platyglossa*, *Haloragis glauca*, *Pratia concolor, Sida fibulifera*, *Boerhavia dominii* and *Solanum esuriale*. Sedges may be common and include *Eleocharis plana, Eleocharis pusilla, Carex inversa* and *Cyperus* spp. The rush *Juncus aridicola* is often present. Nardoo fern (*Marsilea drummondii*) is abundant. Occurs on deep, self-mulching alluvial grey clays (and rarely black earth) that are often gilgaied, in depressions on floodplains or as narrow bands near watercourses that are subject to regular inundation. Distributed within the temperate (hot summer), dry sub-tropical and eastern semi-arid (hot) climate zones which corresponds with the Darling Riverine Plain Bioregion extending eastwards to the Liverpool Plains where small stands occur on the edge of Lake Goran. Grades into Lignum (ID17) in south western NSW and Lignum in far north western NSW (ID25). Compared to those other Lignum communities, this community is more restricted and threatened. Most of its original extent has been cleared and reduced flooding threatens many stands over the long-term.	
BC Act status	Not considered analogous to BC Act TECs – not listed under the BC Act	
EPBC Act status	Not considered analogous to EPBC Act TECs – not listed under the EPBC Act	

5.2.1.13 PCT 418 White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion – High – Medium - Low

PCT Name	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion	
Condition	High – Medium- Low	
PCT number	418	
IBRA region	Darling Riverine Plains	
IBRA sub-region	Northern Basalts Northern Outwash	
Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)	
Class	North-west Slopes Dry Sclerophyll Woodlands	
Percent cleared	25	
General site description used to identify PCT	The areas mapped as PCT 418 all contain tall woodland to open forest dominated by White Cypress Pine (*Callitris glaucophylla*) usually with Silver-leaved Ironbark *(Eucalyptus melanophloia*) interspersed. Tall shrubs were generally sparse and included Wilga (*Geijera parviflora*) and *Alstonia constricta.* This community is found in the west of the study area only within borrow pits. The community occurs on deep cream to red sandy loam soils on lower hillslopes in low hills. Borrow Pit 9 is currently mapped as PCT 35 which is present over approximately half of the site, the other half however contains good quality PCT 418 with both White Cypress and Silver-leaved Ironbark as the dominant tree species. Borrow Pit 25 is also currently mapped as PCT 35 however a reasonable proportion (50 per cent) of the site is White Cypress regrowth with Silver-leaved Ironbark interspersed. Borrow Pit 2 is mapped as PCT 418 which is correct, however there is a small patch of low quality PCT 35 at the base of the hill which has been included in the PCT 35 mapping and is discussed above.	
Benchmark floristic description	Tall to mid-high woodland to open forest dominated by White Cypress Pine (*Callitris glaucophylla*) usually with Silver-leaved Ironbark (*Eucalyptus melanophloia*). Other tree species include *Eucalyptus chloroclada, Eucalyptus albens, Eucalyptus blakelyi, Eucalyptus populnea subsp. bimbil* and *Angophora leiocarpa*. Young regrowth White Cypress Pines, *Acacia cheelii* or *Acacia leiocalyx* may comprise a small tree layer. Tall shrubs are very sparse and include Wilga (*Geijera parviflora), Alstonia constricta, Pimelea neo-anglica, Acacia decora, Notelaea microcarpa var. microcarpa, Cassinia laevis* and *Acacia deanei subsp. paucijuga*. Low shrubs include *Solanum ferocissimum, Breynia cernua, Solanum parvifolium, Abutilon oxycarpum subsp. subsagittatum* and *Carissa ovata*. Vines include *Parsonsia eucalyptophylla* and *Clematis microphylla*. The ground cover is sparse and includes the grasses *Aristida vagans, Austrostipa verticillata, Austrostipa scabra subsp. scabra, Digitaria brownii, Cymbopogon refractus, Eragrostis leptostachya and Austrodanthonia racemosa. Forbs include Einadia nutans subsp. linifolia, Vittadinia dissecta var. hirta, Chenopodium melanocarpum, Calandrinia eremaea, Oxalis perennans, Rostellularia adscendens, Calotis lappulacea, Daucus glochidiatus, Vittadinia sulcata* and *Goodenia paniculata*. Possibly partly a derived community through past forestry silvicultural treatment that favoured cypress pine.	
BC Act status	Not considered analogous to BC Act TECs – not listed under the BC Act	
EPBC Act status	Not considered analogous to EPBC Act TECs – not listed under the EPBC Act	

5.2.1.14 PCT 628 Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion – Medium – Low

PCT Name	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion	
Condition	Medium– Low	
PCT number	628	
IBRA region	Darling Riverine Plains	
IBRA sub-region	Castlereagh-Barwon	
Formation	Grassy Woodlands	
Class	Floodplain Transition Woodlands	
Percent cleared	90	
General site description used to identify PCT	This PCT is generally located on slightly elevated crests adjoining low-lying areas that formally supported Lignum wetlands which have been modified for cropping land uses. It is determined that the benchmark description for this community is slightly inaccurate for what was recorded on site, as it was found that the community is co-dominated by Carbeen *Corymbia tessellaris*, Poplar Box and *Eucalyptus tereticornis* (rather than *Eucalyptus coolabah* or *Eucalyptus camaldulensis*) as described in the PCT benchmark. This community is modified by grazing and generally supports a canopy layer with trees of varying ages and a ground layer consisting of chenopod shrubs and grass species. No other PCT descriptions found fit the community as closely as this one, so it was determined that PCT 628 is an appropriate classification. This PCT has been mapped on soil type Booncarroll on slightly elevated areas which differentiate it from PCT 244 and PCT 56.	
Benchmark floristic description	Mid-high to tall open woodland or woodland dominated by Carbeen (*Corymbia tessellaris*) often with Coolabah (*Eucalyptus coolabah* subsp. *coolabah*), River Red Gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*), Poplar Box (*Eucalyptus populnea* subsp. *bimbil*) or Weeping Myall (*Acacia pendula*). Shrubs are absent or very sparse and include *Geijera parviflora, Acacia salicina, Sclerolaena muricata* var. *muricata* and *Enchylaena tomentosa*. The ground cover may be dense after flooding or rain but is usually mid-dense to sparse. Species include *Enteropogon acicularis*, *Panicum decompositum*, *Eriochloa crebra*, *Einadia nutans* subsp. *nutans* and *Chloris truncata*. Occurs on brown or grey clay loam to loam soils on slightly elevated parts of floodplains in the Moree – Wee Waa and Walgett regions mainly in the Darling Riverine Plains Bioregion. Highly restricted, occurring in small patches and mostly cleared. Grades into Coolabah grassy woodland (ID40) on heavy clay soils and into Poplar Box grassy woodland (ID244) on sandy loam soils. Differs in species composition from Carbeen woodland on sand rises (prior streams) near the Queensland border or Carbeen – cypress pine woodland on sandstone in forests near Narrabri.	
BC Act status	This PCT is consistent with the Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions – Endangered. Detailed analysis is located in Appendix C	
EPBC Act status	Not considered analogous to EPBC Act TECs- not listed under the EPBC Act	

5.2.2 Number of Biodiversity Assessment Methodology plots required for assessment

Based on the assignment of vegetation zones, the area of impact within each zone was assessed to determine the minimum number of BAM plots required for assessment. The results of this analysis is provided in Table 5.2 for the alignment segments and Table 5.3 for each Borrow pit.

Table 5.2 Plant Community Type area and number of BAM plots required within the alignment segments

PCT and IBRA subregion	Zone (segment and condition class)	Area (ha)	Number of transects required	Number of transects completed
Castlereagh Barwon				
36	Early works High	0.66	1	2
36	Brownfield Medium	1.60	2	2
36	Early works Medium	1.56	1	1
36	Greenfield Medium	0.84	1	1
52	Greenfield Medium	26.1	4	4
52	Brownfield Medium	7.31	3	3
56	Brownfield Medium	0.36	1	1
56	Early works Medium	0.24	1	0
56	Brownfield Low	18.3	3	3
56	Early works Low	1.89	1	1
192	Greenfield Medium	2.3	2	3
192	Early works Medium	1.97	1	0
192	Greenfield Low	1.6	1	1
192	Early works Low	1.49	1	1
244	Greenfield Medium	3.8	2	3
244	Greenfield Low	3.7	2	2
244	Brownfield Medium	3.6	2	2
244	Brownfield Low	3.73	2	0
244	Early works Medium	0.28	1	0
247	Brownfield Medium	5.59	3	3
247	Greenfield Medium	0.48	1	0
247	Brownfield Low	2.32	2	0
247	Greenfield Low	2.17	2	3
628	Greenfield Medium	0.97	1	1
628	Brownfield Medium	2.93	2	2
682	Early works Medium	3.12	2	1
628	Greenfield Low	1.18	1	1
628	Brownfield Low	8.19	3	2
628	Early works Low	10.97	3	0
Northern Outwash				
27	Brownfield Medium	.02	1	1
27	Brownfield Low	3.95	2	2
27	Early works Low	4.56	2	2
35	Early works High	5.21	3	3

PCT and IBRA subregion	Zone (segment and condition class)	Area (ha)	Number of transects required	Number of transects completed
35	Early works Low	1.28	1	1
35	Brownfield High	0.24	1	0
35	Brownfield Low	0.4	1	1
36	Brownfield High	0.5	1	1
36	Brownfield Medium	0.23	1	1
56	Brownfield High	0.6	1	1
56	Brownfield Medium	0.96	1	1
56	Brownfield Low	31.17	4	4
56	Early works High	1.38	1	1
56	Early works Low	6.01	3	2
Northern Basalts				
35	Brownfield High	5.35	3	2
35	Brownfield Low	2.02	2	1
35	Early works High	0.33	1	1
53	Brownfield Medium	3.05	2	2
53	Early works Medium	1.2	1	1
55	Brownfield High	0.64	1	3
56	Brownfield High	31.60	4	4
56	Brownfield Medium	5.48	3	3
56	Brownfield Low	24.89	4	4
56	Early works High	2.8	2	3
56	Early works Medium	4.38	2	3
56	Early works Low	5.13	3	2
98	Brownfield High	1.9	1	1

Table 5.3 Plant Community Type area and number of BAM plots required within each Borrow pit

Borrow pit and PCT	Zone (condition class)	Area (ha)	Number of transects required	Number of transects completed
Borrow pit 1				
35	Medium	0.69	1	1
35	Low	.95	1	2
147	High	1.21	1	1
147	Medium	3.40	2	2
Borrow pit 2				
35	Low	0.35	1	2
418	High	6.09	3	3
418	Medium	6.67	3	3
Borrow pit 5				
192	High	9.09	3	3
192	Medium	1.35	3	3
192	Low	1.86	2	2

Borrow pit and PCT	Zone (condition class)	Area (ha)	Number of transects required	Number of transects completed
Borrow pit 7				
56 (Northern outwash)	High	0.13	1	4
Borrow pit 8				
56	Low	21.14	4	4
Borrow pit 9				
418	High	3.95	2	4
418	Medium	2.99	2	3
418	Low	1.05	1	1
Borrow pit 13				
98	High	0.57	1	1
Borrow pit 25				
418	Medium	1.52	1	1
418	Low	0.76	1	2

Where the number of plots required did not meet the number of plots completed benchmark data was used. In areas of low quality PCT where there are no trees present the tree values within the benchmark data were not used but the remaining information such as litter cover and HTE was retained from the benchmark descriptions within the BioNet Vegetation Classification database. Benchmark data was used a total of 13 times within the BAM-C to determine offset liability. Details of the plot numbers are located in Section 3.1.1.

5.2.3 Threatened ecological communities (BC Act)

Following completion of field work a comparison of each PCT present against potential analogous TEC scientific determinations, as shown in the BioNet Vegetation Classification database, was undertaken. This included a review of the advice provided by the Scientific Committee, specifically guidelines for interpreting listings for species, populations and ecological communities under the EPBC Act and BC Act, respectively. A total of five EPBC Act listed and four BC Act listed TECs are considered present within the subject land. Detailed analysis of the vegetation zones with respect to the NSW Scientific Committee and/or the Commonwealth Threatened Species Scientific Committee determinations is provided in Appendix B and Appendix C respectively.

Six of the 14 PCTs mapped within the subject land are considered analogous to EPBC Act and/or BC Act listed TECs, as listed in Table 5.1. The extent of TECs within the study area was determined by the extent of analogous PCTs.

5.2.4 Managed land

Managed land covers 23.65 per cent of the subject land (700.86 ha) including areas surrounding the borrow pits. Managed land has been assessed over the project area following the BCSD approved methodology and in accordance with the Native vegetation regulatory map: method statement. Managed land (or Category 1 land under the LLS Act 2013) is associated with areas that has been modified for playing fields, mining or quarries, agricultural cropping, including dryland broad acre cropping and irrigated cropping. Dryland cropping is generally located in areas that once supported PCT 56 Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW, whilst the cotton cropping is generally located in low-lying areas that formally supported PCT 247 Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion.

An assessment of managed land was achieved though ground truthing between 2018 and 2021, a review of historical aerial images and a review of the NSW Land use mapping (OEH 2017a) for areas mapped as cropping, quarries or recreation and culture as detailed in Sections 3.2 and Figure 7 of the Native vegetation regulatory map: method statement. All areas of managed land have been the target of at least one round of on ground assessment, though not all areas were able to be accessed throughout the whole of the assessment period (2018 – 2021) due to land access issues which developed later in targeted assessment stages (2020 -2021).

Areas that are mapped as Managed land rarely contain scattered paddock trees where cropping has occurred. Non-native pastures sown with *Cenchrus ciliaris* (Buffel grass) are also typically devoid of trees. Where appropriate, scattered paddock trees have been recorded and assessed in accordance with Appendix B of the BAM – Streamlined assessment module – scattered tree assessment (DPIE 2017).

Seven scattered paddock trees have been identified within the subject land (refer Appendix A Map C.6). The scattered paddock trees are of the species *Eucalyptus populnea* (Poplar box) and *Eucalyptus camaldulensis* (River red gum) and both are assumed to contain hollows. These trees may provide habitat refuges for threatened fauna such as Squirrel glider (*Petaurus norfolcensis*) and Glossy black cockatoo (*Calyptorhynchus lathami*) and may also be used as 'stepping stones' during dispersal across areas of managed agricultural land.

5.2.5 Weeds – high threat exotics

Within the subject land a total of 13 High Threat Exotics (HTEs) are recorded. Four of these species are also listed as Weeds of National Significance (WoNS). Details associated with identified HTEs are presented in Table 5.4.

Table 5.4 Hight Threat Exotic species identified within the subject land

Common name	Scientific name	Northern Basalts	Northern Outwash	Castlereagh-Barwon	WoNS
African boxthorn	*Lycium ferocissimum*	Yes	Yes	Yes	Yes
Balloon vine	*Cardiospermum grandiflorum*	-	-	Yes	-
Buffel grass	*Cenchrus ciliaris*	Yes	Yes	Yes	-
Guinea grass	*Megathyrsus maximus*	Yes	_	Yes	-
Lippia	*Phyla canescens*	-	-	Yes	-
Mimosa bush	*Vachellia farnesiana*	Yes	Yes	Yes	-
Harrisia cactus	*Harrisia martinii*	Yes	Yes	Yes	-
Mother of millions	*Bryophyllum* spp.	Yes	-	-	-
Noogoora burr	*Xanthium occidentale*	Yes	Yes	Yes	-
Rhodes grass	*Chloris gayana*	Yes	Yes	Yes	-
Serrated tussock	*Nassella trichotoma*	-	Yes	-	Yes
Tiger pear	*Opuntia aurantiaca*	Yes	Yes	Yes	Yes
Velvet tree pear	*Opuntia tomentosa*	Yes	Yes	Yes	Yes

Most of HTEs were recorded across all IBRA subregions within the subject land, the main exceptions were Balloon vine, Lippia and Mother of millions. Both Lippia and Mother of millions have the potential to be spread by construction works as well as other vectors, as such specific mitigation measures have been developed to contain these species. Balloon Vine was recorded only within PCT36 within Castlereagh-Barwon and tends to rely on the microclimate provided by the proximity to water and shade of larger trees, also the seeds are spread by water. Due to the high level of distribution of this species – specific maps of their locations have not been developed. Lippia was recorded in several PCTs within the subject land, including in areas of managed land. One HTE, Coolatai grass (*Hyparrhenia hirta*) was noted along several road reserves outside of the subject land this species has the potential to invade the subject land given the poor ground cover conditions created by the current drought.

6 Threatened species

6.1 Ecosystem – credit species

6.1.1 Predicted species

Fifty ecosystem-credit species are predicted to occur under BAM across all assessment areas within the subject land. The ecosystem-credit species predicted to occur in the subject land are listed in Table 6.1 and species observed during field investigations are presented in Appendix F. Within the results of the BAM C the predictive list assessment was made on the likelihood of those species occurring based upon the known distribution of the species and whether or not critical habitat features were present within the PCT zone (refer Appendix G).

Where species required trees and the PCT quality was such that no or very few (<1 tree per 0.5 ha) trees were present, then the species was determined not to occur within that area (i.e. Koala or Painted Honeyeater). However, if the species uses trees but may forage in open areas they were assumed present within areas of the PCT in which they were predicted, even where trees did not occur (e.g. Diamond firetail).

Appendix G compiles species information in a tabulated form as derived from the NSW Threatened Biodiversity Profile Data Collection and other relevant sources, database records of the species occurrence, site observations (habitat suitability and species presence), survey effort and justification for exclusion of species (or nominated PCTs) from further assessment under the BAM. A list of the species exclusions and the habitat assumptions associated with low-quality PCTs is located in Table 6.2.

Table 6.1 Ecosystem-credit species predicted to occur under BAM C within the subject land

Species name	Scientific name	EPBC Act	BC Act	Sensitivity to loss	PCTs within the subject land in which the species is predicted to occur		
					Brigalow Belt South IBRA Northern Basalts PCT number	Brigalow Belt South IBRA Northern Outwash PCT number	Darling Riverine Plains IBRA Castlereagh-Barwon PCT number
Australasian bittern	*Botaurus poiciloptilus*	E	E1, P	High	53	-	36,247
Australian painted snipe	*Rostratula australis*	E	E1, P	High	53	-	36,52,247
Barking Owl	*Ninox connivens*	-	V,P	Moderate	35,53,55,56,98,244	35,36,56	36,56,192,244,247,628
Black-breasted buzzard	*Hamirostra melanosternon*	-	V, P, 3	Moderate	55,56,98	-	36,56,247
Black-chinned Honeyeater	*Melithreptus gularis gularis*	-	V,P	Moderate	244	36	36,192,244,628
Black-necked stork	*Ephippiorhynchus asiaticus*	-	E1, P	High	53	36	36,247
Black-striped wallaby	*Macropus dorsalis*	-	E1, P	High	35,147,418	35,418	-
Black-tailed godwit	*Limosa limosa*	M	V, P	Moderate	53	-	
Blue-billed duck	*Oxyura australis*	-	V, P	Moderate	53	-	247
Brolga	*Grus rubicunda*	-	V, P	Moderate	27,53,98	-	36,52,247
Brown treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	-	V, P	Moderate	244,418	-	
Corben's long-eared Bat	*Nyctophilus corbeni*	V	V	Moderate	35,55,56,98,147,244	35,36,56	36,56,192,244,247
Diamond firetail	*Stagonopleura guttata*	-	V, P	Moderate	27,35,55,56,98,147,244, 418	35,36,56,418	36,56,192,244,247,628
Dusky woodswallow	*Artamus cyanopterus cyanopterus*	-	V, P	Moderate	-	-	36,52,56,192,244, 247,628
Eastern bentwing-bat	*Miniopterus orianae oceanensis*	-	V, P	Moderate	55,56,147,244	-	-
Eastern Grass owl	*Tyto longimembris*	-	V,P	Moderate	-	-	52
Five-clawed worm-skink	*Anomalopus mackayi*	V	E1, P	High	27,35,55,56,244	35,36,56	36,52,56,244,247,628
Flame robin	*Petroica phoenicea*	-	V, P	Moderate	-	-	36
Flock Bronzewing	*Phaps histronica*		E, P	High	-	-	52
Freckled duck	*Stictonetta naevosa*	-	V, P	Moderate	53	-	36,247
Glossy black-cockatoo	*Calyptorhynchus lathami*	-	E2, V, P,2	Moderate	55,56,244	36,56	36,56,192,244,247,628

Species name	Scientific name	EPBC Act	BC Act	Sensitivity to loss	PCTs within the subject land in which the species is predicted to occur		
					Brigalow Belt South IBRA Northern Basalts PCT number	Brigalow Belt South IBRA Northern Outwash PCT number	Darling Riverine Plains IBRA Castlereagh-Barwon PCT number
Grey falcon	*Falco hypoleucos*	V	E1, P,2	High	-	35,36,56	36,52,56,192,244, 247,628
Grey-crowned babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	-	V, P	Moderate	27,35,55,56,98,244	35,36,56	36,56,192,244,628
Grey-headed flying-fox	*Pteropus poliocephalus*	V	V, P	Moderate	35,55,56,147,244	35,36,56	-
Hooded robin (south-eastern form)	*Melanodryas cucullata cucullata*	-	V, P	Moderate	27,35,55,56,98,147,244, 418	5,36,56,418	36,56,192,244,628
Koala	*Phascolarctos cinereus*	V	E2, V,P	Moderate	35,55,56,98,244	35,36,56	36,52,56,192,244,247
Kultarr	*Antechinomys laniger*	-	E1, P	High	-	-	52,56,192,244,247
Little eagle	*Hieraaetus morphnoides*	-	V,P	Moderate	27,35,53,55,56,98,147,244	35,36,56	36,36,52,56,247,628
Little lorikeet	*Glossopsitta pusilla*	-	V,P	Moderate	418	-	-
Little pied bat	*Chalinolobus picatus*	-	V,P	Moderate	27,35,56,56,98,147,244, 418	35,36,56	36,56,192,244,247,418, 628
Magpie goose	*Anseranas semipalmata*	-	V,P	Moderate	-	36	36,52,247
Major Mitchell's cockatoo	*Lophochroa leadbeateri*	-	V,P,2	Moderate	-	-	36,56,192,244,628
Masked owl	*Tyto novaehollandiae*	-	V,P,3	Moderate	27,35,55,56,98,147,244	-	36,52,56,192,244,247
Northern free-tailed bat	*Ozimops lumsdenae*	-	V,P	Moderate	36,244	36	36,244,628
Painted honeyeater	*Grantiella picta*	V	V,P	Moderate	27,35,55,56,98,147,244	35,36,56	36,56,192,244,628
Pied honeyeater	*Certhionyx variegatus*	-	V,P	Moderate	-	-	36,56,192,244,247
Red-tailed black-cockatoo (inland subspecies)	*Calyptorhynchus banksii samueli*	-	V,P,2	Moderate	-	-	36,52,56,192,244,247,628
Scarlet robin	*Petroica boodang*	-	V, P	Moderate	-	-	36,56,192,244
Speckled warbler	*Chthonicola sagittata*	-	V,P	Moderate	27,35,55,56,98,147,244	35,56	56,192,244,628
Spotted harrier	*Circus assimilis*	-	V,P	Moderate	27,35,55,56,98,244	35,36,56	36,56,244,247,628
Spotted-tailed quoll	*Dasyurus maculatus*	E	V,P	High	147	-	36,628

Species name	Scientific name	EPBC Act	BC Act	Sensitivity to loss	PCTs within the subject land in which the species is predicted to occur		
					Brigalow Belt South IBRA Northern Basalts PCT number	Brigalow Belt South IBRA Northern Outwash PCT number	Darling Riverine Plains IBRA Castlereagh-Barwon PCT number
Square-tailed kite	*Lophoictinia isura*	-	V,P,3	Moderate	27,35,55,56,98,244	35,36,56	36,56,192,244,247,628
Stripe-faced dunnart	*Sminthopsis macroura*	-	V,P	Moderate	27,35,55,56,244	35,36,56	36,52,56,192,244,247,628
Superb parrot	*Polytelis swainsonii*	V	V,P,3	Moderate	-	-	36,52,56,244
Swift parrot (*feeding*)	*Lathamus discolor*	CE	E1,P,3	Very High	418	-	-
Turquoise parrot	*Neophema pulchella*	-	V,P,3	Moderate	244	36	36,244,628
Varied sittella	*Daphoenositta chrysoptera*	-	V,P	Moderate	27,35,55,56,98,147,244	35,36,56	36,56,192,244,628
White-bellied sea-eagle	*Haliaeetus leucogaster*	C, Ma	V,P	Moderate	-	35,36,56	36,56,244,247,628
White-fronted chat	*Epthianura albifrons*	-	E2,V,P	Moderate	-	-	52,247
Woma	*Aspidites ramsayi*	-	V,P	Moderate	-	-	36,56,192,247
Yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	-	V,P	Moderate	27,35,55,56,98,147,244,418	35,36,56	36,52,192,244,247,628

Table 6.2 Ecosystem Credit Species exclusions based on habitat assumptions

Common name	Species name	PCTs which have been excluded as habitat	Bionet Habitat Constraint, Reasons for exclusion	Details (refer Appendix G for detailed species information)
Black-tailed godwit	*Limosa limosa*	All	Habitat constraint – OEH species mapping	The subject land is not located within the OEH species mapping.
Flock bronzewing	*Phaps histrionica*	All PCTs	Vagrant	The species occurs in inland habitats north of Broken Hill and west of Cobar and is rarely seen in NSW. Study area is outside the normal range of the species.
Freckled duck	*Stictonetta naevosa*	All PCTs	Vagrant	The species is known to occur primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere (OEH). In the region the species disperses from southern areas during drought to large open and permanent water bodies (eg. farm dams). Nominated PCTs are either highly ephemeral (PCT 53 and 247) or are enclosed by riparian vegetation (PCT 36). Species is excluded from further assessment.
Glossy black-cockatoo (Foraging)	*Calyptorhynchus lathami*	Low-quality PCT 55, 56 and 244 All of the following PCTs: 36, 192, 247, 418 and 628 All of Borrow Pit 8	Habitat Constraint – Other (Presence of Allocasuarina and casuarina species)	The species feeds exclusively on *Casuarina* and *Allocasuarina* species neither of which are found within the Low-quality PCTs, in several of the nominated PCTs, or within Borrow Pit 8.
Grey falcon	*Falco hypoleucos*	All PCTs	Vagrant	The species occurs in inland Australia in arid or semi-arid habitats. The species is thought to be extinct in areas with more than 500 mm of rainfall in NSW. The study area receives between 647 mm in the south and 525 mm in the north. Study area is outside the normal range of the species.
Koala (Foraging)	*Phascolarctos cinereus*	Low-quality PCT 35,36, 55, 56,192, 244, 247	Habitat Constraint	The species require trees for food and shelter however the Low-quality PCT contain only highly scattered individual trees or no trees, and therefore do not provide suitable habitat for the species. Based on the NSW SEPP list of Koala forage tree species for the Western Slopes and Plains some PCTs only contain limited preferred forage tree species, based on either observed flora species or benchmark descriptions of the PCT. PCT 247 is a lignum shrubland.
Kultarr	*Antechinomys laniger*	All PCTs	Geographic limitations	The study area is located outside of the species distribution which is around 400 km further west.
Painted honeyeater	*Grantiella picta*	Low-quality PCT 27, 35, 56, 192, 244 and 628	Habitat constraints – Other (Mistletoes present at a density of greater than five mistletoes per hectare)	The species is a specialist feeder on the fruit of mistletoes which require trees to grow on. The Low-quality PCTs contain only highly scattered individual or no trees therefore there is little or no habitat for mistletoes and henceforth no suitable habitat for the Painted Honeyeater in Low quality PCTs.

Common name	Species name	PCTs which have been excluded as habitat	Bionet Habitat Constraint, Reasons for exclusion	Details (refer Appendix G for detailed species information)
Woma	*Aspidites ramsayi*	All PCTs	Geographic limitations	The study area is located outside of the species distribution which is 400 km further west.

6.1.2 Observed species

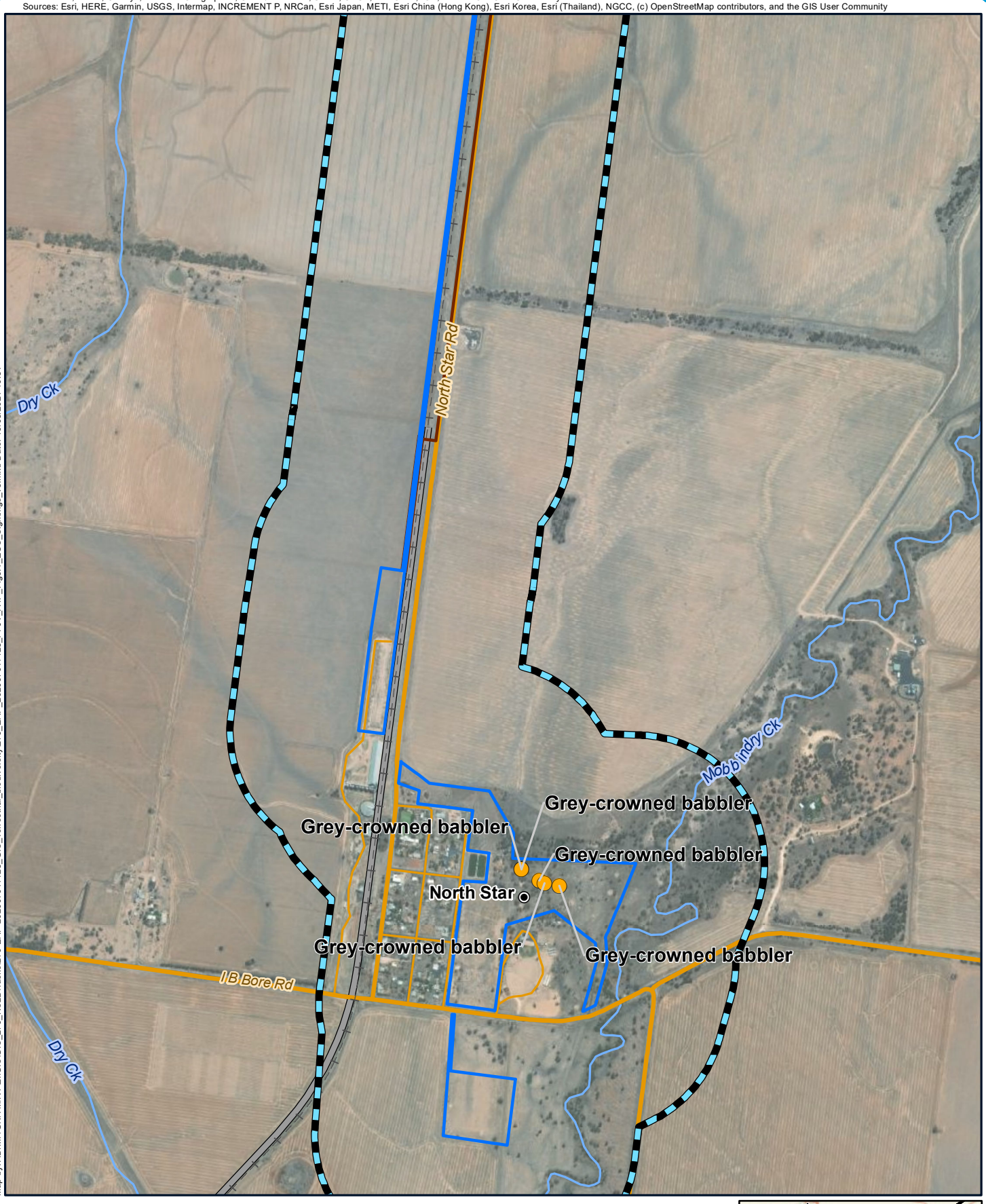
Although targeted surveys for ecosystem-credit species are not required in accordance with the BAM, some of these species were incidentally identified during the surveys undertaken within the subject land (refer Appendix D and Appendix G). Fifteen ecosystem-credit species were observed within the subject land and adjacent areas including:

- Australian bittern (*Botaurus poiciloptilus*)
- Spotted harrier (*Circus assimilis*)
- White-bellied sea-eagle (*Haliaeetus leucogaster*)
- Red-tailed black-cockatoo (inland) (*Calyptorhynchus banksia samueli*)
- Glossy black-cockatoo (*Calyptorhynchus lathami*)
- Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
- Painted honeyeater (*Grantiella picta*)
- Scarlet robin (*Petroica boodang)*
- Black-striped wallaby (*Macropus dorsalis*)
- Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Little pied bat (*Chalinolobus picatus*)
- Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)
- Northern free-tailed bat (*Ozimops lumsdenae*)
- Corben's long-eared bat (*Nyctophilus corbeni*)[1] (possible ID from initial microbat call analyses in 2018 and 2019 – harp trapping for the proposal in February 2021 recorded only *N. gouldii* and *N. geoffroyi*).
- Grey-headed flying-fox (*Pteropus poliocephalus*)

The location of ecosystem-credit species identified in the field is shown in Figure 6.1.

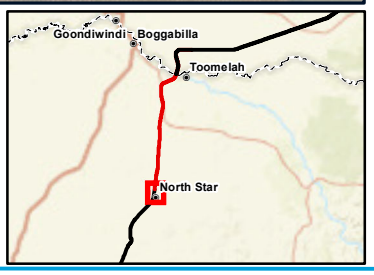
One species listed as an ecosystem-credit species but not predicted to occur was recorded during microbat call recording surveys in 2018 and 2019: Northern free-tailed bat. As a result, this species has been added to the BAM-C within the PCTs and IBRA subregions in which it was located.

[1] The ultrasonic bat call detectors identified one or more *Nyctophilus* species within the subject land (the *Nyctophilus* genus cannot be identified to species level from their calls). Three species potentially occur in the subject land: – *Nyctophilus geoffroyi, Nyctophilus gouldi* and the Vulnerable *Nyctophilus corbeni* which is an ecosystem credit species.



Legend

- Fauna observations
- Localities
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 100 200 300 400 500 m

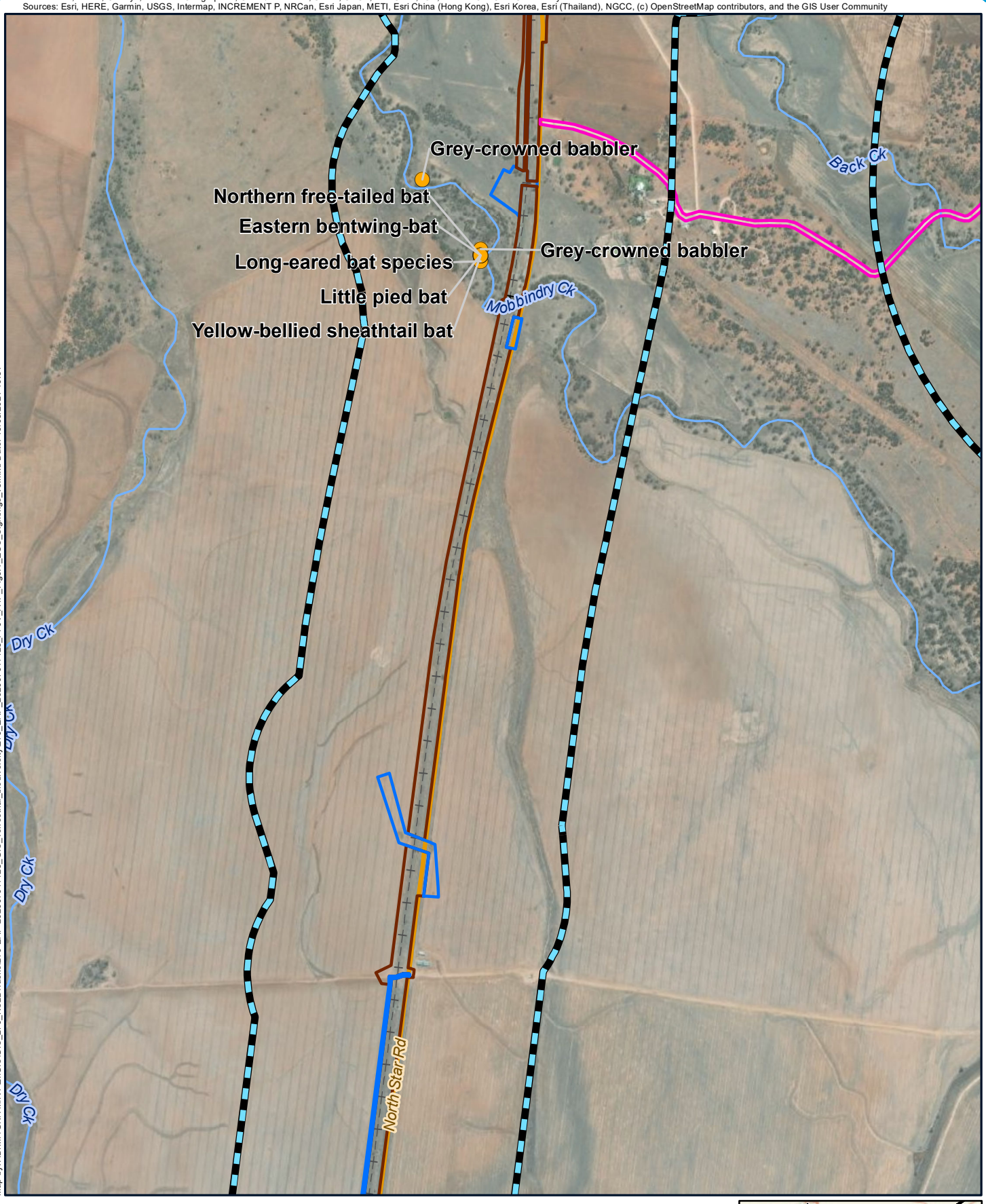
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

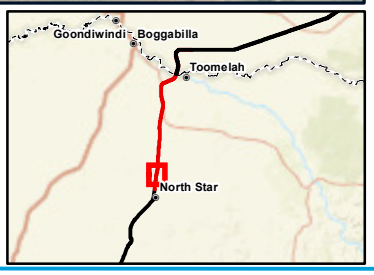
Figure 6.1a: Location of ecosystem-credit species within the study area



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 100 200 300 400 500 m

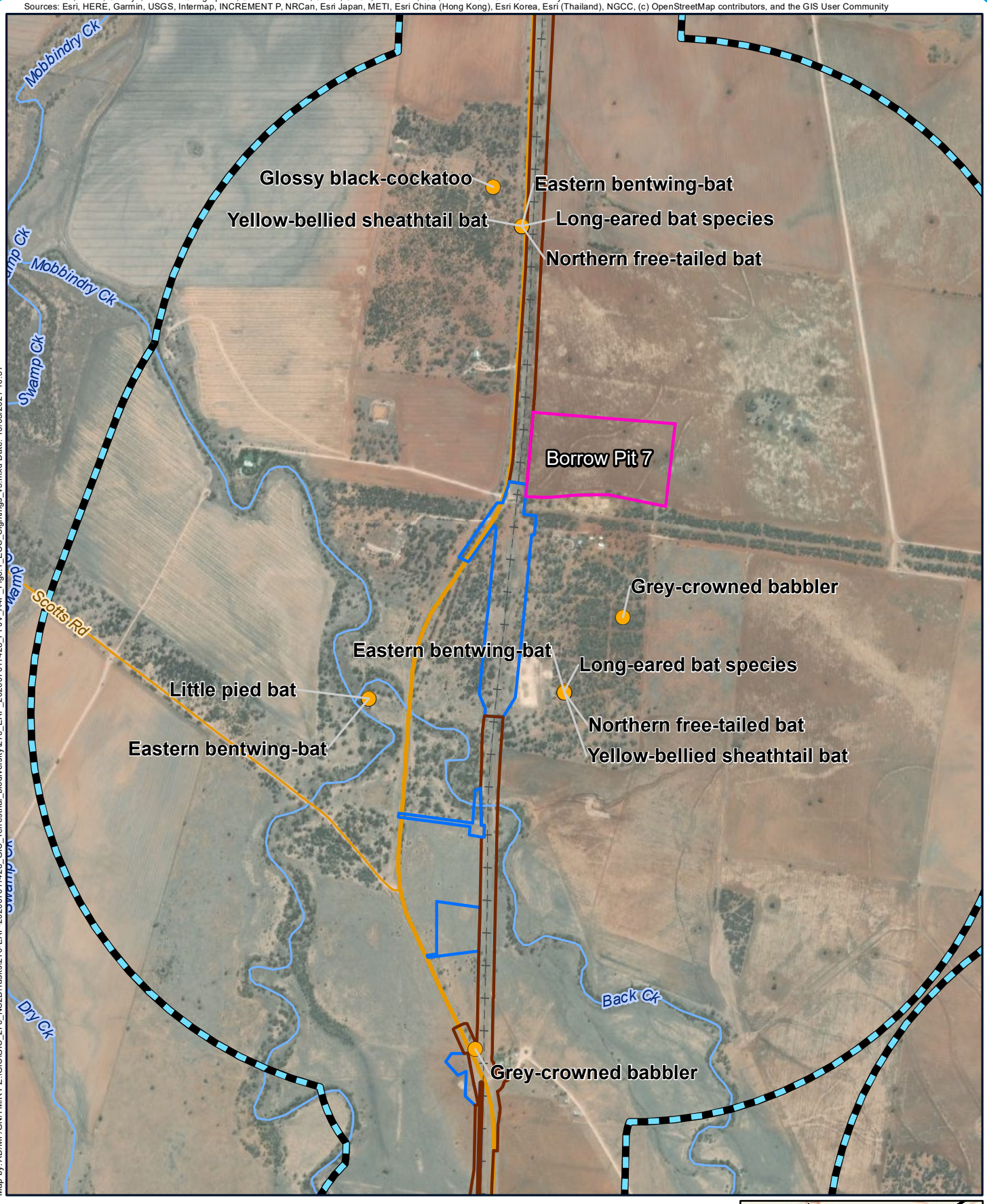
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4

Coordinate System: GDA 1994 MGA Zone 56

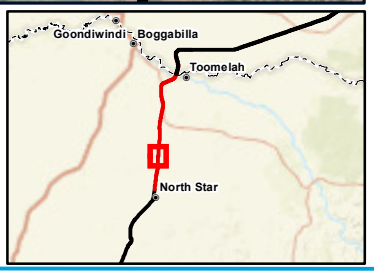
North Star to NSW/QLD border

Figure 6.1b: Location of ecosystem-credit species within the study area



Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 100 200 300 400 500 m

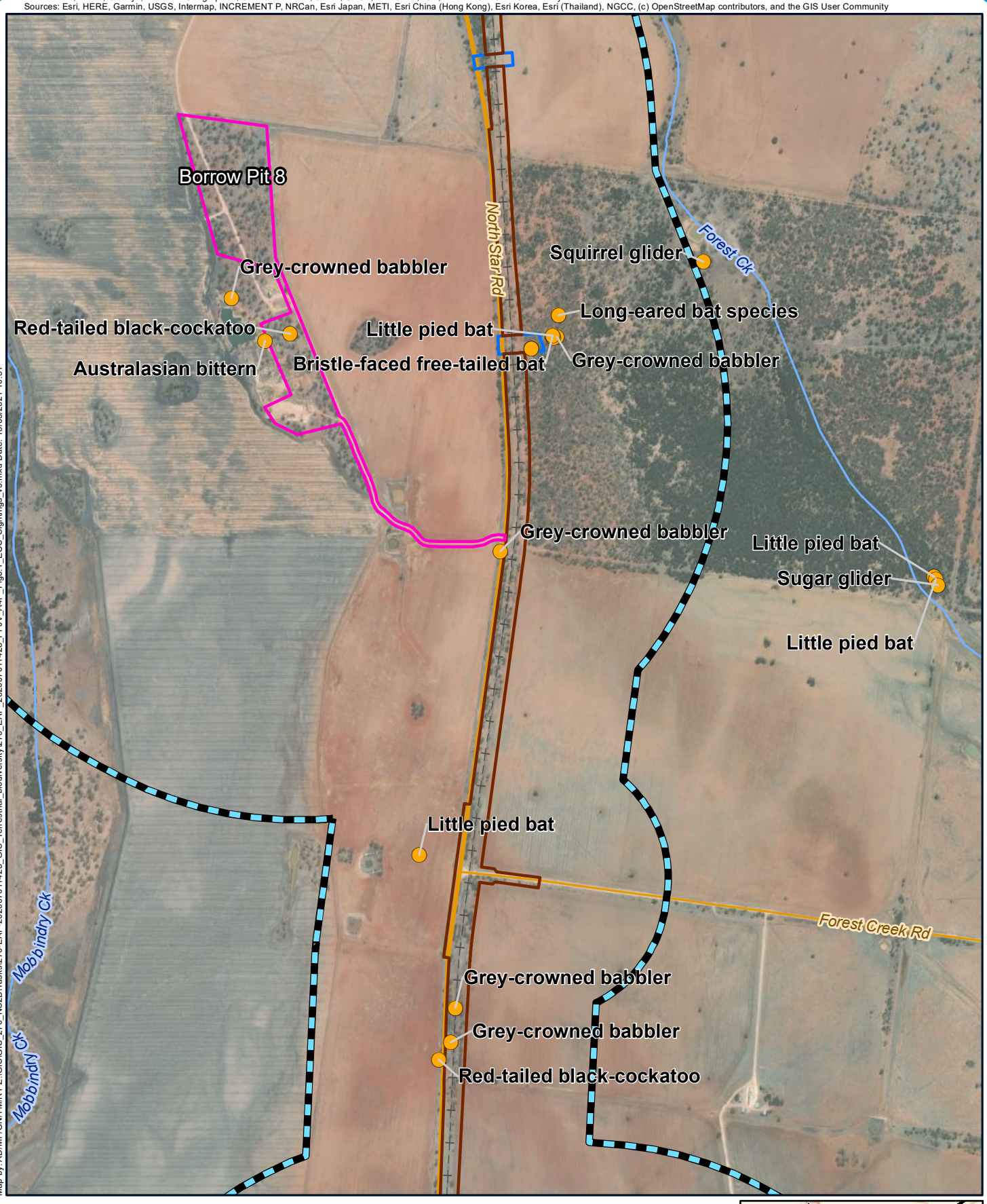
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4

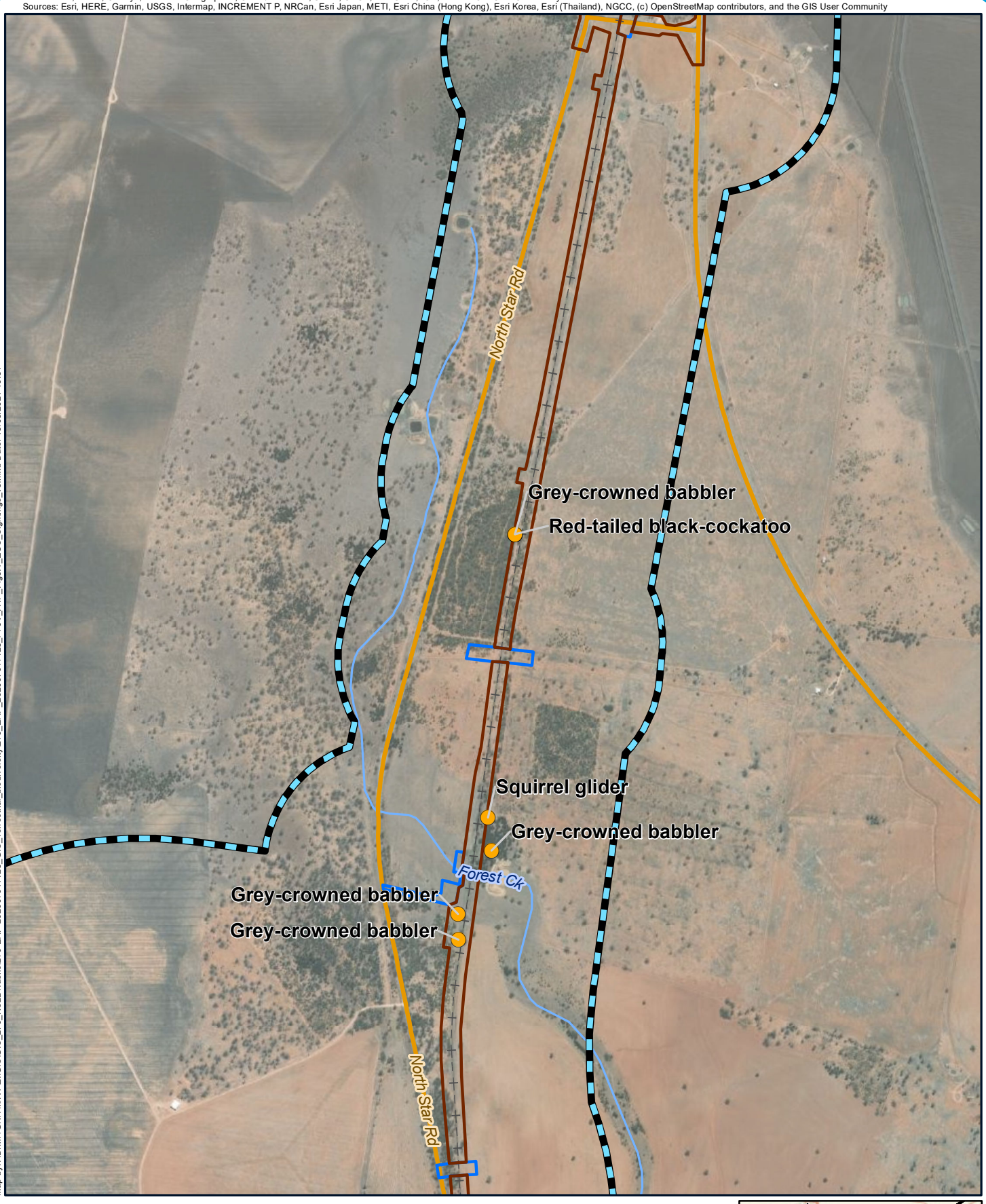
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1c: Location of ecosystem-credit species within the study area


Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Borrow Pit 8
North Star Rd
Forest Ck
Grey-crowned babbler
Squirrel glider
Long-eared bat species
Red-tailed black-cockatoo
Little pied bat
Grey-crowned babbler
Australasian bittern
Bristle-faced free-tailed bat
Grey-crowned babbler
Little pied bat
Sugar glider
Little pied bat
Little pied bat
Forest Creek Rd
Mobbindry Ck
Mobbindry Ck
Grey-crowned babbler
Grey-crowned babbler
Red-tailed black-cockatoo
Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51
Legend
Fauna observations
Existing rail (non-operational)
Major roads
Minor roads
Watercourses
Study area
Subject land (borrow pit)
Subject land (brownfield)
Subject land (early works)
Goondiwindi
Boggabilla
Toomelah
North Star
A4 scale: 1:20,000
0 100 200 300 400 500 m
Future Freight
Integrating Community, Environment and Engineering
Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
North Star to NSW/QLD border
Figure 6.1d: Location of ecosystem-credit species within the study area

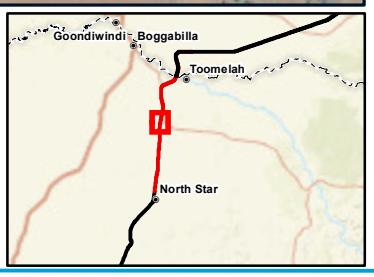
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 100 200 300 400 500 m

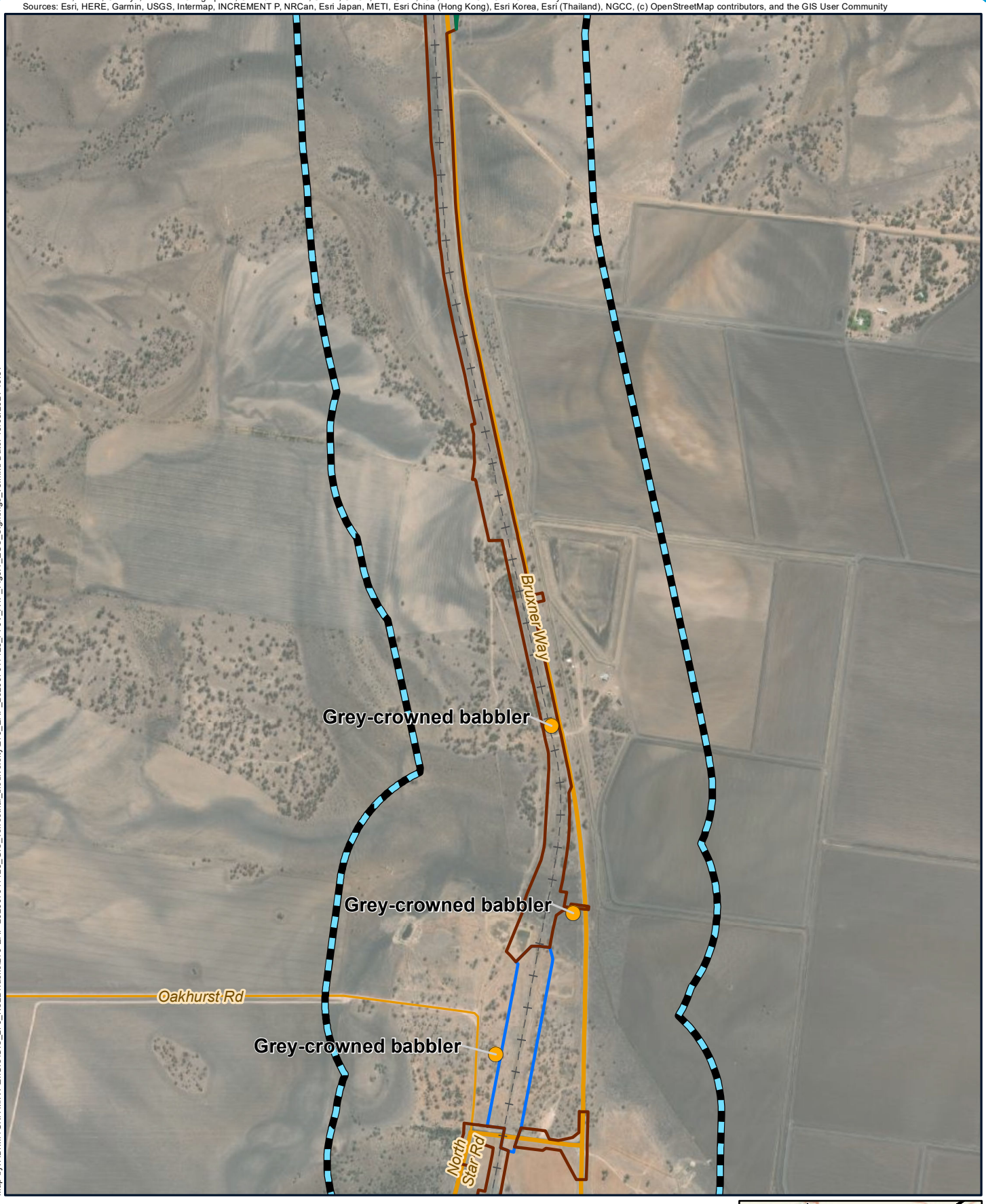
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1e: Location of ecosystem-credit species within the study area

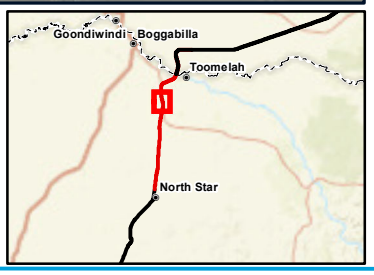
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

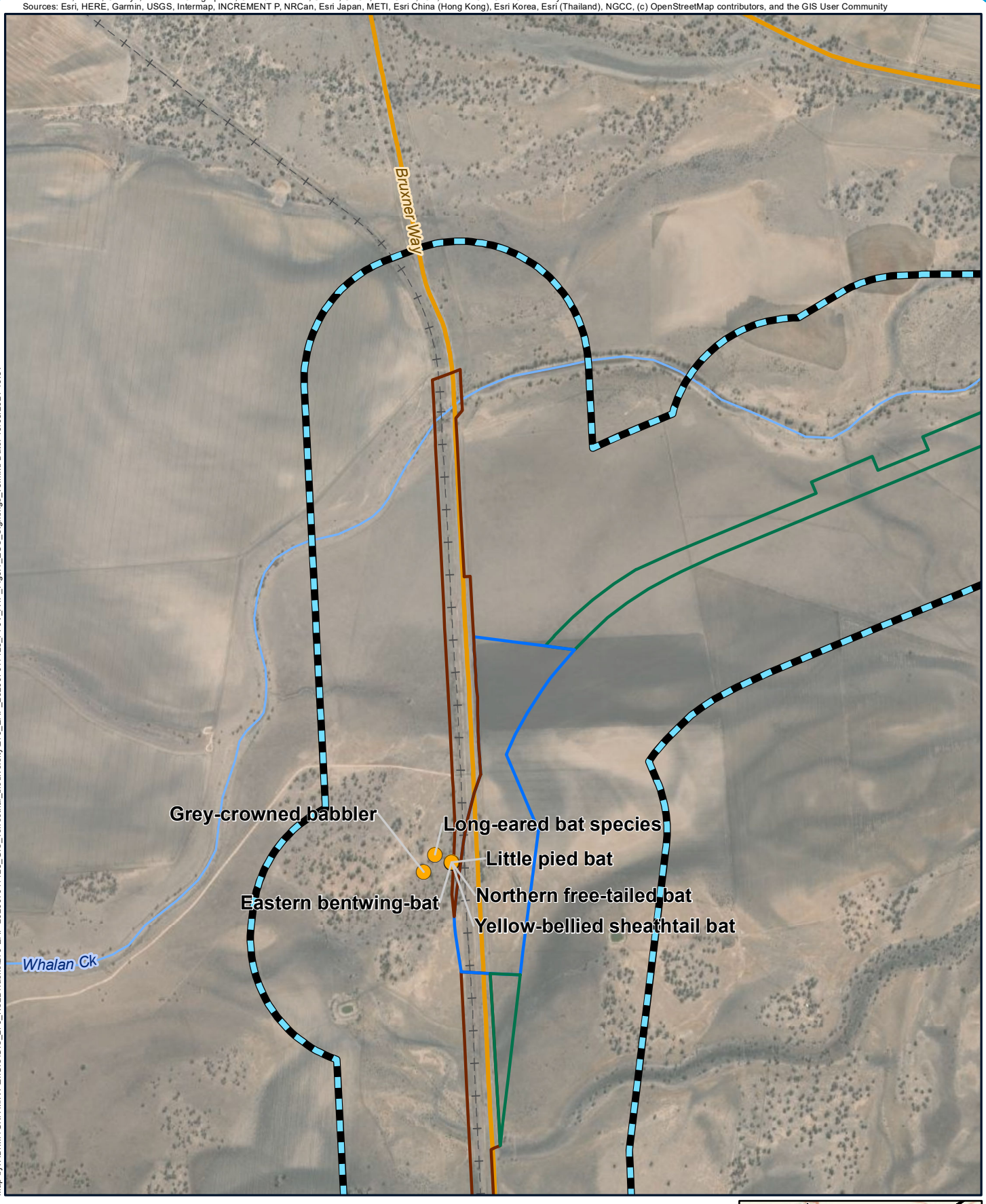
Date: 13/05/2021 Version: 4

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1f: Location of ecosystem-credit species within the study area

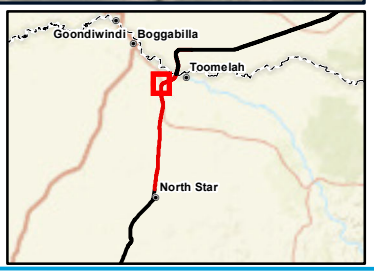
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 100 200 300 400 500 m

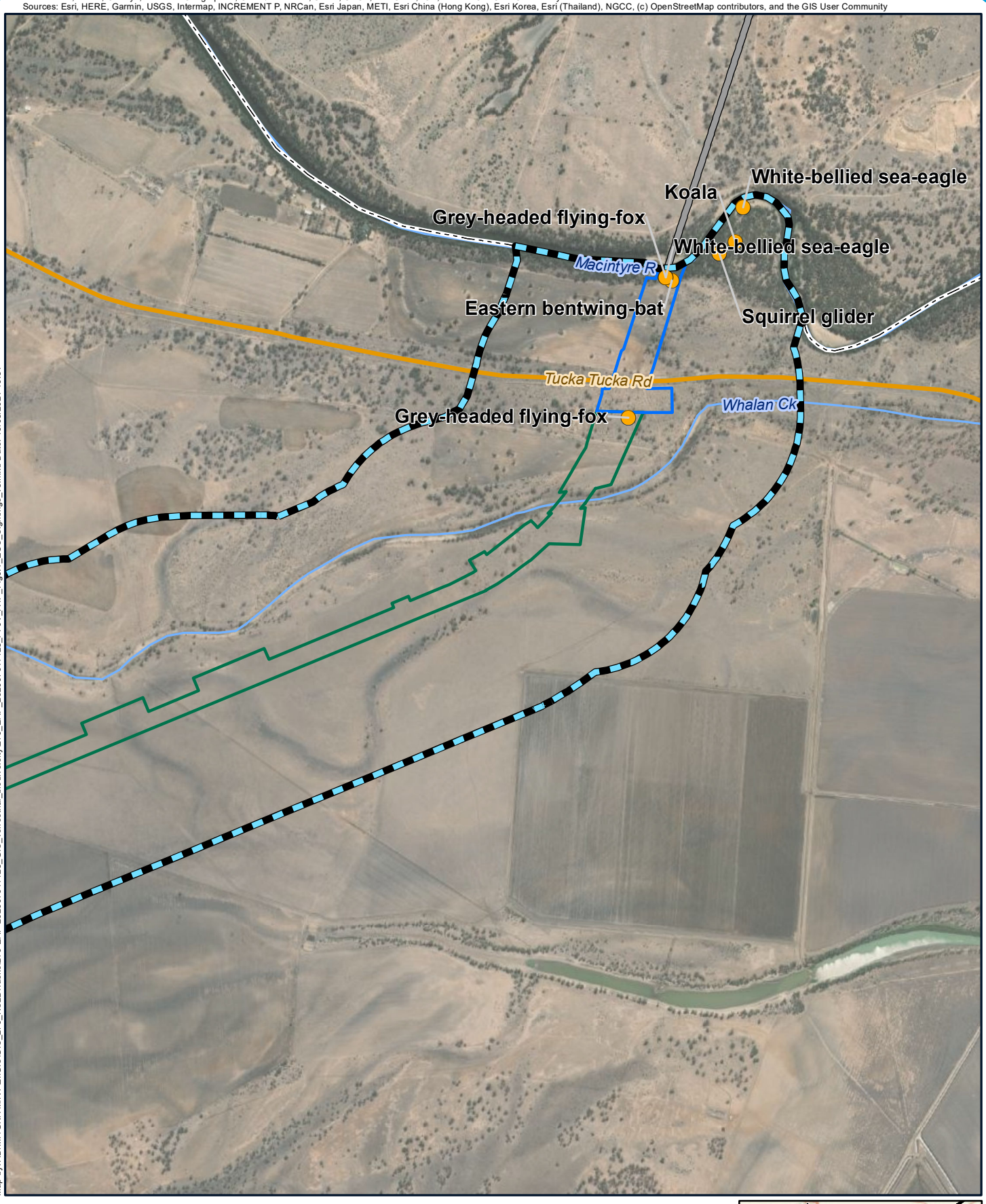
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1g: Location of ecosystem-credit species within the study area

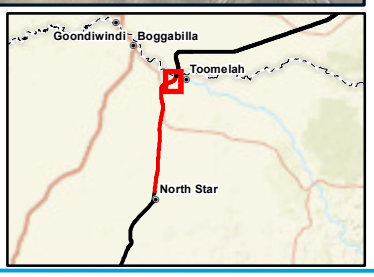
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

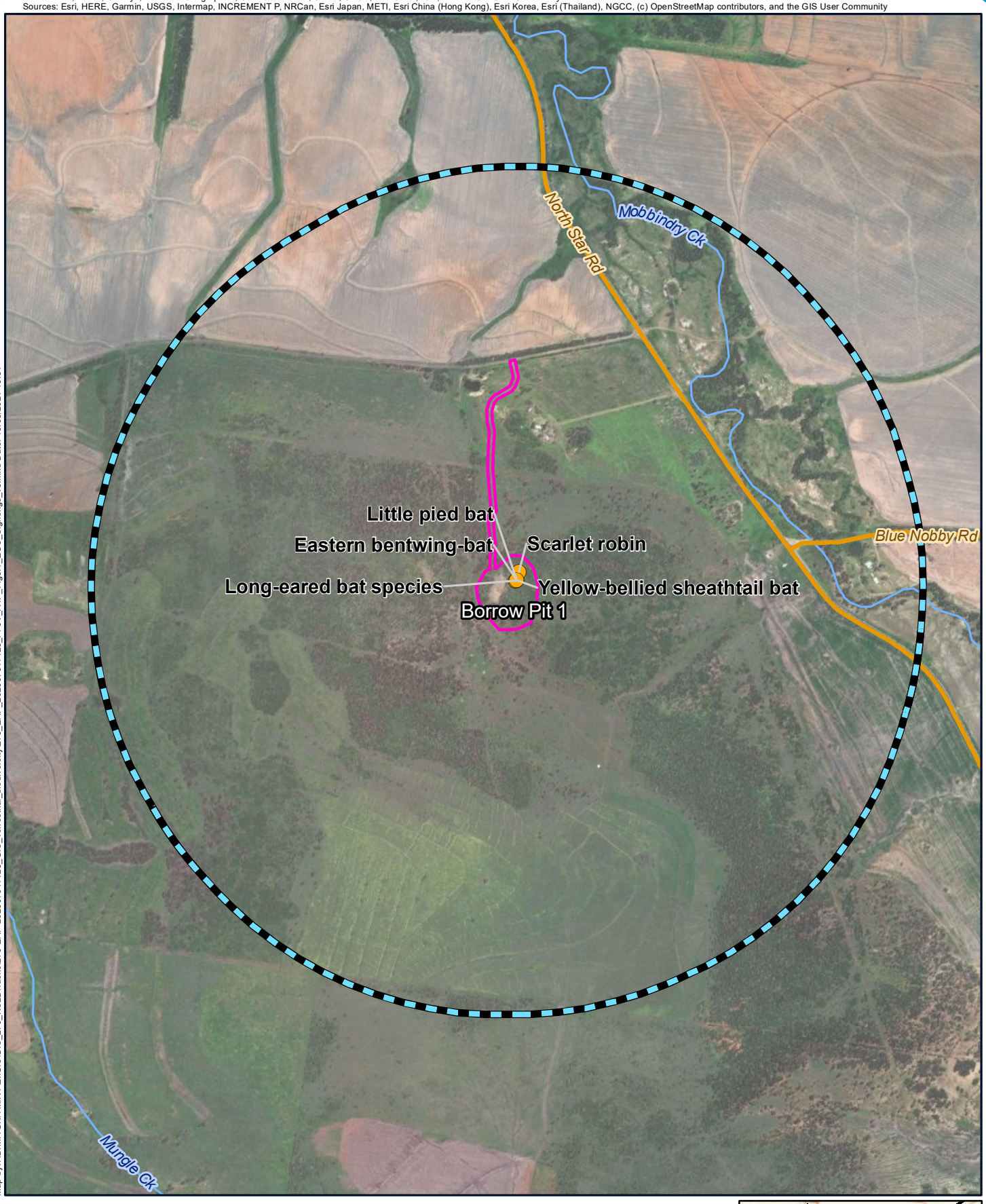
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

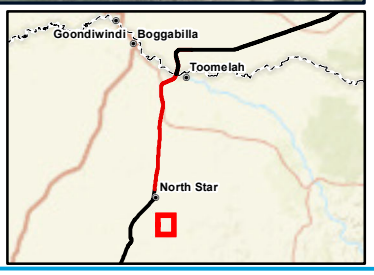
Figure 6.1h: Location of ecosystem-credit species within the study area



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

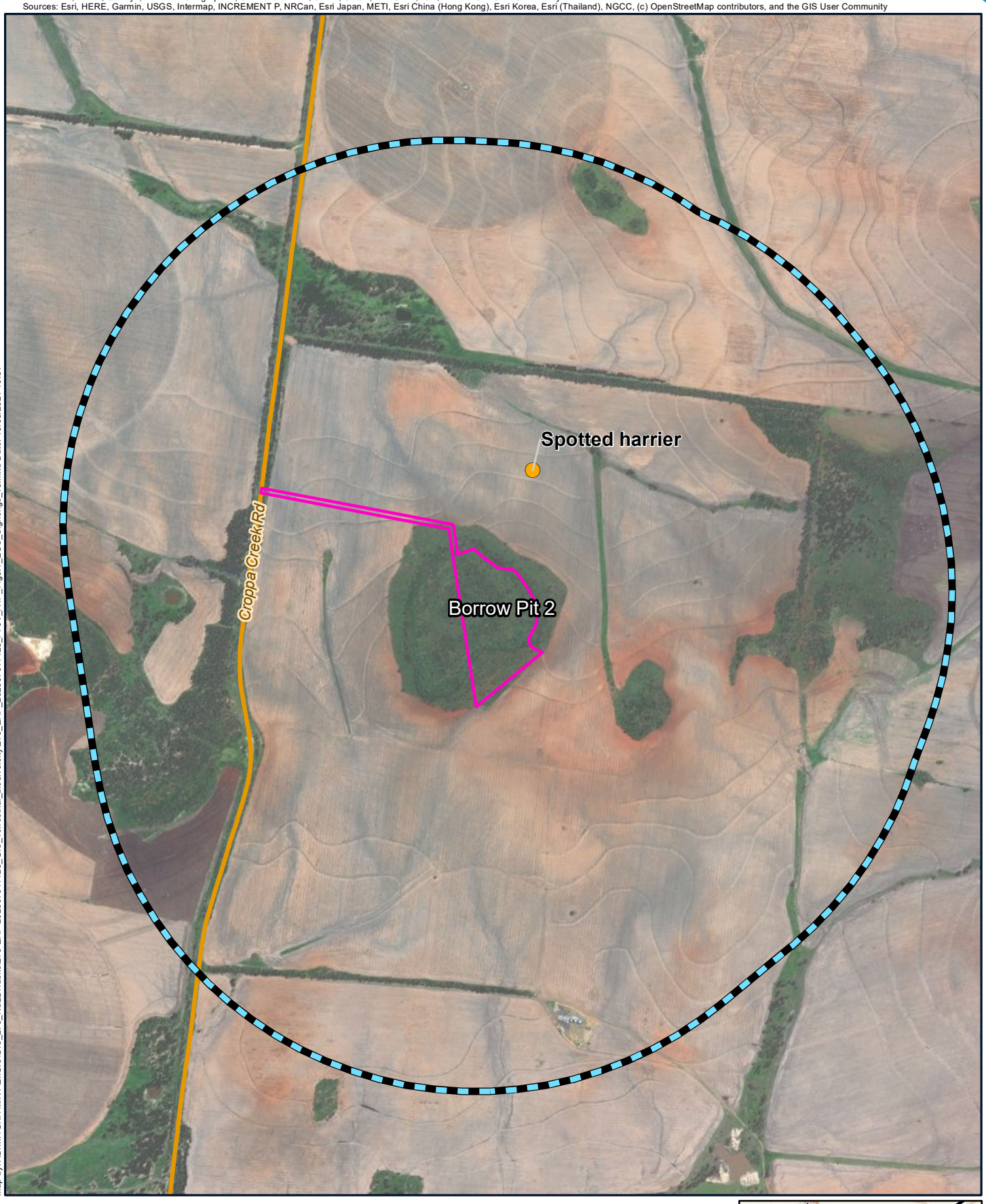
Date: 13/05/2021 Version: 4

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1i: Location of ecosystem-credit species within the study area

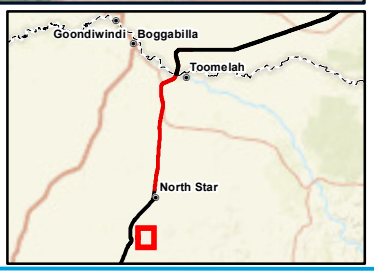
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

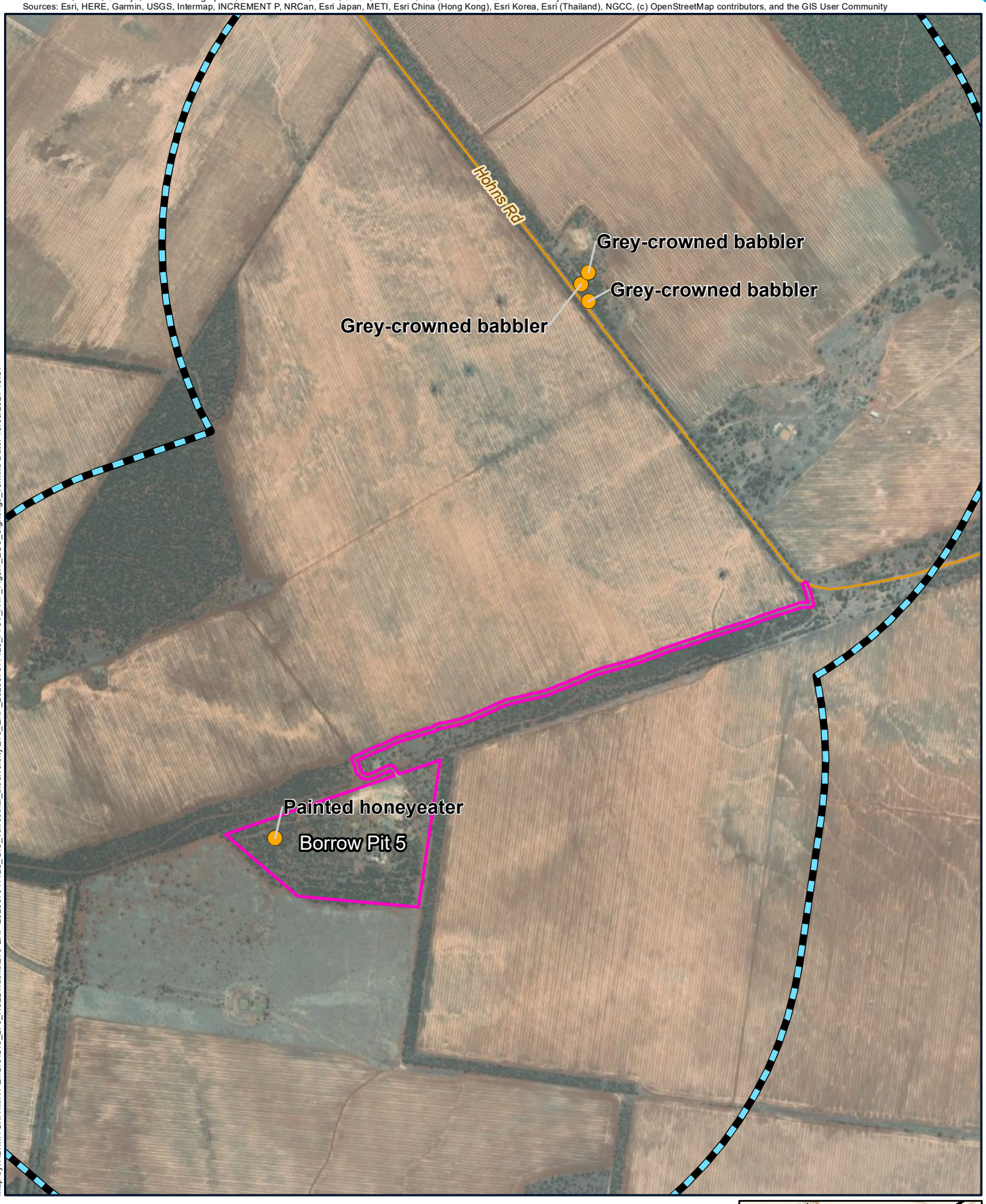
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1j: Location of ecosystem-credit species within the study area



Legend

- Fauna observations
- Minor roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 100 200 300 400 500 m

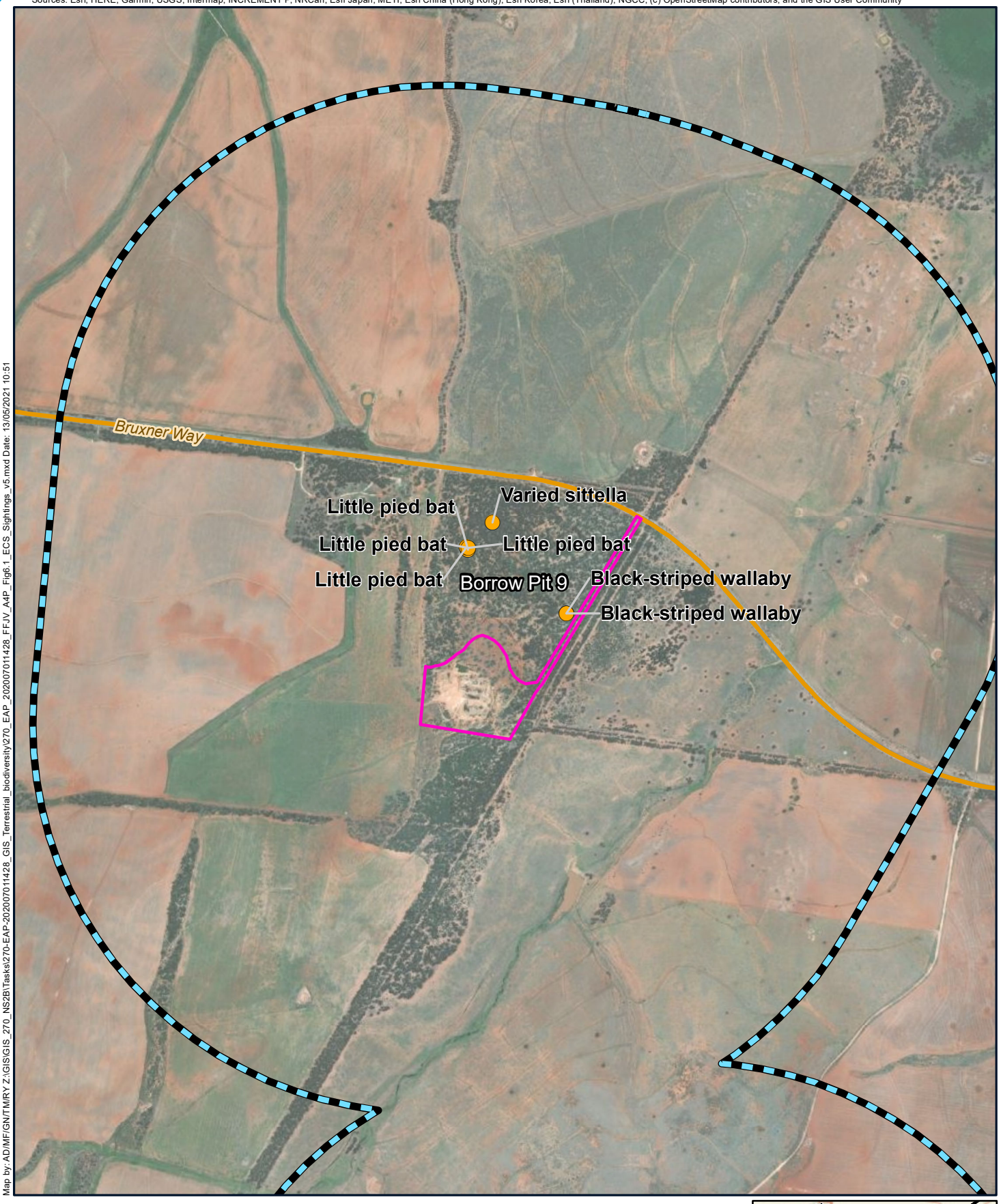
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4

Coordinate System: GDA 1994 MGA Zone 56

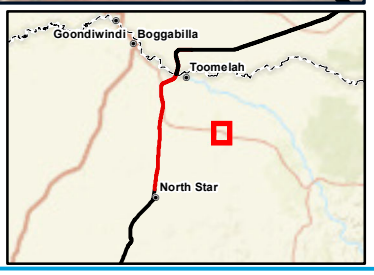
North Star to NSW/QLD border

Figure 6.1k: Location of ecosystem-credit species within the study area



Legend

- Fauna observations
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

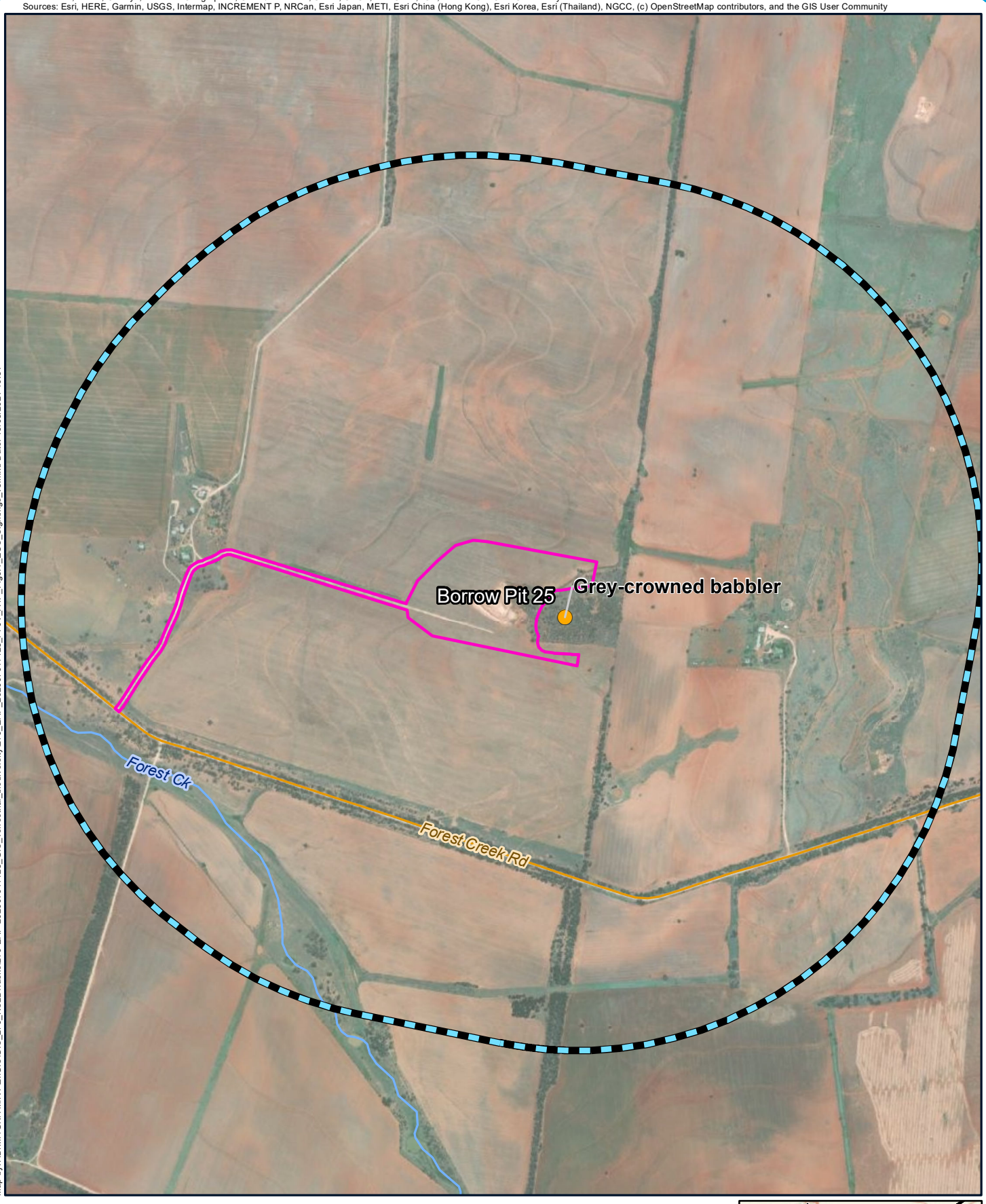
Date: 13/05/2021 Version: 4

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1l: Location of ecosystem-credit species within the study area

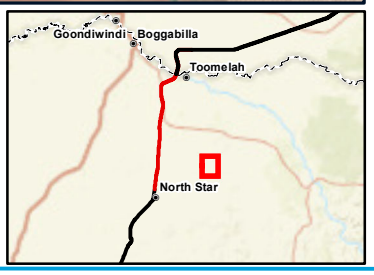
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_A4P_Fig6.1_ECS_Sightings_v5.mxd Date: 13/05/2021 10:51

Legend

- Fauna observations
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.1m: Location of ecosystem-credit species within the study area

6.2 Species – credit species

6.2.1 Threatened species predicted to occur under the BAM

Forty-seven species-credit species are predicted to occur across the subject land as per the BAM C output. Table 6.3 provides a list of species-credit species, including their sensitivity to loss, Biodiversity Risk Rating, and the PCTs in which they are predicted to occur.

Following initial field work in 2018 a revision of habitat feature availability across all PCT zones enabled a refined list of candidate species for targeted surveys to be developed. Since then, a number of the species-credit species predicted within the BAM C have been subject to targeted surveys in October 2019, September 2020 and February/March 2021 (as per the required method and survey effort under the BAM).

Targeted surveys methods are outlined in Section 3.4.8 and 3.5.3 and in Appendices B and D and in detail (method and survey effort) within the species-specific tables located in Appendix G. Table 6.4 outlines those species that have been determined not to be present within the subject land and are therefore not required to be assessed further under the BAM.

6.2.2 Observed species

Five species-credit species were identified within the study area and adjacent areas during the field assessment, including:

- Belson's panic (*Homopholis belsonii*)
- Finger panic grass (*Digitaria porrecta*)
- Squirrel glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*)
- Pale-headed snake (*Hoplocephalus bitorquatus*).

The location of species-credit species observed in the field is shown in Figure 6.2.

A total of four observations of squirrel glider occurred within or directly adjacent to the subject land. One squirrel glider was recorded in 2018 along the Macintyre River in PCT36 in vegetation which is contiguous with the northern section of the subject land. One individual was recorded in 2019 in PCT55 in vegetation which is contiguous with PCT55 within the subject land. Based on these observations the areas of PCT36 and PCT55 within the subject land which are linked to the vegetation where the squirrel gliders were observed have been mapped as habitat.

On two occasions once in 2018 and again in 2021, one Squirrel glider (*Petaurus norfolcensis*) was recorded on the outside edge of the study area in PCT 56, adjoining a patch of PCT244. PCT 244 grades into PCT56 (High) within the study area and subject land. Based on this observation the PCT56 (within the study area) has been added to the species polygon mapping and BAM C workings for this species.

Koala was recorded calling on a single occasion during a spotlighting survey in October 2019 in River Red Gum forest adjoining the Macintyre River, east of the alignment. In February 2021 Koala scats were identified as an incidental observation by FFJV ecologists next to a Poplar box east of the brownfield alignment, within PCT 56. Also in February 2021 two sets of scratches consistent with Koala were observed in PCT 628 – Carbeen +/- Coolabah grassy woodland at the northern end of the brownfield alignment (see detailed maps in Appendix F). In alignment with the precautionary principle the presence of the observed scat and scratches indicates the presence of Koala and Koala habitat at both sites. It is noted that in 2018 large scats located within PCT 628 were sent for analysis and were found to be that of Brush-tailed possum (*Trichosurus vulpecula*). No other records or signs of presence of the Koala were recorded within the study area.

A total of three Pale-headed snake were observed during March 2021 surveys, all occurring within 50 m the subject land. Two species were observed at Mobbindry Creek (occurring 5 to 35 m outside the subject area), both within the flaking bark of two separate *Eucalyptus camaldulensis* trees (refer Photograph 6.1). One Pale-headed snake was observed at road reserve adjacent to Tucka Tucka Rd on the tessellated bark of a *Corymbia tessellaris* (occurring 10 m outside the subject area) (refer Photograph 6.2). All trees in which the snakes were observed were large trees (>80 cm dbh) and supported hollows. It is likely that the habitat surrounding the location of all sightings within the subject area can support the PHS and is considered as habitat. One section of Back Creek south of Borrow pit 7 was not accessed due to wet conditions but contained highly suitable habitat and is mapped as habitat. Other areas which were not able to be accessed but also provided suitable habitat features such as PCT 244 are mapped as species habitat in line with the BAM and the precautionary principle.



Photograph 6.1 Pale-headed Snake in typical microhabitat (flaking bark against trunk)



Photograph 6.2 Pale-headed snake close up within tessellating bark

It is noted a number of other species-credit species were observed during field surveys such as:

- White-bellied sea-eagle (*Haliaeetus leucogaster*)
- Red-tailed black-cockatoo (*Calyptorhynchus banksii samueli*)
- Grey-headed flying fox (*Pteropus poliocephalus*)
- Large bent-winged bat (*Miniopterus orianae oceanensis)*.

However, only ‘breeding’ evidence is considered to represent these species under the BAM with regard to species-credit species. Targeted surveys for these species during the breeding season did not record any breeding pairs within the alignment as such the species has been excluded as a species credit species but remains an ecosystem credit species as per the BAM.

Additionally, two individuals of the Glossy black-cockatoo (*Calyptorhynchus lathami*) were observed during October 2019 spring surveys, although these were not identified as a breeding pair at the time. However, as targeted breeding surveys have not occurred for the species, breeding presence is assumed in all areas which contain potential breeding habitat (i.e. living or dead trees with hollows >15 cm and >5 m above ground). As such, this species is included as a species credit species as per the BAM.

6.2.3 Candidate threatened species (species credit entries)

Following the targeted fauna surveys five species-credit species are recorded as present within the study area and proposal footprint.

Within the results of the BAM C predictive list, an assessment was made on the likelihood of species credit species occurring based upon whether or not critical habitat features are present within the PCT zone (refer Appendix G). For example, where a species required trees and the PCT condition was Low (no mature trees), the species is considered absent within that vegetation zone (e.g. Koala). However, if the species requires trees but also forages in open areas, presence is assumed in associated PCTs in Low condition.

Detailed individual flora and fauna species information is compiled in Appendix G and includes data derived from the NSW Threatened Biodiversity Profile Data Collection and other relevant sources, database records of the species occurrence, site observations (habitat suitability and species presence), survey effort and justification for exclusion of species or species habitat from further assessment under the BAM.

A list of the candidate threatened species and proposed habitat exclusions for species credit entries is provided in Table 6.3 and Table 6.4 with greater detail provided in Appendix G.

Table 6.3 Species-credit species predicted to occur by BAM C within the subject land

Species name	Scientific name	EPBC Act	BC Act	Sensitivity to loss	Biodiversity risk rating	PCTs within the subject land in which the species is predicted to occur		
						Brigalow Belt South IBRA Northern Basalts PCTs (Habitat)	Brigalow Belt South IBRA Northern Outwash PCTs (Habitat)	Darling Riverine Plains IBRA Castlereagh-Barwon PCTs (Habitat)
Flora								
Belson's panic	*Homopholis belsonii*	V	E1,P	High	1	35,55,56,98,147,244	27, 35,56	52,56,244
Bluegrass	*Dichanthium setosum*	V	V,P	Moderate	2	35,55,56,418	27, 35,56,418	52,628
Braid fern	*Platyzoma microphyllum*	-	E1,P,3	Very high	2	53	-	247
Creeping tick-trefoil	*Desmodium campylocaulon*	-	E1,P	High	2	35	27, 35	52
Cyperus conicus	*Cyperus conicus*	-	E1,P	High	2	55,56,	56	56,628
Finger panic grass	*Digitaria porrecta*	-	E1,P	High	2	35,55,56,244,	27, 35,56,	52,56,244,628
Native milkwort	*Polygala linariifolia*	-	E,P	High	2	418	418	192
N/A	*Phyllanthus maderaspatensis*	-	E1,P	High	2	-	-	36,247
Pine donkey orchid	*Diuris tricolor*	-	V,P,2	Moderate	1.5	56	-	-
Scant pomaderris	*Pomaderris queenslandica*	-	E		2	418	-	-
Shrub sida	*Sida rohlenae*	-	E1,P	High	2	-	-	56,244,628
Silky swainson-pea	*Swainsona sericea*	-	V,P	Moderate	2	56,98,244,418	-	-
Slender darling pea	*Swainsona murrayana*	V	V,P	Moderate	1.5	35,55,56,244	27, 35,56,	52,56,244,247,628
Spiny peppercress	*Lepidium aschersonii*	V	V,P	High	2	35,53,55,56	35,56	-
Slender tylophora	*Tylophora linearis*	E	V		2	418	418	
Winged peppercress	*Lepidium monoplocoides*	E	E1,P	High	2	-	-	52,56,244,247, 628
Yetman wattle	*Acacia jucunda*	-	E1,P	Very high	2	35,55	-	-
Fauna								
Australian bustard	*Ardeotis australis*	-	E1,P	High	2	35,53,55,56,244	27, 35,56	52,56,192,244, 247,628

Species name	Scientific name	EPBC Act	BC Act	Sensitivity to loss	Biodiversity risk rating	PCTs within the subject land in which the species is predicted to occur		
						Brigalow Belt South IBRA Northern Basalts PCTs (Habitat)	Brigalow Belt South IBRA Northern Outwash PCTs (Habitat)	Darling Riverine Plains IBRA Castlereagh-Barwon PCTs (Habitat)
Barking owl (Breeding)	*Ninox connivens*	-	V,P	Moderate	2	35,53,55,56,98,244,418	35,36,56,418	36, 56,192,244, 247, ,628
Black-breasted buzzard (Breeding)	*Hamirostra melanosternon*	-	V,P,3	Moderate	1.5	36,55,56,98	-	36,56,247
Black-tailed godwit	*Limosa limosa*	M	V,P	Moderate	2	53	-	-
Border thick-tailed gecko	*Uvidicolus sphyrurus*	E	V		2	418	-	-
Bristle-faced free-tailed bat, Hairy-nosed freetail Bat	*Setirostris eleryi*	-	E, P	High	2	35,55,56,98,244,418	35,56,418	36,56,192,244, 628
Bush stone-curlew	*Burhinus grallarius*	-	E1,P	High	2	35,36,56,98,244	27, 35,36,56	36,52,192,244, 628
Cotton pygmy-Goose	*Nettapus coromandelianus*	-	E1,P	High	2	53	-	-
Large bentwing-bat (Breeding)	*Miniopterus orianae oceanensis*	-	V,P	Moderate	3	55,56,147,244,418	-	-
Eastern cave bat	*Vespadelus troughtoni*	-	V,P	Moderate	3	56,147,418	-	-
Eastern pygmy-possum	*Cercartetus nanus*	-	V,P	Moderate		244, 418	-	-
Glossy black-cockatoo (Breeding)	*Calyptorhynchus lathami*	-	E2,V,P, 2	Moderate	2	36,55,56,244,418	36,56,418	36,56,192,244,247,628
Grey-headed flying-fox (Breeding)	*Pteropus poliocephalus*	V	V,P	Moderate	2	35,55,56,147,244,418	35,56,418	-
Koala (Breeding)	*Phascolarctos cinereus*	V	E2,V,P	Moderate	2	35,55,56,98,244,418	35,36,56,418	36,56,192,244, 628
Large-eared pied bat	*Chalinolobus dwyeri*	V	V	Moderate	3	147, 418	-	-
Little eagle (Breeding)	*Hieraaetus morphnoides*	-	V,P	Moderate	1.5	27,35,53,55,56,98,147 ,244,418	35,36,56,418	36,52,56,192, 244,247,628
Major Mitchell's cockatoo (Breeding)	*Lophochroa leadbeateri*	-	V,P,2	Moderate	2	-	-	36,52,56,192,244, 628

Species name	Scientific name	EPBC Act	BC Act	Sensitivity to loss	Biodiversity risk rating	PCTs within the subject land in which the species is predicted to occur		
						Brigalow Belt South IBRA Northern Basalts PCTs (Habitat)	Brigalow Belt South IBRA Northern Outwash PCTs (Habitat)	Darling Riverine Plains IBRA Castlereagh-Barwon PCTs (Habitat)
Masked owl (Breeding)	*Tyto novaehollandiae*	-	V,P,3	Moderate	2	35,36,56,55,98,147,244,418	-	36,52,56,192,244, 247
Pale imperial hairstreak	*Jalmenus eubulus*	-	E4A,2	Very high	3	35	35	35
Pale-headed snake	*Hoplocephalus bitorquatus*	-	V,P	Moderate	2	53,56,244,418	27,36,56,418	36,52,56,192, 244, 247
Red-tailed black-cockatoo (inland subspecies) (Breeding)	*Calyptorhynchus banksii samueli*	-	V,P,2	Moderate	2	-	-	36,52,56,192,244, 247,628
Rufous bettong	*Aepyprymnus rufescens*	-	V,P	Moderate	2	35, 418	-	-
Sloane's froglet	*Crinia sloanei*	-	V,P	Moderate	1.5	-	-	56, 628
Square-tailed Kite (Breeding)	*Lophoictinia isura*	-	V,P,3	Moderate	1.5	35,36,55,56,98,244,418	27,35,36,56,418	36,56,192,244, 247,418,628
Squatter pigeon (southern)	*Geophaps scripta scripta*	V	E4A,P	Very high	3	36,53,56,98,244,418	-	36,52,56,192,244, 247,628
Superb parrot (Breeding)	*Polytelis swainsonii*	V	V,P,3	Moderate	2	-	-	36,52,56,244
Squirrel glider	*Petaurus norfolcensis*	-	V	Moderate	2	36,418	-	-
Swift parrot (Breeding)	*Lathamus discolor*	CE	E	High	3	418		
White-bellied sea-eagle (Breeding)	*Haliaeetus leucogaster*	C, Ma	V,P	Moderate	2	-	27,35,36,56, 98, 244, 418	36,56,244,247,628
Zigzag velvet gecko	*Amalosia rhombifer*		E	High	2	418	-	-

Table 6.4 Species credit species PCT exclusions following targeted survey

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Flora					
Bluegrass	*Dichanthium setosum*	27, 35,55,56,418,628 Areas of 52	Habitat Constraint N/A	Generally wide environmental tolerances including woodlands, grassy roadsides and pastureland. May be promoted by disturbance	Not found during targeted survey effort within defined survey period. Presence is assumed in relevant PCTs in parts of the alignment not accessible for survey. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Braid fern	*Platyzoma microphyllum*	53,247	Habitat Constraint N/A	Sandy or swampy soils, or in clay soils adjacent to water where it is subject to periodic flooding	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Creeping tick-trefoil	*Desmodium campylocaulon*	27,35 Areas of 52	Habitat Constraint N/A	Nil	Not found during targeted survey effort within defined survey period. Presence is assumed in relevant PCTs in parts of the alignment not accessible for survey. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Cyperus conicus	*Cyperus conicus*	55,56, 628	Habitat Constraint N/A	Associated with vegetation communities including Melaleuca swamps, open Box woodland and sedgelands. Habitat features include floodplains, creed beds and banks, swamps, run-on areas and various watercourses along with bores and dams (OEH 2019).	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Native milkwort	*Polygala linariifolia*	192, 418	Habitat Constraint N/A	Grows sandy soils in dry eucalypt forest and woodland with a sparse understorey. Recorded growing in dark sandy loam on granite at Inverell and Torrington districts in shrubby forests of *Eucalyptus caleyi, E.dealbata* and Callitris, along with yellow podsolic soil on granite in layered open forest (OEH 2019).	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review. Assumed presence in Borrow Pit 5 due to survey exclusion.

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
N/A	*Phyllanthus maderaspatensis*	36,247	Habitat Constraint – Other (Floodplains and/or clay soils)	Occurs in floodplain areas on heavy soils. It is often associated with open grasslands and eucalypt woodlands in or near creek beds, and grassy flats and levees near watercourses (OEH 2017).	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Pine donkey orchid	*Diuris tricolor*	56	Habitat Constraint N/A	Found in sandy soils, either on flats or small rises within *Callitris glaucophylla*, *Eucalyptus populnea*, *E. intertexta* woodland and Ironbark and Acacia shrubland. Herbaceous plants such as Bulbine species often occupy the grassy understorey (OEH 2018)	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Scant pomaderris	*Pomaderris queenslandica*	418	Habitat Constraint N/A	Mostly found in moist eucalypt forest or sheltered woodlands with a shrubby understory, and occasionally along creeks (OEH 2019).	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Shrub sida	*Sida rohlenae*	56, 98, 244, 628	Habitat Constraint N/A	Grows on flood-out areas, creek banks and at the base of rocky hills. In NSW it is recorded from roadsides in hard red loam to sandy-loam soils and is often more common in disturbed sites (OEH 2020).	Not found during targeted survey effort within defined survey period. Samples of sida were sent to the herbarium for identification and were returned as other sida species. Details on the survey effort is located in Section 3.4 and Appendix B and G.
Silky swainson-pea	*Swainsona sericea*	27, 56, 98, 244, 418	Habitat Constraint N/A	Sometimes found in association with cypress-pines Callitris spp.	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Slender darling pea	*Swainsona murrayana*	27,35, ,55,56, 244,247,628 Areas of 52	Habitat Constraint N/A	Found growing in clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a range of vegetation communities including Bladder saltbush, Black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Also found in remnant native grasslands or grassy woodlands that has been intermittently grazed or cultivated (OEH 2017).	Not found during targeted survey effort within defined survey period in the areas accessible for survey. PCT 52 and PCT 244 within the Greenfield segment was not able to be accessed during the survey period therefore presence is assumed in these PCTs at these locations. Details on the survey effort is located in Section 3.4 and Appendix B and G. Copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Spiny peppercress	*Lepidium aschersonii*	35,53,55,56	Habitat Constraint N/A	Found on ridges of gilgai clays dominated by Brigalow, Belah, Buloke and Grey box. Often the understorey is dominated by introduced plants. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter (OEH 2018).	Not found during targeted survey effort within defined survey period and outside of known or expected range. Details on the survey effort is located in Section 3.4 and Appendix B and G.
Slender tylophora	*Tylophora linearis*	418	Habitat Constraint N/A	Grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata, Eucalyptus fibrosa, E.sideroxylon, Eucalyptus albens, Callitris endlicheri, C. glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, A. lineata, Myoporum* spp., and *Casuarina* spp. (OEH 2020)	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.4 and Appendix B and G. copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.
Winged peppercress	*Lepidium monoplocoides*	56, 244, 247, 628 Areas of 52	Habitat Constraint N/A	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Recorded from open woodland dominated by *Allocasuarina luehmannii* (Bulloak) and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. Also recorded in a wetland-grassland community comprising *Eragrostis australasicus*, *Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma* and *Pycnosorus globosus,* on waterlogged grey-brown clay. Also recorded from a *Maireana pyramidata* shrubland (OEH 2019).	Not found during targeted survey effort within defined survey period. Presence is assumed in relevant PCTs in parts of the alignment not accessible for survey. Details on the survey effort is located in Section 3.4 and Appendix B and G. copies of the GPS tracking of the survey team will be forwarded to the BCSD for review.

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Yetman Wattle	*Acacia jucunda*	All areas - 35, 55	Habitat Constraint-Other (Sandstone substrate) Outside of known range.	Mainly restricted to dry eucalypt woodland communities on sandy to sandy-loam soils. Associated species at NSW sites include *Acacia polybotrya* and *Callitris endlicheri*. (OEH 2021)	Not found during targeted survey effort and outside of known or expected range." A*cacia jucunda,* is essentially restricted to Dthinna Dthinnawan National Park.". Email from Officer in charge of species is located in Appendix A.
Fauna					
Australian bustard	*Ardeotis australis*	All areas - 27, 35, 53, 55, 56 ,244, 247, 628 Areas of 52	Habitat Constraint N/A	Tussock and hummock grasslands with a preference to tussock grasses. They are also associated with low shrublands or low open grassy woodlands	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Black-breasted buzzard (Breeding)	*Hamirostra melanosternon*	All areas - 36, 55, 56, 98, 247	Habitat Constraint – Other (Land within 40 m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts)	Prefers timbered watercourses as breeding habitat, and grasslands and sparsely timbered savanna for hunting. The species tends to choose nest sites in the tallest tree available (Menkhorst et al 2017; OEH 2017).	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Barking owl (Breeding)	*Ninox connivens*	All areas – 27,35, 36, 53, 55, 56, 98, 192, 244, 247, 418, 628	Habitat Constraint – Hollow bearing trees (Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground)	Preferred breeding sites occur in or near riparian or gully areas in tall trees (often in red gum species in riparian habitats) with large hollows (>20 cm entrance size) and 4 m above the ground (OEH 2021).	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Black-tailed godwit	*Limosa limosa*	All areas - 53	Habitat Constraint – Other (Areas mapped as an important area, as per OEH mapping)	Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed (OEH 2019).	Habitat constraints following targeted habitat assessment. Details on the survey effort is located in Section 3.5 and Appendix D and G. The subject land is outside of the mapped important areas for the species.
Border thick-tailed gecko	*Uvidicolus sphyrurus*	All areas of PCT 418	Habitat Constraint – N/A	Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy (often featuring cypress pine) that helps create a sparse understorey (DAWE 2021, OEH 2019)	Multiple targeted surveys within the subject land did not record the species. Details on the survey effort is located in Section 3.5 and Appendix D and G.

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Bristle-faced free-tailed bat, Hairy-nosed freetail Bat	*Setirostris eleryi*	All areas of PCT 35, 36, 55, 56, 98, 192, 244, 418, 628	Habitat Constraint – Other (Land within 500 m of watercourses or dams surrounded by eucalypts containing hollows)	OEH (2019) identifies habitat requirements are not well established but limited evidence suggests it depends on hollows and tree fissures for roosting (species from the same family generally roost in tree hollows and fissures) It is thought to prefer riverine habitats and drainage lines and has been recorded on the Macintyre River floodplain upstream of the proposal (from Kwiambal National Park) (Davids 2012).	Not found during targeted survey of 64 trap nights at four locations within the subject land. Details on the survey effort is located in Section 3.5 and Appendix D and G
Bush stone-curlew	*Burhinus grallarius*	All areas - 27, 35, 36, 52, 56, 98, 192, 244, 628	Habitat Constraint – N/A and Fallen/standing dead timber including logs	A wide range of vegetation communities, typically with an open structure, sparse ground layer and abundant woody debris (OEH 2017)	Not found during targeted survey effort within defined survey period. Details on the survey effort is located in Section 3.5.3 and Appendix D and G.
Cotton pygmy-goose	*Nettapus coromandelianus*	All 53	Habitat Constraint – N/A and Waterbodies (Deep permanent fresh waters on floodplains with floating and submergent vegetation)	Freshwater lakes, lagoons, swamps and dams that are vegetated with waterlilies and other aquatic plants. Preferred wetlands are typically deep and include large freshwater lakes and the edges of quiet creeks and rivers, always with waterlilies. Shallow wetlands are not used (OEH 2018)	Habitat constraints are not present following targeted habitat assessment. Nominated PCT is highly ephemeral and shallow as occurs in study area. Species not recorded during targeted surveys or any other site surveys. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Eastern bent-wing bat/ Large bent-winged bat (breeding)	*Miniopterus schreibersii oceanensis/ Miniopterus orianae oceanensis*	All areas - 55, 56, 147, 244, 418	Habitat Constraint – Caves (Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding)	Caves are their primary choice for roosting habitat but they will also utilise man-made structures that include disused mines, storm-water drainage pipes and buildings (OEH 2019).	Habitat constraints are not present in PCT 55, 56, 147 or 244, or within 2km of study area following targeted habitat assessment. No breeding habitat present. Multiple rounds of Anabat survey have been conducted since 2018 without detection. Details on the survey effort is located in Section 3.5 and Appendix D and G.

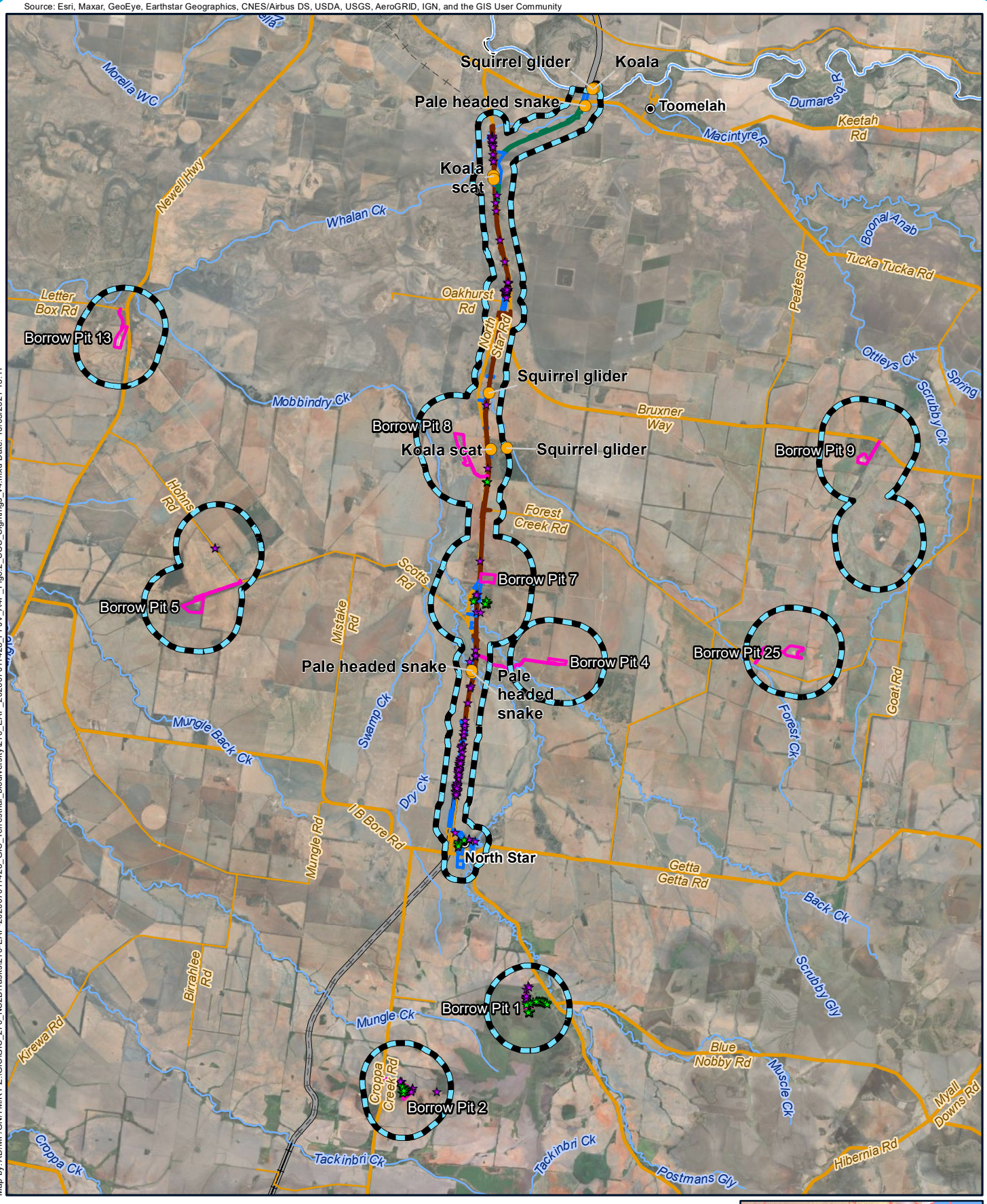
Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Eastern cave bat	*Vespadelus troughtoni*	All areas - 56,147, 418	Habitat Constraint – Caves (within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within 2 km of old mines, tunnels, old buildings or sheds)	They roost in caves and rocky overhangs and are associated with a range of habitats (usually in areas that are close to cliffs and rocky overhangs). They are also known to roost in road culverts, fairy martin nests and occasionally buildings. Colonies consisting of up to 500 individuals have been found in disused mines (OEH 2017).	Habitat constraints are not present in PCT 56, 147 and 418 or within 2km of study area following targeted habitat assessment and no roost habitat present. Species is readily identified using ultrasonic recorders (at any time of year) however was not recorded during surveys. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Eastern pygmy possum	*Cercartetus nanus*	244, 418	Habitat Constraint – N/A	Range of habitats with a preference for woodland and heath. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (Pseudocheirus peregrinus) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks (OEH 2017)	The species was not recorded during surveys in October 2019 or targeted surveys in February 2021 or during any other survey for the proposal. The available habitat in PCT 244 within the study area does not appear suitable for the species presence.
Grey-headed flying-fox (Breeding)	*Pteropus poliocephalus*	All areas - 35, 36, 55, 56, 147, 244, 418	Habitat Constraint – Other (Breeding camps)	Roosts in aggregations of various sizes on exposed branches. Roost sites are typically located near water, such as lakes, rivers or the coast. Roost vegetation includes rainforest patches, stands of Melaleuca, mangroves and riparian vegetation (DAWE 2021a)	No colonies of any flying-fox species located during targeted surveys, colonies tend to be easily recognised by both sight and smell. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Koala (Breeding)	*Phascolarctos cinereus*	All with the exception of PCT 36 High, and areas of PCT56 and 628.	Habitat Constraint – Other (Areas identified via survey as important habitat due to density of Koalas and quality of habitat)	See Appendix G	One koala was heard calling during targeted survey in 2019 in PCT 36 High. Multiple scat collections have been made throughout the alignment and sent for analysis, all returned as Brush-tailed possum (*Trichosurus vulpecula*). In February 2021 a koala scat was found as an incidental observation within PCT 56 -Poplar Box grassy woodland. These were identified as Koala scats by FFJV. In addition, two sets of scratches were observed at SP6 in PCT 628 – Carbeen +/- Coolabah grassy woodland.

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Large-eared pied bat	*Chalinolobus dwyeri*	All areas - 147	Habitat Constraint - Cliffs (Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels)	Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin nests (Woinarski et al 2014; DAWE 2021).	Habitat constraints do not occur within 2 km of the proposal. Single patch of PCT associated with this species present in study area (147) has no suitable rocky roost habitat for this species in this patch or elsewhere in the study area. No records from targeted surveys. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Little eagle (Breeding)	*Hieraaetus morphnoides*	All areas - 27,35,36,52 53,55,56,98,147, 192, 244, 247, 418, 628	Habitat Constraint – Other (Nest trees - live (occasionally dead) large old trees within vegetation)	Tall living trees within a remnant patch are used for nest, where pairs build a large stick nest in winter (OEH 2017).	No breeding pairs were recorded during targeted surveys undertaken within specified time frames. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Major Mitchells cockatoo (Breeding)	*Lophochroa leadbeateri*	All areas - 36, 52,56, 192, 244, 628	Habitat Constraint – Hollow bearing trees (Living or dead tree with hollows greater than 10 cm diameter)	Small pairs, groups and large flocks are associated with food supply such as native and exotic melons, and native seeds (saltbush, wattles and cypress pines). They feed mostly on the ground and the species nests in tree hollows (OEH 2017).	No breeding pairs were recorded during targeted surveys undertaken within specified time frames. Species likely out of range in study area. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Red-tailed black-cockatoo (inland) (Breeding)	*Calyptorhynchus banksii samueli*	All areas - 36, 56, 192, 244, 247, 628	Habitat Constraint – Hollow bearing trees (Living or dead tree with hollows greater than15 cm diameter and greater than 5 m above ground)	It inhabits riparian woodland and adjacent wooded plains, and nests in large hollow trees (OEH 2017)	No breeding pairs were recorded during targeted surveys undertaken within specified time frames. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Rufous bettong	*Aepyprymnus rufescens*	All areas - 35	Habitat Constraint – N/A	A dense cover of tall native grasses is the preferred shelter. Day nesting is in cone-shaped nests constructed of grass in a shallow depression at the base of a tussock or fallen log (OEH 2020).	Not found during surveys, targeted or otherwise. Spotlighting carried out across study area (i.e. not restricted to nominated PCTs). Details on the survey effort is located in Section 3.5 and Appendix D and G.

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Sloane's froglet	*Crinia sloanei*	All areas - 56	Habitat Constraint – N/A and Semi-permanent/ ephemeral wet areas (Containing relatively shallow sections with submergent and emergent vegetation, or within 500 m of wet area), Swamps (Within 500 m of swamps), and Waterbodies (Within 500 m of waterbody)	The species requires periodically inundated environments such as grasslands, woodland or disturbed habitat (OEH 2019).	Species no longer considered to occur north of Dubbo as advised by Threatened Species Officer. In addition, not detected in any surveys including those during wet conditions in February and March 2021 where 18 different frog species were recorded. Refer Appendix G.
Square-tailed Kite (breeding)	*Lophoictinia isura*	All areas – 27,35, 36, 55, 56, 98, 192, 244, 247, 418, 628	Habitat Constraint – Other (nest trees)	Large old nesting trees	No individuals or breeding pairs were recorded during targeted surveys within specified time frames. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Squatter pigeon (southern)	*Geophaps scripta scripta*	All areas - 36, 53, 56, 98, 192, 244, 247, 418, 628	Habitat Constraint – N/A	N/A	Not found during any surveys, targeted or otherwise. This species is well known to a number of ecologists conducting the surveys and is not likely to have been overlooked had it been present. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Squirrel glider	*Petaurus norfolcensis*	PCTs 36,56, 244 and 418 outside of those mapped within the species polygon	Habitat Constraint – N/A	Large old trees with hollows. Trees to be closely connected (no more than 50 m apart). Inhabit mature or old growth Box/Box-ironbark woodlands and River red gum forest west of the Great Dividing Range. They prefer mixed species stands with a shrub or Acacia midstorey (OEH 2017)	Targeted surveys have recorded the species in three locations PCT 36 High, 55 medium and PCT 244 outside of the subject land but adjacent to PCT56 high which has been included in the species polygon. Both of these locations contained a large area of remnant vegetation with a high number of hollow bearing trees.

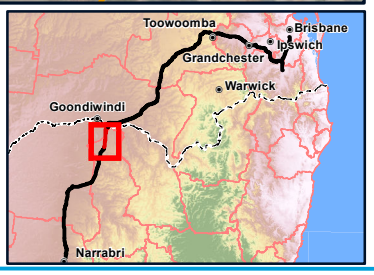
Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Superb parrot (breeding)	*Polytelis swainsonii*	All areas - 35, 36, 52, 56, 98, 244	Habitat Constraint – Hollow bearing tees (Living or dead *Eucalyptus blakelyi, E. melliodora, E. albens, E. camaldulensis, E. microcarpa, E. polyanthemos, E. mannifera, E. intertexta* with hollows greater than 5cm diameter; greater than 4m above ground or trees with a DBH of greater than 30 cm)	Found in Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest but will forage in grassy box woodlands. The species feeds in all canopy layers (trees, understorey shrubs and ground layer) on mainly grass seeds and herbaceous plants, but also fruits, berries, nectar, buds, flowers, insects and grain (OEH 2017).	No individuals or breeding pairs were recorded during targeted surveys within specified time frames. Species is out of range in study area. Details on the survey effort is located in Section 3.5 and Appendix D and G.
White-bellied sea-eagle (breeding)	*Haliaeetus leucogaster*	All areas - 35, 36, 56, 98, 244, 247, 418, 628	Habitat Constraint – Other (Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines)	Areas with large open water bodies including rivers, swamps, lakes and the ocean. Inland they will occupy areas within the vicinity of lakes, reservoirs, billabongs and saltmarshes. They will utilise terrestrial habitats that include grasslands, heathlands and woodlands. They will use emergent and dead trees as 'guard roosts' creating large nests from sticks lining the nest with leaves (OEH 2019).	No breeding pairs or suitable nests were recorded during targeted surveys within specified time frames. Details on the survey effort is located in Section 3.5 and Appendix D and G.
Zigzag velvet gecko	*Amalosia rhombifer*	All areas 418	Habitat Constraint – N/A	The species is confined to woodland habitats that are dominated by eucalypt species including *Eucalyptus sideroxylon, E. moluccana, E. blakelyi*, *Callitris* species. It is an arboreal species that is found beneath the decorticating bark of live trees (OEH 2019).	Multiple targeted surveys within the subject land and PCT418 did not record the species. Details on the survey effort is located in Section 3.5 and Appendix D and G.

Common name	Scientific name	PCTs	Habitat constraint	Microhabitats (from OEH threatened species profiles as referenced in Appendix G)	Reason for exclusion
Insects					
Pale imperial hairstreak	*Jalmenus eubulus*	35	Habitat Constraint – N/A and Other (Brigalow (*Acacia harpophylla*) or *Acacia melvillei*)	The species has only ever been known to breed in older growth brigalow forest and does not appear to colonise regrowth.	All areas of Low-quality PCT 35 no longer contain mature trees and therefore do not provide habitat for this species. Three separate surveys were conducted at 15 sites in January, February and March 2021. Surveys were conducted in all vegetation condition classes (Low, Medium and High) of the Brigalow PCT 35, and any additional PCTs that were observed to contain regrowth brigalow. No *Jalmenus eubulus* were recorded at any sites, although the not threatened Stencilled Hairstreak (*Jalmenus ictinus*) was observed at three sites.



Legend

- Localities
- Fauna observations
- Belson panic
- Finger panic
- Existing rail (operational)
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- NSW/QLD border
- Watercourses
- Study area



A4 scale: 1:200,000

0 1 2 3 4 5 km

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Figure 6.2: Location of species-credit species within the study area

6.2.4 Species habitat polygons

Species habitat polygons were prepared for all species-credit species recorded or assumed present within the subject land and are shown in Appendices A and F. Species polygon mapping was undertaken upon completion of the 2020/21 summer surveys and subject land optimisation. This enabled the assessor to further refine, identify and map areas having the potential to provide habitat for species-credit species (refer Appendix A and Appendix D) in accordance with the BAM. Any species which was not subject to a targeted survey effort in spring 2019 or summer 2021 and which had suitable habitat present was considered to occur. All predicted PCT zones which provide suitable habitat features such as hollow bearing trees, logs, cracking clay soils or mistletoe, depending upon the species, were considered suitable habitat and were included within the species polygon mapping for that species. Where suitable habitat did not occur (i.e. lack of hollow bearing trees for hollow dependent breeding species) then that PCT zone was excluded from the species polygon map for the species requiring that habitat feature. A detailed breakdown of the areas excluded as potential habitat for species credit species is located in Table 6.5.

Species polygons were prepared using the following parameters:

- Using the unit of measurement identified for those species in the Threatened Species Profile Database
- Including the location of the species or areas likely occupied by the species
- Containing the specific habitat feature associated with the species at the subject land i.e. hollow bearing trees.

Due to the large scale and number of individual species polygons, the output is presented as combined figures in Appendix A and Appendix F. The shape files for these polygons will be submitted to DPIE.

The PCT vegetation zones that are associated with each species is shown in Table 6.5 for the alignment segments and Table 6.7 for the Borrow pits. Each table shows the PCT number and condition (H = High, M=Medium, L=Low). A more detailed breakdown by segment is provided in Section 12.

Species habitat features and constraints along with estimated area of habitat are detailed in Table 6.8. It is important to note that the polygons have been developed based on assumed presence for the majority of species.

Table 6.5 Species Credit Species exclusions based on habitat assumptions

Common name	Scientific name	Excluded PCTs and Borrow pits	Reason for exclusion	Detailed reasoning (refer Appendix G)
Silky swainson-pea	*Swainsona sericea*	All of PCT 628	Geographic limitations	Areas of PCT 628 within the subject land are only located within the Castlereagh-Barwon IBRA subregion. As the species is only associated with Northern Basalts and Northern Outwash IBRA subregions within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 628 habitat are considered outside of known species range. However targeted flora surveys did occur over this PCT during the species survey window.

Common name	Scientific name	Excluded PCTs and Borrow pits	Reason for exclusion	Detailed reasoning (refer Appendix G)
Border thick-tailed gecko	*Uvidicolus sphyrurus*	All of PCT 192	Geographic limitations	Areas of PCT 192 within the subject land are only located within the Castlereagh-Barwon and Northern Outwash IBRA subregions. As the species is only associated with Northern Basalt IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 192 habitat are considered outside of known species range. Additional survey within PCT 192 did not find record the species and provides further evidence that the area is outside species known range
Glossy black-cockatoo (breeding)	*Calyptorhynchus lathami*	Low-quality PCT 36, 56, 192, 244 and 628 All of PCT 55 and 52	Habitat Constraint – Hollow bearing trees (Living or dead tree with hollows greater than 15cm diameter and greater than 8m above ground)	The species requires large tree hollows (>15 cm diameter >5 m above ground) for breeding and these Low-quality PCTs do not contain large trees with hollows, therefore these areas are not considered habitat for the species. In addition, two of the nominated PCTs comprise vegetation that do not form large tree hollows (PCT 55) or comprise trees at all (PCT 247).
Large bentwing-bat (Breeding)	*Miniopterus orianae oceanensis*	All of PCT 192 and 628	Geographic limitations	Areas of PCT 192 within the subject land are only located within the Castlereagh-Barwon and Northern Outwash IBRA subregions. Additionally, areas of PCT 628 within the subject land are only located within the Castlereagh-Barwon IBRA subregion. As the species is only associated with Northern Basalt IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 192 and 628 habitat are considered outside of known species range.
Eastern Cave Bat	*Vespadelus troughtoni*	All of PCT 192 and 628	Geographic limitations	Areas of PCT 192 within the subject land are only located within the Castlereagh-Barwon and Northern Outwash IBRA subregions. Additionally, areas of PCT 628 within the subject land are only located within the Castlereagh-Barwon IBRA subregion. As the species is only associated with Northern Basalt IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 192 and 628 habitat are considered outside of known species range. Additional survey within PCT 192 did not find record the species and provides further evidence that the area is outside species known range
Eastern pygmy-possum	*Cercartetus nanus*	All of PCT 628	Geographic limitations	Areas of PCT 628 within the subject land are only located within the Castlereagh-Barwon IBRA subregion. As the species is only associated with Northern Basalts and Northern Outwash subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 628 habitat are considered outside of known species range.

Common name	Scientific name	Excluded PCTs and Borrow pits	Reason for exclusion	Detailed reasoning (refer Appendix G)
Grey-headed flying fox	*Pteropus poliocephalus*	All of PCT 628	Geographic limitations	Areas of PCT 628 within the subject land are only located within the Castlereagh-Barwon IBRA subregion. As the species is only associated with Northern Basalts subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 628 habitat are considered outside of known species range. Additionally, incidental survey through this PCT did not identify any colonies.
Lage-eared pied bat	*Chalinolobus dwyeri*	All of PCT 147, 418 And PCT 192	Habitat constraints - Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.	There are no rocky areas which contain caves, overhangs or escarpments within two km of the subject land. Further to this there are no old mines or tunnels within that range. PCT 192 is located outside of known geographic range of species.
Masked owl (breeding)	*Tyto novaehollandiae*	Low-quality PCTs 35, 36, 56, 192, 244 and 418 All of PCT 52,55, 247	Habitat Constraints – Hollow bearing trees (Living or dead trees with hollows greater than 20 cm diameter)	The species breed in large nest hollows (>20 cm diameter). The low-quality PCTs do not contain large trees with hollows therefore these areas are not considered habitat for the species. In addition, four of the nominated PCTs comprise vegetation that do not form large tree hollows (PCTs 52, 55) or comprise of any trees at all (PCT 247).
Red-tailed black-cockatoo (inland subspecies) (Breeding)	*Calyptorhynchus banksii samueli*	All of PCT 52	Habitat Constraint – Hollow bearing trees (Living or dead tree with hollows greater than15cm diameter and greater than 5m above ground)	The species breed in large nest hollows (>15 cm diameter). As PCT 52 is a floodplain grassland community it does not contain large trees with hollows. Therefore, this PCT is not considered suitable habitat.
		All of PCT 27, 35 and 55	Geographic limitations	Areas of PCTs 27, 35 and 55 within the subject land are only located within the Northern Basalts and/or Northern Outwash IBRA subregion. As the species is only associated with Castlereagh-Barwon IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 27, 35 and 55 habitats are considered outside of known species range.
Rufous bettong	*Aepyprymnus rufescens*	All of PCT 147	Geographic limitations	PCT 147 located outside of known geographic range of species which is restricted to the Northern Basalts
Sloane's froglet	*Crinia sloanei*	All areas - 56	Geographic limitations	The species predicted range has been revised and is now restricted to south of Dubbo. Email from BCSD officer in charge of species is located in Appendix D (OEH 2019). Further to this non-targeted survey following summer rain recorded 18 species of frog none of which were Slone's froglet.

Common name	Scientific name	Excluded PCTs and Borrow pits	Reason for exclusion	Detailed reasoning (refer Appendix G)
Squatter pigeon (southern)	*Geophaps scripta scripta*	All of PCT 27	Geographic limitations	Areas of PCT 27 within the subject land are only located within the Northern Outwash IBRA subregions. As the species is only associated with Northern Basalt and Castlereagh-Barwon IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 27 habitat are considered outside of known species range.
Superb parrot (Breeding)	*Polytelis swainsonii*	All of PCT 27, 35, 55 and 418	Geographic limitations	Areas of PCTs 27, 35, 55 and 418 within the subject land are only located within the Northern Basalts and/or Northern Outwash IBRA subregion. As the species is only associated with Castlereagh-Barwon IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 27, 35, 55 and 418 habitats are considered outside of known species range.
Squirrel glider (Breeding)	*Petaurus norfolcensis*	All of PCT 628	Geographic limitations	Areas of PCT 628 within the subject land are only located within the Castlereagh-Barwon IBRA subregion. As the species is only associated with Northern Basalts subregion within the subject land (as per Threatened Biodiversity Database Collection), the areas of potential PCT 628 habitat are considered outside of known species range.
Swift parrot (breeding)	*Lathamus discolor*	All	Habitat Constraint – Other (as per mapped areas)	The species is only known to breed in Tasmania

Table 6.6 Polygon mapping for Species Credit Species and their related PCT zones within the alignment segments

Species name	Scientific name	Alignment segment	Northern Basalts	Northern Outwash	Castlereagh-Barwon
Glossy black-cockatoo (Breeding) - Assumed present	*Calyptorhynchus lathami*	Greenfield	-	-	36M, 36H, 56M, 192M, 244M, 628M
		Brownfield	56M, 56H, 98H	36H, 36M, 56H, 56M	36M, 56M, 244M, 628M
		Early works	56M, 56H	56H	56M, 244M,
Creeping Tick-trefoil - Assumed present in greenfield as access was denied not located in other areas	*Desmodium campylocaulon*	Greenfield	-	-	52M, 244M
		Brownfield	-	-	-
		Early works	-	-	-
Bluegrass - Assumed present in greenfield as access was denied	*Dichanthium setosum*	Greenfield	-	-	52M
		Brownfield	-	-	52M
		Early works	-	-	-

Species name	Scientific name	Alignment segment	Northern Basalts	Northern Outwash	Castlereagh-Barwon
Finger panic grass - surveyed	*Digitaria porrecta*	Greenfield	-	-	247L, 52M, 244M
		Brownfield	35H, 53M, 56L, 56L, 56M, 56H	27M, 56L, 56M, 56H	25M, 52M, 56L, 56M, 244L, 244M, 247L, 247M, 628L, 628M
		Early works	56L	35H, 35L, 56L, 56H	244M
Belson's panic – surveyed	*Homopholis belsonii*	Greenfield	-	-	52M, 244M
		Brownfield	56L	-	52M
		Early works	56H	35H	-
Pale-headed snake – recorded in surveys	*Hoplocephalus bitorquatus*	Greenfield	-	-	36M, 192M, 244M
		Brownfield	-	36H, 36M, 56H, 56M	-
		Early works	-	56L	36M, 36H, 192M
Winged peppercress - Assumed present in greenfield as access was denied not located in other areas	*Lepidium monoplocoides*	Greenfield	-	-	52M
		Brownfield	-	-	56L
		Early works	-	-	-
Squirrel glider – surveyed	*Petaurus norfolcensis*	Greenfield	-		36H
		Brownfield	56H	-	-
		Early works	56H	-	-
Koala	*Phascolarctos cinereus*	Greenfield	-	-	-
		Brownfield	56H	-	628M
		Early works	56L	-	36H, 628M
Silky swanson-pea - Assumed present in greenfield as access was denied not located in other areas	*Swainsona sericea*	Greenfield	-	-	52M, 244M
		Brownfield	-	-	52M
		Early works	-	-	-
Masked owl (breeding) – assumed present	*Tyto novaehollandiae*	Greenfield	-	-	36M, 192M, 244M
		Brownfield	35H, 56M 56H,98H	-	36M, 244M, 628M
		Early works	35H,56H,56M	-	36M, 36H, 56M, 244M, 628M

Table notes:

H = High, M=Medium, L=Low PCT zones

Table 6.7 Polygon mapping for Species Credit Species and their related PCT zones within the Borrow pits

Species name	Scientific name	BP 1	BP 2	BP5	BP7	BP8	BP9	BP13	BP25
Belson's panic	*Homopholis belsonii*	35M,147H,147M	418H, 418M	-	-	-	-	98H,98L	-
Finger panic grass	*Digitaria porrecta*	35L,35M,147H, 147M	35L, 418H, 418M	-	-	-	-	-	-
Glossy black-cockatoo (Breeding)	*Calyptorhynchus lathami*	-	418M, 418H	192M,192H	56H	56M	418H,418M	-	418M
Masked owl (Breeding)	*Tyto novaehollandiae*	147H, 147M	-	-	-	56M	418H,418M	-	-
Native milkwort	*Polygala linariifolia*	-	-	192L, 192M,192H	-	-	-	-	-
Pale headed snake	*Hoplocephalus bitorquatus*	-	-	192L, 192M,192H	-	-	-	-	-

Table 6.8 Species-credit species recorded or assumed present within the subject land

Species name	Scientific name	Habitat feature/ constraints	Northern Basalts area (ha)	Northern Outwash area (ha)	Castlereagh-Barwon area (ha)	Borrow pits area(ha)	Total area (ha)
Flora							
Belson's panic	*Homopholis belsonii*	None listed	1.77	0.33	29.9	14.36	**46.36**
Bluegrass	*Dichanthium setosum*	None listed	-	-	26.1	-	**26.1**
Creeping tick-trefoil	*Desmodium campylocaulon*	None listed	-	-	29.9	-	**29.9**
Finger panic grass	*Digitaria porrecta*	None listed	34.38	41.82	76.95	14.41	**167.47**
Native Milkwort	*Polygala linariifolia*	None listed	-	-	-	12.4	**12.4**
Slender darling pea	*Swainsona murrayana*	None listed	-	-	29.9	-	**29.9**
Winged peppercress	*Lepidium monoplocides*	None listed	-	-	26.08	-	**26.08**
Fauna							
Glossy black-cockatoo (Breeding)	*Calyptorhynchus lathami*	Hollow bearing trees: living or dead with hollows greater than 15 cm diameter and greater than 5 m above ground	44.6	3.57	22.64	52.03	**123.84**
Koala (Breeding)	*Phascolarctos cinereus*	Important habitat consists of suitable habitat and the observed presence of koalas and koala scat.	21.1	-	6.66	-	**27.76**
Masked owl (Breeding)	*Tyto novaehollandiae*	Hollow bearing trees living or dead with hollows greater than 20 cm diameter	50.33	-	22.64	32.6	**105.57**
Pale-headed snake	*Hoplocephalus bitorquatus*	Trees with hollows and /or decorticating bark within 500 m of water	-	1.57	11.2	12.4	**24.99**
Squirrel glider	*Petaurus norfolcensis*	None listed	34.24	-	0.66	-	**34.9**

6.3 Threatened flora survey records

Two flora species listed as threatened under the BC Act or EPBC Act were recorded in the study area during the January 2021 targeted surveys as identified in Table 6.9.

Table 6.9 Threatened and migratory species observed within the study area and adjacent area

Family	Species name	Common name	BC Act status	EPBC Act status
Poaceae	*Homopholis belsonii*	Belson's panic	E,P	V
Poaceae	*Digitaria porrecta*	Finger panic grass	E,P	-

6.4 Threatened fauna survey records

A total of 207 fauna species were observed within the subject land, including nine (four per cent) non-native species. Observed species consisted of 145 birds, 37 mammals, 20 reptiles, and five amphibians. A full list of fauna species recorded within the study area is located in Appendix D.

Fauna species listed as threatened under the BC Act and/or EPBC Act or listed as migratory under the EPBC Act which have been observed within the study area and adjacent areas during site investigations are detailed in Table 6.10.

Table 6.10 Threatened and migratory species observed within the study area and adjacent area

Species name	Common name	Credit type	BC Act status	EPBC Act status
Botaurus poiciloptilus	Australasian bittern	Ec	E,P	E
Circus assimilis	Spotted harrier	Ec	V	-
Haliaeetus leucogaster	White-bellied sea-eagle	Ec, Sp(Br)	V,P	Ma
Gallinago hardwickii	Latham's snipe	Ec	P	M
Calyptorhynchus banksii samueli	Red-tailed black-cockatoo (inland subspecies)	Ec, Sp(Br)	VP	-
Calyptorhynchus lathami	Glossy black-cockatoo	Ec, Sp(Br)	V	-
Pomatostomus temporalis	Grey-crowned babbler	Ec	V,P	-
Grantiella picta	Painted honeyeater	Ec	V	V
Daphoenositta chrysoptera	Varied sittella	Ec	V	-
Petroica boodang	Scarlet robin	Ec	V	-
Petaurus norfolcensis	Squirrel glider	Sp	V,P	-
Phascolarctos cinereus	Koala	Sp	V	V
Macropus dorsalis	Black-striped wallaby	Ec	E	-
Pteropus poliocephalus	Grey-headed flying fox	Ec, Sp(Br)	V	V
Saccolaimus flaviventris	Yellow-bellied sheathtail-bat	Ec	V,P	-
Ozimops lumsdenae	Northern free-tailed bat	Ec	V,P	-
Setirostris eleryi[1]	Bristle-faced free-tailed bat[1]	Sp	V,P	-
Miniopterus orianae oceanensis (previously *Miniopterus schreibersii oceanensis)*	Large bent-winged bat (previously Eastern bentwing-bat)	Ec, Sp(Br)	V	-
Nyctophilus corbeni[2]	Corben's long-eared bat[2]	Ec	V,P	-

Species name	Common name	Credit type	BC Act status	EPBC Act status
Miniopterus orianae oceanensis	Large bent-winged bat	Ec, Sp	V,P	-
Chalinolobus picatus	Little pied bat	Ec	V,P	-
Hoplocephalus bitorquatus	Pale-headed Snake	Sp	V	-

Table notes:

P=Protected, V=Vulnerable, E=Endangered, M=Migratory, Ma=Marine, Ec= Ecosystem Credit, Sp=Species Credit, Sp(Br) = Species Credit for breeding habitat

1 Potentially recorded via ultrasonic bat call detectors

2 Potentially recorded via ultrasonic bat detectors. The ultrasonic bat call detectors identified one or more Nyctophilus species within the subject land (the *Nyctophilus* genus cannot be identified to species level from their calls). Three species potentially occur in the subject land: – *Nyctophilus geoffroyi* and *Nyctophilus gouldi* were recorded during harp trapping for the proposal in February 2021 and the Vulnerable *Nyctophilus corbeni* which is an ecosystem credit species (not recorded in February 2021 harp trapping).

6.5 Pest fauna species survey records

Ten introduced fauna species were identified within the subject land, including:

- Feral cat (*Felis catus*)
- Pig (*Sus scrofa*)
- European rabbit (*Oryctolagus cuniculus*)
- European fox (*Vulpes vulpes*)
- European hare (*Lepus europaeus*)
- Dog (*Canis lupus*)
- Camel (*Camelus dromedaries*)
- Rock dove (*Columbia livia)*
- Common myna (*Sturnus tristis*)
- Common starling (*Sturnus vulgaris*).

Feral cats (*Felis catus*) were seen in high numbers during spotlighting surveys, and numerous captures of the European fox (*Vulpes vulpes*) were recorded on five of the camera traps, including two individuals in one picture.

7 Matters of national environmental significance

The following sections summarise the MNES values associated with the proposal based on the desktop assessment and field observations.

7.1 Threatened ecological communities

A total of six TECs identified under the provisions of the EPBC Act are were returned from the database interrogations. These TECs have been identified exclusively from the EPBC Act PMST (Australian Government 2018a).

The EPBC listing of Poplar box grassy woodland on alluvial plains occurred following the proposal's controlled action decision (listing effective as at 4 July 2019). As such this community is not required to be addressed within this assessment.

TECs were identified by extrapolation using DAWE conservation listing advice contained on the Species Profile and Threats Database (SPRAT), for each TEC identified during the desktop review phase. Analogous vegetation communities (i.e. PCTs) as mapped on the NSW State Vegetation Type Map were identified which were then used to spatially map out the extent of each of the identified TECs. Assumptions associated with the development of the TEC model are outlined in Appendix C. Identified TECs and the analogous PCTs used to map each of the TECs as stipulated by the SPRAT is presented in Table 7.1. Where field investigations had identified/conformed/rejected the presence of the TEC, this was incorporated into the mapping.

Predictive mapping indicates that suitable habitat for White-box-Yellow box-Blakely's Red Gum grassy woodland and derived native grassland and Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions TECs does not occur within the subject land. This was confirmed during site assessments and these two TECs were not considered for further assessment as receptors.

Four TECs (as listed under the EPBC Act) occur within the overall Proposal area as summarised in Table 7.1. Assessment of the relevant vegetation communities (PCT) against the key diagnostic characteristics and condition thresholds for each TEC (as described in the relevant approved conservation advice) is located within Appendix C.

Table 7.1 Threatened ecological communities (EPBC Act) identified within the Proposal

Name	Status under the EPBC Act	Habitat requirements for analogous PCTs	Extent within proposal
Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	The following High or medium quality condition PCTs are considered to be analogous to the TEC: PCT 35 as they meet the condition thresholds as described in Section 1.7 of the *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community*	11.17 ha of high quality PCT 35 across several patches throughout the alignment (refer Table 5.1). Following detailed review with project ecologists and engineers all areas of Brigalow within Borrow Pits have been excluded from the subject land

Name	Status under the EPBC Act	Habitat requirements for analogous PCTs	Extent within proposal
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CE	The following High and Medium condition PCTs are considered to be analogous to the TEC: PCT 52, when ≥0.5 ha as described on page 16 of the "*Nationally Threatened Ecological Communities:* *Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland, and* *Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin'*	33.5 ha of PCT 52 located within the alignment (refer Table 5.1)
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E	The following High and Medium condition PCT 147 is considered to be to meet the vegetation description in the National recovery plan for the "*Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions" ecological community*	4.6 ha in a single area associated with Borrow Pit 1 (refer Table 5.1)
Weeping Myall Woodlands	E	The following Medium condition PCTs are considered to be analogous to the TEC: PCT 27, when ≥ 0.5 ha and it meets the condition thresholds as set out in *Weeping myall woodlands – Policy statement 3.17*	0.02 ha of PCT 27 (Medium quality) is currently located within the subject land (refer Table 5.1), this is part of a larger patch of PCT 27 which is not located within the subject land. This area of PCT 27 will be buffered to ensure it is not impacted by the project.

7.2 Threatened species

7.2.1 Threatened flora

A total of eight threatened flora species listed under provisions of the EPBC Act were identified as potentially occurring within the search area by database searches (refer Table 7.2). Of the eight species identified in databases, five are derived exclusively from the EPBC Act PMST (Australian Government 2018a) which is a predictive search tool that does not rely on specimen backed records.

Four flora species were considered a likely or possible occurrence within the search area and subject to targeted surveys and impact assessment under the BAM (refer Section 179 and Appendix G for species habitat requirements, survey methods and effort). One threatened flora species was recorded during the targeted surveys carried out for the Project: Belson's panic (*Homopholis belsonii*). No other threatened species listed under the EPBC Act was recorded and the remaining species are therefore considered as unlikely to occur. One threatened species which was not reported as potentially present under BAM but is known to the ecologists to be a listed species Austral toadflax was not recorded during any survey events so has been excluded from further assessment.

Two flora species, *Westringia parvifolia* and *Androcalva procumbens*, were considered unlikely occurrences due to the absence of suitable habitat and/or an absence of historical records in the region and were not considered further.

Based on the results of the targeted surveys completed in March 2021 no further assessment on flora species is required under the EPBC Act.

Table 7.2 Threatened flora species listed under the EPBC Act identified from database searches

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence
			BC Act	EPBC Act		
Poaceae	*Dichanthium setosum*	Bluegrass	V	V	BioNet, PMST, SEAR	Possible. Targeted surveys carried out within the study area did not locate this species.
Poaceae	*Homopholis belsonii*	Belson's panic	E	V	BioNet, PMST, SEAR	Known. Targeted surveys carried out within the study area recorded this species.
Surianaceae	*Cadellia pentastylis*	Ooline	V	V	PMST	Unlikely. Detailed survey within habitat did not locate the species.
Apocynaceae	*Tylophora linearis*	Slender tylophora	V	E	PMST, SEAR	Unlikely. Targeted surveys carried out within the study area did not locate this species.
Malvaceae	*Androcalva procumbens*	-	V	V	PMST	Unlikely. Suitable habitat found in communities of *Eucalyptus dealbata–E. sideroxylon* woodland, *Melaleuca uncinata* shrubland, and mallee eucalypt with *Calytrix tetragona* understorey (DAWE 2021). Habitat and species known distribution do not occur within the study area.
Fabaceae	*Swainsona murrayana*	Slender Darling-pea	V	V	PMST	Unlikely. Targeted surveys carried out within the study area did not locate this species.
Santalaceae	*Thesium australe*	Austral toadflax	V	V	PMST	Unlikely. Detailed flora surveys over the subject land have not recorded the species and surveyors are familiar with the species.
Lamiaceae	*Westringia parvifolia*	-	-	V	PMST	Unlikely. Grows with Baker's Mallee (*Eucalyptus bakeri*) and Green Mallee (*E. viridis*) and between clumps of Spinifex (*Triodia* sp.) on sandy and stony soils (DAWE 2021). Habitat and species known distribution do not occur within the study area.

Table notes:

1 Listing under the *Biodiversity Conservation Act 2016* (New South Wales): E = Endangered; V = Vulnerable.
2 Listing under the *Environment Protection and Biodiversity Conservation Act 1999*: E = Endangered; V = Vulnerable.
- Species not listed or no common name

7.2.2 Threatened fauna

A total of 20 threatened fauna species listed under provisions of the EPBC Act were identified as potentially occurring within the search area by database searches (refer Table 7.3). Of the 20 species identified in database searches, 17 are derived exclusively from the EPBC Act PMST (DAWE 2019a) (including nine species required under the SEAR). The PMST is a predictive search tool that does not rely on specimen backed records. Three species have been previously recorded in the Bionet database search area (10 km radius surrounding the study area).

A total of 14 fauna species were considered a likely or possible occurrence within the search area based on desktop assessments. Twelve species are subject to impact assessment under the BAM, several of which were subject to targeted species and habitat surveys (refer Section3.5, Appendix D and Appendix G for species habitat requirements, survey methods and effort). Targeted surveyed conducted in summer 2021 was carried out in accordance with the EPBC Act *Survey guidelines for Australia's threatened bats* (DEWHA, 2010). Five species have been recorded during site surveys and are therefore considered as known to occur. Four species listed only under the EPBC Act are subject to assessment for significant residual impacts as MNES species (refer Section 261).

Six species were considered unlikely occurrences due to the current distribution of the species and/or the absence of suitable habitat, including Squatter pigeon (*Geophaps scripta scripta*), Superb parrot (*Polytelis swainsonii*), Large-eared pied bat (*Chalinolobus dwyeri*), Regent honeyeater (*Anthochaera phrygia*), Collared delma (*Delma torquata*), and Greater glider (*Petauroides volans*) and are not considered further.

Table 7.3 Threatened fauna species listed under the EPBC Act identified from database searches

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence^
			BC Act	EPBC Act		
Accipitridae	*Erythrotriorchis radiatus*	Red goshawk	CE	V	PMST	Possible. While suitable habitat does exist the species was not recorded during targeted raptor survey and the closest record is over 120 km south east of the subject land
Apodidae	*Hirundapus caudacutus*	White-throated needletail	-	V, M	BioNet, PMST	Likely. Several historical records occur within the search area
Ardeidae	*Botaurus poiciloptilus*	Australasian bittern	E	E	PMST	Known. Single individual recorded at farm dam associated with Borrow Pit 8 during Project surveys
Columbidae	*Geophaps scripta scripta*	Squatter pigeon	CE	V	PMST, SEAR	Unlikely. Targeted bird surveys over multiple years did not record the species. Study area is outside of the current known distribution for the species. Table 6.2 and Appendix G for survey effort details
Dasyuridae	*Dasyurus maculatus maculatus*	Spot-tailed quoll (Southeastern mainland population)	V	E	PMST	Possible. The area contains suitable habitat for the species, however the closest record in 50 km east

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence^
			BC Act	EPBC Act		
Elapidae	*Furina dunmalli*	Dunmall's snake	-	V	PMST, SEAR	Unlikely. The species was not recorded during targeted nocturnal or diurnal reptile surveys and the subject land is outside of the 'The modelled distribution of Dunmall's snake (*Furina dunmalli*)' found in the '*EPBC Act - Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* '
Gekkonidae	*Uvidicolus sphyrurus*	Border thick-tailed gecko	V	V	PMST	Unlikely. Not recorded during targeted survey in suitable habitat over multiple survey efforts see Table 6.2 and Appendix G for survey effort details
Meliphagidae	*Anthochaera phrygia*	Regent honeyeater	CE	CE	PMST	Unlikely. Suitable habitat does not occur within or adjacent to the study area. The areas is outside of the mapped habitat for the species.
Meliphagidae	*Grantiella picta*	Painted honeyeater	V	V	BioNet, PMST, SEAR	Known. Individual recorded on a single occasion in Poplar box woodland during October 2019 field survey.
Percichthyidae	*Maccullochella peelii*	Murray cod	-	V	PMST, SEAR	Known. Recorded in the Macintyre River during targeted surveys for adjacent Inland Rail project (B2G)
Petauridae	*Petauroides volans*	Greater glider	-	V	PMST	Unlikely. Suitable habitat does not occur within or adjacent to the study area.
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	BioNet, PMST, SEAR	Known. Koala heard calling (during spotlighting) on a single occasion within riparian River Red Gum open forest on the Macintyre River in October 2019. Koala scat and scratches were also found in PCT 56 and 628. No other records or signs of presence of the species were recorded within the study area following multiple spotlighting events. Several scats sent for analysis were found to be that of Brush-tailed possum (*Trichosurus vulpecula*). Table 6.2 and Appendix G for survey effort details

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence^
			BC Act	EPBC Act		
Psittacidae	*Polytelis swainsoni*	Superb parrot	V	V	PMST	Unlikely. The proposal is located outside the known range of this species.
Pteropodidae	*Pteropus poliocephalus*	Grey-headed flying-fox	V	V	PMST	Known. Individuals recorded in riparian River Red Gum open forest and Poplar box woodland during field surveys. The subject land does not contain a flying fox roost so the area is considered to be foraging habitat only. Refer Table 6.2 and Appendix G for survey effort details.
Pygopodidae	*Delma torquata*	Collared delma	-	V	PMST, SEAR	Unlikely. Suitable habitat does not occur within or adjacent to the study area. The proposal is located well outside the known range of the species.
Rostratulidae	*Rostratula australis*	Australian painted-snipe	E	E	PMST	Possible. The species has been recorded 50 km to the south west but this was in permanent wetlands.
Scincidae	*Anomalopus mackayi*	Five-clawed worm-skink	E	V	PMST, SEAR	Possible. Habitat does exist with a probable find recorded 4km south of the study area on 5 July 2021 during the separate Narrabri to North Star project preclearing survey in PCT 52. Prior to July 2021 the closest record of the species is 50 km south east or 80 km south west
Scolopacidae	*Calidris ferruginea*	Curlew sandpiper	E	CE	PMST	Possible. Limited habitat exists, the closest record of the species in 80 km north east
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared pied bat	V	V	PMST, SEAR	Unlikely. Suitable rocky roost habitat does not occur within or adjacent to the study area. Study area is outside of the known distribution for the species.

Family	Species name	Common name	Conservation status		Data source	Likelihood of occurrence^
			BC Act	EPBC Act		
Vespertilionidae	*Nyctophilus corbeni*	Corben's long-eared bat	V	V	PMST, SEAR	Possible. Microbat echolocation calls from the genus *Nyctophilus* recorded during field surveys in 2018 and 2019. Calls within the genus cannot be reliably distinguished between species. Three species may be present. Only *Nyctophilus gouldii* and *N. geoffroyi* were recorded during harp trapping for the proposal in February 2021. The species has been recorded in the Dthinna Dthinnawan National Park 20 km to the east.

Table notes:

1 Listing under the *Biodiversity Conservation Act 2016* (New South Wales): CE = Critically endangered; E = Endangered; V = Vulnerable.
2 Listing under the *Environment Protection and Biodiversity Conservation Act 1999*: CE = Critically endangered; E = Endangered; V = Vulnerable.
- Species not listed or no common name
LoO – Known – the species was recorded during field survey or recent other survey effort. Possible – Suitable habitat is present but the species has not been recorded. Unlikely – the subject land is outside of the know distribution of the species and no suitable habitat present.

7.2.3 Other matters of national environmental significance

7.2.3.1 World heritage properties

No world heritage properties were identified during database searches.

7.2.3.2 National heritage places

No National heritage places were identified during database searches.

7.2.3.3 Wetlands of international importance

Wetlands of international importance identified during database searches are discussed in Section 4.4.5.

7.2.3.4 Great Barrier Reef Marine Park

No areas of the Great Barrier Reef Marine Park were identified during database searches.

7.2.3.5 Commonwealth Marine Area

No areas of a Commonwealth Marine Area were identified during database searches.

7.2.3.6 Critical habitat

No areas of critical habitat listed on the Register of Critical Habitat (EPBC Act) occurs within or adjacent to the study area.

8 Potential impacts and impact mitigation

8.1 Introduction

The location of infrastructure associated with the alignment has been determined through the feasibility design process, this includes access tracks, laydown areas and the North Star camp. The final determination of which borrow pits will be utilised will be determined by the level of biodiversity impact, amount of suitable fill they are able to provide and the proximity to the works. Given the legislative requirements of the BC Act though the BAM, multiple assessment methodologies as detailed in Section 3.1.1 were utilised. Ecological receptors specific to the BAM have been assessed in Section 9.1 and those ecological receptors not subject to the BC Act have been assessed in Section 10 in accordance with the SIAM.

Following detailed investigation and collaboration with engineering staff the total number and areas of potential borrow pits has been reduced to limit the impact on TEC's and listed species. Further details on the decision making process are discussed in Section 8.6.

Potential impacts and proposed mitigation measures are the same for ecological receptors assessed under the BAM and those assessed as MNES.

8.2 Proposal activities

Infrastructure activities proposed as part of the proposal have been categorised into three phases; construction, commissioning and reinstatement, and operation. A description of proposal related activities and the duration of their disturbance is provided in Table 8.1.

Table 8.1 Description of proposal related activities associated with construction, commissioning and reinstatement and operation phases

Phase	Infrastructure activity	Description of activities	Duration of disturbance (refer Table 10.2 for definitions)
Construction	Site preparation	Vegetation clearing	Permanent
		Topsoil stripping	Medium term/ Permanent
		Construction of temporary site compounds	Medium term
		Construction of rail access roads	Permanent
		Installation of boreholes and construction water	Medium term
		Installation of offices, hardstands, etc.	Medium term
		Stockpiling	Medium term
		Dewatering of Borrow pits	Short term
	Utility diversions	Excavation	Permanent
		Trenching	Short term
		Modification, diversion and realignment of utilities and associated infrastructure	Short term/Medium term
	Drainage	Culvert installation	Permanent
	Structures	Construction of bridges over main waterways	Medium term
		Road/rail bridge construction	Medium term
	Civil works	Cutting construction	Medium term
		Embankment construction using cut to fill from rail alignment and borrow to fill from external borrow sources, where required	Medium term
		Construction of temporary haul roads	Medium term

Phase	Infrastructure activity	Description of activities	Duration of disturbance (refer Table 10.2 for definitions)
		Drainage controls	Medium term
		Borrow pits use	Medium term
	Road works	Road realignment	Permanent
		Construction of permanent rail maintenance access roads	Permanent
	Rail logistics	Sleeper stockpiling	Medium term
		Rail stockpiling	Medium term
	Rail construction	Drilling	Temporary
		Blasting	Temporary
		Ballast installation	Short term
		Sleeper placement	Short term
		Rail placement	Short term
		Installation Train signals and communications infrastructure	Short term
		Demobilising site compounds	Short term
		Material borrow extraction	Permanent
	Signals and communications installation	Removal of temporary fencing	Temporary
Commissioning and reinstatement	Demobilisation	Establish permanent fencing	Temporary
		Restoration of disturbed areas, including revegetation where required	Short term
	Road conversion	Conversion of haul roads and construction access roads into permanent roads	Medium term
	Fencing	Fence construction and installation	Permanent
	Restoration	Minor maintenance works	Temporary
Operation	Train operations	Train movement along rail	Permanent
	Operational maintenance	Ongoing vehicle movement within rail corridor	Permanent
	Road works	Bridge and culvert inspections	Temporary
		Sleeper replacement	Temporary
		Rail welding	Temporary
		Rail grinding	Temporary
		Ballast dropping	Temporary
		Track tamping	Temporary
		Major periodic maintenance	Temporary

8.3 Nature of impacts

8.3.1 Habitat loss and degradation from vegetation clearing/removal

The removal of vegetation resulting in habitat loss and degradation is likely to pose the largest risk of adverse impacts for terrestrial biodiversity arising from the proposal. The impact may be direct in the form of vegetation and habitat removal, or indirect, such as a reduction in flora and fauna diversity due to shortages in available habitat resources or habitat degradation in areas adjacent to direct impacts. Small-scale clearing within largely intact patches of vegetation can cause localised depletion of some species (Kutt et al. 2012). Habitat loss as a result of vegetation clearing is likely to occur during the construction phase activities. TECs and habitats for threatened species are included in the likely ecological receptors potentially impacted. The subject land including borrow pits covers 432 ha of native vegetation in various condition types and 119 ha of managed land.

It is acknowledged that the majority of the subject land within the alignment segments and several of the borrow pits is in a highly modified state and the potential vegetation removal associated with the proposal is considered to be relatively minor compared to the surrounding historical broad scale vegetation clearing for agricultural purposes. However this broader context does not diminish the potential significance of such loss.

Vegetation clearing and habitat loss that cannot be avoided, particularly in high constraint areas, is likely to result in permanent impacts to ecological receptors. Specifically, there is a risk that some of the proposed clearing of TECs may pose a direct threat to the local viability of these ecosystems and potentially impact upon individual threatened species (refer Section 7). The majority of impacts will occur in or directly adjacent to the existing rail corridor and in areas cleared of native vegetation or with highly modified vegetation communities.

Vegetation within some of the proposed borrow pits is relatively intact. Removal of this vegetation is likely to cause larger impacts where the whole remnant patch is removed rather than were a subset of remnant vegetation is cleared. Vegetation clearing and habitat loss that cannot be avoided, particularly in high constraint areas, is likely to result in permanent impacts to ecological receptors. This includes a reduction of feed availability for herbivores as well as sheltering offered by trees and fallen timber. Specialist feeders such as the Pale imperial hairstreak are most likely to be severely impacted by the removal of their obligate food source (mature old growth Brigalow). Other ecological receptors that are potentially impacted include TECs and habitat-specialist fauna species which are dependent on native vegetation, such as Dunmall's snake, Koala, Large-eared pied bat, Five-clawed worm-skink, and Spot-tailed quoll. The potential effects associated with this impact include direct loss of breeding habitat, fragmentation of habitat and loss of foraging habitat which will in turn lead to greater pressure on remining available habitat outside of the subject land. The resulting increase in pressure on resource availability is likely to increase individual animal stress levels which may result in reduced breeding success, genetic isolation and population decline over time.

8.3.2 Fauna species injury or mortality

Fauna injury and/or death is a direct impact that reduces local population numbers and is most likely to occur during vegetation removal associated with the proposal activities. This trauma has the potential to occur during construction activities that involve vegetation clearing, earthworks, trenching and increased labour force in the fields (through the movement of vehicles). This potential impact will be proportionate to the extent of vegetation and habitat potential for species that is removed and has the potential to impact ecological receptors, including habitat for threatened fauna species listed under the provisions of the EPBC Act and/or BC Act.

Some diurnal (active during the day) and mobile species, such as birds, may move away from areas being disturbed (i.e. vegetation removal) and may not be adversely impacted unless they are nesting. Other species that are less mobile (i.e. Zigzag velvet gecko and Koala), or those that are nocturnal and nest or roost in tree hollows during the day (i.e. such as Spot-tailed quoll and Corben's long-eared bat), may find it difficult to move away from roosts.

There is the potential for fauna injury or mortality during all phases of the proposal through vehicle collision, but particularly when high volumes of vehicle activity occur or during the operational stages of the rail. Vehicle collision is a direct impact that reduces local population numbers and is a common occurrence in Australia (Coffin 2007; Rowden et al. 2008). The establishment of construction tracks and borrow pits, as well as the general use of access tracks and roads across the proposal site will result in increased vehicle movements that may cause injury or death to fauna by vehicle strike. In addition, once operational, train strike may also occur. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike, particularly common species (e.g. macropods) that are tolerant of disturbance and/or those species that can utilise roads for movement pathways or as foraging habitat. Threatened species such as Squirrel Gliders may be impacted where the alignment passes close to woodland vegetation. Due to the height of trains with double-stacked containers, gliders may be particularly vulnerable to train strike when gliding across the alignment.

In addition, entrapment of wildlife in utility diversions (e.g. trenches) or other excavations associated with the proposal may also cause physical trauma to fauna. For example, open trenches for underground utilities, or other pits are known to be effective at trapping a wide variety of wildlife and often result in mortality (Ayres and Wallace 1997; Doody et al. 2003; Winooski et al. 2006). Threatened species most likely to become trapped in pits or other excavations during development of the proposal are ground dwelling species that are capable of moving across modified areas in the absence of woodland or forest habitat such as Black-striped Wallaby, Pale-headed snake and Koala.

The unmitigated potential occurrence of fauna species injuries or mortalities can be permanent where mortality to the species occurs, or temporary where the species is rehabilitated and re-released.

8.3.3 Reduction in biological viability of soil to support plant growth due to soil compaction

Compaction of soil as a result of the proposal activities may result in direct impacts to soil consistency (i.e. the strength and coherence of a soil) and soil structure (i.e. the arrangement of soil particles). Changes to soil consistency and structure can affect the productive capacity of the soil for agricultural practices, the suitability of the soils for various land uses, how the soil and landscape will respond to management practices, and the flow paths by which water moves within the soil and landscape (Fitzpatrick *et al.* 1999).

The most direct effect of soil compaction is an increase in the bulk density of soil which can restrict plant root growth and function. Due to the increase in bulk density, large pores essential for water and air movement in soil are primarily affected. This influence over water and air movement can impact root penetration, seedling emergence and plant growth (Fitzpatrick *et al.* 1999; Duiker 2004). Threatened flora species most likely to be affected by this impact include *Desmodium campylocaulon*, *Homopholis belsonii*, *Dichanthium setosum*, and *Swainsona murrayana*. This impact may also affect TECs in the long term, with a reduction in recruitment leading to a gradual decline in condition.

Soil biota may also be affected by compaction, for example earthworm numbers and activity can be reduced in compacted soils. In addition, water infiltration and percolation are slower in compacted soils, thereby inhibiting root growth, leading to the potential reduced uptake of immobile nutrients such as phosphorus and potassium; and increased nitrogen losses can be expected because of prolonged periods of saturated conditions in compacted soils.

Larger non-burrowing soil animals such as mites and springtails may also be affected by soil compaction. Burrowing animals such as earthworms, termites, ants, and beetles can defend themselves better but may still suffer negative effects.

The unmitigated potential impacts of soil compaction resulting from the proposal are generally short-term and temporary.

8.3.4 Displacement of flora and fauna species from invasion of weed and pest species

Weed and pest species have the potential to impact on terrestrial biodiversity as native species can become displaced through predation and competition with exotic biota. Pest species can also damage native vegetation by grazing and trampling (Adair and Groves 1998; Clarke *et al.* 2000; Thorp and Lynch 2011).

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of the proposal activities) that may have cumulative effects as each proposal activity, as well as agricultural practices and other resource proposal activities, may act in conjunction to increase the chances of weed and pest proliferation throughout the proposal area and adjoining areas. Proliferation of weed and pest species has the potential to occur during all phases of all proposal activities, especially during the construction phase, however the highest likelihood of weed and pest species occurring is from vegetation clearing and soil disturbance from agricultural land practices.

The effects of proliferation of weed and pest species may not be noticeable immediately or even in the short-term, as visible signs may take several months or seasons to impact on ecological receptors and processes. These potential impacts are likely to be long-term and affect all ecological receptors in the subject land, including affecting the quality and integrity of TECs. TECs in the subject land that are most likely to be affected include Poplar box grassy woodland on alluvial plains, Natural grasslands on basalt and fine-textured alluvial plains, and Semi-evergreen vine thickets. PCTs, habitat for threatened species, wetlands and waterways may also be affected.

Numerous non-native species are recorded within large expanses of the subject land, and there many existing vectors present that assist in their spread. This includes the movement of agricultural machinery and vehicles, livestock, native and pest animals, wind and flood vents. Of the non-native species present, 13 species are listed under the provisions of the *Biosecurity Act 2015* as high threat exotic weeds or exotic weeds. Without appropriate management strategies, the proposal activities have the potential to disperse weeds into areas of remnant vegetation where weed species are currently limited or occur in low densities.

Proposal activities also have the potential to introduce new weed species into the subject land area. The most likely causes of weed dispersal and introduction associated with the proposal include earthworks, movement and disturbance of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. Weed dispersal by vehicles along access tracks and roads is a key source of weed invasion (Birdsall *et al.* 2012). Weed invasion is an indirect impact that may degrade the quality of habitats, potentially resulting in habitat loss.

Soil disturbance during construction may increase the risk of invasion from weed and/or pest species, which can further reduce habitat quality and compromise the integrity of adjacent areas such as TECs.

Large areas of the subject land have significant weed growth, particularly non-native grasses, which have been introduced as part of historic agricultural land use of the area. Therefore, the potential for habitat modification from weed invasion resulting from the proposal is highest where proposal activities take place in relatively intact areas, such as those identified as containing intact remnant vegetation that currently has low weed diversity and abundance.

Eight pest animal species are recorded from the subject land, including two birds and six mammals.

Unmitigated proposal activities have the potential to disperse pest (animal) species from the subject land into the surrounding landscape, due to habitat removal, noise disturbance, and human presence during the construction and operation phases of the proposal. Construction of access tracks and the rail infrastructure through patches of intact vegetation may result in the establishment of pest species (particularly predators such as foxes and cats) into areas where they are currently absent or in low numbers. Therefore, unmitigated potential impacts of the displacement of native species through the invasion of non-natives may be temporary or permanent.

8.3.5 Reduction in the connectivity of biodiversity corridors

Biodiversity corridors can be defined as systems of linear habitat which enhance the connectivity of wildlife populations and may help to overcome the main consequences of habitat fragmentation (Wilson and Lindenmayer 1995). Corridors can assist ecological functioning at a variety of spatial and temporal scales from daily foraging movements of individuals, to broad-scale genetic gradients across biogeographical regions. Some connectivity, especially around waterways and some roadside vegetation is present throughout parts of the subject land. Several borrow pits exist as isolated islands surrounded by agricultural activity. These islands may act as 'stepping stones' for species movement across the landscape.

Most of the study area exists within a generally fragmented broader landscape. Within the subject land, some functional connectivity is retained through local linkages of remnant and regrowth vegetation, associated with riparian corridors linking larger patches of vegetation on private land. These linkages are likely to provide landscape permeability for mobile species such as birds, mammals and reptiles. Riparian vegetation associated with the Macintyre River is the most significant corridor in the region and traverses the subject land.

The potential impacts of linear infrastructure traversing these biodiversity corridors include habitat fragmentation, edge effects and barrier effects. These potential impacts are discussed further in the sections below. An additional potential impact upon biodiversity corridors resulting from the proposal is the additional spread of weeds and pest species into new areas, as mentioned previously, although there is an existing baseline level of weeds and pest species already established in the study area. Receptors involving threatened species which utilise these corridors and wildlife refugia are most likely to be impacted due to the overall importance of high quality linkages at a local and regional landscape scale. Threatened fauna species most likely to utilise biodiversity corridors in the study area include Spot-tailed quoll, Squirrel glider, Red goshawk, and Australasian bittern.

The unmitigated potential impacts to biodiversity corridors resulting from the proposal are likely to be long-term and irreversible.

8.3.6 Edge effects

Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats. These new environmental conditions along habitat edges can promote the growth of different vegetation types (including weed species), promote invasion by pest animals specialising in edge habitats, or change the behaviour of resident native animals (Moenting and Morris 2006). Edge zones can be subject to higher levels of predation by introduced mammalian and native avian predators. The distance of edge effect influences can vary and has been previously recorded from 50 m to greater than 1 km from an edge (Forman *et al.* 2000; Bali 2005).

Within the subject land, many patches of vegetation are small, irregularly shaped, and fragmented, and as such are already subject to considerable edge effects. The majority of the subject land adjoins existing open agricultural areas or roads. Therefore, it is unlikely that the proposal would increase the overall extent of edge effects in these areas. However, in large habitat patches with low edge to area ratios, proposal activities may create edge effects resulting in habitat degradation and a reduction of the habitat available for a range of species. The proposal is most likely to create edge effects where vegetation clearing for the alignment segments reduces the size of existing native vegetation patches.

Edge effects have the potential to adversely impact threatened flora and fauna species identified as potentially occurring in the subject land, especially upon the species with specific micro-habitat requirements that are less tolerant to disturbance (i.e. Dunmall's snake, Speckled warbler, Brown treecreeper, and Australian painted snipe). Birds a particularly sensitive to disturbance during breeding and may abandon nests.

Conversely, some threatened plant species appear to respond positively to edge effects, particularly ground disturbance, and can colonise these edge areas reasonably quickly (e.g. *Dichanthium setosum*).

The unmitigated potential impacts of edge effects resulting from the proposal are considered to be both short-term in some instances and irreversible in others.

8.3.7 Habitat fragmentation

Habitat fragmentation relates to the physical dividing up of a continuous habitat into separate smaller fragments (Fahrig 2002). The habitat fragments tend to be smaller and separated from each other by a matrix of less suitable habitat. The new habitat type situated between fragments is often artificial and less suitable to the species remaining within these newly created fragments (Bennett 1990) or is generally only used by adaptive and aggressive generalist species (i.e. Noisy miners) (Loyn *et al.* 1983) which further decreases population levels of other species remaining in the fragments.

The landscape in which the proposal is situated is highly fragmented with most vegetation occurring as small fragments due to agricultural practices such as pasture and cropping, and the existing road and dormant rail corridor. The proposal activities will contribute to further fragmentation. Receptors involving threatened species, regionally significant vegetation, bioregional corridors and wildlife refugia may be impacted upon the most from habitat fragmentation. This is due to the importance of connectivity, dispersal opportunities and habitat quality for species at a local scale and the cumulative impacts at a regional scale.

Proposal activities may result in some further localised fragmentation which has the potential to be detrimental to the dispersal of relatively sedentary species, such as small mammals, frogs, and reptiles which can lead to crowding effects and increased competition within habitat patches. However at some locations within the current dormant rail corridor failed or blocked culverts currently may be acting as a barrier to movement, and new culverts associated with the project may enhance dispersal opportunities once established. Woodland specialist species with limited dispersal capabilities are most likely to be affected by habitat fragmentation. Receptors with limited dispersal capability in fragmented landscapes include Brown treecreeper, Five-clawed worm-skink, Squirrel glider and Eastern pygmy-possum.

Mobile species such as larger mammals, birds, and bats may not be affected by this small-scale fragmentation, as the landscape in which they currently exist is fragmented and the predicted level of fragmentation would not be enough to restrict their dispersal between habitat patches providing that mitigation measures are in place to facilitate dispersal in these species.

The fragmentation of habitat resulting from the proposal is most likely to occur where the proposal intersects existing areas of native vegetation, such as along the Macintyre River. The unmitigated potential impacts of habitat fragmentation resulting from the proposal are considered to be long-term and irreversible.

8.3.8 Barrier effects

Barrier effects occur where particular species are either unable or are unwilling to move between suitable areas of habitat due to the imposition of a barrier. This can include a habitat type that has become unsuitable or a physical barrier such as a fence. Species most vulnerable to barrier effects include uncommon species, smaller ground-dwelling species, and relatively sessile species with smaller home ranges.

Various proposal activities may create barrier effects, particularly those that may create a hard barrier that restricts fauna movement (e.g. access tracks, easements). This impact may affect small mammals, frogs, reptiles and threatened species such as Dunmall's snake, Five-clawed worm-skink, Pale-headed snake, Stripe-faced dunnart, Squirrel gliders and Woma. Mobile species such as larger mammals, birds, and bats may not be affected to the same extent.

Human activity and infrastructure can create a barrier and many species are known to avoid areas of human activity resulting in indirect habitat loss. Human presence may affect species in different ways. Some species display avoidance behaviour while others may habituate and become attracted to areas of human activity. Predators and prey may respond differentially to human activity, causing a disruption of community interaction and potentially disrupting ecological processes (Caro 2005). Human presence and activities are likely to produce avoidance responses in larger mammalian predators that are sensitive to disturbance (i.e. Spot-tailed Quoll), while species such as macropods (i.e. kangaroos and wallabies) and smaller amphibian and reptile species are more likely to habituate to human presence. The construction phase of the project is likely to contribute to highest number of persons present, although once operational the project will be similar to current levels.

Similarly, barrier effects may be experienced by native animals in the form of increased patrolling and predation by pest animals along barriers, such as a cleared corridor. Foxes and wild dogs target these barrier areas if prey becomes more exposed and easier to detect and catch.

Barrier effects resulting from the proposal are most likely to occur where cutting or embankments are required for flood immunity. Although as noted above the replacement of failed or blocked culverts within the current dormant rail corridor with new culverts may enhance dispersal opportunities at these localities.

Given a large proportion of the proposed works will occur within the existing rail corridor much of the most permanent barrier related to the proposal already exists. The unmitigated potential impacts of barrier effects resulting from the proposal are considered to be in most cases short-term and temporary but may in some cases may be long-term and irreversible where new infrastructure is developed.

8.3.9 Noise, dust and light impacts

Noise, dust, and light are direct impacts that have the potential to occur as a result from the proposal activities during all phases and may also have cumulative effects. The likelihood of potential impacts is anticipated to be greatest where the proposal activities take place near vegetated areas and known habitat, during the construction and rehabilitation phases. Operating rail lines will generate noise and vibration and it is likely that many species will habituate as a result of the regularity of generated noise.

The proposal will result in impacts from light spill into adjacent receiving environments (e.g. fauna habitat) due to the operation of plant and equipment throughout the construction phase of the proposal and installation of lighting on infrastructure required for the operation of the proposal. Impacts associated with light spill may include direct impacts (e.g. increased susceptibility to predation from increased light) or indirect impacts related to altered foraging and habituation in areas exposed to increased lighting. Insectivorous microbats may benefit from artificial light sources at night that attract insect prey. Light impacts associated with construction will be temporary in nature, however operational lighting impacts will be long term and localised (e.g. infrastructure) or transient in nature (i.e. vehicle movement).

Ecological receptors affected by these potential impacts include all threatened flora and fauna species listed under the provisions of the EPBC Act and/or BC Act. Ecological receptors involving remnant vegetation and habitat may also be impacted to a lesser extent. These types of impacts are likely to be short in duration and localised.

8.3.10 Increase in litter (waste)

Littering and the dumping of waste has the potential to impact the surrounding environment by causing injury to wildlife, posing a potential threat to human health and is aesthetically displeasing. When discarded as litter, human-made materials such as plastic, glass and aluminium have the potential to cause external injury to wildlife, entanglement, and if accidentally ingested, may cause starvation or suffocation. Littered objects may also provide suitable habitat for disease-spreading insects, such as flies and mosquitoes (Healthy Waterways 2014) and contaminated materials may impact waterways and human health.

According to the National Litter Index, across Australia the most littered items are cigarette butts; and plastic objects are the most littered by volume of material. Cigarette butts and small plastic items are often mistaken for food resources and have been found in the stomachs of juvenile birds. In addition, littering of cigarette butts also poses a bushfire risk (Healthy Waterways 2014).

Ecological receptors affected from this potential impact include all threatened flora and fauna species listed under the provisions of the EPBC Act and BC Act. Where unmitigated this type of impact has the potential to be long in duration due to the varying times of decomposition; however, it is likely to be localised, manageable and preventable.

8.3.11 Erosion and sedimentation

Terrestrial impacts associated with erosion and sedimentation include compaction of soil, loss of soil structure, nutrient degradation, and increased soil salinity all of which can lead to reductions in the carrying capacity of the terrestrial environment as a result of decreasing habitat value.

The transport of sediment and eroded material can be washed off areas of exposed soil, stockpile locations, or localised areas in proximity to proposal infrastructure (e.g. culverts and bridges) during rainfall events. In addition, it may also result from activities that interfere directly with waterways (e.g. augmentation to channels, uncontrolled livestock access and removing riparian vegetation).

Erosion and subsequent sedimentation can be damaging to the ecological health of waterways and the surrounding terrestrial environment and may be a proximate cause of environmental degradation. Mobilised coarse sandy sediment tends to accumulate in areas of slow-flow and may smother bottom-dwelling organisms and their habitats. Deep permanent river pools, that are valuable habitats for aquatic fauna and refuges for wildlife during summer and drought, may become filled by course sediments, which may render them ineffective in relation to their ability to support aquatic and terrestrial species.

Large sediment accumulations can cause upstream flooding or deflect the flow into the adjacent stream bank or even onto adjacent land, causing further erosion and transported sediments can fill the deep permanent pools of rivers to ruin this critical refuge habitat. Threatened species dependent on water sources include in the subject land include Australasian bittern, Australian painted snipe, Diamond firetail, Freckled duck, Turquoise parrot, and Black-necked stork.

8.3.12 Changes to hydrology and flooding

Physical habitat modification due to hydrological regime change may degrade current habitat morphological features including substrate composition, channel form and bank stability which may reduce aquatic ecological values both instream and on adjacent floodplain wetland areas. Further loss of ecological services may occur from a removal of riparian vegetation required for both watercourse and drainage feature infrastructure (within construction and operation phases), which may compound physical habitat modification from any changes to hydrological regimes. It is noted most waterways intersected by the Project are already subject to significant habitat modification due to adjacent land use.

An assessment of the impacts of the proposal on local flooding regimes has been carried out in detail in EIS Chapter 13: Flooding and Hydrology. In summary this analysis modelled the current state of development (Existing Case) and details of the existing flood regime were determined for the modelled design events. The proposed works associated with the Project were incorporated into the hydraulic models (Developed Case) and assessment of the potential impacts upon the existing flood regime was undertaken. The hydraulic models were run for a suite of design events from the 20% AEP event to the 1 in 10,000 AEP and Probable Maximum Flood (PMF) events. Changes in peak water levels, velocities, flow patterns and flood inundation extents and durations were identified, mapped or tabulated.

The hydrologic and flooding assessment (refer Table 8.2) demonstrated that the proposal is predicted to result in impacts on the existing flooding regime that generally comply with the proposed flood impact objectives. Best practice flood risk management, including sensitivity testing, has been applied in developing the proposal design to minimise risk to life, property, infrastructure, the community and environmental values. The proposal is not expected to result in any substantial impact to ecological communities located outside of the proposal footprint or wetland values. Any change that is more than minor in nature will be localised and temporary (i.e. during flooding events).

Table 8.2 Flood impact objectives and outcomes

Parameter	Objectives and outcomes				
Change in peak water levels	Existing habitable and/or commercial and industrial buildings/ premises (e.g. dwellings, schools, hospitals, shops)	Residential or commercial/industrial properties/lots where flooding does not impact dwellings/ buildings (e.g. yards, gardens)	Existing non-habitable structures (e.g. agricultural sheds, pump-houses)	Roadways	Agricultural and grazing land/forest areas and other non-agricultural land
	≤ 10 mm	≤ 50 mm	≤ 100 mm	≤ 100 mm	≤ 200 mm with localised areas up to 400 mm
	Objective: Changes in peak water levels are to be assessed against the above proposed limits. **Outcome:** Generally, the proposal design meets the above limits with number of small localised areas along the proposal alignment where these increases of up to 400 mm occur. These areas are very small in extent with increases dissipating within 30 m to 200 m of the alignment. No flood sensitive receptors are impacted by the changes in peak water levels under the 1% AEP event. There are two locations where the change in peak water levels exceed 400 mm. These are located in the north where the alignment intersects the Bruxner Hwy south of the Macintyre River (refer EIS Chapter 13: Flooding and Hydrology). In both locations the impact reduces to less than 200 mm within 100 m or less of the rail embankment, with the impact limited to an area 0.025 km^2 or less. With regard to ecological values this includes tracts of natural grasslands (PCT 52) in the vicinity of the Macintyre River which may also be considered as an EPBC-listed TEC, provides habitat for some threatened species and for which changed hydrological regimes is listed as a threatening process. Flood modelling shows the change in peak water levels across much of this area as being a potential increase of up to 50 mm only. Where this patch approaches and intersects the Bruxner Hwy the predicted increase rises up to 200 mm. This represents a relatively small proportion of the overall area of the PCT. As noted below, changes to flood inundation times are expected to be minor, localised and represent a negligible impact.				
Change in duration of inundation	**Objective:** Identify changes to time of inundation through determination of the duration of inundation (TOS). For roads, determine AATOS and consider impacts on accessibility during flood events. **Outcome:** There are minor localised changes in the TOS upstream and downstream of the proposal alignment. These changes in inundation duration do not affect flood sensitive receptors and compared to the duration of the flood events on the Macintyre River floodplain these changes are minor. The modelling results at a number of local roads have been inspected with the depth of water, TOS and AAToS assessed. With the exception of one localised area on Bruxner Way, there is no adverse impact on existing roads. The localised area on Bruxner Way is isolated during normal flood events by flood waters to the north and south for long durations and with over 1 m of flood water. The localised increase in this location is therefore considered not to be an adverse impact.				
Flood flow distribution	**Objective:** Aim to minimise changes in natural flow patterns and minimise changes to flood flow distribution across floodplain areas. Identify any changes and justify acceptability of changes through assessment of risk with a focus on land-use and flood sensitive receptors. **Outcome:** The Project has minimal impacts on flood flows and floodplain conveyance/storage with significant floodplain structures included to maintain the existing flood regime.				
Velocities	**Objective:** Maintain existing velocities where practical. Identify changes to velocities and impacts on external properties and waterway geomorphology. Determine appropriate scour mitigation measures taking into account existing soil and geomorphological conditions. **Outcome:** In general, changes in velocities are minor, with most changes in velocities experienced immediately adjacent to the proposal alignment and no flood sensitive receptors impacted. The proposal results in minimal changes to peak water levels, velocities and flood flow distribution across the floodplain and in each of the waterways. This means that the proposal design minimises potential changes to the geomorphological conditions in the waterways and as such the risk of change to geomorphological conditions in each of the waterways is low. Scour protection has been specified where the outlet velocities for the 1% AEP event exceed the allowable soil velocities for the particular soil type for each location, which was identified from published soil mapping.				
Hazard	**Objective:** Identify changes to hazard categories and any impacts on external properties. Justify acceptability of changes through assessment of risk with a focus on land-use and flood sensitive receptors. **Outcome:** There are no significant changes to hazard classifications across the floodplain as a result of the proposal alignment works.				

Parameter	Objectives and outcomes
Extreme event risk management	**Objective:** Consider the risks posed to neighbouring properties for events larger than the 1% AEP event to ensure no unexpected or unacceptable impacts. **Outcome:** A review of impacts under the 1 in 2,000 AEP, 1 in 10,000 AEP and PMF events has been undertaken with the existing flood depths and increase in peak water levels at flood sensitive receptors identified on each floodplain. Overall, considering the high flood depths that occur, particularly under the PMF event, the changes in peak water levels would be unlikely to exacerbate flood conditions during extreme events. There are three locations, one house and two sheds, where water levels increase significantly under the extreme events. During detailed design these outcomes will be discussed in detail with landholders and a range of alternative mitigation measures will be further investigated including refined drainage structures, property solutions, scour and embankment protection etc. Formal third party agreements will be negotiated with landholders that takes account of these impacts and the adopted mitigation measures.
Emergency management	**Objective:** Consider the impacts the proposal may have upon existing community emergency management arrangements for flooding as well changes to flood safety risks on private and public land including roads and pathways. **Outcome:** There are no significant changes to flood depths, inundation extents or durations and therefore there are no changes to existing flood safety risks.
Sensitivity testing	**Objective:** Consider risks posed by climate change and blockage in accordance with ARR 2016. Undertake assessment of impacts associated with proposal alignment for both scenarios. **Outcomes:** Climate change – climate change has been assessed in accordance with ARR 2016 requirements with the representative concentration pathway 8.5 (2090 horizon) scenario adopted giving an increase in rainfall intensity of 23 per cent across the catchment areas. The impacts resulting from changes in peak water levels under the 1% AEP event with climate change are generally similar to those seen under the 1% AEP event. Blockage – Blockage of drainage structures has been assessed in accordance with ARR 2016 requirements. The blockage assessment resulted in no blockage factor being applied to bridges and a blockage factor of 25 per cent being applied to culverts. Two blockage sensitivity scenarios were tested with both 0 per cent and 50 per cent blockage of all culverts assessed. The resulting changes in peak water levels associated with the Project alignment are still localised and do not impact on any flood sensitive receptors.
Compliance with Floodplain Management Plan	Check to ensure consistency with Check to ensure consistency with applicable Council or DPIE floodplain management plans. **Outcomes:** Existing floodplain management plans have been reviewed including: ▪ Moree Plains Development Control Plan ▪ Border Rivers Valley Floodplain Management Plan (BRVFMP) For the portion of the proposal within Gwydir Shire Council an EIS is required to be undertaken for works of this nature and this current document addresses this requirement. The Moree Plains Development Control Plan does not cover the Macintyre River floodplain with the key document to be addressed being the BRVFMP. The BRVFMP has been reviewed and the proposal complies with all requirements. This includes consideration of impacts under a range of events, consideration of cumulative impacts, demonstrating acceptable changes in peak water levels, no significant increases in velocities with velocities not to cause erosion and siltation and no potential concentration of flows in rivers or creeks which may affect river stability or geomorphological conditions.

8.3.13 Disturbance to specialists breeding and foraging habitat

Many fauna species have specific requirements for breeding and foraging. Hollow nesting birds often have a limited range in the size of hollows that they will use for breeding purposes. Masked owls require a hollow which is at least 20 cm in diameter in tall trees while Glossy black cockatoos require hollows of at least 15 cm in diameter which are at least 5 m above ground (DPIE 2019) and are specialist feeders on *Allocasuarina* and *Casuarina* species.

Works associated with the proposal will have both direct and indirect effect on specialist habitat. Direct impacts will include the removal of hollow bearing trees and feed trees while indirect impacts such as noise during project works and rail line operations may affect where these species choose to nest and feed. Species which may be impacted due to the disturbance of these habitat features where present include Masked owls, Barking owls, Glossy black cockatoos and Squirrel gliders. These impacts are likely to be long term in relation to the removal of hollow bearing trees where this occurs and may be short or long term in relation to operational noise depending upon individual species resilience.

8.3.14 Trampling of threatened species

Trampling of threatened species has the potential to reduce an individual plants resilience or result in its mortality. This, in turn, can lead to a reduction in the number of individuals of a threatened species found within a location, thus further increasing its vulnerability at a local or broader level.

Project works have the potential to impact on areas of native vegetation during the construction phase if site personnel choose to drive or park in non-designated access areas. Threatened flora species identified within the study area to date include Belson's Panic (*Homopholis belsonii*) and Finger Panic Grass (*Digitaria porrecta*) as such are at potential risk of trampling. Other species which may be impacted by trampling include Native milkwort, other listed native grasses and listed Swainsona species.

8.3.15 Fallen timber and bush rock collection or removal

The removal of fallen timber and bush rock causes a decrease in habitat for small reptiles, small mammals, arachnids, and flora species. Fallen timber and bush rock create microclimates by increasing shade and reducing wind effects thus providing habitat for small fauna to hide from predators, hunt for food, shelter and escape from fires. Species which may be affected by the removal of fallen timber and bush rock removal include the Border thick-tailed gecko.

Wood and bush rock collection is not considered to be an increased risk in relation to the proposed works outside of those areas which will be directly impacted by the works. Borrow Pits 1 and 2 have the highest amount of surface bush rock areas of which will be removed as part of the development of those borrow pits should that occur. Access to remnant vegetation areas are not likely to change as a result of the proposed works therefore no additional removal of habitat material is considered likely to occur. Species which may be impacted by the removal of fallen timber and bush rock include Pale-headed snake and Border thick-tailed gecko.

8.3.16 Fertiliser drift

Fertiliser drift has the potential to cause damage to native remnant vegetation communities by changing the growth rate of some species in relation to others, often exotic species are more likely to benefit from the addition of fertiliser over that of native species. Fertiliser drift also has the potential to change the native species composition of ecological communities which in turn can affect the habitat suitability for threatened species.

Some listed native grasses may benefit from a small amount of fertiliser drift however other species such as Swainsona may be crowded out grass species. An increase in grass density may also reduce the ability of forbs and tree species to germinate and/or grow above the grass height and reach maturity. Fertiliser drift is usually associated with highly intensive agricultural activities such as cotton farming or viticulture however a limited amount may already occur in areas where the existing native vegetation is located directly adjacent to areas of intensive agriculture. The removal of native vegetation as part of the project works may lead to a new area of vegetation becoming exposed to fertiliser drift due to the removal of that vegetation buffer. However, the distance between any farming practices and remnant vegetation will remain the same as clearing will be associated with project works which do not include the use of fertiliser and not farming practices which may.

Plant communities which may be adversely affected by fertiliser drift include Weeping Myall and Brigalow, while growth rates and densities of individual listed species such Bluegrass, Finger panic grass, Belson's panic and Swainsona may also be affected.

8.3.17 Increased bushfire risk

An increase in bushfire frequency disrupts the life cycle of flora and fauna, as repeated higher intensity bushfires change the vegetation structure which includes loss of fallen timber, hollow and habitat trees/stags and is often followed by an increase in shrub density. While many Australian flora species have developed mechanisms to regenerate with fire, at the landscape scale frequent high intensity bushfires will decrease the resilience of the plant communities. Some flora species may be burnt before they are mature enough to seed thus reducing the diversity of the vegetation community which in turn can further reduce its habitat quality. Excessively hot fires have the potential to sterilise the ground by killing the seedbank, contributing to loss of substrate from post fire erosion and alter the vegetation structure.

The loss of fallen timber, live hollow trees and stags decreases habitat availability for many native species and is likely to increase stress and resource pressure on fauna species. The loss of these habitat features may also increase the risk of predation of species by both native and introduced fauna.

Without mitigation measures, the proposal may increase the risk of fire due to hot works during construction activities and the chance of sparks occurring off the train wheels during times of hot and dry conditions. Species which may be impacted upon by an increased fire frequency include hollow dependant species such as Barking and Masked owls, Squirrel gliders and large cockatoo species. Flora which may be impacted by increased fire frequency include Scant pomaderris, Native milkwort and *Tylophora linearis*.

8.4 Potential impact to fauna species-credit species which have been identified within the subject land

8.4.1 Squirrel glider

This species was identified within the riparian vegetation of the Macintyre River (PCT 36), within PCT 244 *Eucalyptus populnea* woodland and within PCT 55 Belah woodland. Figure 6.2 shows the location of the species records in relation to the subject land.

The Squirrel glider is a small, nocturnal, tree dependent gliding marsupial that feed on nectar, pollen, plant exudates (Acacia gum and *Eucalyptus* spp.), invertebrates and honeydew. This species live in social groups of two to nine individuals in leaf lined nests in tree hollows generally within a 5 to 15 ha home range (Goldingay, Sharpe and Dobson 2010). Home range varies according to habitat quality, especially presence of feed trees and habitat trees with suitable hollows. This species has a strong affinity with their home range and even if clearing claims most of the home range they typically do not move to adjacent vegetation (Wildlife Preservation Society Queensland 2016).

Squirrel glider occurrence is highly localised and dependent on availability of suitable foraging habitat with tree hollows. Colonies require multiple den trees within their home ranges. High population density is only achievable in habitats with abundant hollow bearing trees (>4 habitat trees/ha) and abundant food trees (Sharpe and Goldingay 2010). Dead trees (stags) are an important habitat component and are used when available. A high abundance of tree hollows (including stags) and food trees were observed in select locations throughout the subject land, particularly within the riparian corridors of the Macintyre River and the major creeks.

Tree hollows utilised can have entrance sizes of 2.5 to 12 cm diameter, although hollows with entrances ≤ 5 cm wide are used most frequently. Gliders select small entrances (about 3 to 5 cm entrance diameter) to exclude competitors and predators. Most foraging is within about 400 m of dens.

The main threats are loss and degradation of habitat, habitat fragmentation and resulting population fragmentation, loss of tree hollows, road kill, frequent fire, predation, collision with barbed wire fencing, weed invasion, and removal of dead wood and dead trees (OEH 2017). Habitat loss and degradation has the potential to reduce the local abundance of the species, particularly when hollow-bearing trees are removed. The loss of suitable hollow-bearing trees may make habitat unsuitable. Habitat fragmentation and resulting population fragmentation has the potential to reduce the genetic diversity of the local population and therefore reduce species resilience. As described in Section 8.3.2, direct mortality resulting from train strike may reduce the local abundance of the species.

8.4.2 Koala

This species was identified within the riparian vegetation of the Macintyre River (PCT 36), and scats and scratches recorded in February 2021 further south adjacent to the alignment. Figure 6.2 shows the location of the species record in relation to the subject land.

The Koala is a medium-sized arboreal marsupial with a highly specialised diet of eucalypt leaves. The distribution of the Koala ranges from north east Queensland to south east South Australia, including most of New South Wales except the far north west. The Koala is sexually dimorphic, with males generally larger than females. Individuals in the north of the species range are typically smaller than individuals in the south. The average weight of males is 6.5 kg in Queensland and 12 kg in Victoria. Female Koalas typically produce a single offspring annually, during October to May (Martin and Handasyde 1999). Joeys remain in the pouch for six to eight weeks, when they move to their mother's back and remain dependent until 12 months of age.

Foraging occurs during dawn, dusk and night, and is restricted to the foliage of trees from the *Eucalyptus*, *Angophora*, *Lophostemon* and *Corymbia* genera. Specific food trees differ between regions, with Koala habitat at most sites supporting one or a few suitable food tree species. Suitable habitat for the species includes temperate, sub-tropical and tropical forest, woodland and semi-arid vegetation communities dominated by *Eucalyptus* spp. (Martin and Handasyde 1999). Shelter trees from a range of genera are an important component of Koala habitat and play an essential role in thermoregulation (Crowther et al. 2013). The Koala is not territorial but forages within home ranges that overlap with the home ranges of other individuals. Males usually have a larger home range than females. Home ranges vary in size from less than 10 ha to over 100 ha, depending on habitat quality.

The main threats to the Koala are habitat loss and fragmentation, vehicle strike, predation by dogs, disease, climate change, and drought. Historical land clearing in eastern Australia has significantly reduced the extent of habitat available for Koala. Remaining habitat is often fragmentated and ultimately unviable due to isolation. Local declines and extinctions in isolated Koala sub-populations may be contributed to *Chlamydia* infection, which reduces female fertility (NSW DECC 2008).

8.4.3 Pale-headed Snake

The species was recorded in three locations during surveys. Two records were within the flaking bark of two separate *Eucalyptus camaldulensis* trees adjacent to Mobrindry Creek (within PCT 36). One location was at the road reserve adjacent to Tucka Tucka Road, on the tessellated bark of a *Corymbia tessellaris* (within PCT 192). All trees where this species was recorded were large trees with >80cm dbh and supported hollows.

The Pale-headed Snake is a small, nocturnal, predominantly arboreal reptile that has a diet preference of frog species. The species is known to inhabit wet and dry sclerophyll forest and open woodlands and rely upon heavily on old and dead standing trees with hollows and exfoliating bark for shelter. In drier environments, it appears to favour habitats close to riparian areas. Shelters during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees (OEH 2021).

The key threats to the Pale-headed Snake are habitat clearing (particularly of old, large and hollow trees), disturbance of riparian habitat, and invasion by the toxic Cane Toad species (OEH 2021, Shelton et al. 2018). Impacts as a result of habitat clearing are exacerbated by the fact that the species has been found to have a slow recovery following population loss. As a habitat specialist, the continued fragmentation of riparian *Eucalyptus camaldulensis* forests is likely to continue to place increased pressure on species populations (Shelton et al. 2018).

8.5 Groundwater dependent ecosystems

High potential aquatic GDEs were identified over 1 km from the proposed alignment at Malgarai Lagoon and in an upstream portion of the Macintyre River. High potential terrestrial GDEs were identified in several of the ephemeral waterbodies crossed by the proposal (refer Section 4.4.7). Proposal activities are not anticipated to affect shallow groundwater near these high priority GDEs given their distance from the alignment and/or the fact that construction works are not anticipated to intersect groundwater.

Only a very limited impact on groundwater levels is expected (refer EIS Chapter 14: Groundwater). As such, there is unlikely to be any adverse impacts upon the identified high potential terrestrial GDEs and these are not addressed further within this report.

8.6 Impact mitigation

This section outlines the impact avoidance options and mitigation measures included as part of the proposal design. The proposed site selection to avoid impacts to biodiversity and mitigation measures proposed to manage predicted environmental impacts are also described. The impacts are initially assessed with consideration of the design mitigation measures and then reassessed to determine residual impact after the inclusion of the proposed mitigation measures. Specifically, some of the borrow pit and laydown areas identified initially in the EIS for the project (ARTC 2020) have been removed or boundaries reduced and buffered to avoid potential impacts on threatened entities.

8.6.1 Avoidance options

Following the hierarchical approach to environmental management, options to avoid and minimise impacts have been considered. These options include use of the existing rail corridor wherever feasible, the location of temporary infrastructure to be within managed land or highly disturbed vegetation where possible, and the siting of bridges has been altered throughout the early development phase. Site selection for the proposal was informed by previous studies of potential alignment segments (refer Table 3.6).

Where possible the proposal footprint was restricted to avoid areas of MNES, BC Act listed ecological receptors and their associated habitat as far as practical, to that required to safely and efficiently construct and operate the proposal, thereby minimising significant adverse residual impacts to these matters.

Specifically, during detailed consultation with ecologists and engineers in 2020/2021 the design has sought to reduce the areas of potential impact associated with both laydown areas and the construction footprint associated with the following potential SAIIs:

- PCT 35 – Brigalow – Belah open forest/woodland
- Pale imperial hairstreak (*Jalmenus eubulus*).

Final targeted surveys for Pale imperial hairstreak were completed in accordance with BCSD methodology in March 2021, and did not locate any Pale imperial hairstreak within the subject land. However two populations of Stencilled hairstreak (*Jalmenus Ictinus*) (not listed) were recorded within PCT35 during these targeted surveys.

The following changes to the design footprint were implemented to reduce potential impacts on these with SAIIs:

- Borrow pit 2 has had the footprint modified to exclude all PCT35 with a 40 m buffer from the edge of the mapped PCT35. This buffer will be ground-truthed by a biodiversity specialist at the time of establishment.
- Borrow pit 5 was reviewed and retained as it does not contain PCT35
- Borrow pit 7 has had all of the southern section of the borrow pit removed, protecting PCT 35 and high quality PCT 56. The northern section of BP7 is located on Manged land which contains five scattered trees. The borrow pit is located on the border between the Northern Outwash and Northern Basalt IBRA subregions. The five scattered trees, located within a cropped paddock, have been assessed within the Northern Basalts subregion as this was a separate assessment with all trees solely within this IBRA subregion. The remaining area of PCT 56 has been assessed as part of the Northern Outwash as the original assessment, prior to targeted efforts to reduce impacts on PCT35, was located within this subregion.
- Borrow pit 9 has had the footprint modified to exclude PCT35 and is now limited to the southern quarter of the site with a 40 m buffer applied between the borrow pit footprint and the mapped PCT35 boundary. This buffer will be ground-truthed by a biodiversity specialist at the time of establishment. The access track to BP9 has been reviewed are relocated to include a cleared fire break area adjacent to the property boundary, this has further moved the subject land from areas of low quality PCT35 which would have been impacted by construction of the access track.
- Borrow pit 11 has been removed from the project as all vegetation within the subject land was PCT 35
- Borrow pit 25 has had the footprint modified to exclude PCT35 in the east of the area, with a 40 m buffer between the borrow pit footprint and PCT35. This footprint will be ground-truthed by a biodiversity specialist at the time of establishment.
- Borrow pit 26 has been removed from the project as all vegetation within the subject land was PCT 35
- Where ever possible laydown areas have been reduced to limit impacts on low quality PCTs including PCT27 and 56.

These efforts have reduced the potential impact on PCT 35 within the subject land from 101.1 ha to 17.51 ha. Appendix A.6 shows the revised subject land.

Overall the optimisation of the proposal footprint that has been completed post the submission of the EIS (ARTC 2020) with the objective of avoiding areas of disturbance. This included the reduction of areas attributed to borrow pits, laydown areas and early works. This activity has resulted in a reduction in disturbance footprint as presented in Table 8.3

Table 8.3 Reductions in disturbance area – EIS and post EIS

Area/feature	PCT	EIS disturbance area (ha)	Post EIS disturbance area (ha)	Reduction in disturbance area (ha)
Alignment Segments (Greenfield, Brownfield and Early Works)				
Castlereagh-Barwon	36 Medium	5.6	4.04	1.56
Castlereagh-Barwon	36 High	0.7	0.7	0.04
Castlereagh-Barwon	52 Medium	42	33.5	8.5
Castlereagh-Barwon	56 Low	14.3	20.2	-5.9
Castlereagh-Barwon	56 Medium	14.7	0.3	14.4
Castlereagh-Barwon	192 Low	3	1.2	1.8
Castlereagh-Barwon	192 Medium	5.3	2.3	3
Castlereagh-Barwon	244 Low	9.5	3.7	5.8
Castlereagh-Barwon	244 Medium	3.6	7.4	-3.8
Castlereagh-Barwon	247 Low	4.4	4.5	-0.1

Area/feature	PCT	EIS disturbance area (ha)	Post EIS disturbance area (ha)	Reduction in disturbance area (ha)
Castlereagh-Barwon	247 Medium	6.9	6.2	0.7
Castlereagh-Barwon	628 Medium	11.7	6.0	5.7
Castlereagh-Barwon	628 Low	21.1	20.4	0.7
Total Castlereagh-Barwon		**142.8**	**110.4**	**32.4**
Northern Basalts	35 Low	**4.9**	**2.0**	2.9
Northern Basalts	35 High	10	10.6	-0.6
Northern Basalts	53 Medium	5.8	4.2	1.6
Northern Basalts	55 High	0.5	0.64	-0.14
Northern Basalts	56 Low	38.4	30.1	8.3
Northern Basalts	56 Medium	12.3	7.9	4.4
Northern Basalts	56 High	27.9	34.5	-6.6
Northern Basalts	98 High	1.8	2.2	-0.4
Northern Basalts	244 Low	1.1	0	1.1
Northern Basalts	244 Medium	4.7	0	4.7
Northern Basalts	244 High	10.1	0	10.1
Total Northern Basalts		**117.5**	**91.14**	**25.36**
Northern Outwash	27 Low	4.3	8.6	-4.3
Northern Outwash	27 Medium	0.01	0.02	0.01
Northern Outwash	35 Low	4.7	2.1	2.6
Northern Outwash	35 High	4.2	5.44	-1.24
Northern Outwash	36 Medium	0.5	0.23	0.27
Northern Outwash	36 High	0.4	0.51	-0.11
Northern Outwash	56 Low	47.4	37.2	10.2
Northern Outwash	56 Medium	2.3	0.96	1.34
Northern Outwash	56 High	2.7	1.87	0.83
Total Northern Outwash		**66.51**	**56.93**	**9.58**
Total Alignment Reduction (ha)				**67.34**
Borrow Pits				
BP1	35 M	0	0.68	-0.68
BP1	35L	0	0.95	- 0.95
BP2	35 L	3.2	0.67	2.53
BP5	192 Low	2.5	1.9	0.6
BP7	35L	7.7	0	7.7
BP7	35H	17.5	0	17.5
BP9	35H	21.8	0	21.8
BP9	418M	6.07	2.9	3.1
BP9	418H	21.19	3.9	17.9
BP11	35L	0.9	0	0.9
BP11	35H	18.5	0	18.5
BP25	35H	2.4	0	2.4
BP26	35L	0.9	0	0.9
BP26	35M	3.3	0	3.3

Area/feature	PCT	EIS disturbance area (ha)	Post EIS disturbance area (ha)	Reduction in disturbance area (ha)
BP26	35H	1.1	0	1.1
Total Borrow pits reduction (ha)		107.06	30.58	95.5
Total reduction within subject land (ha)				**162.84**

Further details of the impact assessment on SAIIs is provided in Section 9.2 Appendix A Map C.7 (flora) and Appendix F Map D.2 (fauna). Details of alternative options are provided in EIS Chapter 3: Alternatives and proposal options.

8.6.2 Design considerations

The mitigation measures and controls presented in Table 8.4 have been factored into the feasibility designs for the proposal. These design considerations are proposed to minimise the environmental impacts of the proposal on flora and fauna and therefore contribute to a lowering of the initial impact risk rating for each potential impact.

Table 8.4 Initial mitigations of relevance to terrestrial ecology

Aspect	Initial mitigations
Minimisation of impacts to ecology	■ Portions of the proposal are located within the existing rail corridor and wherever possible are aligned to be co-located with existing road infrastructure, minimising the need to develop natural and rural landscapes that have not previously been subject to disturbance to the greatest extent possible. However, the alignment is within a protected corridor, so avoidance opportunities are limited ■ Multiple potential borrow pits have been identified and assessed in an effort to reduce overall impact to receptors with a number of borrow pits removed from further consideration or the area modified to reduce potential impacts ■ Disturbance footprints are limited to those areas required to construct and operate the works, as practical for safety, especially in regard to the clearing of existing vegetation communities ■ The rail corridor is an average of 40 m wide, with wider areas to provide temporary and permanent erosion and sediment control measures/pollution control measures, as required ■ Disturbance footprints are limited to that required to construct the works and associated environmental management controls ■ Design defines temporary and permanent storm water, erosion and sediment/pollution control measures in an Erosion and Sediment Control Plan and Reinstatement and Rehabilitation Plan, that complies with the relevant regulatory requirements and guidance. Temporary and permanent measures must be appropriate to the site conditions, responding to the erosion risk assessment, ecological receptors, climatic zone and seasonal factors. The aforementioned plans are to also establish and specify the monitoring and performance objectives for handover on completion of construction ■ Watercourse crossing structures (including culverts and bridges) are designed to minimise the need for ongoing maintenance and inspection to maintain aquatic fauna (e.g. fish) passage and minimise the risk of blockages in reference to fish passage requirements (Faifull and Witheridge 2003) and the Policy and guidelines for fish habitat conservation (DPI 2013) ■ Bridges and waterway crossings are designed to minimise impacts to bed, banks and environmental flows, in accordance with relevant regulatory requirements (as per requirements of DPI and the FM Act 1994) ■ Fauna crossing opportunities have been co-located with waterway crossing structures to maintain habitat connectivity and where possible, these align with potential fauna movement corridors or areas of important fauna habitat i.e. areas which are considered to be fauna habitat corridors such as treed waterways

Aspect	Initial mitigations
	■ Fauna crossing structures will be installed where suitable to enhance connectivity for threatened fauna and may include glider poles, culvert furniture and rope bridges ■ Fauna fencing will be incorporated into the design to minimise risk to fauna and channel fauna toward safe movement opportunities. Whilst no specific guidelines exist for NSW, design specification for fauna fencing will be guided by the *Fauna Sensitive Road Design Manual, Volume 2* (TMR 2010).

8.6.3 Mitigation measures

In order to manage and mitigate proposal risks during construction, mitigation measures have been proposed. In the construction phase of the proposal, dust sources will be variable and transitory in nature and the potential for impacts will vary with proximity to ecological receptors. Construction phase mitigations have been identified with consideration of this potential for variability.

The proposed additional mitigation measures are presented in Table 8.5. These proposed mitigation measures respond to proposal specific issues and opportunities, address legislative requirements, and incorporate industry standard practice. The measures have been presented separately for each phase of the proposal.

These proposed mitigation measures have been segregated with the phase during which they would be implemented:

- Detailed design
- Pre-construction
- Construction
- Operation.

The proposed mitigation measures are outlined in Table 8.5.

Table 8.5 Proposed additional mitigation measures

Delivery phase	Aspect	Proposed mitigation measures
Detailed design	Flora and fauna/biodiversity	■ Undertake detailed design and/or construction planning to minimise the construction footprint and avoid impacts to vegetation as far as practicable. Clearing of vegetation will be limited as far as practicable and disturbance is to only occur within the approved footprint. ■ Trees which are located in areas which have been mapped as Managed land as described in Section 5.2.4 and in accordance with the *Native Vegetation Regulatory Map Method Statement* i.e the playing fields at North Star will be retained where ever possible. ■ A Biodiversity Management Sub-plan will be developed as part of the CEMP. This plan should include appropriate criteria, directives and procedures in relation to: – Methods and sequencing of threatened plant surveys, in accordance with the requirements of NSW Guide to Surveying Threatened Plants (OEH 2016) – Methods and sequencing of pre-clearance fauna surveys, including terrestrial, aquatic and breeding habitats (including burrows and hollow bearing trees/logs, existing culverts and structures). – Location and establishment of buffer zones to avoid sensitive areas (such as buffer zones around PCT35, retained habitat trees, retained vegetation or other sensitive locations) – Staging works to avoid animal breeding periods where possible. ■ Develop a Soil Management Sub-plan which includes procedures and protocols relevant to potential impacts to the receiving environment: – Soil/land conservation objectives for the proposal – Management of problem soils (refer EIS Chapter 15: Land Resources and Contamination), such as: ■ Cracking clays (vertosols) that are expected to be encountered directly south of the Macintyre River ■ Saline soils, particularly in potential expression areas such as soil salt stores, artificial restrictions and roads. – Specification of the type and location of erosion and sediment controls. The erosion and sediment control measures, developed in accordance with the 'Managing Urban Stormwater' series (Bluebook) to be implemented during construction of the proposal include: ■ Minimise disturbance of areas identified as susceptible to erosion ■ Where possible use existing tracks. Design new access tracks (permanent and temporary) with the aim of minimising disturbance of substrates and vegetation ■ Water quality and erosion control measures that consider site specific soil types ■ Prescribed erosion and sediment controls relevant to the site risk.
	Riparian vegetation and aquatic habitats	■ The design will continue to be developed to minimise the extent of impacts to waterways, riparian vegetation and in-stream flora and habitats, in accordance with relevant policies and guidelines, including: – Policy and Guidelines for Fish Habitat Conservation and Management Update 2013 – Guidelines for controlled activities on waterfront land (DPI 2012).
	Water quality	■ A Surface Water Management Sub-plan will be developed as a component of the CEMP. The Sub-plan will provide a surface water monitoring framework for the proposal that establishes: – Frequency, testing requirements and location of surface water sampling during construction of the proposal, with consideration for: ■ Construction activities with potential to impact water quality

Delivery phase	Aspect	Proposed mitigation measures
		▪ Seasonality ▪ Sensitivity of receiving watercourse. – A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of instances (including accidental discharge of contaminants and sediments) that trigger contingency and ameliorative measures – Responses to impact threshold exceedances.
	Fauna passage	▪ Fauna movement opportunities identified during the reference design process will be developed and refined during detailed design. Development of these opportunities will involve: – Assessment of the compatibility of each approach with the general design principles at each location – Assessment of adjacent habitat and connectivity (including existing adjacent land use) – Consideration of safety requirements for the rail corridor and adjoining properties. – Elevated fauna crossing structures may be required to provide clearance over double-stacked trains (e.g. glider poles). To be determined at detailed design taking into account safety requirements (e.g. for higher bridges or viaducts, rope-bridges may be more practical) – For higher bridges or viaducts, rope-bridge underpasses may be more practical – Fauna crossing structures that may be suitable include glider poles, rope-bridge underpasses and fauna furniture within culverts – Fauna exclusion fencing will be used to channel fauna towards crossing structures.
	Fauna fencing	▪ Fauna fencing opportunities will be further developed during detailed design. Development of these opportunities will involve: – Assessment of the compatibility of each approach with the general fencing principles at each location and existing land use – Consideration of safety requirements for the rail corridor and adjoining properties. For example, rail corridor fencing has not been proposed across the Macintyre River floodplain to prevent the possibility of debris accumulation in fencing during flood events – Consideration for maintenance constraints that a fauna connectivity or fencing opportunity may introduce. ▪ Priority will be given to fauna fencing in areas identified as State, regional or local fauna movement corridors to channel fauna toward safe movement options (i.e. culverts) to limit vehicle strikes and associated incidents.
	Flora	▪ Construction areas including compounds, stockpiles, fuel storage areas, laydown areas and staff parking will be located and established outside the tree protection zone as defined in AS4970-2009 Protection of trees on development sites.
	Weeds and pests	▪ A Biosecurity Management Sub-plan will be developed as a component of the CEMP in accordance with the Biosecurity Act 2015 ▪ Property-specific biosecurity requirements will be agreed with the relevant landowner/operator prior to pre-construction/construction activities occurring on that property. Agreed protocols will be documented in individual property management agreements, to be signed by ARTC and the landowner/operator.
	Rehabilitation	▪ A Rehabilitation and Landscaping Management Sub-plan will be developed for the proposal, as a component of the CEMP. This Sub-plan will be based on the Inland Rail Landscape and Rehabilitation Strategy, the Inland Rail Landscape and Rehabilitation Framework and property-specific reinstatement commitments. As a minimum it will establish the following: – Location-specific objectives for rehabilitation of borrow pit sites, reinstatement and/or stabilisation. Objectives will differ for within the rail corridor and outside of the rail corridor. Outside of the rail corridor, property-specific and township-specific (e.g. North Star) rehabilitation and landscaping requirements may apply

Delivery phase	Aspect	Proposed mitigation measures
		– Timeframes for rehabilitation and/or reinstatement/stabilisation works to be achieved – Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the agreed objectives – Include rehabilitation requirements such as: ■ Milling and removal of bitumen pavement ■ Removal of any decommissioned culverts ■ Tyning and ripping of base and sub-base material ■ Application of soil ameliorants ■ Topsoiling and/or compost blanket ■ Stabilisation and rehabilitation (e.g. planting and or seeding). – Consideration for maintenance or performance issues of rehabilitation e.g. vegetation that does not grow and obscure signals or impact the longevity of rail infrastructure – Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas – Where temporary construction facilities/borrow pits are required, land shall be returned to a stable condition that complies with the conditions of applicable landowner agreements and regulatory approvals.
	Offsets	■ Biodiversity offsets will be developed in consultation with the Department of Agriculture, Water and the Environment (Commonwealth) and the Department of Planning, Industry and Environment (NSW)
Pre-construction/Construction	Flora and fauna/biodiversity	■ Scheduling of construction activities to minimise time of works in or adjacent to drainage lines, waterways or watercourses, particularly during periods of flow ■ Clearly mark designated ‘No go’ areas and clearing extents/site boundary/limit of works prior to any vegetation clearing. ■ Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species ■ A qualified ecologist with relevant NSW licences will undertake pre-clearance surveys of remnant and regrowth vegetation ■ The ecologist will supervise the subsequent clearing of where damage to any trees 3 m or greater in height, where arboreal fauna has been identified in or adjacent to the clearing front, known and potential habitat trees, log piles, burrows, stags and nests may occur and areas identified as containing threatened fauna species, habitat and mapped PCT/TECs ■ Scheduling of clearing activities will be done to avoid breeding seasons as far as reasonably practical. Where this is not practical, and where breeding sites are identified within the corridor during pre-clearance surveys, a suitably qualified person will provide mitigation measures for exclusion zones/ relocation requirements relevant to the specific species identified ■ Clearing extents will be limited to the area of the permanent and temporary works, avoiding impacts to native vegetation and habitats as far as practicable.
	Riparian vegetation and aquatic habitats	■ Plant maintenance activities and refuelling must be carried out a minimum of 50 m from riparian vegetation and waterways, where practical, with appropriate interception measures in place to avoid impacts to waterways, aquatic habitats, and groundwater. Where this cannot be achieved, as risk management approach will be applied with additional management controls applied appropriate to the level of environmental risk ■ The Surface Water Management Sub-plan, as a component of the CEMP, will be implemented (refer above)

Delivery phase	Aspect	Proposed mitigation measures
		■ Works within or adjacent to watercourses will be conducted in accordance with the intent of: – Policy and Guidelines for Fish Habitat Conservation and Management Update 2013 – Guidelines for controlled activities on waterfront land (DPI 2012) – The salvage and relocation of fish within isolated aquatic environments will be managed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management Update 2013 – Why do fish need to cross the road? Fish passage requirements for waterway crossings (Fairfull and Witheridge 2003). ■ In the event of a spill incident during construction any impacted aquatic environments, will be assessed for the presence of fauna. If necessary, salvage and recovery efforts will be undertaken.
	Flora	■ Minimise clearance of remnant vegetation to that necessary for construction. Ensure all necessary permits and approvals are in place prior to the commencement of construction ■ Clearly mark designated revegetation/rehabilitation zones and other no go areas (including large significant trees) prior to any vegetation clearing. High visibility tape, barricade webbing or similar should be utilised. All contractors are to be briefed on clearing requirements and restrictions (including fines) to prevent over-clearing of these areas. ■ Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species ■ Topsoil stockpiles will be a maximum of 2.5 m in height to avoid heat sterilisation of the seed bank ■ Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species such as Slender Darling-pea, Silky Swainson-pea and Winged peppercress.
	Fauna fencing	■ Any required fauna fencing will be installed in accordance with the fencing strategy which will be finalised and documented in the detailed design.
	Weeds and pests	■ The Biosecurity Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ■ The effectiveness of weed hygiene measures will be monitored as a component of the environmental monitoring procedure for the proposal ■ Vegetation material will be managed with a general biosecurity duty to prevent, eliminate or minimise any cross contamination due to the spreading of known weeds ■ ARTC's Enviroline will be advertised for the proposal to enable members of the public to notify ARTC of issues, including concerns regarding weeds and pests.
	Erosion and sediment control	■ Implement the Soil Management Sub-plan including erosion and sediment controls as a component of the CEMP.
	Rehabilitation and landscaping	■ The Rehabilitation and Landscaping Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ■ Rehabilitation of disturbed areas will be undertaken progressively and in accordance with the rehabilitation management sub-plan.

Delivery phase	Aspect	Proposed mitigation measures
Operation	Riparian vegetation and aquatic habitats	■ Maintenance activities within or adjacent to watercourses will be conducted in accordance with relevant NSW policies and guidelines.
	Weeds and pests	■ Weed management protocols for the operational rail corridor and other ARTC facilities will be in accordance with the requirements of the *Biosecurity Act 2015* and incorporated into the OEMP. These protocols will include: – Site hygiene and waste management procedures to deter pest animals – Weed surveillance and treatment during operation and maintenance activities – Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of MNES or BC Act listed receptors habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides. – Erosion and sediment control risks associated with broad scale weed removal or treatment. ■ ARTC's Enviroline will be advertised for the proposal to enable members of the public to notify ARTC of issues, including concerns regarding weeds and pests.
	Fauna fencing	■ Fauna fencing, and adjacent vegetation clearance zones (3 m) will be inspected and maintained during operation to retain the fauna fencing integrity ■ Vegetation maintenance on the habitat side of the fauna exclusion fencing associated with fauna passages would be required to ensure that species cannot use vegetation to climb onto the exclusion fencing.

9 Impact assessment under Biodiversity Assessment Methodology

As identified in Section 3, separate impact assessments have been performed, those prescribed under the BC Act using the BAM (refer Section 9.1) and those to assess receptors that are not subject to the BC Act, utilising the Commonwealth guidelines to assess MNES (refer Section 10). This section presents the results associated with these assessments. Further to this each borrow pit has been assessed as an individual proposal but is reported as part of the whole assessment. This assists with offsetting for those borrow pits which are identified to be developed and allow segmented offsets to be implemented prior to borrow pits being utilised.

9.1 Impact assessment

The information below is based on the assumed presence of species-credit species which have not undergone targeted survey in line with the BAM. Species which have been surveyed for and are not present have been removed from further assessment and full details of those species and their associated survey effort is reported in Appendix D and Appendix G. Species which were surveyed for and found to be present have had a species polygon prepared for them, which are shown in Appendix A and D with further details provided below. A list of species and their associated credit liability as reported within the BAM C is detailed in Table 6.8. The outputs of the BAM C are reproduced below.

The assessment is delineated into several segments based on staging of the project work. This allows for ARTC to meet its offset obligations prior to each segment being activated. The segments are as follows

- Brownfield alignment - the existing rail corridor
- Greenfield alignment - new works including access tracks which will remain
- Early works alignment – Accommodation camp at North Star and construction laydown areas
- Borrow pits.

As identified previously not all borrow pits are expected to be required for the project. The segmented approach allows for individual borrow pits and project segments to meet their individual offset obligations prior to works commencing within that area. The location of each of these segments is shown in Figure 3.5.

9.1.1 Impacts not triggering further assessment

Impacts not requiring further assessment under Section 3.1 of the BAM guidelines include areas within the subject land that are managed land as defined in Section 5.2.4. The subject land contains 181.3 ha of exempt land (refer Appendix A, Figure C.3). Borrow pit 4 is located entirely within managed land and has not been further assessed under the BAM. The definition of ‘native vegetation’ is defined under the LLS Act.

Managed land is used to describe vegetation which is not subject to assessment under the LLS Act as defined in the Native vegetation regulatory map: method statement (OEH 2017a) and includes cropped land and quarries as mapped on the 2017 Land Use mapping data set. Areas of managed land which do not require offsets have been included within the PCT mapping located in Appendix C and shapefiles will be provided to DPIE as required to support this reporting documentation (i.e. the BDAR).

Many non-threatened flora and fauna species were recorded within the subject land during on-ground surveys. These species do not require specific offsetting under the BAM guidelines as they are considered to be covered as part of the PCT ecosystem offsets.

Between the site visits in 2019 and 2021 an area of PCT192 within Borrow Pit 5 was cleared. This has reduced the overall area of ‘subject land’ within Borrow pit 5 by 8.35ha as the area no longer contains native vegetation.

9.1.2 Plant Community Types and threatened species requiring offset

9.1.2.1 Ecosystem credits

Ecosystem credits measure the offset requirements for impacts to TECs and threatened species habitat for species that can reliably be predicted to occur within the PCTs assessed.

Offsets are required for all impacts of development associated with:

(a) A vegetation zone that has a vegetation integrity score of ≥ 15 where the PCT is representative of an endangered or critically endangered ecological community, or

(b) A vegetation zone that has an integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or is representative of a vulnerable ecological community, or

(c) A vegetation zone that has a vegetation integrity score of ≥ 20 where the PCT is not representative of a TEC or associated with threatened species habitat.

Subsequently, Table 9.1 and Table 9.2 detail the vegetation zones and associated PCTs which require offsetting. The number of ecosystem credits required for their offset are a direct output of the BAM C. Full copies of the BAM C reports are located in Appendix H. PCT 35 (Brigalow) spread over several locations is candidate SAII and this is discussed in Section 9.2. Maps showing the locations of those areas requiring and not requiring offsetting are located in Appendix A.

Section 12 provides a detailed breakdown of the credit requirements for each segment of the project. In line with the assessment and project timing this has been reported in four main segments, Early works, Greenfield, Brownfield and Borrow Pits.

In some locations due to refinement of the alignment BAM plot data which was collected is no longer relevant to the subject land (refer Table 9.3). This may be due to reduction in the size of the ‘subject land’ or relocation of the subject land to avoid ecological impacts. Most plots within PCT35 within borrow pits are no longer relevant to the project as the design of the borrow pits has been altered to avoid impacts to this PCT. BAM plots outside the subject land were retained and the data used where they are part of a contiguous PCT within the subject land and are representative of the existing vegetation values within the subject land.

Where, due to changes in the delineation of segments within the alignment, there was an insufficient numbers of BAM plots allocated in an area, the benchmark data for that PCT was used. If an area had been mapped as ‘Low’ due to the absence of trees within that zone, the tree data for that PCT was not included within the Benchmark information used within the BAM-C. Information for those areas which benchmark data was used is shown in Table 9.4.

At some locations BAM plots had not recorded hollow bearings trees, but subsequent the habitat assessment in directly adjacent vegetation did record hollows being present. Where this occurred the data from the habitat assessment was used to augment the data within the BAM-C to allow for a true representation of the vegetation quality and habitat features present within that PCT zone.

In some instances the PCT names on the field sheets did not align with the final mapped PCT. This has generally occurred in locations where PCTs containing Poplar Box have been reassigned based on the underlying soil type (as described in Section 5.2.1), and in one location where further analysis using one meter contours and soil mapping found an area of grasses thought to be PCT 56 Low (Poplar box) was confirmed as PCT 27 Low (Weeping myall).

A total of 7,050 credits are required for impacts within the combined alignment segments and a further 1,523 credits for impacts within the borrow pits. This amounts to a total of 8,573 ecosystem credits (including scattered tree credits) for the proposal.

As noted above, between site visits in 2019 and then 2021 an area of PCT192 within Borrow Pit 5 was cleared of vegetation. This has reduced the overall area of ‘subject land’ within Borrow pit 5 by 8.35ha as the area no longer contains native vegetation.

Table 9.1 Plant Community Types requiring offset and the total ecosystem credits required within the Rail Alignment segments

PCT	Zone (condition class)	Total area to be impacted (ha)	SAII candidate	Vegetation integrity score	Ecosystem credits required
Castlereagh Barwon					
Greenfield					
36	Greenfield Medium*	0.84	No	63.3	24
52	Greenfield Medium	26.1	No	85.2	1076
192	Greenfield Medium	2.3	No	45	39
192	Greenfield Low	1.6	No	28.7	17
244	Greenfield Medium	3.8	No	75.9	146
247	Greenfield Low	2.2	No	40.2	38
628	Greenfield Low	1.2	No	25.8	15
Total greenfield segment impacted		**38.04**			
Total greenfield segment credits (inclusive of one scattered tree credit)					**1,355**
Brownfield					
36	Brownfield Medium	1.6	No	30.9	22
52	Brownfield Medium	7.6	No	83.8	308
56	Brownfield Low	18.3	No	63.7	583
244	Brownfield Medium	3.3	No	77.6	138
244	Brownfield Low	3.7	No	40.1	75
247	Brownfield Medium	6.2	No	35	94
247	Brownfield Low	2.3	No	97	98
628	Brownfield Medium	2.9	No	87.5	128
628	Brownfield Low	8.2	No	34	139
Total brownfield segment impacted		54.2			
Total brownfield segment credits					**1,585**
Early works					
36	Early works High	0.66	No	81.8	24
36	Early works Medium	1.6	No	87.7	60
56	Early works Medium	0.3	No	69.1	10
56	Early works Low	1.9	No	48.2	46
192	Early works Low	1.5	No	17	9
192	Early works Medium	2	No	40.1	30
628	Early works Medium	3.1	No	92.2	144
628	Early works Low	11	No	45.9	252
Total early works segment impacted		**22.06**			
Total early works segment credits					**575**
Northern Outwash					
Brownfield					
27	Brownfield Medium	0.02	No	65.1	1
27	Brownfield Low	3.9	No	37.7	73
35	Brownfield High	0.24	YES	64.7	8

PCT	Zone (condition class)	Total area to be impacted (ha)	SAII candidate	Vegetation integrity score	Ecosystem credits required
35	Brownfield Low	0.4	YES	20	4
36	Brownfield High	0.51	No	65.5	15
36	Brownfield Medium	0.23	No	61.1	6
56	Brownfield High	0.47	No	70.7	17
56	Brownfield Medium	0.96	No	29.2	14
56	Brownfield Low	31.2	No	28.4	443
Total brownfield segment impacted		**38.03**			
Total brownfield segment credits					**581**
Early works					
27	Early works Low	4.6	No	24.7	56
35	Early works High	5.2	No	83.2	217
35	Early works Low	1.7	No	41.5	33
56	Early works High	1.4	No	24.3	17
56	Early works Low	6	No	41.5	125
Total Early works segment impacted		**18.9**			
Total Early works segment credits					**448**
Northern Basalts					
Brownfield					
35	Brownfield High	5.4	YES	94.4	253
35	Brownfield Low	2	YES	31.7	32
53	Brownfield Medium	3	No	80.4	107
55	Brownfield High	0.64	No	26.2	8
56	Brownfield High	31.6	No	65.2	1031
56	Brownfield Medium	3.5	No	57.6	100
56	Brownfield Low	25	No	42	525
98	Brownfield High	2.2	No	91.9	75
Total brownfield segment impacted		**73.34**			
Total brownfield segment credits					**2131**
Early works					
35	Early works High	0.33	YES	77.9	13
53	Early works Medium	1.2	No	77.8	40
56	Early works Medium	4.4	No	51.1	112
56	Early works High	2.9	No	68.3	98
56	Early works Low	5.1	No	43.8	112
Total Early works segments impacted		**13.93**			
Total Early works segment credits					**375**

PCT	Zone (condition class)	Total area to be impacted (ha)	SAII candidate	Vegetation integrity score	Ecosystem credits required
Alignment segments totals					
Total Brownfield credits					4,297
Total Greenfield credits (inclusive of one scattered tree ecosystem credit)					1,355
Total Early works credits					1398
Total ecosystem credits					**7,050**

Table note:

* Inclusive of one scattered tree ecosystem credit

Table 9.2 Plant Community Types requiring offset and the total ecosystem credits required within Borrow pits

IBRA sub-region	Vegetation zone	Associated PCT	SAII Candidate	Vegetation Integrity score	Total area to be impacted (ha)	Ecosystem credits required
Northern Basalts	BP1_35_Low	35	Yes	21.1	0.9	9
Northern Basalts	BP1_35_Medium	35	Yes	48.0	0.67	16
Northern Basalts	BP8_56_Medium	56	No	74.4	21.1	787
Northern Basalts	BP1_147_Medium	147	No	56.8	3.4	96
Northern Basalts	BP1_147_High	147	No	51.8	1.2	31
Northern Basalts	BP7 Scattered Paddock Trees	56	N/A	N/A	5 Trees	5
Northern Basalts	BP9_418_Low	418	No	5.9	1	0
Northern Basalts	BP9_418_Medium	418	No	39.4	3	44
Northern Basalts	BP9_418_High	418	No	63.3	3.9	93
Northern Basalts	BP25_418_Low	418	No	28.4	1.5	16
Northern Basalts	BP25_418_Medium	418	No	42.3	1.5	24
Total Northern Basalt Borrow pits					**38.17**	**1,121**
Northern Outwash	BP2_35_Low	35	Yes	29.0	0.67	10
Northern Outwash	BP7_56_High	56	No	36.6	0.12	2
Northern Outwash	BP13_98_High	98	No	56.1	0.57	12
Northern Outwash	BP5_192_Low	192	No	29.8	1.9	21
Northern Outwash	BP5_192_Medium	192	No	33.3	1.4	17
Northern Outwash	BP5_192_High	192	No	45.6	9.1	155
Northern Outwash	BP2_418_Medium	418	No	25.0	6.8	104
Northern Outwash	BP2_418_High	418	No	35.7	6.1	81
Total Northern Outwash Borrow pits					**26.66**	**402**
Total Borrow pits					**64.83**	**1,523**
Total Ecosystem Credits for alignment segments and Borrow pits*						**8,573**

Table note:

* Inclusive of total scattered paddock tree credits

Table 9.3 BAM plots which were not used with the BAM-C and reason

BAM Plot	Reason for exclusion from BAM-C
Alignment	
CB-39-M1	This PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-39-M3	This PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-39-M4	This PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-56-M2	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-56-M3	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-56-M4	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-244-M1	This PCT and area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-244-M2	This PCT and area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
CB-628-M1	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
NB-244-H1	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
NB-244-H2	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
NB-244-H3	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
NB-244-H4	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
NB-35-L1	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts
NB-56_L5	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts. The data was not required to augment other areas data
NB-56-H6	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts. The data was not required to augment other areas data
NB-56_L1	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts. The data was not required to augment other areas data
NB-56-M4	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts. The data was not required to augment other areas data
NO-244LP10	The data within this plot was not considered to be the best representation of the vegetation community present within Northern Outwash PCt56 low which is was mapped as following mapping review
NO-56-H2	The data within this plot was not considered to be the best representation of the vegetation community present within this section of the subject land, sufficient data had been entered into the BAM-C
NO-56-L5	This area of PCT is no longer with the subject land. The survey was conducted prior to the footprint being rationalised to reduce environmental impacts. The data was not required to augment other areas data

BAM Plot	Reason for exclusion from BAM-C
Borrow pits	
BP735HP1	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP735HP2	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP735HP5	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP735LP7	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP735LP8	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP756HP1	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP756HP2	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP756HP3	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP756HP4	Large areas of Borrow pit 7 have been removed from the subject land to reduce impacts to ecological values including PCT 56 and 35
BP935HP1	All areas of PCT 35 within Borrow pit 9 have been removed from the subject land to reduce impact to ecological values
BP935HP2	All areas of PCT 35 within Borrow pit 9 have been removed from the subject land to reduce impact to ecological values
BP935HP3	All areas of PCT 35 within Borrow pit 9 have been removed from the subject land to reduce impact to ecological values
BP935HP4	All areas of PCT 35 within Borrow pit 9 have been removed from the subject land to reduce impact to ecological values
BP935HP1	All areas of PCT 35 within Borrow pit 9 have been removed from the subject land to reduce impact to ecological values
BP935HP2	All areas of PCT 35 within Borrow pit 9 have been removed from the subject land to reduce impact to ecological values
BP935HP3	All areas of PCT 35 within Borrow pit 9 have been removed from the subject land to reduce impact to ecological values
BP1135HP2	All areas of PCT 35 within Borrow pit 11 have been removed from the subject land to reduce impact to ecological values
BP1135HP3	All areas of PCT 35 within Borrow pit 11 have been removed from the subject land to reduce impact to ecological values
BP1135HP4	All areas of PCT 35 within Borrow pit 11 have been removed from the subject land to reduce impact to ecological values
BP1135LP1	All areas of PCT 35 within Borrow pit 11 have been removed from the subject land to reduce impact to ecological values
BP2535MP1	All areas of PCT 35 within Borrow pit 25 have been removed from the subject land to reduce impact to ecological values
BP2535MP2	All areas of PCT 35 within Borrow pit 25 have been removed from the subject land to reduce impact to ecological values
BP2635HP1	Borrow pit 26 has been removed from the subject land to reduce impacts to ecological values
BP2635LP4	Borrow pit 26 has been removed from the subject land to reduce impacts to ecological values
BP2635MP2	Borrow pit 26 has been removed from the subject land to reduce impacts to ecological values
BP2635MP3	Borrow pit 26 has been removed from the subject land to reduce impacts to ecological values

Table 9.4 Locations where benchmark data was used within the BAM-C

Benchmark data used	Number of plots	Segment mapping location
PCT 628	3	CB 628 Early works Low
PCT 628	1	CB 628 Brownfield Low
PCT 628	1	CB 628 Brownfield Medium
PCT 628	1	CB 628 Early works Medium
PCT 35	1	NB 35 Greenfield High
PCT 35	1	NB 35 Brownfield Low
PCT 35	1	NO 35Brownfield High
PCT 56	2	NB 56 Early works Low
PCT244	2	CB 244 Brownfield Low
PCT244	2	CB 244 Early works Low
PCT247	2	CB 247 Brownfield Low
PCT27	1	NB 27 Early works Low

Species credits

Species credits measure the offset requirement for impacts on individual threatened species or their area of habitat. As discussed in Section 6.2, following the completion of targeted surveys a number of the predicted species-credit species have been excluded from further assessment based on the results of targeted surveys and/or lack of suitable species-specific habitat factors in the available habitat. Should any of those excluded species be located during additional surveys they will be reintroduced into the offset calculations. Table 9.5 details the species-credit species requiring offset within the subject land. A copy of the Credit Summary Report for each IBRA subregions is located in Appendix H. A total of 26,267 species credits are required to offset the clearing impacts of this proposal as detailed in Table 9.5.

Table 9.5 Species-credit species requiring offset for works within the alignment segments and the number of species credits required

Species name	Scientific name	SAII Candidate	Brownfield area of impact (ha)	Brownfield number of credits (Alignment)	Early works area of impact (ha)	Early works area number of credits (Alignment)	Greenfield area of impact (ha)	Greenfield area number of credits (Alignment)	Alignment total
Flora									
Belson's panic	*Homopholis belsoniii*	No	0.07	1	2.03	72	29.9	1,222	1,295
Bluegrass	*Dichanthium setosum*	No	--	-	-	-	26.1	1076	1,076
Finger panic grass	*Digitaria porrecta*	No	103.87	2493	17.18	432	32.1	1265	4,190
Creeping tick-trefoil	*Desmodium campylocaulon*	No	0.28	12	-	-	29.9	1222	1,234
Slender darling pea	*Swainsona murrayana*	No	-	-	-	-	29.9	1222	1,222
Winged peppercress	*Lepidium monoplocoides*	No	0.28	9	-	-	25.8	1064	1,073
Glossy black-cockatoo	*Calyptorhynchus lathami*	No	47.57	1551	16.3	513	6.94	225	2,289
Koala	*Phascolarctos cinereus*	No	22.9	779	4.86	208	-	-	987
Masked owl	*Tyto novaehollandiae*	No	50.8	1749	15.23	509	6.94	225	2,483
Pale-headed snake	*Hoplocephalus bitorquatus*	No	1.56	37	4.26	134	6.94	225	396
Squirrel glider	*Petaurus norfolcensis*	No	32.24	1039	2.66	95	-	-	1,134
Total of all alignment segments species credits				**7,641**		**1961**		**7692**	**17,379**

Table notes:

N/A applies where there is no known or predicted habitat for the species within the disturbance area
BP = Borrow pit

Table 9.6 Species-credit species requiring offset for works within borrow pits - species credits required and impact area (ha)

Species name	Scientific name	SAII Candidate	BP5	BP7	BP8	BP9	BP13	BP25	BP1	BP2
Belson's panic	*Homopholis belsoniii*	No	N/A	N/A	N/A	N/A	N/A	N/A	127 4.65ha	182 9.7ha
Finger panic grass	*Digitaria porrecta*	No	N/A	N/A	N/A	N/A	N/A	N/A	121 4.9ha	177 9.5 ha
Native milkwort	*Polygala linariifolia*	No	257 12.4ha	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fauna										
Glossy black-cockatoo	*Calyptorhynchus lathami*	No	229 10.5ha	2 0.12ha	787 21.1ha	184 6.9ha	N/A	32 1.5ha	N/A	247 12.8ha
Masked owl	*Tyto novaehollandiae*	No	N/A	N/A	785 21.1ha	184 6.9ha	N/A	N/A	127 4.6ha	N/A
Pale-headed snake	*Hoplocephalus bitorquatus*	No	257 12.4ha	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total of all species credits			**743**	**2**	**1572**	**368**	**0**	**32**	**375**	**606**

9.1.2.2 Scattered paddock tree assessment

A total of six scattered paddock trees within the alignment segments and borrow pit study area were assessed. These trees were identified to species level using a field data from roadside locations. As the trees were not assessed individually and to follow the precautionary principle they have been designated as high value habitat trees containing hollows. A map of the location of the habitat trees is located in Appendix C and Table 9.7 details the number, species and IBRA subregion of those trees.

For the purposes of staged offsetting methodology, the 1 scattered tree ecosystem credit associated with the Castlereagh-Barwon IBRA sub-region will be offset as part of the early-works alignment. Meanwhile, the 5 scattered tree ecosystem credits associated with Borrow Pit 7 will be offset as part of the borrow pit.

It is noted that due to Borrow Pit 7 being intersected by the IBRA subregion boundary, the 5 scattered tree credits are part of the Northern Basalts sub-region as they are wholly within this IBRA region, whilst the remaining ecosystem credits for PCT 56 within the borrow pit have been assessed within the Northern Outwash IBRA sub-region as the original assessment had the majority of remnant vegetation within this subregion.

Table 9.7 Scattered paddock tree assessment results

Location	PCT	Common name	Scientific name	Number	DBH Category	Contain hollows	Class	Ecosystem Credits
BP7	56	Poplar Box	*Eucalyptus populnea* subsp. *bimbil*	5	>50 cm	True	3	5
Castlereagh -Barwon	36	River red gum	*Eucalyptus camaldulensis*	1	>50 cm	True	3	1
Total Number Scattered Paddock Trees				**6**				**6**

9.2 Serious and irreversible impacts

One PCT and one species-credit species were identified by the BAM C as possibly being candidates for SAII (refer Appendix H) as listed below:

- PCT35 – Brigalow – Belah open forest/woodland known to occur
- Pale imperial hairstreak (*Jalmenus eubulus*).

Following targeted surveys, in line with BCSD approved methodology, in January, February and March 2021 no Pale imperial hairstreaks were found within or adjacent to the subject land, therefore this species has been removed from this section of the report.

SAIIs are determined by the following four criteria (refer to following section):

- Principle 1 – species or ecological community currently in a rapid rate of decline
- Principle 2 – species or ecological communities with very small population size
- Principle 3 – species or area of ecological community with very limited geographic distribution
- Principle 4 – species or ecological community that is unlikely to respond to management and is therefore irreplaceable.

9.2.1 Threatened Ecological Community

9.2.1.1 PCT 35 Brigalow – Belah open forest/woodland

Serious and irreversible impacts were expected on PCT Brigalow-Belah based in Principle 1 and 2 and further details are provided below including additional impact assessment. Having completed the detailed review of the subject land in early 2021, and in consultation with project ecologists and engineers, the number and layout of the proposed borrow pits has been significantly refined to reduce the potential impact on the Brigalow community. In order to understand the magnitude of the reduction in impacts the original assessment (August 2020) has been left within this report and a comment on the new outline or impacts has been included at the end of each borrow pit description.

The Brigalow community is a low woodland or forest community dominated by Brigalow (*Acacia harpophylla*), with pockets of Belah (*Casuarina cristata*) and Poplar Box (*Eucalyptus populnea* subsp. *bimbil*). The canopy tends to be quite dense and the understorey and ground cover are only sparse. This community has been extensively cleared for agriculture, with most surviving remnants along roadsides and paddock edges (NSW EES Threatened Species Database 2019, Benson *et al*. 2006).

The historical coverage of Brigalow communities within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregion within NSW is not known however based on soil mapping completed in the 1960s it is estimated to have been around 115,300 ha (Isbell 1962) and is shown in the Threatened Biodiversity Database as 120,000 ha with around 30,000ha within the Moree Plains Shire. Mapping of the vegetation community within the northern wheatbelt in around 1995 estimated the total area of Brigalow community within these bioregions to be reduced to 12,000 ha which is largely fragmented (DPIE 2019).

Some of the threats listed by NSW EES include land clearing and fragmentation, invasion and establishment of weed species changing community structure and floristic composition, overgrazing by domestic stock, spray drift of herbicides and pesticides, fragmentation resulting in edge effects, lack of value and understanding of the TEC by landholders. A modelling study by Bradley *et al* (2010) based on brigalow communities in the BBS in southern Queensland indicated that it may take up to 90 years post clearing for regrowth to reach 90 per cent of pre-clearing species richness and structural complexity.

Data from the BioNet Vegetation Classification database shows that within the Brigalow belt south IBRA there are three PCTs which are analogous to the listed TEC Brigalow community. They are;

- PCT 35 Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion,
- PCT 445 - Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion and
- PCT 629 Brigalow - Bladder Saltbush open woodland to tall open shrubland in the Come-By-Chance region, Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.

Data exported from the State vegetation type map – Border Rivers Gwydir/Namoi has been integrated to determine the amount of each PCT remaining within the IBRA, IBRA subregion, 1,000 ha and 10,000 ha radius as required under the BAM. Table 9.8 details these findings.

Table 9.8 PCT area in each IBRA, IBRA subregion, 1000 ha and 10 000 ha radius as required under the BAM

Location	PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion area (ha)
1,000 ha radius of subject land	951
10,000 ha radius of subject land	3,950
IBRA – Brigalow Belt South (NSW)	21,040
IBRA subregion - Castlereagh-Barwon	368

Location	PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion area (ha)
IBRA subregion – Northern basalts	5,723
IBRA subregion – Northern outwash	4,513

The total area of impact for PCT 35 is 17.31 ha. This includes vegetation within the alignment corridor and two borrow pits. This represents a removal of 0.0008 per cent of the remaining Brigalow community within NSW based on current mapping.

The patch of vegetation through which the existing rail line is located is approximately 30 ha in size with around 4.1 ha of low-quality brigalow being impacted as part of the proposal. Relocation of the rail line to avoid this section of vegetation would result in further clearing and disturbance of other areas of brigalow. Wherever possible disturbance to this vegetation community will be reduced to the least area practicable for construction purposes. Wherever practicable no laydown or access roads will be developed through this vegetation community. In other locations, such as a section directly north of Borrow pit 7, brigalow has regrown within the rail alignment and up to 8.6 ha of this vegetation is required to be removed to reinstate the rail network.

Borrow pit 1 is located 6 km south east of North Star. It is located within and adjacent to an existing borrow pit on a small hill of PCT 147 surrounded by remnant and cleared PCT 35. In order to access the proposed subject land it is necessary to improve the exiting access track which is located within low and medium quality PCT35. This will result in the removal of 0.9 ha of PCT 35 with a VI score of 21.1 and 0.67 ha of PCT 35 with a VI score of 48.0. In the initial round of survey and planning there had been two access tracks planned one for incoming vehicles and one for outbound vehicles, this has been reduced to one track to limit the total area of disturbance.

Borrow pit 2 is located 9 km south of North Star. It is located on a rise in an open paddock. The vegetation patch is circular in shape and is 38 ha in size, the majority of which is PCT 418. There is a ring of low-quality Brigalow at the base of the hill which is approximately 0.67 ha and contains very few remnant trees. The mapping of Brigalow is based on the surrounding vegetation and the conclusion of what would have been growing there prior to very heavy disturbance, including clearing and spray drift from agricultural practices in the paddock surrounding the remnant stand. Evidence of the defoliation and vegetation mortality as a result of spray drift from agricultural practices was documented during field survey and is shown in Photograph 9.1. The proposed borrow pit has been refined and while originally it was planned to remove 3.2 ha of mapped low-quality Brigalow this impact has been reduced to 0.67ha to allow for an access track to be developed to reach from the road to PCT 418. This vegetation is in such poor condition that it does not meet the condition requirements as set out in Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (BC Act) or the Brigalow (*Acacia harpophylla* dominant and co-dominant) (EPBC Act) descriptions.



Photograph 9.1 Dieback due to spray drift noted at Borrow pit 2

Borrow pit 7 (BP7) crosses the existing rail alignment and includes both PCT 56 and PCT 35. The total area of BP7 is 66.79 ha; of this, 17.5 ha is mapped as high-quality Brigalow vegetation which means it includes both mature and semi mature brigalow trees and understory species. A total of 7.7 ha is low-quality Brigalow containing very few highly scattered or no mature trees. The site is part of a larger mosaic of woody vegetation which joins Mobbindry and Back Creeks. During the site visit in June 2019 the borrow pit appeared active and had increased in size since the last site visit in December 2018. Due to the highly degraded nature of the low-quality vegetation, it is considered that in its current state it does not meet benchmark conditions for a Brigalow Community. Removal of 17.5 ha of high-quality Brigalow represents a loss of just over 0.001 per cent of the remnant community within NSW.

Following a detailed review with project ecologists and engineers in late 2020/2021 the southern section of BP7 has been removed from the subject land. This will result the protection of all PCT 35 within the footprint, totalling 17.5 ha of high quality and 7.7 of low quality brigalow community and the protection of approximately 25 ha of PCT56.

Borrow pit 9 (BP9) is located 14 km east of the existing rail alignment. The proposed clearing sits within a mixed vegetation patch of PCT 35 and 418 in varying conditions. The patch size is over 100 ha. Total clearing for BP9 is expected to be 50.16 ha of which 21.8 ha is high quality mature and semi mature Brigalow which equates to just under 0.002 per cent of the remnant community.

Following detailed review with project ecologists and engineers in 2020/21 the northern section of Borrow Pit 9 has been removed from the subject land. This will result the protection of all PCT 35 within the footprint and a 40 m buffer around the Brigalow to help counter indirect impacts such as noise and dust. This results in the protection of 21.8 ha of PCT 35. Further to this the access track has been located along the eastern side of the borrow pit within an existing firebreak to further reduce the impact on PCT 35 and PCT 418. As a result of these actions no Brigalow of any condition will be required to be removed should this borrow pit be developed.

Borrow pit 11 (BP11) is located 15 km east of the alignment and 3 km south of BP9 within approximately 55 ha of remnant Brigalow. The proposed clearing includes 18.5 ha of mature and semi mature Brigalow and 0.9 low-quality vegetation which contains few or no Brigalow. The vegetation patch is isolated from other reasonably sized > 5 ha patches of woodland vegetation by around 0.6 km which may restrict movement of some smaller fauna. The remaining area of Brigalow within the patch would be around 35 ha. The low-quality vegetation community is not likely to meet the benchmarks for a Brigalow community in its current state.

Following detailed review with project ecologists and engineers in 2020/21 in order to protect the Brigalow community this Borrow pit has been removed from the project.

Borrow pit 25 (BP25) is located 12.5 km east of the existing rail corridor and 5km south west of BP11. It is located within an area of 7.5 ha of wooded vegetation comprising PCT 418 and 35. The proposed borrow pit would remove a total of 2.4 ha containing semi-mature Brigalow. Given the degraded nature of the site and the low density of remnant or regrowth Brigalow this vegetation association does not meet currently meet the benchmarks for a Brigalow community under the EPBC guidelines.

Following detailed review with project ecologists and engineers in 2020/21 in order to protect the Brigalow community this borrow pit has been reshaped so that it will no longer impact PCT 35 and a 40 m buffer has been place around the community to protect it from indirect impacts.

Borrow pit 26 is located 10 km west of the existing rail alignment small patch of relatively disturbed Brigalow. The proposed clearing would remove a total of 1.1 ha high quality Brigalow community (mature and semi-mature trees with native understory), 3.3 ha of medium quality (mainly Poplar Box with some suckering Brigalow outside of the BAM plots) and 0.9 ha of low-quality with no remaining Brigalow component. At the time of field survey on 22 June 2019, the borrow pit appeared to be active and had increased in size since the scoping visit in December 2018. It is considered that the medium and low-quality areas of this mapped PCT do not currently meet the definition of a Brigalow community as defined in the BioNet Threatened Species Data base benchmark descriptions due to lack of structural integrity and species richness.

Following detailed review with project ecologists and engineers in 2020/21 in order to protect the Brigalow community this borrow pit has removed from the project.

It is worth noting that not all borrow pits may be used for the proposal. This assessment is reporting on the 'worst case' scenario. Following review of borrow pit design and location should the remaining borrow pits be developed it would result in the clearing of 2.24 ha of PCT 35. The remining clearing is associated with the alignment works. As such should all section of the project proceed a total of 17.31 ha of Brigalow community (including low, medium quality patches) representing 0.0008 per cent of the remnant vegetation community within the BBS of NSW.

Actions and measure taken to avoid direct and indirect impacts

As discussed in the section above, a detailed review by project ecologists and engineers of all Borrow pits which contained exclusively PCT 35 resulted in their removal from the project. Further to this Borrow pits which contained some PCT 35 in conjunction with other PCTs have had the PCT 35 removed from the impact area and a 40 m buffer placed around the remnant Brigalow to assist with regeneration of the community and to limit indirect impacts such as dust. Reduction of impacts within the alignment was more difficult as there are several areas where Brigalow has regrown within the existing rail corridor since it was decommissioned in the 1970s. In some areas this regrowth now meets the condition requirements for the listed Brigalow community under the EPBC guidelines. Wherever possible potential impacts on Brigalow within the alignment have been reduced via reduction or relocation of laydown areas. As a result of these efforts the total impact on Brigalow of all condition classes has been reduced from 101 ha to 17.31 ha (refer Table 8.3).

Details of alternative options are provided in EIS Chapter 3: Alternatives and proposal options.

Table 9.9 The area and condition of the TEC to be impacted

PCT	Zone (condition class)	Total area to be impacted (ha)	SAII candidate	Vegetation integrity score	Ecosystem credits required
Northern Outwash					
Brownfield					
35	Brownfield High	0.24	YES	64.7	8
35	Brownfield Low	0.4	YES	20	4
Total brownfield alignment area impacted		**0.64**			
Total brownfield alignment credits					12

PCT	Zone (condition class)	Total area to be impacted (ha)	SAII candidate	Vegetation integrity score	Ecosystem credits required
Early works					
35	Early works High	5.2	No	83.2	217
35	Early works Low	1.7	No	39	33
Total Early works alignment area impacted		**6.9**			
Total Early works credits					250
Northern Basalts					
Brownfield alignment					
35	Brownfield High	5.4	YES	94.4	253
35	Brownfield Low	2	YES	31.7	32
Total brownfield alignment area impacted		**7.4**			
Total brownfield credits					288
Early works alignment					
35	Early works High	0.33	YES	77.9	13
Total Early works alignment area impacted		**0.33**			
Total Early works credits					13
Borrow Pits					
Borrow Pit 1	Low	0.95	YES	21.1	9
	Medium	0.67	YES	48.0	16
Borrow Pit 2	Low	0.67	YES	29.0	10
Total borrow pit alignment area impacted		**2.24**			
Total borrow pit credits					35
Project totals					
Total Brownfield alignment credits					300
Total Early works alignment credits					263
Total Borrow pit credits					35
Total ecosystem credits					**598**

The total area of impact for PCT 35 is 17.31 ha. This includes vegetation within the alignment segments and two borrow pits. This represents a removal of 0.0008 per cent of the remaining Brigalow community within NSW based on current mapping.

Extent to which the impacts exceed any threshold

Impacts on Brigalow communities have not allocated an area threshold. The total area of impact for potential habitat is 17.31 ha. This includes vegetation within the alignment segments and two borrow pits proposed in the EIS (ARTC 2020).

Extent and overall condition of the potential TEC

Data from the BioNet Vegetation Classification database shows that within the Brigalow belt south IBRA there are three PCTs which are analogous to the listed TEC Brigalow community. They are;

- PCT 35 Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion,

- PCT 445 - Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion and
- PCT 629 Brigalow - Bladder Saltbush open woodland to tall open shrubland in the Come-By-Chance region, Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Data exported from the State vegetation type map – Border Rivers Gwydir/Namoi has been integrated to determine the amount of each PCT remaining within the IBRA, IBRA subregion, 1,000 ha and 10,000 ha radius as required under the BAM. Table 9.10 details these findings.

Table 9.10 PCT area in each IBRA, IBRA subregion, 1,000 ha and 10,000 ha radius as required under the BAM

Location	PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion area (ha)
1,000 ha radius of subject land	951
10,000 ha radius of subject land	3,950
IBRA – Brigalow Belt South (NSW)	21,040
IBRA subregion - Castlereagh-Barwon	368
IBRA subregion – Northern basalts	5,723
IBRA subregion – Northern outwash	4,513

The condition of the vegetation remaining is difficult to quantify at these scales. Areas which are protected within road reserves and travelling stock reserves are often of a higher quality than those on private land. The removal of up to 5.94 ha of low quality brigalow is unlikely to directly impact the community as vegetation within this condition group does not contain mature or regrowth brigalow at rate higher than one stem per ha. Removal of the remaining high quality brigalow situated within the existing rail corridor, which is itself regrowth, represents the removal of less than 0.0001% of the remaining brigalow mapped within the Brigalow Belt South within NSW.

Estimate of potential Brigalow within the reserve system

The BioNet vegetation classification database suggests that current extent of PCT35 is 12,000ha. The NSW Scientific determination states that Brigalow in NSW has been extensively cleared for agricultural purposes and the remnants have often been thinned and modified. The original extent of the Brigalow community is not known but mapping of “Brigalow soils” in the early 1960s gives an area of potential habitat for this community in NSW of 115,300 ha (Isbell 1962). Recent vegetation mapping of the northern wheatbelt has found that only 13,500 ha remains of this community and that it is severely fragmented (D. Sivertsen & L. Metcalfe, pers. comm.) and that the community is poorly represented in the existing reserve system with only “Brigalow Park Nature Reserve”, of 202 ha containing the community.

The projects impact on abiotic factors, change of functionally important species through indirect impacts, Increase in threats and indirect impacts including invasive flora and fauna

The project impacts within the alignment segments are not considered likely to further impact the Brigalow community. The areas within the alignment which are to be cleared consist of regrowth situated within the rail reserve which has occurred since the line closure in the 1970s. This argues strongly for the resilience of this vegetation community. The areas which are to be impacted as a result of borrow pit activation occur in low quality brigalow where there are no remnant trees or regrowth. The area proposed for the location of the access track for Borrow pit 1 which intersects medium quality Brigalow has been realigned to an existing track to limit further impacts. Borrow pit 1 currently operates as a quarry with no negative impacts noticed on the surrounding high quality Brigalow community. The access to Borrow pit 1 will as been located so as to reduce impacts as far as practicable to allow for development of this pit.

Anecdotally several areas of remnant Brigalow, surrounding other active borrow pits which will be protected by a 40 m buffer do not appear to have suffered negative impacts as a result of the existing activities. The movement of surface water adjacent to Brigalow communities will not be impacted by the alignment works, however there may be limited reduction to surface flow as a result of the development of some borrow pits, which are situated upslope of the Brigalow communities.

The project is not expected to increase the rate of increase in or number of high threat exotic or other weeds species within the subject land, or the areas adjacent to it.

The placement of a 40 m buffer is intended to provide additional protection to this vegetation community.

Direct or indirect fragmentation

Within the rail alignment the vegetation community is reasonably fragmented by the existing rail structures. The works associated with reinstating the rail network may create a medium term impact in some small localised areas such as north of Borrow pit 7. All areas within the Borrow pits which may be impacted already have an existing track present or the impact area is at a maximum 20 m wide which is not likely to impact the survival of the community.

Measures proposed to contribute to the recovery of the species in the IBRA subregion

Offset requirements associated with the proposal for the loss of PCT 35 will contribute to the recovery of the vegetation community. As stated above all borrow pits containing PCT 35 have been removed or reshaped to avoid impact on this vegetation community. In addition to this not all borrow pit sites are expected to be utilised as part of this project and should the Pale imperial hairstreak (*Jalmenus eubulus)* be located within one of these borrow pits it is likely to reduce the feasibly of that site.

9.3 Prescribed biodiversity impacts

Under the BC Act, a series of actions are prescribed as impacts and must be assessed under the offset scheme. Impacts relevant to this proposal include:

a) Impacts of development on the habitat of threatened species or ecological communities associated with
   i) Karst, caves, crevices and cliffs
   ii) Rocks
   iii) Human made structures
   iv) Non-native vegetation

b) Impacts of development on the connectivity of different areas of habitat of threatened species that facilitate the movement of those species across their range

c) Impacts of development on movement of threatened species that maintains their lifestyle

d) Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

e) The impacts of wind turbine strikes on protected animals,

f) Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

Prescribed biodiversity impacts can be difficult to quantify, replace or offset, making avoiding and minimising impacts essential. Table 9.11 and Table 9.12 considers relevant prescribed impacts to native vegetation and threatened species, highlights the mitigation measures to reduce impacts and describes the nature, extent and duration of the impact and provides a prediction of impact consequences.

Table 9.11 Prescribed biodiversity impacts on native vegetation

Prescribed Impact Category	Specific feature	Species or community to be impacted	Mitigation measure	Nature, extent and duration of impact	Importance of impact within bioregion	Consequence of impact
Habitat connectivity	Habitat corridors	All vegetation types including those located within Managed land	Refer Section 8.6.3	Increased 'edge' effect for all communities where vegetation clearing has occurred. Duration of impact permanent.	Moderate	Additional increased fragmentation of already fragmented landscapes. The existing rail line is often situated on the edge of the road alignment or adjacent to a farm access track. The final width of the proposed work is not considered likely to greatly decrease the existing connectivity of the region for flora species. Larger pollinators such as birds and larger mammals will continue to traverse the rail line while smaller ones may already have limited mobility due to existing conditions, however new and upgraded culverts may provide improvements in areas. The location of some borrow pits may result in further fragmentation of the landscape depending on the final areas to be cleared.
Threatened species movement	Changes to roadside and riparian corridors	Wind or ant dispersed species	Refer Section 8.6.3	Changes to the topography of the landscape will alter wind patterns across the landscape on a permanent basis. Clearing of vegetation types will alter the distribution of ant species, thereby changing the potential distances ant dispersed species may be dispersed.	Moderate	Consequences within the alignment are likely to be minimal, however this is also difficult to predict due to a lack of information about dispersal mechanisms of local species and changes to dispersal vectors (e.g. ants, wind). The removal/reduction in size of some vegetation islands at borrow pit locations is likely to reduce threatened species dispersal should they be found to be present.
Water quality, hydrological processes	Changes to drainage patterns throughout greater subject land	PCT 55 – Belah woodland, PCT 247 – Lignum swamp	Refer Section 8.6.3	Changes to the hydrology within and surrounding the impact area may permanently change the composition of vegetation communities. Belah woodland may be favoured over Poplar Box which was observed throughout the subject land from changes to hydrology when the previous rail line was in operation. In addition, if drainage is cut off to Lignum swamps, it is likely that these communities would be unable to persist into the long-term.	Moderate/High	Permanent change to vegetation communities dependent on particular hydrological conditions. These changes will depend upon the final design and existing eroding drainage structures along the current disused rail easement will be repaired as part of the project.

Table 9.12 Prescribed biodiversity impacts on threatened species

Prescribed Impact Category	Specific feature	Species or community to be impacted	Mitigation measure	Nature, extent and duration of impact	Importance of habitat within bioregion	Consequence of impact
Habitat	Man-made structures – Removal of timber bridges	Micro-bats	Refer Section 8.6.3	Removal of old timber bridges – Permanent	Limited	Unknown until design is finalised. Considered to be low with the removal of two small bridges which did not appear to supply habitat for microbat species to the open nature of their timber construction. Micro-bats are known to utilise new concrete structures which are associated with bridges and larger culverts, these new structures may provide higher quality habitat that what is planned for replacement.
Habitat	Man-made Structures – 'Dam' removal	Fish Amphibians Reptiles Crustaceans	Refer Section 8.6.3	Removal of 'dam' and changed waterflow regimes - Permanent	Medium	There is a small waterhole which has developed under the existing rail line due to lack of maintenance over many years. This waterhole may provide habitat for fish species as well as turtles and waterbirds. There are other shallow waterbodies including an adjacent dam and a natural pool within Forest Creek which may provide habitat for those more mobile species, however any less mobile species are likely to be permanently displaced.
Habitat	Man-made Structures – Ballast removal/ replacement	Reptiles Arachnids Small mammals	Refer Section 8.6.3	Removal and replacement of rail ballast – Temporary	Medium	The existing rail ballast is likely to provide sheltering habitat for a variety of animal species which will be displaced during works. The level of displacement and impact on populations is unknown. The ballast will be replaced as part of works so provided the species still reside within the vicinity they may return.
Habitat	Removal of rock cover Borrow pits 1 and 2	Reptiles Arachnids Small mammals	Refer Section 8.6.3	Removal of loose rock over the surface of the borrow pit area – Permanent	Habitat	The existing rock cover is likely to provide sheltering habitat for a variety of animal species which will be displaced during works. The level of displacement and impact on populations is unknown.
Habitat connectivity	Habitat corridors	Koalas Possums Gliders Small birds Reptiles	Refer Section 8.6.3	Increase in distance between areas of habitat – Permanent	Medium/high	The existing environment within the alignment is highly fragmented, and the existing fauna usage is not considered to be greatly impacted once construction work has been completed. Clearing for borrow pits is considered likely to have a larger impact upon species movement especially where vegetation islands will be cleared or highly modified as a result of the works. Clearing works within Managed Land will be reduced to the smallest areas practicable.
Threatened species movement	Changes to roadside and riparian corridors	Koalas Gliders Small mammals Small birds	Refer Section 8.6.3	Clearing – During construction	Medium/high	The existing alignment environment is highly fragmented. Noise, vibration and lighting during the construction phase is likely to impact fauna movement. Clearing for borrow pits is considered likely to have a larger impact upon species movement especially where vegetation islands will be cleared or highly modified as a result of the works.

Prescribed Impact Category	Specific feature	Species or community to be impacted	Mitigation measure	Nature, extent and duration of impact	Importance of habitat within bioregion	Consequence of impact
Threatened species movement	Changes to roadside and riparian corridors	Koalas Possums Gliders Small birds	Refer Section 8.6.3	Maintenance – During operation	Low/medium	The existing rail alignment is highly fragmented, and the existing fauna usage is not considered to be greatly impacted once construction work is completed. Clearing for borrow pits is considered likely to have a larger impact upon species movement especially where vegetation islands will be cleared or highly modified as a result of the works.
Water quality, hydrological processes	Changes to drainage patterns throughout study region	Fish Amphibians Crayfish Molluscs	Refer Section 8.6.3	Permanent flow changes -During construction	Low	The existing environment is in a state of altered patterns due the existing rail line, road network, drains, dams and farming practices. It is not considered likely that the construction works will significantly alter the current state. The final landform for the borrow pits may create further water storage/wetland areas.
Water quality, hydrological processes	Changes to drainage patterns throughout study region	Fish Amphibians Crayfish Molluscs	Refer Section 8.6.3	During operation	TBA	The final design of the proposal will take into consideration the mitigation measures outlined in Section 8.6.3. The final landform for the borrow pits may create further water storage/wetland areas which may in time become habitat for native aquatic species.
Vehicle impact on threatened species	Construction vehicles	Terrestrial species	Refer Section 8.6.3	During construction	Low	Provided mitigation measures outlined in Section 8.6.3 are adhered to the number of vehicle strikes should be very low. The threatened species predicted to occur are generally mobile and as such there should be very limited impact on threatened species
Vehicle impact on threatened species	Operational phase - Trains	Terrestrial species	Refer Section 8.6.3	During operation	Low	Provided mitigation measures outlined in Section 8.6.3 are adhered to the number of vehicle strikes over time should be low. The threatened species predicted to occur are highly mobile and the trains will be audible as they approach and as such there should be very limited impact on threatened species.

9.4 Key threatening processes

There are 37 terrestrial Key Threatening Processes (KTPs) listed under the BC Act and 15 under the EPBC Act. Table 9.13 lists each these threatening processes and their applicability to the proposal.

Table 9.13 Key threatening processes and their applicability to the proposal

Key threatening process	BC Act/EPBC Act/ FM Act	Applicable	Comments
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy miners (*Manorina melanocephala*)	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP. The Noisy Miner is already ubiquitous across the landscape in degraded and fragmented woodland and forest habitats
Alteration of habitat following subsidence due to longwall mining	BC Act	No	The proposal is not considered likely to trigger this KTP
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	BC Act	Yes	Design considerations to reduce any impact on flow regimes are part of the detailed design process. Mitigation measures are outlined in Section 8.6
Anthropogenic climate change	BC and EPBC	No	The proposal is not considered likely to trigger this KTP
Bushrock removal	BC Act	Yes	The proposal will trigger to trigger this KTP should Borrow pit 1 or 2 be developed as part of the proposal.
Clearing of native vegetation	BA and EPBC Act	Yes	The detailed design will determine the final area of native vegetation to be cleared. Section 9 discusses the impacts of native vegetation clearing as a result of the proposal.
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Competition and habitat degradation by Feral goats (*Capra hircus*)	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Competition from feral honey bees (*Apis mellifera*)	BC Act	No	The proposal is not considered likely to trigger this KTP
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners (*Manorina melanophrys*)	BC Act	No	The proposal is not considered likely to trigger this KTP
Habitat degradation and loss by Feral horses (*Equus caballus*)	BC Act	No	The proposal is not considered likely to trigger this KTP
Herbivory and environmental degradation caused by feral deer	BC Act	No	The proposal is not considered likely to trigger this KTP
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	BC Act	No	The proposal is not considered likely to trigger this KTP
Importation of Red Imported Fire Ants (*Solenopsis invicta*)	BC and EPBC	Possible	The proposal is not considered likely to trigger this KTP. Mitigation measures outlined in Section 8.6 including vehicle and soil hygiene will reduce the risks associated with the KTP.
Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	BC Act	No	The proposal is not considered likely to trigger this KTP

Key threatening process	BC Act/EPBC Act/ FM Act	Applicable	Comments
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP.
Infection of native plants by *Phytophthora cinnamomi*	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP. Fill material will be locally sourced. *P. cinnamomi* is not known to the local area
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	BC Act	No	The proposal is not considered likely to trigger this KTP
Introduction of the Large Earth Bumblebee (*Bombus terrestris*)	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion and establishment of exotic vines and scramblers	BC Act	No	The proposal is not considered likely to trigger this KTP. Where exotic vines already occur within the subject land mitigation measures around the control of weeds will be designed to reduce this risk.
Invasion and establishment of Scotch Broom (*Cytisus scoparius*)	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion and establishment of the Cane Toad (*Bufo marinus*)	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP as the successful expansion of the species is restricted to their natural climatic ranges.
Invasion of native plant communities by African Olive (*Olea europaea* subsp. *cuspidate*)	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion of native plant communities by Chrysanthemoides monilifera	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion of native plant communities by exotic perennial grasses	BC Act	Potential	There are large patches on introduced grasses within and adjacent to the proposed works. The mitigation measures outlined in Section 8.6 will be further developed to address this issue.
Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*) into NSW	BC Act	No	The proposal is not considered likely to trigger this KTP
Invasion, establishment and spread of Lantana (*Lantana camara*)	BC Act	Potential	While not recorded within the proposal area Lantana is known to colonise disturbed areas. Mitigation measures outlined in Section 8.6 including vehicle wash down will help reduce the risks associated with this KTP
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	BC and EPBC Act	Potential	There are several invasive weed species currently recorded within the proposal area. The mitigation measures outlined in Section 8.6 will help reduce the risk associated with this KTP
Loss of Hollow-bearing Trees	BC Act	Yes	The subject land extended out to 500 m from the proposed centreline and areas within the borrow pits. Some known HBTs occur within this area. The mitigation measures outlined in Section 8.6 will help reduce the risk associated with this KTP.

Key threatening process	BC Act/EPBC Act/ FM Act	Applicable	Comments
Loss or degradation (or both) of sites used for hill-topping by butterflies	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation and hybridisation by Feral Dogs, Canis lupus familiaris	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish)	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation by the European Red Fox *Vulpes vulpes* (Linnaeus 1758)	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Predation by the Feral Cat *Felis catus* (Linnaeus 1758)	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Predation by the Ship Rat *Rattus rattus* on Lord Howe Island	BC Act	No	The proposal is not considered likely to trigger this KTP
Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa*	BC and EPBC Act	No	The proposal is not considered likely to trigger this KTP
Removal of dead wood and dead trees	BC Act	Yes	The removal of native vegetation within the final footprint may trigger this KTP. Mitigation measures outlined in Section 8.6 including restoration of habitat will help to address this issue
Invasion of northern Australia by Gamba Grass and other introduced grasses	EPBC Act	No	The proposal is not located within northern Australia
Novel biota and their impact on biodiversity	EPBC Act	Potential	The proposal does not involve the introduction of novel biota into Australia. Mitigation measures around weed and pest management as outlined in Section 8.6 will assist in reducing this risk.

10 Significant Impact Assessment – Matters of National Environmental Significance

10.1 Introduction

The Department of the Environment and Energy (DotEE) (currently DAWE) declared the proposal as a controlled action 'to be assessed by an accredited assessment under Part 5, Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979*. Representatives from Future Freight Joint Venture (FFJV) and ARTC met with the representatives from the DotEE and the Office of Environment and Heritage (OEH) (currently DPIE) on 21 September 2018 to discuss the proposed approach to impact assessment. The majority of MNES identified as potentially impacted by the proposal are also listed matters under the NSW BC Act (refer Section 7). Under the bilateral agreement only EPBC Act-listed threatened species and ecological communities (i.e. MNES) that have not been assessed under the BAM are required to be assessed for significant residual impacts using the relevant Commonwealth guidelines, such as the *MNES significant impact guidelines 1.1* (MNES Guidelines) (DotE 2013).

The MNES that have been assessed for proposal impacts and requirement for biodiversity offsets using the BAM are summarised in Section 10.3. The MNES required to be assessed under the MNES Guidelines are identified in Section 10.4.

The following sections summarise the methodology used to a) model the potential habitat for the identified MNES available within the proposal area, and b) the initial impact assessment applied prior to the significant impact assessment under the MNES Guidelines.

10.2 Significant Impact Assessment

The impact assessment for the MNES ecological receptors of the proposal, that are listed under the EPBC Act, uses a significance-based impact assessment framework to identify and assess proposal related impacts in relation to ecological receptors.

For the purpose of assessment, the relevant receptors were assessed qualitatively, informed by a quantitative assessment of magnitude. A significant impact depends upon the sensitivity of an ecological value, the quality of the environment which is impacted, and upon the intensity, duration, magnitude and potential spatial extent of the potential impacts. Determination of the sensitivity or vulnerability of the ecological receptor and the magnitude of the potential impacts facilitate the assessment of the significance of potential ecological impacts. The sections below discuss and define impact magnitudes, ecological receptor sensitivity and impact significance.

10.2.1 Magnitude of impacts

The magnitude of a potential impact informs the determination of its level of significance on receptors. For the purposes of this assessment, impact magnitude is defined as being comprised of the nature and extent of the potential impacts, including direct and indirect impacts. The magnitude of disturbance is assessed in the context of the extent of the relevant ecological receptor in the local area (i.e. within a 1km buffer of the alignment centreline). The impact magnitude is divided into five categories (refer Table 10.1). The magnitude of impacts is determined using techniques and tools (i.e. GIS) that facilitate an estimation of the **extent**, **duration** (refer Table 10.2) and **frequency** of the impacts.

Table 10.1 Criteria for magnitude

Magnitude	Description
Major	An impact that is widespread, permanent and results in substantial irreversible change to the ecological receptor. Avoidance through appropriate design responses or the implementation of environmental management controls are required to address the impact (e.g. greater than 50% of the habitat within the greater area disturbed).
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the ecological receptor. Avoidance through appropriate design responses or the implementation of site-specific environmental management controls are required to address the impact (e.g. between 13-50% of the habitat within the greater area disturbed).
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the proposal is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls (e.g. between 2-13% of the habitat within the greater area disturbed).
Low	A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls (e.g. between 1-2% of the habitat within the greater area disturbed).
Negligible	An extremely localised impact that is barely discernible and is effectively mitigated through standard environmental management controls (e.g. less than 1% of the habitat within the greater area disturbed).

Table 10.2 Timeframes for duration terms

Duration term	Timeframe – to be defined for each activity type
Temporary	Days to months (e.g. 1 to 2 seasons; 3 to 6 months)
Short term	Up to 2 years (i.e. 6 to 24 months)
Medium term	From 2 to 10 years[1]
Long-term/long lasting	From 10 to 20 years[2]
Permanent or irreversible	More than 20 years[3]

Table notes:

1 Derived from the term ‘moderate’ EAM Risk Management Framework 2009 (Great Barrier Reef Marine Park Authority 2009)
2 Derived from the term ‘major’ EAM Risk Management Framework 2009 (Great Barrier Reef Marine Park Authority 2009)
3 Derived from the term ‘catastrophic’ EAM Risk Management Framework 2009 (Great Barrier Reef Marine Park Authority 2009)

10.2.2 Sensitivity

To assess the significance of potential impacts on receptors, sensitivity categories are applied to each of the receptors. The sensitivity categories are split into five discrete groups as described in Table 10.3. These groupings are based on qualitative assessments utilising information related to the sensitivity of the ecological receptor, in addition to the potential of an ecological receptor’s occurrence within the receiving environment.

Through the determination of sensitivity categories for each of the receptors, the receptors are then able to be assessed through a matrix against the magnitude of the potential proposal impact type to indicate the level of significance for each of the impact types on the receptors.

Receptors are treated individually. In the case where there are conflicting classes, the "worst-case" is assumed.

Table 10.3 Sensitivity criteria for ecological receptors within the subject land

Sensitivity	Description
Major	▪ The ecological receptor is listed on a recognised or statutory state, national or international register as being of conservation significance ▪ The ecological receptor is **entirely** intact and **wholly** retains its intrinsic value ▪ The ecological receptor is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region, state, country or the world ▪ It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the ecological receptor. ▪ Proposal activities would have an adverse effect on the ecological receptor.
High	▪ The ecological receptor is listed on a recognised or statutory state, national or international register as being of conservation significance ▪ The ecological receptor is **relatively** intact and **largely** retains its intrinsic value ▪ The ecological receptor is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region ▪ The ecological receptor has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the ecological receptor. ▪ Proposal activities would have an adverse effect on the ecological receptor.
Moderate	▪ The ecological receptor is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers ▪ The ecological receptor is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements ▪ The ecological receptor is relatively well represented in the systems/areas in which it occurs but its abundance and distribution are exposed to threatening processes ▪ Threatening processes have reduced the ecological receptor‘s resilience to change. Consequently, changes resulting from proposal activities may lead to degradation of the ecological receptor ▪ Replacement of unavoidable losses is possible due to its abundance and distribution.
Low	▪ The ecological receptor is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations (e.g. historical societies) ▪ The ecological receptor is in a poor to moderate condition as a result of threatening processes, which have degraded its intrinsic value ▪ It is not unique or rare and numerous representative examples exist throughout the system/area ▪ It is abundant and widely distributed throughout the host systems/areas ▪ There is no detectable response to change or change does not result in further degradation of the ecological receptor ▪ The abundance and wide distribution of the ecological receptor ensures replacement of unavoidable losses is achievable.
Negligible	▪ The ecological receptor is not listed on any recognised or statutory register and is not recognised locally by relevant suitably qualified experts or organisations ▪ The ecological receptor is not unique or rare and numerous representative examples exist throughout the system/area ▪ There is no detectable response to change or change does not result in further degradation of the ecological receptor.

10.2.3 Significance of impact

The significance of a potential impact is a function of an impacted ecological receptors’ **sensitivity** and the **magnitude** of the potential impact. Although the sensitivity of the ecological receptor will not change (i.e. is determined qualitatively by the interaction of the ecological receptor’s condition, adaptive capacity and resilience), the **magnitude** of the potential impact is variable and may be categorised quantitatively to facilitate the prediction of the significance of the potential impact.

Once the ecological receptor has been identified, and the **sensitivity** of the ecological receptor and the **magnitude** of the potential impact have been determined, this will facilitate the assessment of the significance of the potential impact through use of a five by five matrix (refer Table 10.4).

Table 10.4 Significance assessment matrix

Magnitude of impact	Sensitivity				
	Major	High	Moderate	Low	Negligible
Major	Major	Major	High	Moderate	Low
High	Major	Major	High	Moderate	Low
Moderate	High	High	Moderate	Low	Low
Low	Moderate	Moderate	Low	Negligible	Negligible
Negligible	Moderate	Low	Low	Negligible	Negligible

Table note:
Significance categories as identified in Table 10.4 are defined Table 10.5

Table 10.5 Significance classifications

Significance rating	Description
Major	Arises when an impact will potentially cause irreversible or widespread harm to an ecological receptor that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation. A post-mitigation rating of 'major' may constitute a potential significant residua adverse impact (refer Section 10.2).
High	Occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristics and structural elements of the ecological receptor. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve its intactness or conservation status. A post-mitigation rating of 'high' may constitute a significant residual adverse impact (refer Section 10.2).
Moderate	Results in degradation of the ecological receptor due to the scale of the impact or its susceptibility to further change even though it may be reasonably resilient to change. The abundance of the ecological receptor ensures it is adequately represented in the region, and that replacement, if required, is achievable. A post-mitigation rating of 'moderate' may constitute a significant residual adverse impact (refer Section 10.2).
Low	Occurs where an ecological receptor is of local importance and temporary or transient changes will not adversely affect its viability provided standard environmental management controls are implemented.
Negligible	Does not result in any noticeable change and hence the proposed activities will have negligible effect on ecological receptors. This typically occurs where the activities are located in already disturbed areas.

Following the identification of the initial level of significance, additional mitigation measures were then applied to the initial impacts (incorporating design mitigation measures) to identify the residual (mitigated) impacts in a tabular form. The initial assessment of impacts was undertaken to identify which MNES may be subject to residual adverse impacts following mitigation. It is important to note that the initial impact assessment does not assess impacts against the MNES significant impact criteria and only considers direct impacts and not indirect impacts.

10.3 Summary of impacts on matters of national environmental significance assessed under Biodiversity Assessment Methodology

The majority of MNES identified as associated with the proposal have been assessed for proposal impacts and any resulting biodiversity offsets under the BAM, as per the bilateral agreement between DAWE and the NSW Government. As such, only MNES that have not been addressed under the BAM are required to be assessed for significant residual impacts using the EPBC Act assessment guidelines, however select BAM assessed species and communities (as summarised in Section 10.7.1.2 to 10.7.2.2**)** have been assessed for significance as recommended by the BCSD assessment team due to the extent of impacts identified. The MNES that have been assessed using the BAM (refer Section 6.1 and 6.2) are summarised in Table 10.6.

Appendix G provides summaries of each species habitat requirements, survey effort within the study area and previous occurrence within the wider area associated with the proposal.

Based on the direct and permanent impacts associated with the proposal that are summarised in Section 8.3 and the range of avoidance, mitigation and management measures described in Section 8.6, the proposal is considered to have potential to result in impacts on three ecological communities and 10 threatened flora and fauna species subject to the BAM assessment pathway that are also protected under the EPBC Act. Impacts of the proposal on these MNES assessed through BAM may be offset in accordance with the BAM guidelines, as detailed in Table 10.6. The offsets described quantify the credits required to satisfy offset obligations under the BOS for species-credit species and TECs also listed as threatened under the EPBC Act, as is stated in the SEARs by the Commonwealth Minister for the Environment.

Table 10.6 Like-for-like offsets within the Biodiversity Assessment Method

Matter	Proposal impact (BAM)	Like-for-like Offset in accordance with BAM guidelines
TECs		
Brigalow (*Acacia harpophylla*) dominant and co-dominant) community	At total of up to 17.51 ha of this vegetation community will be removed as part of the proposal all within the alignment and borrow pits (refer Table 5.1 and Appendix C). Of this, only 11.84 ha of medium quality or higher PCT 35 meet the TEC condition assessment as per EPBC guidelines. Given the extent of impact, additional assessment of significance in accordance with MNES guidelines has been completed in Section 10.7.2.1.	507 ecosystem credits will be retired within the alignment segments Borrow pits to offset impacts to this TEC, in accordance the BAM guidelines. This aligns only with the high and medium quality value PCT 35 which meet the EPBC condition guidelines. An additional 88 credits of low quality PCT 35 which do not meet the definition of a TEC as per EPBC condition assessments will still be offset in accordance with BAM guidelines. With the addition of these 88 low quality credits, a total of 595 credits will be retired.
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	At total of up to 4.6 ha of this vegetation community will be removed as part of the proposal (refer Table 5.1 and Appendix C).	127 ecosystem credits will be retired for impacts on this TEC within Borrow pit 1, in accordance with the Program Biodiversity Offset Strategy and the BAM guidelines
Weeping myall	A total of up to 0.02 ha of medium quality community that meet EPBC condition thresholds will be impacted. An additional 8.6 ha of low quality community that does not meet EPBC condition threshold guidelines will be impacted (See Appendix C)	1 ecosystem credits will be retired for impacts on this TEC within the early works alignment segment in accordance with the Program Biodiversity Offset Strategy and the BAM guidelines where the community meets the EPBC condition threshold. An additional 129 credits will be used to offset low condition PCT 27 in accordance with the BAM guidelines, which do not meet EPBC condition thresholds for the TEC. With the addition of these 129 low quality credits, a total of 130 credits will be retired.
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	A total of up to 33.5 ha of this vegetation community will be removed as part of the proposal within the alignment (refer Table 5.1 and Appendix C). Given the extent of impact, additional assessment of significance in accordance with MNES guidelines has been completed in Section 10.7.2.2.	1,384 ecosystem credits will be retired within the alignment segments to offset impacts to this TEC, in accordance with the Program Biodiversity Offset Strategy and the BAM guidelines.
Species-credit species	**These credits are based on assumed presence over all potential habitats**	
Belson's panic *(Homopholis belsonii)*	A total of up to 46.34 ha of potential habitat will be removed as part of the proposal. Given the extent of impact, additional assessment of significance in accordance with MNES guidelines has been completed in Section 10.7.1.2	1604 species credits will be retired to offset impacts to this species for the alignment segments and borrow pits respectively, in accordance with the Program Biodiversity Offset Strategy and the BAM guidelines.

Matter	Proposal impact (BAM)	Like-for-like Offset in accordance with BAM guidelines
Bluegrass (*Dichanthium setosum*)	Bluegrass was not found during targeted survey effort within the defined survey period, although its presence is assumed within 26.08 ha of potential habitat where targeted surveys were not undertaken.	1076 species credits will be retired to offset impacts to this species for the alignment segments, in accordance with the Program Biodiversity Offset Strategy and the BAM guidelines.
Koala *(Phascolarctos cinereus)*	A total of up to 27.7 ha of potential habitat will be removed as part of the proposal. Given the extent of impact, additional assessment of significance in accordance with MNES guidelines has been completed in Section 10.7.1.5.	987 species credits will be retired to offset impacts to this species for the alignment segments, in accordance with the Program Biodiversity Offset Strategy and the BAM guidelines.
Ecosystem-credit Species	**These credits are based on habitat values found within a PCT where that species is considered reliably likely to occur. As such, no individual credits are assigned to each species. Associated PCTs within associated IBRA sub-regions as detailed via the BAM-C on 15 October 2021 are listed below (also refer Appendix G for species habitat descriptions and assumptions). Species are not associated with scattered tree ecosystem credits, except where specifically stated, as per the BAM-C.**	
Australasian bittern *(Botaurus poiciloptilus)*	PCTs 36, 53, 247, within the associated Castlereagh-Barwon and Northern Basalts sub-regions.	506 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments.
Australian painted snipe (*Rostratula australis*)	PCTs 36, 52, 53, 247 within the associated Castlereagh-Barwon and Northern Basalts sub-regions.	1,890 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments.
Swift parrot (*Lathamus discolor)*	PCT 418 within the associated Northern Basalts sub-region	177 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments and borrow pits.
Spotted-tailed quoll *(Dasyurus maculatus)*	PCTs 36, 147, 192, 244, 418 and 628 within the associated Castlereagh-Barwon and Northern Basalts sub-regions.	1,111 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments and borrow pits.
Corben's long-eared Bat (*Nyctophilus corbeni*)	PCTs 35, 36, 55, 56, 98, 147, 192, 244, 247, and 418 PCT 418 within Borrow Pit 25 was excluded as potential habitat for the species by the BAM Calculator as at 15 October 2021	6,188 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments and borrow pits.
Five-clawed worm-skink (*Anomalopus mackayi)*	PCTs 27, 35, 36, 52, 55, 56, 244, 247, 628 and scattered paddock trees for PCTs 36 and 56 Given the extent of impact, additional assessment of significance in accordance with MNES guidelines has been completed in Section 10.7.1.4	7,562 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments and borrow pits.
Painted honeyeater *(Grantiella picta)*	Medium and high quality PCTs 27, 35, 36, 55, 56, 98, 147, 192, 244, 418, 628 and scattered paddock trees for PCTs 36 and 56. PCT 35 within Borrow Pit 1 and PCT 418 within Borrow Pit 25 were excluded as potential habitat for the species by the BAM accredited assessor as at 15 October 2021 due to the habitat constraint of mistletoes not being present	4,177 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments and borrow pits.
Grey-headed flying-fox *(Pteropus poliocephalus)*	PCTs 35, 36, 55, 56, 147, 418 within the Northern Outwash and Northern Basalts sub-regions	4,496ecosystem credits will be retired to offset potential impacts to this species within the alignment segments and borrow pits.

Matter	Proposal impact (BAM)	Like-for-like Offset in accordance with BAM guidelines
Koala *(Phascolarctos cinereus)*	Medium and high quality PCTs 35, 36, 55, 56, 98, 147, 192, 244, 418, 628 and scattered paddock trees for PCTs 36 and 56 PCT 35 within Borrow Pit 1 was excluded as potential habitat for the species by the BAM accredited assessor as at 15 October 2021 due to the absence of preferred feed trees at this location.	4,073 ecosystem credits will be retired to offset potential impacts to this species within the alignment segments and borrow pits.

10.4 Identification of ecological values and MNES receptors and initial impact assessment

10.4.1 Ecological values

Consistent with the relevant legislation as stated in Section 2, the overarching ecological values adopted for the subject land for the proposal consisted of the following:

- NSW natural environmental and native flora, fauna and ecological communities
- Biodiversity.

10.4.2 Ecological receptors

For those threatened flora and fauna species regulated under the EPBC Act and not subject to survey or assed under the BAM, predictive habitat mapping has been used to assess the species potential to occur within the subject land. In instances where species/communities did not have predicted habitat contained within the subject land, these species were not subject to impact assessment and were no longer considered to constitute receptors as the risk of impacts to any these species is considered low. The receptors identified for terrestrial ecology within the subject land are identified in Table 10.7 along with their assigned sensitivity value as determined by Table 10.3.

Table 10.7 EPBC Act listed ecological receptors assessed by the Significant Impact Assessment Methodology

Associated ecological value	Identified ecological receptors	Assigned sensitivity (refer Table 10.3)	Justification
■ Native flora and fauna ■ Biodiversity	Threatened terrestrial flora and fauna species listed under the provisions of the EPBC Act (some species also BC Act listed): **Fauna:** ■ Murray cod (*Maccullochella peelii*) ■ White-throated needletail (*Hirundapus caudacutus*)*	High	■ Conservation significant: protected by EPBC Act ■ Unique to the environment: species are unique to the region ■ Poorly represented in the region: species are uncommon in the region ■ Proposal activities would have an adverse impact on TECs: vegetation clearing within TECs would remove habitat for the species

Table note:

* The White-throated needletail (*Hirundapus caudacutus*) is thought to be a predominantly aerial foraging species present in Australia during the summer months. The species may forage over most habitats including heavily degraded areas. There are few recorded instances of the species roosting and it does not breed in Australia. A review of the potential risk associated with a collision by an individual with a train has been conducted. The Approved Conservation Advice for the species notes that collision with powerlines and wind turbines are of 'low severity and affects a small number of birds'. The DAWE (2021) profile notes that collision with powerlines, windows, and lighthouses affects only a few individuals and is not a threat to the species overall. There are no reports of collisions with vehicles (including aircraft). Impacts of the proposal on the species and its habitat are not considered to be significant and the species is not considered further in the impact assessment.

10.5 Quantification of the magnitude of potential environmental impact to identified matters of national environmental significance

Estimation of the potential magnitude of disturbance was undertaken for each of the MNES receptors identified during the desktop and field components of the proposal (refer Table 10.7). This was achieved using predictive habitat modelling, which was supported by field validation, government GIS datasets and material gathered during the field component of the assessment.

In addition, the subject land was used to determine the initial disturbance area (including consideration of design mitigation measures) as a percentage of the extent of the ecological receptor within the broader proposal context (i.e. within a 1km buffer of the alignment centreline). The percentage was then used to determine relative disturbance magnitude as per the criteria presented in Table 10.1.

Calculated estimates of potential disturbance magnitudes for each of the ecological receptors is provided in Table 10.8.

Table 10.8 Estimation of potential magnitude of disturbance for each of the ecological receptors identified for the proposal

Ecological receptor	Total coverage of ecological receptor within the context area (1km buffer). Context area extent = 12783.38 ha	Total unmitigated potential disturbance area associated with the subject land. Subject land extent = 700.86 ha	Percentage (%) disturbance to receptors within the subject land based on the unmitigated potential disturbance	Magnitude of disturbance area (refer Table 10.1 for magnitude criteria)*
Threatened fauna (EPBC Act)				
Murray cod (*Maccullochella peelii*)	38.13	1.15	3.96	Moderate

Table note:

* There is potential for each of the ecological receptor impacts to overlap spatially. As a result, addition of disturbance values presented in the above table would not represent a true reflection of the total disturbance footprint.

10.6 Initial significance of potential impacts

The qualitative initial impact assessment of the proposal on MNES values is provided in Table 10.9. These tables present both the initial impact significance (i.e. application of mitigation measures already incorporated into the reference design) and the residual significance of impact following the application of Project mitigation measures.

The initial significance of impacts resulting from initial mitigation measures presented in Table 8.4 were determined for each phase of the proposal for the identified MNES receptors presented in Table 10.8 (except those with a magnitude of N/A). Each ecological receptor's sensitivity was determined using the criteria outlined in Table 10.3 and presented in Table 10.7. The initial magnitude of impacts used in Table 10.9, take into consideration those associated with direct impacts associated with the direct removal of habitat (refer Table 10.8) and also considers those potential indirect impacts associated with Air Quality, Surface water and Hydrology, Groundwater, and Noise and vibration.

The impacts to ecological receptors displayed below in Table 10.9 have been grouped by:

- Ecological receptor type (e.g. aquatic and terrestrial)
- Sensitivity (e.g. low, moderate, high)
- Magnitude of direct disturbance (refer Table 10.8).

In addition to the mitigation measures presented in Section 8.6, rehabilitation works may also be an effective mitigation measure to minimise potential impacts over time.

The initial assessment of impacts has taken a conservative approach and those MNES that returned an impact rating of Major, High, or Moderate were subsequently re-assessed against the MNES significant impact guidelines to confirm the initial impact assessment results (refer Section 10.7).

Table 10.9 Initial significance impact assessment of the proposal upon identified MNES

Ecological receptor(s)	Sensitivity (refer Table 10.3)	Phase	Potential impacts[1]	Initial significance (application of initial mitigation measures in Table 8.2)		Proposed additional mitigation measures to be applied (refer Table 5.3)	Residual significance following the application of proposal mitigation measures presented in Table 8.3[2]	
				Magnitude	Significance		Magnitude (refer Table 10.8)	Significance[3]
Commonwealth significant ecological constraint (species listed under the EPBC Act): **Fauna:** ▪ Murray cod (*Maccullochella peelii*)	**High**	Construction	▪ Disturbance from temporary waterway impoundment ▪ Barrier effects ▪ Dust impacts ▪ Erosion and sedimentation	Moderate	**Moderate**	▪ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▪ Aquatic fauna (design and construction) ▪ Weeds and pests (preconstruction and construction mitigation measures) ▪ Erosion and sediment control (pre-construction and construction) ▪ Riparian vegetation and aquatic habitats (construction)	Negligible	**Low** (refer to Section 10.4.2.3 for impact assessment as per the Significant Impact Guidelines Version 1.1 – MNES)
		Commissioning and reinstatement	▪ Displacement of flora and fauna species from invasion of weed and pest species ▪ Aquatic habitat degradation ▪ Erosion and sedimentation	Low	**Moderate**	▪ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▪ Weeds and pests (preconstruction and construction mitigation measures) ▪ Erosion and sediment control (construction) ▪ Landscape, rehabilitation and stabilisation (design, pre-construction, construction)	Negligible	**Low**
		Operation	▪ Erosion and sedimentation	Negligible	**Low**	▪ Erosion and sediment control maintenance (operation)	Negligible	**Low**

Ecological receptor(s)	Sensitivity (refer Table 10.3)	Phase	Potential impacts[1]	Initial significance (application of initial mitigation measures in Table 8.2)		Proposed additional mitigation measures to be applied (refer Table 5.3)	Residual significance following the application of proposal mitigation measures presented in Table 8.3[2]	
				Magnitude	Significance		Magnitude (refer Table 10.8)	Significance[3]
		Commissioning and reinstatement	▪ Displacement of flora and fauna species from invasion of weed and pest species ▪ Noise, dust and light impacts	Low	Moderate	▪ Flora and fauna (design, preconstruction and construction proposed mitigation measures) ▪ Weeds and pests (preconstruction and construction mitigation measures) ▪ Erosion and sediment control (construction) ▪ Landscape, rehabilitation and stabilisation (design, pre-construction, construction)	Negligible	**Low**
		Operation	▪ Fauna species injury or mortality ▪ Displacement of flora and fauna species from invasion of weed and pest species ▪ Noise, dust and light impacts ▪ Aquatic habitat degradation	Low	Moderate	▪ Weeds and Pests (operations) ▪ Riparian vegetation and aquatic habitats (operations)	Negligible	**Low**

Table notes:

1 Potential impacts to terrestrial and aquatic receptors in the above table are based upon those identified in Section 8.3.

2 The use of offsets has not been considered as a mitigation measure for the purposes of proposal mitigation for the assessment of potential impacts.

10.7 Significant Impact Assessment – MNES Guidelines

Following detailed survey effort, there is one species listed as a MNES relevant to the proposal area. Three fauna species which are not assessed under the BAM, Curlew sandpiper, Dunmall's snake and Red goshawk, have been surveyed for in accordance with EPBC guidelines and not found to occur within the study area and as such require no further assessment. Two threatened flora species listed as a MNES (*Cadellia pentastylis* and *Thesium australe* – both vulnerable under the EPBC Act) are not considered relevant to the proposal area as they were not found during flora surveys (refer Table 10.8). As such, these species are not considered further in this assessment.

For the other entities listed in the controlled action, and to clarify the relevance of the entities identified in the Protected Matter Search Tool (refer Appendix E) to this project, a summary and recommendation for each is provided in the tables below. Other additional species where clarification was also sought from BCSD are also included in the table below, with supplementary significance assessments are provided for a subset of these in Sections 10.7.1-2..

Table 10.10 MNES listed in the SEARS and summary recommendation

MNES	Summary discussion and recommendation	Document reference
Adorned delma (*Delma torquata*)	The species was not detected during a range of reptile surveys which were completed under favourable conditions in early 2021 or incidentally during other surveys. Suitable habitat does not occur within or adjacent to the study area. The proposal is located well outside the known range of the species. There is not expected to be a significant impact on this species.	Table 3.12 and Section 7.2.2
Belson's panic (*Homopholis belsonii*)	Targeted surveys carried out within the study area recorded this species and it is a species credit species. The overall cumulative impact on the species is identified as low and overall impact significance is assessed as medium, as such an additional significance of impact assessment is provided in Section 10.7.1.2. With mitigation and offsetting measures there will not be a significant impact on this species.	Section 8.6.2 and Section 8.6.3, Table 11.1, Table 11.2, and Appendix B and Appendix G
Bluegrass (*Dichanthium setosum*)	Bluegrass was not found during targeted survey effort within the defined survey period, although its presence is assumed within 26.08 ha of potential habitat where targeted surveys were not undertaken. An additional significance of impact assessment is provided in Section 10.7.1.3, identifying that with mitigation and offsetting measures there will not be a significant impact on this species.	Table 6.4, Section 3.4 and Appendix B and Appendix G.
Corben's long-eared bat (*Nyctophilus corbeni*)	As a species credit species, Corben's long-eared bat was only recorded as a possible species from anabat recording, and was not recorded from harp trapping when *N. gouldii* and *N. geoffroyi* were recorded, under favourable conditions. The overall cumulative impact on the species is assessed as low and the project is not expected to have a significant impact on this species.	Section 3.5.4 and Section 6.1.2, Table 11.1 and Table 11.2.
Dunmall's snake (*Furina dunmalli*)	Targeted nocturnal or diurnal reptile surveys were completed over several rounds and the species was not recorded. The subject land is outside of the 'The modelled distribution of Dunmall's snake (*Furina dunmalli*)' found in the 'EPBC Act - Draft Referral guidelines for the nationally listed Brigalow Belt reptiles'. There is not expected to be a significant impact on this species.	Table 3.12 and Table 7.3

MNES	Summary discussion and recommendation	Document reference
Five-clawed worm skink *(Anomalopus mackayi)*	The species was not detected during a range of reptile surveys which were completed under favourable conditions in early 2021 or incidentally during other surveys. Habitat does exist but the closest database record of the species is 50 km south east or 80 km south west. However a probable find was recorded 4km south of the study area on 5 July 2021 during a preclearing survey in PCT 52, as part of the separate Narrabri to North Star segment of the Inland Rail project. It is identified as an ecosystem credit species with low potential cumulative impact, however areas of predicted important habitat will be impacted and as such an assessment of significance assessment has also been conducted in accordance with MNES guidelines (refer Section 10.7.1.4). In accordance with MNES guidelines, the proposal is likely to have a significant impact on important habitats of the species. The extent of impact will be reduced through the offsetting of ecosystem credits associated with the species.	Table 3.12 and Table 7.3
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	A total of up to 33.5 ha of this vegetation community will be removed as part of the proposal within the alignment, with associated ecosystem credits retired to offset impacts. Overall project cumulative impacts are identified as low, although there is likely to be significant residual impacts in accordance with MNES guidelines as detailed in Section 10.7.2.2. However, offsets are being provided under the bilateral agreement, in relation to areas of PCT 52 to be cleared.	Table 5.1 and Appendix C, Table 11.1 and Table 11.2
Koala (*Phascolarctos cinereus*)	The Koala is a species credit species and was subject to extensive targeted surveys, however the species was only recorded as a vocalised observation on the MacIntyre River in PCT 36 in 2019. One set of scats was sent to B.Triggs in 2019, which was identified as possum. Incidentally during the range of other surveys completed, scats and scratches were recorded in February 2021 just outside the subject land. No other signs of this species were detected in the study area across a range of survey types. The species require trees for food and shelter however the Low-quality PCT contain only highly scattered individual trees or no trees, and therefore do not provide suitable habitat for the species. Some PCTs only contain limited preferred forage tree species, based on either observed flora species or benchmark descriptions of the PCT. There is not expected to be a significant impact in accordance with MNES guidelines on this species as detailed in Section 10.7.1.5.	Section 3.5, Section 8.4.2, Table 6.4, Table 7.3 Appendix G
Ooline (*Cadellia pentastylis*)	Ooline is associated with vine thickets in Queensland may be locally dominant in vegetation in northern New South Wales and occurs in similar areas to vine thickets (Floyd 1990; Benson 1993; McDonald 1996). However detailed survey within potential habitat did not locate the species. There is not expected to be a significant impact to the species from the project.	Table 7.2 and Section 10.7
Painted honeyeater (*Grantiella picta*)	Painted Honeyeater is an ecosystem credit species. Bird surveys at 75 sites carried out in October 2018 and 2019 (call playback and spotlighting) recorded a single bird in Poplar box woodlands. There are numerous records from the wider area surrounding the proposal. The species is a specialist feeder on the fruit of mistletoes which require larger trees to grow on. Low-quality PTCs contain no trees therefore there is little or no habitat for mistletoes and henceforth no suitable habitat for the Painted honeyeater – however medium to high PCTs are considered habitat. The overall cumulative project impacts on the species is low and there is not expected to be a significant impact to the species from the project.	Table 6.2, Table 7.3, Table 11.1 and Table 11.2, Appendix G

MNES	Summary discussion and recommendation	Document reference
Weeping myall woodlands	An area of 0.02 ha of PCT 27 (Medium quality) Weeping Myall open woodland occurs in a shallow depression within a flat alluvial plan adjacent to Mobbindry Creek. This area contains a monotypic stand of Weeping Myall. Ecosystem credits will be retired for potential impacts on this TEC. Other areas of PCT27 (27 Low) do not met the condition requirements for PEBC listing of Weeping Myall as there are no Myall trees present. The proportion of overall cumulative impact is determined as low, and a significant impact on this TEC is not expected.	Section 5.2.1, Table 5.1, Table 11.1 and Table 11.2, Appendix B and Appendix C

Table 10.11 MNES listed in the PMST (Appendix E) and select other species, and summary recommendation

MNES	Summary discussion and recommendation
Ramsar wetlands:	
Banrock Station Riverland Coorong and Lakes Alexandria and Albert	The following Ramsar wetlands are located more than 1000 km from the proposal: ■ Banrock Station Ramsar site (>1,100 km to the south-west in South Australia) ■ Riverland Ramsar site (>1,000 km to the south-west in South Australia) ■ Coorong and Lakes Alexandria and Albert (>1,200 km to the south-west in South Australia) The project is not expected to have a significant impact on these Ramsar wetlands
Migratory species:	
Common sandpiper (*Actitis hypoleucos*) Sharp-tailed sandpiper (*Calidris acuminata*) Pectoral sandpiper *(Calidris melanotos)* Osprey (*Pandion haliaetus*) Common greenshank (*Tringa nebularia*) Fork-tailed swift (*Apus pacificus*) Great egret (*Ardea alba*) Cattle egret (*Bubulcus ibis*) Black-eared cuckoo (*Chalcites osculans*) Yellow wagtail (*Motacilla flava*)	These species have no recent records in the IBRA sub-region,and/or suitable habitat is not present within the study area. No significant impact is expected on these species.
Threatened species:	
Greater glider (*Petauroides volans*)	The nearest records for this species are more than 100km to the east (Torrington) and more than 150km to the south (Mt Kaputar). No individuals were recorded during multiple rounds of nocturnal survey. Suitable habitat does not occur for this species within or adjoining the study area. The project is not expected to have a significant impact on this species
Species recorded on site:	
Australasian bittern (*Botaurus poiciloptilus*)	An individual was recorded at farm dam associated with Borrow Pit 8 during Project surveys and this is an ecosystem credit species. Suitable habitat for this species will not be impacted by the project, and a significant impact on this species is not expected.
Latham's snipe (*Gallinago hardwickii*)	The species was recorded once in 2018 outside the subject land and just outside the eastern boundary of the study area at a farm dam. It has not been detected during multiple rounds of survey since. This migratory species has a widespread range and suitable habitat for this species will not be impacted by the project, and a significant impact on this species is not expected.

MNES	Summary discussion and recommendation
White-bellied sea eagle (*Haliaeetus leucogaster*)	An individual was recorded over the Macintyre River in October 2019. No evidence of breeding activity (raptor nests or pairs) was observed. No breeding pairs were recorded during targeted surveys within specified time frames. The project is not expected to have a significant impact on this species.
Rainbow bee-eater (*Merops ornatus*)	This species was recorded on site and occurs in a wide range of habitat types. Because no evidence of large breeding colonies were observed, as per EPBC guidelines for migratory species, the project is not expected to have a significant impact on this species.
Satin flycatcher (*Myiagra cyanoleuca*)	This species was recorded on site within PCT 36 and occurs in a wide range of habitat types. Breeding habitat is mostly associated with coastal and tableland mature eucalypt forests (Department of Agriculture, Water and the Environment 2020). The project does not involve the removal of key life cycle habitat identified for the species and therefore is not expected to have a significant impact on this species.
Ecosystem credit species:	
Superb parrot (*Polytelis swainsonii*)	Species credit (breeding) exclusion from BAM-C. No breeding pairs were recorded during targeted surveys within the specified time frames. The study area is outside of the species normal distribution. The project is not expected to have a significant impact on the species.
Spotted-tailed quoll (*Dasyurus maculatus*)	This is an ecosystem credit species (refer Table 6.1). No evidence of the species was recorded throughout multiple survey rounds over several years. There are no recent records within the region and the project is not expected to have a significant impact on the species.
Grey-headed flying fox (*Pteropus poliocephalus*)	Ecosystem credit species for associated medium and high quality PCTS. No evidence of breeding (i.e. roost sites or large numbers of individuals) recorded in study area during surveys. No colonies of any flying-fox species located within the study area during targeted surveys, colonies tend to be easily recognised by both sight and smell. In addition, only one of the nominated PCTs (36) represent likely 'breeding' habitat for the species which requires dense vegetation adjacent to water. The project is not expected to have a significant impact on this species.

Relevant Commonwealth documents applicable to each species including threat abatement plans, approved conservation advices, and recovery plans are also summarised in Appendix C. This section of the MNES report assesses the potential for significant residual impacts from the Project on threatened fauna species using the MNES Guidelines.

Impacts to aquatic species (i.e. Murray cod) include temporary barrier works in waterways, impacts to riparian and instream habitat, and surface water quality (refer Table 10.9 and EIS Appendix S: Aquatic Biodiversity Technical Report). These impacts are expected to be temporary and largely during Project construction (i.e. sporadic maintenance works may be required at sites during the Project operation).

The assessment of significant impacts on the identified MNES species from the Project is based on:

- The design and layout of the Project
- Currently known information about the MNES affected
- Information on potential impacts of Project construction and operation (refer Section 8.3)
- Proposed Project mitigation measures (refer Section 8.6).

A summary of the findings of the assessment of the significant residual impact assessment for threatened fauna is provided in Table 10.12. Section 10.7.1 provides the significant impact assessment for vulnerable species with potential to be impacted by the Project.

Table 10.12 Summary of the results of the significant impact assessment for matters of national environmental significance fauna species

Species	EPBC Act status*	Results of assessment	Table containing assessment against MNES Guidelines
Murray cod (*Maccullochella peelii*)	V	No significant residual impact expected	Table 10.13

Table notes:
CE = Critically endangered, E = Endangered, V = Vulnerable

10.7.1 Vulnerable species

The assessment of vulnerable species includes an evaluation of the likely importance of the population of vulnerable species associated with the impact assessment area. Under several criteria within the Guidelines vulnerable species are considered as subject to significant impacts when an 'important population' is impacted.

An 'important population' as defined within the Guideline significant impact criteria for vulnerable species is as follows:

'An important population is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

Given the specificity of the above definition and the scarcity of information and records available for most listed species and populations in the region (and Australia), it is difficult to determine: 1) attributes such as breeding and dispersal behaviour and whether the population is a 'key source' and 2) the genetic diversity of individuals inhabiting a population or sub-population. It is noted the Project is linear and is not expected to impact the potential distribution of local pollinators for most (if not all) plant species and as such is not considered likely to impact dispersal or genetic exchange within a plant population. Significance of impacts to threatened species has been based on experience of the assessment team and the latest available information including from both State and Commonwealth sources.

10.7.1.1 Murray cod (*Maccullochella peelii*) – vulnerable

Ecology and distribution

The Murray cod (*Maccullochella peelii*) is the largest freshwater species of fish in Australia, measuring up to 1.8 m in length and weighing about 10 kg although some records indicate the species may reach over 100 kg in weight. The habitat of the species is diverse, ranging from clear rocky streams to slow-flowing, turbid lowland rivers or billabongs where the fish is found frequently in the main channel. Due to the species preferred breeding environment, it is often found in streams containing large rock, snags, overhanging vegetation, stumps or other woody structures. Due to the size of the Murray cod, it is considered the apex predator of the Murray-Darling river system and known to ambush its prey. The demersal species is known to hunt from sunset to sunrise, feeding on spiny crayfish and shrimp as well as reptiles and other fish species including cod (DAWE 2020).

The species is known to take long distance journeys prior to spawning travelling up to several hundred kilometres upstream despite their naturally sedentary nature (Koehn et al. 2009). The Murray cod has relatively low fertility compared to many other freshwater fish with the species generally reaching sexual maturity, which is heavily dependent on size, at 5 years of age. Male Murray cod, who are known to guard and fan the eggs during incubation, mature at a larger size than females with the species breeding as a pair. A female cod weighing 3 kg can produce up to 10,000 eggs often laid in logs or snags after developing them through winter until spawning, which is triggered by an increase in temperature and day length (DAWE 2020).

The Murray cod was once a widespread species and abundant in the lower and mid reaches of the Murray-Darling Basin between Queensland and South Australia. However, the distribution of the species has now reduced to several bioregions between Queensland and Victoria, including the Brigalow Belt South Bioregion (NMCRT 2010).

Distribution in context to the Project

This species has been recorded within the Macintyre River during targeted surveys for fish species for the adjacent section of the Inland Rail project: Border to Gowrie (Eco logical Australia 2020). There are no Bionet records of the species from the search area. Database records from the wider region (AoLA 2021) indicate the species is only known from Macintyre River (with regard to the proposal). Records indicate the species has been found as recently as 2011 and there are several other records upstream and downstream of the proposal crossing on the Macintyre River. Surveys of aquatic habitat values for the proposal indicate that apart from the Macintyre River, other waterways intersected by the proposal are unlikely to provide habitat for Murray cod (refer EIS Appendix S: Aquatic Ecology Technical Report).

Recovery plans/threat abatement plans

The *National Recovery Plan for the Murray Cod Maccullochella peelii peelii* (NMCRT 2010) identifies the following threatening processes as applicable to the species:

- River regulation of flows and instream impoundments impact spawning movements and recruitment processes and impact water quality in rivers
- Habitat degradation caused by the removal of habitat elements (large woody debris), sedimentation and siltation events from broad-scale land clearing and following large fires
- Competition/predation from introduced fish species including European carp (*Cyprinus carpio*), Redfin perch (*Perca fluviatilis*), Goldfish (*Carassius auratus*) and Mosquitofish (*Gambusia holbrooki*)
- Commercial and recreational fishing
- Stocking and translocation of the species impacting the genetic integrity of populations.

There are no threat abatement plans considered applicable to this species.

Important populations and Habitat critical to the survival of the species

The *Draft referral guidelines for the vulnerable Murray cod (Maccullochella peelii)* (DotE 2016) identifies the following important populations for Murray cod in Queensland:

- Condamine River upstream of Warwick
- Border rivers (see also populations listed for NSW):
  - the Macintyre-Dumaresq Rivers to approximately 50 km downstream of Goondiwindi
  - Weir River
  - Macintyre Brook downstream of Inglewood
  - Severn River

- Pike Creek downstream of Glenlyon Dam
- Warrego River between Charleville and Cunnamulla.

As such, the population within the Macintyre River is considered to be an important population that is relevant to the Project footprint. Habitat critical to the survival of the species has not been defined for the species in either the Recovery plan or the Referral guidelines. Predictive habitat mapping indicates that the proposal may impact 1.15 ha of 'general habitat' for Murray cod and based on maximum potential unmitigated disturbance (refer Table 10.8 and EIS Appendix S: Aquatic Biodiversity Technical Report). As identified in the Aquatic Report this assessment is to reconsidered post-EIS in the context of the mitigation measures to be implemented including detailed bridge design with a single span crossing the Macintyre River, complimented by construction and operation controls. Consideration is also given to the baseline level of external impacts which may be influencing the river environment, and the relative influence of the proposed crossing in relation to the current ecosystem condition. Impacts on 'general habitat' of the Murray cod are considered unlikely.

The following significant impact assessment under the MNES guidelines (DotE 2013) has been informed by the impacts and mitigation measures in Section 8.6 and the information detailed above.

Table 10.13 Assessment against the significant impact criteria: Murray cod

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Murray cod has been recently recorded in the Macintyre River during targeted surveys for an adjacent section of the Inland Rail project (Eco Logical Australia 2020). This waterway is considered as supporting an 'important population' under the draft referral guidelines for the species. Waterways elsewhere along the alignment did not provide suitable habitat to support the species. Predictive habitat mapping indicates that without any mitigation measures the proposal may impact 1.15 ha of 'general habitat' for the species (as defined for this species). The proposal design incorporates culverts, bridges and viaducts to allow fish passage, including a single span crossing at the Macintyre River and floodplain. No bridge supports will be located within the bed of the Macintyre River minimising instream construction disturbance and changes to river flows during operation. Flood modelling indicates that flows in the Macintyre River (e.g. flood heights and flow velocities) will not be adversely impacted as a result of the proposal (refer EIS Appendix H: Hydrology and Flooding Technical Report). The proposal's construction phase may require temporary impoundments at waterway crossing points, along with the removal of instream habitat. These works will be temporary and localised. Dewatering activities of impounded areas will be carried out with consideration of the Policy and Guidelines for Fish Habitat Conservation and Management Update 2013. The impacts of the proposal are considered unlikely to lead to any long-term decrease in the size of an important population.
Reduce the area of occupancy for an important population	Murray cod has been recently recorded in the Macintyre River during targeted surveys for an adjacent section of the Inland Rail project and this waterway is considered to support an important population. Waterways elsewhere along the alignment did not provide suitable habitat to support the species. Predictive habitat mapping indicates that without mitigation the proposal may impact 1.15 ha of 'general habitat' for the species. However the proposal design incorporates culverts, bridges and viaducts to allow fish passage, including the single span crossing at the Macintyre River (without in-stream supports). Stream impoundments may be required temporarily only during the construction phase. The impacts of the proposal are temporary and considered unlikely to reduce the area of occupancy of the species.
Fragment an existing important population into two or more populations	The proposal is not considered to represent a barrier to movement for the species. The proposal design incorporates culverts, bridges and viaducts to allow fish passage, including the crossing at the Macintyre River and floodplain. Stream impoundments may be required temporarily only during the construction phase. These structures and construction measures will avoid fragmentation of an existing population. It is considered unlikely that the proposal will fragment an existing important population into two or more populations.

Criterion	Assessment against significance criteria
Adversely affect habitat critical to the survival of a species	The proposal will intersect 'general habitat' as defined under this assessment on the Macintyre River. This waterway is considered to support an important population of Murray cod and as such, may be also be considered as 'habitat critical to the survival of a species'. This is a conservative assessment given the species occurs across a wide area. Proposal disturbance to these areas will be temporary being restricted to the construction period. Following construction, no impact to flows will occur as a result of the proposal. It is considered unlikely the proposal will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Murray cod is restricted to areas of permanent water and is known to complete their lifecycle entirely within freshwater habitats (i.e. potamodromous). Breeding occurs in Spring as associated with warmer temperatures and increased day length. The species is known to make significant upstream migrations prior to spawning. The temporary impoundment of the Macintyre River may pose a risk to the species given they are potamodromous. The proposal design incorporates culverts, bridges and viaducts to allow fish passage, including the crossing at the Macintyre River and floodplain. Waterway impoundment may be required temporarily only during the construction phase. Where possible construction will be timed to occur outside of the potential spawning season. Project disturbance to waterways will be temporary being restricted the construction period. It is considered unlikely that the Project will disrupt the breeding cycle of a population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Aquatic habitat degradation is a contributing factor to the decline in Murray cod populations. The degradation generally occurs at a catchment scale such as land clearing, broad-scale fires and river regulation which influence water quality. The proposal may require works within waterway habitat in the Macintyre River, which may result in the localised removal of important habitat features such as woody debris and changes to the local geomorphology. The majority of the water crossing points along the alignment are ephemeral and instream habitat complexity is very limited and do not constitute habitat for the species. Proposal disturbance to waterways will be localised and temporary being restricted the construction period. Changes to water quality may also occur if not appropriately managed during construction (e.g. erosion and sediment controls) or operations (accidental spills and maintenance of waterway barriers). However, the risk of impact is likely to be low and localised. Mitigation measures will be in place to ensure surface water quality associated with the surrounds is not impacted as a result of proposal activities (e.g. erosion and sediment controls and water quality monitoring program) (refer Section 8.6.3). The impacts of the proposal are considered unlikely to be of the extent that the species is likely to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Introduced fish species are identified as a potential threat to the species. Targeted fish assessments identified Goldfish and Mosquito fish in the Macintyre River (Eco Logical Australia 2020). As such, there is potentially already elevated competition levels from these species within this waterway. Weed and pest control measures will be incorporated into the proposal Biosecurity Management Sub-plan to control the introduction of novel weeds and spread of existing weed species across the proposal footprint. This will include measures to ensure aquatic weeds and pest species are not introduced as a result of the proposal. The Plan will be in place for the life of the proposal and will minimise the potential for weed invasion and may in the long-term improve habitat condition within vegetation communities located adjacent to proposal infrastructure. The proposal is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the species to decline	The proposal's Biosecurity Management Sub-plan will incorporate the management of invasive species which will assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The proposal is considered unlikely to introduce disease that may cause the species to decline.

Criterion	Assessment against significance criteria
Interfere with the recovery of the species	The *National Recovery Plan for the Murray Cod Maccullochella peelii peelii* (NMCRT 2010) includes the following recovery objectives: ■ Determine the distribution, structure and dynamics of Murray cod populations across the Murray-Darling Basin ■ Manage river flows to enhance recruitment to Murray cod populations ■ Evaluate the risks of threats and benefits of recovery options on Murray Cod populations for each management unit ■ Determine the habitat requirements of Murray cod life stages and populations ■ Manage the recreational fishery for Murray Cod in a sustainable manner while recognising the social, economic and recreational value of the fishery ■ Encourage community ownership for Murray Cod conservation With mitigation measures in place, particularly for the construction phase, the proposal is considered unlikely to interfere with any of the recovery actions listed above and will not interfere with the recovery of the species.
Assessment of potential for significant residual impacts	The proposal is currently considered unlikely to have a significant impact on Murray cod

10.7.1.2 Belson's Panic (*Homopholis belsonii*) – vulnerable

Ecology and distribution

Belson's Panic is known to grow often in poor soils in dry woodlands especially in NSW as well as in areas which receive irregular or intermittent flooding, where Belson's panic can be found on higher, well-drained rises. An elevation level of 200 to 520 m is required for the species in NSW whilst in Queensland, the species range from 342 to 500 m elevation (DAWE 2020).

The species is classified as growing in three specific habitats which include:

- Rocky and basaltic hills featuring White Box (*Eucalyptus albens*) and Wilga (*Geijera parviflora*) woodlands with various shrub and grass species
- Flat to gently undulating alluvial areas featuring Belah (Casuarina cristata) forests and occasionally Brigalow (*Acacia harpophylla*) forests
- Drainage lines featuring Belah and sandy country dominated by Cypress Pine-Bloodwood-Ironbark-She-Oak Forest (TSSC 2008).

Distribution in context to the Project

This species was recorded from multiple locations within the both alignment and within borrow pits (1 and 2) during January 2021 surveys, with up to 46.43 ha of suitable habitat potentially impacted by the proposal. Generally, the species was found to largely occur amongst other taller species, especially shrubs such as *Carissa ovata*, and amongst woody debris, supporting the theory that the species may be shade dependent (DAWE 2020).

All records are within the Northern Basalts and Northern Outwash IBRA sub-regions. Additionally, presence is assumed in areas of potential habitat within the Castlereagh-Barwon IBRA sub-region based upon the precautionary principle in areas where targeted surveys were not conducted during the appropriate survey period. Whilst this assumption of presence would be an extension of known range, the species is still predicted to occur in this region.

Although the entire distribution throughout the project area is scattered, where present the species was found to be locally abundant.

Recovery plans/threat abatement plans

Whilst no specific recovery/threat abatement plans are available for Belson's Panic, the following actions are identified as potential management measures (DAWE 2020):

- Management of remnant habitats, including maintaining overstorey to retain shrub layer
- Native vegetation regeneration
- Strategic protection of land
- Stock exclusion
- Effective weed control

Important populations and Habitat critical to the survival of the species

Approved Commonwealth conservation advice for the species (TSSC, 2008) does not identify any current criteria or known locations of important populations or critical habitats. The species is known to occur amongst a range of habitats (including disturbed roadside habitats). As such, impacted areas are not considered to be habitat critical to the survival of the species. Furthermore, the proposal is not considered likely to disrupt seed dispersal mechanism of the species (i.e. windblown seed heads), such that dispersal or genetic exchange within the surrounding plant population will be impacted.

OEH (2021b) identifies the following key priority management sites in NSW, of which none are within the proposal impact area:

- Kirramingle Nature Reserve in Moree Plains LGA
- Gurley Road in Moree Plains LGA.

Therefore, in consideration of the above factors, the proposal area is not considered to contain an important population or habitat critical to the survival of the species.

The following significant impact assessment (refer Table 10.14) under the MNES guidelines (DotE 2013) are informed by the impacts and mitigation measures in Section 8.6 and the information detailed above.

Table 10.14 Assessment against the significant impact criteria: Belson's Panic (*Homopholis belsonii*)

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Species is not considered to be part of an important population. Regardless, the proposal is unlikely to lead to a long-term decrease in population, particularly due to the fact that the species has demonstrated capacity to recolonise disturbed areas (such as roadsides and railway corridors) and individuals of the species were identified outside of the proposed impact area.
Reduce the area of occupancy for an important population	Species is not considered to be part of an important population. Regardless, 46.43 ha of known and potential habitat is expected to be impacted because of the proposal. However, the species demonstrates a capacity to recolonise disturbed areas (such as roadsides and railway corridors) and therefore reduction of occupancy is expected to be temporary and return once construction is finalised and revegetation occurs.
Fragment an existing important population into two or more populations	Species is not considered to be part of an important population. However, species distribution is known to be scattered which is likely facilitated by the wind dispersal mechanism. As the proposal is unlikely to significantly disrupt wind dispersal of seeds for non-impacted species, there is not considered to be a fragmentation of the species.
Adversely affect habitat critical to the survival of a species	Species is known to occur amongst a range of habitats (including disturbed roadside habitats). As such, impacted areas are not considered to be habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Species is not considered to be part of an important population. Regardless, as the proposal is unlikely to significantly disrupt wind dispersal of seeds for non-impacted species, there is not considered to be a disruption to the breeding cycle of the species.

Criterion	Assessment against significance criteria
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Up to 46.43 ha of known or potential habitat will be impact by the proposal. While some of these impacts may be temporary in nature, the permanent footprint will result in less opportunity for a suitable overstorey to develop, which provides a shaded habitat that the species prefers. Additionally, soil compaction (as discussed in Section 8.3.3) during construction may result in lowered biological viability of the soil which may limit recolonisation potential. Mitigation measures such as limiting the size of stockpile sites to avoid heat sterilisation of the soil may assist in reducing impacts associated with soil modification. As such, temporarily impacted areas may be able to be recolonised following construction such that extent of species may not decline locally.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Known weed species that have previously outcompeted Belson's Panic within known habitat sites include Green Panic Grass (*Panicum maximum var. trichoglume*), *Hyparrhenia hirta,* and Tiger Pear (*Opuntia aurantiaca*) (DAWE 2020). Provided that weed management and mitigation measures as listed in Section 8.6 are followed, it is unlikely these species will become established.
Introduce disease that may cause the species to decline	Provided that biosecurity measures as listed in Section 8.6 are followed, it is unlikely that introduced disease will be introduced, and that diseases will contribute to the species decline.
Interfere with the recovery of the species	Whilst a recovery plan is not prepared for this species, the clearing of native vegetation may temporarily impact recovery of the species in the area. However, the species is known to be able recolonise disturbed areas such as roadsides and therefore the potential for impacts on recovery is not considered to be significant.
Assessment of potential for significant residual impacts	Impacted areas of habitat are not considered to contain important populations or critical habitat features and mitigation measures are also expected to minimise the effects of native vegetation clearing. Additionally, impacted areas of known locations and predicted habitat will be offset in accordance with the NSW Biodiversity Assessment Methodology. As such, there is not expected to be significant residual impacts.

10.7.1.3 Bluegrass (*Dichanthium setosum*)

Ecology and distribution

Bluegrass is associated with heavy basaltic black soils and red-brown loam with clay subsoil and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture. The extent to which this species tolerates disturbance is unknown (OEH 2020).

The species occurs within the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland (OEH 2020).

Distribution in context to the Project

Systemic targeted survey did not identify the species within the alignment, borrow pits, or other impacted areas. However, presence is assumed in areas of PCT 52 in the northern part of the alignment where surveys were not completed during recommended survey period, in accordance with the *precautionary principle.*

Recovery plans/threat abatement plans

Bluegrass (*Dichanthium setosum*) is identified as a threatened species affected by rabbits within the *Threat abatement plan for competition and land degradation by rabbits* (DoEE, 2016). This threat abatement plan aims to:

- Strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas

- Improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes
- Improve the effectiveness of rabbit control programs, and
- Increase engagement of, and awareness by, the community of the environmental impacts of rabbits and the need for integrated control.

The proposal is not expected to interfere with the objectives of this threat abatement plan.

There is not a recovery plan applicable to this species. However, the following actions are identified as potentially assisting the recovery of the species (DAWE 2020):

- Support local Landcare groups
- Assist with the control of the Rabbit (*Oryctolagus cuniculus*)
- Protect areas of known and potential habitat from frequent fire (< 5 year intervals)
- Practice sustainable grazing to maintain native grass ground cover in areas of known and potential habitat
- Control invasive exotic grasses in areas of habitat
- Protect known populations and areas of potential habitat from pasture improvement and cropping
- Rehabilitate and protect degraded areas of potential habitat
- Report new records of Bluegrass to the NSW Office of Environment and Heritage.

Important populations and Habitat critical to the survival of the species

Approved Commonwealth conservation advice for the species (DEWHA 2008) does not identify any current criteria or known locations of important populations or habitats critical to the survival of the species. Instead, the species is likely to occur on a wide variety of habitats, including highly disturbed pasture. As such, impacted areas are not considered to be habitat critical to the survival of the species. Furthermore, the proposal is not considered likely to disrupt seed dispersal mechanism of the species (i.e. windblown seed heads), such that dispersal or genetic exchange within the surrounding plant population is impacted.

OEH (2021c) identifies the following key priority management sites in NSW, of which none are within the proposal impact area:

- East of Guyra in Armidale Regional LGA
- Apex Lookout in Armidale Regional LGA
- Armidale Arboretum in Armidale Regional LGA
- Saumarez North TSR in Armidale Regional, Uralla LGA
- Wallabadah Cemetery in Liverpool Plains LGA

Therefore, in consideration of the above factors, the proposal area is not considered to contain and an important population or habitat critical to the survival of the species.

The following significant impact assessment (refer Table 10.15) under the MNES guidelines (DotE 2013) is informed by the impacts and mitigation measures in Section 8.6 and the information detailed above.

Table 10.15 Assessment against the significant impact criteria: Bluegrass (*Dichanthium setosum*)

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Up to 26.08 ha of potential habitat will be impacted by the proposal. As this is not the location of an important population, there will not be a long-term decrease in the size of an important population.
Reduce the area of occupancy for an important population	Up to 26.08 ha of potential habitat will be impacted by the proposal. As this is not the location of an important population, there will not be a reduction of occupancy for an important population.

Criterion	Assessment against significance criteria
Fragment an existing important population into two or more populations	The species is not considered to be part of an important population. As the proposal is unlikely to significantly disrupt wind dispersal of seeds for non-impacted species, the project is not considered to lead to a fragmentation of the species.
Adversely affect habitat critical to the survival of a species	The species is known to occur amongst a range of habitats (including disturbed and heavily grazed pastures). As such, impacted areas are not considered to be habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	The species is not considered to be part of an important population. Regardless, as the proposal is unlikely to significantly disrupt wind dispersal of seeds for non-impacted species, and there is not considered to be a disruption to the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Up to 26.08 ha of potential habitat may be impacted by the proposal. While some of these impacts may be temporary in nature, effects such as soil compaction (as discussed in Section 8.3.3) during construction may result in lowered biological viability of the soil which may limit recolonisation potential. Mitigation measures such as limiting the size of stockpile sites to avoid heat sterilisation of the soil will assist in minimising impacts associated with soil modification. Conversely, the species may benefit in some cases, where disturbance and edge effects produce conditions that are favourable to the species (refer Section 8.3.6). Given the above factors, and the fact that an important population is not present within the proposal area, there is unlikely to be a decline in species.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Known weed species that have previously outcompeted Bluegrass within known habitat sites include Coolatai Grass (*Hyparrhenia hirta*), Lippia (*Phyla canescens*), and African Lovegrass (*Eragrostis curvula*) (DEWHA 2008). Provided that weed management and mitigation measures as listed in Section 8.6 are followed, it is unlikely these competing weed species will become established.
Introduce disease that may cause the species to decline	Provided that biosecurity measures as listed in Section 8.6 are followed, it is unlikely that introduced disease will be introduced, such that the species is likely to decline.
Interfere with the recovery of the species	Whilst no specific recovery plan has been developed for this species, the clearing of native vegetation may temporarily impact recovery of the species in the area. However, the species is known to be able recolonise disturbed areas and therefore interference with the recovery is not considered to be significant.
Assessment of potential for significant residual impacts	Impacted areas of habitat are not considered to contain important populations and do not contain critical habitat features, and mitigation measures are expected to minimise the effects of native vegetation clearing. Additionally, impacted areas of predicted habitat will be offset in accordance with the NSW Biodiversity Assessment Methodology. As such, there is not expected to be significant residual impacts.

10.7.1.4 Five-clawed worm-skink (*Anomalopus mackayi*)

Ecology and distribution

The Five-clawed worm skink (*Anomalopus mackayi*) is known to occur in Grasslands and Woodlands on alluvial, cracking clay soils or self-mulching friable basalt soils (DSEWPC 2011). Microhabitat sites of the species include:

- Underneath decaying leaf litter, coarse woody debris, or artificial debris
- Loose, friable topsoils or cracks in alluvial clay soils
- Live or decaying plant material such as tussock bases, rotting logs and bases of trees.

Within NSW, the species has a patchy distribution throughout the north-west slopes and plains of north east NSW, and is found in a range of IBRA subregions including *Northern Basalts, Northern Outwash* and *Castlereagh-Barwon* (OEH 2017c)

Distribution in context to the Project

The species was not detected during a range of active reptile surveys completed under ideal survey conditions, nor was it identified incidentally. At the time of survey, the nearest database record is 50km south east of the proposal area. However a probable find of this species was recorded 4km south of the study area on 5 July 2021 during the separate Narrabri to North Star project preclearing survey in PCT 52 (BCSD 2021, personal communications, August 4) which may indicate a greater likelihood of occurrence of the species within the proposal area.

The proposal area is located entirely within areas of predicted habitat, as mapped within the SPRAT database profile for the species (DAWE 2020)

Recovery plans/threat abatement plans

The Five-clawed worm skink (*Anomalopus mackayi*) is identified as a threatened species affected by Cats within the *Threat abatement plan for predation by feral cats* (DoE, 2015). This threat abatement plan aims to:

- Effectively control feral cats in different landscapes
- Improve effectiveness of existing control options for feral cats
- Develop or maintain alternative strategies for threatened species recovery
- Increase public support for feral cat management and promote responsible cat ownership

The proposal may result in densification of feral cats or allow the establishment of feral cats into new areas through the creation of temporary works areas and cover during construction.

There are no specific recovery plans for this species. However, a recovery plan for Queensland Brigalow Reptiles includes the Five-clawed worm-skink (Richardson 2006). This plan includes the following actions which may assist in the recovery of the species:

- Encourage involvement, provide incentives and adopt a collaborative approach with government agencies, NRM regional bodies, the Indigenous community, key industry stakeholders and local governments to deliver region-specific information and implement sustained, effective recovery actions.
- Identify research priorities: develop and support the implementation of research projects undertaken by tertiary and research institutions.
- Inspect and identify suitable habitat for conservation of the Five-clawed worm-skink.
- Identify key threats and develop management guidelines to protect key habitat.
- Maximise the establishment of appropriate reserves to protect the Five-clawed Worm-skink habitat and landscape connectivity over the long term, e.g. on stock route networks, road reserves and private lands.
- Ensure the Five-clawed Worm-skink conservation is incorporated into appropriate land management decisions made by all levels of government and industry.
- Develop and provide land management guidelines and incentives for landowners to reduce the impact of current land use practices on the species outside reserves.
- Negotiate management agreements and voluntary conservation agreements with landholders, on whose land the Five-clawed worm-skink occurs, in line with the recommended management guidelines.
- Facilitate on-grounds projects to manage and protect habitats on a range of land tenures in line with recommended management guidelines, for example, in integrated weed and feral predator management programs.
- Develop community awareness within the species' known range through media campaigns and education material and provide incentives for wider community involvement, e.g. local governments and schools participating in reptile educational programs and adopting a local reptile species as their shire and/or school icon.
- Implement recommended fire management guidelines in property and reserve designs

- Work with landholders and key stakeholders to undertake monitoring programs on selected sites
- Monitor and evaluate recovery actions applying an adaptive management approach.

Important populations and Habitat critical to the survival of the species

Due to the limited detectability and lack of population information available, important habitat is used as a surrogate for important population for this species, as per the *Draft Referral Guidelines for Nationally Listed Brigalow Belt Reptiles* (DSEWPC 2011). As per these guidelines, suitable habitat is considered important if it is:

- Habitat where the species has been identified during a survey (noting the species is not recorded from the project area)
- Near the limit of the species' known range
- Large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations)
- A habitat type where the species is identified during a survey, but which was previously thought not to support the species

Specifically, for the Five-clawed worm skink, known important habitats are defined as:

- All suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands
- Suitable habitat within the Known/Likely-to occur distribution of the species

As suitable habitat is present within the proposal area, it is considered as important habitat within the proposal area.

The following significant impact assessment (refer Table 10.16) under the MNES guidelines (DotE 2013) and *Draft Referral Guidelines for Nationally Listed Brigalow Belt Reptiles* (DSEWPC 2011) has been informed by the impacts and mitigation measures in Section 8.6 and the information detailed above.

Table 10.16 Assessment against the significant impact criteria: Five-clawed worm-skink (*Anomalopus mackayi*)

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	Active reptile surveys did not identify the species within the study area, however important habitat (which is a surrogate for important populations) is present. Therefore, an impact to this important habitat has the potential to contribute to a long-term decrease of an important population
Reduce the area of occupancy for an important population	As greater than 4 ha of important habitat will be cleared as a result of the proposal, there is considered to be a reduction in the area of occupancy of the species.
Fragment an existing important population into two or more populations	Habitat within the proposal area is already highly fragmented, with main connectivity feature being remnant vegetation and grassland along road reserves and rail corridors. Whilst these connectivity features will largely still be present following construction, there still may be impacts to these features that may limit dispersal capability or create barriers such as access tracks and easements) between microhabitat sites (as discussed in Sections 8.3.7 and 8.3.8).
Adversely affect habitat critical to the survival of a species	All suitable habitat within the proposal area is considered important habitat and as such is likely to potentially be critical to the survival of the species.
Disrupt the breeding cycle of an important population	Very little is known about the species life cycle, however preventing access to microhabitats through barrier effects may disrupt dispersal and therefore the breeding cycle of the species
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Important habitats will be cleared or modified (such as through soil compaction) such that the availability and quality of habitat will be reduced. This may result in a decline of the species.

Criterion	Assessment against significance criteria
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Cats (*Felis catus*) are a key invasive species that is likely to cause harm to the Five-clawed Worm-skink. The proposal may result in densification of feral cats in non-disturbed areas (due to increased disturbance and human activity) or allow the establishment of feral cats into new areas through the creation of new access tracks and temporary shelter during construction.
Introduce disease that may cause the species to decline	Provided that biosecurity measures as listed in Section 8.6 are followed, it is unlikely that introduced disease will be introduced, such that the species is likely to decline
Interfere with the recovery of the species	Key recovery strategies within Richardson (2006) largely involve continued research, monitoring of the species, and identifying and preserving habitat. Clearing of potential important habitat may interfere with recommendations of protecting habitat for the species.
Assessment of potential for significant residual impacts	As impacted areas of suitable habitat are considered important habitat, there is a chance that the proposal will result in significant residual impacts for the species. Impacted areas of suitable habitat will be offset in accordance with the NSW Biodiversity Assessment Methodology which may assist in reducing the overall residual impact.

10.7.1.5 Koala (*Phascolarctos cinereus*)

Ecology and distribution

Suitable habitat for the species includes temperate, sub-tropical and tropical forest, woodland and semi-arid vegetation communities dominated by Eucalyptus spp. (Martin and Handasyde 1999). This species feeds on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select a preferred browse species (OEH 2020). Shelter trees from a range of genera are an important component of Koala habitat and play an essential role in thermoregulation (Crowther et al. 2013).

The list of preferred Koala use of tree species from the Western Slopes and Plains Koala Management Area (KMA) was reviewed based on *A review of koala tree use across New South Wales* (OEH 2018) (refer Table 22 and Table 23). Relevant tree species from the study area (refer flora data in Appendix B) include the following:

- River red gum (*Eucalyptus camaldulensis*) considered as 'regional high use' species. In study area occurs in PCT 36 and 628
- Silver-leaved ironbark (*Eucalyptus melanophloia*) considered as 'significant use' species. In study area occurs in PCT 192 and 418
- White cypress pine (*Callitris glaucophylla*) considered as 'local high use' species. In study area occurs in PCT 98 and 418
- The dominant tree species in the study area is Poplar box (*Eucalyptus populnea*). Poplar box is considered as 'Local High Use' in the Western Slopes and Plains KMA (Table 23 in OEH 2018).

For this KMA other species that are documented as 'low use' and are not considered relevant to the persistence of this species include Wilga (*Geijera parviflora*), Western Silver Wattle (*Acacia decora*), Ironwood (*Acacia excelsa*), Hakea Wattle (*Acacia hakeoides*), Brigalow (*Acacia harpophylla*) Weeping Myall (*Acacia pendula*) and Cooba (*Acacia salicina*).

Distribution in context to the project

A single Koala was recorded calling in River red gums (PCT 36) along the Macintyre River in October 2019. This habitat area is isolated from potential habitat areas (PCTs) further south by extensive tracts of heavily cleared lands and pure grassland areas (ie. PCT 52). Koala scats and scratches were also found in PCT 56 and 628. No other records of Koala or signs of its presence were found (several scats were sent for analysis and found to be possum scats only).

Database records of Koala in the region (AoLA 2021) are largely located to the south and east of the study area and with records from the wider area summarised as follows:

- Three records within 20 km of North Star ranging of indeterminate age and with a high spatial uncertainty (>10,000 m) placed on the location. There are many more records further south to Moree.
- No other records in close vicinity (within 30 km) to the proposal. There are very few records to the north and west. To the east there are records associated with Dthinna Dthinniwan National Park and the surrounds.
- BioNet contains seven records of the species in the vicinity of the subject land including the project record from October 2019. Four of the records, one from 2015 and three from 2019, are sourced from a Wildlife Rehabilitation Database so may be release sites and not wild sightings.

Recovery plans/threat abatement plans

A draft national recovery plan developed under the EPBC Act is currently being developed and is on public display up until September 2021 (DAWE, 2021), and as such is not currently in force. However, this plan does detail recovery strategies and actions in alignment with the overarching goal to "*To reverse the trend of decline in population size of the listed Koala, by having resilient, connected, and genetically healthy metapopulations across its range, and to increase the extent, quality and connectivity of habitat occupied*."

There are no current threat abatement plans relevant to this species.

Important populations and Habitat critical to the survival of the species

There are no currently identified important populations Koala within the context of the EPBC Act of as identified with the *EPBC Act referral guidelines for the vulnerable koala* (DoE, 2014). The NSW 'Saving Our Species' program has identified the Southern Highlands, Port Macquarie and the Northern Rivers regions as areas of significant Koala populations. As the proposal is not located within these areas, there is not considered to be an important population within the proposal area.

Critical Koala habitat can be determined through the Koala habitat assessment tool as provided within the *EPBC Act referral guidelines for the vulnerable koala* (DoE, 2014). This tool has been used to determine whether critical Koala habitat is present within the proposal area (refer Table 10.17)

Table 10.17 Koala assessment tool

Attribute	Score (0 to 2)	Habitat appraisal for the inland region
Koala occurrence	+2 for areas of PCT 36, 56, and 628 +0 for all other areas	Limited evidence of occurrence from desktop assessment, but field survey has active heard at least one individual at the Macintyre River, and localised scattered evidence of scat and scratches recorded once at sites within PCT 56 and 628 within the proposal area No other evidence of occurrence has been observed at other possible habitat locations as determined via extensive survey efforts (both targeted and non-targeted) over a period of four years.
Vegetation structure and composition	+2 for areas of medium to high quality PCT 418, 192, 98 +1 for areas of medium to high quality PCT 36, 56, 244, 628 +0 for all other vegetation zones	Given the linear nature of the proposal with oftentimes fragmented and scattered vegetation communities, it is difficult to prescribe a vegetation composition score for the entire proposal area. Areas of medium and high quality PCT 418, 192 and 98 contain two Koala feed trees: ▪ PCT 98 – Poplar Box and White Cypress Pine ▪ PCT 192 – Silver-leaved Ironbark and Poplar Box ▪ PCT 418 - White Cypress Pine and Silver-leaved Ironbark Areas of medium and high quality PCT 35, 36, 55, 56, 244 and 628 contain least one Koala feed tree: ▪ PCT 35, 55, 56, 244, 628 – Poplar Box ▪ PCT 36 – River Red Gum (This includes the Riparian zone of Macintyre River)

Attribute	Score (0 to 2)	Habitat appraisal for the inland region
		All other areas (including low quality areas of the above listed PCTs) contain limited tree canopy or appropriate feed trees.
Habitat connectivity	+2 For the Macintyre River area +0 For all other areas	The Macintyre River is a key habitat connectivity corridor in the region and the mostly contiguous riparian zone represents >1000ha of possible koala habitat connectivity. However this area of habitat is fragmented from other areas of Koala habitat to the south by extensive grasslands with minimal to no tree presence and Tucker Tucker Road. All other areas are generally highly fragmented patches of native vegetation, with areas of suitable koala habitat consisting of remnant roadside vegetation, or isolated forested 'islands' <500ha in size surrounded by actively managed pasturelands and cropping areas.
Key existing threats	+1	There are no recorded examples of vehicle strike or dog attack of within the proposal area, however there is limited accurate evidence of Koala's presence within the surrounding 30km prior to surveys conducted for this proposal. As such it is possible that incidence of these events has not been recorded if they have occurred. During field surveys, it was noted that roads surrounding the proposal area such as North Star Road and the Bruxner Highway regularly contained roadkill of Macropods and Wild Boars, likely resultant from the regular passing of large trucks passing at speeds up to 100km/hr. Additionally, a local newspaper has reported upon a story of a North Star woman photographing a Koala drinking water from the road between North Star and Moree (Biddle, 21 Jan 2020). Whilst the exact location is unknown, if this is a regular behaviour of Koalas in the area (particularly during times of drought) then it is not unfeasible that Koalas in the area are at significant risk of vehicle strike.
Recovery value	+2 For the Macintyre River area +0 For all other areas	The riparian zone along the Macintyre River represents a key area of recovery value, as it provides sufficient habitat connectivity, and serves as a habitat refuge during periods of drought or heat stress. Other sites generally consist of areas of isolated vegetation patches, with other smaller creeks/riparian zones having unreliable water availability.
Total	+10 for the Macintyre River area +4 (maximum) for all other areas	Given the large size of the linear infrastructure of the proposal, which encompasses various non-contiguous areas of habitat, the total score has been divided areas to reflect the differences in habitat values across the site. The Macintyre River riparian zone represents an area of critical Koala habitat based upon the known presence of Koalas, its habitat connectivity value and its vegetation composition. All other sites have a maximum habitat score +4 and therefore do not represent areas of critical Koala habitat as it does not meet the score threshold of +5 as detailed within DoE (2014). This scoring is based upon varying factors such as the fragmented nature of vegetation, lack of evidence of Koala presence within vegetation zones, or the absence of suitable vegetation composition/structure with multiple local feed trees present.

The following significant impact assessment (refer Table 10.18) under the MNES guidelines (DotE 2013) and *EPBC Act referral guidelines for the vulnerable koala* (DoE, 2014) has been informed by the impacts and mitigation measures in Section 8.6 and the information detailed above

Table 10.18 Assessment against the significant impact criteria: Koala (*Phascolarctos cinereus*)

Criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of an important population	There is not considered to be an important population within the proposal area. Regardless, given the likely low density at which the Koala utilises the area (based upon limited evidence of occurrence throughout multiple survey campaigns) and the presence of other suitable habitat in the region (particularly along the Macintyre River riparian corridor) there is not expected to be a long-term decrease in the local population.

Criterion	Assessment against significance criteria
Reduce the area of occupancy for an important population	There is not considered to be an important population within the proposal area. Regardless, 27.7 ha of Koala habitat will be impacted, of which only 2.66 ha of critical Koala habitat is expected to be impacted. As critical Koala habitat is localised to the Macintyre River region, of which contains a vastly greater expanse of suitable Koala habitat, the removal of 2.66 ha of critical habitat is unlikely to result in the reduction of the area of occupancy in the region.
Fragment an existing important population into two or more populations	Most areas of habitat are already heavily fragmented by roads and pasturelands, with most habitat existing as 'islands' of remnant vegetation along the roadside or the occasional forested paddock. Possible fragmentation of the species may arise at waterway crossings, such as the Macintyre River viaduct, however fauna crossing opportunities will be available at these locations, and additional structures such as culvert furniture will be utilised to decrease impacts associated with fragmentation.
Adversely affect habitat critical to the survival of a species	2.66 ha of critical Koala habitat will be impacted by the proposal. The *EPBC Act referral guidelines for the vulnerable koala* (DoE, 2014) provides guidance in determining significance of impact and states that whilst assessment needs to be undertaken within the context of the surrounding environment, the clearing of up to 5 ha of habitat score 10 would unlikely be considered a significant impact. As, the clearing will only be half of this 5-hectare threshold, there is unlikely to be a significant adverse effect to habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Recommendations have been presented for clearing activities to occur outside the breeding season. Where this is not possible, pre-clearance surveys will be undertaken to ensure that no direct mortality impacts will occur to Koalas, especially for breeding adults or infants.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	2.66 ha of critical Koala habitat will be removed; however, this is not expected to significantly alter the quality of habitat in the area such that the species is expected to decline. Areas of non-critical koala habitat are already generally in low quality and as such impacts to these areas are unlikely to result in a decline of the species.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Dogs are a key non-native species that poses a significant threat to Koalas. The proposal is not expected to result in further establishment of both wild or non-wild dogs in the area.
Introduce disease that may cause the species to decline	*Chlamydia* and Koala *retrovirus* are both major diseases that are impacting Koala populations (DAWE 2020). The proposal is not expected to introduce or spread these diseases further, provided that appropriate fauna handling and hygiene practices are followed (i.e. only qualified wildlife experts to handle the species, and only if absolutely necessary)
Interfere with the recovery of the species	Current recovery activities within NSW include activities such as additional Koala research, purchasing of Koala habitat for conservation purposes, the development of fauna exclusion fencing in key roadkill hotspots and the development of a genetic biobank (DAWE 2021). The proposal will include some of these activities, such as the incorporation of fauna exclusion fencing and crossing/underpass structures, and the offsetting of impact Koala habitat for conservation purposes. As such, the proposal is not considered to interfere with the recovery of the species.
Assessment of potential for significant residual impacts	Due to the minimal extent of clearing of critical Koala habitat, and the likely low density to which the species utilises the area, there is not expected to be a significant impact on the species. Additionally, all impacted areas of predicted habitat will be offset in accordance with the NSW Biodiversity Assessment Methodology. As such, there is not expected to be significant residual impacts.

10.7.2 Endangered and critically endangered ecological communities

As detailed within Section 7.1, threatened ecological communities have been assessed in accordance with their condition thresholds, as specified with DAWE conservation listing advice contained on the Species Profile and Threats Database (SPRAT). For the below assessed TECs, areas of analogous NSW plant community types with a vegetation condition score of medium or high are determined as meeting the condition threshold under their EPBC listing. As such, only these areas have been considered within the below assessment. The condition threshold assessment is provided within Appendix C.

10.7.2.1 Brigalow (*Acacia harpophylla* dominant and co-dominant)

Ecology and distribution

Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened community is an open forest or woodland up to 25 m high largely dominated by Brigalow (*Acacia harphophylla*) and oftentimes Belah (*Casuarina cristata*) and Poplar Box (*Eucalyptus populnea* subsp. *bimbii*). The community usually contains a sparse shrub layer and bare or vary bare groundcover layer (refer Section 5.2.1.2 for further details of this community).

Within NSW the community occurs on heavy, gilgaied, grey or brown cracking clay or clayey loam soils over mainly sedimentary strata on flats or gentle rises on alluvial plains or undulating peneplains mainly in the Northern Outwash sub-region in the Brigalow Belt South Bioregion, in the dry subtropical and temperate (hot summer) climatic zones with a rainfall from 500 to 700 mm per annum. Mainly distributed south and west of Narrabri and north-east of Moree, with small patches in the Pilliga forest.

This community is subject to significant historical clearing throughout NSW and Queensland, with approximately only 8% of its original 7.3 million hectare extent remaining in Queensland, with only about a third of its estimated 300,000 ha believed remaining in NSW (Butler 2007).

Distribution in context to the Project

The initial disturbance footprint of the proposal included 101.7 ha of this community throughout the alignment and within multiple borrow pits. To minimise this extent of impact to the community, the footprint has been refined so only 17.51 ha of this community is expected to be impacted. Impact areas are located adjacent to existing road and rail corridor within the proposed alignment, and borrow pits with extensive patches of this community have been excluded, buffered and/or redesigned to avoid any impacts to the Brigalow community.

Recovery plans/threat abatement plans

A recovery plan is required for this community, although a finalised document is not available. However, the SPRAT Database profile does cite a draft recovery plan *Recovery plan for the "Brigalow (Acacia harpophylla dominant and co-dominant" endangered ecological community - draft of 1 May 2007* (Butler 2007). This draft plan identifies the following key objectives:

- Increase the area of the Brigalow ecological community and its representation in conservation reserves,
- Improve knowledge of the Brigalow ecological community and its condition as habitat for native species, and
- Mitigate key threats to the Brigalow ecological community by controlling fire, weeds and animal pests.

The threat abatement plan *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads* (DSEWPC 2011) is relevant to this community. The proposal is not likely to interfere with the objectives of this threat abatement plan.

Habitat critical to the survival of the community

The *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DoE 2013) defines areas critical to the survival of the community to include "*all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community; plus the buffer zones, particularly where these include native vegetation*". As the impacted areas meet these condition thresholds and diagnostic criteria, all areas of impacted community are considered to contain habitat critical to the survival of the community.

The following significant impact assessment (refer Table 10.19) under the MNES guidelines (DotE 2013) has been informed by the impacts and mitigation measures in Section 8.6 and the information detailed above

Table 10.19 Assessment against the significant impact criteria: Brigalow (*Acacia harpophylla* dominant and co dominant)

Criterion	Assessment against significance criteria
Reduce the extent of an ecological community	Following impact avoidance measures during the detailed design stage, the reduction of the extent of the ecological community has decreased to 17.51 ha, compared to the originally proposed 101.1 ha. The removal of 17.51 ha is expected to result in the removal of at least 0.02% of the predicted coverage of the community within NSW as of 2006 (DAWE 2020). Impacts associated with the clearing of this community will have a like-for-like offset in accordance with the NSW Biodiversity Assessment Methodology
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	Areas of brigalow community remaining within the proposal area consists of patches already fragmented by existing road, agricultural and rail infrastructure. The proposal may slightly widen the fragmentation in these areas, but this is not expected to be a substantial impact.
Adversely affect habitat critical to the survival of an ecological community	All 17.51 ha of impacted community is considered to be habitat critical to the survival of the community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Detailed flood study has been completed for the proposal and changes to flood levels and hydrological drainage patterns are expected to be minor, localised and represent a negligible impact (refer Table 8.2) Soil compaction and sterilisation of the seed bank have the potential to occur which may affect the recovery of temporarily disturbed areas. However mitigation measures such as height limits on stockpiles (to prevent heat sterilisation of the underlying seed bank) will assist in mitigating these impacts.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	Clearing of areas within the proposal area will result in the loss of Brigalow (*Acacia harpophylla*). Whilst temporarily impacted areas may be able to see return of these species, areas of permanent impacts, or where vegetation will be actively managed (such as within the rail corridor) will see a decrease in this key species.

Criterion	Assessment against significance criteria
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: ▪ Assisting invasive species, that are harmful to the listed ecological community, to become established, or ▪ Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	Disturbance of the soil and the removal of native vegetation in congruence with increase weed vectors such as vehicle movements and introduced soil has the potential to increase the presence of weed species within remaining patches of the community. Mitigation measures such as effective biosecurity management during construction (i.e. wash down procedures, active weed management and use of clean material) and post-construction rehabilitation measures will minimise the likelihood of substantial weed invasion. Spills, pollution and sedimentation will also be managed as per the sediment and erosion control plan to reduce the likelihood of increased impacts to areas of the community within and adjacent to the proposal area.
Interfere with the recovery of an ecological community.	Butler (2007) states '*avoiding further clearing and fragmentation of the Brigalow community*' as a key recovery action for the threatened community. As clearing of this community will be occurring, there is likely to be interference with the recovery of the community.
Assessment of potential for significant residual impacts	As there will be clearing of critical habitat for this threatened ecological community, there is likely to be a significant impact to the community. Like-for-like offsetting in accordance with the NSW Biodiversity Assessment Methodology will be conducted to reduce the risks of significant residual impacts.

10.7.2.2 Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland

Ecology and distribution

This community exists predominantly as mixed tussock grassland on alluvial grey clays on alluvial plains within the northern section of the Darling Riverine Plains Bioregion and western section of the Brigalow Belt South Bioregion. Shrubs and tree layers are sparse to non-existent. The community is highly dependent on slope and requires a flat landscape with no more than 5% inclination (DSEWPC 2013).

Distribution in context to the Project

This community is present largely as greenfield at the northern extent of the proposed alignment. The most common species present at this location include *Astrebla* spp, *Enteropogon* spp, *Chloris truncata*, *Digitaria divaricatisim*,*Solanum esuriale*, *Sclerolaena murica*, and *Marsilea drummondii* .

Recovery plans/threat abatement plans

There are no detailed recovery plans or threat abatement plans specifically associated with this community.

Habitat critical to the survival of the community

This community is heavily reliant upon the presence of fine textured cracking clay soils made from either basalt or quaternary alluvium (TSSC, 2009). These soils are critical to the survival of the community, as the expansion and contraction cycle of the soil during wet/dry periods tears up the tap roots of larger trees and shrubs, allowing the understorey grasslands to thrive in the absence of canopy cover. Additionally, the community is reliant upon flat slopes of no more than 5% inclination, with any steeper slopes encouraging woody vegetation such as Weeping Myall (*Acacia pendula*) and Coolabah (*Eucalyptus coolabah*).

The following significant impact assessment (refer Table 10.20) under the MNES guidelines (DotE 2013) has been informed by the impacts and mitigation measures in Section 8.6 and the information detailed above

Table 10.20 Assessment against the significant impact criteria: Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland

Criterion	Assessment against significance criteria
Reduce the extent of an ecological community	33.5 ha will be impacted by the proposal. Estimates of the total extent of this community are approximately 29 000 ha, however the actual extent of good condition patches without significant weed invasion is expected to be lower than this (TSSC 2009). As such, impacting of 33.5 ha will result in a loss of at least approximately 0.1% of the total community.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	Within the proposal area, the community is located largely within greenfield land that does not have existing linear infrastructure in place. As such works within these areas will result in fragmentation of the community of between approximately 80 to 100 m wide, for a total length of approximately 2.5 km.
Adversely affect habitat critical to the survival of an ecological community	The combination of slope and soil type is integral to the survival of the community. As the proposal area contains suitable habitat that allows the presence of this community, there is expected to be 33.5 ha of adverse effects on habitat critical to the survival of the community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	A detailed flood study for the proposal identified that changes to flood levels and hydrological drainage patterns are expected to be minor, localised and represent a negligible impact (refer Table 8-2). For this community, one small section close to the Macintyre River may lead to a rise in flood inundation of up to 200 mm, however this is a small proportion of the community and the majority will only see a maximum of 50 mm increase in potential flood inundation. Soil compaction and sterilisation of the seed bank have the potential to occur which may affect the recovery of temporarily disturbed areas. However, mitigation measures such as height limits on stockpiles (to prevent heat sterilisation of the underlying seed bank) will assist in mitigating these impacts.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	Clearing for the proposal area may result in the loss of grassland species associated with this community such as *Astrebla spp* and *Digitaria divaricatisim*. Whilst temporarily impacted areas may be able to see return of these species, areas of permanent impacts, or where vegetation will be actively managed (such as within the rail corridor), will see a decrease in this key species.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: ■ Assisting invasive species, that are harmful to the listed ecological community, to become established, or ■ Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	Disturbance of the soil and the removal of native vegetation in congruence with increase weed vectors such as vehicle movements and introduced soil has the potential to increase the presence of weed species within remaining patches of the community. Mitigation measures such as effective biosecurity management during construction (i.e. wash down procedures, active weed management and use of clean material) and post-construction rehabilitation measures will minimise the likelihood of substantial weed invasion. Spills, pollution and sedimentation will also be managed as per the sediment and erosion control plan to reduce the likelihood of increased impacts to areas of the community within and adjacent to the proposal area.
Interfere with the recovery of an ecological community.	Recovery efforts for this species centre around sustainable grazing and agricultural practices to protect disturbed remnants of this species (DSEWPC 2013). However, the impact to 33.5 ha of the community and associated areas of habitat will likely interfere with recovery efforts to restore and protect remnants of this community.

Criterion	Assessment against significance criteria
Assessment of potential for significant residual impacts	Given the large reduction in the area of occupancy (33.5 ha) of the threatened ecological community, there is likely to be a significant impact to the community. Like-for-like offsetting in accordance with the NSW Biodiversity Assessment Methodology will be conducted to reduce the risks of significant residual impacts.

11 Cumulative impact assessment

Cumulative impacts were assessed using the methodology identified in Section 3.1.2, incorporating the projects identified in Table 3.3 and depicted in Figure 3.2.

The cumulative impacts of multiple projects occurring in the vicinity of the subject land will likely include the continued loss of biodiversity in the Brigalow Belt South bioregion. The major potential impacts identified as a result of the proposal are common to all projects throughout the region and are therefore cumulative in nature. Twelve projects have been identified which are either currently underway or are going through the EIS process, all of which will likely result in some extent of:

- Habitat loss from vegetation clearing/removal
- Fauna species injury or mortality
- Reduction in biological viability of soil to support growth due to soil compaction
- Displacement of flora and fauna species from invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light
- Increase in litter (waste)
- Erosion and sedimentation.

Cumulative impacts range from short-term to long-term. The magnitude of impact to ecological receptors contained within the footprint of the projects occurring within the cumulative impact assessment area, based on bioregional and State extents, is provided in Table 11.1.

The results of the significance assessment of these cumulative impacts are presented in Table 11.2.

As a result of the proposal and other similar projects, cumulative impacts of high significance are predicted to occur. The following potential impacts are predicted to result in high impact significance to terrestrial ecological receptors:

- Habitat loss from vegetation clearing/removal
- Edge effects
- Habitat fragmentation
- Barrier effects
- Reduction in connectivity of biodiversity corridors.

These cumulative impacts of high significance are predicted to impact the following receptors:

- TECs (EPBC and BC)
- Threatened flora and fauna (EPBC and BC Acts)
- State significant landscape feature – Great Artesian Basin.

In general, potential impacts with the greatest duration and probability resulted in high impact significance, whilst the magnitude of potential impacts with high impact significance varied.

Mitigation strategies, including avoidance options, design considerations and proposal specific mitigation measures are provided in Section 8.6. Specific mitigation measures that avoid ecological receptors or reduce impacts to ecological receptors through scheduling or a reduction in the duration of works are most likely to reduce the significance of cumulative impacts.

Table 11.1 Magnitude rating and justification of cumulative impacts within the cumulative impact assessment area

Ecological receptor	Magnitude rating (1-3)	Justification for ranking
Brigalow (*Acacia harpophylla*) dominant and co-dominant) community (EPBC Act)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Weeping Myall Open Woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions (EPBC Act)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Semi-evergreen vine-thicket of the Brigalow Belt (North and South) and Nandewar Bioregions	3	▪ Proportion of overall cumulative project impacts is moderate ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Dichanthium setosum (Bluegrass)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Homopholis belsonii (Belson's panic)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Lepidium monoplocoides (Winged peppercress)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Swainsona murrayana (Slender darling pea)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Tylophora linearis (Slender tylophora)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Australasian bittern (*Botaurus poiciloptilus*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Australian painted snipe (*Rostratula australis*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Grey-headed flying fox (*Pteropus poliocephalus*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Koala (*Phascolarctos cinereus*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Five-clawed worm-skink (*Anomalopus mackayi*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Painted honeyeater (*Grantiella picta*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution

Ecological receptor	Magnitude rating (1-3)	Justification for ranking
Corben's long-eared bat (*Nyctophilus corbeni*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Spot-tailed quoll (*Dasyurus maculatus maculatus*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Superb parrot (*Polytelis swainsonii*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Swift parrot (*Lathamus discolor*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Desmodium campylocaulon (Creeping tick-trefoil)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Digitaria porrecta (Finger panic grass)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Phyllanthus maderaspatensis	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is low ▪ Cumulative projects within known distribution
Swainsona sericea (Silky swainson-pea)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is low ▪ Cumulative projects within known distribution
Barking owl (*Ninox connivens*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Black-chinned honeyeater (*Melithreptus gularis gularis*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Black-necked stork (*Ephippiorhynchus asiaticus*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Black-striped wallaby (*Macropus dorsalis*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Bristle-faced free-tailed bat (*Setirostris eleryi*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Brown treecreeper (*Climacteris picumnus victoriae*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Diamond firetail (*Stagonopleura guttata*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution

Ecological receptor	Magnitude rating (1-3)	Justification for ranking
Dusky woodswallow (*Artamus cyanopterus cyanopterus*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Eastern grass owl (*Tyto longimembris*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Eastern pygmy-possum (*Cercartetus nanus*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Flame robin (*Petroica phoenicea*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Glossy black-cockatoo (*Calyptorhynchus lathami*)	2	▪ Proportion of overall cumulative project impacts is moderate ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis)*	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Little lorikeet (*Glossopsitta pusilla*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Little pied bat (*Chalinolobus picatus*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Magpie goose (*Anseranas semipalmata*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Masked owl (*Tyto novaehollandiae*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Northern free-tailed bat (*Mormopterus lumsdenae*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Pale imperial hairstreak (*Jalmenus eubulus*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Pale-headed snake (*Hoplocephalus bitorquatus*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Pied honeyeater (*Certhionyx variegatus*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution

Ecological receptor	Magnitude rating (1-3)	Justification for ranking
Red-tailed black-cockatoo (inland subspecies) (*Calyptorhynchus banksii samueli*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
Rufous bettong (*Aepyprymnus rufescens*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Scarlet robin (*Petroica boodang*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Speckled warbler (*Chthonicola sagittata*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Squirrel glider (*Petaurus norfolcensis*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Stripe-faced dunnart (*Sminthopsis macroura*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Turquoise parrot (*Neophema pulchella*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Varied sittella (*Daphoenositta chrysoptera*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
White-bellied sea eagle (*Haliaeetus leucogaster*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is moderate ▪ Cumulative projects within known distribution
White-fronted chat (*Epthianura albifrons*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Western olive perchlet (*Ambassis agassizii*)	2	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is small ▪ Cumulative projects within known distribution
PCTs of High condition	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
PCTs of Medium condition	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
PCTs of Low condition	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution
Great Artesian Basin	1	▪ Proportion of overall cumulative project impacts is low ▪ Regional extent of ecological receptor is large ▪ Cumulative projects within known distribution

Ecological receptor	Magnitude rating (1-3)	Justification for ranking
Area/s of connectivity joining different areas of habitat that intersect with the subject land and the areas of habitat that are connected	2	■ Proportion of overall cumulative project impacts is low ■ Regional extent of ecological receptor is moderate ■ Cumulative projects within known distribution
Patches of native woody and non-woody vegetation	1	■ Proportion of overall cumulative project impacts is low ■ Regional extent of ecological receptor is large ■ Cumulative projects within known distribution
Important and local wetlands	2	■ Proportion of overall cumulative project impacts is low ■ Regional extent of ecological receptor is small ■ Cumulative projects within known distribution
Waterways and riparian buffers	2	■ Proportion of overall cumulative project impacts is low ■ Regional extent of ecological receptor is moderate ■ Cumulative projects within known distribution

Table 11.2 Significance assessment of cumulative impacts within the cumulative impact area

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
Commonwealth significant ecological constraint (community listed under the EPBC Act): ▪ Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	▪ Habitat loss from vegetation clearing/removal	3	3	3	3	12	High
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	3	3	12	High
	▪ Fauna species injury or mortality	1	1	3	3	8	Medium
	▪ Noise, dust and light and contaminant disturbance	1	1	3	3	8	Medium
	▪ Increase in litter (waste)	1	1	3	3	8	Medium
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	3	3	9	Medium
	▪ Displacement of species from invasion of weed and pest species	1	1	3	3	8	Medium
	▪ Erosion and sedimentation	1	2	3	3	9	Medium
	▪ Aquatic habitat degradation	1	1	3	3	8	Medium
Commonwealth significant ecological constraint (community listed under the EPBC Act): ▪ Brigalow (*Acacia harpophylla*) dominant and co-dominant) community ▪ Weeping Myall Open Woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions ▪ Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland	▪ Habitat loss from vegetation clearing/removal	3	3	2	3	11	High
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	2	3	11	High
	▪ Fauna species injury or mortality	1	1	2	3	7	Medium
	▪ Noise, dust and light and contaminant disturbance	1	1	2	3	7	Medium
	▪ Increase in litter (waste)	1	1	2	3	7	Medium

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	2	3	8	Medium
	▪ Displacement of species from invasion of weed and pest species	1	1	2	3	7	Medium
	▪ Erosion and sedimentation	1	2	2	3	8	Medium
	▪ Aquatic habitat degradation	1	1	2	3	7	Medium
Commonwealth significant ecological constraint (species listed under the EPBC Act) (some species also BC Act listed): **Flora**: ▪ *Homopholis belsonii* (Belson's panic) ▪ *Swainsona murrayana* (Slender Darling-pea) ▪ *Tylophora linearis* **Fauna**: ▪ Australasian bittern (*Botaurus poiciloptilus*) ▪ Australian painted snipe (*Rostratula australis*) ▪ Large-eared pied bat (*Chalinolobus dwyeri*) ▪ Spot-tailed quoll (*Dasyurus maculatus maculatus*) ▪ Superb parrot (*Polytelis swainsonii*) ▪ Swift parrot (*Lathamus discolor)*	▪ Habitat loss from vegetation clearing/removal	3	3	2	3	11	High
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	2	3	11	High
	▪ Fauna species injury or mortality	1	1	2	3	7	Medium
	▪ Noise, dust and light and contaminant disturbance	1	1	2	3	7	Medium
	▪ Increase in litter (waste)	1	1	2	3	7	Medium
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	2	3	8	Medium
	▪ Displacement of species from invasion of weed and pest species	1	1	2	3	7	Medium
	▪ Erosion and sedimentation	1	2	2	3	8	Medium
	▪ Aquatic habitat degradation	1	1	2	3	7	Medium

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
Commonwealth significant ecological constraint (species listed under the EPBC Act) (some species also BC Act listed): **Flora:** ■ *Dichanthium setosum* (Bluegrass) ■ *Lepidium monoplocoides* (Winged peppercress) **Fauna**: ■ Grey-headed flying fox (*Pteropus poliocephalus*) ■ Koala (*Phascolarctos cinereus*) ■ Five-clawed worm-skink (*Anomalopus mackayi*) ■ Painted honeyeater (*Grantiella picta*) ■ Corben's long-eared bat (*Nyctophilus corbeni*)	■ Habitat loss from vegetation clearing/removal	3	3	1	3	10	High
	■ Edge effects ■ Habitat fragmentation ■ Barrier effects ■ Reduction in connectivity of biodiversity corridors	3	3	1	3	10	High
	■ Fauna species injury or mortality	1	1	1	3	6	Low
	■ Noise, dust and light and contaminant disturbance	1	1	1	3	6	Low
	■ Increase in litter (waste)	1	1	1	3	6	Low
	■ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium
	■ Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low
	■ Erosion and sedimentation	1	2	1	3	7	Medium
	■ Aquatic habitat degradation	1	1	1	3	6	Low
Threatened Ecological Communities (BC Act): ■ Semi-evergreen vine thickets in Brigalow Belt and Nandewar Bioregions	■ Habitat loss from vegetation clearing/removal	3	3	3	3	12	High
	■ Edge effects ■ Habitat fragmentation ■ Barrier effects ■ Reduction in connectivity of biodiversity corridors	3	3	3	3	12	High
	■ Fauna species injury or mortality	1	1	3	3	8	Medium
	■ Noise, dust and light and contaminant disturbance	1	1	3	3	8	Medium
	■ Increase in litter (waste)	1	1	3	3	8	Medium
	■ Reduction in biological viability of soil to support growth due to soil compaction	1	2	3	3	9	Medium

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
	▪ Displacement of species from invasion of weed and pest species	1	1	3	3	8	Medium
	▪ Erosion and sedimentation	1	2	3	3	9	Medium
	▪ Aquatic habitat degradation	1	1	3	3	8	Medium
Threatened Ecological Communities (BC Act): ▪ Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions ▪ Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions ▪ Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions ▪ The Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River	▪ Habitat loss from vegetation clearing/removal	3	3	2	3	11	High
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	2	3	11	High
	▪ Fauna species injury or mortality	1	1	2	3	7	Medium
	▪ Noise, dust and light and contaminant disturbance	1	1	2	3	7	Medium
	▪ Increase in litter (waste)	1	1	2	3	7	Medium
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	2	3	8	Medium
	▪ Displacement of species from invasion of weed and pest species	1	1	2	3	7	Medium
	▪ Erosion and sedimentation	1	2	2	3	8	Medium
	▪ Aquatic habitat degradation	1	1	2	3	7	Medium
Threatened terrestrial flora and fauna species listed under the provisions of the BC Act: **Flora:** ▪ *Desmodium campylocaulon* (Creeping tick-trefoil) ▪ *Digitaria porrecta* (Finger panic grass) ▪ *Phyllanthus maderaspatensis*	▪ Habitat loss from vegetation clearing/removal	3	3	2	3	11	High
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	2	3	11	High
	▪ Fauna species injury or mortality	1	1	2	3	7	Medium

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
▪ *Swainsona sericea* (Silky swainson-pea) **Terrestrial fauna:** ▪ Black-chinned honeyeater (*Melithreptus gularis gularis*) ▪ Black-necked stork (*Ephippiorhynchus asiaticus*) ▪ Black-tailed godwit (*Limosa limosa*) ▪ Bristle-faced free-tailed bat (*Setirostris eleryi*) ▪ Brown treecreeper (*Climacteris picumnus victoriae*) ▪ Cotton-pygmy goose (*Nettapus coromandelianus*) ▪ Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) ▪ Eastern grass owl (*Tyto longimembris*) ▪ Freckled duck (*Stictonetta naevosa*) ▪ Little lorikeet (*Glossopsitta pusilla*) ▪ Magpie goose (*Anseranas semipalmata*) ▪ Pale imperial hairstreak (*Jalmenus eubulus*) ▪ Red-tailed black-cockatoo (inland subspecies) (*Calyptorhynchus banksii samueli*) ▪ White-bellied sea eagle (*Haliaeetus leucogaster*) ▪ White-fronted chat (*Epthianura albifrons*)	▪ Noise, dust and light and contaminant disturbance	1	1	2	3	7	Medium
	▪ Increase in litter (waste)	1	1	2	3	7	Medium
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	2	3	8	Medium
	▪ Displacement of species from invasion of weed and pest species	1	1	2	3	7	Medium
	▪ Erosion and sedimentation	1	2	2	3	8	Medium
	▪ Aquatic habitat degradation	1	1	2	3	7	Medium

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
Threatened terrestrial flora and fauna species listed under the provisions of the BC Act: **Flora:** ■ *Digitaria porrecta* (Finger panic grass) ■ *Polygala linariifolia* (Native milkwort) **Fauna:** ■ Brolga (*Grus rubicunda*) ■ Bush stone-curlew (*Burhinus grallarius*) ■ Diamond firetail (*Stagonopleura guttata*) ■ Dusky woodswallow (*Artamus cyanopterus cyanopterus*) ■ Flame robin (*Petroica phoenicea*) ■ Flock bronzewing (*Phaps histronica*) ■ Glossy black-cockatoo (*Calyptorhynchus lathami*) ■ Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis)* ■ Hooded robin (south-eastern form) *(Melanodryas cucullata cucullata*) ■ Little eagle (*Hieraaetus morphnoides*) ■ Little pied bat (*Chalinolobus picatus*) ■ Masked owl (*Tyto novaehollandiae*) ■ Northern free-tailed bat (*Mormopterus lumsdenae*) ■ Pale-headed snake (*Hoplocephalus bitorquatus*) ■ Pied honeyeater (*Certhionyx variegatus*) ■ Scarlet robin (*Petroica boodang*) ■ Speckled warbler (*Chthonicola sagittata*) ■ Spotted harrier (*Circus assimilis*) ■ Square-tailed kite (*Lophoictinia isura*)	■ Habitat loss from vegetation clearing/removal	3	3	1	3	10	High
	■ Edge effects ■ Habitat fragmentation ■ Barrier effects ■ Reduction in connectivity of biodiversity corridors	3	3	1	3	10	High
	■ Fauna species injury or mortality	1	1	1	3	6	Low
	■ Noise, dust and light and contaminant disturbance	1	1	1	3	6	Low
	■ Increase in litter (waste)	1	1	1	3	6	Low
	■ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	3	7	Medium
	■ Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low
	■ Erosion and sedimentation	1	2	1	3	7	Medium
	■ Aquatic habitat degradation	1	1	1	3	6	Low

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
▪ Squirrel glider (*Petaurus norfolcensis)* ▪ Turquoise parrot (*Neophema pulchella*) ▪ Varied sittella (*Daphoenositta chrysoptera*) ▪ Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)							
State Significant Ecological Constraint - PCTs (BC Act): ▪ PCTs of high condition ▪ PCTs of moderate condition	▪ Habitat loss from vegetation clearing/removal	3	3	1	2	9	Medium
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	1	2	9	Medium
	▪ Fauna species injury or mortality	1	1	1	2	5	Low
	▪ Noise, dust and light and contaminant disturbance	1	1	1	2	5	Low
	▪ Increase in litter (waste)	1	1	1	2	5	Low
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	▪ Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
	▪ Erosion and sedimentation	1	2	1	2	6	Low
	▪ Aquatic habitat degradation	1	1	1	2	5	Low
State Significant Ecological Constraint - PCTs (BC Act): ▪ PCTs of low condition	▪ Habitat loss from vegetation clearing/removal	3	3	1	1	8	Medium
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	1	1	8	Medium
	▪ Fauna species injury or mortality	1	1	1	1	4	Low

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
	▪ Noise, dust and light and contaminant disturbance	1	1	1	1	4	Low
	▪ Increase in litter (waste)	1	1	1	1	4	Low
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	1	5	Low
	▪ Displacement of species from invasion of weed and pest species	1	1	1	1	4	Low
	▪ Erosion and sedimentation	1	2	1	1	5	Low
	▪ Aquatic habitat degradation	1	1	1	1	4	Low
State Significant Ecological Constraint - Landscape features (BC Act): ▪ Great Artesian Basin	▪ Habitat loss from vegetation clearing/removal	3	3	2	3	11	High
	▪ Edge effects ▪ Habitat fragmentation ▪ Barrier effects ▪ Reduction in connectivity of biodiversity corridors	3	3	2	3	11	High
	▪ Fauna species injury or mortality	1	1	2	3	7	Medium
	▪ Noise, dust and light and contaminant disturbance	1	1	2	3	7	Medium
	▪ Increase in litter (waste)	1	1	2	3	7	Medium
	▪ Reduction in biological viability of soil to support growth due to soil compaction	1	2	2	3	8	Medium
	▪ Displacement of species from invasion of weed and pest species	1	1	2	3	7	Medium
	▪ Erosion and sedimentation	1	2	2	3	8	Medium
	▪ Aquatic habitat degradation	1	1	2	3	7	Medium

Ecological receptor(s)	Potential impacts[#]	Relevance factor of aspects				Sum of relevance factors	Impact significance (refer to Section 8.6 for mitigation strategies)
		Probability	Duration	Magnitude	Sensitivity		
State Significant Ecological Constraint - Landscape features (BC Act): ■ Patches of native woody and non-woody vegetation ■ Area/s of connectivity joining different areas of habitat that intersect with the subject land and the areas of habitat that are connected ■ Waterways and riparian buffers ■ Important and local wetlands	■ Habitat loss from vegetation clearing/removal	3	3	1	2	9	Medium
	■ Edge effects ■ Habitat fragmentation ■ Barrier effects ■ Reduction in connectivity of biodiversity corridors	3	3	1	2	9	Medium
	■ Fauna species injury or mortality	1	1	1	2	5	Low
	■ Noise, dust and light and contaminant disturbance	1	1	1	2	5	Low
	■ Increase in litter (waste)	1	1	1	2	5	Low
	■ Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	■ Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
	■ Erosion and sedimentation	1	2	1	2	6	Low
	■ Aquatic habitat degradation	1	1	1	2	5	Low

Table notes:

Table 3.4 defines the consequences of the impact significance ratings, as follows:

- **Low** (sum of relevance factors = 1 to 6): Negative impacts need to be managed by standard environmental management practices. Special approval conditions unlikely to be necessary. Monitoring to be part of general proposal monitoring program
- **Medium** (sum of relevance factors = 7 to 9): Mitigation measure likely to be necessary and specific management practices to be applied. Specific approval conditions are likely. Targeted monitoring program required
- **High** (sum of relevance factors = 10 to 12): Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Specific approval conditions required. Targeted monitoring program necessary

12 Biodiversity offsets

ARTC has, where possible, altered the proposal to avoid and minimise ecological impacts in the proposal planning phase as required under the BC Act and EPBC Act, and a range of impact mitigation strategies have been included in the proposal to mitigate the impact on ecological receptors (refer Section 8.6). This includes further potential to reduce the impact footprint where possible during the detailed design phase.

Optimisation of the disturbance footprint, in particular the reduction in borrow pit, laydown and early works areas of disturbance occurred during the development of the preliminary design and post EIS submission. This has resulted in the avoidance or reduction of disturbance for a number of sensitive habitats and their associated fauna and flora species.

Residual impacts are those impacts that remain after the successful implementation of the avoidance hierarchy and mitigation measures. The significance of residual impacts reflects the effectiveness of the proposed mitigation measures but allows for the identification of areas where further management measures may be required.

Although terrestrial ecological receptors will be avoided where practicable and potential impacts will be minimised and mitigated to the greatest extent practical, in some instances the magnitude and significance ratings will remain unchanged following the implementation of the mitigation measures. There is the potential for some proposal activities to have a cumulative, irreversible and/or permanent impact upon threatened communities and species, even after the implementation of all mitigation measures, including rehabilitation. In these cases, the residual impact will require offset should the residual impact be considered significant in accordance with the impact assessment carried out under either the BAM or the MNES Guidelines.

As detailed in Section 10.7 none of the species assessed under the MNES Guidelines are considered as subject to significant residual impacts from the proposal. The following section summarises the results of the impact assessment under the BAM and those communities and species requiring offsetting as a result of the proposal impacts.

12.1 Biodiversity credit report

Together, ecosystem credits, species credits and scattered paddock tree credits are referred to as ‘biodiversity credits’. Table 12.1 provides a summary of the ecosystem and species-credits that require offsetting as a result of work that is within and relating to the alignment and borrow pits. Table 12.2 to Table 12.5 provides a summary by individual segments of the ecosystem credits per PCT and species credits per species that require retirement as for each segment of the proposal.

Full Credit Calculator reports are included in Appendix H.

Table 12.1 Summary of all credits generated within the project segments

Segments	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	PCTs impacted	Ecosystem credits	Species credits	Scattered tree credits
Greenfield Alignment	38.04	1.64	39.68	36, 52, 192, 244, 247, 628	1,354	7,746	1
Brownfield Alignment	165.57	26.47	192.04	27,35,36,52, 53, 55, 56, 98, 244, 247, 628	4,297	7,670	-
Early works Alignment	54.89	59.03	113.92	27, 35, 36, 53, 56, 192, 628	1,398	1,963	-
Borrow Pit 1	6.17	0.64	6.81	35, 147	152	375	-
Borrow Pit 2	13.57	1.27	14.84	35, 418	195	606	-
Borrow Pit 4	0	8.56	8.56	56	0	0	-

Segments	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	PCTs impacted	Ecosystem credits	Species credits	Scattered tree credits
Borrow Pit 5	12.4	19.9	32.1	192	193	743	-
Borrow Pit 7	0.13	15.68	15.81	56	2	2	5
Borrow Pit 8	21.1	6.17	27.27	56	787	1572	-
Borrow Pit 9	7.9	4.7	12.6	418	137	368	-
Borrow Pit 13	0.57	11.04	11.61	98	12	0	-
Borrow Pit 25	3	19.6	22.6	418	40	32	-
Total	**323.34**	**174.7**	**498.04**	**27, 35, 36, 52, 53, 55, 56, 98, 147, 192, 244, 247, 418, 628**	**8,567**	**21,077**	**6**

Table 12.2 All credits generated within the project Greenfield alignment segment

Segment – Greenfield alignment segment	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
Total	38.04	1.64	39.68	1,354	7,746	1
Ecosystem Credit breakdown						
▪ PCT 36 - River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	0.84	-	-	23	-	1
▪ PCT 52 - Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion	26.1	-	-	1,076	-	-
▪ PCT 192 - Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW – Low	1.6	-	-	17		
▪ PCT 192 - Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW – Medium	2.3	-		39		
▪ PCT 244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt). – Medium	3.8	-	-	146		
▪ PCT 247 - Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion – Low	2.2	-	-	38		

Segment – Greenfield alignment segment	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
▪ PCT 628 - Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion – Low	1.2	-	-	15		
Species Credit breakdown						
▪ *Desmodium camplylocaulon* (Creeping tick-trefoil)	29.9		-		1222	
▪ *Dichanthium setosum* (Bluegrass)	26.1				1076	
▪ *Digitaria porrecta* (Finger panic grass)	32.1		-		1,265	
▪ *Homopholis belsonii* (Belson's panic)	29.9		-		1,222	
▪ *Lepidium monoplocoides* (Winged peppercress)	25.82		-		1,064	
▪ *Swainsona murrayana* (Slender Darling pea)	29.9		-		1,222	
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	6.94	-	-		225	
▪ *Hoplocephalus bitorquatus* (Pale-headed snake)	6.94	-	-		225	
▪ *Tyto novaehollandiae* (Masked owl)	6.94	-	-		225	

Table 12.3 All credits generated within the project Brownfield alignment segment

Segment – Alignment Brownfield	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
Total	165.57	26.47	192.04	4,297	7,670	-
Ecosystem Credit breakdown						
▪ PCT 27 - Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion – Medium	0.02			1		
▪ PCT 27 - Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion - Low	4	-	-	73	-	-
▪ PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion - High	5.64	-	-	261	-	-
▪ PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion – Low	2.4			36		

Segment – Alignment Brownfield	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
▪ PCT 36 - River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion - High	0.51			15	-	-
▪ PCT 36 - River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion – Medium	1.83			28		
▪ PCT 52 - Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion – Medium	7.4			308	-	-
▪ PCT 53 - Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains – Medium	3	-	-	107	-	-
▪ PCT 55 - Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions. – High	0.64	-	-	8	-	-
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW - High	32.07	-	-	1,048	-	-
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW - Medium	4.46			114		
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW – Low	74.5			1,551		
▪ PCT 98 - Poplar Box - White Cypress Pine - Wilga - Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow – High	2.2			75	-	-
▪ PCT 244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt). – Medium	3.6			138	-	-
▪ PCT 244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt). – Low	3.7			75		

Segment – Alignment Brownfield	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
▪ PCT 247 - Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion - Medium	6.2			94	-	-
▪ PCT 247 - Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion – Low	2.3			98		
▪ PCT 628 - Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion - Medium	2.9	-	-	128	-	-
▪ PCT 628 - Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion – Low	8.2	-	-	139		
Species Credit breakdown						
▪ *Desmodium camplylocaulon* (Creeping tick-trefoil)	0.28				12	
▪ *Dichanthium setosum* (Bluegrass)	-				-	
▪ *Digitaria porrecta* (Finger panic grass)	103.87				2493	-
▪ *Homopholis belsonii* (Belson's panic)	0.07				1	-
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	47.57	-	-		1,551	-
▪ *Hoplocephalus bitorquatus* (Pale-headed snake)	1.56				37	-
▪ *Petauris norfolcensis* (Squirrel glider)	32.24				1039	-
▪ *Phascolarctos cinereus* (Koala)	22.9				779	-
▪ *Tyto novaehollandiae* (Masked owl)	50.8				1749	-

Table 12.4 All credits generated within the project Early works alignment segment

Segment – Alignment Early works	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
Total	54.89	59.03	113.92	1,398	1,963	-
Ecosystem Credit breakdown						
▪ PCT 27 - Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion – Low	4.6	-	-	56	-	-

Segment – Alignment Early works	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
▪ PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion - High	5.53	-	-	230	-	-
▪ PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion – Low	1.7			33		
▪ PCT 36 - River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion - High	0.66			24		
▪ PCT 36 - River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion - Medium	1.6			60		
▪ PCT 53 - Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains _Medium	1.2	-	-	40	-	-
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW - High	4.3	-	-	115	-	-
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW - Medium	4.7			122		
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW – Low	13			283		
▪ PCT 192 - Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW – Medium	1.5			30		
▪ PCT 192 - Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW – Low	1.5			9		
▪ PCT 628 - Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion - Medium	3.1	-	-	144	-	-
▪ PCT 628 - Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion – Low	11			252		

Segment – Alignment Early works	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
Species Credit breakdown						
▪ *Digitaria porrecta* (Finger panic grass)	17.18	-	-	-	432	-
▪ *Homopholis belsonii* (Belson's panic)	2	-	-	-	72	-
▪ *Polygala linariifolia* (Native Milkwort)		-	-	-		-
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	16.3	-	-	-	513	-
▪ *Hoplocephalus bitorquatus* (Pale-headed snake)	4.26	-	-	-	134	-
▪ *Petauris norfolcensis* (Squirrel glider)	2.66	-	-	-	95	-
▪ *Phascolarctos cinereus* (Koala)	4.86	-	-	-	208	-
▪ *Tyto novaehollandiae* (Masked owl)	15.23	-	-		509	-

Table 12.5 All credits generated within the project Borrow pits segment

Segment – Borrow Pits	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
Borrow Pit 1 - Total	**6.17**	**0.64**	**6.81**	**152**	**375**	**-**
Ecosystem Credit breakdown						
▪ PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion – Medium	0.67			16		
▪ PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion – Low	0.9			9		
▪ PCT 147 - Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion - High	1.2	-	-	31	-	-
▪ PCT 147 - Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion - Medium	3.4			96		
Species Credit breakdown						
▪ *Digitaria porrecta* (Finger panic grass)	-	-	-	-	121 (4.9ha)	-
▪ *Homopholis belsonii* (Belson's panic)	-	-	-	-	127 (4.66ha)	-
▪ *Tyto novaehollandiae* (Masked owl)	-	-	-	-	127 (4.6ha)	-

Segment – Borrow Pits	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
Borrow Pit 2 – Total	**13.57**	**1.27**	**14.84**	**195**	**606**	**-**
Ecosystem Credit breakdown						
▪ PCT 35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion -Low	0.67	-	-	10	-	-
▪ PCT 418 - White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion - High	6.1	-	-	81	-	-
▪ PCT 418 - White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion - Medium	6.7			104		
Species Credit breakdown						
▪ *Digitaria porrecta* (Finger panic grass)	-	-	-	-	177 (9.5ha)	-
▪ *Homopholis belsonii* (Belson's panic)	-	-	-	-	182 (9.7ha)	-
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	-	-	-	-	247 (12.9ha)	-
Borrow Pit 5 - Total	**12.4**	**19.9**	**32.3**	**193**	**743**	**-**
Ecosystem Credit breakdown						
▪ PCT 192 - Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW	12.4	-	-	193	-	-
Species Credit breakdown						
▪ *Polygala linariifolia* (Native Milkwort)	-	-	-	-	257 (12.4ha)	-
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	-	-	-	-	229 (10.5ha)	-
▪ *Hoplocephalus bitorquatus* (Pale-headed snake)	-	-	-	-	257 (12.4ha)	
Borrow Pit 7- Total*	**0.13**	**15.68**	**15.81**	**2**	**2**	**5**
Ecosystem Credit breakdown						
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW - Northern Outwash Vegetation Zone	0.13	-	-	2	-	-
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW - Northern Basalts Scattered Trees						5
Species Credit breakdown						
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	-	-	-	-	2 (0.13ha)	-

Segment – Borrow Pits	Native vegetation impacted (ha)	Managed land impacted (ha)	Total area impacted (ha)	Ecosystem credits	Species credits	Scattered tree credits
Borrow Pit 8 – Total	**21.1**	**6.17**	**27.27**	**787**	**1572**	**-**
Ecosystem Credit breakdown						
▪ PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	21.1	-	-	787		
Species Credit breakdown						
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	-	-	-	-	787 (21.1ha)	-
▪ *Tyto novaehollandiae* (Masked owl)	21.1	-	-	-	785 (21.1ha)	-
Borrow Pit 9 - Total	**7.9**	**4.7**	**12.6**	**137**	**368**	**-**
Ecosystem Credit breakdown						
▪ PCT 418 - White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion	7.9	-	-	137		
Species Credit breakdown						
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	-	-	-	-	184 (6.9ha)	-
▪ *Tyto novaehollandiae* (Masked owl)	-	-	-	-	184 (6.9ha)	-
Borrow Pit 13 - Total	**0.57**	**11.04**	**11.61**	**12**	**0**	**-**
Ecosystem Credit breakdown						
▪ PCT 98 - Poplar Box - White Cypress Pine - Wilga - Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow	0.57			12		
Borrow Pit 25 – Total	**3**	**19.6**	**22.6**	**40**	**32**	**-**
Ecosystem Credit breakdown						
▪ PCT 418 - White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion	3			40		
Species Credit breakdown						
▪ *Calyptorhynchus lathami* (Glossy black-cockatoo)	-	-	-	-	32 (1.5ha)	-

Table note:

* Scattered tree credits expressed separately to PCT 56 vegetation zone due to location within the Northern Basalts side of the IBRA sub-region boundary. See Section 9.1.2.2 for further details.

The information above is based on the assumption of assumed presence of two species credit species which have not undergone targeted survey within BAM specified months, Glossy-black cockatoo and Masked owl. The exceptions to this are as outlined in Table 6.4.

As detailed in Table 12.1 a total of 1,354 ecosystem, one scattered paddock tree and 7,746 species credits will be required for the greenfield segment of the project. The brownfield segment will require 4,297 ecosystem and 7,671 species credits and the early works segment will require 1,398 ecosystem and 1,962 species credits to be retired prior to works commencing.

Overall within the project 7,049 ecosystem credits, 17,379 species credits and one scattered paddock tree credit will be required to offset the direct impacts of the combined alignment segments and 1,518 ecosystem credits, 3,698 species and five scattered paddock tree credits are required for the combined borrow pits. Total credits of 8,567 for ecosystem impacts, 21,077 for species credit species impacts and 6 credits for scattered paddock trees will be required should all aspects of the proposal proceed.

The above credit numbers assume that all borrow pits will be utilised, however this is unlikely to eventuate. Individual borrow pits have been assessed as separate areas in order to facilitate segmented offsetting if and when those areas are to be utilised. The number of credits required (i.e. biodiversity impacts) will be considered during the final selection of borrow pit sites.

ARTC commits to the retirement of biodiversity credits in accordance with the Biodiversity Offsets Scheme. ARTC will apply the like-for-like or variation rules under the BC Act to meet the relevant biodiversity credit obligations. Variations rules would not apply to any Matters of National Environmental Significance (MNES) listed under the EPBC Act.

13 Evaluation and conclusion

The subject land provides suitable habitat for a number of TECs and threatened species listed under the provisions of the EPBC Act and/or the BC Act. The subject land contains a suite of other ecological receptors including habitat connectivity, wetlands and waterways.

The subject land was assessed under the BAM for all BC Act listed entities and under the EPBC Act requirements where those species and or communities were not captured under BAM.

Multiple ecological receptors were identified within the subject land for the purposes of this assessment. These varied from broad scale receptors such as landscape features, down to finer species-scale receptors, including TECs (six TECs listed under BC and/or EPBC Acts), and habitat for threatened flora and fauna significant species (six flora species and seven fauna species). As well as being assessed under the BAM many of these receptors were grouped into high, moderate and low sensitivity categories based on factors, including conservation status, exposure to threatening processes, resilience and representation in the broader landscape.

The construction and operation of the proposal has the potential to impact on ecological receptors through the following potential impacts:

- Habitat loss and degradation from vegetation clearing/removal
- Fauna species injury or mortality
- Reduction in biological viability of soil to support growth due to soil compaction
- Displacement of flora and fauna species by invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light impacts
- Increase in litter (waste)
- Erosion and sedimentation
- Disturbance to specialists breeding and foraging habitat
- Trampling of threatened species
- Fallen timber and bush rock collection and removal
- Fertiliser drift
- Increased fire risk.

The proposed avoidance and mitigation measures for the proposal were identified in order to reduce the significance of the potential impacts upon the ecological receptors. The mitigation strategies associated with the proposal are presented in Section 8.6. Following the application of the mitigation hierarchy (i.e. avoid, minimise, mitigate), which included a range of mitigation measures and management plans, the residual impacts to the identified ecological receptors were reduced for threatened species and for BC Act-listed TECs (refer Table 8.3, Table 8.4 and Table 8.5). Aside from avoidance and impact minimisation, the application of additional mitigation measures was not likely to significantly reduce impacts associated with the loss of vegetation through clearing/removal, resulting in an adverse residual impact to each of the terrestrial ecological receptors.

Impact assessment under the BAM identified Serious And Irreversible Impacts (SAII) for one Plant Community Type (PCT) The PCT identified under BAM as SAII is:

- PCT35 – Brigalow – Belah open forest/woodland known to occur.

Targeted surveys for Pale imperial hairstreak according to the approved BCSD methodology across three rounds in February and March 2021 failed to detect this species, although it was detected at reference sites that are not part of the study area during the same period. Therefore it is assumed not to be present.

In order to reduce the area of impact on PCT 35 Brigalow, project ecologists and engineers worked together to refine the greenfield, brownfield and early works segments of the alignment (including temporary laydown areas) and borrow pit shape. This has resulted in the removal of two potential borrow pits from the subject land and the re-shaping of a further three. In total these efforts have reduced the area of potential impact from 101 ha to 17.51 ha including low quality brigalow which does not meet the benchmark condition set out in the EPBC guidelines.

In addition to habitat loss, the unmitigated impacts of fauna injury and mortality, and a reduction in the connectivity of biological corridors are predicted to impact ecological receptors including threatened fauna. Threatened fauna species considered most likely to be adversely affected by an increase in mortality and a reduction in landscape connectivity as a result of the proposal include:

- Squirrel glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*).

For those species listed under the EPBC Act and not assessed under the BAM the nature of each unmitigated potential impact was considered in relation to the identified ecological receptors (EPBC Act regulated) to derive an initial assessment of impact significance for the proposal (refer Table 10.9). This was determined by assigning sensitivity and magnitude ratings which were then allocated a significance rating through the significance assessment matrix. The potential impacts upon the ecological receptors (EPBC Act regulated) were assigned a major, high, moderate, low or negligible rating (refer Table 10.9). None of the six species assessed (two flora and four fauna species) are considered to be significantly impacted by the proposal under the MNES guideline assessment (refer Section 10.7)

Predicted cumulative impacts were assessed incorporating twelve projects within the vicinity of the proposal that have been identified as either currently underway or are going through the EIS process and are likely to contribute to the continued loss of biodiversity in the Brigalow Belt South and Darling Riverine Plains bioregions.

The cumulative impacts of multiple similar projects occurring in the vicinity of the proposal may include the following potential impacts:

- Habitat loss from vegetation clearing/removal
- Fauna species injury or mortality
- Reduction in biological viability of soil to support growth due to soil compaction
- Displacement of flora and fauna species from invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light
- Increase in litter (waste)
- Erosion and sedimentation.

High significance cumulative impacts as a result of the proposal and other similar projects are predicted to impact the following ecological receptors:

- TECs (EPBC and BC Acts)
- Threatened flora and fauna (EPBC and BC Acts)
- State significant landscape feature – Great Artesian Basin.

Mitigation measures presented in Section 8.6.3 will contribute to the reduction of potential cumulative impact to ecological receptors in the region.

During Phase 2 of the proposal (detailed design, post-EIS), sensitive ecological receptors identified during the EIS will be subject to further investigation, in order to more accurately determine the magnitude of the significant adverse impacts upon the identified ecological receptors. The specific mitigation measures will then be applied to ensure that the significance ratings of any potential impacts are classified as low as reasonably practicable and the more significant adverse impacts are offset. The findings of these investigations will be used to refine the BAM C data for the proposal. The current requirements are 29,650 credits for BC Act offsets.

There is the potential for some proposal activities to have a cumulative, irreversible and/or permanent impact upon some ecological receptors, even after the implementation of all mitigation measures. In these cases, the compensation for the residual impact will need to occur. Compensation in the form of Biodiversity Credit retirements will be required as per the BC Act.

14 References

Adair, R.J. and Groves, R.H. (1998). Impact of environmental weeds on biodiversity: a review and development of a methodology, Environment Australia, Canberra.

Atlas of Living Australia. (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/.

Australian Rail Track Corporation (2010). Melbourne-Brisbane Inland Rail Alignment Study - Final Report. [online] Available at: https://inlandrail.artc.com.au/13223/documents/29738 [Accessed 12 Sept. 2019]

Australian Rail Track Corporation (2017). Inland Rail – Narrabri to North Star EIS: Technical Report 3 Aquatic Ecology Assessment. [online] Available at: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7474 [Accessed 19 Nov 2019]

Australian Rail Track Corporation (2020) North Star to NSW/Queensland Border – Environmental Impact Statement. Australian Rail Track Corporation, Brisbane Queensland

Australiana and New Zealand Environment Conservation Council (2000) Australian and New Zealand Guidelines for fresh and Marine Water Quality [online] Available at: https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf [Accessed 24 November 2019].

Ayers, D. and Wallace, G. (1997). Pipeline trenches: an under-utilised resource for finding fauna, in P. Hale and D. Lamb (eds), Conservation Outside Nature Reserves, Centre for Conservation Biology, The University of Queensland, Brisbane., pp. 349 – 357.

Bali, R. (2005). Discussion Paper – Compensating for Edge Effects, Ecosense Consulting for the NSW Roads and Traffic Authority, Sydney.

Bennett, A.F. (1990). Habitat Corridors. Their Role in Wildlife Management and Conservation., Department of Conservation and Environment, Sydney.

Benson, JS (1993) The biology and management of Ooline (*Cadellia pentastylis*) in New South Wales. Species Management Report No. 2. NSW National Parks and Wildlife Service, Hurstville

Benson, JS, Allen, CB, Togher, C. and Lemmon, J (2006) New South Wales Vegetation Classification and Assessment: Part 1 Plant communities of the NSW Western Plains. Cunninghamia 9: 383-450

Biddle, C, 2020 January 21. 'Moree koala photo goes viral'. *Goondiwindi Argus*. https://www.goondiwindiargus.com.au/story/6591547/how-a-koala-became-an-instant-celebrity/. Viewed 17 August 2021

Birdsall, J.L., McCaughey, W. and Runyon, J.B. (2012). Roads Impact the Distribution of Noxious Weeds More Than Restoration Treatments in a Lodgepole Pine Forest in Montana, U.S.A, Restoration Ecology, vol. 20, no. 4, pp. 517 – 523.

Braby, M.F. (2000), Butterflys of Australia: Their identification, biology and distribution. CISRO, Melbourne.

Bradley, M., House, A., Robertson, M., Wild,C. (2010) Vegetation succession and recovery of ecological values in the southern Queensland Brigalow Belt. Ecological Restoration and Management. Vol 11 (2) Pgg. 113-118.

Brigalow Belt Reptiles Workshop. (2010). *Proceedings from the workshop for the nine listed reptiles of the Brigalow Belt bioregions*. 18-19 August. Brisbane: Queensland Herbarium.

Brunner, H & Coman. B.J. (1974). The Identification of Mammalian Hair. Inkata Press, Melbourne.

Butler, DW (2007) Recovery plan for the "Brigalow (*Acacia harpophylla* dominant and co-dominant" endangered ecological community (draft of 1 May 2007). Report to the Department of the Environment and Water Resources, Canberra. Queensland National Parks and Wildlife Service, Brisbane

Caro, T. (2005). Antipredator defences in birds and mammals. University of Chicago Press, Chicago, Illinois, USA.

Chapple, DG, Tingley, R, Mitchell, NJ, Macdonald, SL, Keogh, JS, Shea, GM, Bowles, P, Cox, NA & Woinarski, JCZ (2019), *The action plan for Australian lizards and snakes 2017*, CSIRO Publishing, Clayton South.

Churchill, S. (2008). Australian Bats. Allen and Unwin, Crows Nest. NSW. Australia

Clarke, G.M., Grosse, S., Matthews, M., Catling, P.C., Baker, B., Hewitt, C.L., Crowther, D. and Saddlier, S.R. (2000). Environmental Pest Species in Australia, Australia: State of the Environment, Second Technical Paper Series (Biodiversity), Department of the Environment and Heritage, Canberra.

Coffin, A.W. (2007). From roadkill to road ecology: A review of the ecological effects of roads, Journal of Transport Geography, vol. 15, no. 5, pp. 396 – 406.

Cogger, H.G., Cameron, E.E., Sadlier R.A. & Eggler, P. (1993). The Action Plan for Australian Reptiles. Canberra, ACT: Australian Nature Conservation Agency. Available from: http://www.environment.gov.au/biodiversity/threatened/action/reptiles/index.html .

Covacevich, J., Dunmall W. & J.A. Sorley. (1988). Reptiles. In: Scott, G., ed. Lake Broadwater. Page(s) 265-273. Darling Downs Institute Press.

Covacevich, J.A. (1995). Realities in the Biodiversity Holy Grail: Prospects for Reptiles of Queensland's Brigalow Biogeographic Region. The Royal Society of Queensland. 106 (1):1-9.

Covacevich, J.A., Couper P.J., & McDonald, K.R. (1996). Reptiles of Queensland's Brigalow Biogeographic Region: Distributions, Status and Conservation. Page(s) 148. Canberra: Australian Nature Conservation Agency (ANCA).

Crowther, M.S., D. Lunney, J. Lemon, R. Wheeler & G. Madani (2010). Restoration of koala habitat in Gunnedah II: movement of koalas across a patchy rural landscape. In: Australian Mammal Society 56th Meeting. Canberra, ACT.

Crowther, M., D. Lunney, J. Lemon, E. Stalenberg, R. Wheeler, G. Madani, K. Ross and M. Ellis (2013). Climate-mediated habitat selection in an arboreal folivore. Ecography. 36:001-008

Debus, S.J.S. & Czechura, G. (1988). 'The Red Goshawk *Erythrotriorchis radiatus*: a review'. *Australian Bird Watcher,* vol. 12 ,pp. 175-199.

Department of Agriculture, Water and the Environment (2020), *Species profile and threats (SPRAT) database.* Commonwealth Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/sprat.

Department of Agriculture, Water and the Environment (2021), *National Recovery plan for the Koala: Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territort*, Canberra. CC BY 4.0.

Department of the Environment and Energy (2016). *Threat abatement plan for competition and land degradation by rabbits*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016. In effect under the EPBC Act from 07-Jan-2017.

Department of Environment and Conservation (2004). Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales, [online]. Available at: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/water/approvedmethods-water.pdf [Accessed 13 Sept. 2019].

Department of Environment and Conservation (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft. Published for the NSW DEC. 2004.

Department of Environment. (1999). The Action Plan for Australian Bats [online]. Available at: http://155.187.2.69/biodiversity/threatened/publications/action/bats/1.html [Accessed Aug. 2019].

Department of the Environment (2013). *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community*. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/028-conservation-advice.pdf. In effect under the EPBC Act from 17-Dec-2013.

Department of the Environment (2014). *EPBC Act referral guidelines for the vulnerable Koala.* Canberra, ACT: Commonwealth of Australia

Department of the Environment (2015). Threat abatement plan for predation by feral cats. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats. In effect under the EPBC Act from 23-Jul-2015.

Department of Environment and Resource Management (2012), *National recovery plan for the red goshawk Erythrotriorchis radiatus*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra. Queensland Department of Environment and Resource Management, Brisbane. Available from: https://www.environment.gov.au/system/files/resources/115185bc-74f7-40e4-a0af-f46aaa482dc7/files/erythrotriorchis-radiatus.pdf

Department of Environment and Science (2017a). *Dunmall's snake*. Queensland Government. Available from: https://www.ehp.qld.gov.au/wildlife/animals-az/dunmalls_snake.html. [Accessed 22 August 2018].

Department of Environment and Science (2017b). 'Red Goshawk'. Queensland Government. Available: https://www.ehp.qld.gov.au/wildlife/threatened-species/endangered/endangered-animals/red_goshawk.html

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Approved Conservation Advice for Dichanthium setosum. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/14159-conservation-advice.pdf. In effect under the EPBC Act from 26-Mar-2008.

Department of Natural Resources, Mines and Energy (2019) Queensland Globe [online]. Avaiable at: https://qldglobe.information.qld.gov.au/ [Accessed Aug 2019].

Department of Planning, Industry and Environment (2018). Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions - Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act [online]. Available at: https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2011-2012/Brigalow-within-the-Brigalow-Belt-South-Nandewar-Bioregions-minor-amendment-Determination [Accessed 24 September 2019]

Department of Planning, Industry and Environment (2017). Biodiversity Assessment Method Operation Manual. NSW Government [online] – Stages 1, 2 and 3. Available at: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-assessment-method [Accessed 20 April 2021].].

Department of Planning, Industry and Environment (2020b). Biodiversity Assessment Method Operation Manual. NSW Government [online] – Stages 1, 2 and 3. Available at: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-assessment-method [Accessed 20 April 2021].

Department of Planning, Industry and Environment (2020c). Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method. Available at: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/surveying-threatened-plants-and-habitats-nsw-survey-guide-biodiversity-assessment-method-200146.pdf [Accessed 30 April 2021].

Department of Primary Industries (2006) Threatened species assessment guidelines: The assessment of significance [Online]. Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/634947/Threatened-Species-Guidelines.pdf [Accessed 24/01/2020]

Department of Primary Industries (2013). Policy and guidelines for fish habitat conservation and management [online]. Available at: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/468927/Policy-and-guidelines-for-fish-habitat.pdf [Accessed 12 Sept. 2019].

Department of Primary Industries (2018). About threatened species. Available from: https://www.dpi.nsw.gov.au/fishing/species-protection/conservation. [12 September 2019].

Department of Primary Industries (2018). Protecting Habitats. Available from: https://www.dpi.nsw.gov.au/fishing/habitat/protecting-habitats. [12 September 2019].

Department of Primary Industries, Office of Water (2012) Guidelines for controlled activities on waterfront land. Available at: https://www.industry.nsw.gov.au/__data/assets/pdf_file/0019/160471/licensing_approvals_controlled_activities_watercourse_crossings.pdf [Accessed 23/11/2019].

Department of Sustainability, Environment, Water, Populations and Community (2011). *The draft referral guidelines for the Brigalow Belt reptiles.* Australian Government, Canberra. Available from: http://www.environment.gov.au/system/files/resources/570964ac-15bf-4e07-80da-848fead7b0cd/files/draft-referral-guidelines-comment-brigalow-reptiles.pdf.

Department of Sustainability, Environment, Water, Population and Communities (2011). *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads*. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/resource/threat-abatement-plan-biological-effects-including-lethal-toxic-ingestion-caused-cane-toads. In effect under the EPBC Act from 06-Jul-2011

Department of Sustainability, Environment, Water, Population and Communities (2012). EPBC Act environmental offsets policy [online]. Available at: https://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf [Accessed 12 Sept. 2019].

Department of Sustainability, Environment, Water, Population and Communities (2013) *Nationally Threatened Ecological Communities: Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland, and Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin - A guide to the identification, assessment and management of nationally threatened ecological communities.* Available at: http://www.environment.gov.au/system/files/resources/347c5d4e-cef8-411c-b53c-bed3ed1d3e1c/files/bio237-0512-natural-grasslands-guide.pdf [Accessed 18 Aug 2021]

Department of the Environment (2013), *Matters of National Environmental Significance: Significant impact guidelines 1.1*. Commonwealth of Australia, Canberra.

Department of the Environment (2014). *Approved Conservation Advice for Furina dunmallii (Dunmall's Snake).* Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/59254-conservation-advice.pdf.

Department of the Environment (2015). *Conservation Advice Calidris ferruginea curlew sandpiper.* Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/856-conservation-advice.pdf.

Department of the Environment (2016). *Draft referral guidelines for the vulnerable Murray cod (Maccullochella peeli).* Commonwealth of Australia. Canberra. Available from: https://www.environment.gov.au/system/files/resources/7a17c9a0-bd7c-4bea-ab6c-965059223aa9/files/draft-referral-guidelines-vulnerable-murray-cod.pdf.

Department of the Environment (2019). *Haliaeetus leucogaster* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=943. [12 September 2019].

Department of the Environment and Energy (2015). EPBC Act environmental offsets policy [online]. Available at: http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy [Accessed 2018].

Department of the Environment and Energy (2015). Protected Matters Search Tool. Australian Government. Available from: http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf. [12 September 2019].

Department of the Environment and Energy (2017). *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* Available from: http://www.environment.gov.au/system/files/resources/67d7eab4-95a5-4c13-a35e-e74cca47c376/files/bio4190517-shorebirds-guidelines.pdf.

Department of Transport and Main Roads (2010). Fauna Sensitive Road Design Manual, Volume 2. Queensland Government, Brisbane. Available from: https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Fauna-Sensitive-Road-Design-Volume-2. [Accessed 20 July 2020].

Doody, J. S., West, P., Stapley, J., Welsh, M., Tucker, A., Guarino, e., Pauza, M., Bishop, M., Head, M., Dennis, S., West, G., Pepper, A., and Jones, A. (2003). Fauna by-catch in pipeline trenches: conservation, animal ethics, and current practices in Australia. Australian Zoologist 32:410-419.

Duiker, S.W. (2004). Effects of Soil Compaction, College of Agricultural Sciences [online]. Available at: http://pubs.cas.psu.edu/FreePubs/pdfs/uc188.pdf. [Accessed 4 September 2018].

Eco logical Australia (2020). Inland Rail (Border to Gowrie): Aquatic ecology technical report. Report prepared for ARTC (January 2020).

Environmental Resources Information Network (2003) Map of Brigalow (*Acacia harpophylla* dominant and co-dominant) [Accessed 19 September 2019]

Ernst and Young (2006). North-South Rail Corridor Study – Detailed Study Report, [online] p. 188. Available at: https://investment.infrastructure.gov.au/files/north_south_rail_corridor_study/chapter_1_9.pdf [Accessed 13 Sept. 2019].

Fahrig, L. (2002). Effect of habitat fragmentation on the extinction threshold: a synthesis, Ecological Applications, vol. 12, no. 2, pp. 346 – 351.

Fairfull, S., Witheridge, G. (2003). Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries Cronulla [online]. Available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/633505/Why-do-fish-need-to-cross-the-road_booklet.pdf [Accessed 12 Sept. 2019].

Fitzpatrick, R.W., McKenzie, N. and Maschmedt, D.J. (1999). Soil morphological indicators and their importance to soil fertility in Soil Analysis: An Interpretation Manual, (eds) K.T. Peverill, L.A. Sparrow and D.J. Reuter, CSIRO Publishing, Collingwood, VIC.

Floyd, A.G. (1990) Australian Rainforests in New South Wales Volume 2. Surrey Beatty and Sons Pty Limited: Chipping Norton, New South Wales.

Forman, R.T.T., Sperling, D., Bissonette, J.A., Clevenger, A.P., Cutshall, C.D., Dale, V.H., Fahrig, L., France, R., Goldman, C.R., Heanue, K., Jones, J.A., Swamson, F.J., Turrentine, T. and Winter, T.C. (2000). Road Ecology. Science and Solutions., Island Press, Washington.

Future Freight Joint Venture (2019) FFJV Inland Rail Portal, viewed 10 February 2019, https://inlandrail.anzgeo.com/cmv/index.html.

Goldingay, R.L., Sharpe, D. & Dobson, M.D.J. (2010), 'Variation in the home-range size of the squirrel glider (*Petaurus norfolcensis*)', Australian Mammalogy, vol. 32, no. 2, pp. 183-188. American Society of Mammalogists, Allen Press Inc.

Green, D., Ali, A., Petrovic, J., Burrell, M., Moss, P., (2012). Water resource and management overview: Border Rivers Catchment, NSW Department of Primary Industries, Sydney [online]. Available at: http://www.water.nsw.gov.au/__data/assets/pdf_file/0003/549318/catchment_overview_border.pdf [Accessed 12 Sept. 2019]

Hansen, B. D., Fuller, R. A., Watkins, D., Rogers, D. I., Clemens, R. S., Newman, M., Woehler, E. J. and Weller, D. R. (2016*). Revision of the East Asian-Australasia Flyway Population Estimates for 37 listed Migratory Shorebird Species*. Unpublished report for the Department of the Environment. BirdLife Australia, Melbourne.

Healthy Waterways (2014). Litter in our waterways, Available from: https://hlw.org.au/download-topic/waterways/litter-in-our-waterways/. [12 September 2019].

Higgins, PJ & Davies, SJJF (eds.) (1996), *Handbook of Australian, New Zealand & Antarctic Birds, Volume 3, Snipe to Pigeons*, Oxford University Press, Melbourne.

Industry and Investment NSW (2009). Bringing back the fish – improving fish passage and aquatic habitat in coastal NSW: Appendix F – Stream Order and Waterway Classification System [online]. Available at: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/324338/9.-Appendices-F-to-J.pdf [Accessed 12 Sept. 2019].

Infrastructure Australia (2018). Assessment Framework – For initiatives and projects to be included in the Infrastructure Priority List. Infrastructure Australia.

Ingram, G.J., McDonald, K.R. and Nattrass, A.E.O. (2002). Revised common names for Queensland frogs in Nattrass, A.E.O. (ed) Frogs in the Community: Proceedings of the Brisbane symposium 13-14 February 1999. Queensland Frog Society, Brisbane.

Inland Rail Implementation Group Report to the Australian Government (2015). Inland Rail Melbourne to Brisbane Inland Rail 2015 – Attachment A: ARTC 2015 Inland Rail Programme Business Case [online]. Available at: https://inlandrail.artc.com.au/13223/documents/29739 [Accessed 12 Sept. 2019].

Isbell, I. F. (1962) *Soils and vegetation of the Brigalow Lands, Eastern Australia*. Soils and Land Use Series No. 43. CSIRO:Melbourne

Koehn J.D., J.A. McKenzie, D.J. O'Mahony, S.J. Nicol, J.P. O'Connor and W.G. O'Connor. (2009). Movements of Murray cod (*Maccullochella peelii peelii*) in a large Australian lowland river. *Ecology of Freshwater Fish*. Vol. 18, pp. 594-602.

Kutt, A.S., Vanderduys, E.P., Ferguson, D. and Mathieson, M. (2012). Effect of small-scale woodland clearing and thinning on vertebrate fauna in a largely intact tropical savanna mosaic, Wildlife Research, vol. 39, no. 4, pp. 366 – 373.

Longcore, T. & Rich, C. (2004). Ecological light pollution. Frontiers in Ecology and the Environment 2: 191–198.

Loyn, R.H., Runnalls, R.G., Forward, G.Y. and Tyers, J. (1983). Territorial bell miners and other birds affecting populations of insect prey, Science, vol. 221, pp. 1411 – 1412.

Marchant, S., and P.J. Higgins (eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.

Martin, R. and Handasyde, K. (1999). The Koala: Natural history, conservation and management. UNSW Press, Sydney.

McDonald, WJF (1996) *Spatial and temporal patterns in the dry season subtropcial rainforests of eastern Australia, with particular reference to the vine thickets of central and southern Queensland*. PhD thesis, Botany Department, University of New England, Armidale. Available at: https://rune.une.edu.au/web/handle/1959.11/12122 [Accessed 12 Feb 2021].

McDonald, K.R., Covacevich, J.A., Ingram, G.J., & Couper, P.J. (1991). *The status of frogs and reptiles. In: Ingram, G.J. & R.J. Raven, eds. An Atlas of Queensland's Frogs, Reptiles, Birds and Mammals*. Page(s) 338-345. Brisbane: Queensland Museum.

McDonald, W.J.F. 2010. *National recovery plan for the "Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions" ecological community*. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Queensland Department of Environment and Resource Management, Brisbane

Menkhorst, P. and Knight, F. (2011). *Field Guide to the Mammals of Australia* 3rd Edition. Oxford University Press. Australia.

Moenting, A.E. and Morris, D.W. (2006). Disturbance and habitat use: is edge more important than area?, Oikos, vol. 115, no. 1, pp. 23 – 32.

National Herbarium of NSW (2019). Flora Online Database Plant Net. National Herbarium of NSW, Royal Botanic Garden, Sydney. Available from: http://plantnet.rbgsyd.nsw.gov.au/floraonline.htm. [12 September 2019].

National Murray Cod Recovery Team (2010). *National Recovery Plan for the Murray Cod Maccullochella peelii peelii*. Department of Sustainability and Environment, Melbourne. Available from: https://www.environment.gov.au/system/files/resources/bcc0fbf6-279b-4c52-88c5-42ce4d44b864/files/murray-cod.pdf.

New South Wales Department of Environment and Climate Change (2008). Recovery plan for the koala (*Phascolarctos cinereus*). Sydney, NSW: New South Wales Department of Environment and Climate Change. Available from: http://www.environment.nsw.gov.au/resources/threatenedspecies/08450krp.pdf.

NSW Environment, Energy and Science (2019). BioNet Atlas. Office of Environment and Heritage. Available from: http://www.bionet.nsw.gov.au/. [12 September 2019].

NSW Environment, Energy and Science (2019). BioNet Vegetation Classification (PCT descriptions). Office of Environment and Heritage. Available from: https://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx2. [12 September 2019].

NSW Environment, Energy and Science (2019). Threatened biodiversity profile search. Available from https://www.environment.nsw.gov.au/threatenedspeciesapp/. [12 September 2019].

NSW Government (2007). State Environmental Planning Policy (Infrastructure). Available from: https://www.legislation.nsw.gov.au/#/view/EPI/2007/641/whole. [12 September 2019].

NSW Government (2011). State Environmental Planning Policy (State and Regional Development). Available from: https://www.legislation.nsw.gov.au/#/view/EPI/2011/511. [12 September 2019].

NSW Government (2015). Noxious Weeds Act 1993 No.11. Available from: https://www.legislation.nsw.gov.au/#/view/act/1993/11/whole. [12 September 2019].

NSW Government (2017). Native Vegetation Act 2003 No.103. Available from: https://www.legislation.nsw.gov.au/#/view/act/2003/103/whole. [12 September 2019].

NSW Government (2017). Threatened Species Conservation Act 1995 No. 101. Available from: https://www.legislation.nsw.gov.au/#/view/act/1995/101/whole. [12 September 2019].

NSW Government (2018). Biodiversity Conservation Regulation. Available from: https://www.legislation.nsw.gov.au/#/view/regulation/2017/432/whole. [12 September 2019].

NSW Government (2018). Environmental Trust Act 1998 No.82. Available from: https://legislation.nsw.gov.au/#/view/act/1998/82/whole. [12 September 2019].

NSW Government (2018). Fisheries Management Act 1994 No.38. Available from: https://www.legislation.nsw.gov.au/#/view/act/1994/38/whole. [12 September 2019].

NSW Government (2018). National Parks and Wildlife Act 1974 No.80. Available from: https://www.legislation.nsw.gov.au/#/view/act/1974/80/whole. [12 September 2019].

NSW Government (2018). Protection of the Environment Administration Act 1991 No. 60. Available from: https://www.legislation.nsw.gov.au/#/view/act/1991/60/whole. [12 September 2019].

NSW Government (2019). Biodiversity Conservation Act 2016 No.63. Available from: https://www.legislation.nsw.gov.au/#/view/act/2016/63/whole. [12 September 2019].

NSW Government (2019). Environmental Planning and Assessment Act 1979 No. 203. Available from: https://www.legislation.nsw.gov.au/#/view/act/1979/203/whole. [12 September 2019].

NSW Government (2019). Local Land Services Act 2013 No. 51. Available from: https://www.legislation.nsw.gov.au/#/view/act/2013/51/whole. [12 September 2019].

NSW Government (2019). State Environmental Planning Policy (Vegetation in Non- Rural Areas) 2017. Available from: https://legislation.nsw.gov.au/#/view/EPI/2017/454/whole. [12 September 2019].

Office of Environment and Heritage (2012). Revocation, Re-categorisation and Road Adjustment Policy. Available at: https://www.environment.nsw.gov.au/topics/parks-reserves-and-protected-areas/park-policies/revocation-recategorisation-and-road-adjustment [Accessed 21 November 2019].

Office of Environment and Heritage (2013). Guidelines for developments adjoining land managed by the Office of Environment and Heritage. Available at: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Development-guidelines/guidelines-for-developments-adjoining-land-managed-by-OEH-130122.pdf [Accessed 21 November 2019].

Office of Environment and Heritage (2014). NSW Biodiversity Offsets Policy for Major Projects 2014 [online]. Available at: https://www.environment.nsw.gov.au/resources/biodiversity/140672biopolicy.pdf [Accessed 12 Sept. 2019].

Office of Environment and Heritage (2016). NSW Guide to Surveying Threatened Plants [online]. Available at: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/guide-surveying-threatened-plants-160129.pdf [Accessed 12 Sept. 2019].

Office of Environment and Heritage (2017a) Native vegetation regulatory map: method statement -Made under the Local Land Services Act 2013. NSW OEH, Goulburn St, Sydney NSW

Office of Environment and Heritage (2017b). 'Red Goshawk – Profile'. New South Wales Government. Available: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10279

Office of Environment and Heritage (2017c). 'Five-clawed Worm Skink – Profile'. New South Wales Government. Available:https://www.environment.nsw.gov.au/threatenedspeciesapp/profileData.aspx?id=10055&cmaName=Brigalow+Belt+South

NSW Office of Environment and Heritage (2020), Dichanthium setosum – Profile. Available at https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10221 [Accessed 8 December 2020]

Office of Environment and Heritage (2021). 'Pale-headed Snake – Profile. New South Wales Government. Available: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10412

Office of Environment and Heritage (2021b). Belson's Panic (*Homopholis belsonii*) – Saving our Species Profile. Available: https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=1055&ReportProfileID=10925 [Accessed 16 August 2021)

Office of Environment and Heritage (2021c). Bluegrass (*Dichanthium setosum*) – Saving our Species Profile. Available:https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=1192&ReportProfileID=10221 [Accessed 16 August 2021]

Braid Fern – profile [online]. Available at: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10636 [Accessed 19 August 2020].

Office of Environment and heritage (2019). Pale Imperial Hairstreak – profile [online]. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20123 [Accessed 19 August 2020].

http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10841 [Accessed 12 Sept. 2019].

Parris, K. M. (2013). Anthropogenic noise constrains acoustic communication in urban-dwelling frogs. Proceedings of Meetings on Acoustics 19: 010055.

Parris, K. M. (2015). Ecological impacts of road noise and options for mitigation. Pp. 151-158 in R. van der Ree, C. Grilo and D. Smith (eds), Ecology of Roads: A practitioners Guide to Impacts and Mitigation. Wiley-Blackwell, Oxford.

Parris, K.M., Velik-Lord, M. and North, J. M. A. (2009) Frogs call at a higher pitch in traffic noise. Ecology and Society 14(1): 25.

Parsons,M.,Thoms,M., Norris,R. (2002*) Australian River Assessment System: AUSRIVAS Physical Assessment Protocol*. CRC for Freshwater Ecology. University of Canberra ACT.

Pizzey, G and Knight, F. (2010). The field guide to the Birds of Australia – The definitive work on bird identification 8th Edition. Harper Collins. Sydney. Australia.

Popper A.N. and Hastings M.C. (2009) The effects of human-generated sound on fish. Integrative Zoology **4**, 43-52

Pusey, B., Kennard, M., Arthington, A. (2004). Freshwater Fishes of North-Eastern Australia. CISRO Publishing. Australia

Queensland Government (2016). Biodiversity Planning Assessment for South-east Queensland, version 4.1. Department of Environment and Heritage Protection, Brisbane.

Queensland Government (2019). State Development and Public Works Organisation Act 1971. Available from: https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-1971-055. [12 September 2019].

Richardson, R. (2006). *Draft Queensland Brigalow Belt Reptile Recovery Plan 2008 - 2012*. Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. Brisbane, Queensland: WWF-Australia

Rowden, P., Steinhardt, D. and Sheehan, M. (2008). Road crashes involving animals in Australia, Accident Analysis and Prevention, vol. 40, no. 6, pp. 1865 – 1871.

Sharpe, D. and Goldingay, R.L. (2010), 'Population ecology of the nectar-feeding squirrel glider (*Petaurus norfolcensis*) in remnant forest in subtropical Australia', Wildlife Research, vol. 37, no. 2, pp. 77-88.

Shelton, M.B., Goldingay, R.L. and Phillips, S.S. (2018). Population ecology of a cryptic arboreal snake (*Hoplocephalus bitorquatus*). Australian Journal of Zoology, 65(6), pp.383-390.

Stephenson, G. and Schmida. G. (2008). *A second record of the elapid snake Furina dunmalli from New South Wales*. *Herpetofauna*. Vol. 38, pp. 22-23.

Taylor, R. (2014). 'A Survey of the Pale Imperial Hairstreak Butterfly *Jalmenus eubulus* in New South Wales', Australian Zoologist vol. 37 pp.248 – 255.

Thackway R, Cresswell ID (1995) An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program. (Version 4.0. Australian Nature Conservation Agency: Canberra.)

Thorpe, J. and Lynch, R. (2011). The Determination of Weeds of National Significance, National Weeds Strategy Executive Committee, Launceston.

Threatened Species Scientific Committee (2008). Commonwealth Conservation Advice on Homopholis belsonii. Available from http://www.environment.gov.au/biodiversity/threatened/species/pubs/2406-conservation-advice.pdf [Accessed 18 September 2019].

Threatened Species Scientific Committee (2009). Commonwealth Listing Advice on Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland. Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/88-listing-advice.pdf. In effect under the EPBC Act from 07-Jan-2009.

Transport for NSW (2017) Sustainable Design Guidelines. Available at: https://www.transport.nsw.gov.au/sites/default/files/media/documents/2017/sustainable-design-guidelines-v4.pdf [Accessed 23/11/2019].

Wildlife Preservation Society of Queensland (2019). Squirrel Glider. Available from: https://wildlife.org.au/squirrel-glider/. [13 September 2019].

Williams, J (1999) Comments on public nomination of semi-evergreen vine thicket, material provided to Executive Officer, Endangered Species Scientific Subcommittee 9 February 1999, Environment Australia file

2001/04938 – as referenced in Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions Profile (Department of Agriculture, Water and the Environment (2020), *Species profile and threats (SPRAT) database.* Commonwealth Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/sprat).

Williams, J (2003) Personal communication. University of New England, Armidale – as referenced in Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions Profile (Department of Agriculture, Water and the Environment (2020), *Species profile and threats (SPRAT) database.* Commonwealth Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/sprat).

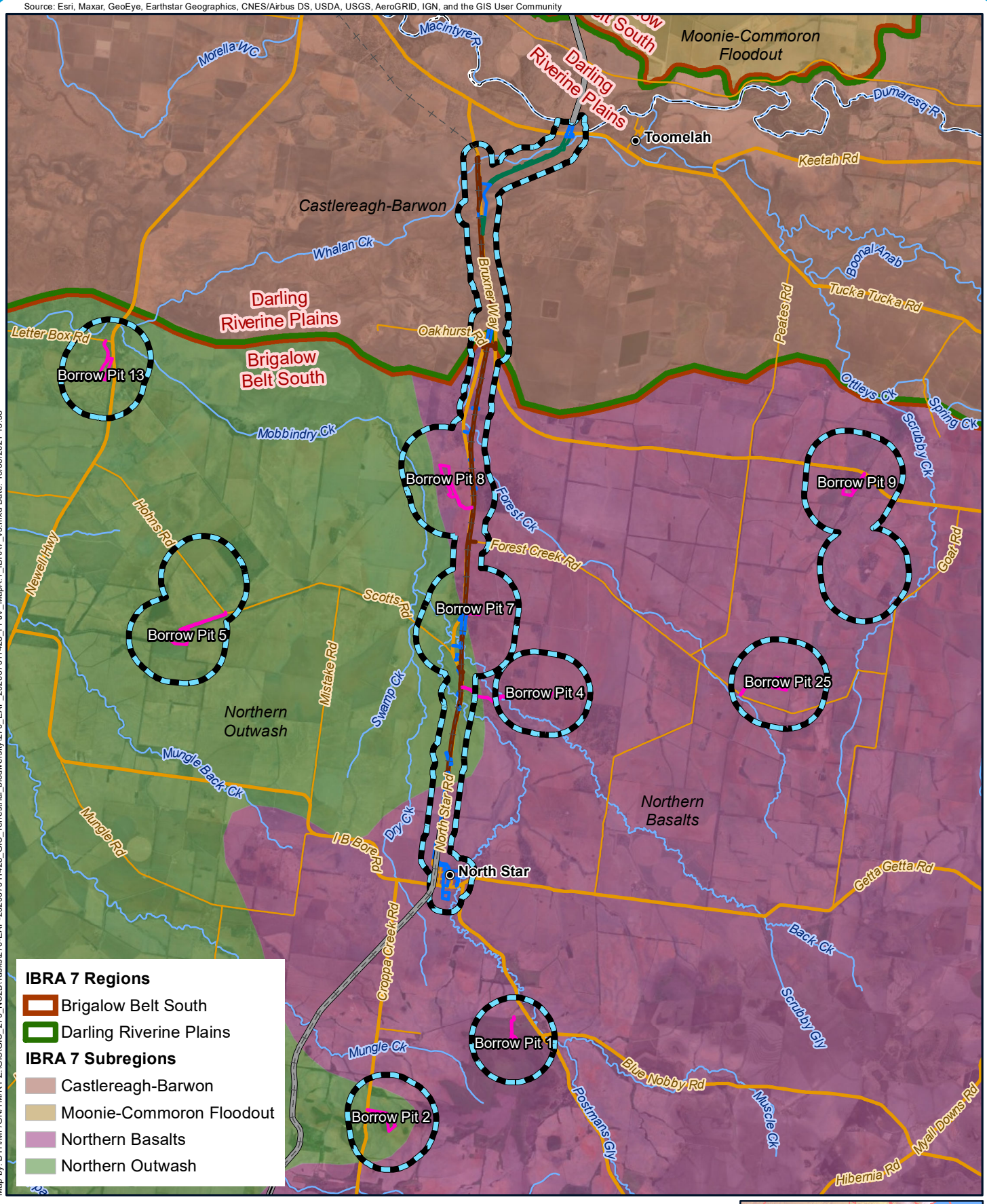
Wilson, A. and Lindenmayer, D.B. (1995). Wildlife Corridors and the Conservation of Biodiversity: A Review, National Corridors of Green Program, Green Australia Ltd., Canberra.

Wilson, S. and Swan, G. 2003. *A complete guide to reptiles of Australia*. New Holland. Australia

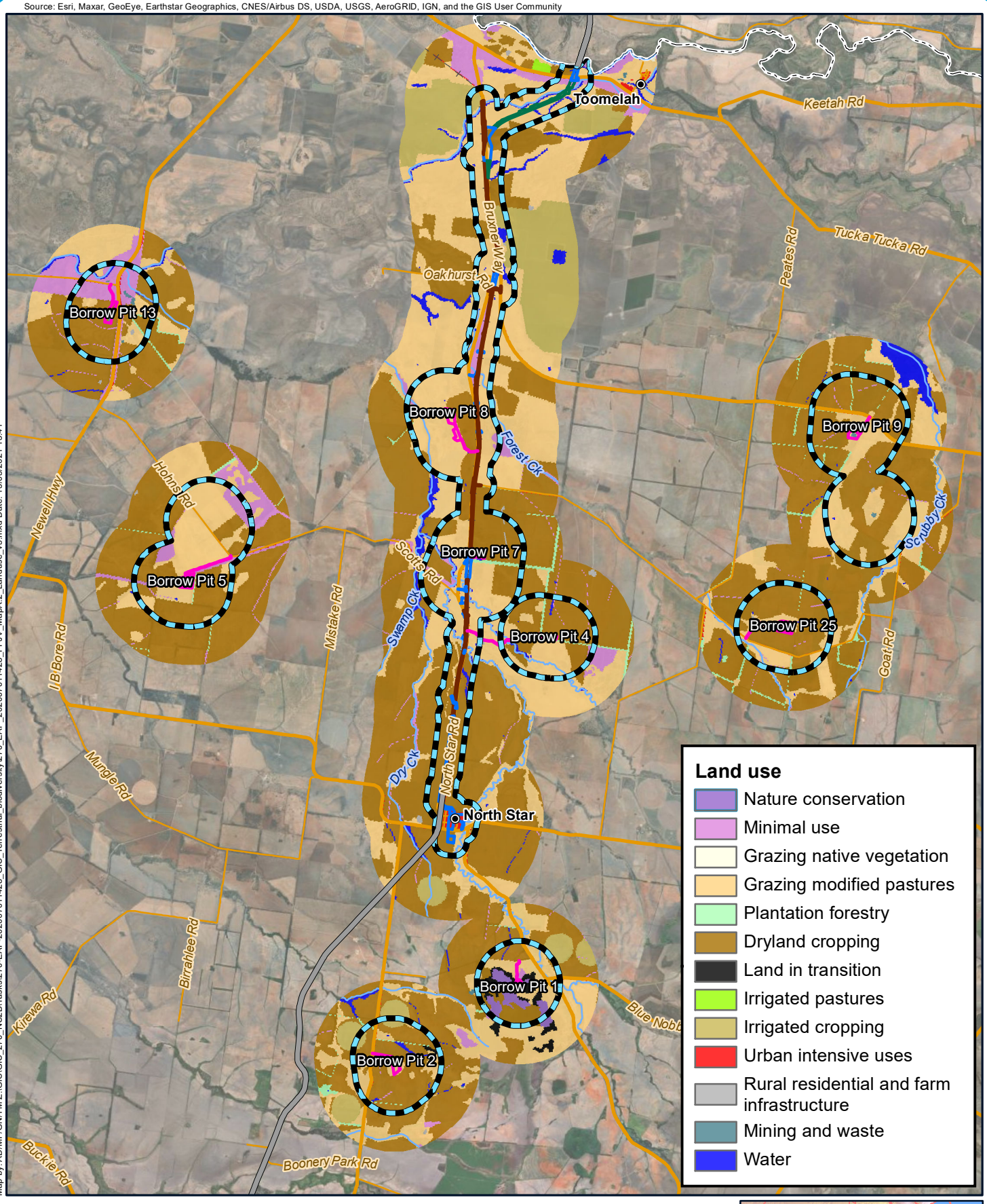
Woinarski, J.C.Z., McCosker, J.C., Gordon, G., Lawrie, B., James, C.D., Augusteyn, J., Slater, L. and Danvers, T. (2006). Monitoring change in the vertebrate fauna of central Queensland, Australia, over a period of broad-scale vegetation clearance, 1973–2002, Wildlife Research, vol. 33, no. 4, pp. 263 – 274.

Appendices

Appendix A
Flora and Supplementary Site Maps


Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Macintyre R
Darling Riverine Plains
Moonie-Commoron Floodout
Dumaresq R
Toomelah
Keetah Rd
Castlereagh-Barwon
Whalan Ck
Bruxner Way
Boonal-Anab
Tucka Tucka Rd
Peates Rd
Darling Riverine Plains
Brigalow Belt South
Letter Box Rd
Oakhurst Rd
Borrow Pit 13
Ottleys Ck
Spring Ck
Scrubby Ck
Mobbindry Ck
Borrow Pit 8
Borrow Pit 9
Forest Ck
Forest Creek Rd
Hohns Rd
Newell Hwy
Goat Rd
Scotts Rd
Borrow Pit 7
Borrow Pit 5
Mistake Rd
Swamp Ck
Borrow Pit 4
Borrow Pit 25
Northern Outwash
Mungle Back Ck
Northern Basalts
Mungle Rd
I B Bore Rd
Dry Ck
North Star Rd
North Star
Getta Getta Rd
Back Ck
Croppa Creek Rd
Scrubby Gly
Borrow Pit 1
Mungle Ck
Blue Nobby Rd
Borrow Pit 2
Postmans Gly
Muscle Ck
Myall Downs Rd
Hibernia Rd
IBRA 7 Regions
Brigalow Belt South
Darling Riverine Plains
IBRA 7 Subregions
Castlereagh-Barwon
Moonie-Commoron Floodout
Northern Basalts
Northern Outwash
Map by: DTH/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FF.JV_MapA.1_IBRA7_v5.mxd Date: 13/05/2021 13:38
Legend
Localities
Existing rail (operational)
Existing rail (non-operational)
Adjoining alignments
Major roads
Minor roads
NSW/QLD border
Watercourses
Study area
Subject land (borrow pit)
Subject land (brownfield)
Subject land (early works)
Subject land (greenfield)
Toowoomba
Brisbane
Ipswich
Grandchester
Warwick
Goondiwindi
Narrabri
A4 scale: 1:200,000
0 1 2 3 4 5km
Future Freight
Integrating Community, Environment and Engineering
Date: 13/05/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56
North Star to NSW/QLD border
Map A.1:
IBRA v7 bioregions and subregions

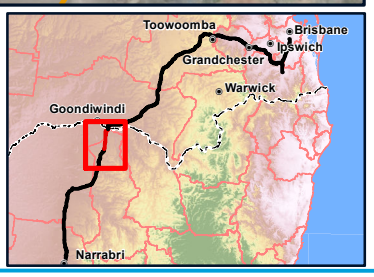
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: AD/MF/GN/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.2_Landuse_v5.mxd Date: 13/05/2021 13:41

Legend

- Localities
- Existing rail (operational)
- Existing rail (non-operational)
- Adjoining alignments
- NSW/QLD border
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:200,000

0 1 2 3 4 5km

Future Freight
Integrating Community, Environment and Engineering

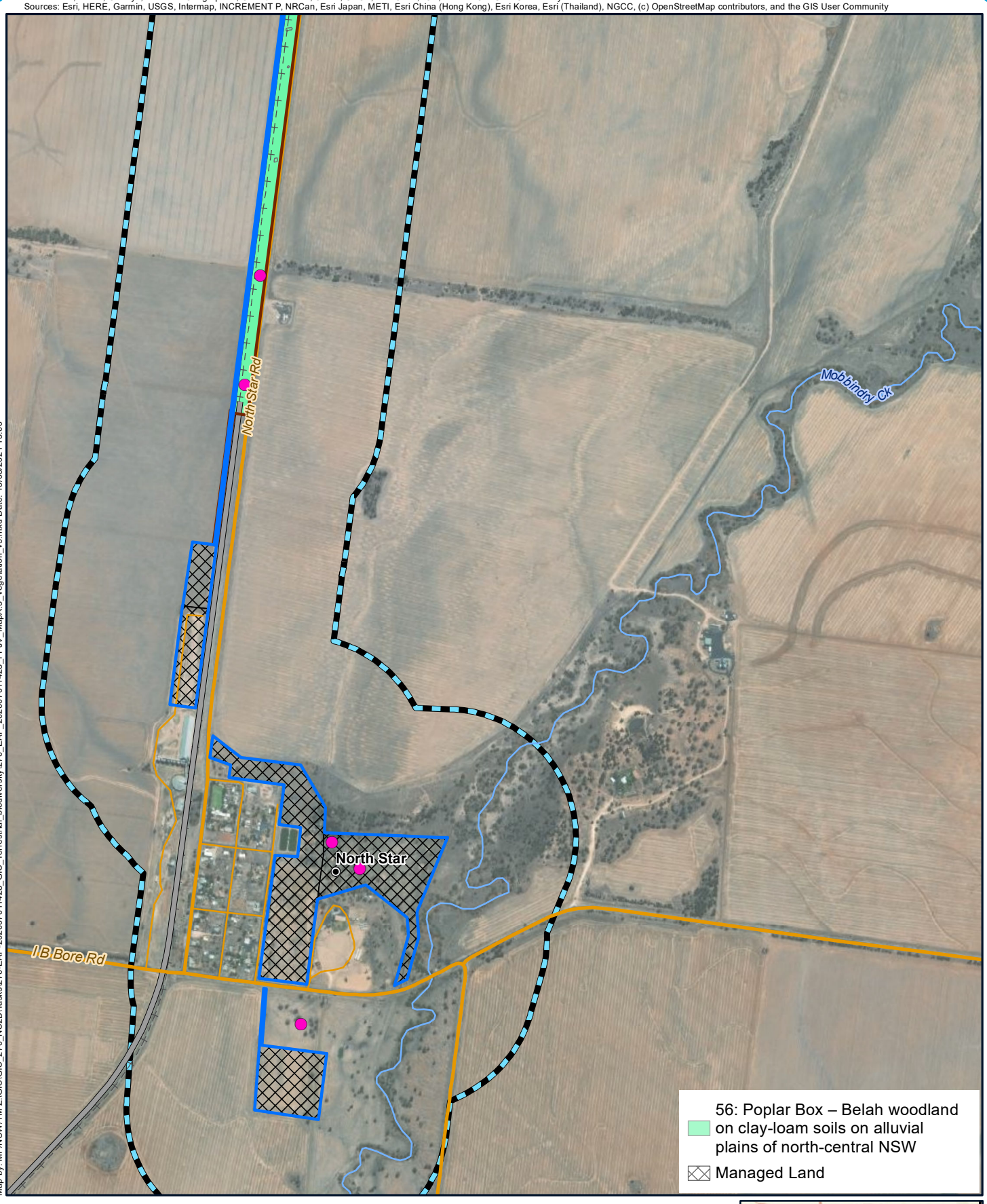
Date: 13/05/2021 Version: 4

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.2: Existing Land use

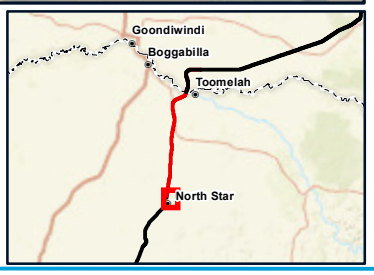
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- Localities
- BAM plot
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

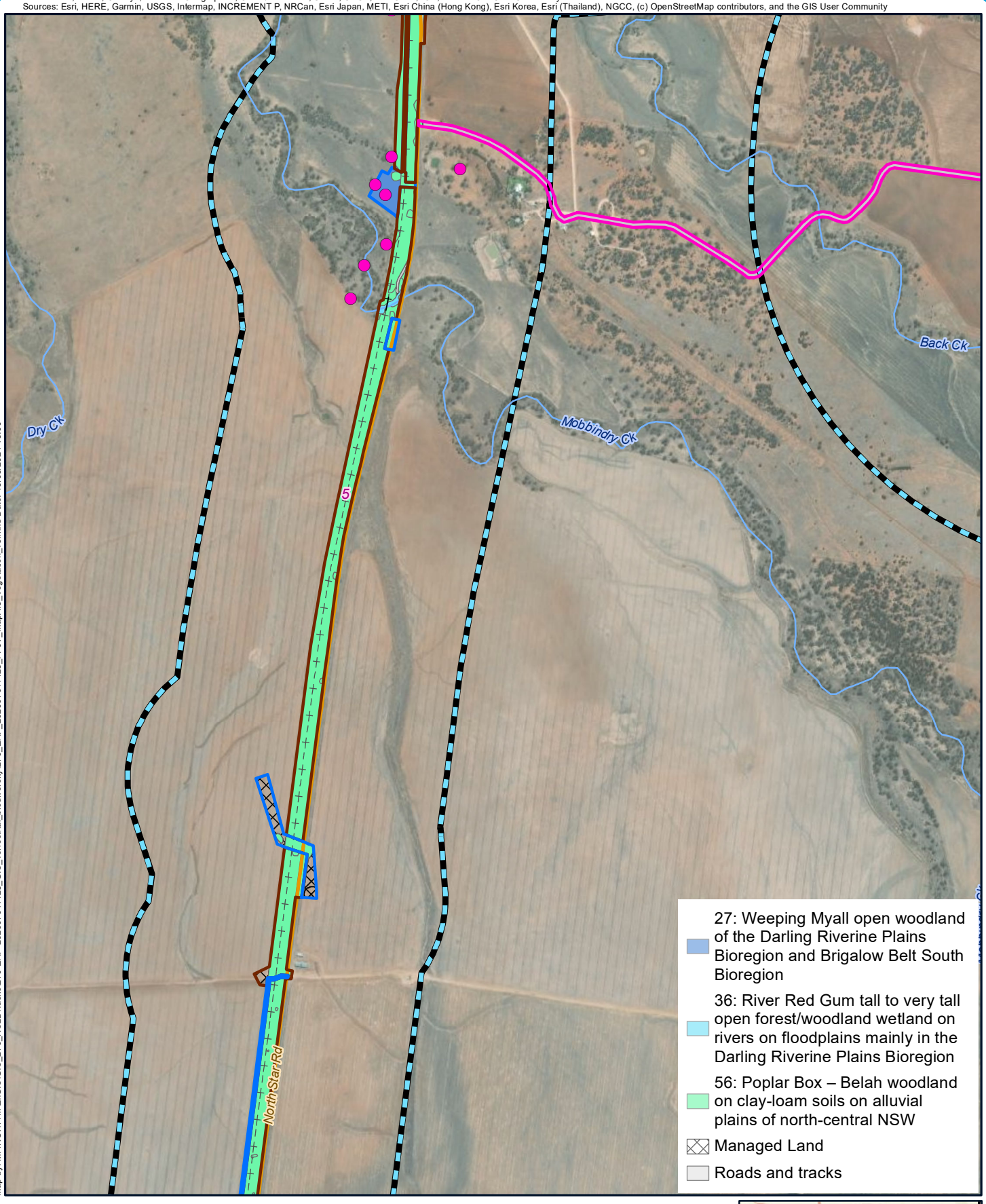
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3a:
Field verified PCTs and BAM plot location

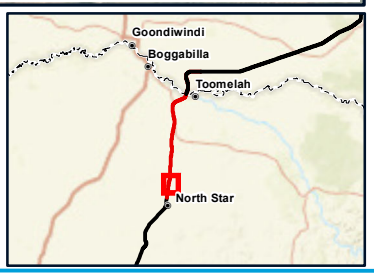
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

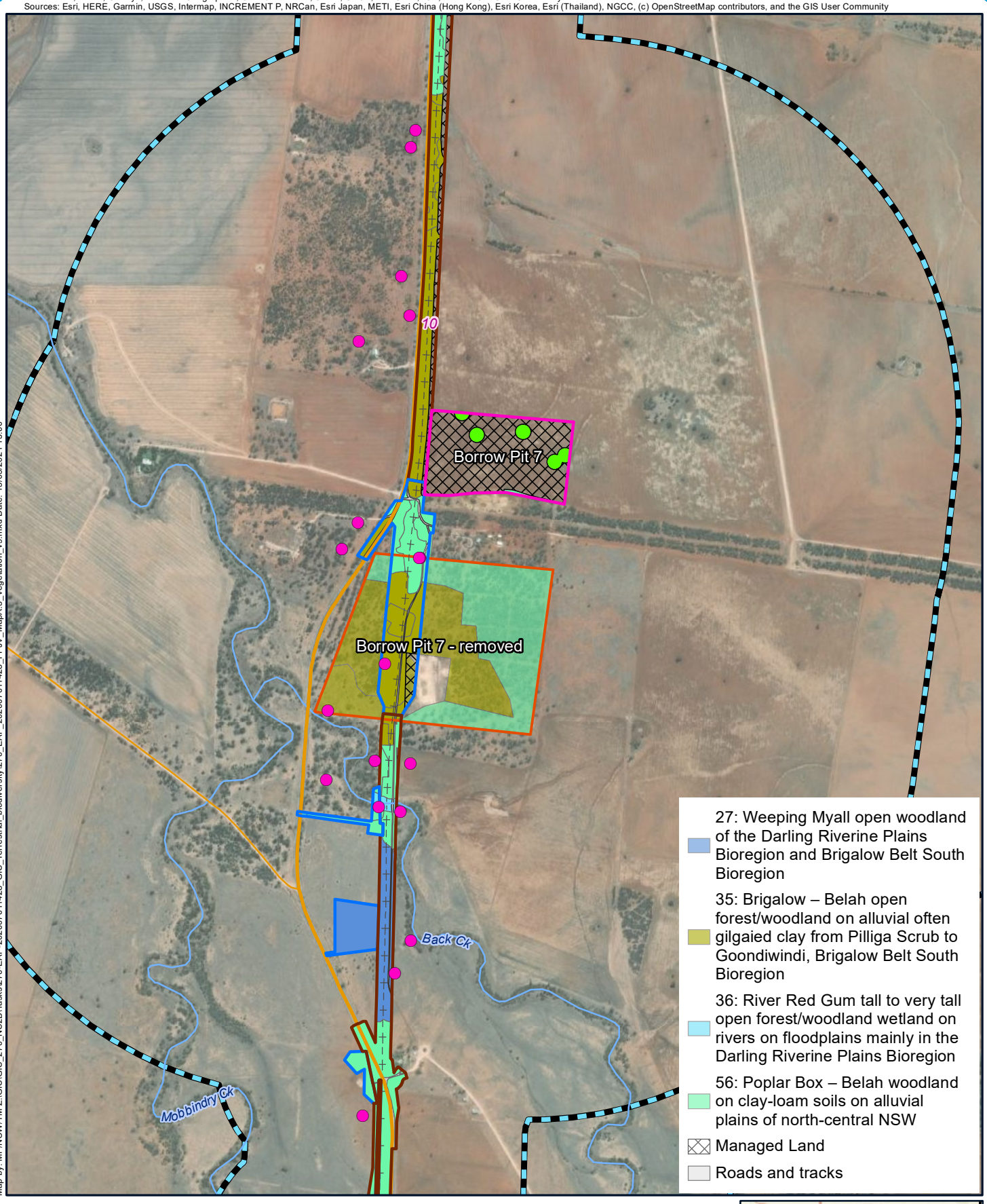
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 9
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3b:
Field verified PCTs and BAM plot location

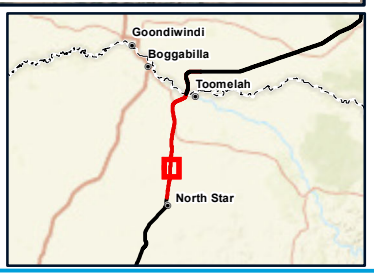
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Scattered paddock trees
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

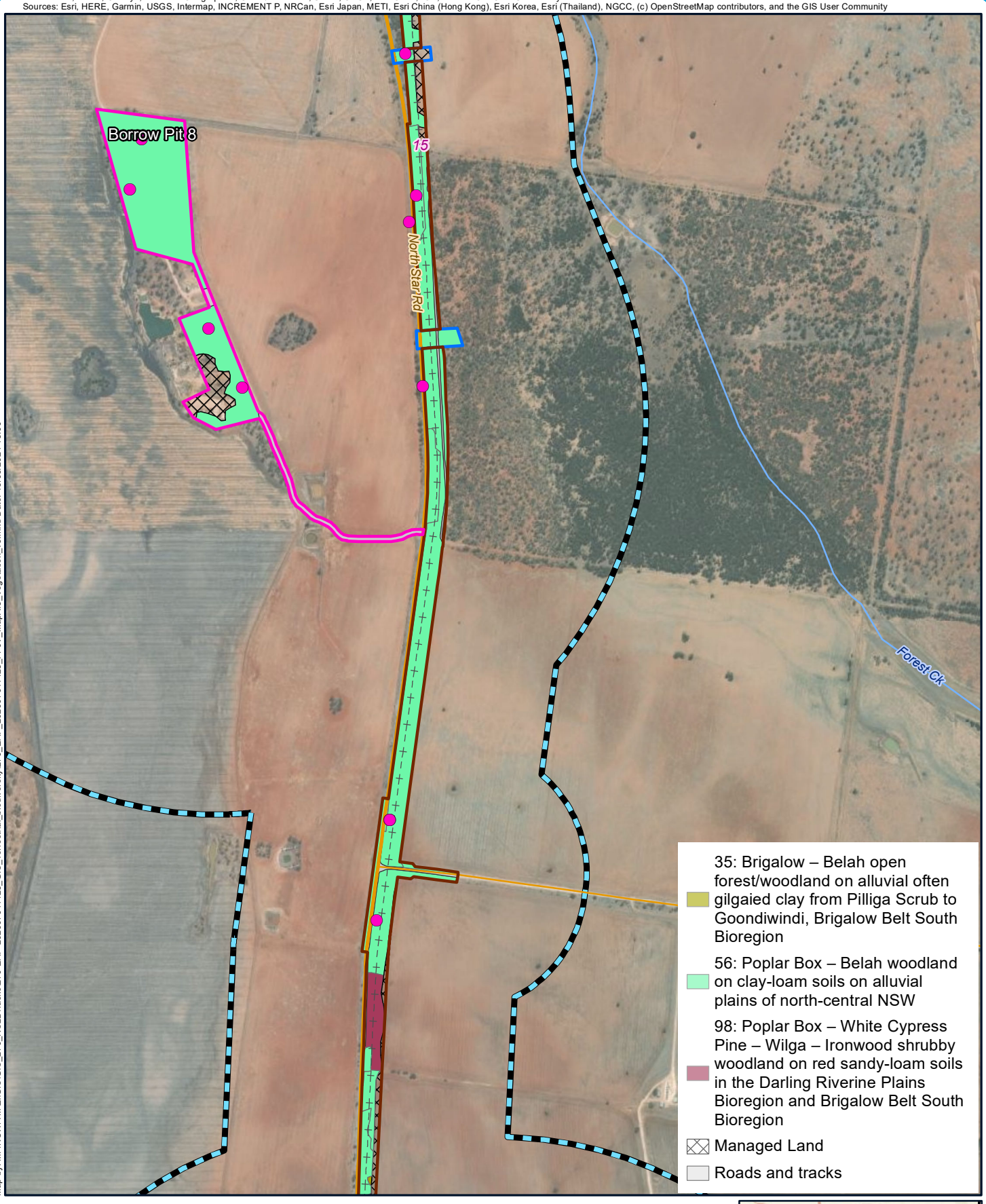
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3c:
Field verified PCTs and BAM plot location

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FF-JV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

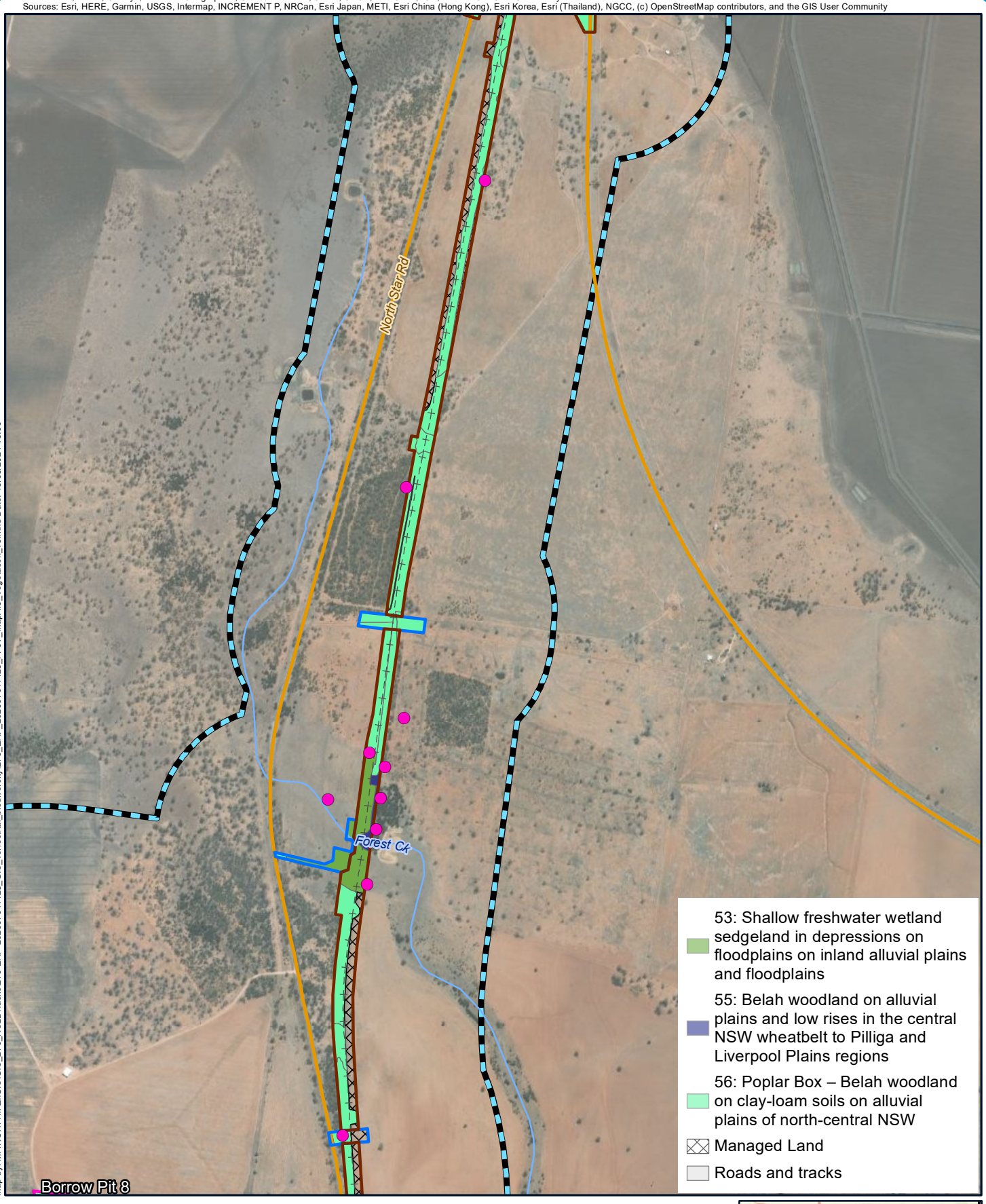
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3d:
Field verified PCTs and BAM plot location

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

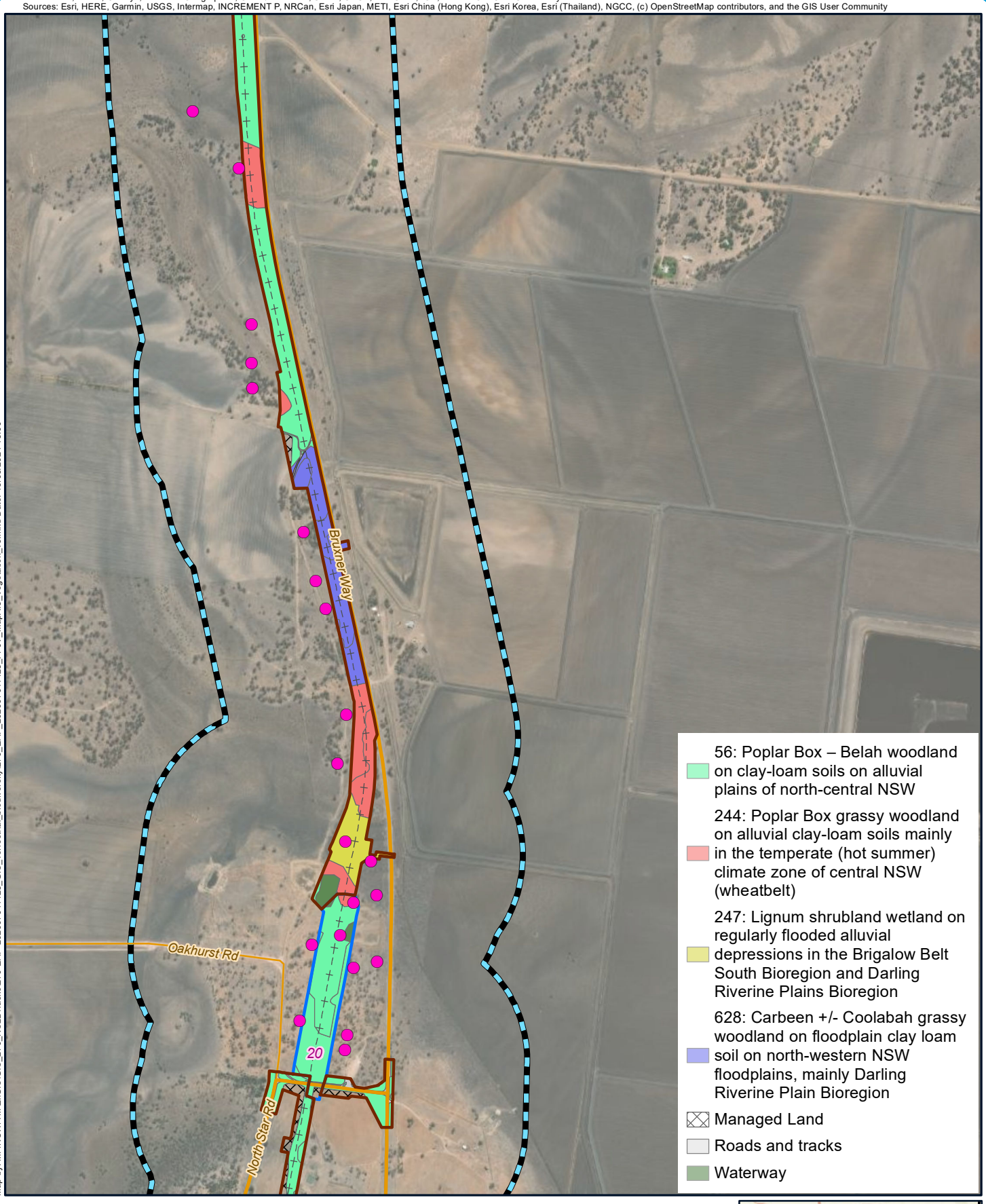
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3e:
Field verified PCTs and BAM plot location

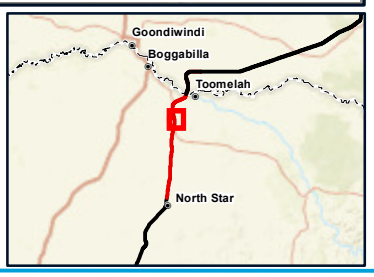
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 9

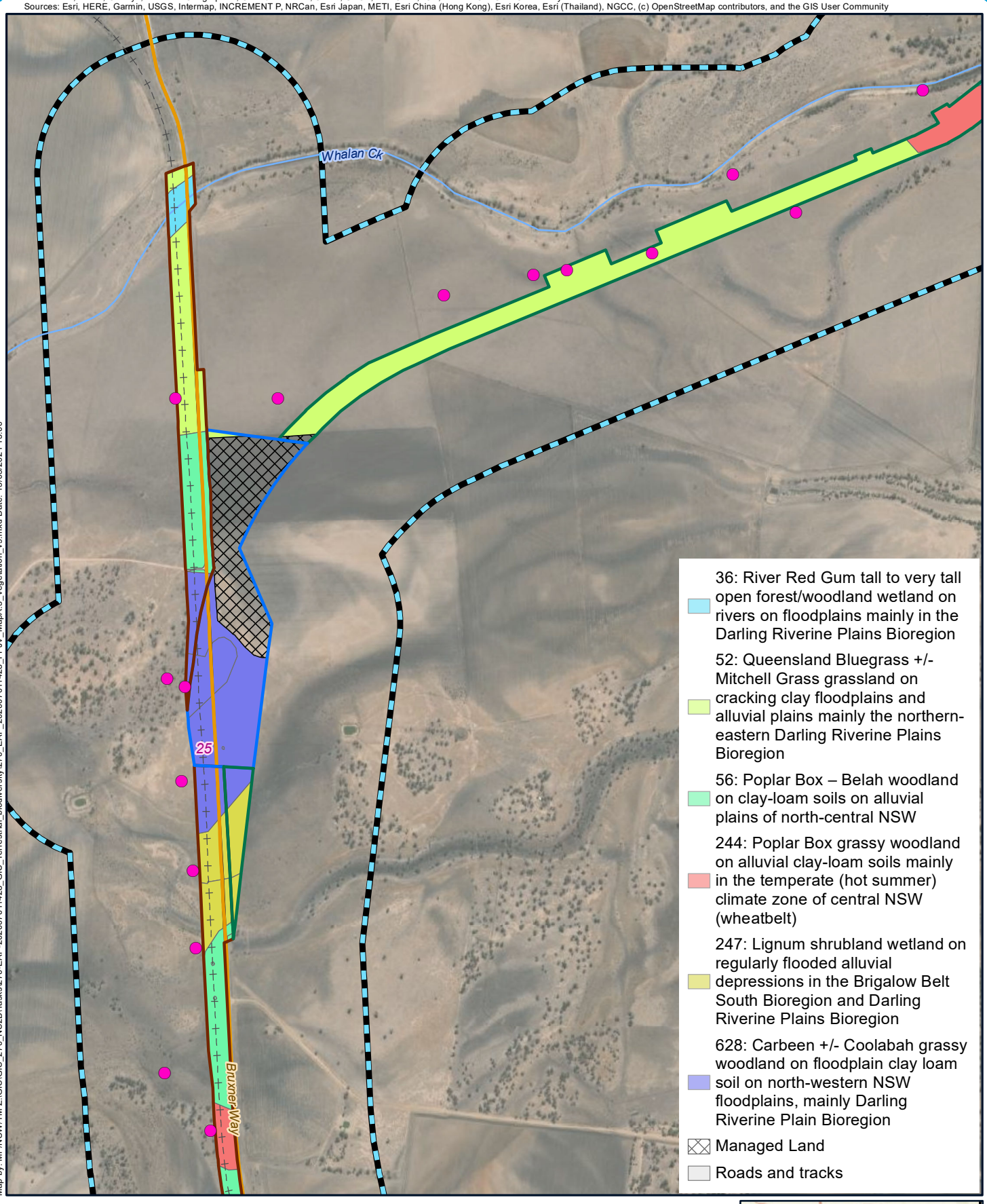
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3f:

Field verified PCTs and BAM plot location

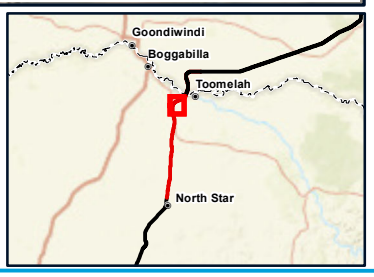
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

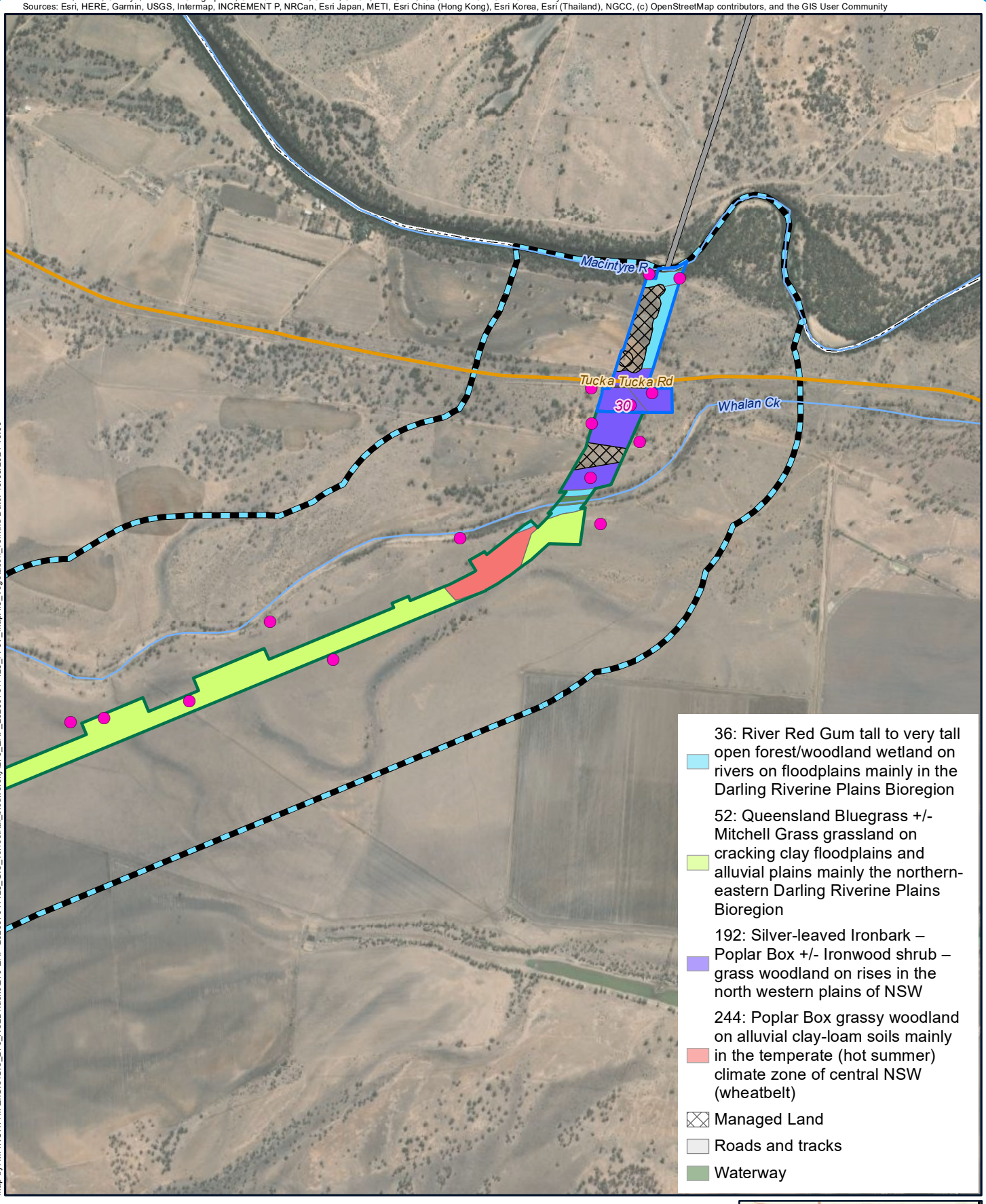
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3g:
Field verified PCTs and BAM plot location

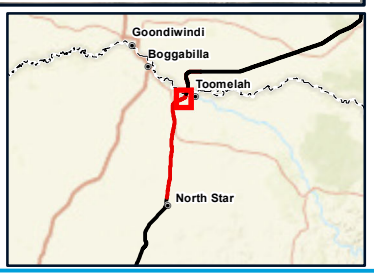
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

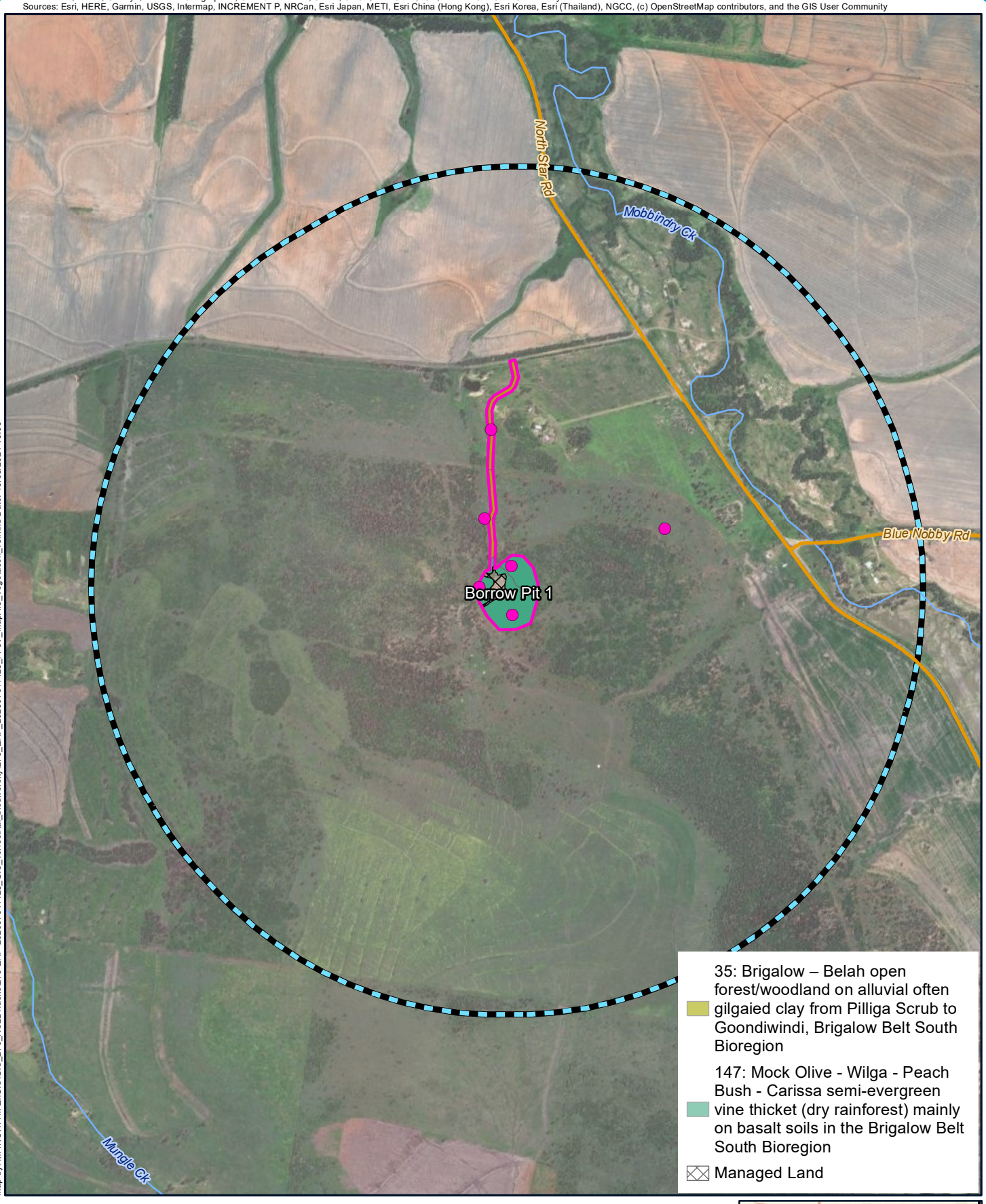
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3h:
Field verified PCTs and BAM plot location

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FF_JV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 9

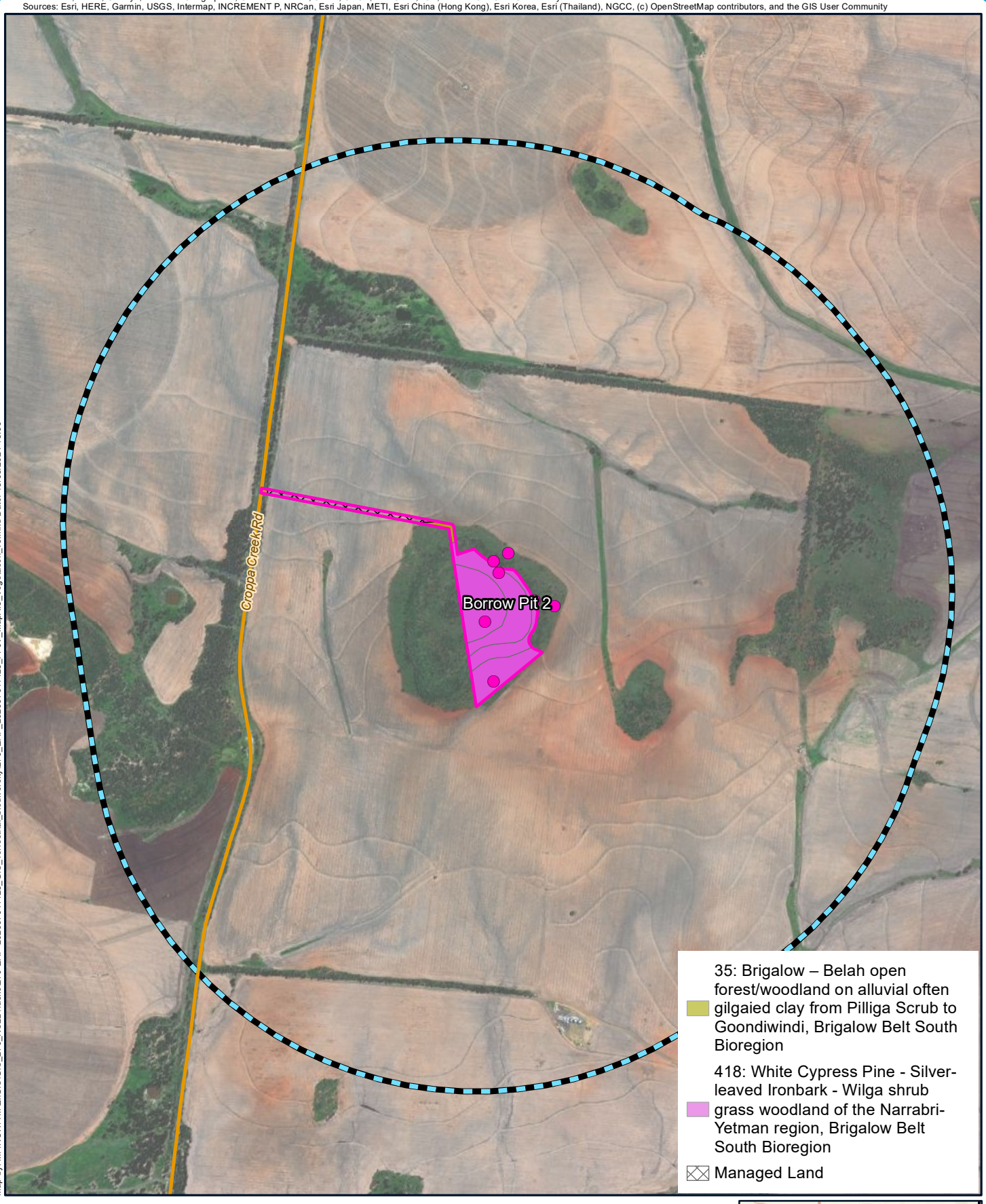
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3i:

Field verified PCTs and BAM plot location

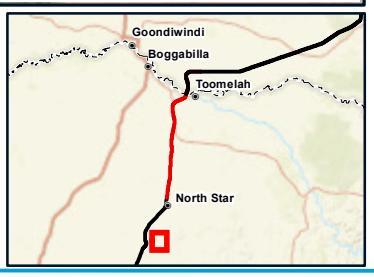
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

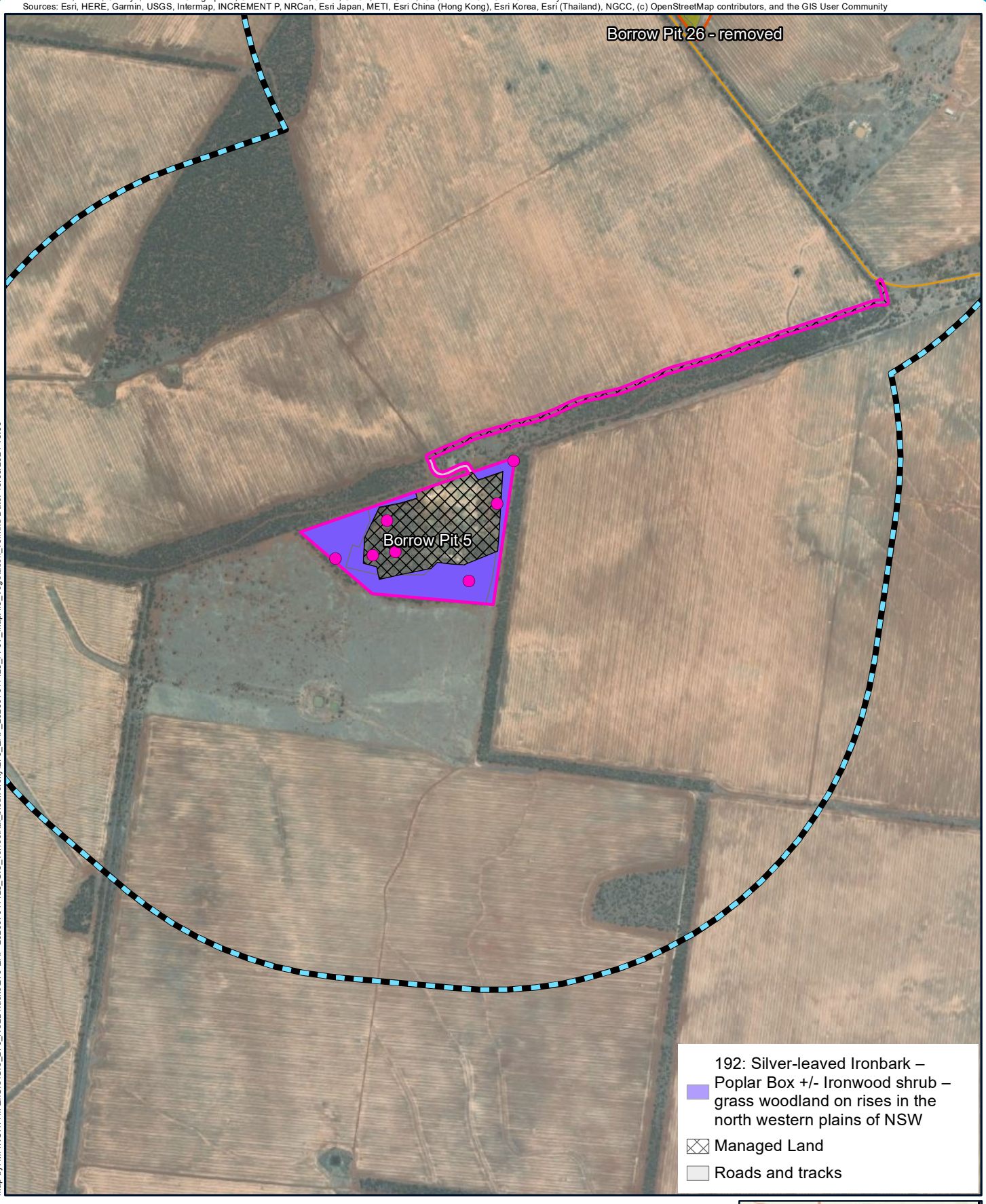
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 9
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3j:
Field verified PCTs and BAM plot location

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Minor roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

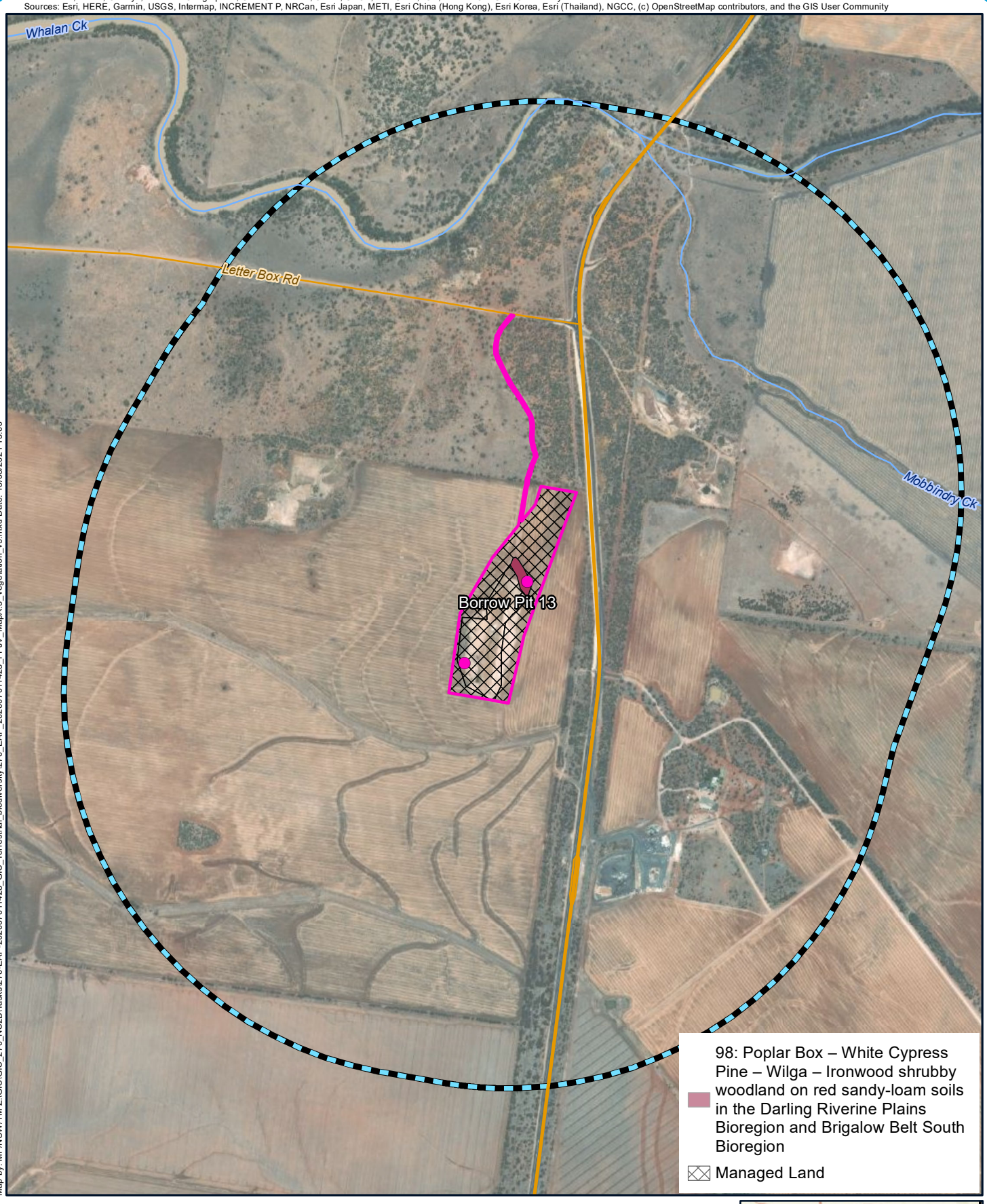
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3k:
Field verified PCTs and BAM plot location

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

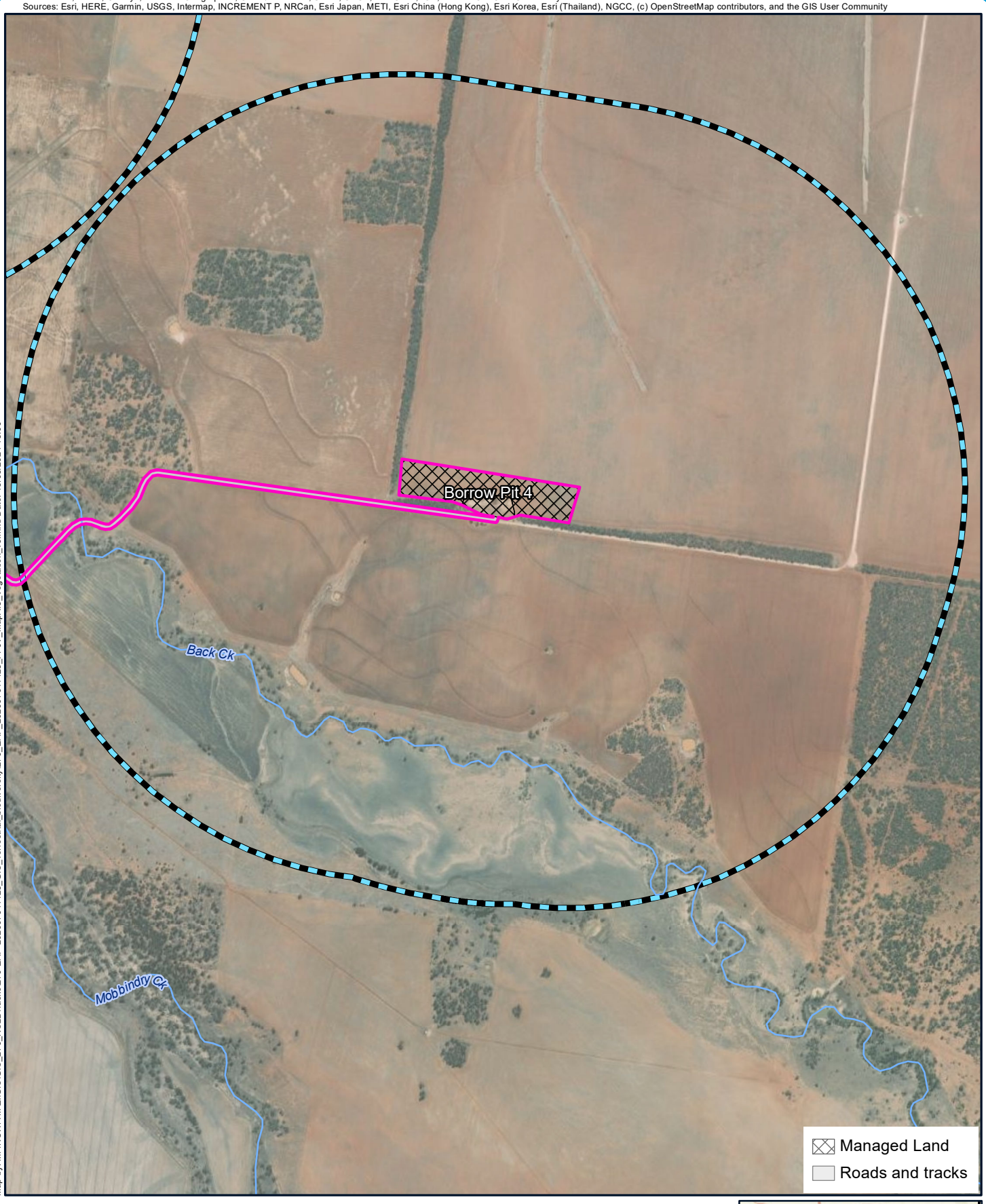
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3l:
Field verified PCTs and BAM plot location

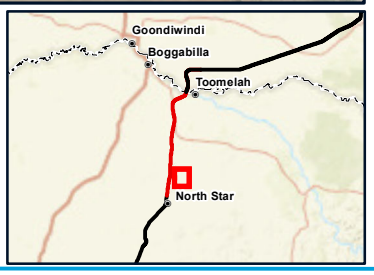
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FF_JV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

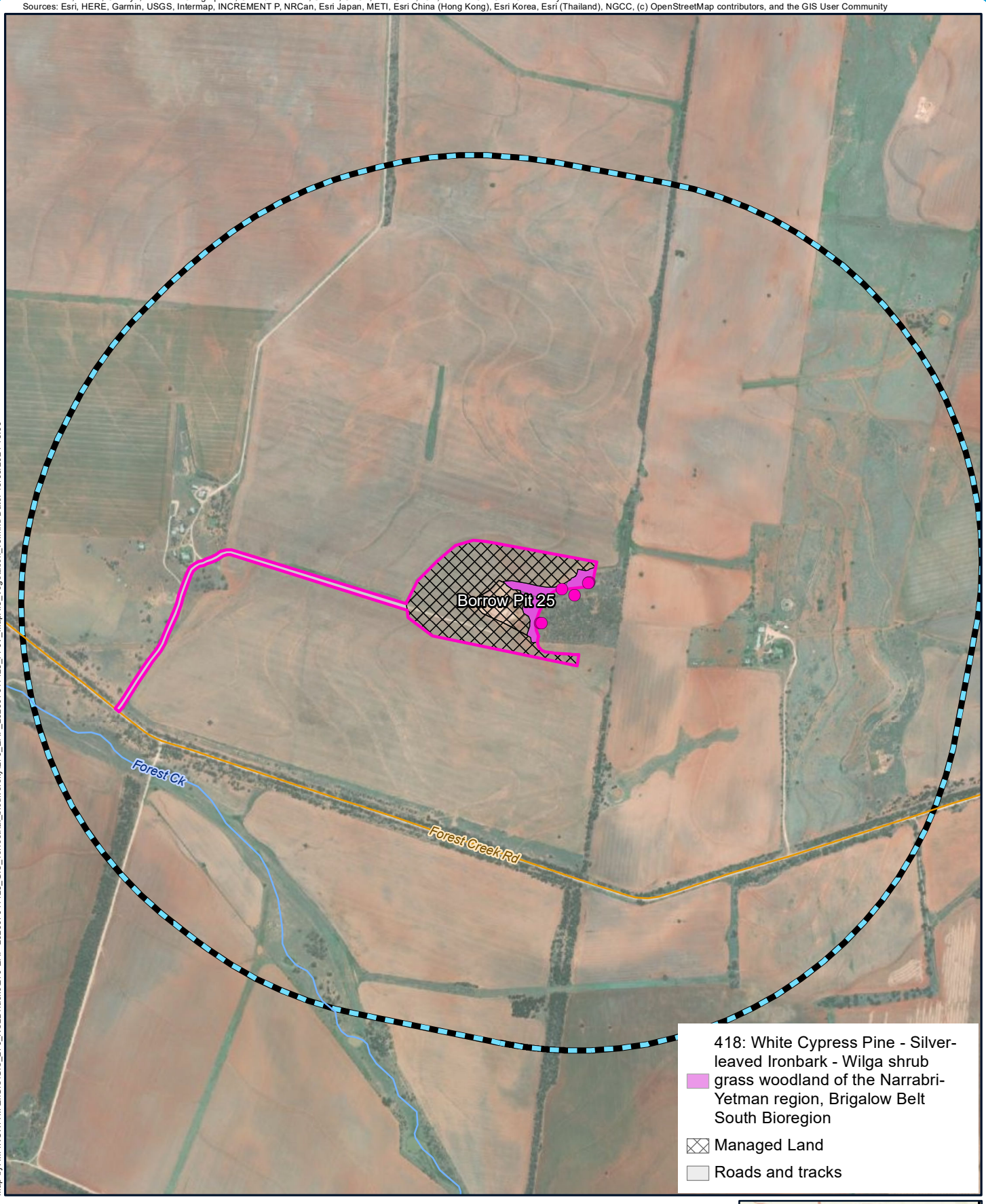
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 9
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3m:
Field verified PCTs and BAM plot location

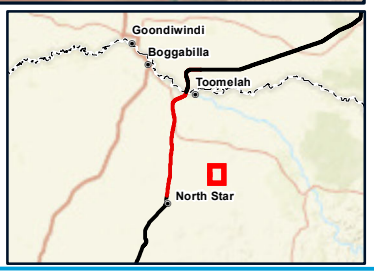
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

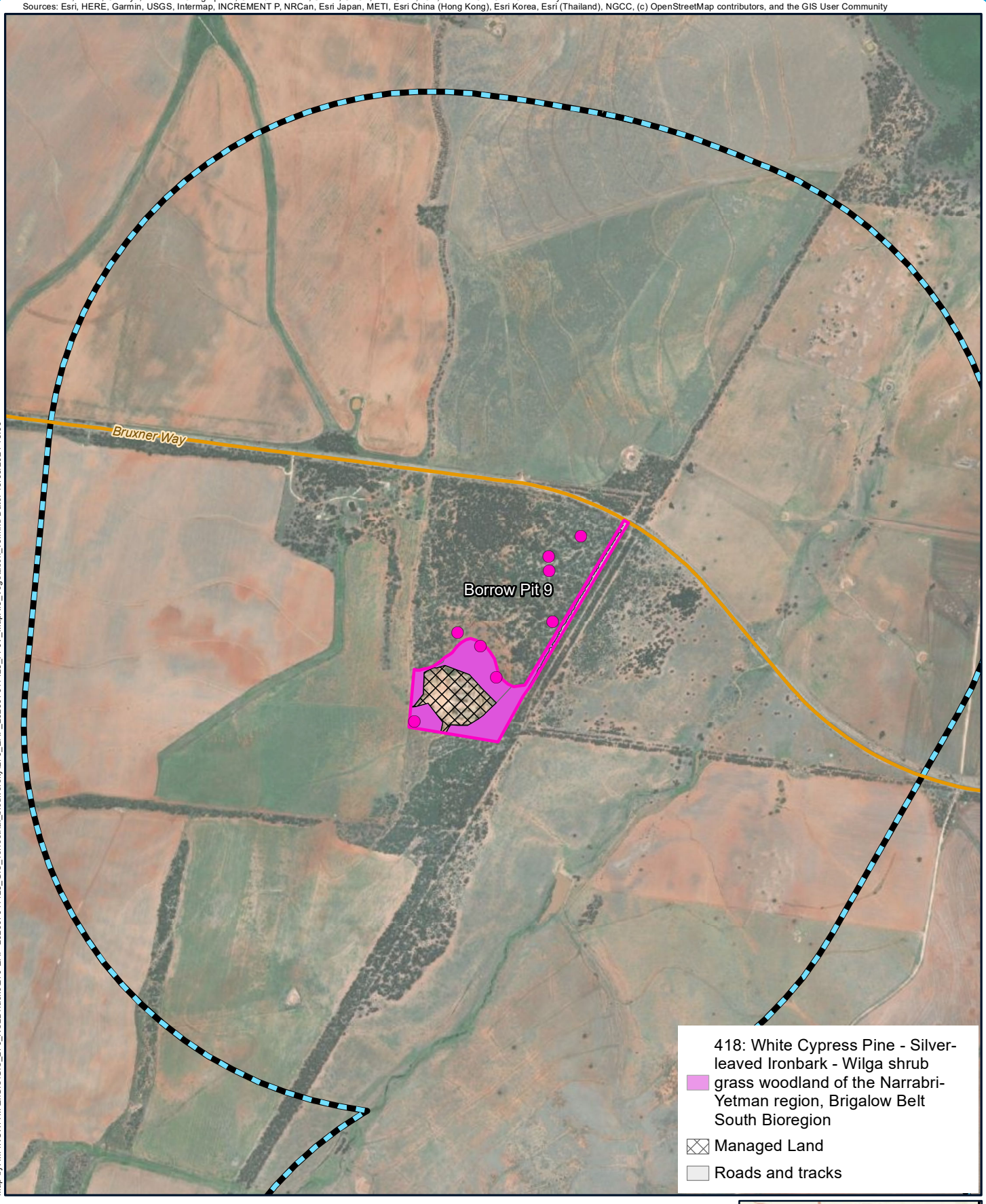
Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 9
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3n:
Field verified PCTs and BAM plot location

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/NCW/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.3_Vegetation_v9.mxd Date: 13/05/2021 13:00

Legend

- BAM plot
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

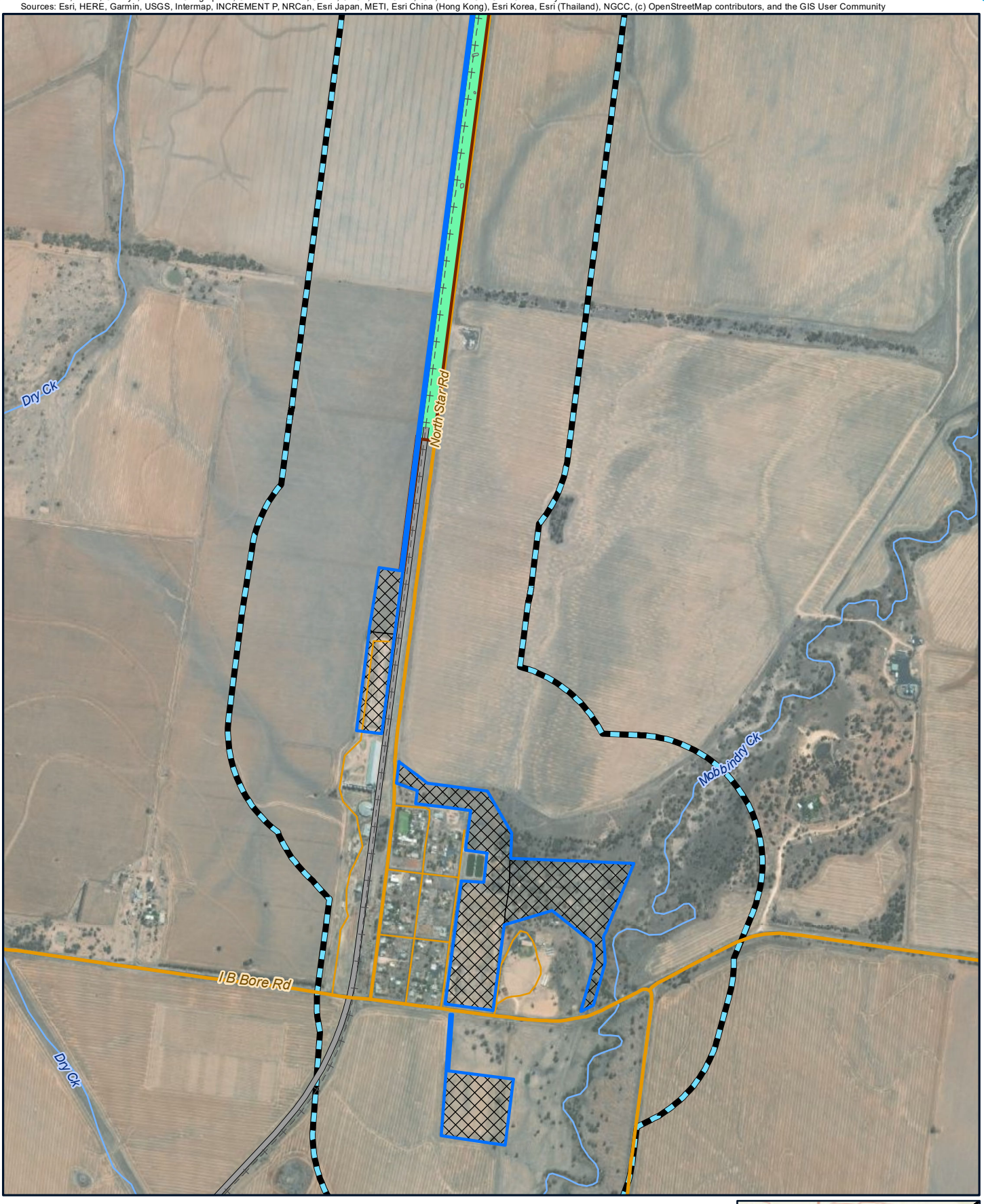
Date: 31/05/2021 Version: 9

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.3o:
Field verified PCTs and BAM plot location

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- 56
- Managed Land



A4 scale: 1:20,000

0 400 800 m

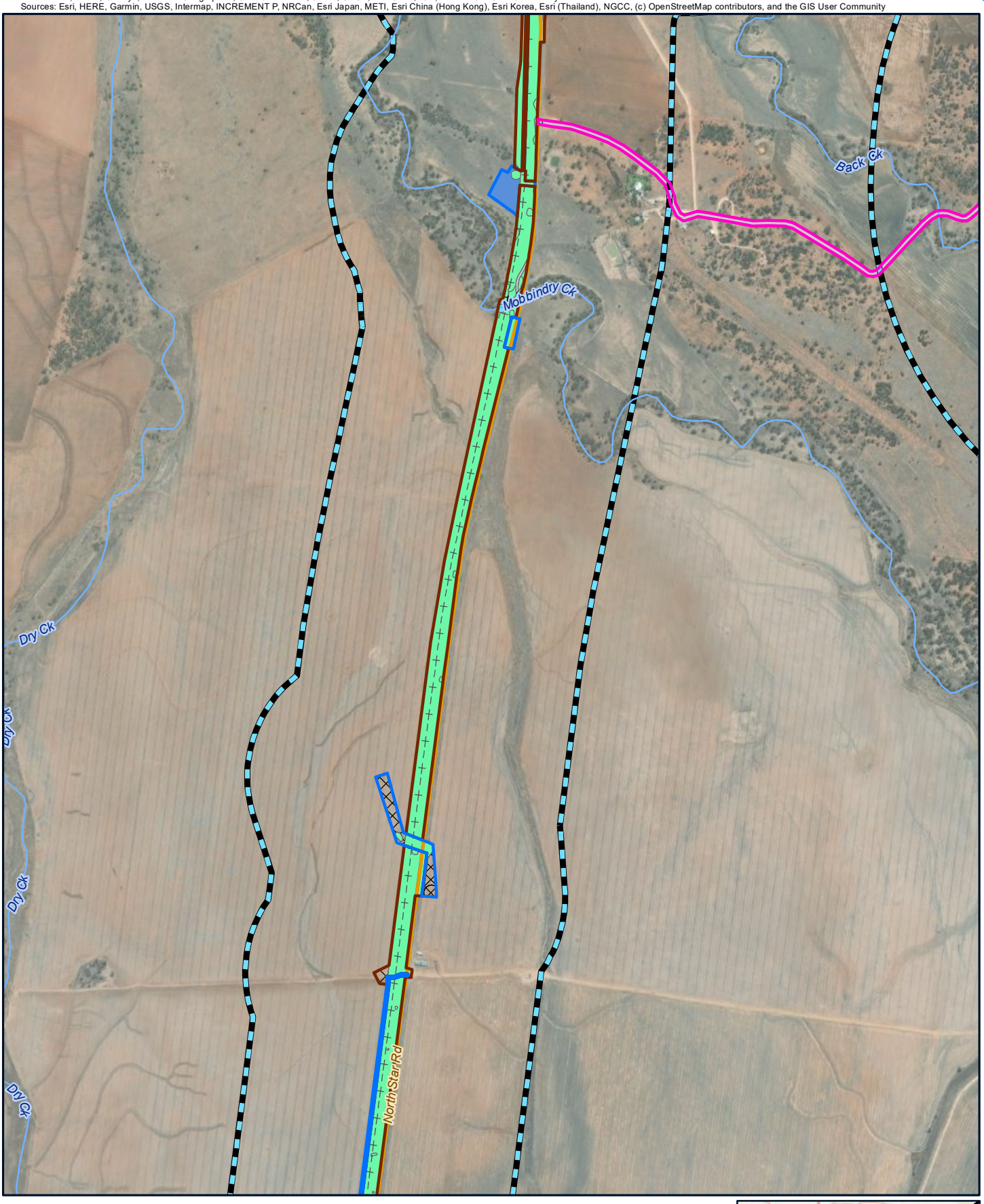
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4a:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- 27
- 36
- 56
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

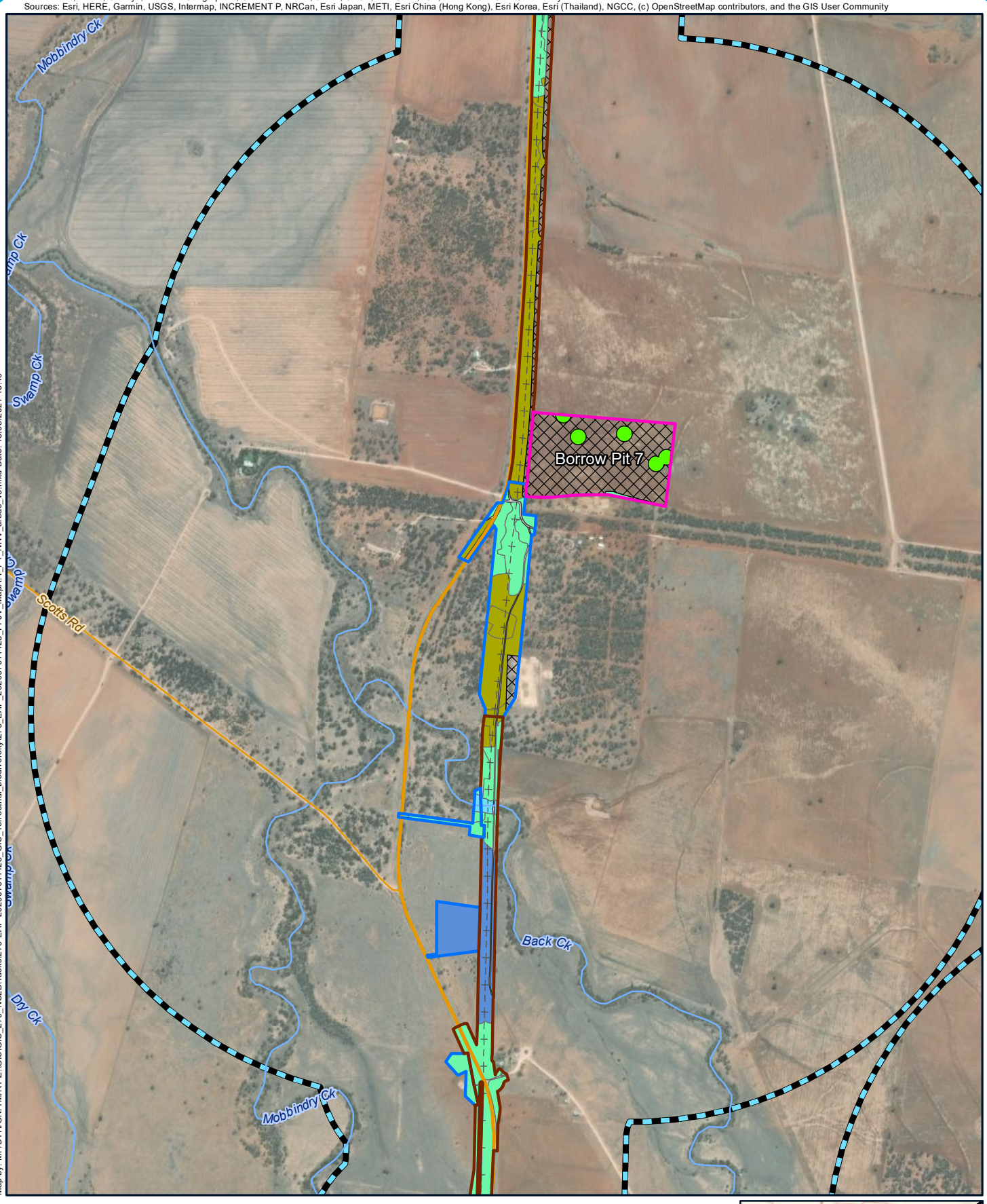
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4b:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- 27
- 35
- 36
- 56
- Managed Land
- Roads and tracks
- Scattered paddock trees



A4 scale: 1:20,000

0 400 800 m

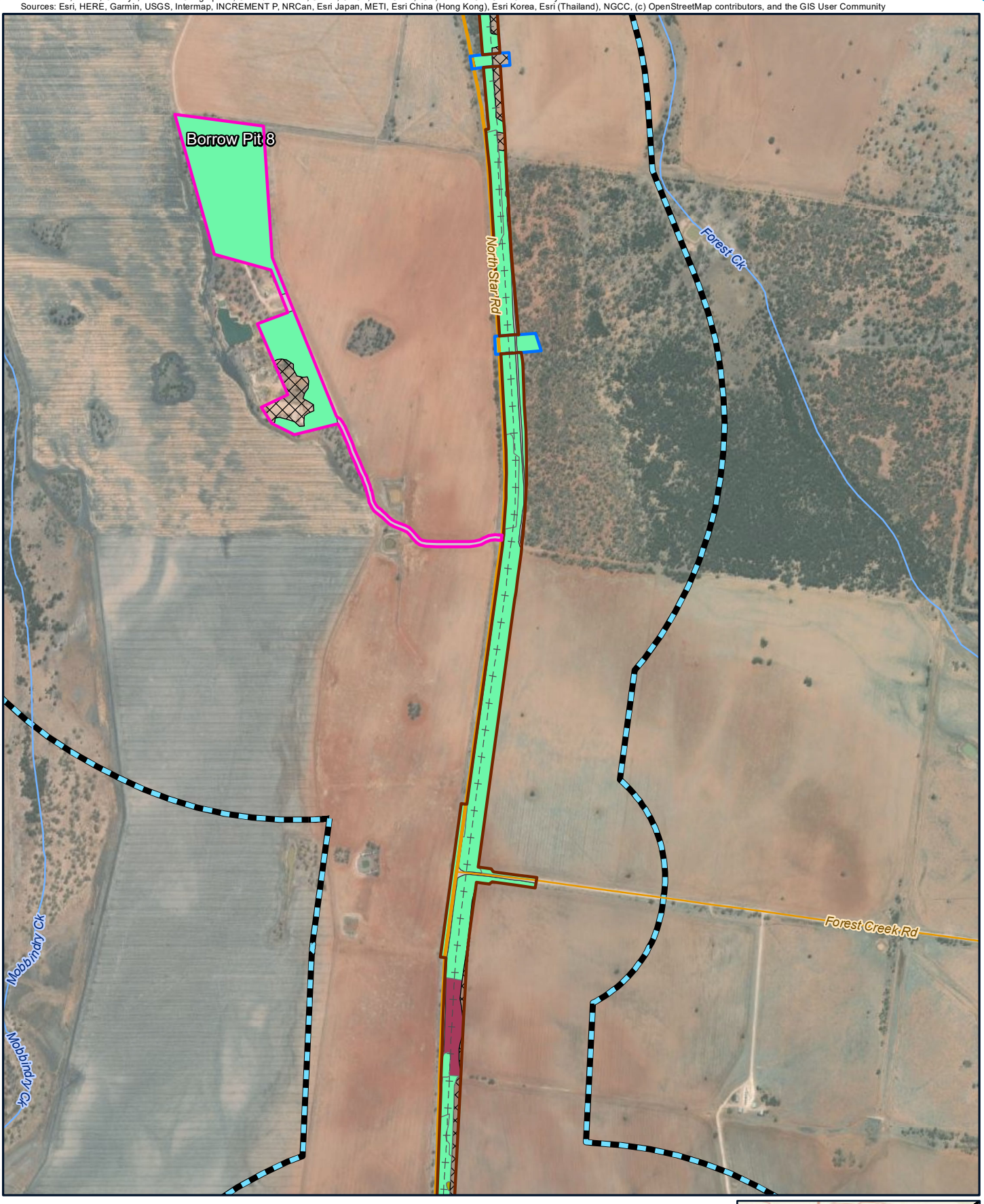
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4c:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- 35
- 56
- 98
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

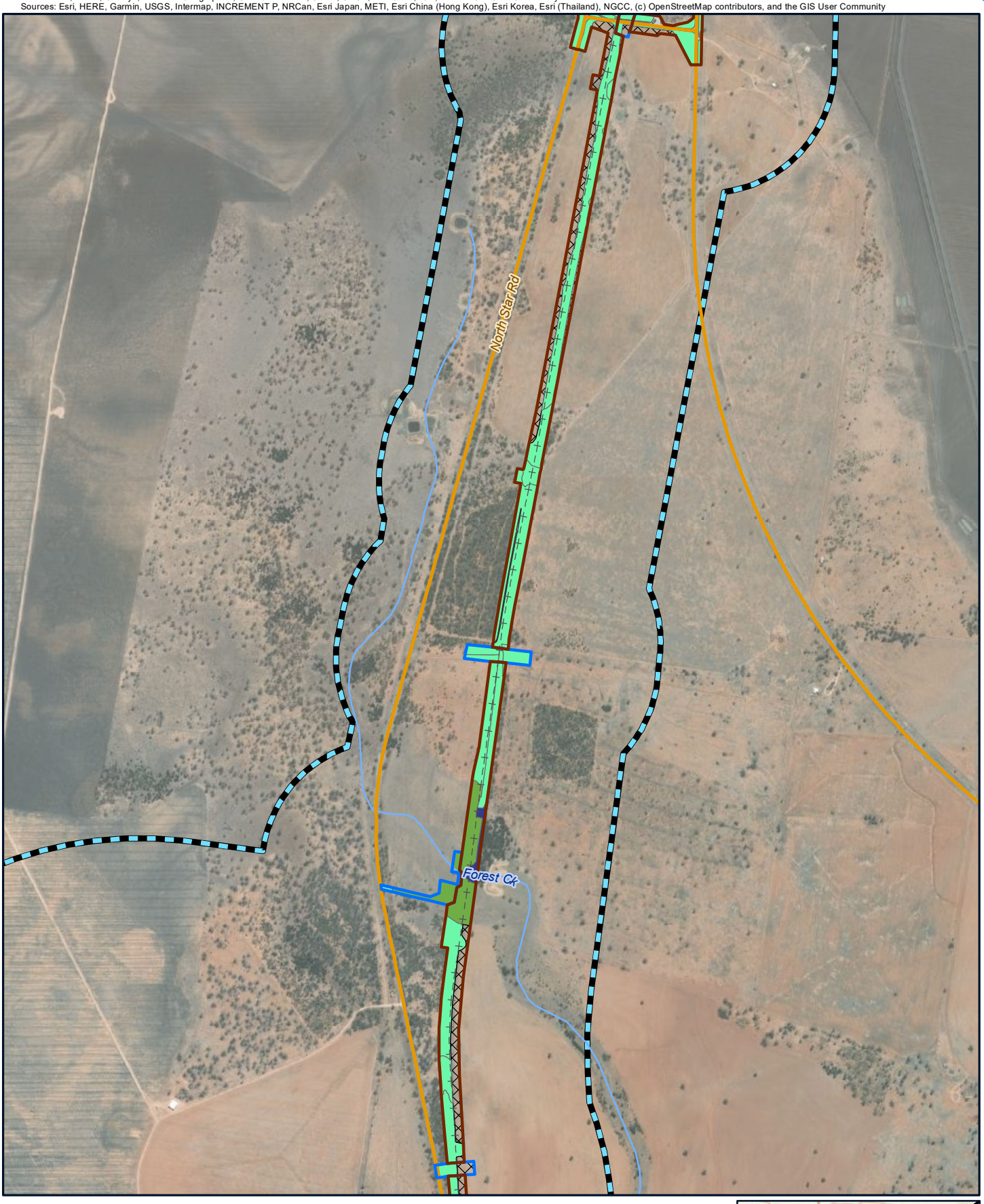
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4d:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- 53
- 55
- 56
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

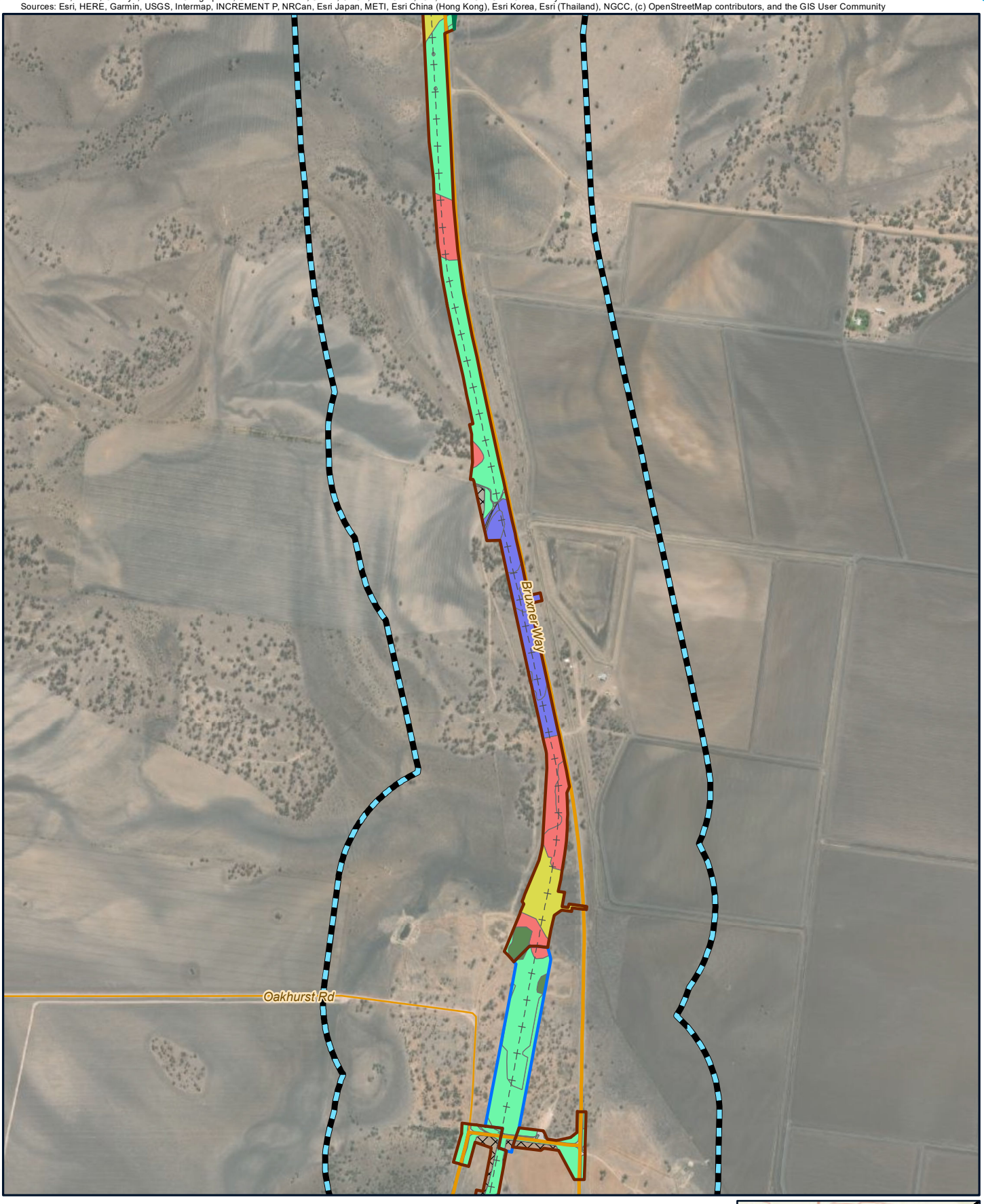
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4e:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2Bi\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- 56
- 244
- 247
- 628
- Managed Land
- Roads and tracks
- Waterway



A4 scale: 1:20,000

0 400 800 m

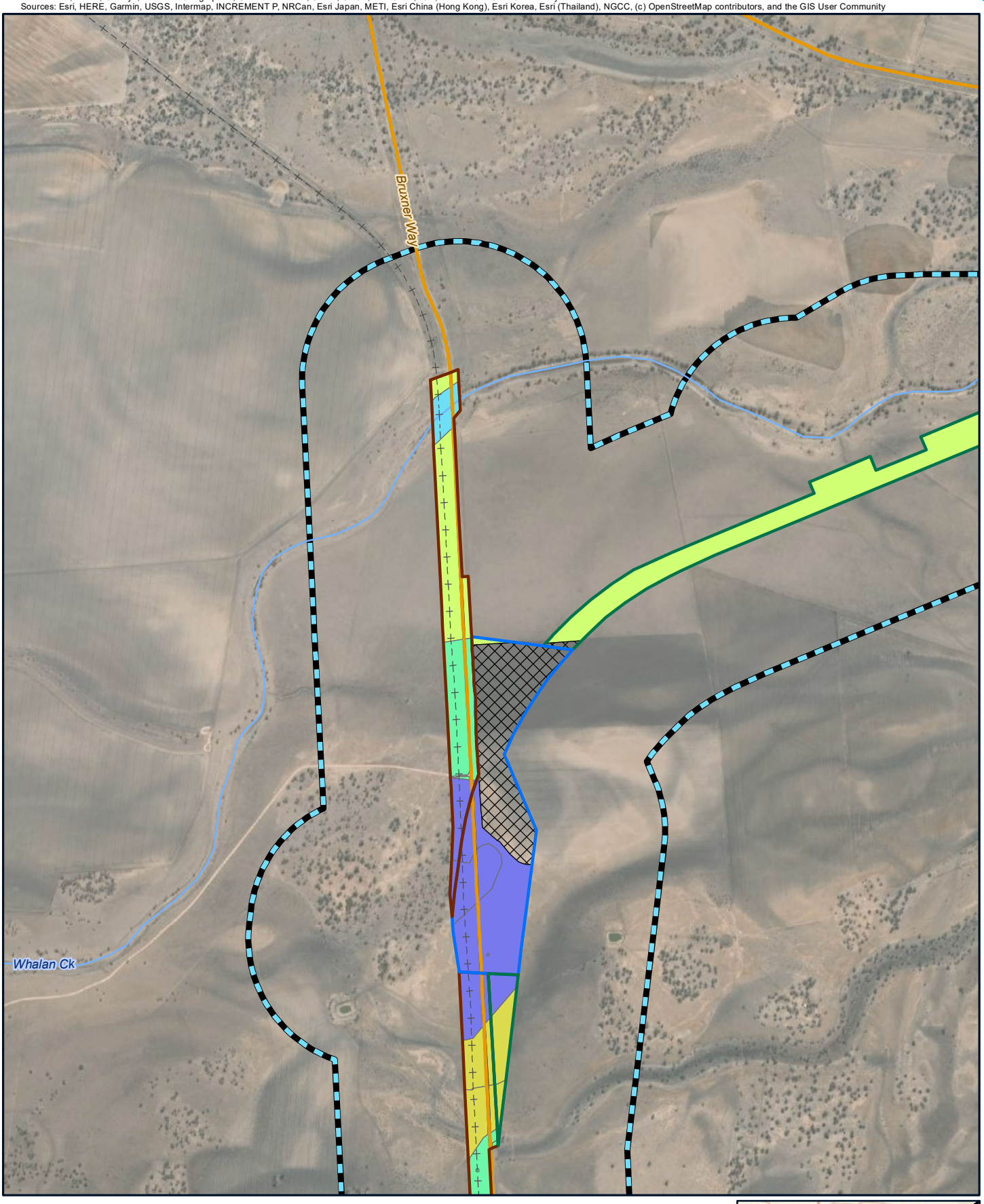
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4f:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- 36
- 52
- 56
- 247
- 628
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

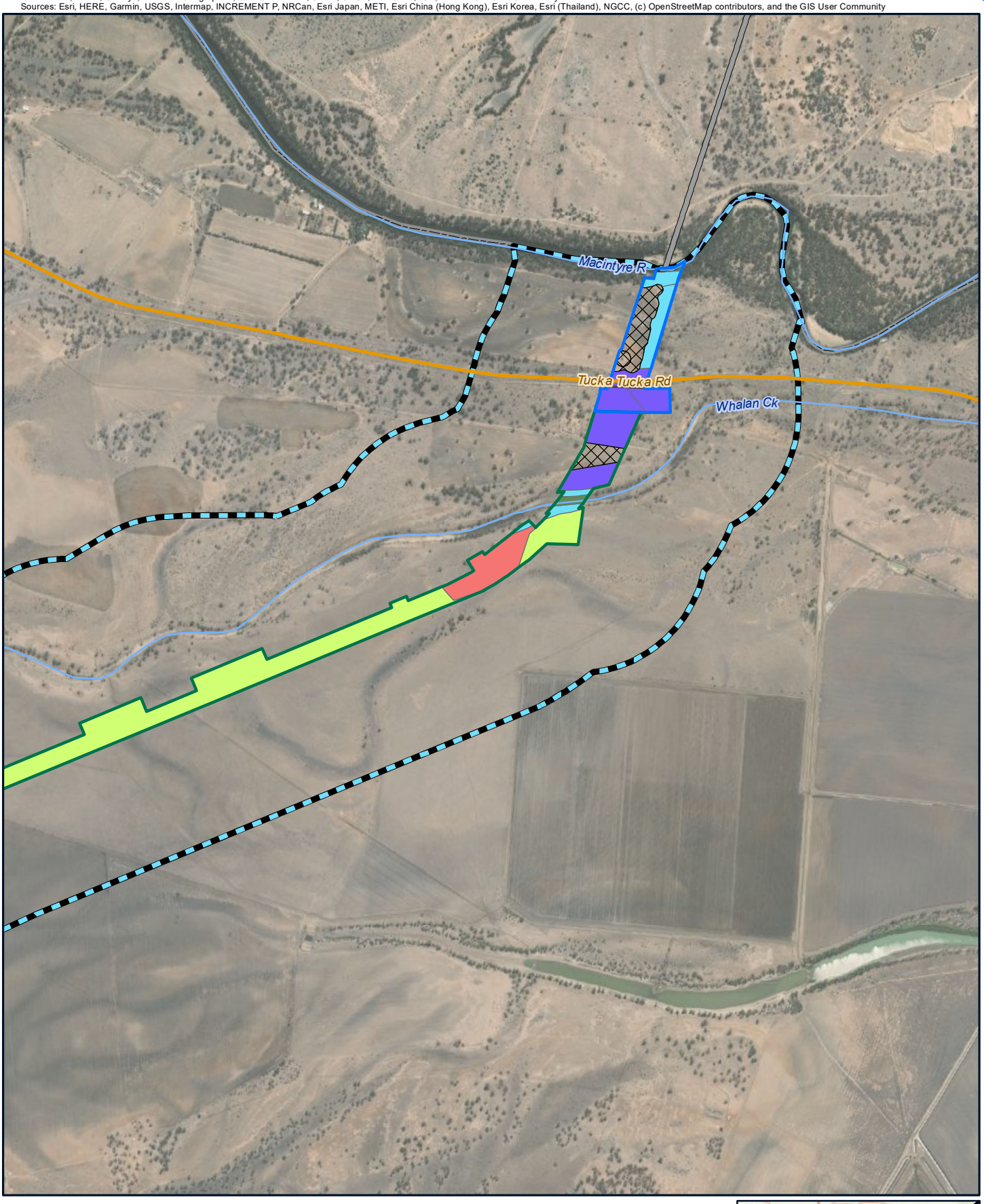
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4g:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Major roads
- QLD/NSW Border
- Watercourses
- Study area
- Subject land (early works)
- Subject land (greenfield)
- 36
- 52
- 192
- 244
- Managed Land
- Roads and tracks
- Waterway



A4 scale: 1:20,000

0 400 800 m

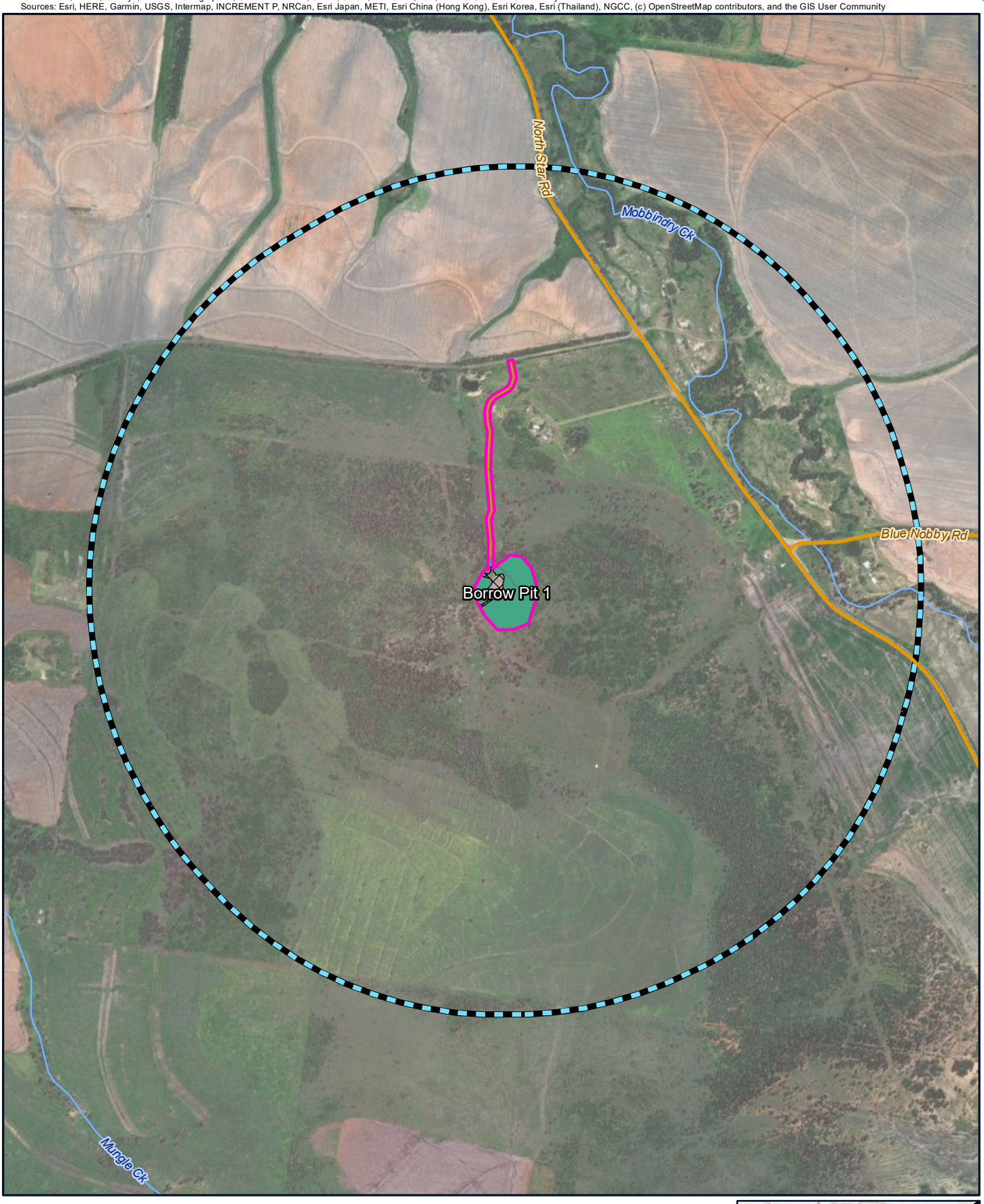
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4h:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- 35
- 147
- Managed Land



A4 scale: 1:20,000

0 400 800 m

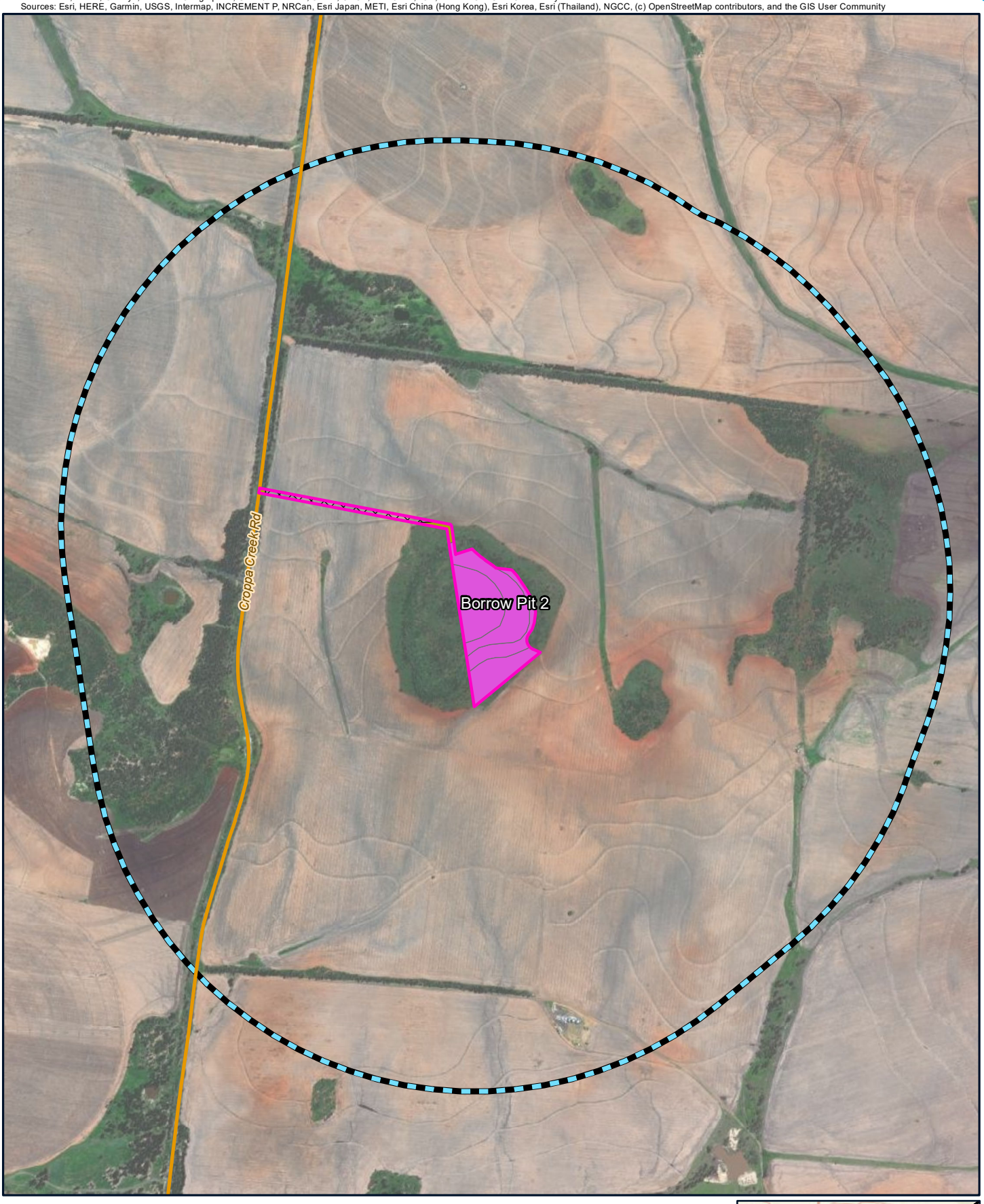
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4i:
Scattered paddock trees and Managed land

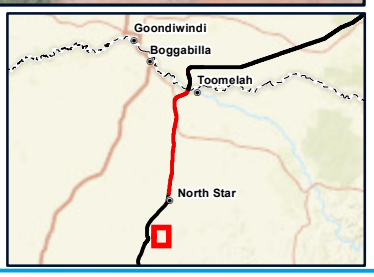
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- 35
- 418
- Managed Land



A4 scale: 1:20,000

0 400 800 m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4j:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2Bi\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- 192
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

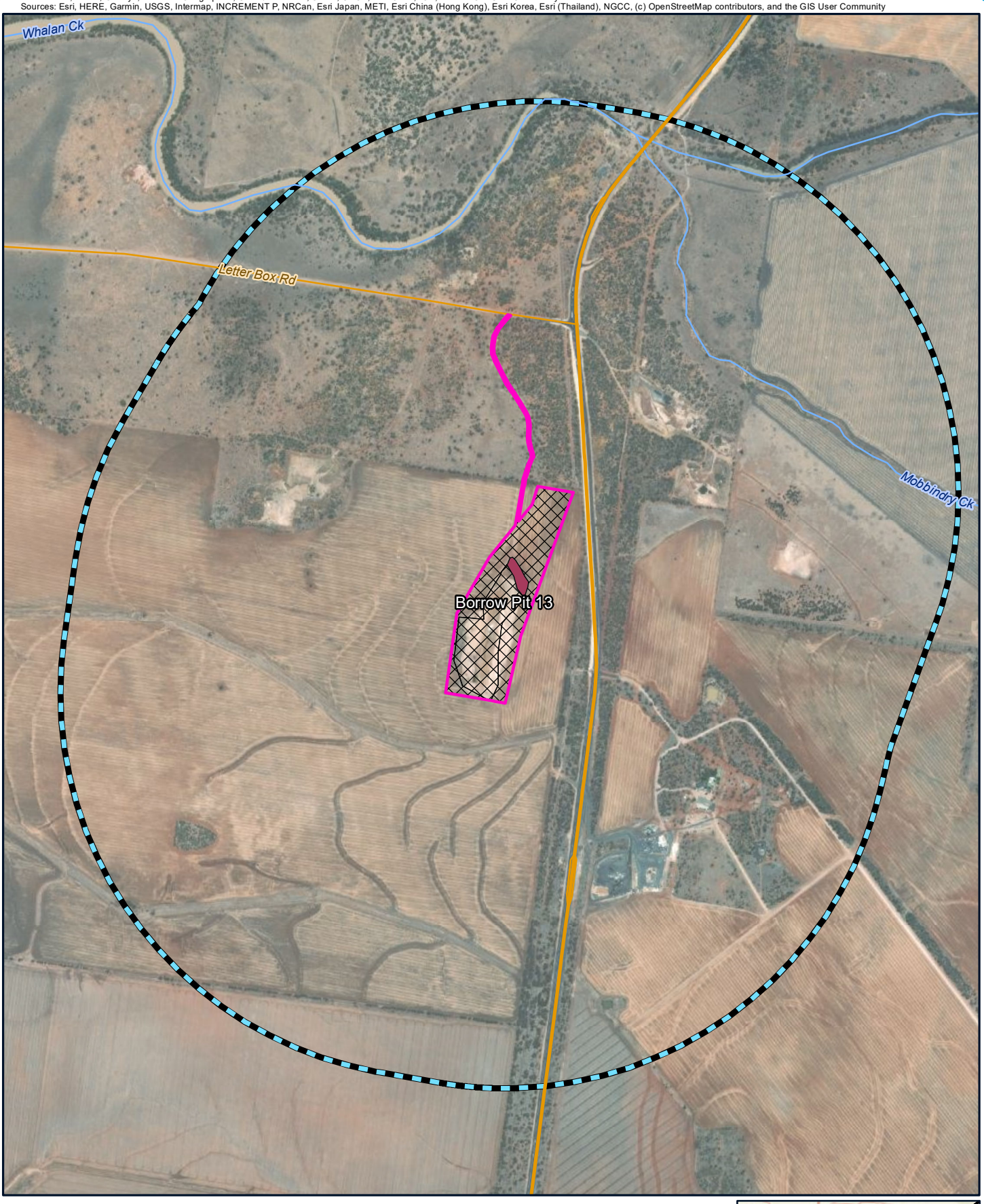
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4k:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- 98
- Managed Land



A4 scale: 1:20,000

0 400 800 m

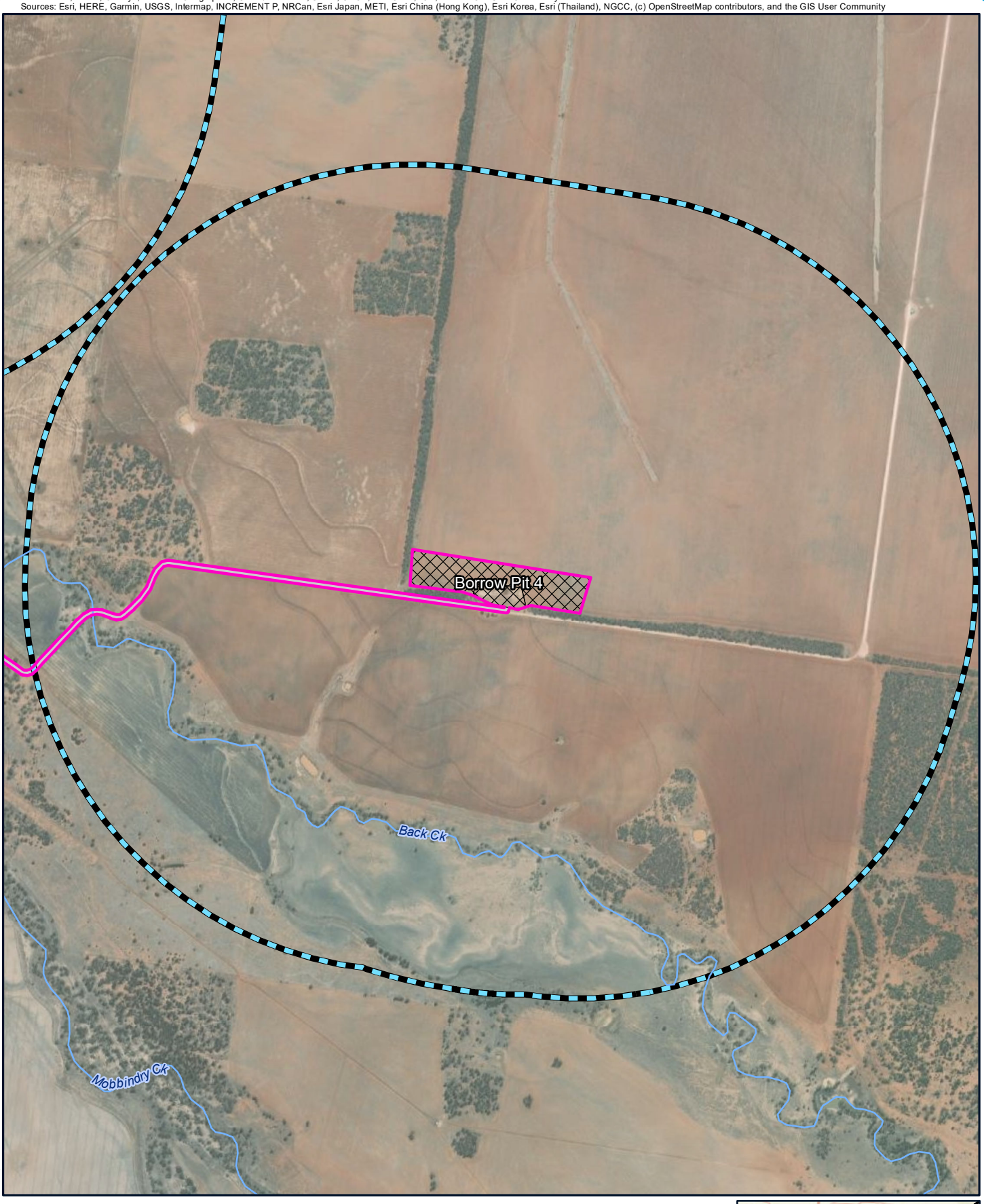
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4l:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Watercourses
- Study area
- Subject land (borrow pit)
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

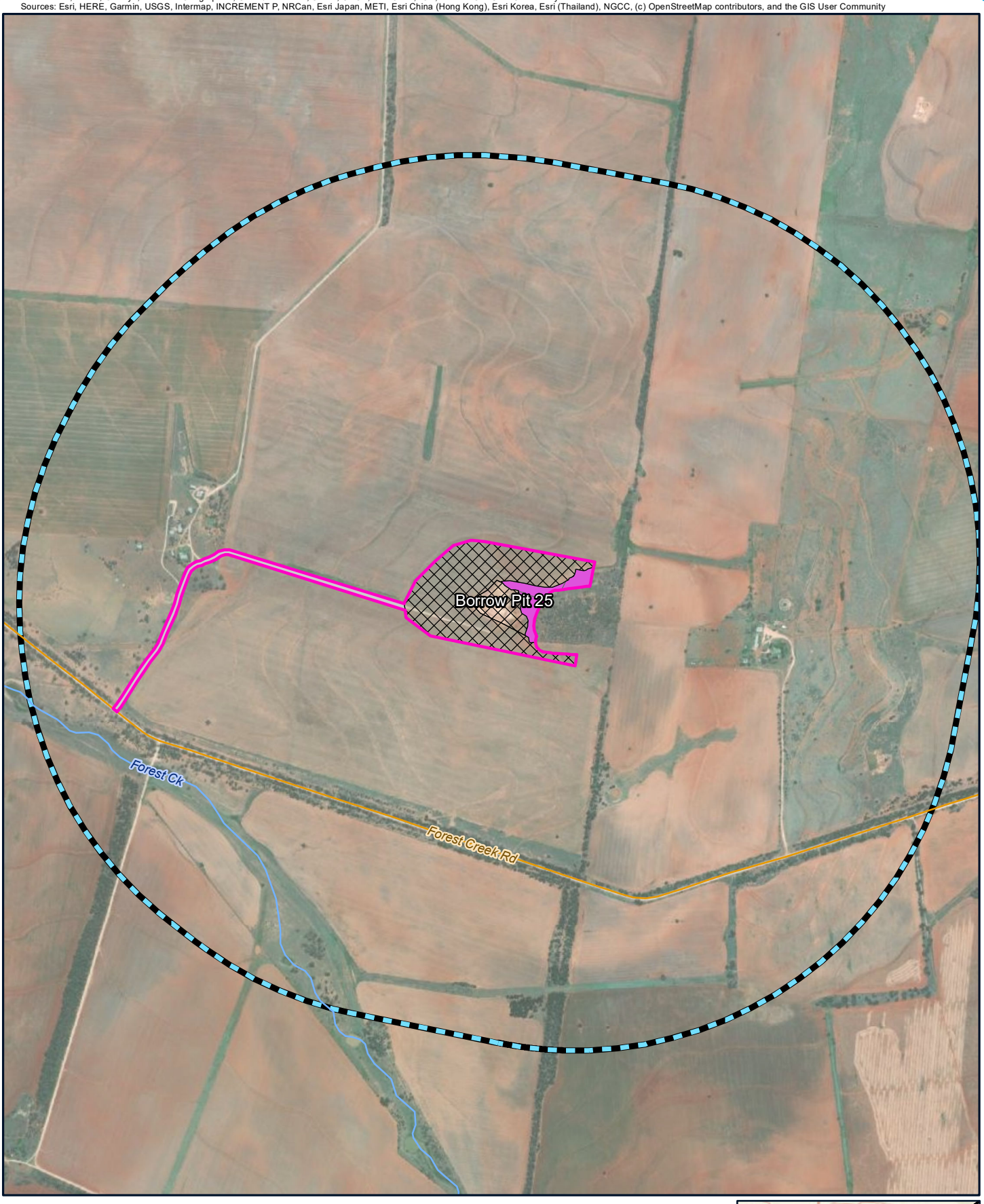
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4m:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- 418
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

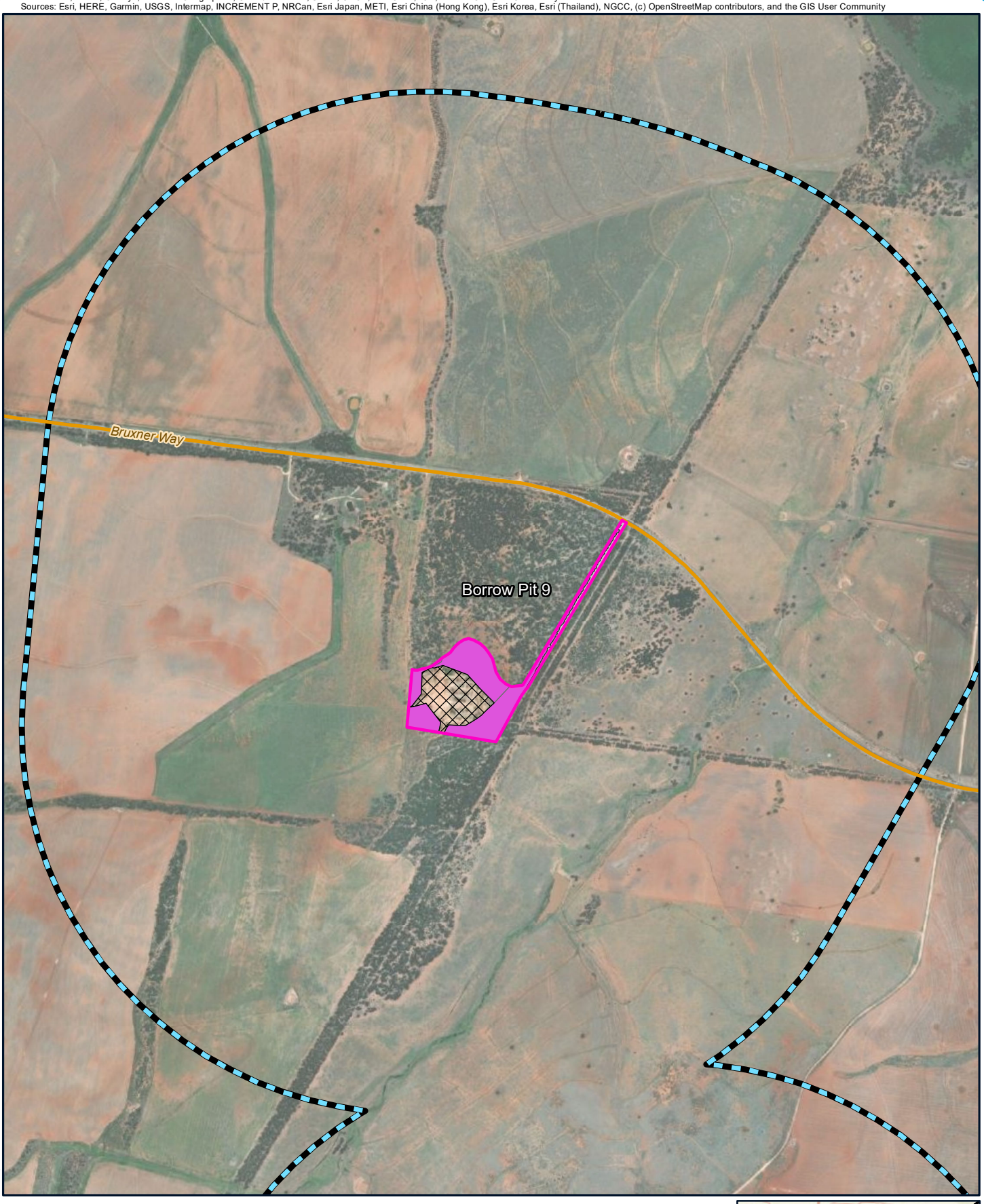
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4n:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.4_PT_NNV_areas_v5.mxd Date: 13/05/2021 13:49

Legend

- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- 418
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 400 800 m

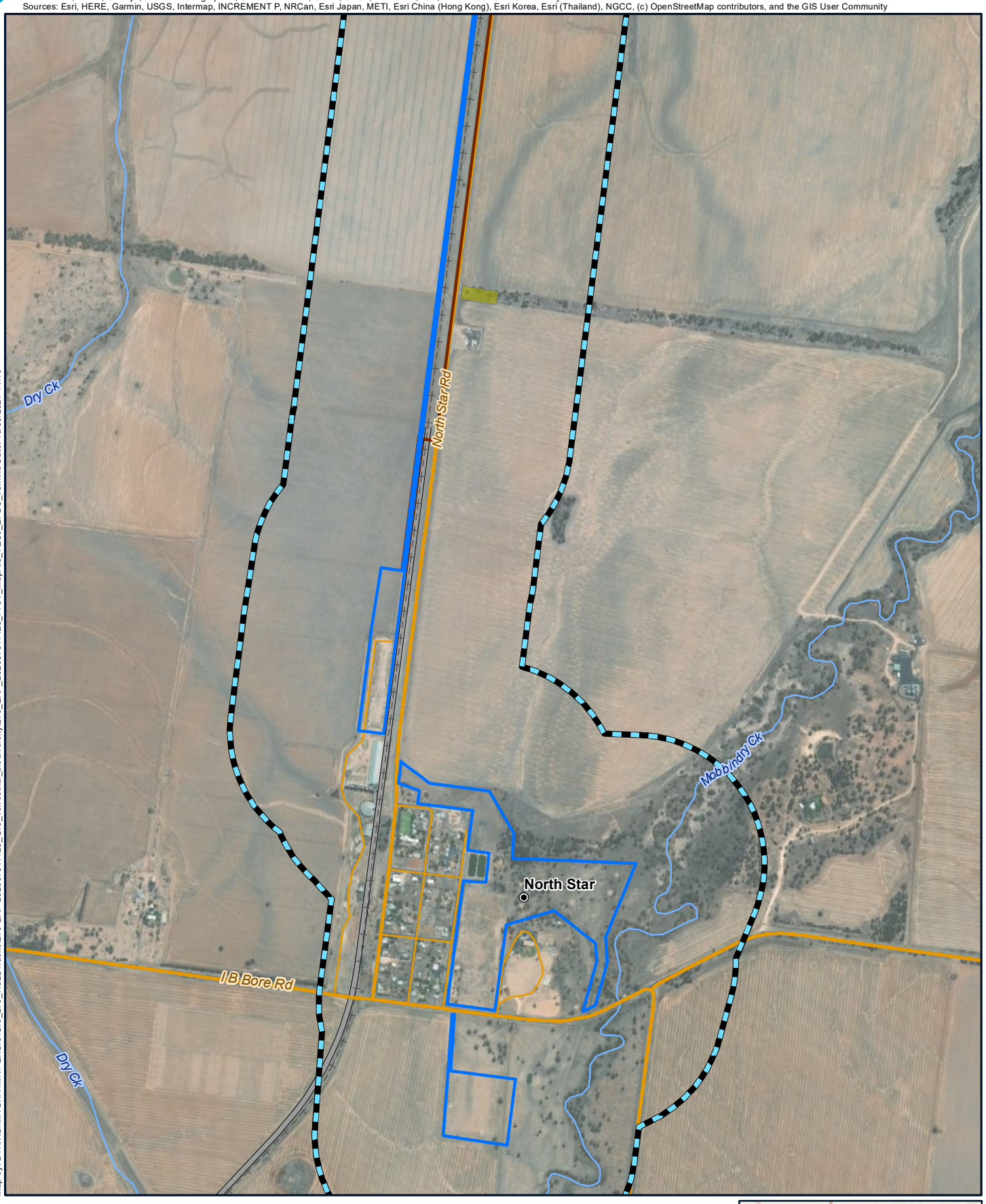
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 4
Coordinate system: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.4o:
Scattered paddock trees and Managed land

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



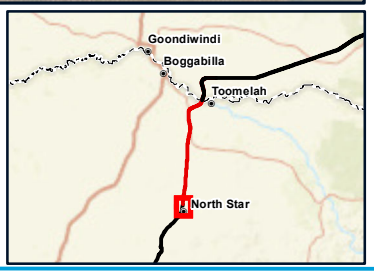
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Localities
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)

BC Act and EPBC Act listed TECs

- Brigalow (Acacia harpophylla dominant and co-dominant)



A4 scale: 1:20,000

0 80 160 240 320 400 m

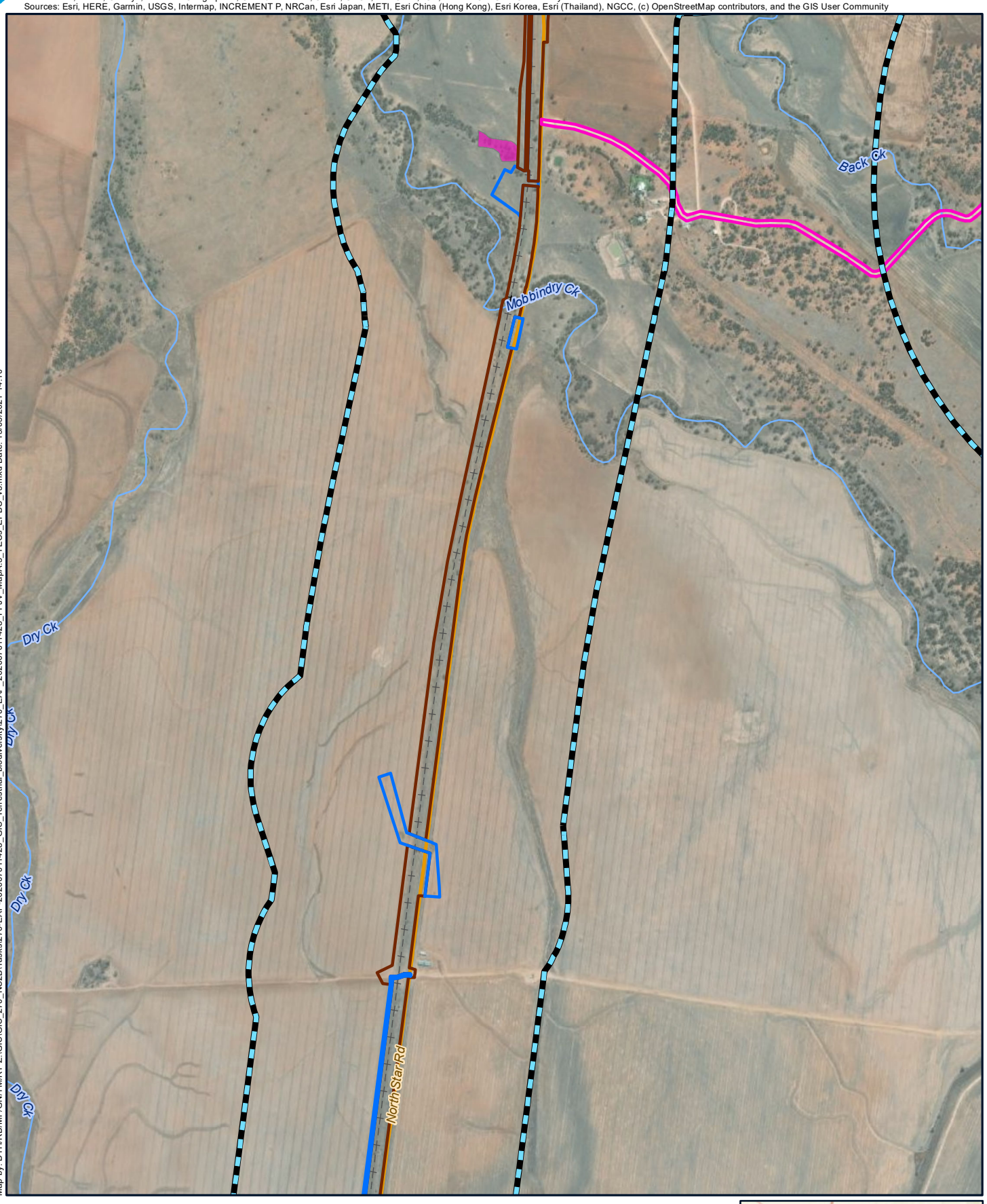
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5a: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



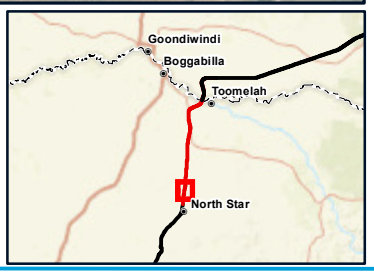
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)

BC Act and EPBC Act listed TECs

- Weeping Myall Woodlands



A4 scale: 1:20,000

0 80 160 240 320 400 m

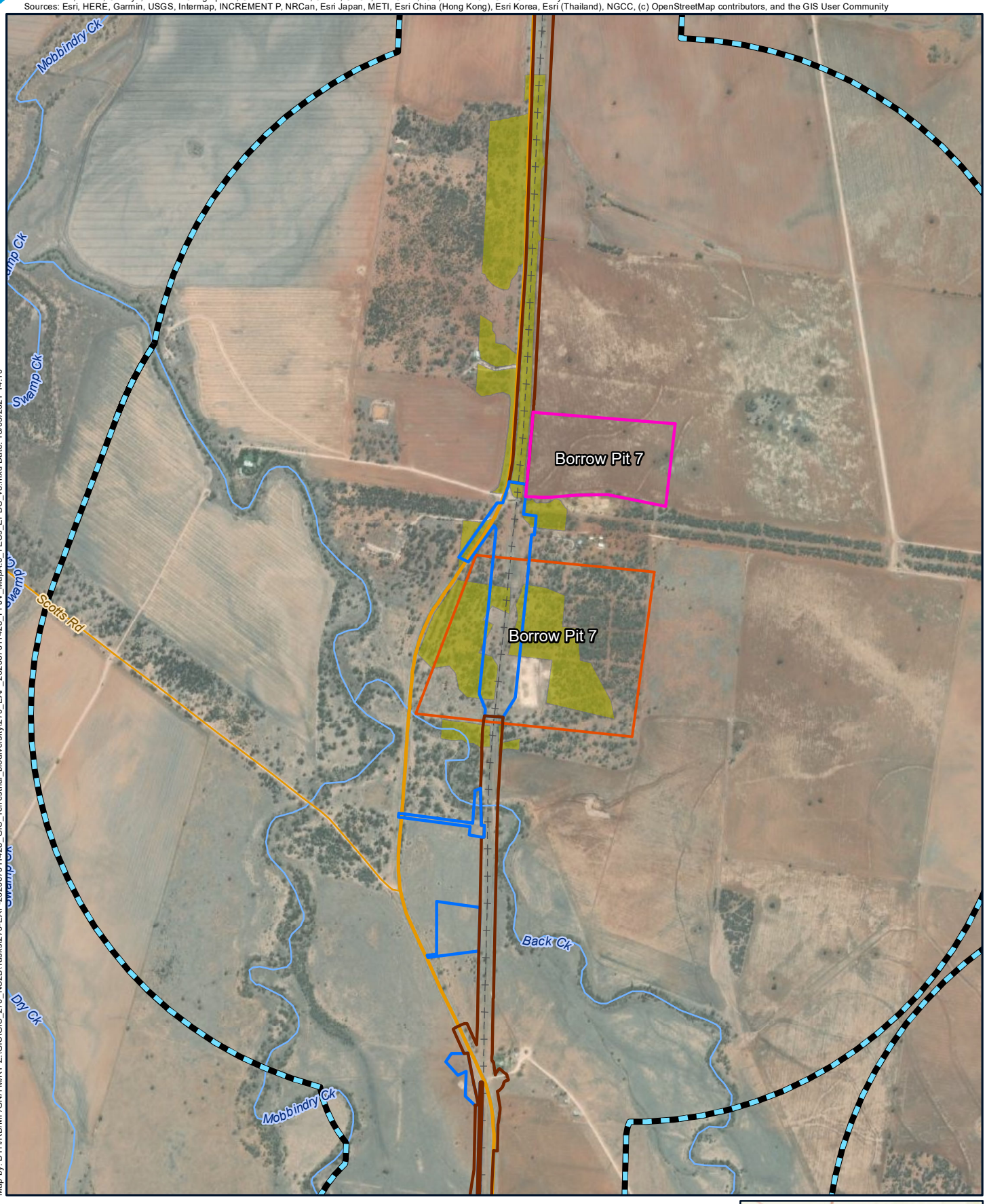
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5b: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



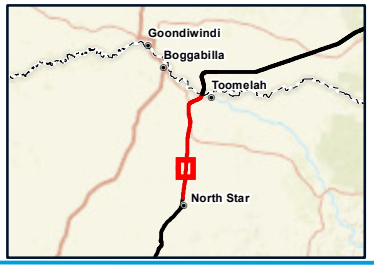
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Borrow pit removed to limit impacts on Brigalow

BC Act and EPBC Act listed TECs

- Brigalow (Acacia harpophylla dominant and co-dominant)



A4 scale: 1:20,000

0 80 160 240 320 400 m

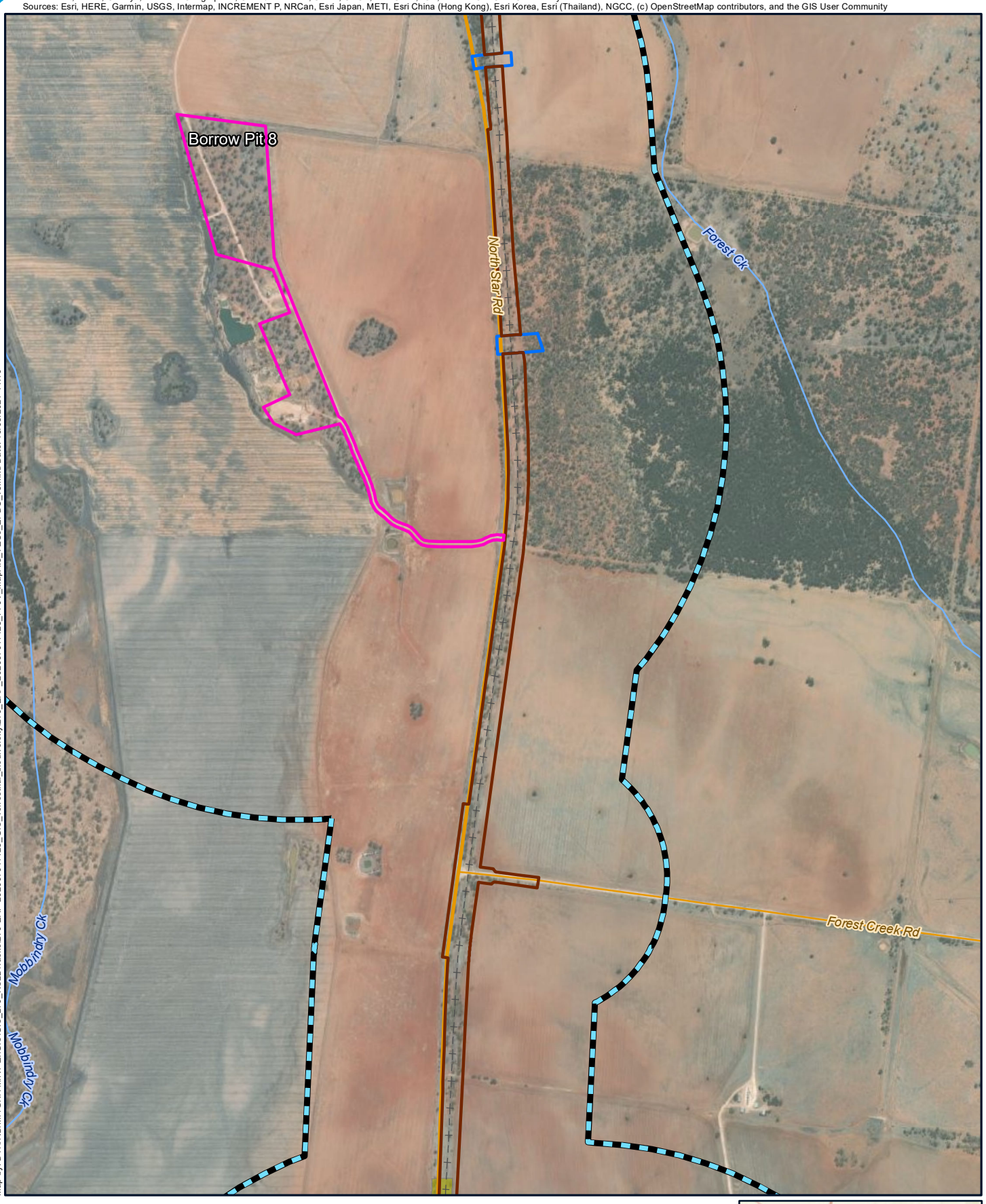
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5c: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



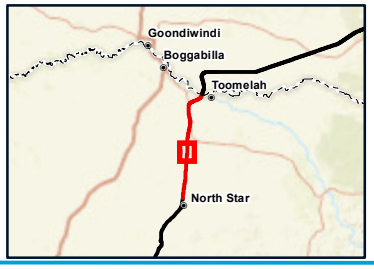
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)

BC Act and EPBC Act listed TECs

- Brigalow (Acacia harpophylla dominant and co-dominant)



A4 scale: 1:20,000

0 80 160 240 320 400 m

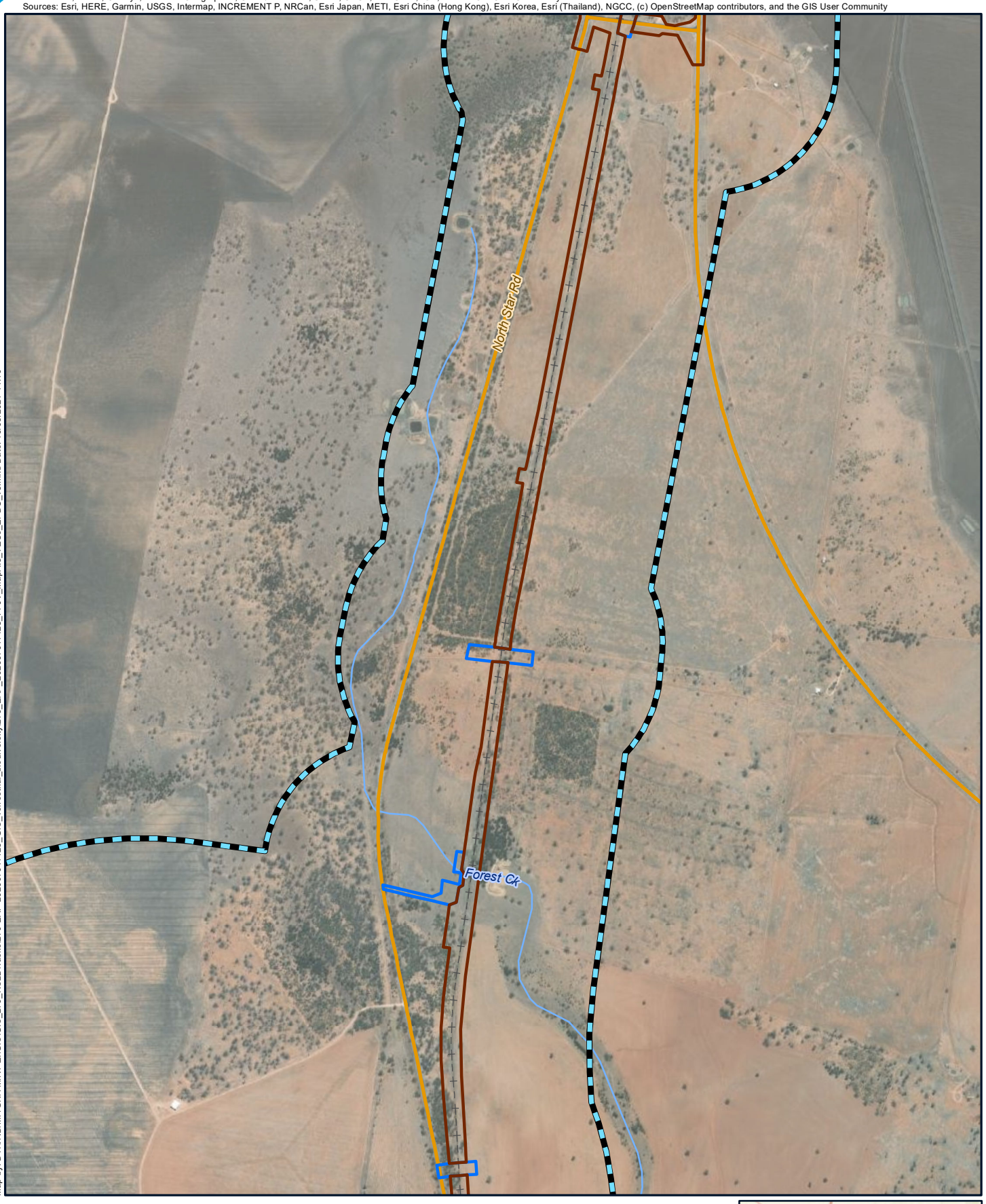
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5d: Threatened Ecological Communities under BC and EPBC Acts

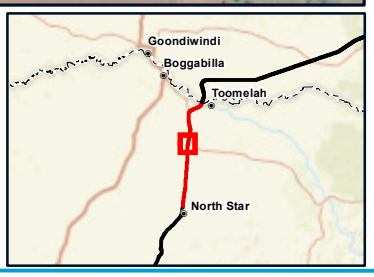
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 80 160 240 320 400 m

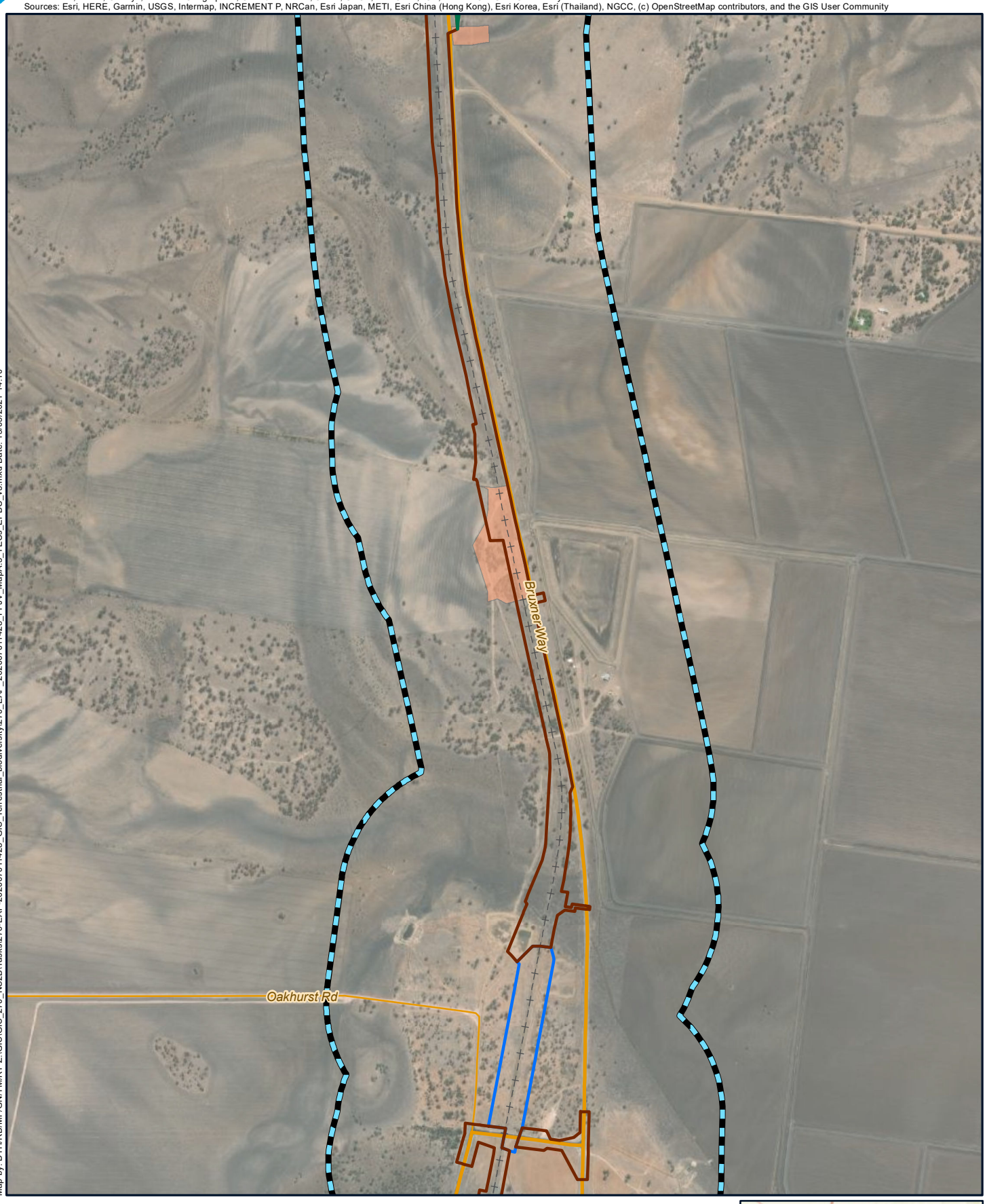
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5e: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



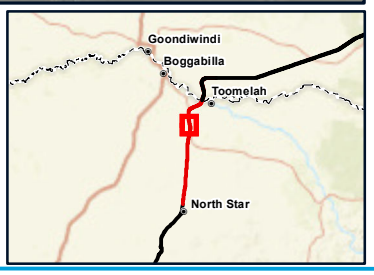
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)

BC Act listed TEC

- Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions



A4 scale: 1:20,000

0 80 160 240 320 400 m

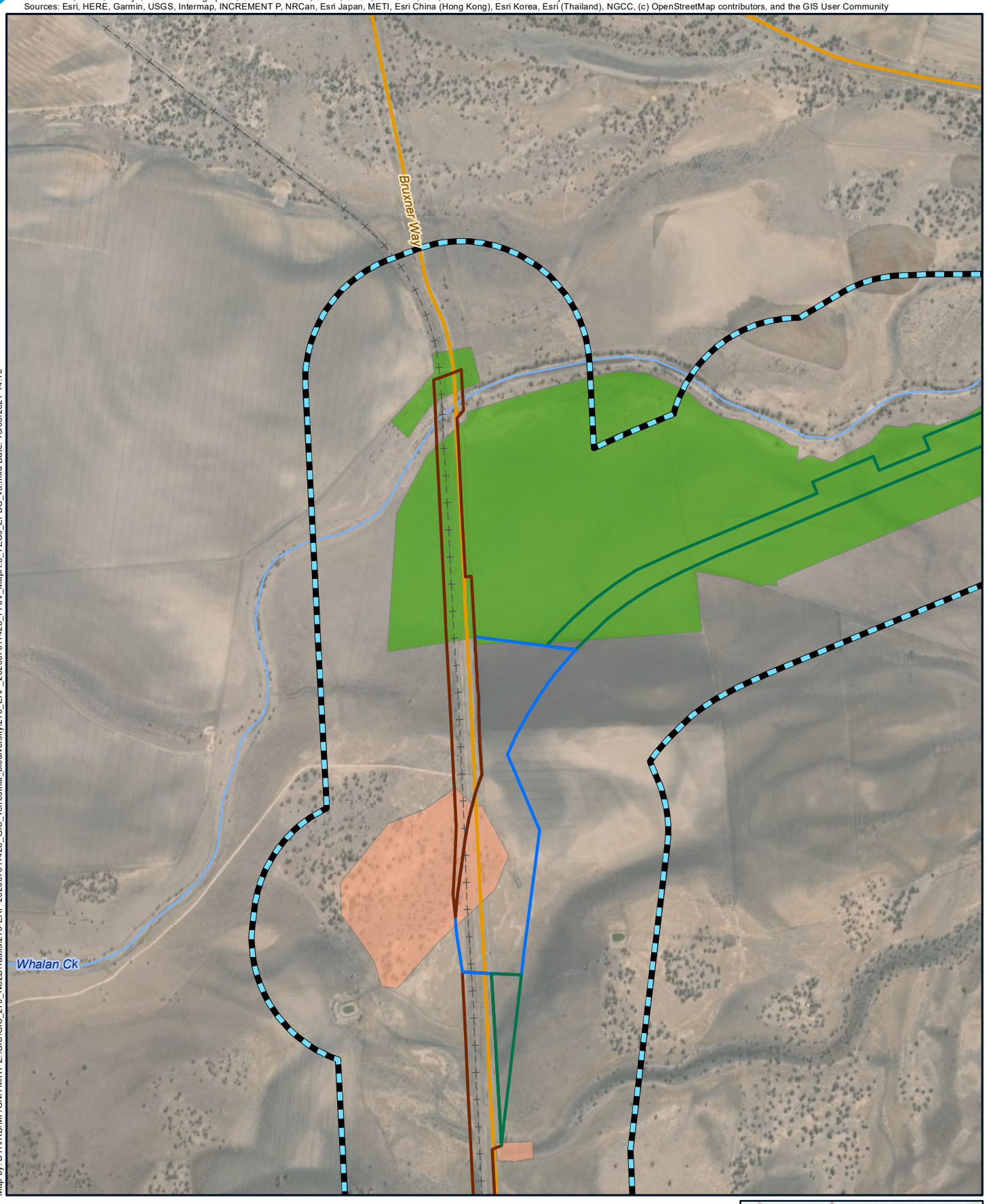
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5f: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

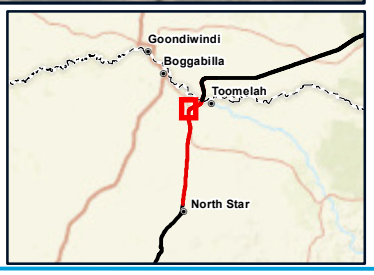
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)

BC Act listed TEC

- Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions

EPBC Act listed TEC

- Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern QLD



A4 scale: 1:20,000

0 80 160 240 320 400 m

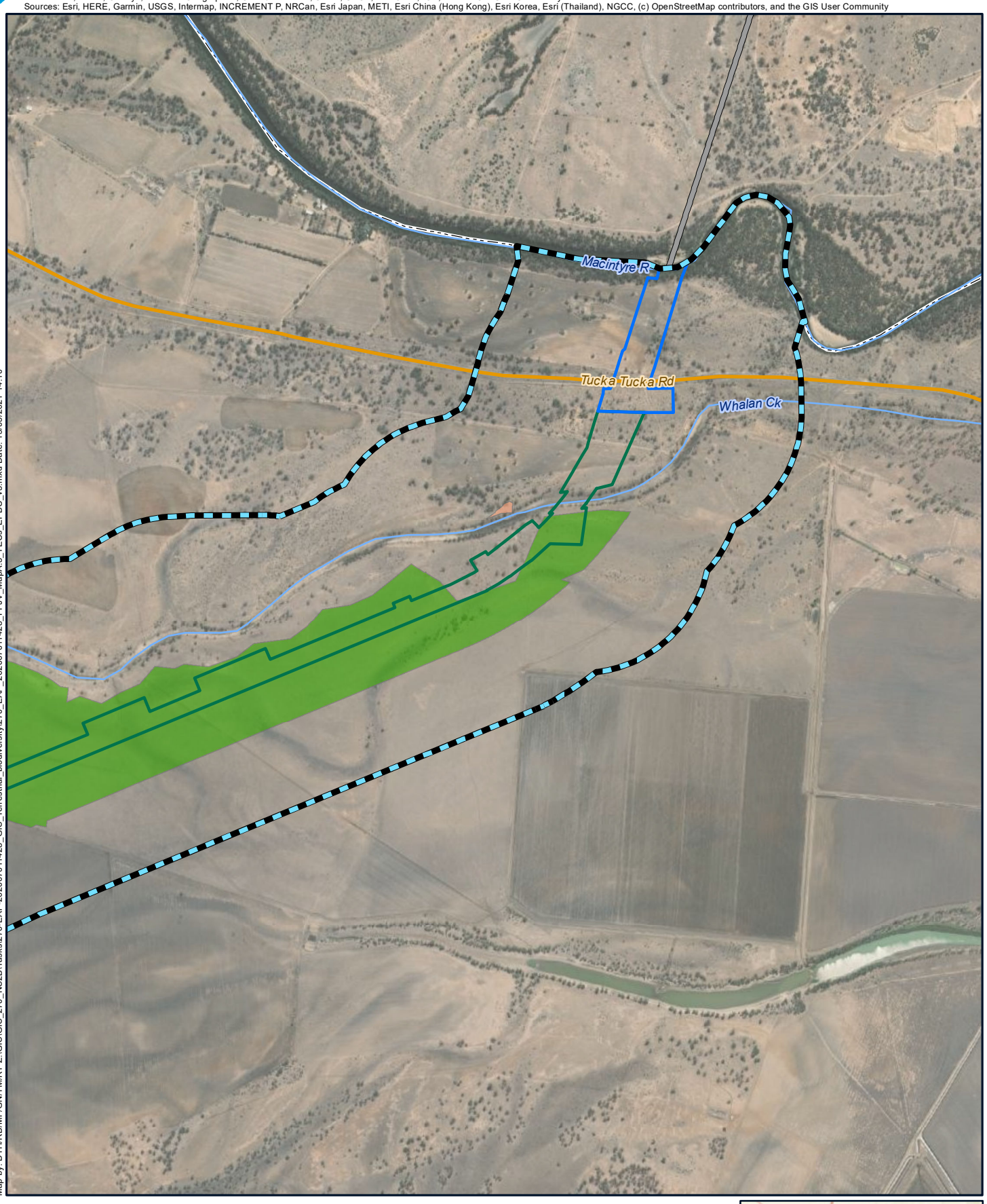
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5g: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

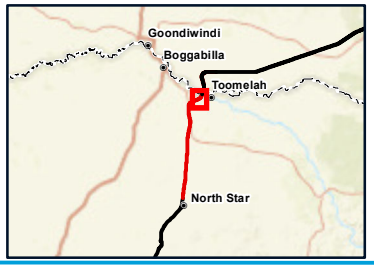
- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (early works)
- Subject land (greenfield)

BC Act listed TEC

- Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions

EPBC Act listed TEC

- Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern QLD



A4 scale: 1:20,000

0 80 160 240 320 400 m

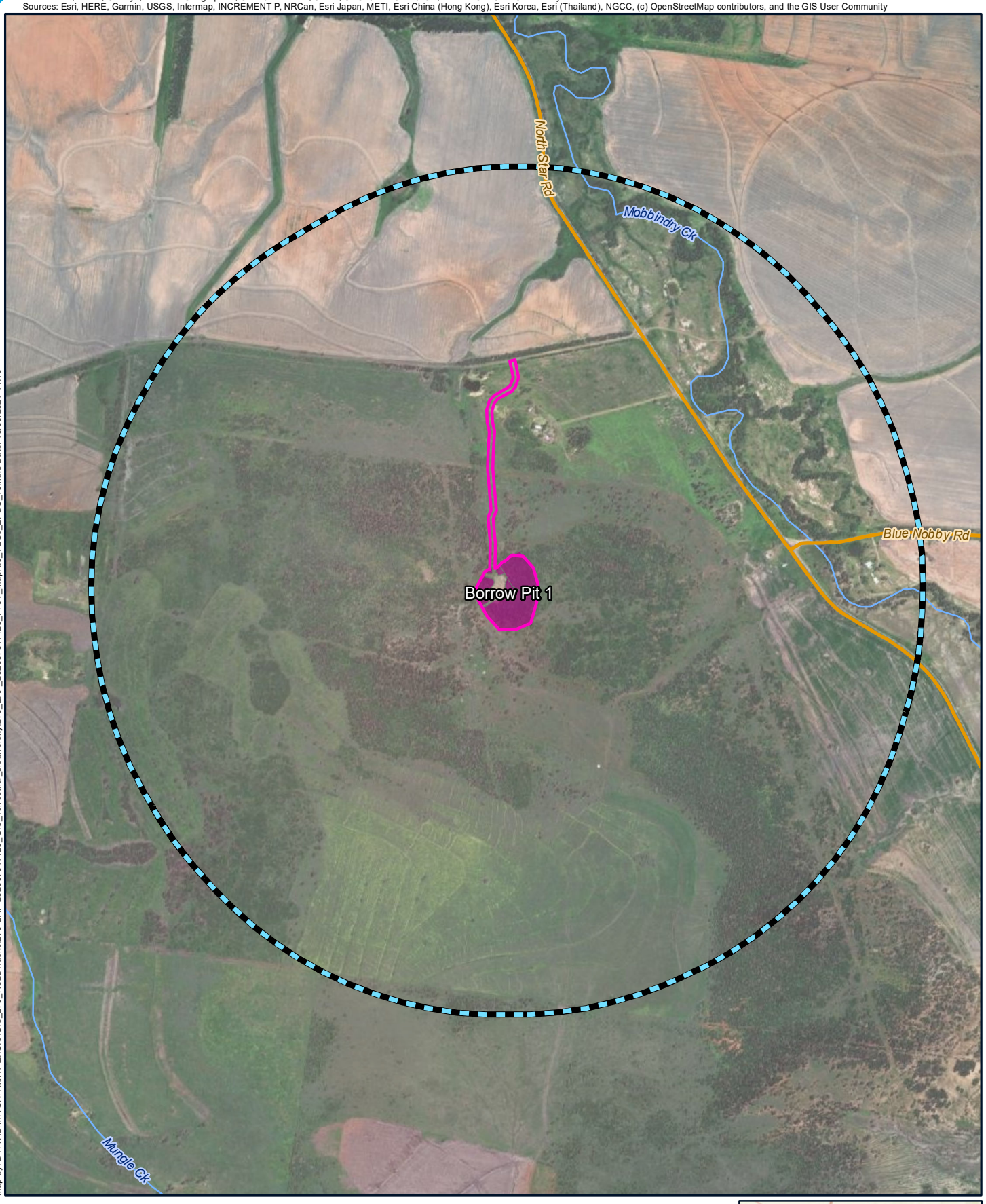
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5h: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



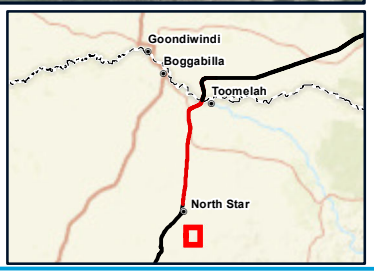
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA.5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)

BC Act and EPBC Act listed TECs

- Semi-evergreen vine thickets



A4 scale: 1:20,000

0 80 160 240 320 400 m

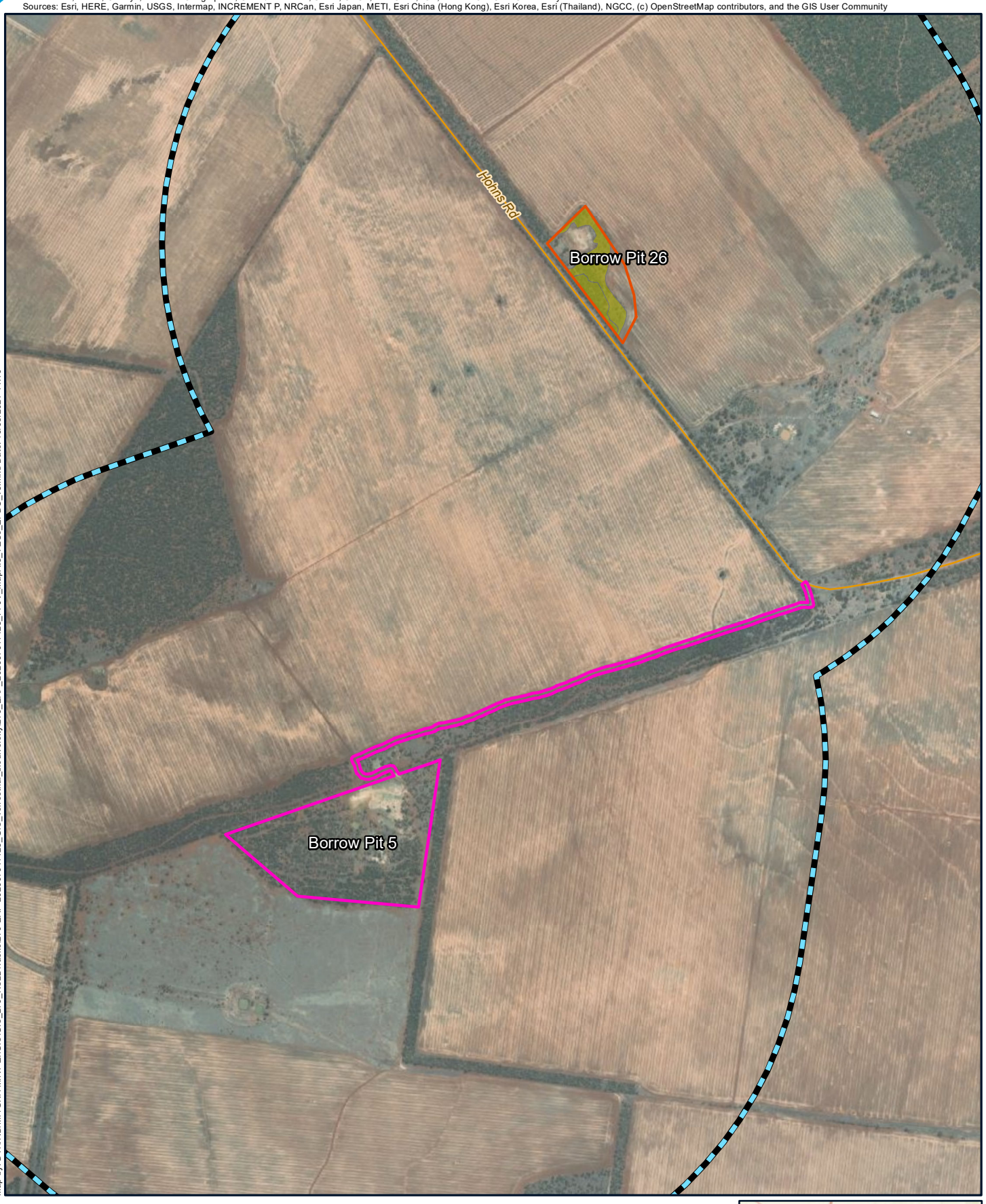
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5i: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



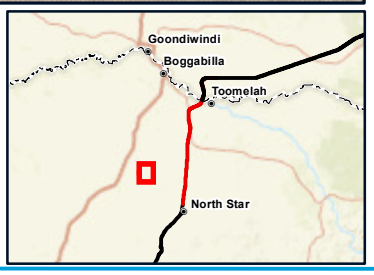
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Minor roads
- Study area
- Subject land (borrow pit)
- Borrow pit removed to limit impacts on Brigalow

BC Act and EPBC Act listed TECs

- Brigalow (Acacia harpophylla dominant and co-dominant)



A4 scale: 1:20,000

0 80 160 240 320 400 m

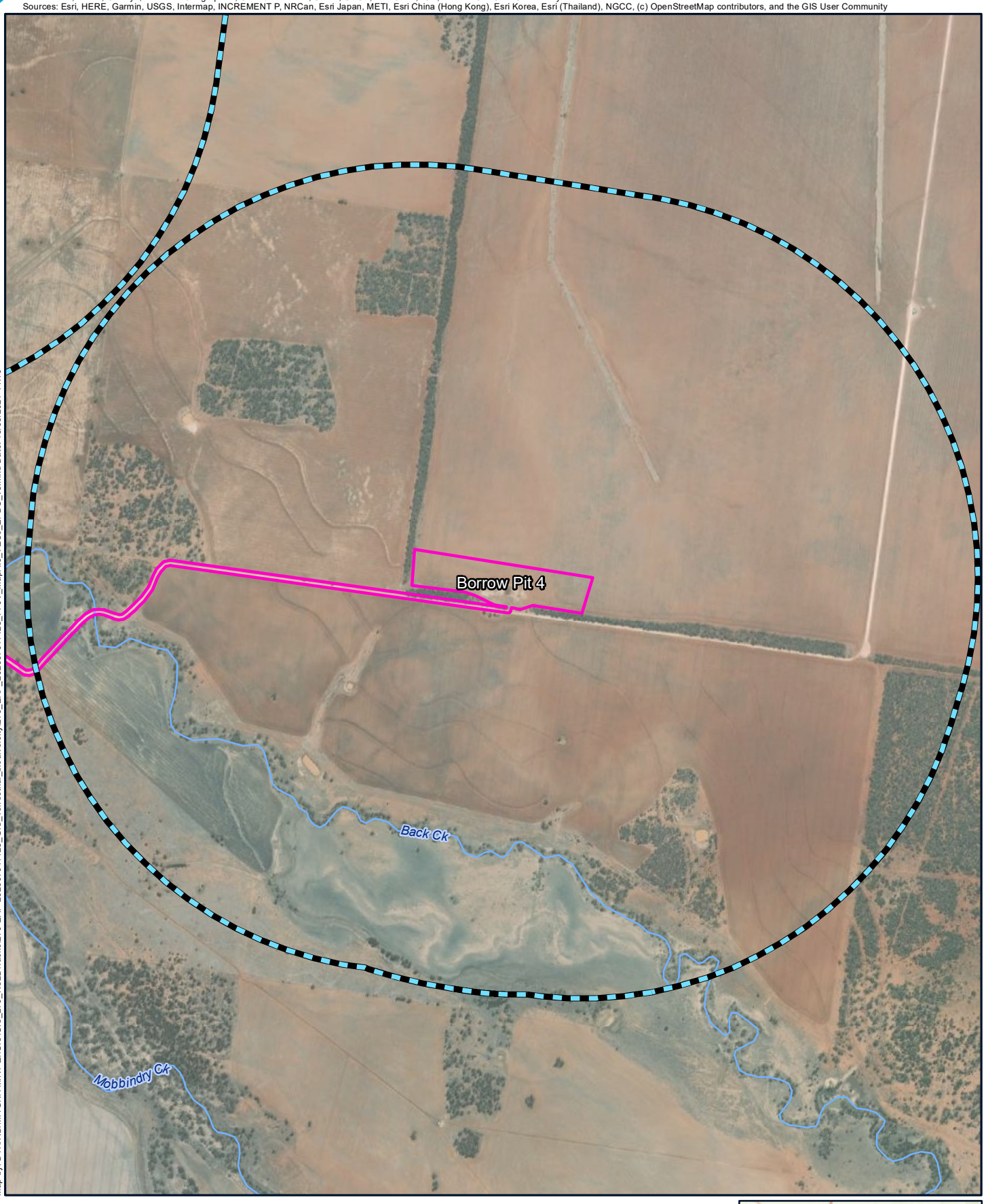
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5k: Threatened Ecological Communities under BC and EPBC Acts

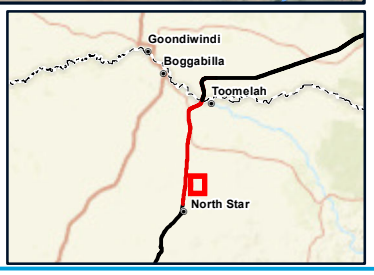
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000

0 80 160 240 320 400 m

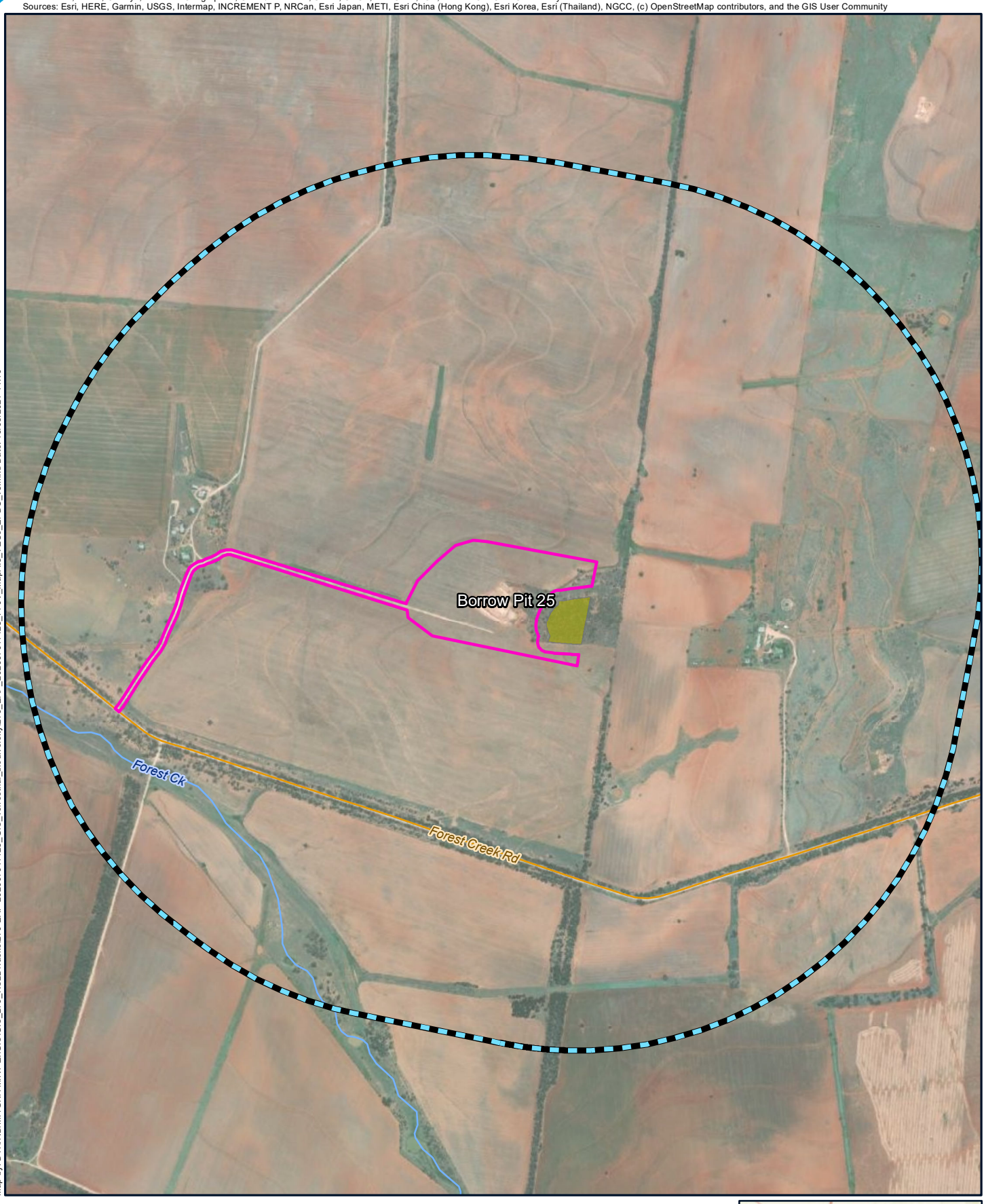
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5m: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



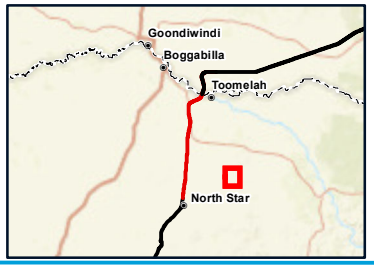
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)

BC Act and EPBC Act listed TECs

- Brigalow (Acacia harpophylla dominant and co-dominant)



A4 scale: 1:20,000

0 80 160 240 320 400 m

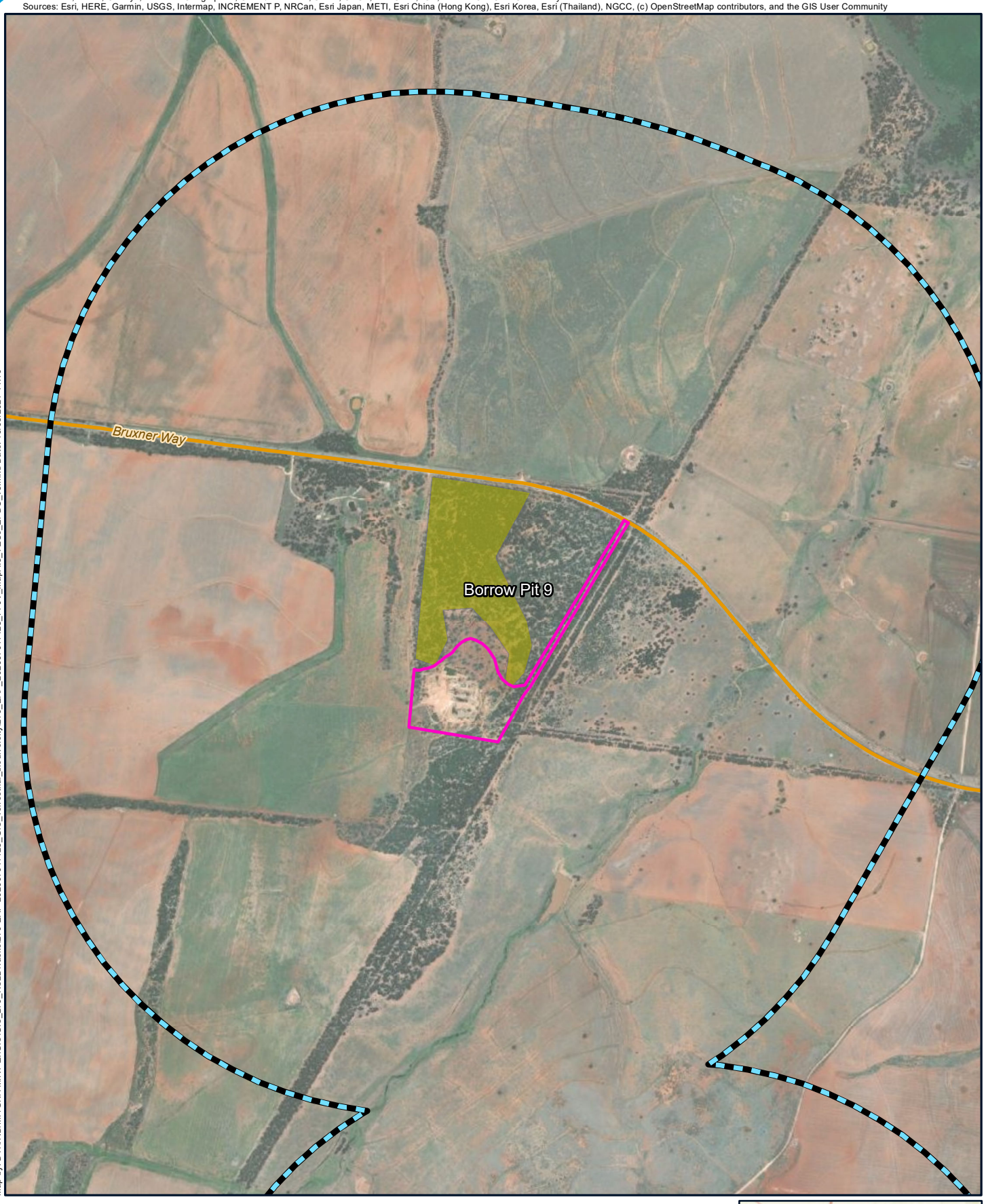
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5n: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



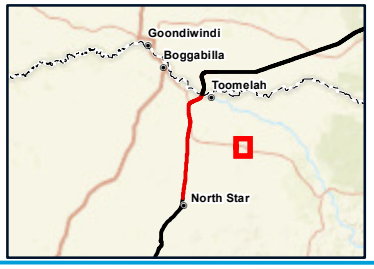
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Major roads
- Study area
- Subject land (borrow pit)

BC Act and EPBC Act listed TECs

- Brigalow (Acacia harpophylla dominant and co-dominant)



A4 scale: 1:20,000

0 80 160 240 320 400 m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5o: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



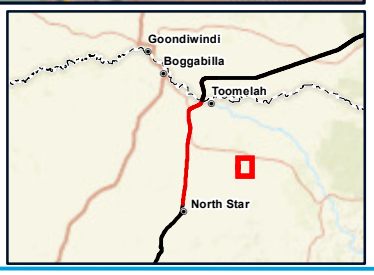
Map by: DTH/RB/MF/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapA-5_TECs_EPBC_v5.mxd Date: 13/05/2021 14:10

Legend

- Minor roads
- Watercourses
- Study area
- Borrow pit removed to limit impacts on Brigalow

BC Act and EPBC Act listed TECs

- Brigalow (Acacia harpophylla dominant and co-dominant)



A4 scale: 1:20,000

0 80 160 240 320 400 m

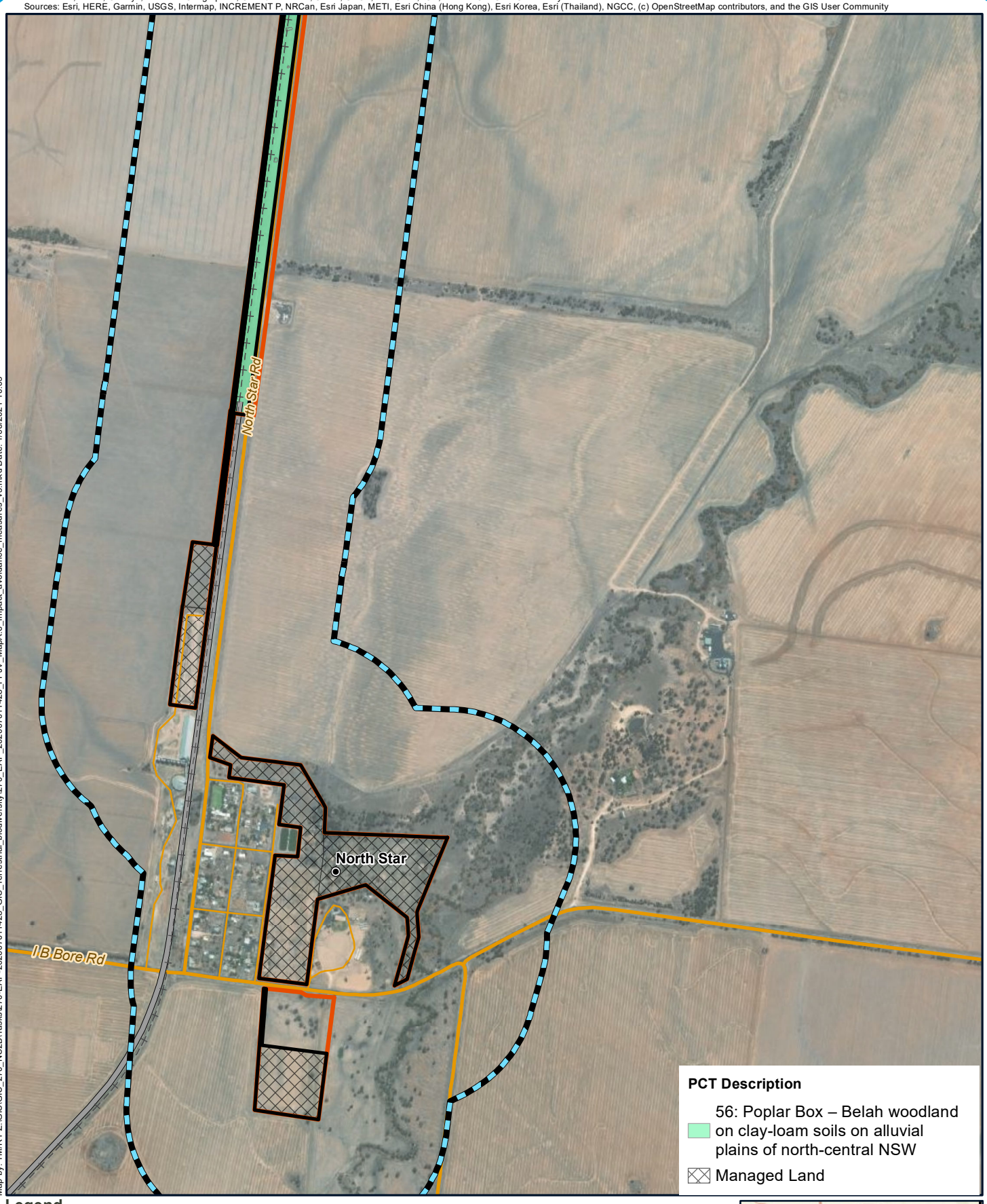
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version:
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.5p: Threatened Ecological Communities under BC and EPBC Acts

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



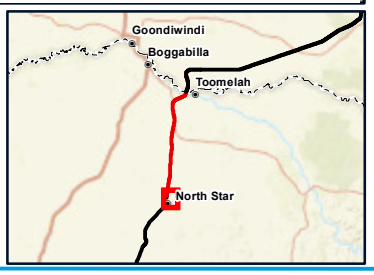
Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- Managed Land

Legend

- Localities
- Major roads
- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Adjoining alignments
- Study area
- Old subject land
- Revised subject land



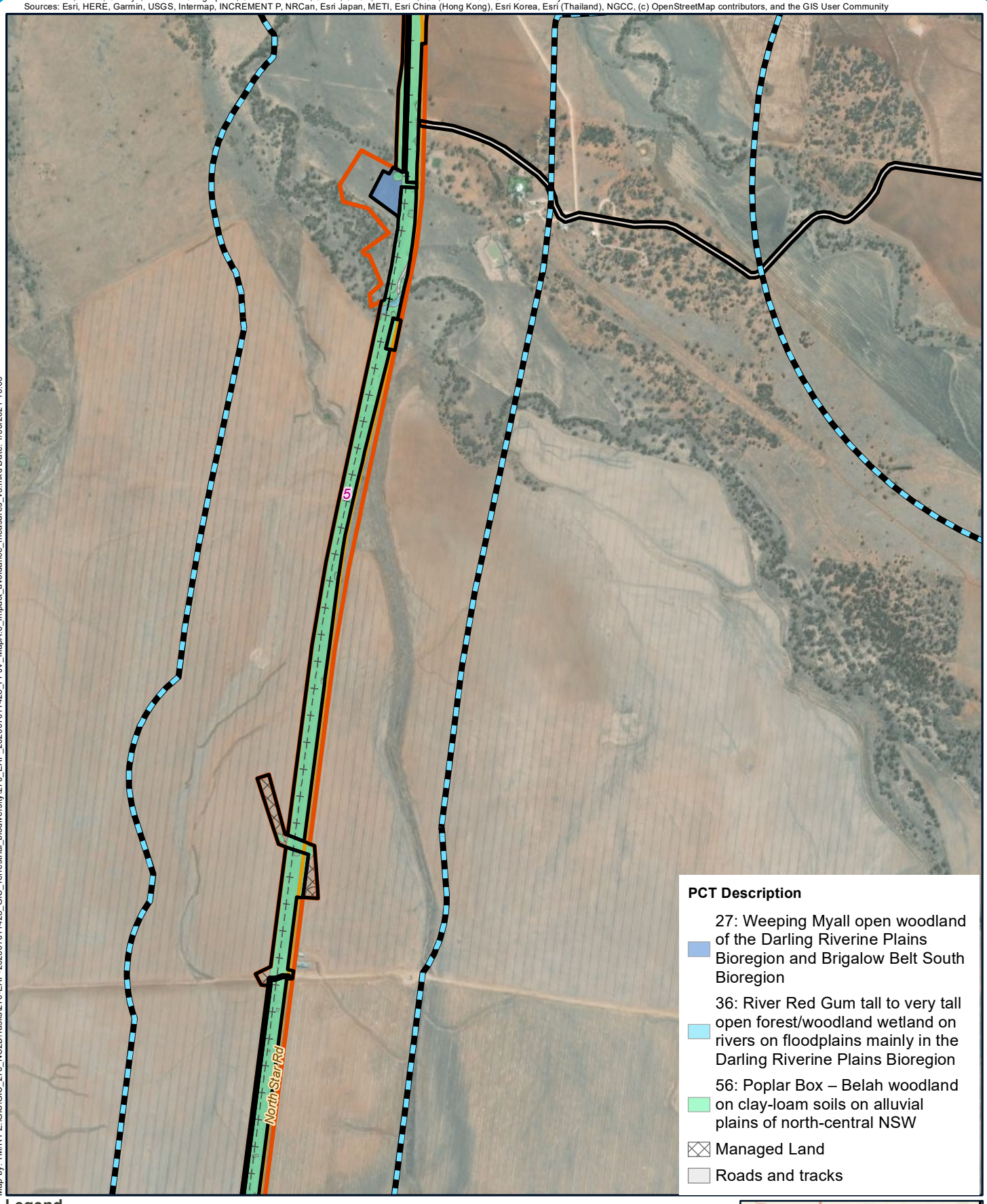
A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6a:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



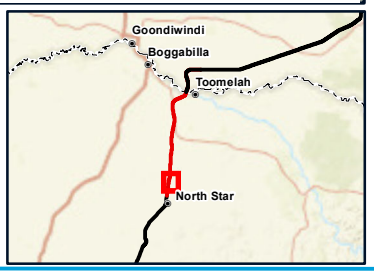
Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

- 27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
- 36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- Managed Land
- Roads and tracks

Legend

- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



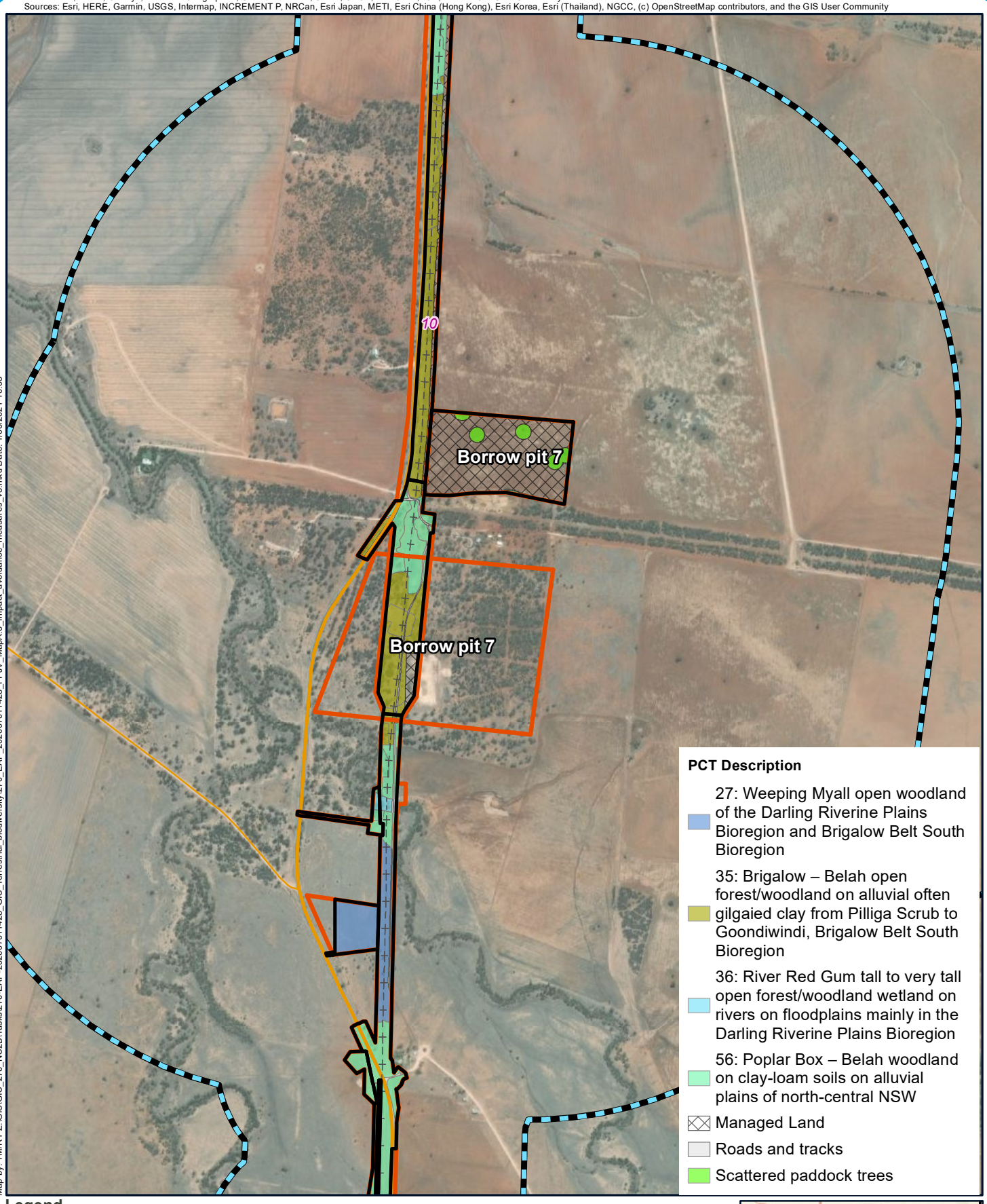
A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6b:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

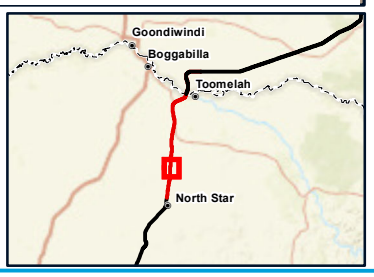


PCT Description

- 27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
- 35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
- 36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- Managed Land
- Roads and tracks
- Scattered paddock trees

Legend

- Major roads
- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3

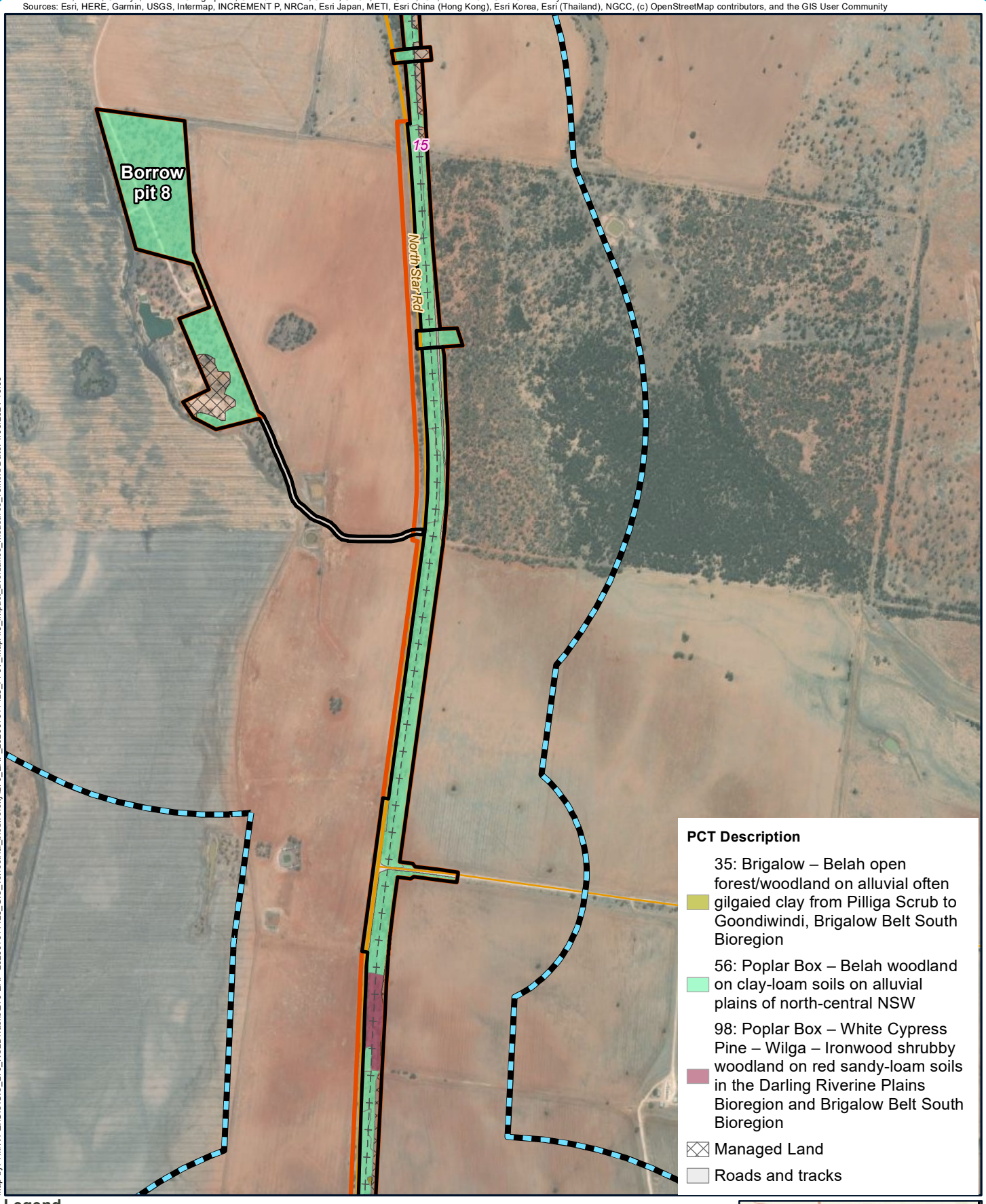
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6c: Impact avoidance measures

Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

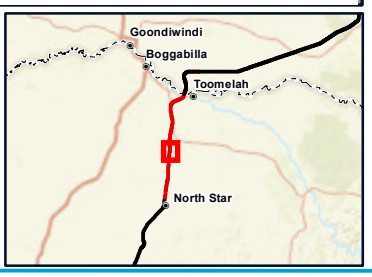


PCT Description

- 35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- 98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
- Managed Land
- Roads and tracks

Legend

- Major roads
- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3

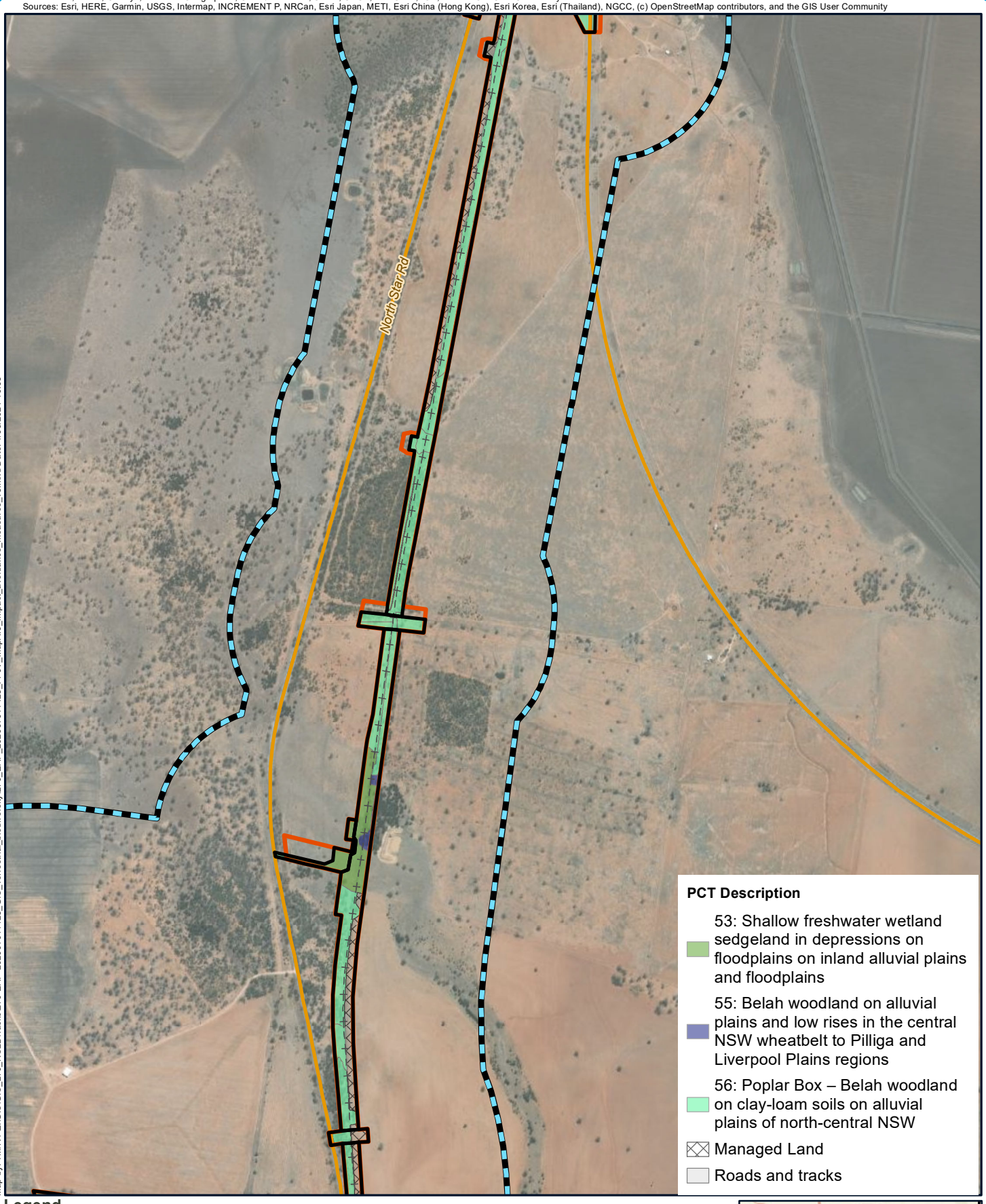
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6d: Impact avoidance measures

Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

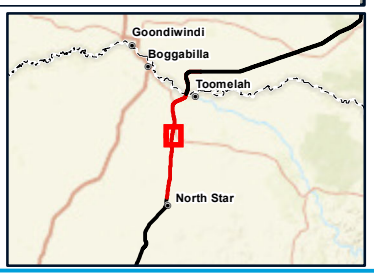
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

Legend

- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

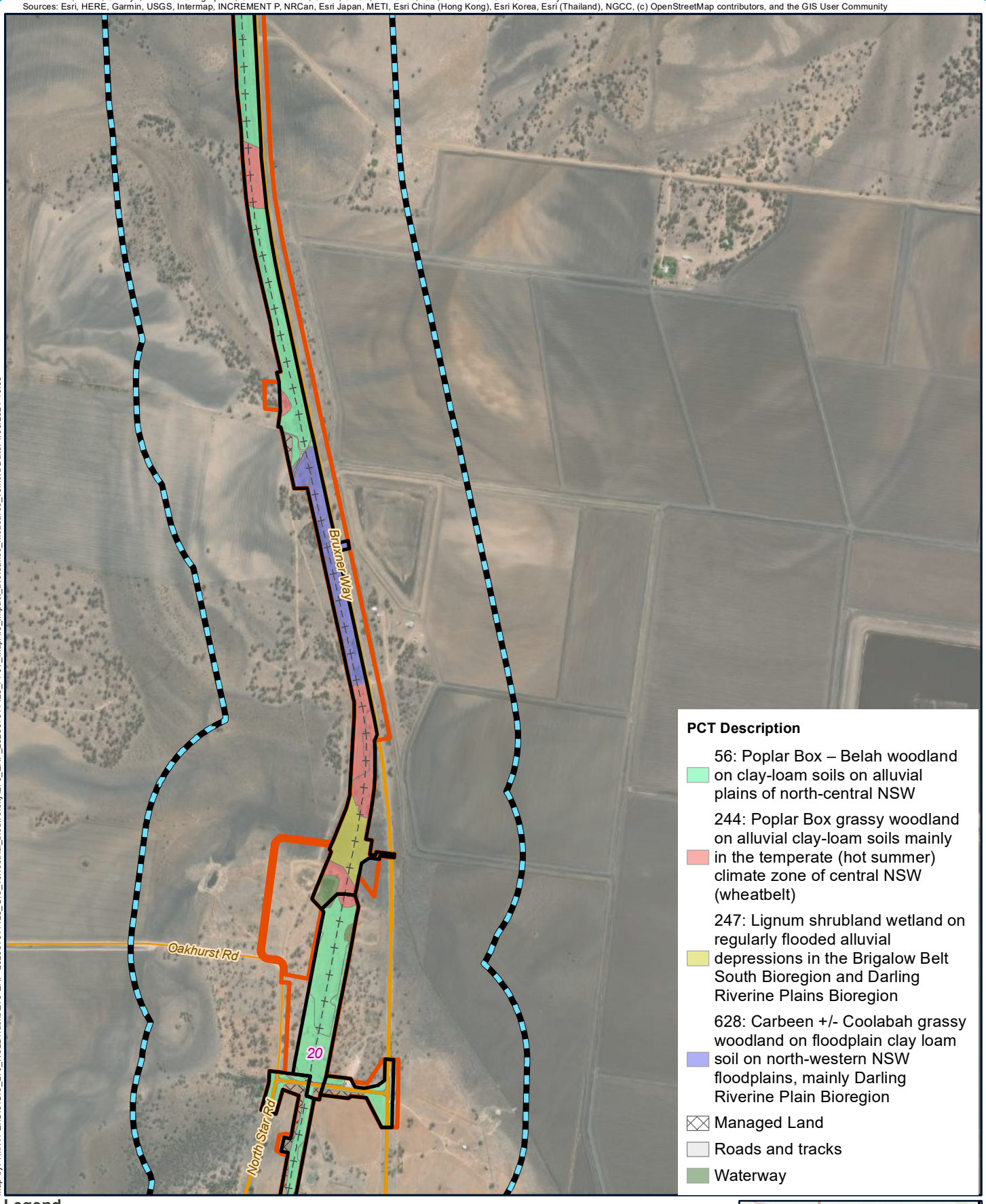
Date: 1/06/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6e:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

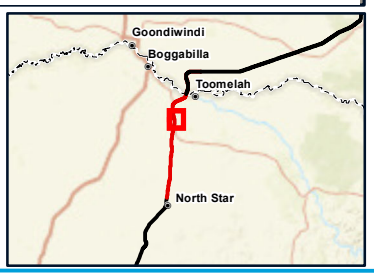


PCT Description

- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- 244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- 247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
- 628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
- Managed Land
- Roads and tracks
- Waterway

Legend

- Major roads
- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3

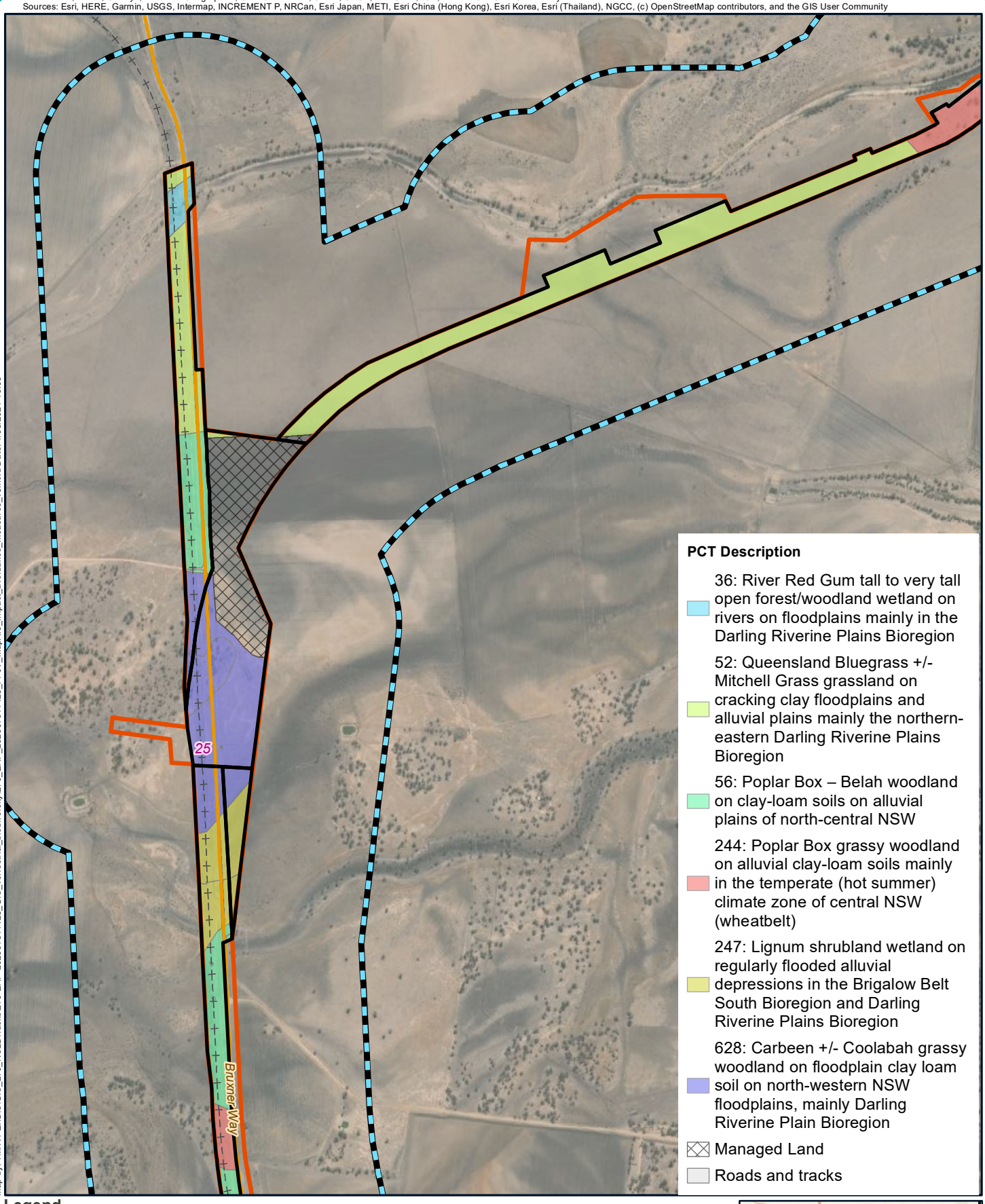
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6f: Impact avoidance measures

Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



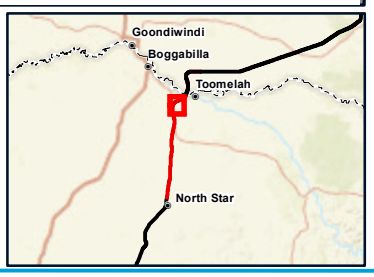
Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

- 36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
- 52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
- 56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- 244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- 247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
- 628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
- Managed Land
- Roads and tracks

Legend

- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

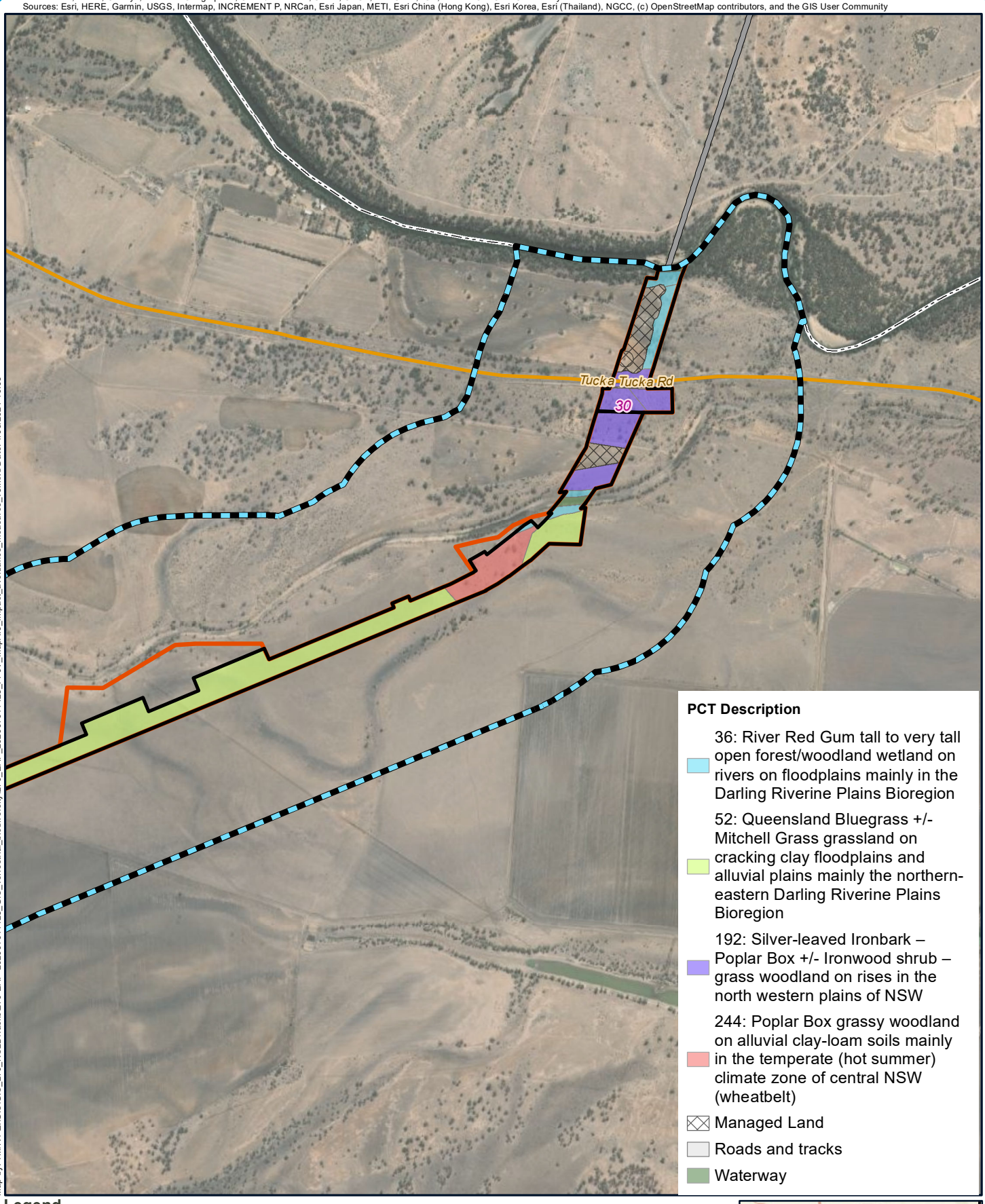
Date: 1/06/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6g: Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

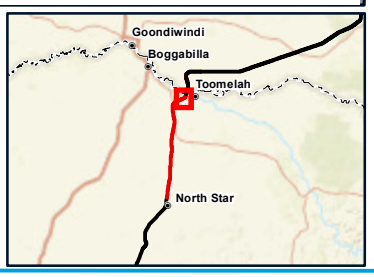


PCT Description

- 36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
- 52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
- 192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
- 244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
- Managed Land
- Roads and tracks
- Waterway

Legend

- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- NSW/QLD border
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3

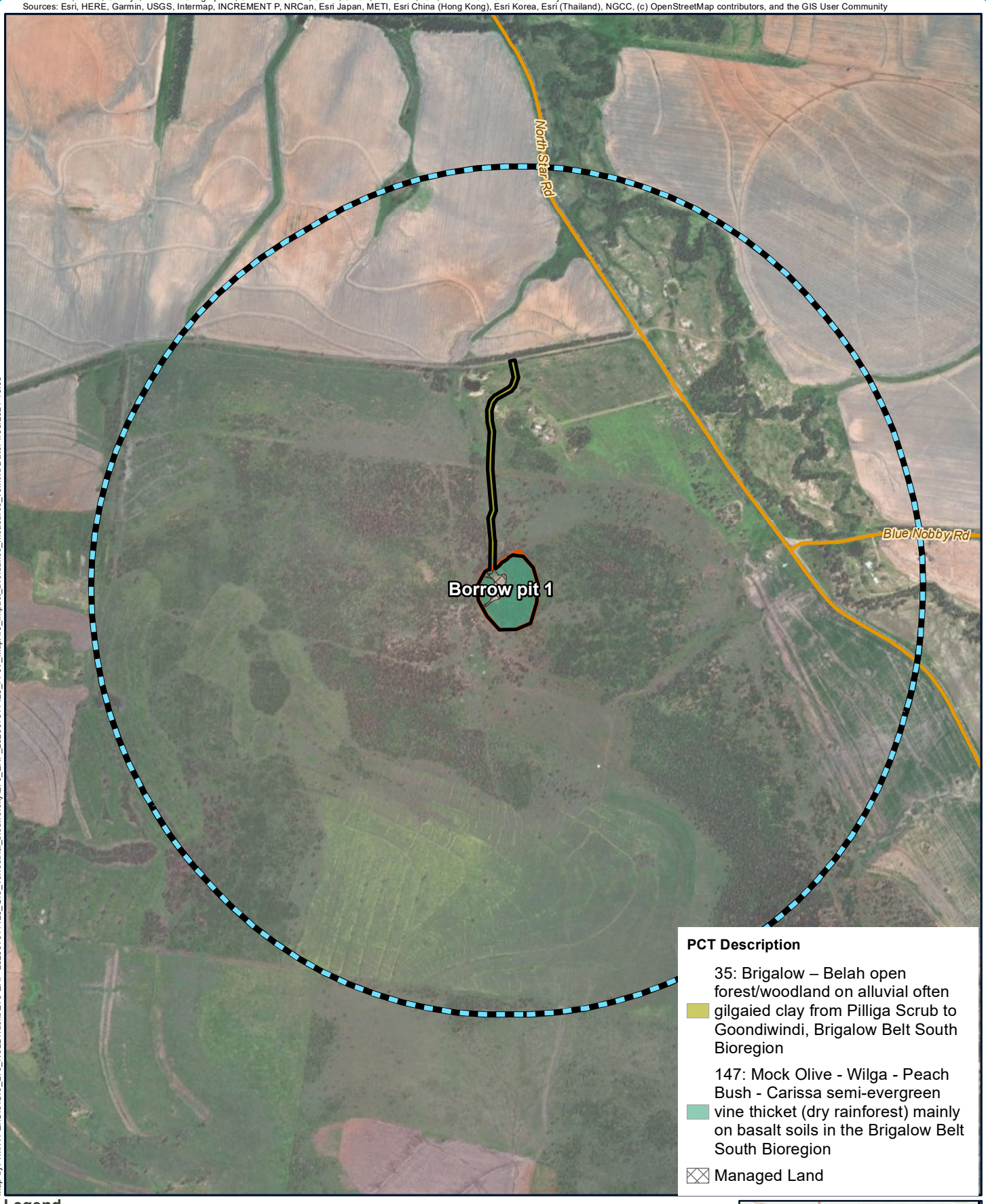
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6h:
Impact avoidance measures

Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



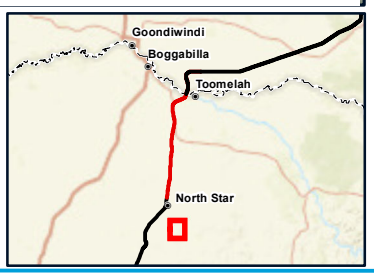
Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

- 35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
- 147: Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion
- Managed Land

Legend

- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



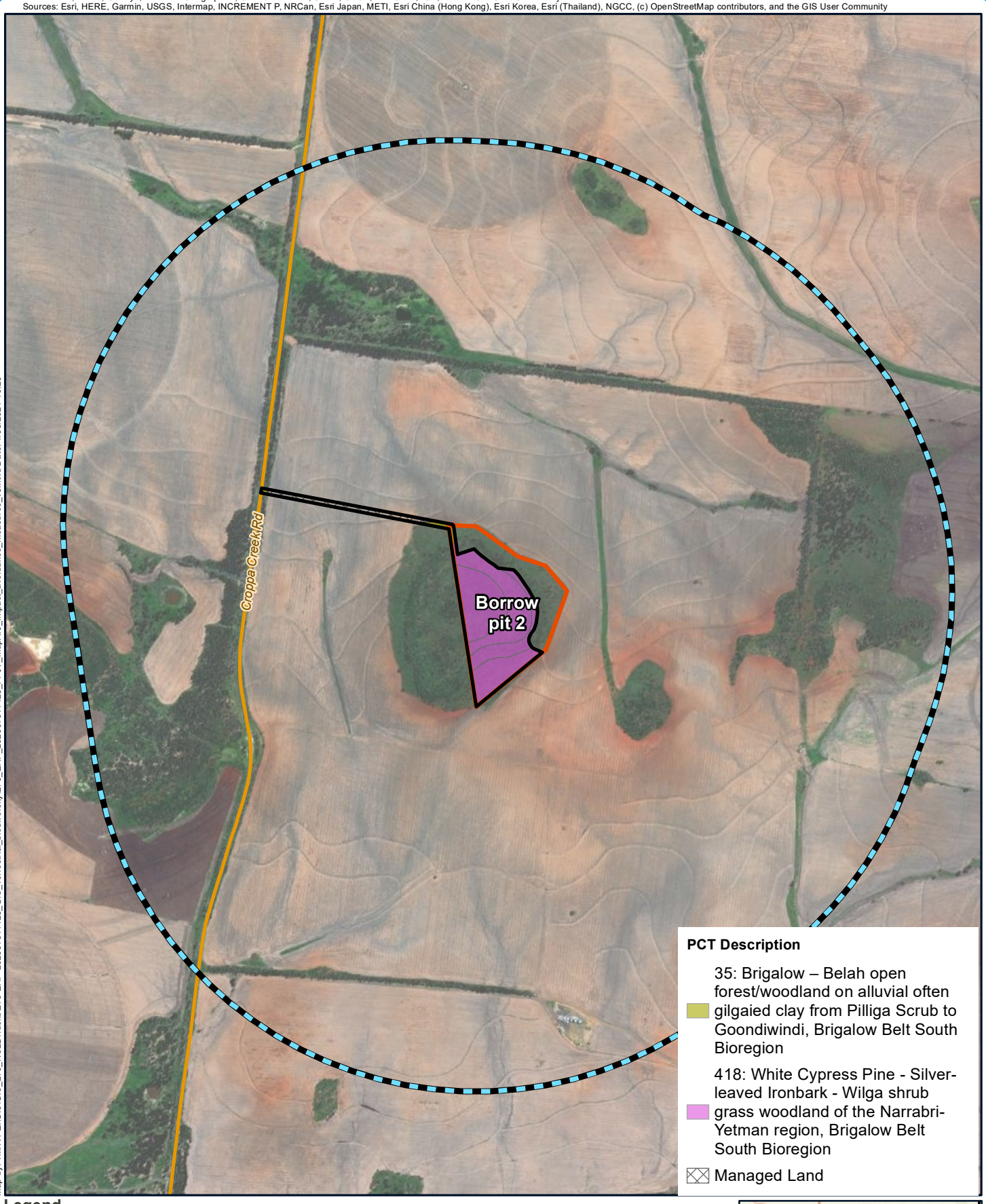
A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6i:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



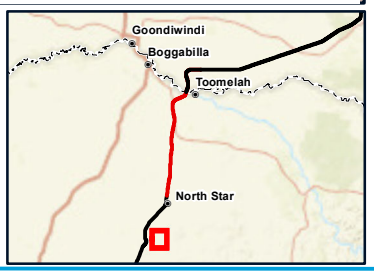
Map by: TM/RY Z:\GIS\GIS_270_NS2BITasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:26

PCT Description

- 35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
- 418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
- Managed Land

Legend

- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



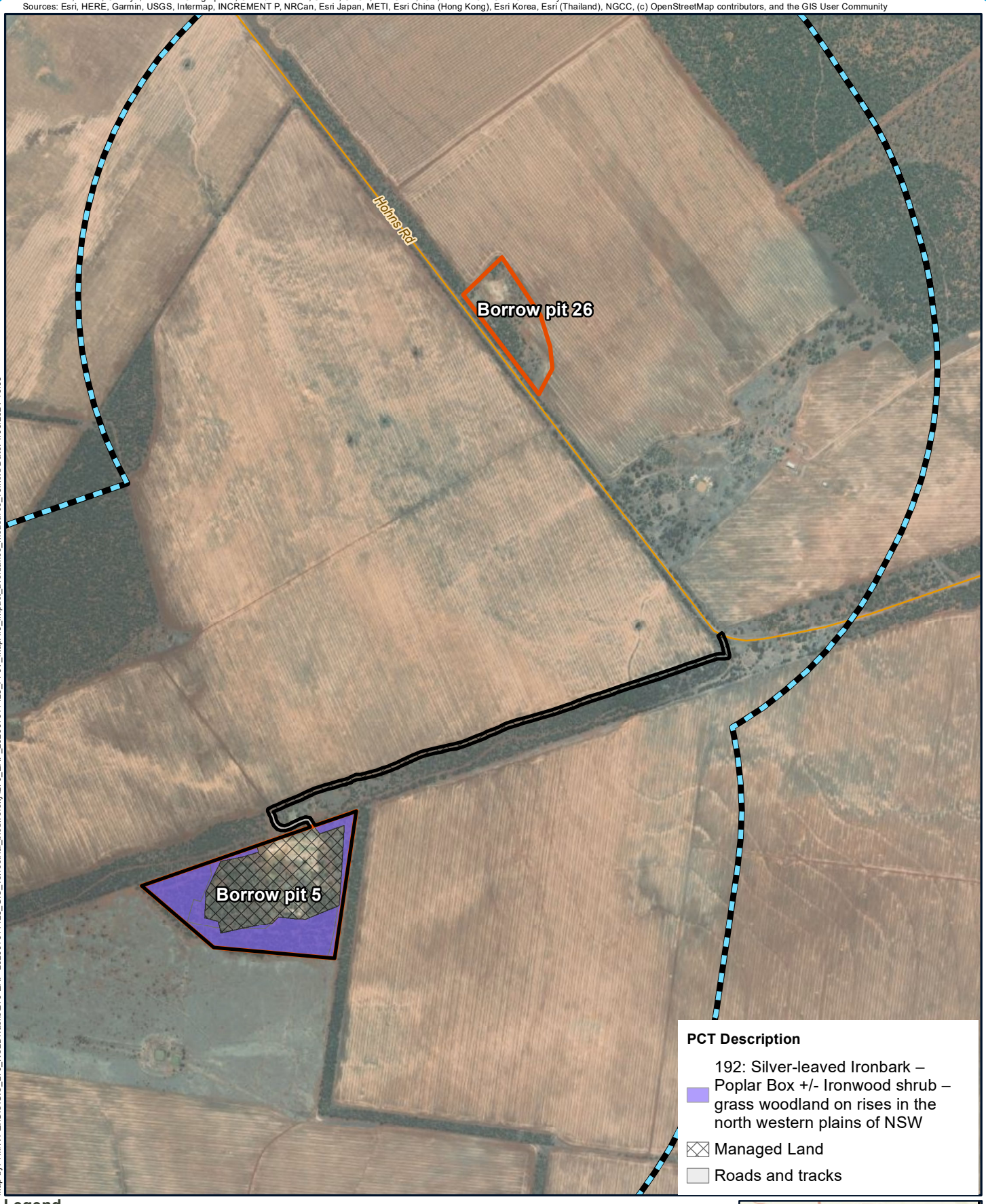
A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6j:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



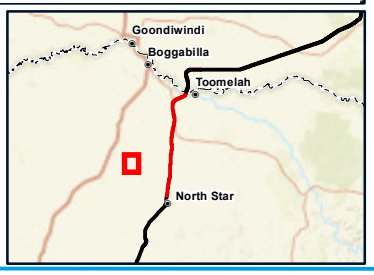
Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

- 192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
- Managed Land
- Roads and tracks

Legend

- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



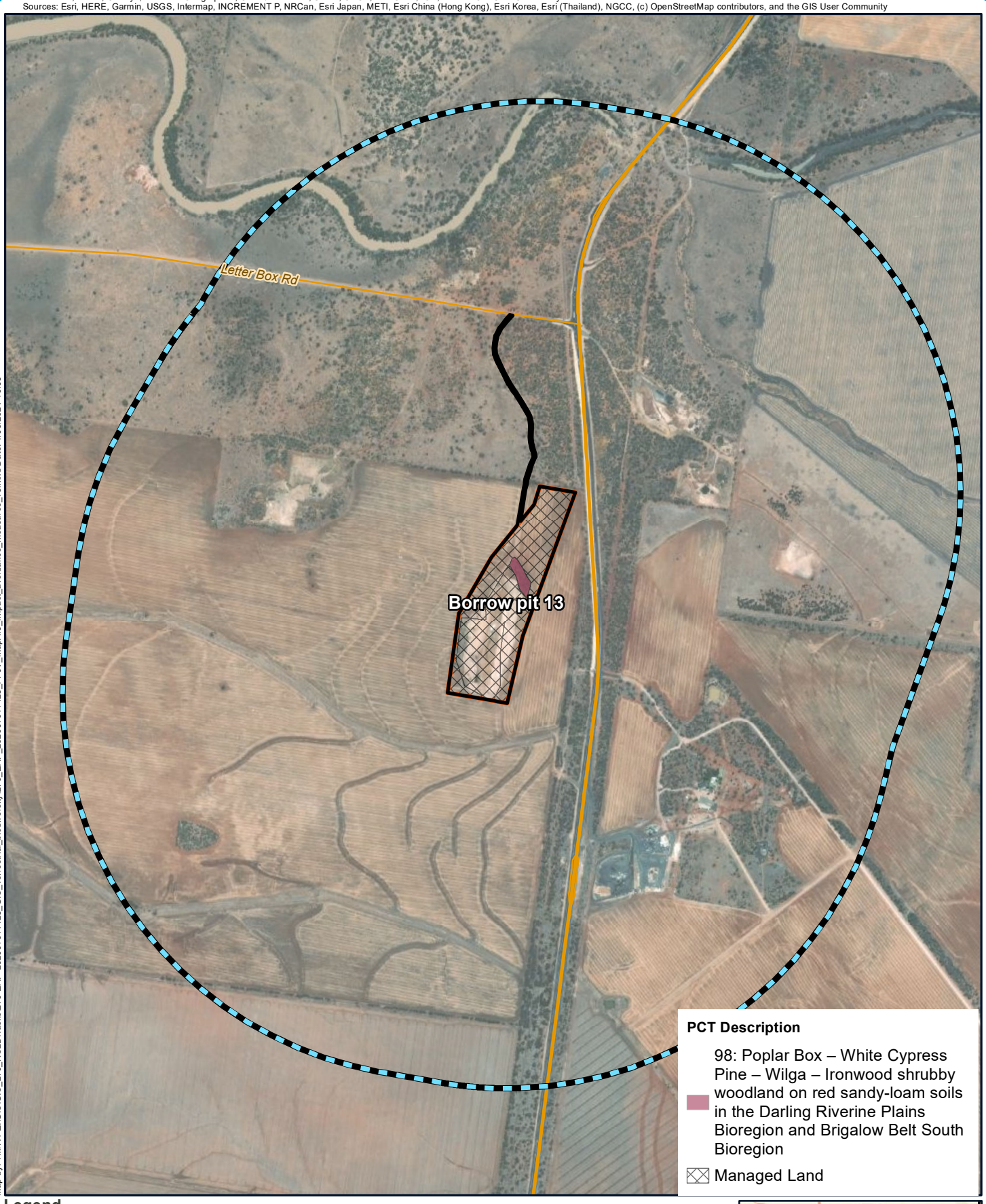
A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6k:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2BITasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

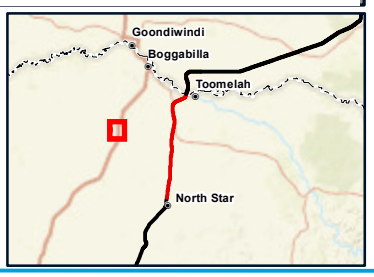
PCT Description

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Managed Land

Legend

- Major roads
- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6l: Impact avoidance measures

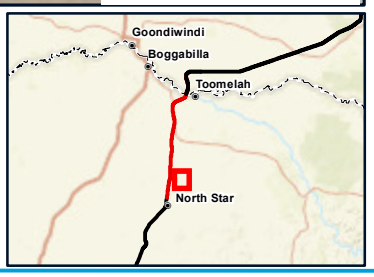
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

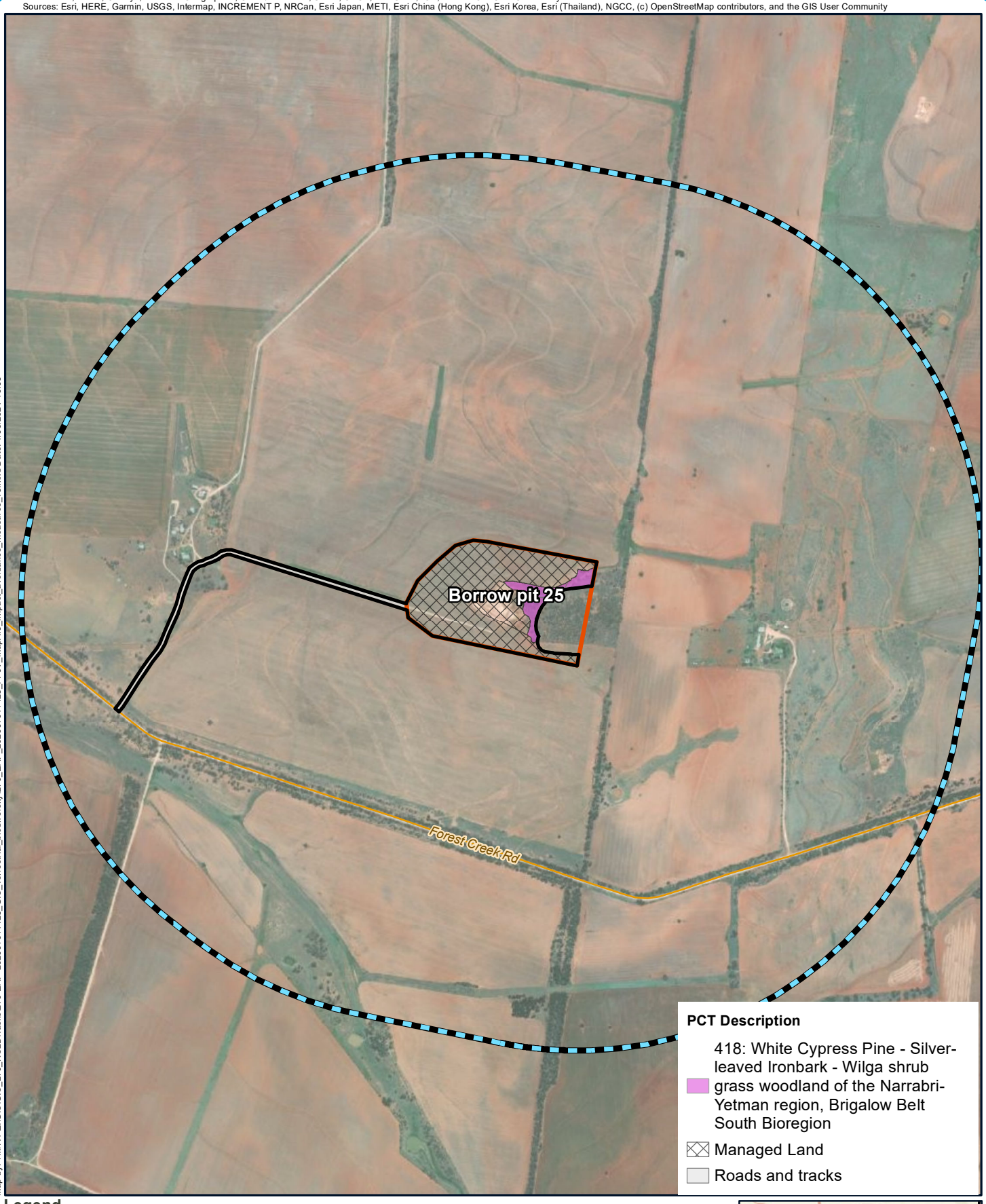
Date: 1/06/2021 Version: 3

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.6m:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



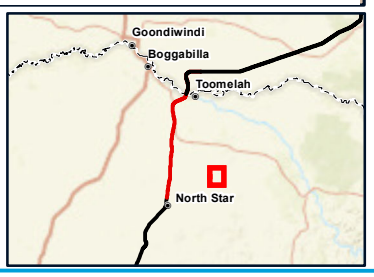
Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

- 418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
- Managed Land
- Roads and tracks

Legend

- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



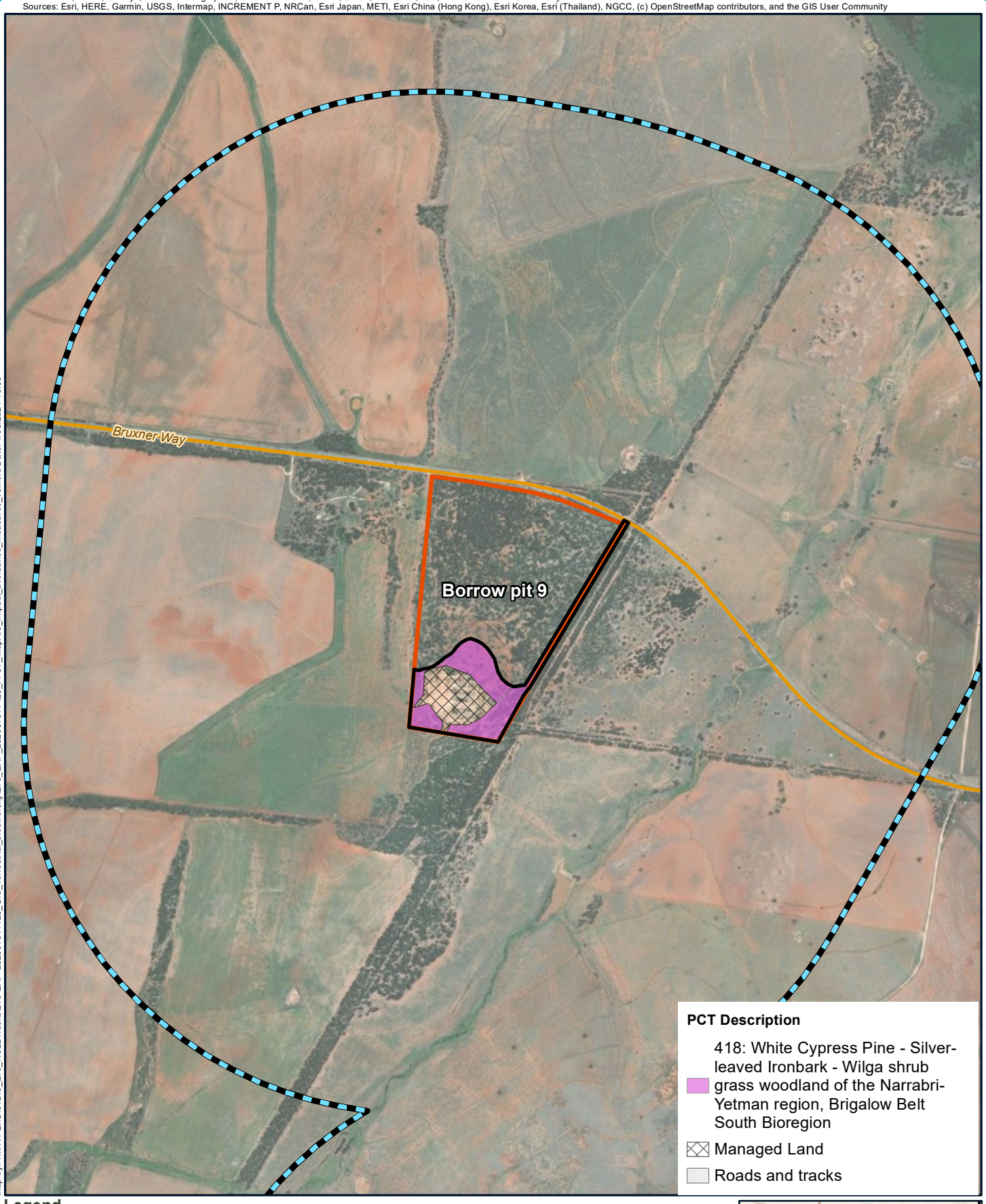
A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6n:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



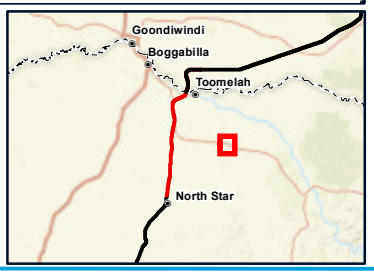
Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

- 418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
- Managed Land
- Roads and tracks

Legend

- Major roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land
- Revised subject land



A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6o:
Impact avoidance measures

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

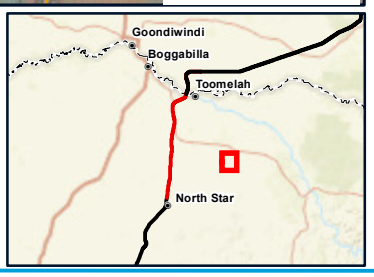


Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapA.6_Impact_avoidance_measures_v3.mxd Date: 1/06/2021 10:03

PCT Description

Legend

- Minor roads
- Existing rail (operational)
- Existing rail (non-operational)
- Study area
- Old subject land



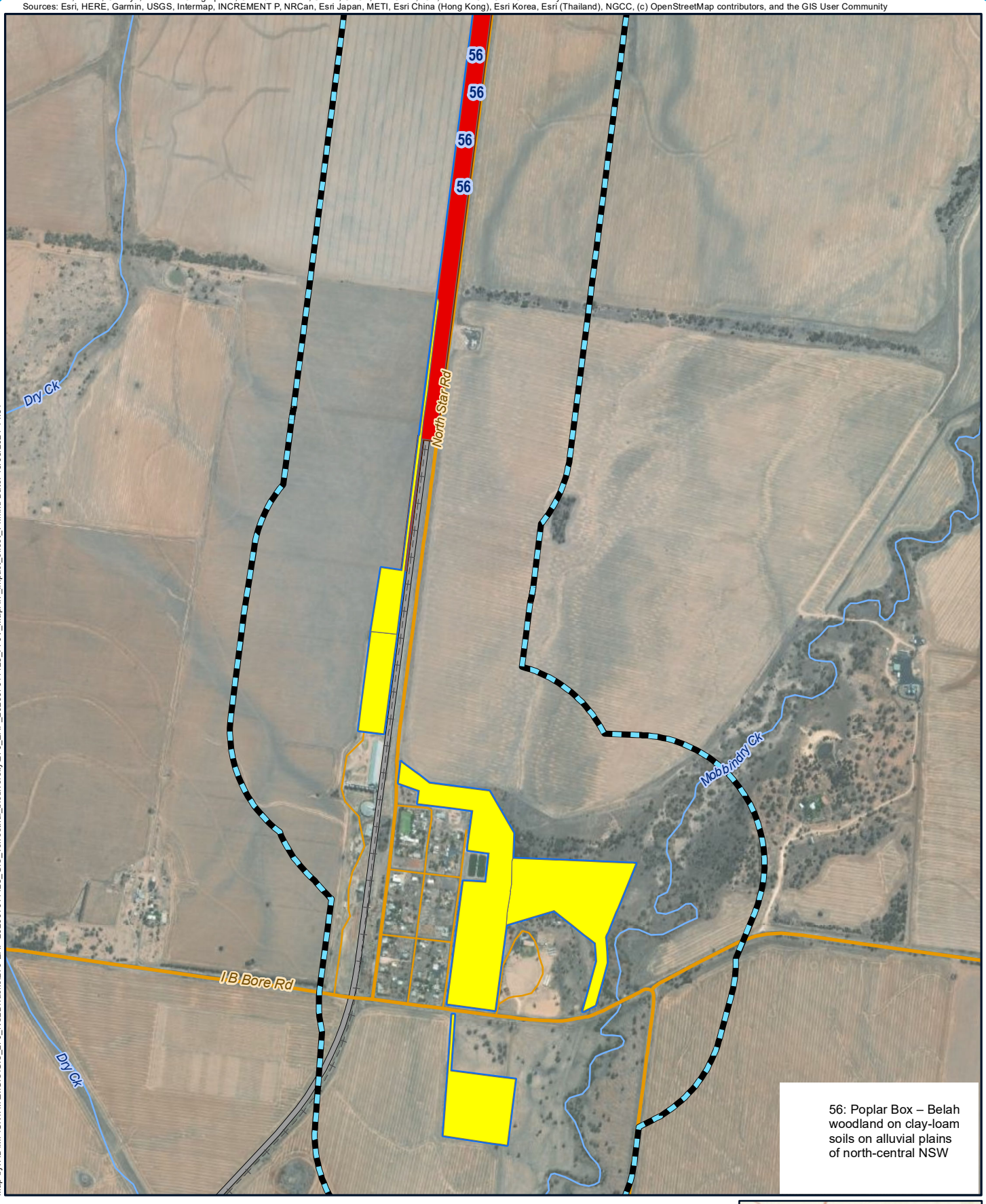
A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 1/06/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border
Map A.6p:
Impact avoidance measures

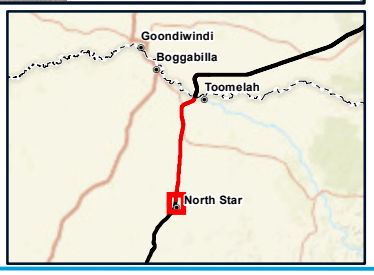
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

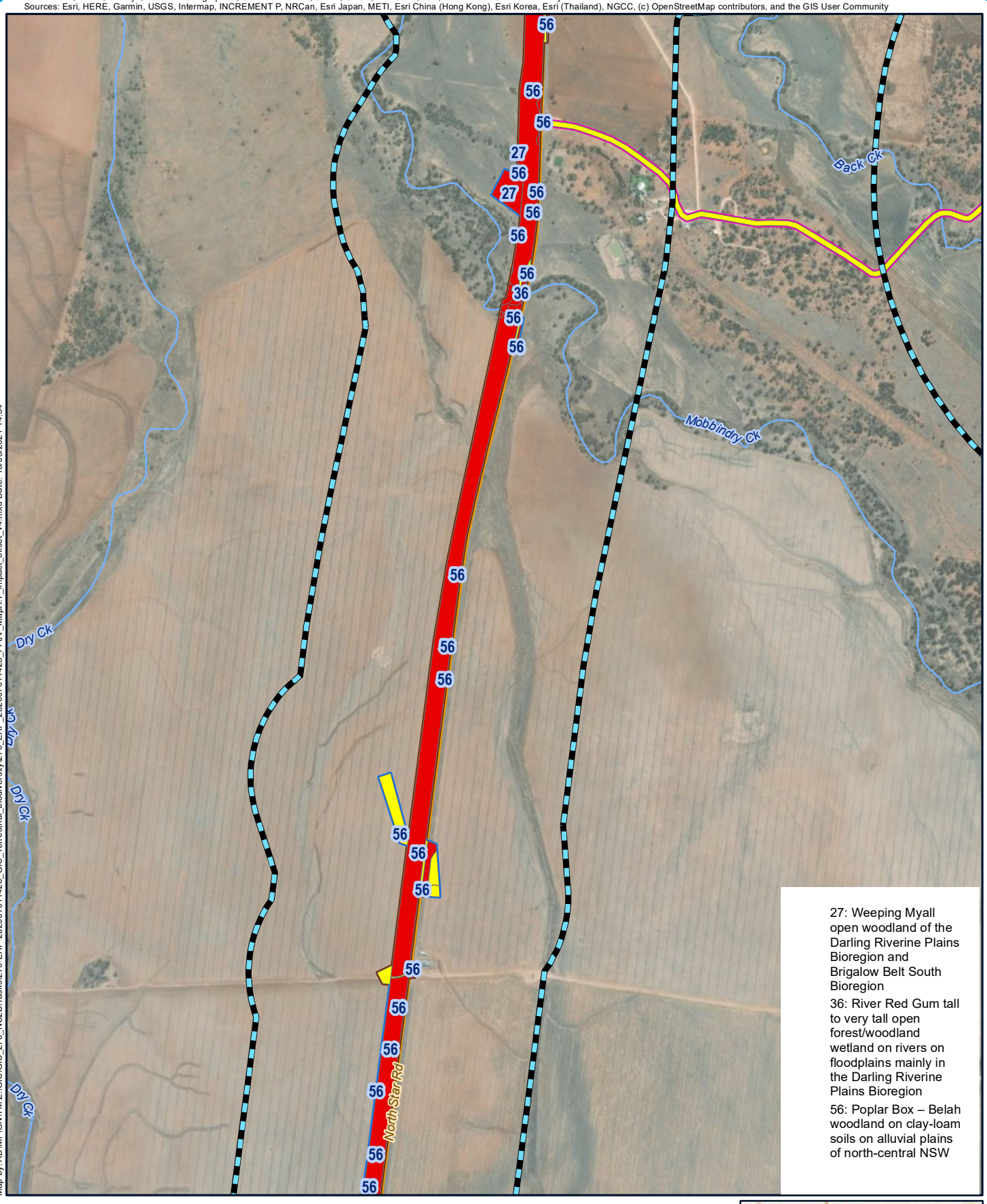
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7a:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

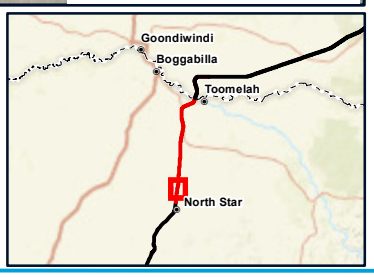
36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by:ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

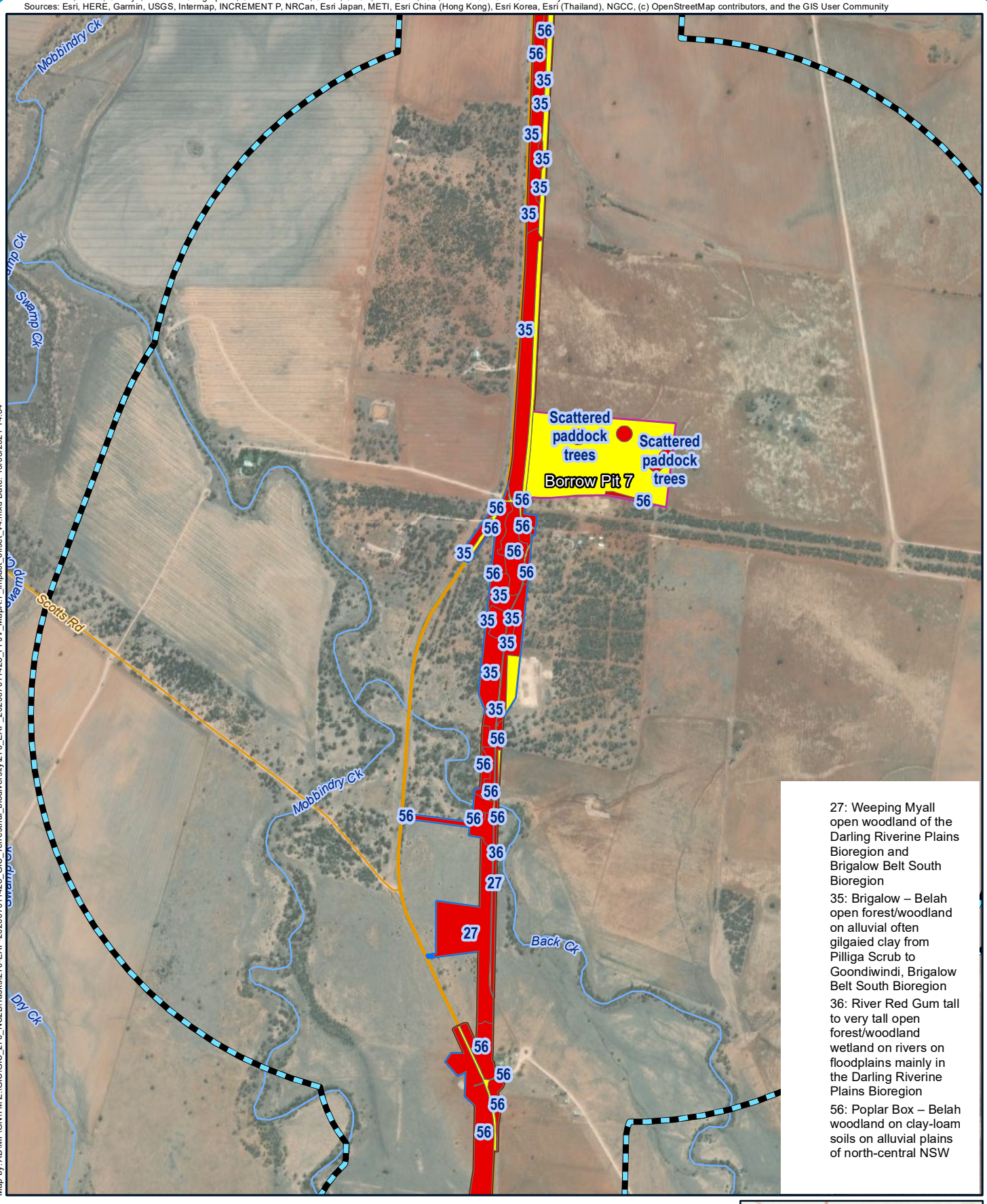
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7b:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

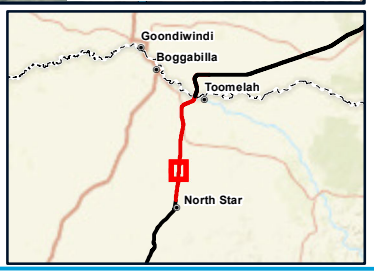
36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

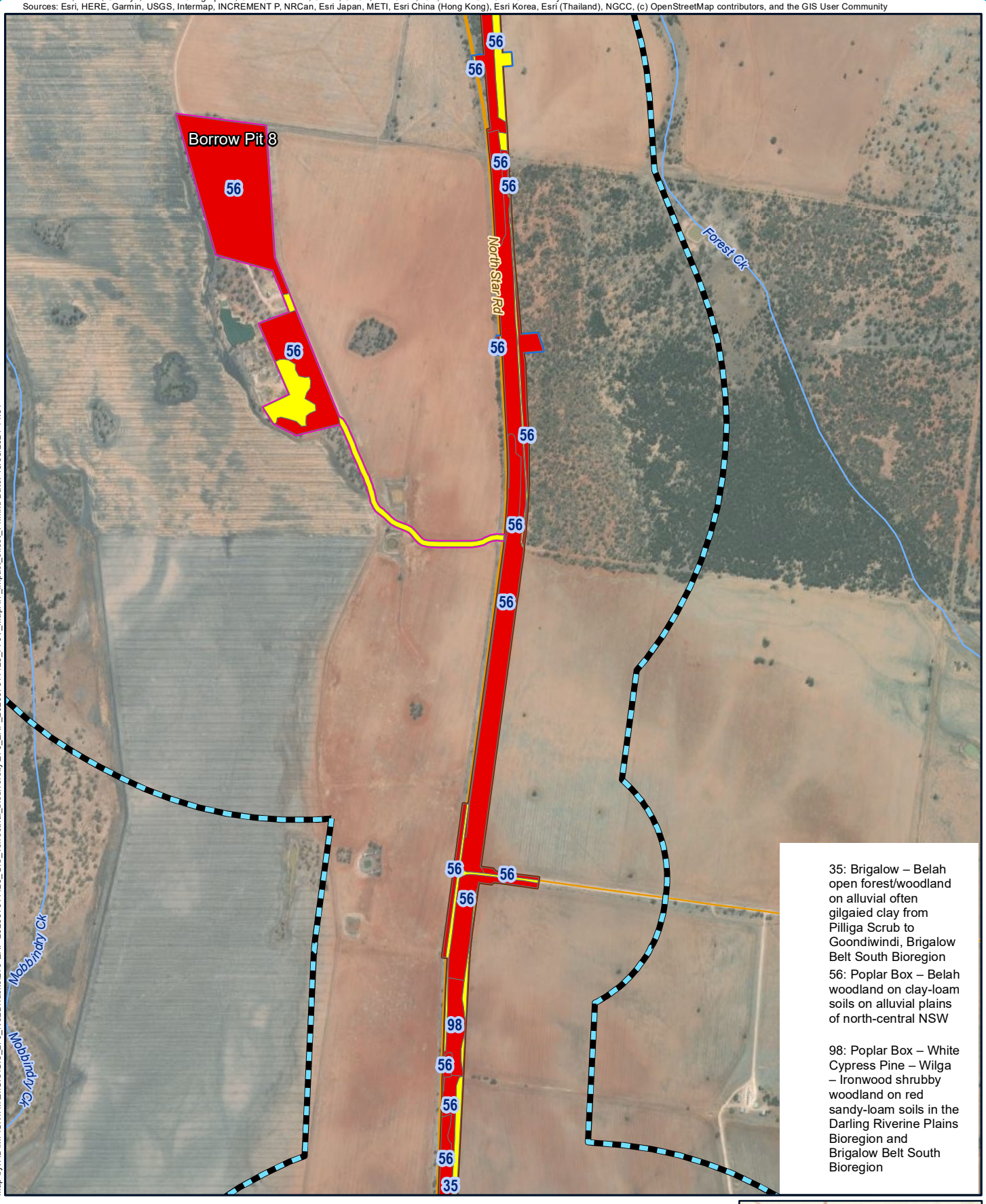
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7c:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

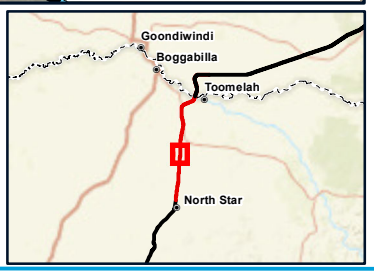
56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

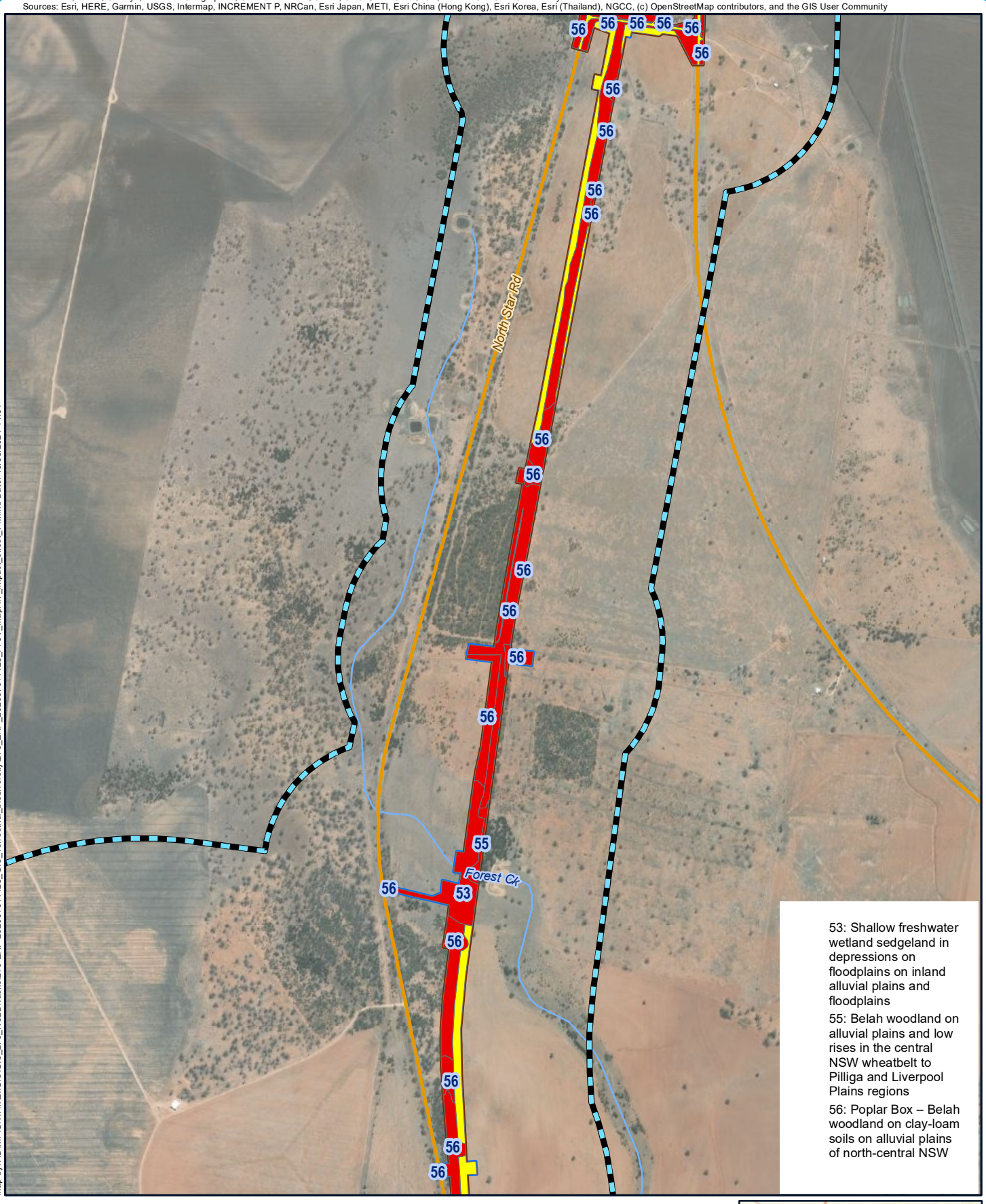
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7d:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

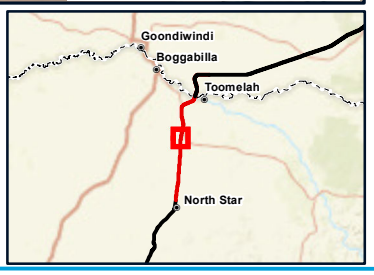
55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: ADMF\GN\TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

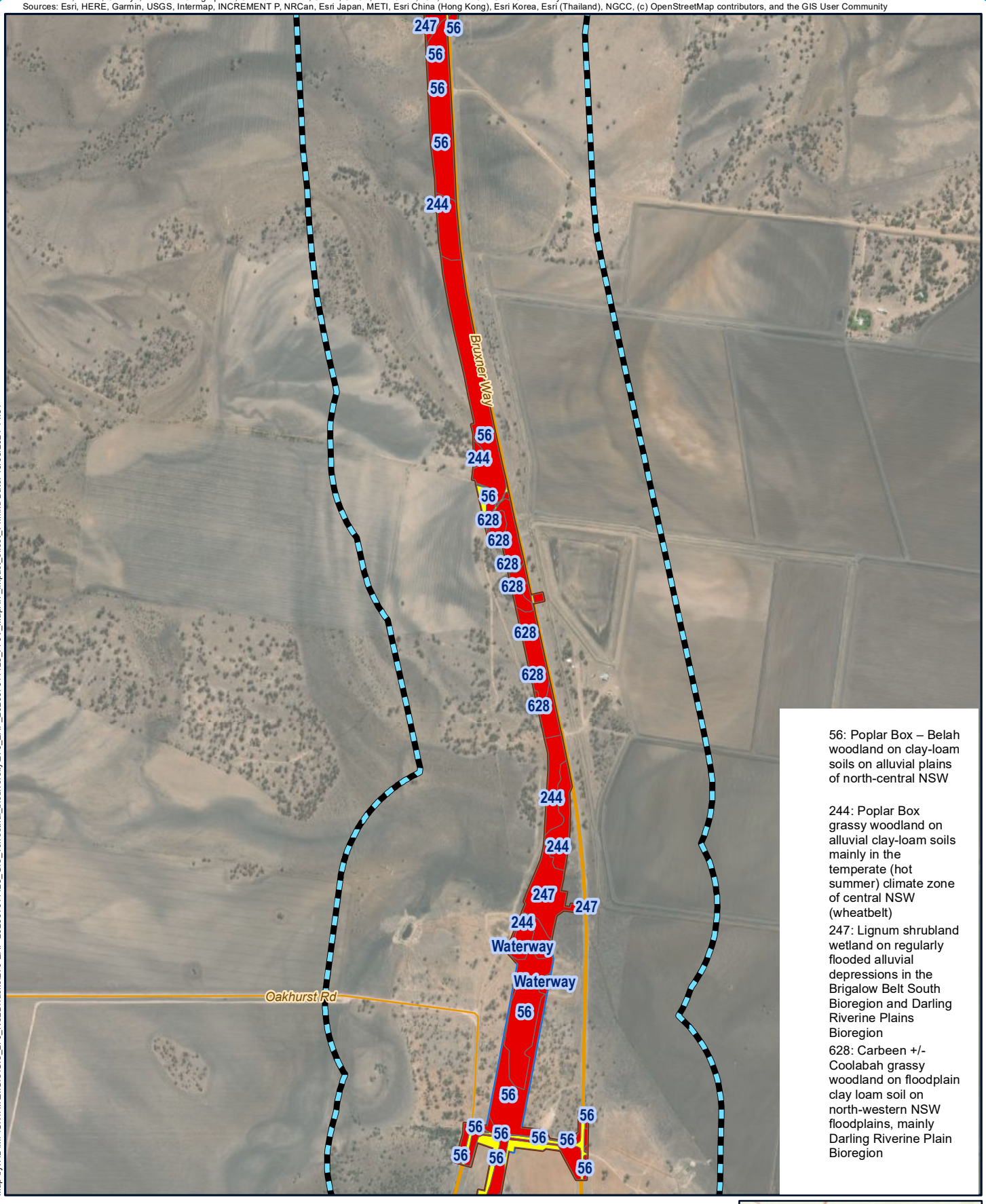
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7e:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

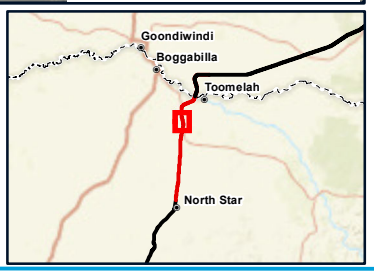
247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

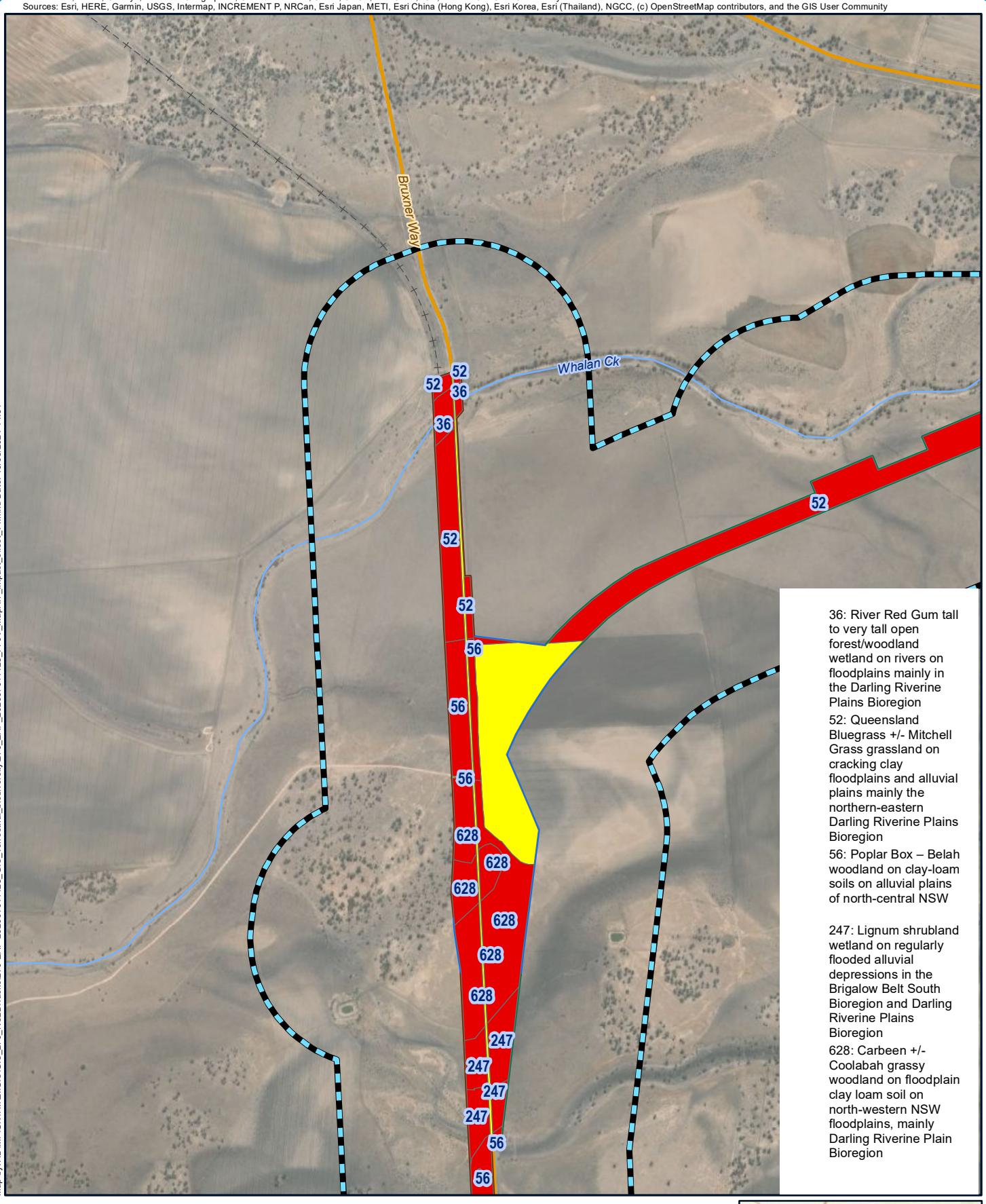
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7f:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

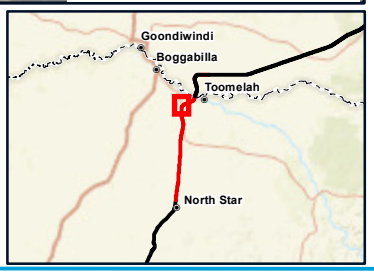
247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

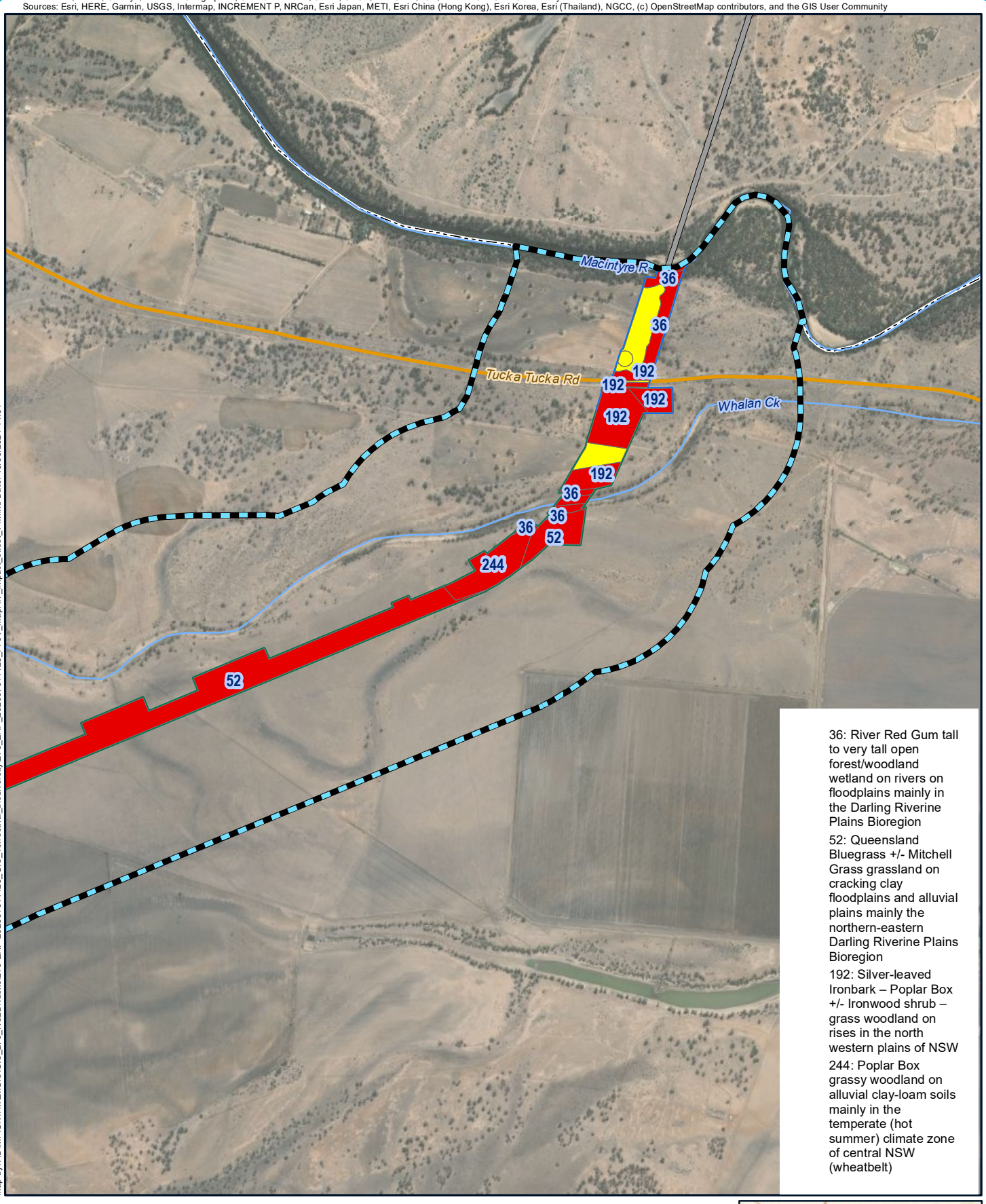
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7g:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

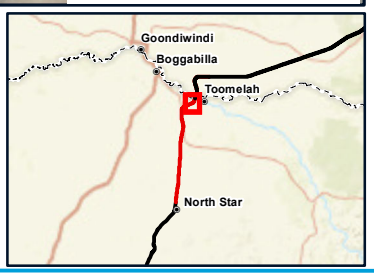
192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Adjoining alignments
- Major roads
- Watercourses
- Study area
- NSW/QLD border
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

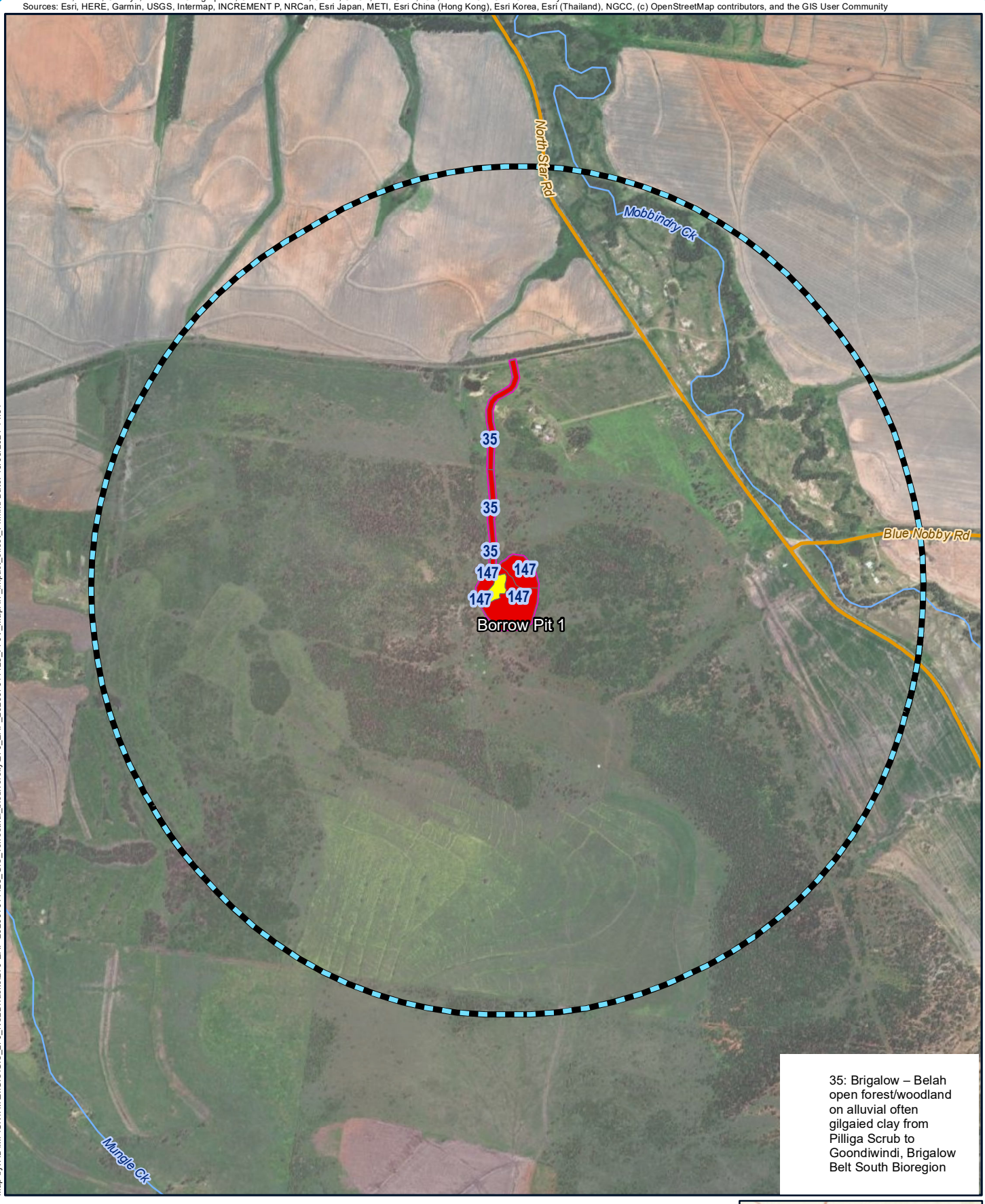
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7h:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

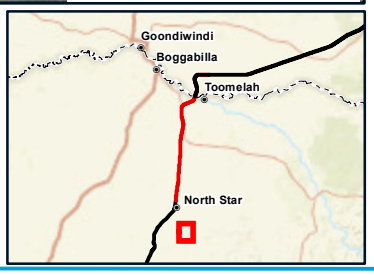


Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Legend

- Major roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

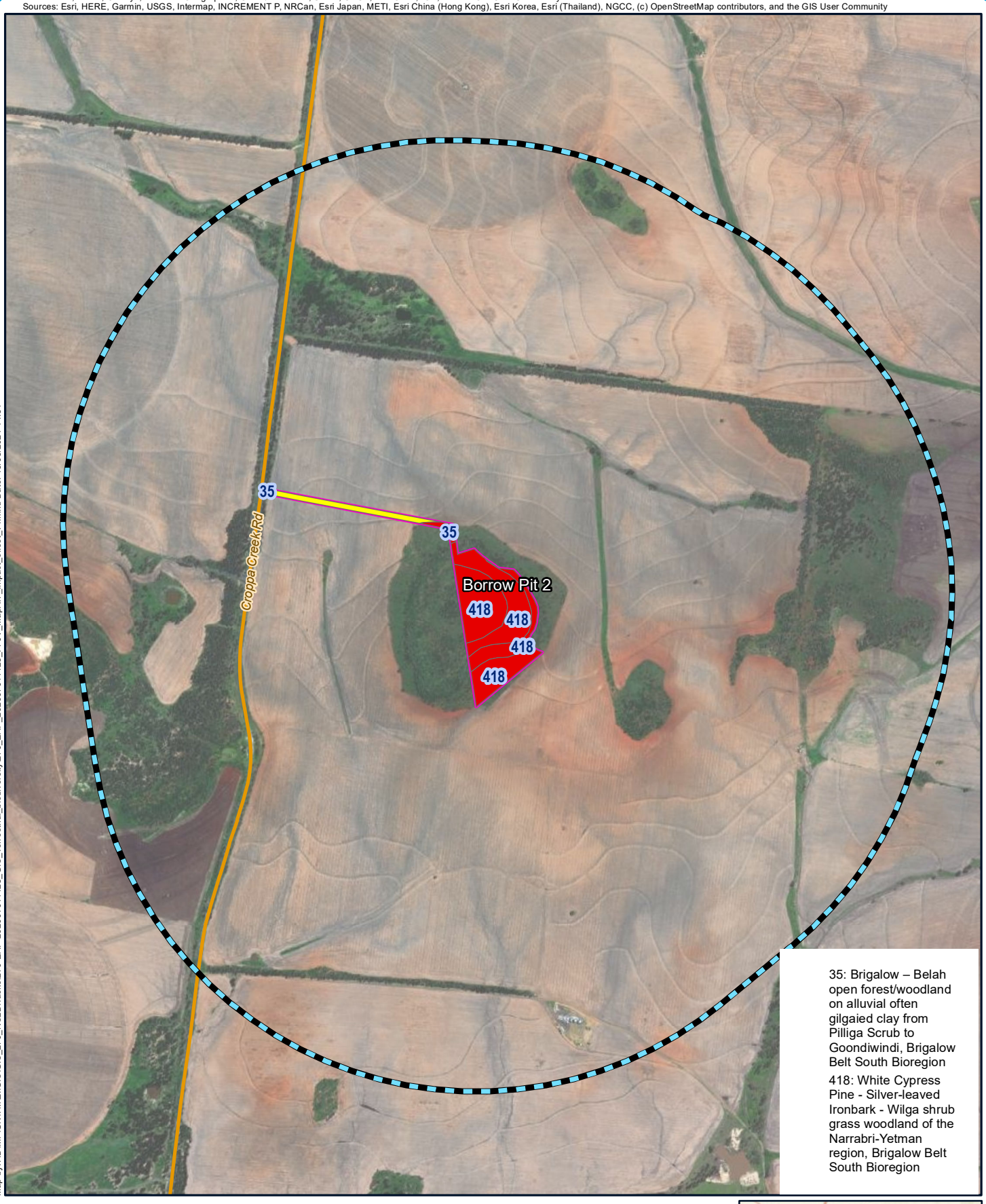
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7i:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



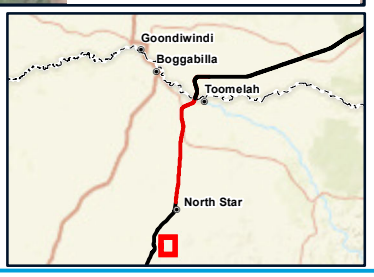
35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Major roads
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

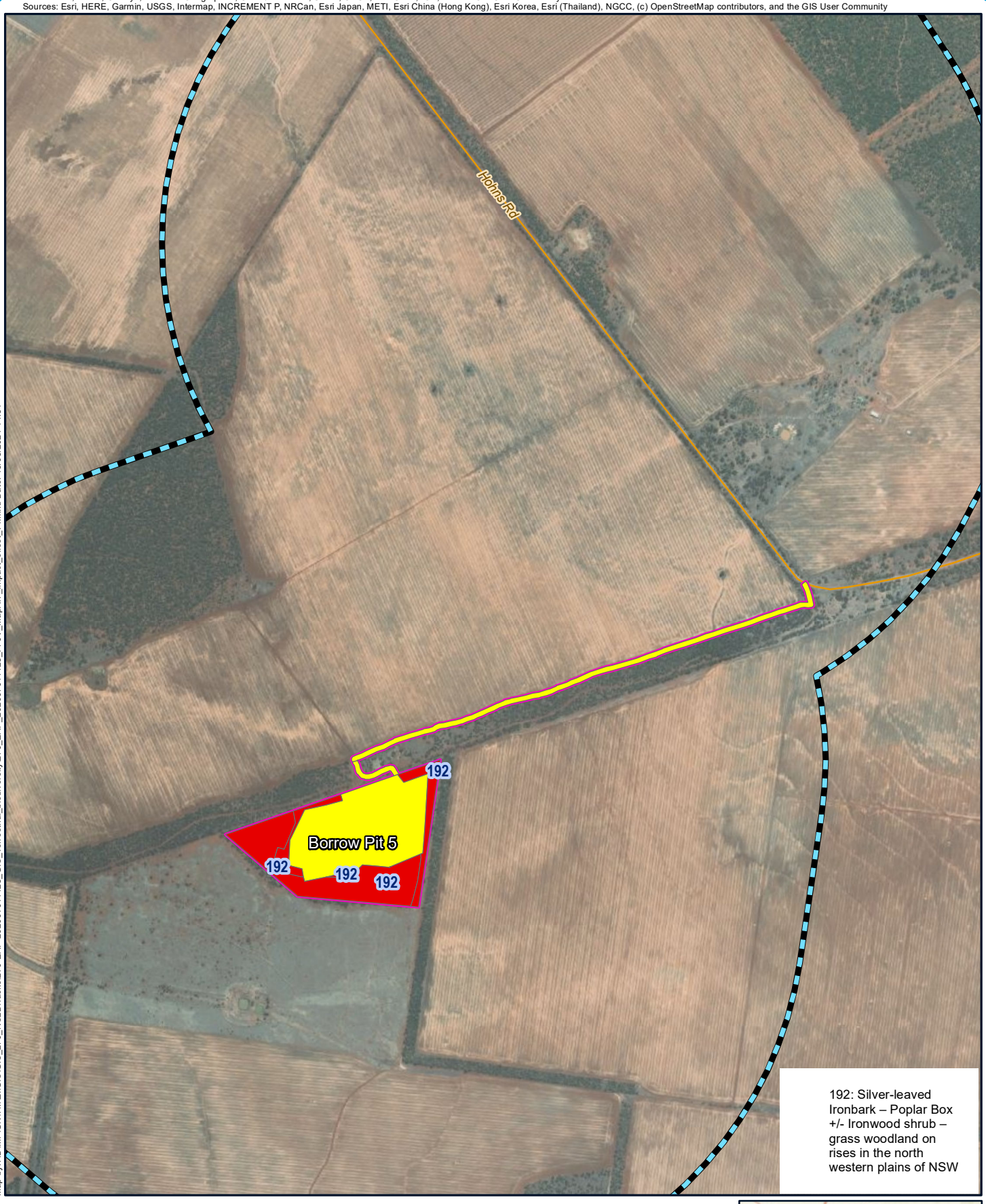
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7j:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

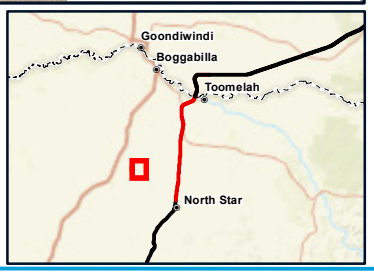


192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Minor roads
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

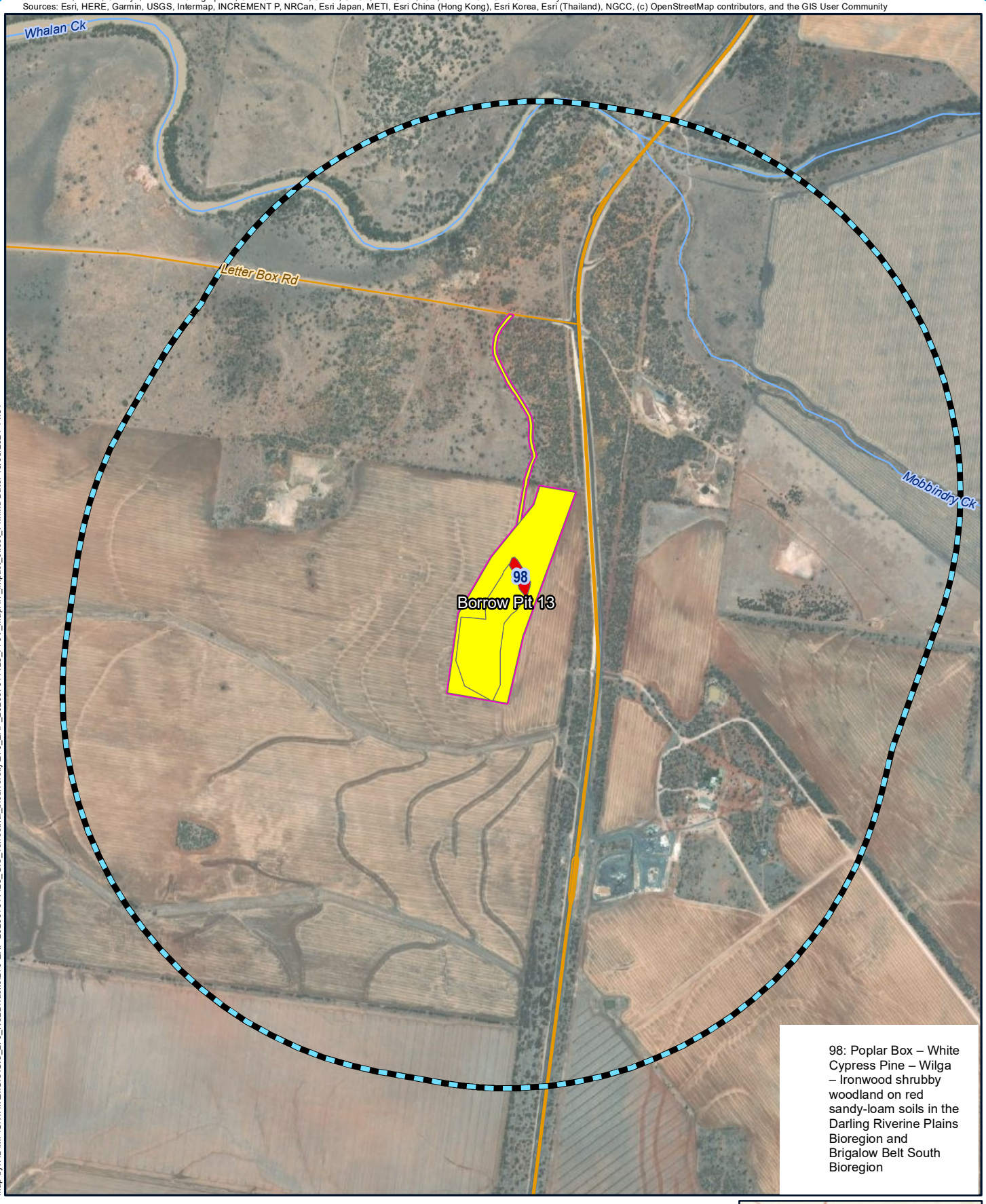
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7k:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

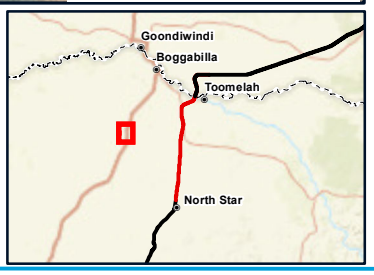


98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Major roads
- Minor roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

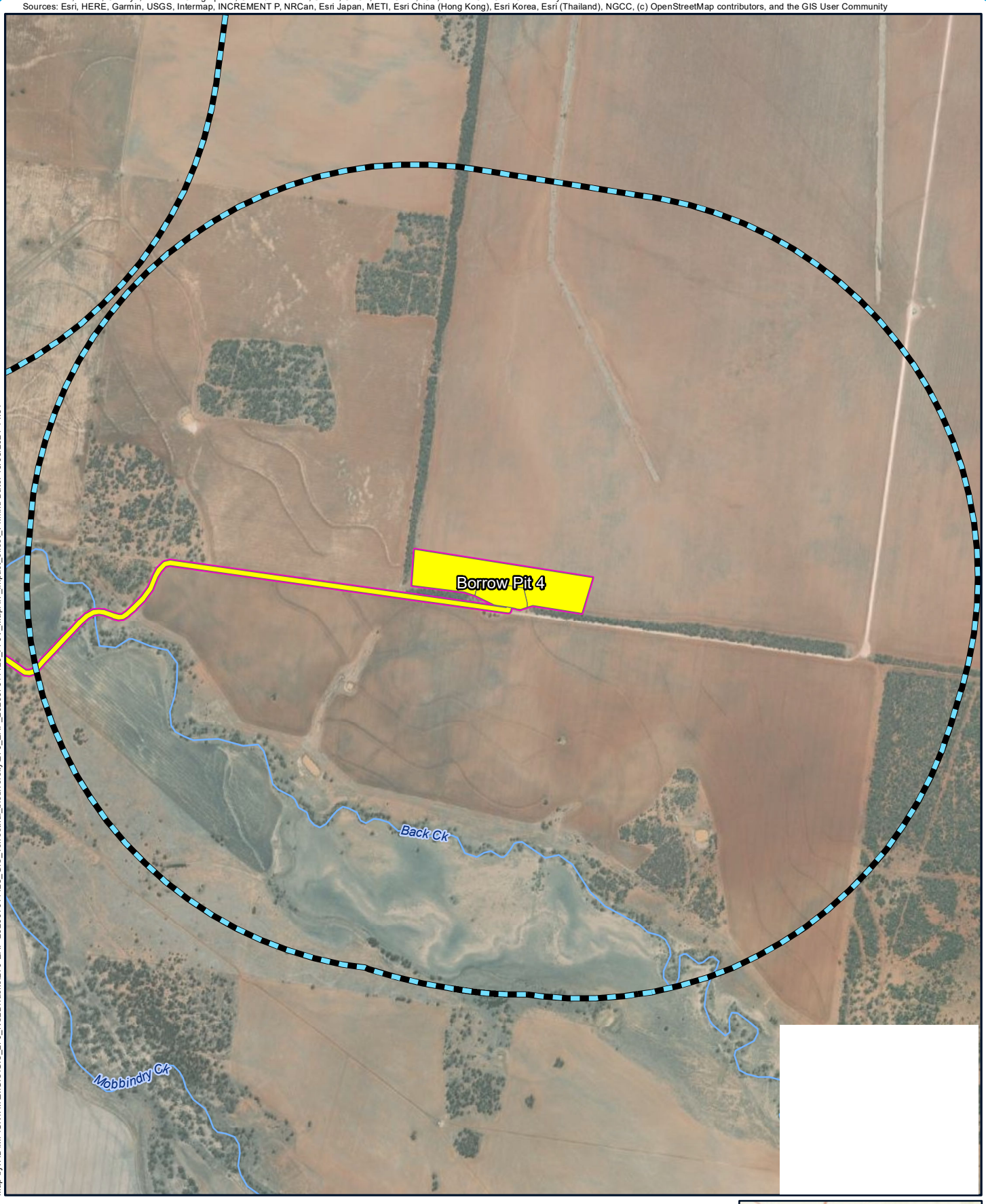
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7l:
Area of impacts requiring offset under BC Act

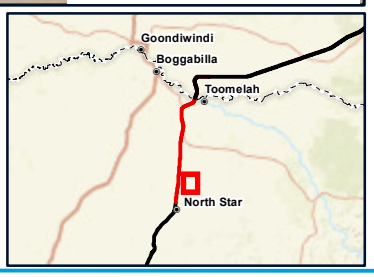
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Watercourses
- Study area
- Impacts not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

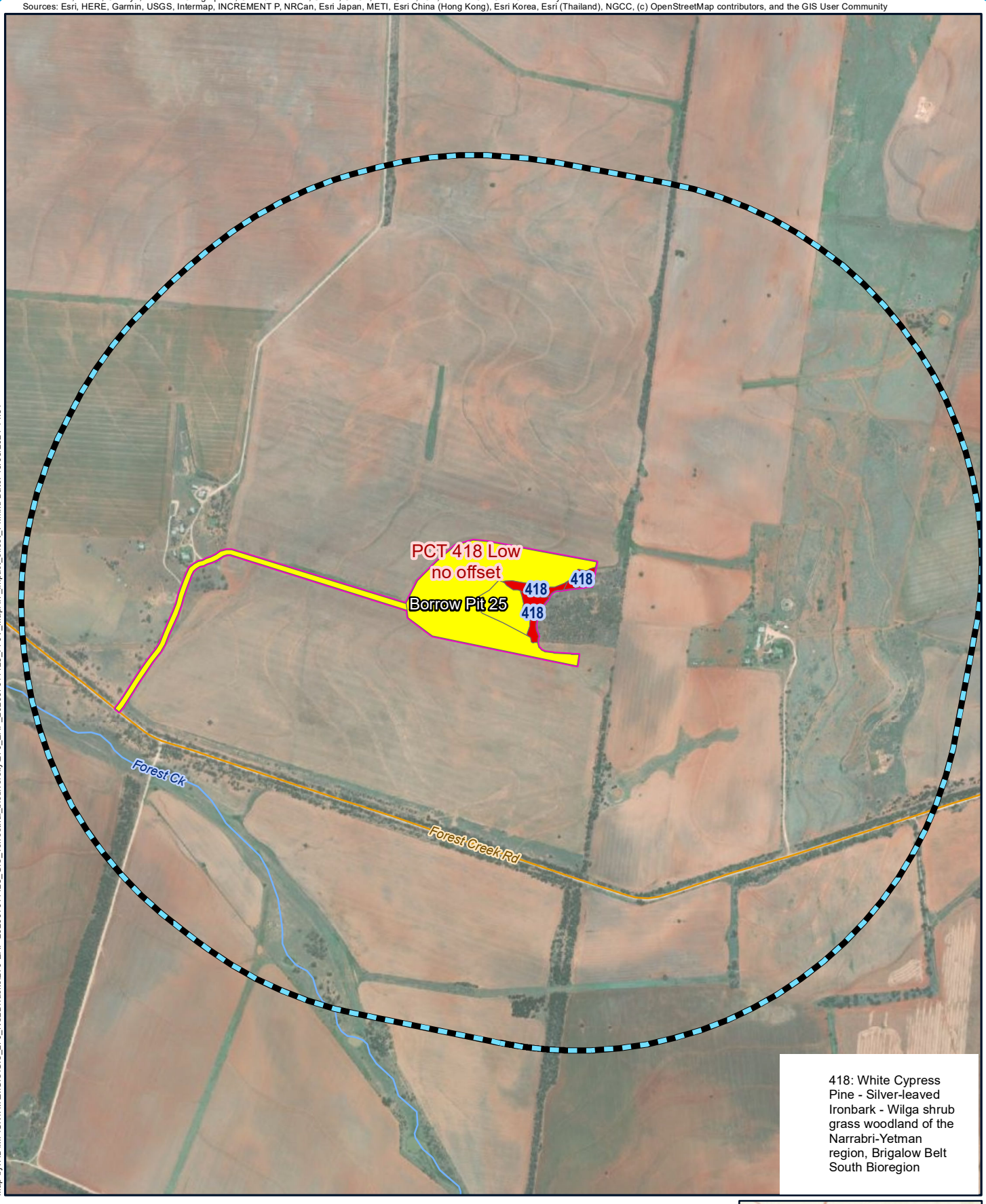
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7m:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

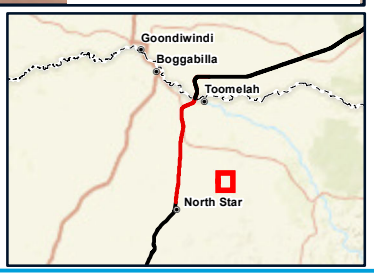


418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

Legend

- Minor roads
- Watercourses
- Study area
- Impacts requiring offset
- Impacts not requiring offset
- PCT 418 Low - not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

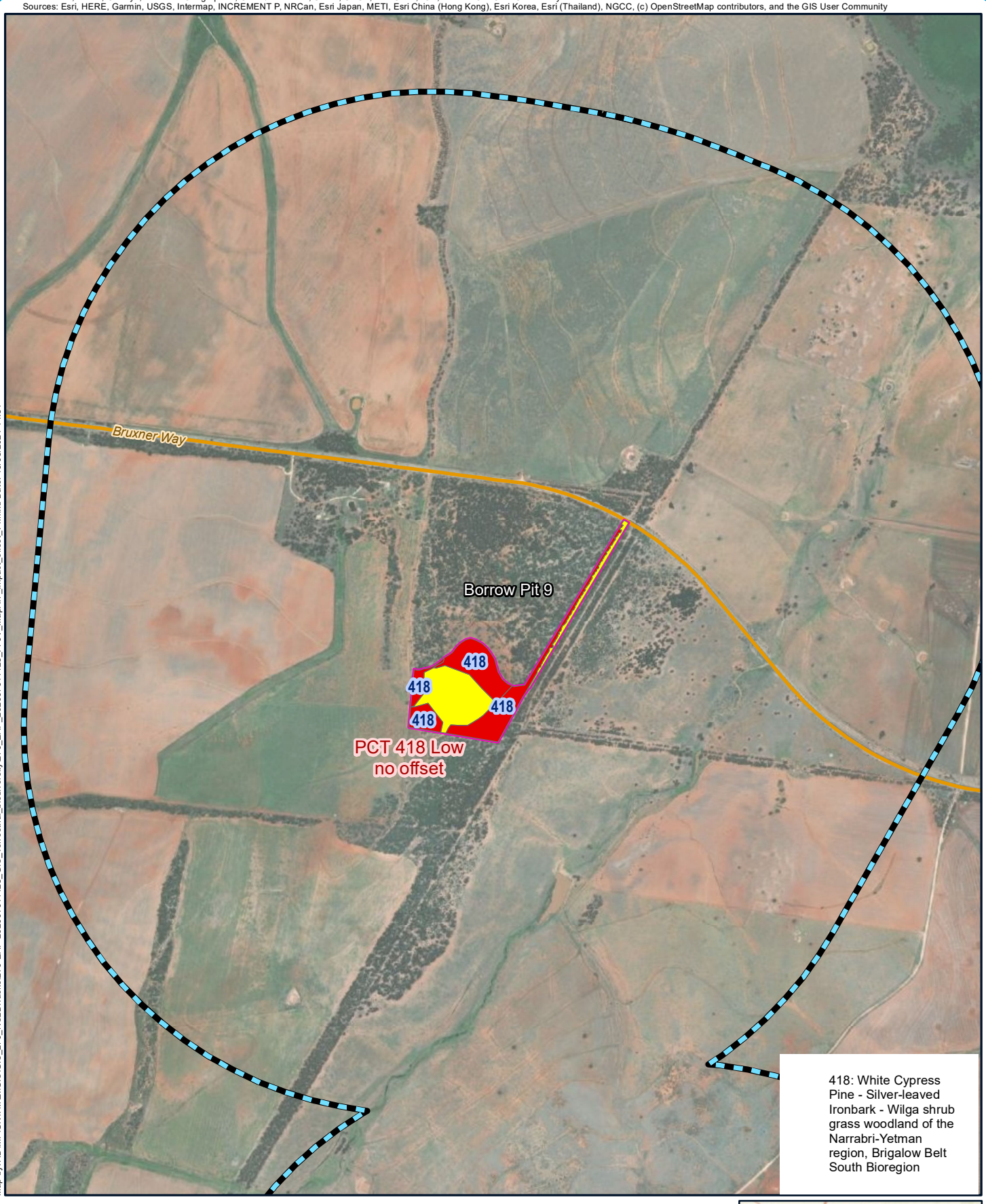
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7n:
Area of impacts requiring offset under BC Act

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

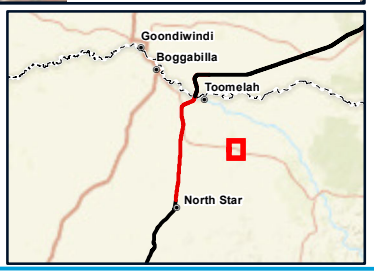


Map by: ADMF\GNTM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-202007011428_GIS_Terrestrial_biodiversity\270_EAP_202007011428_FFJV_MapA.7_impact_offset_v4.mxd Date: 13/05/2021 14:54

418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Legend

- Major roads
- Study area
- Impacts requiring offset
- Impacts not requiring offset
- PCT 418 Low - not requiring offset



A4 scale: 1:20,000

0 80 160 240 320 400 m

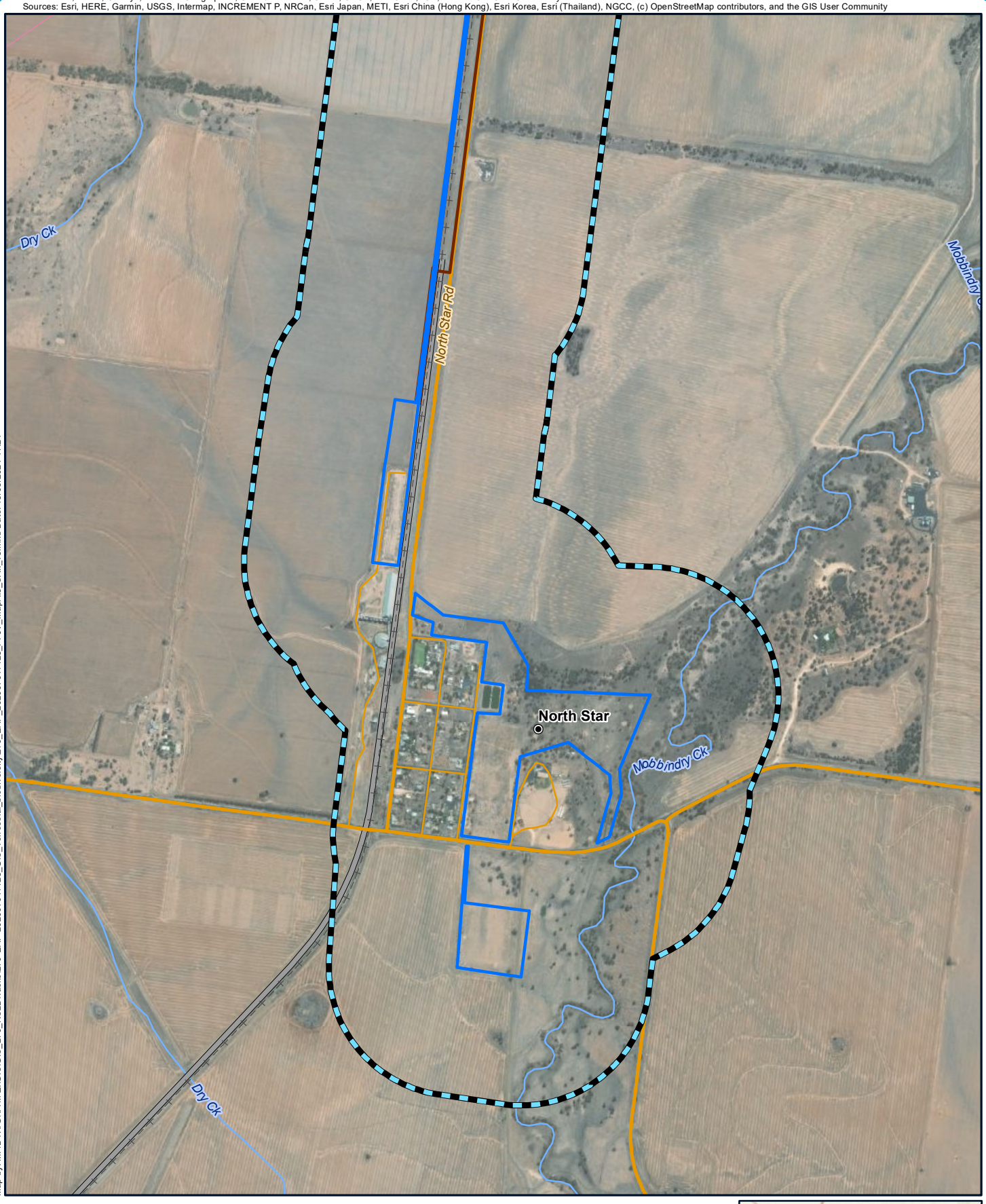
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.7o:
Area of impacts requiring offset under BC Act

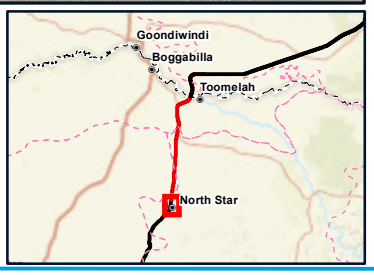
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Localities
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- Study area
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 80 160 240 320 400 m

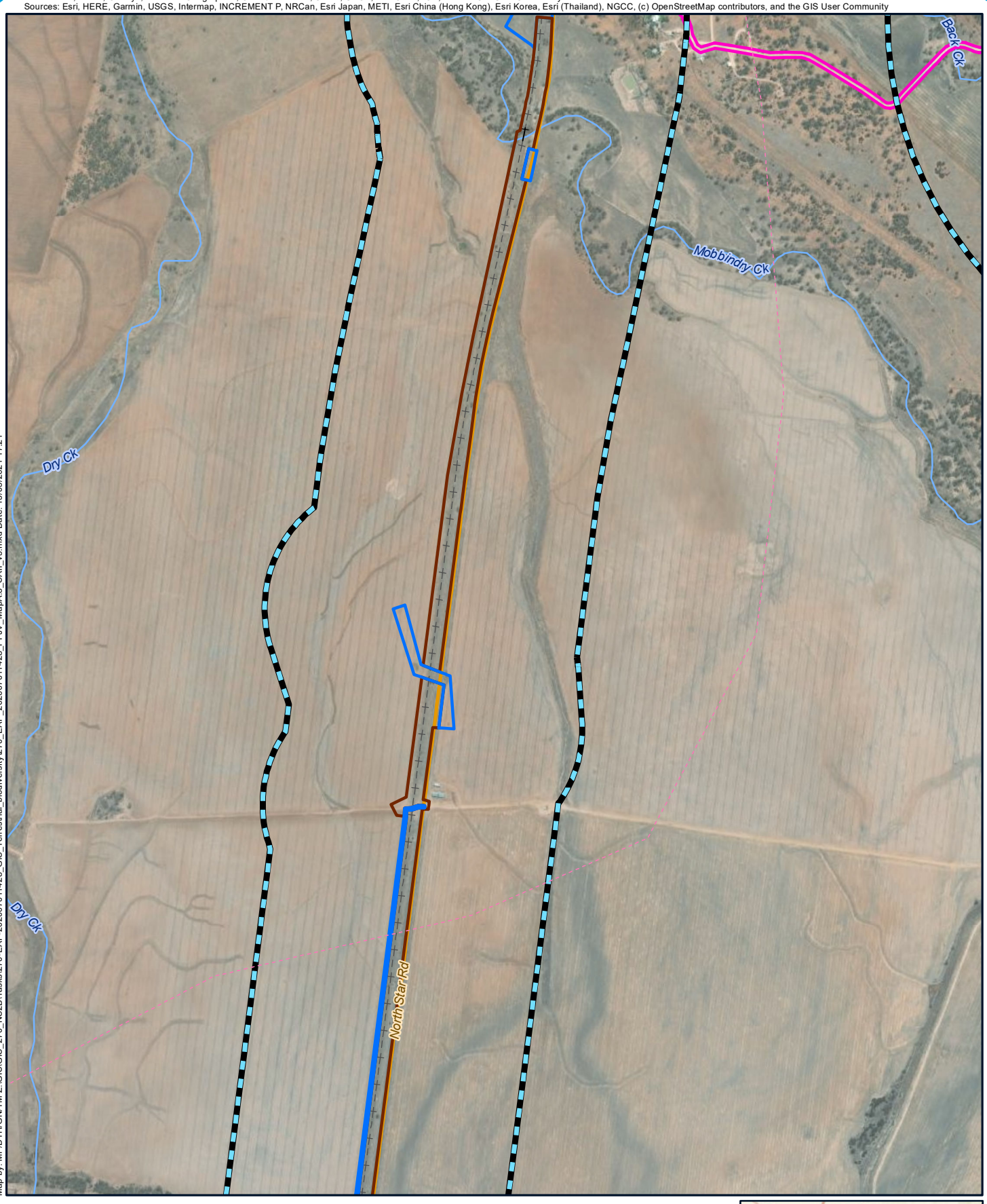
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8a: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

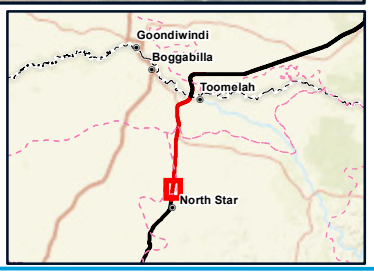
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Major roads
- Watercourses
- Study area
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000

0 80 160 240 320 400 m

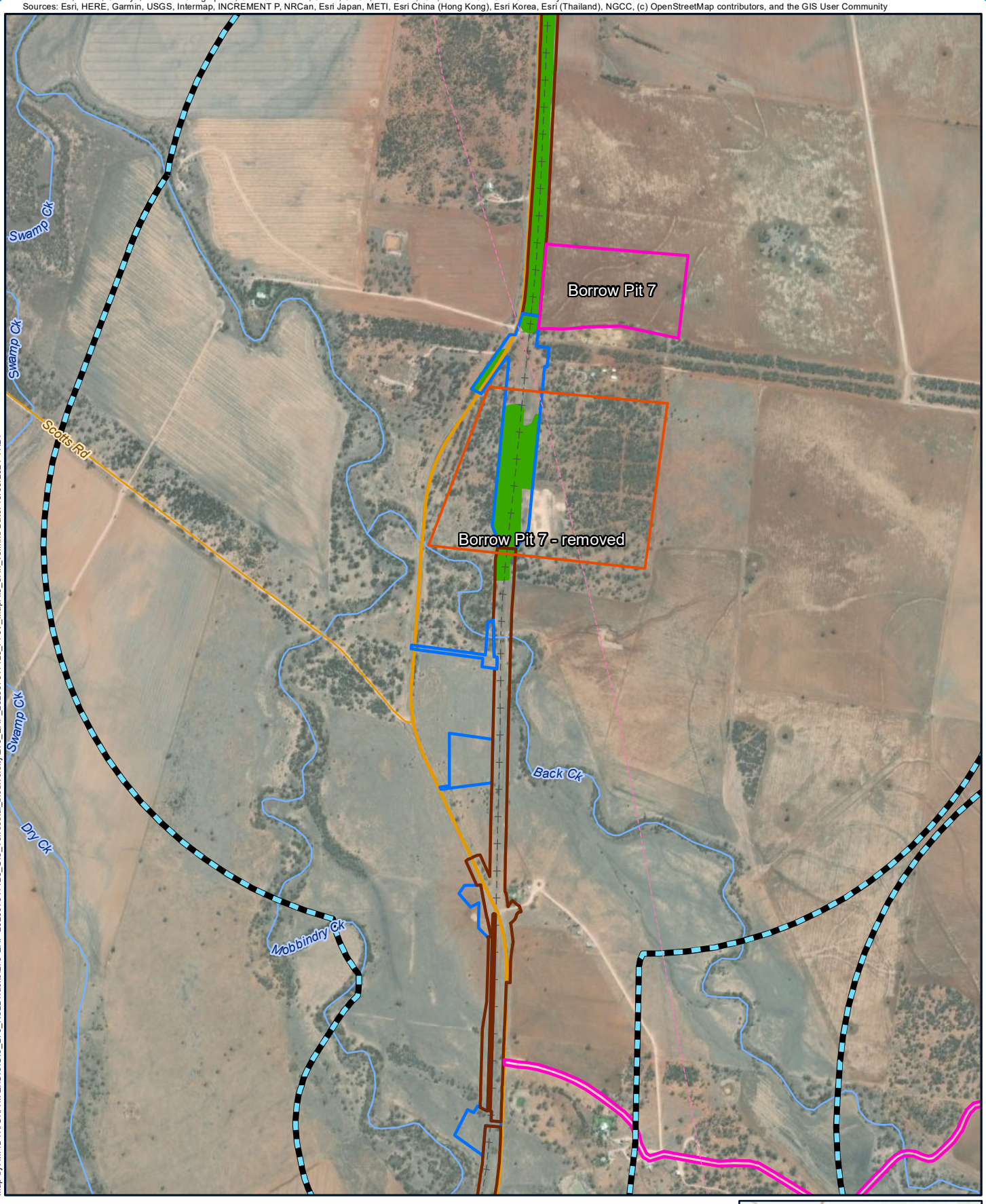
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8b: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Major roads
- Minor roads
- Watercourses
- Study area
- IBRA 7 sub-region boundary
- Borrow pit removed to limit impacts on Brigalow
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Potential serious and irreversible impact

PCT description

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion



A4 scale: 1:20,000

0 80 160 240 320 400 m

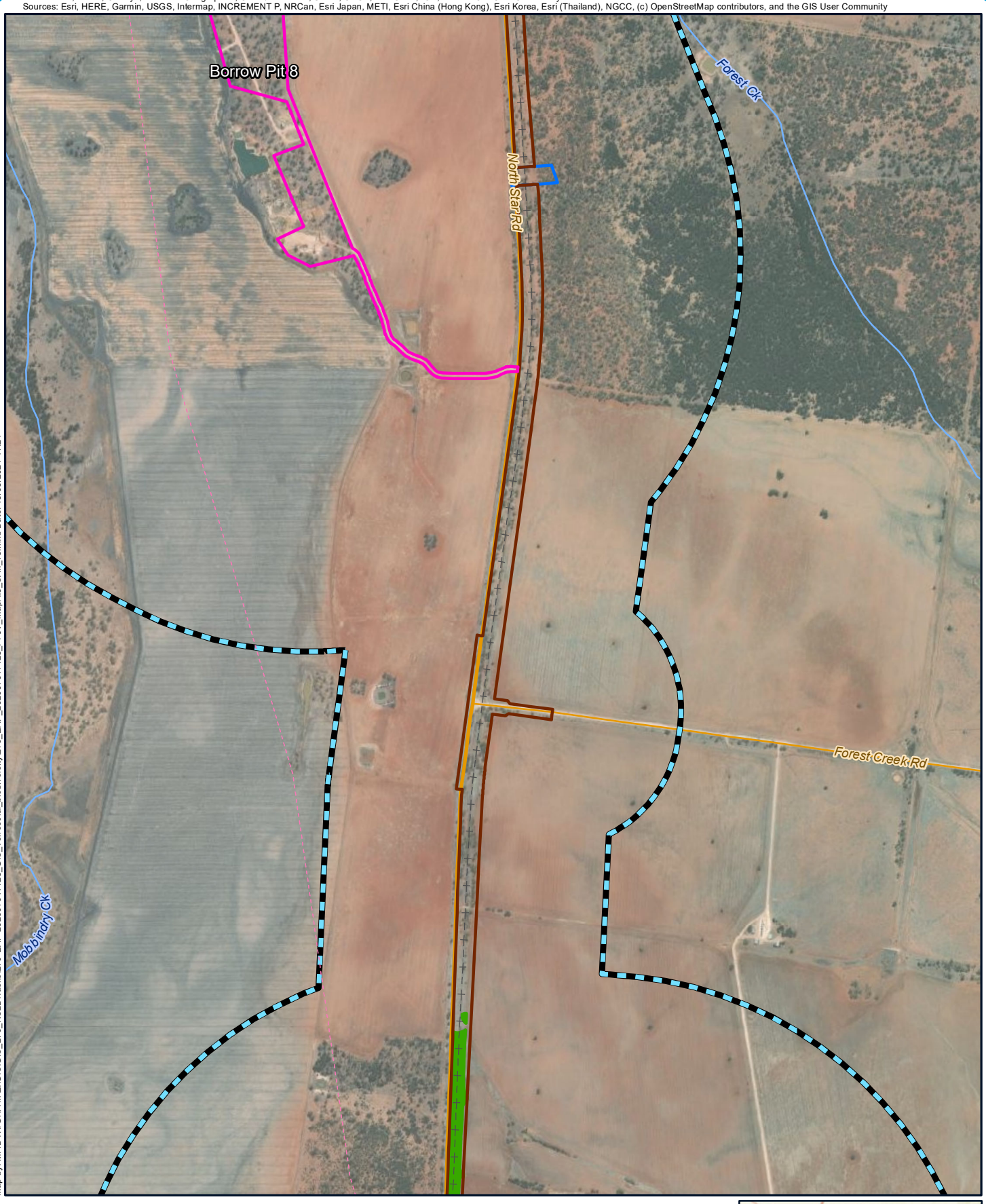
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8c: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



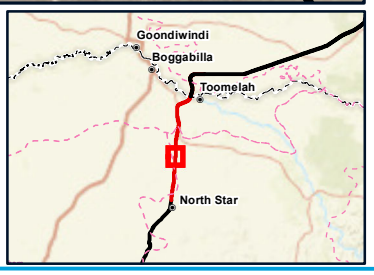
Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2BTasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Major roads
- Minor roads
- Watercourses
- Study area
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Potential serious and irreversible impact

PCT description

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion



A4 scale: 1:20,000

0 80 160 240 320 400 m

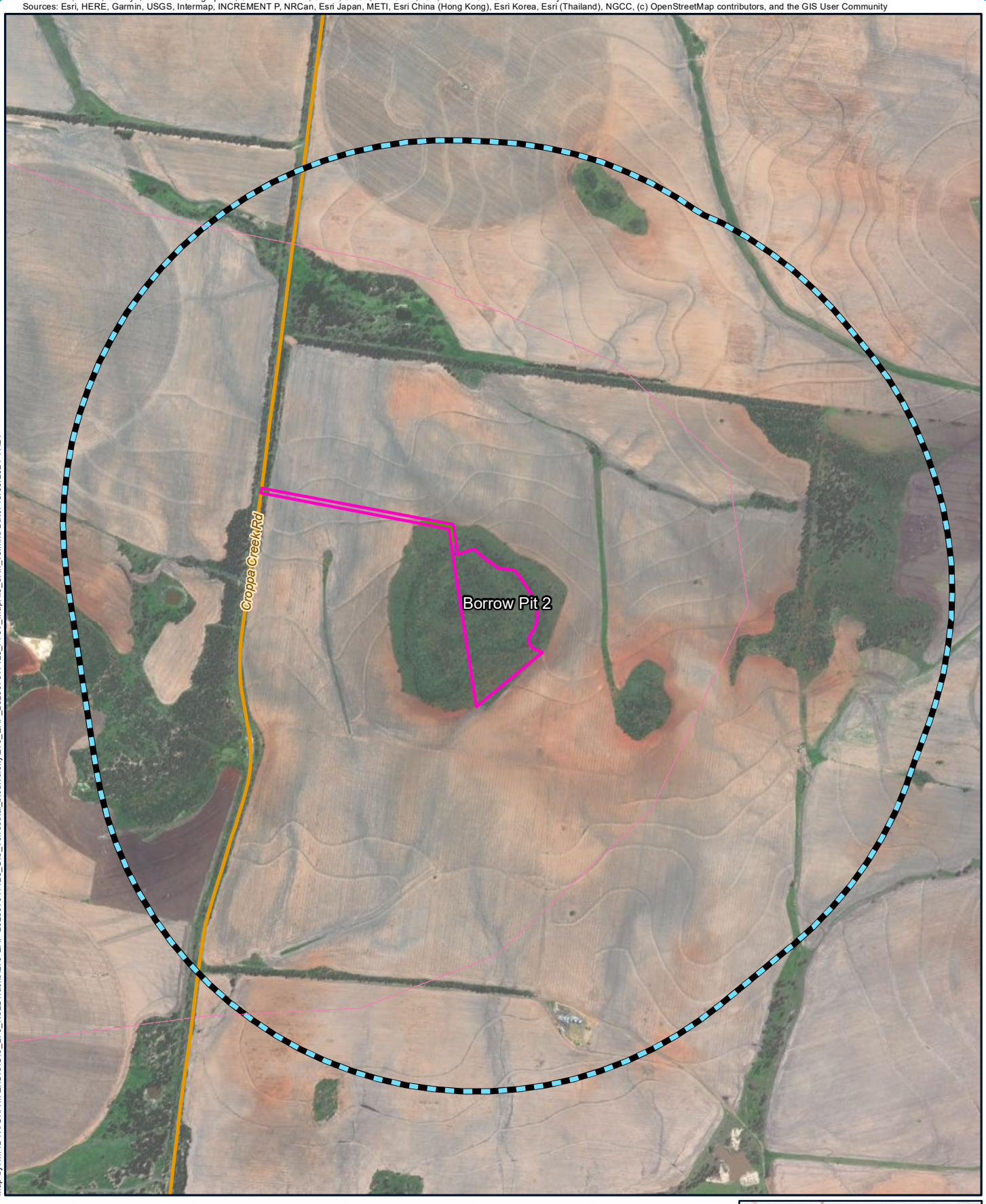
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8d: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



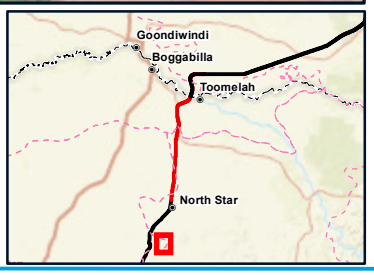
Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2BTasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Major roads
- Study area
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Potential serious and irreversible impact

PCT description

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion



A4 scale: 1:20,000

0 80 160 240 320 400 m

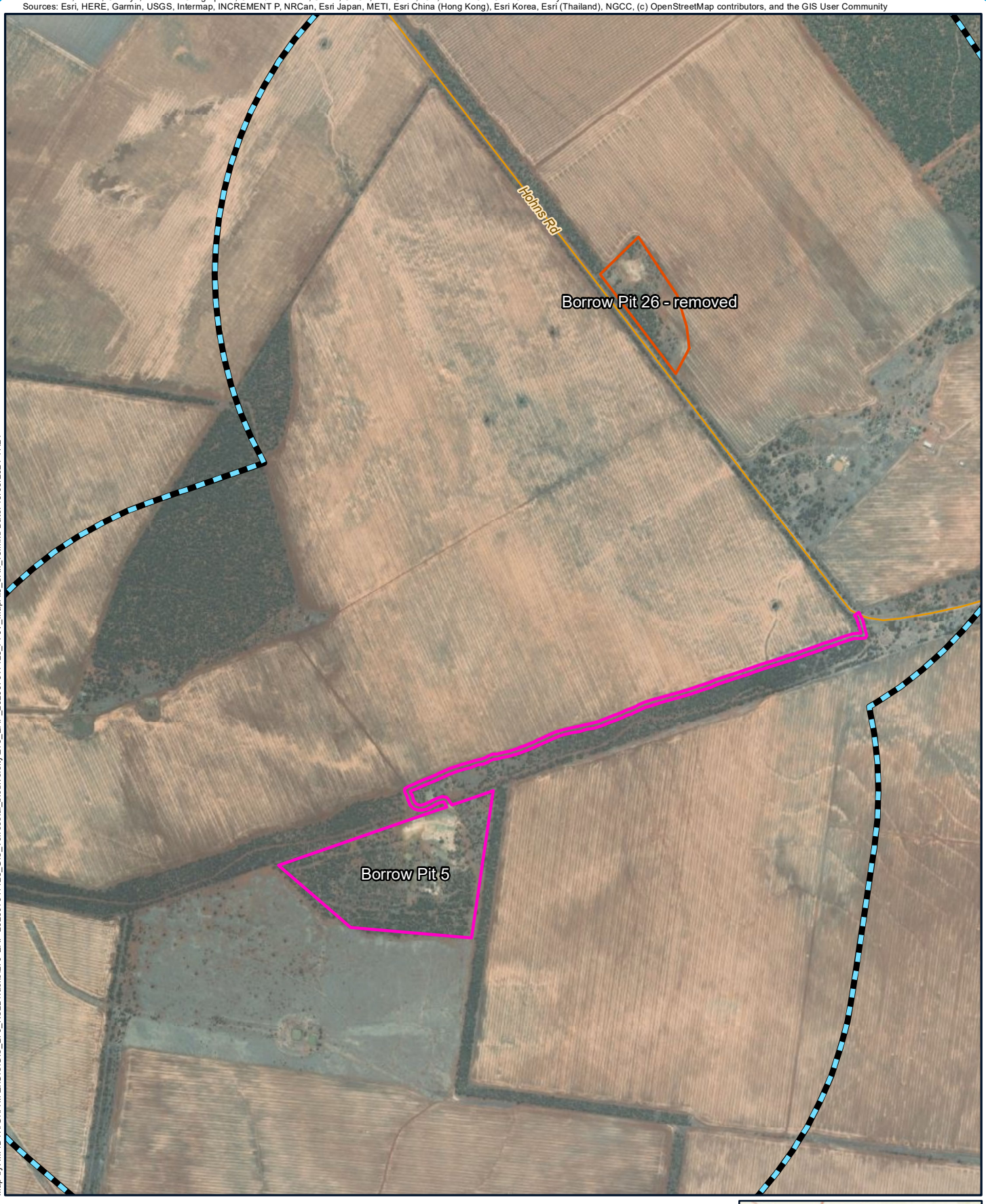
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8e: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

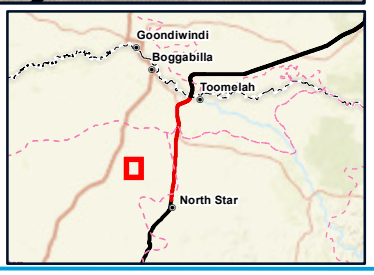
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Minor roads
- Study area
- IBRA 7 sub-region boundary
- Borrow pit removed to limit impacts on Brigalow
- Subject land (borrow pit)



A4 scale: 1:20,000

0 80 160 240 320 400 m

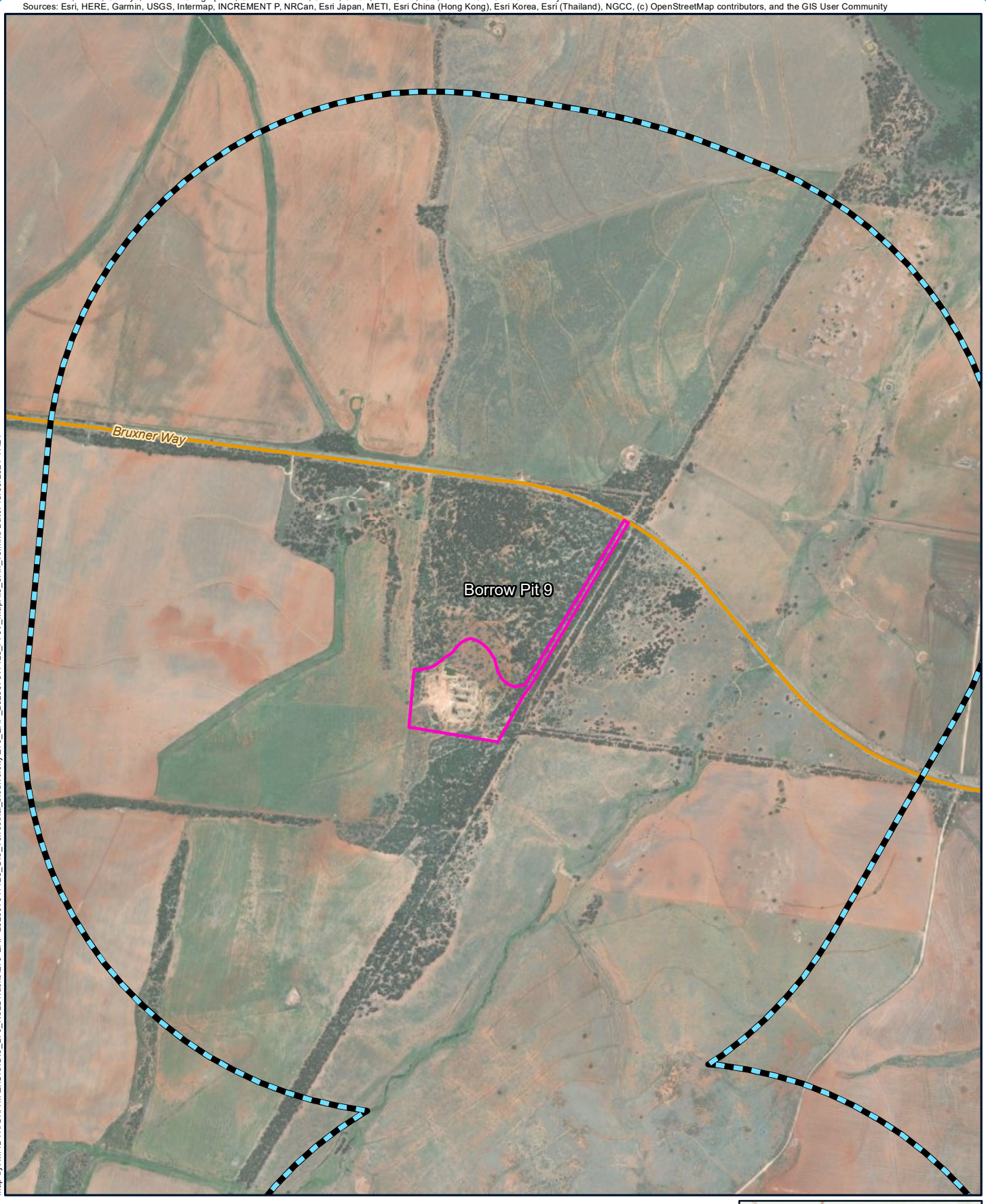
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8f: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

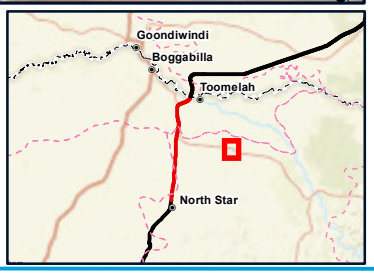
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2BTasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Major roads
- Study area
- IBRA 7 sub-region boundary
- Subject land (borrow pit)



A4 scale: 1:20,000

0 80 160 240 320 400 m

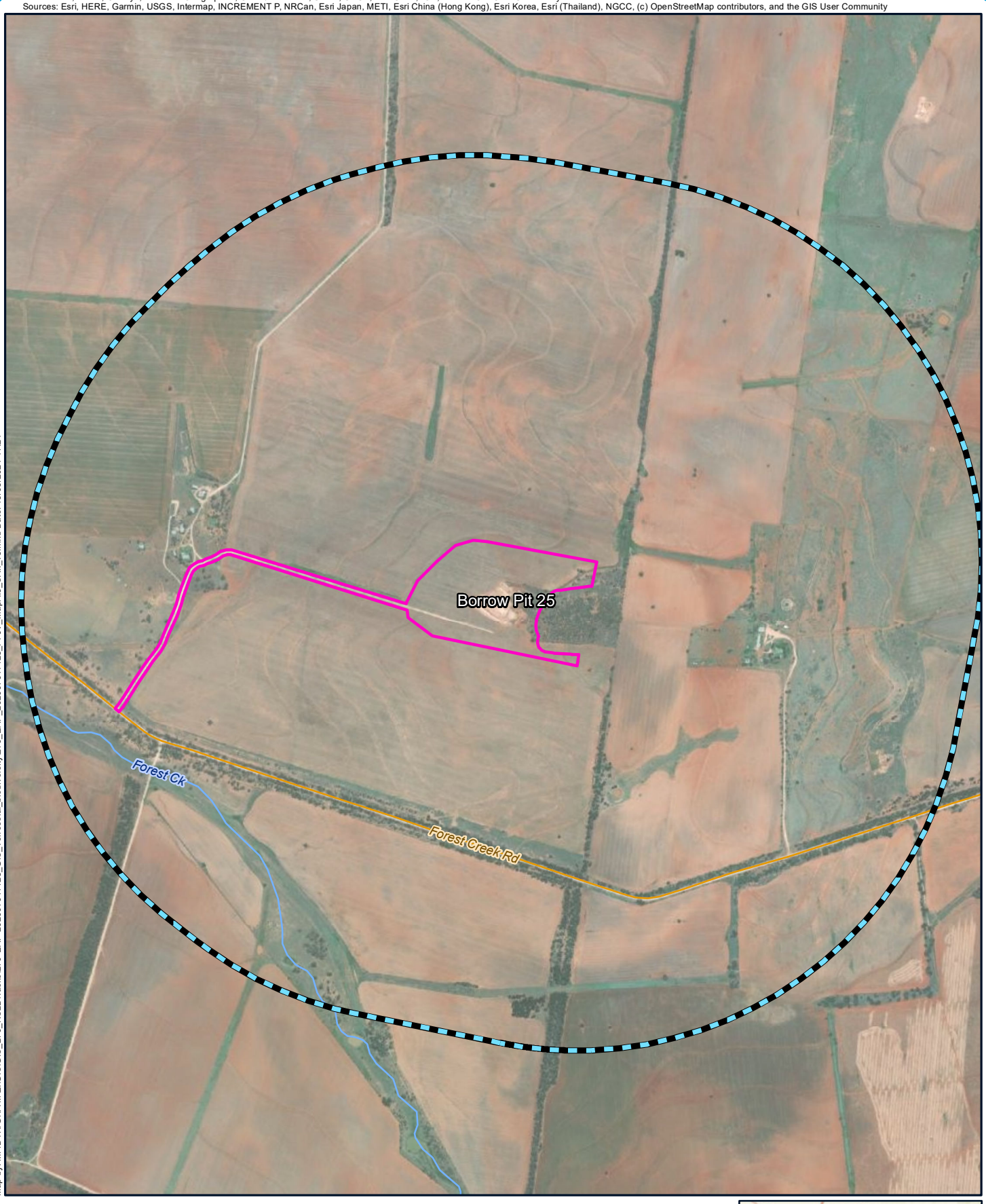
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8g: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

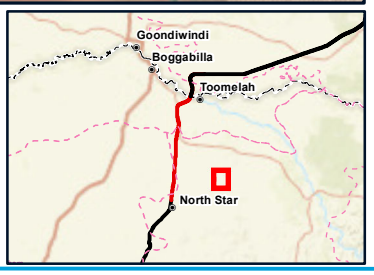
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.8_SAII_v5.mxd Date: 13/05/2021 17:21

Legend

- Minor roads
- Watercourses
- Study area
- IBRA 7 sub-region boundary
- Subject land (borrow pit)



A4 scale: 1:20,000

0 80 160 240 320 400 m

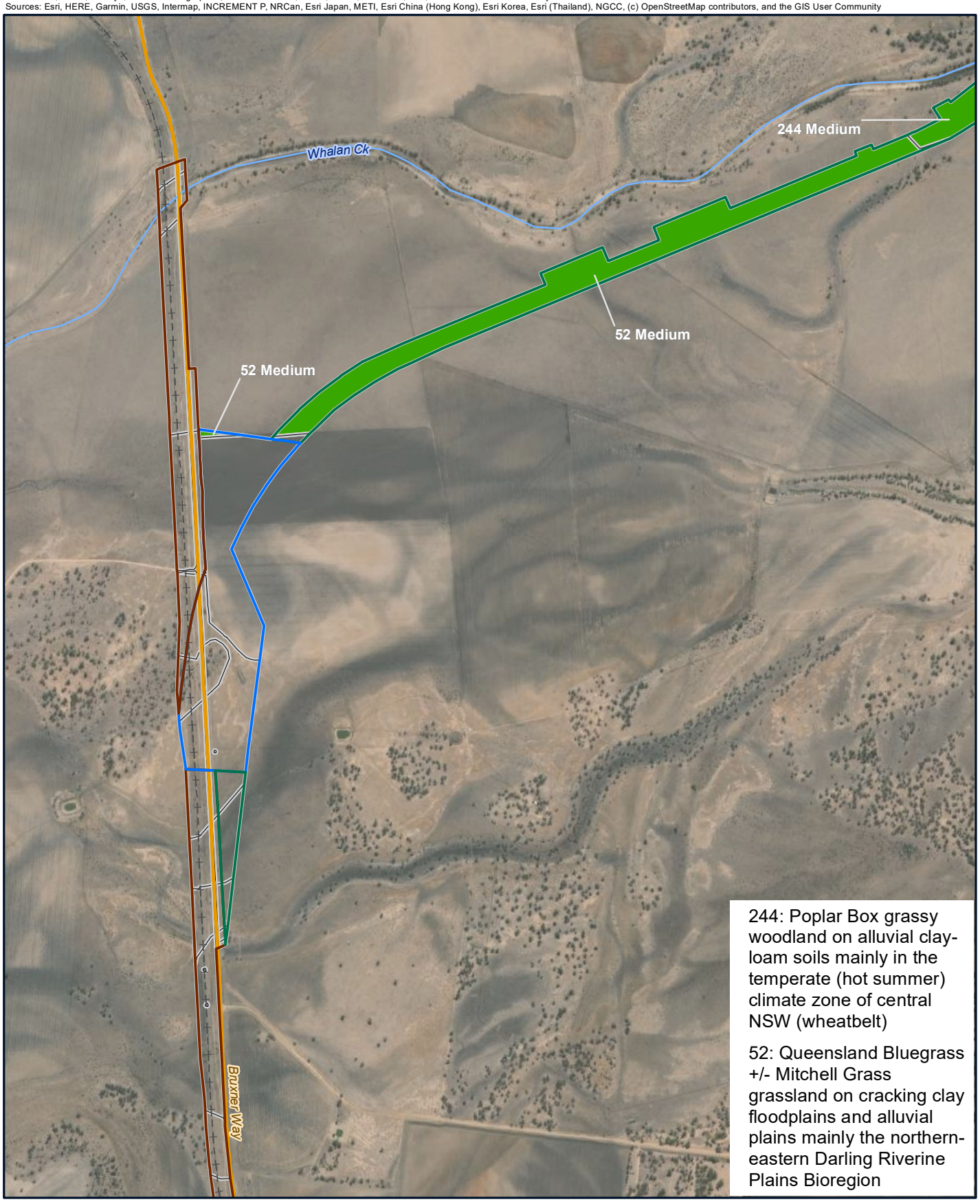
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.8h: Potential SAII species - PCT35 – Brigalow – Belah open forest/woodland

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



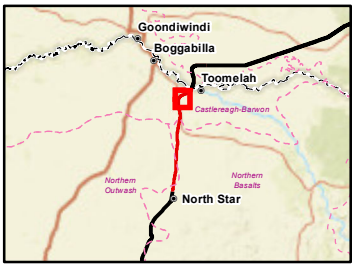
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:53

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

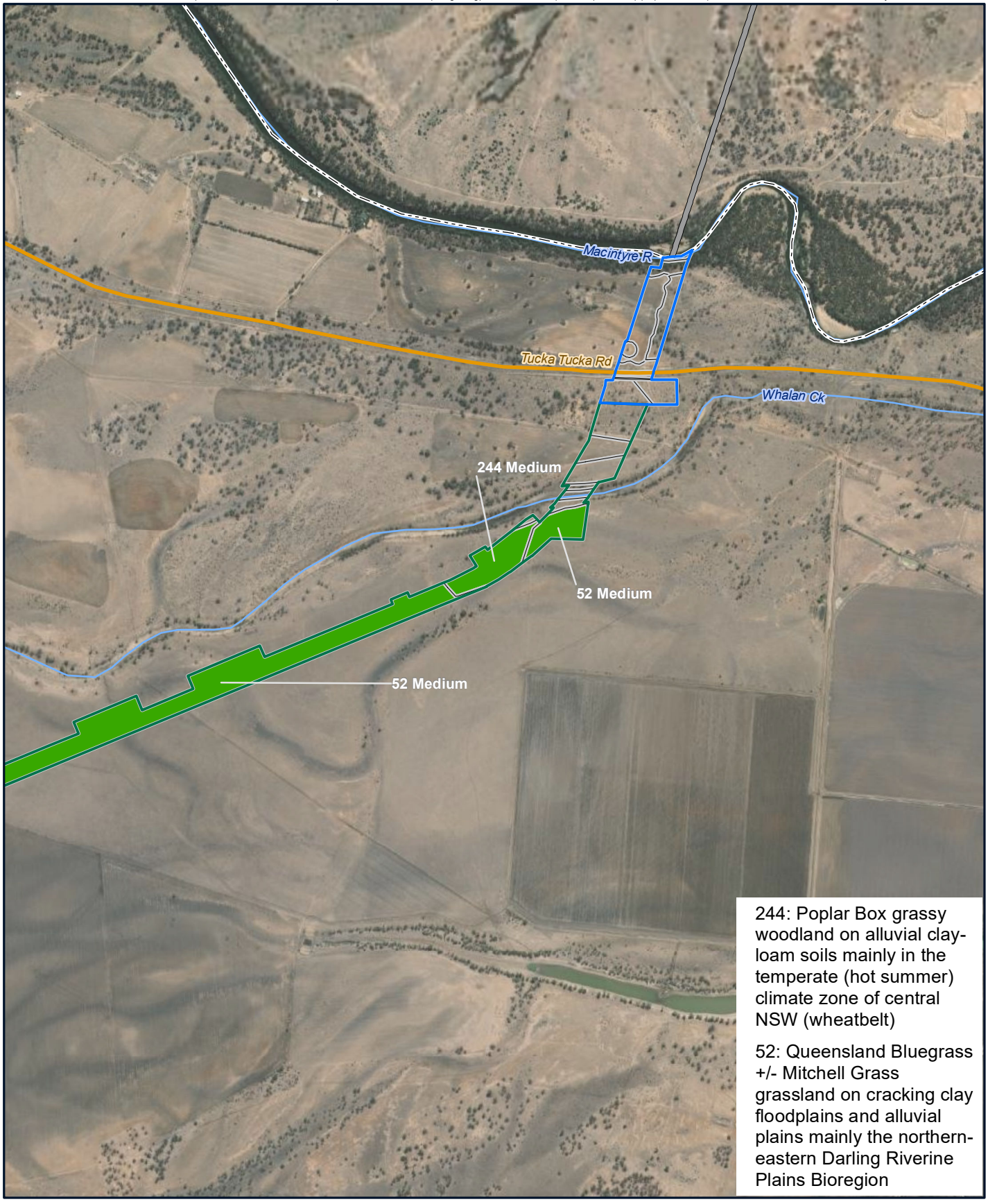
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9a: *Desmodium campylocaulon* (Creeping Tick-trefoil)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



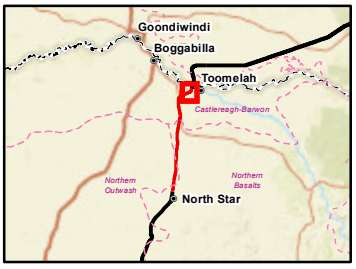
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

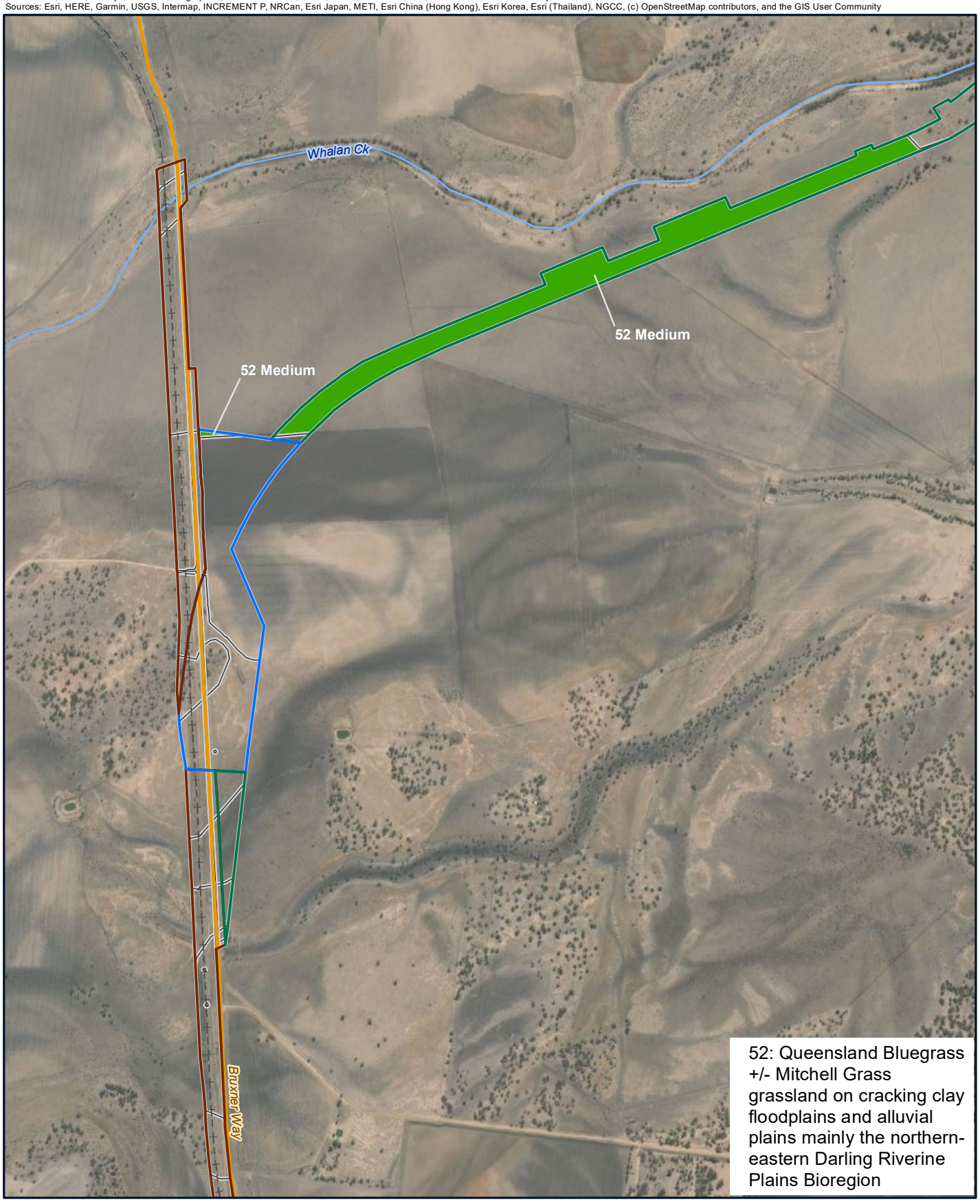
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9b: *Desmodium campylocaulon* (Creeping Tick-trefoil)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

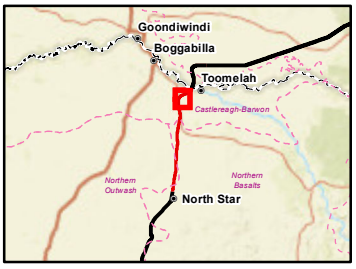


52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9c: *Dichanthium setosum* (Bluegrass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

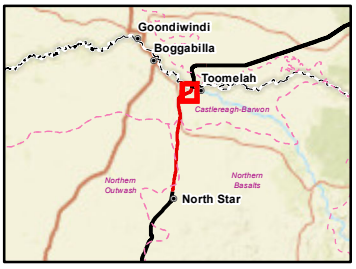


52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2BiTask\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9d: *Dichanthium setosum* (Bluegrass)

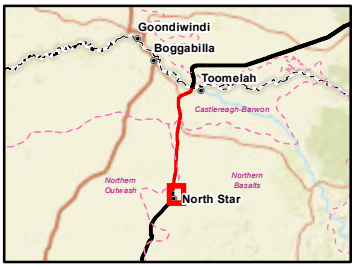
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Localities
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

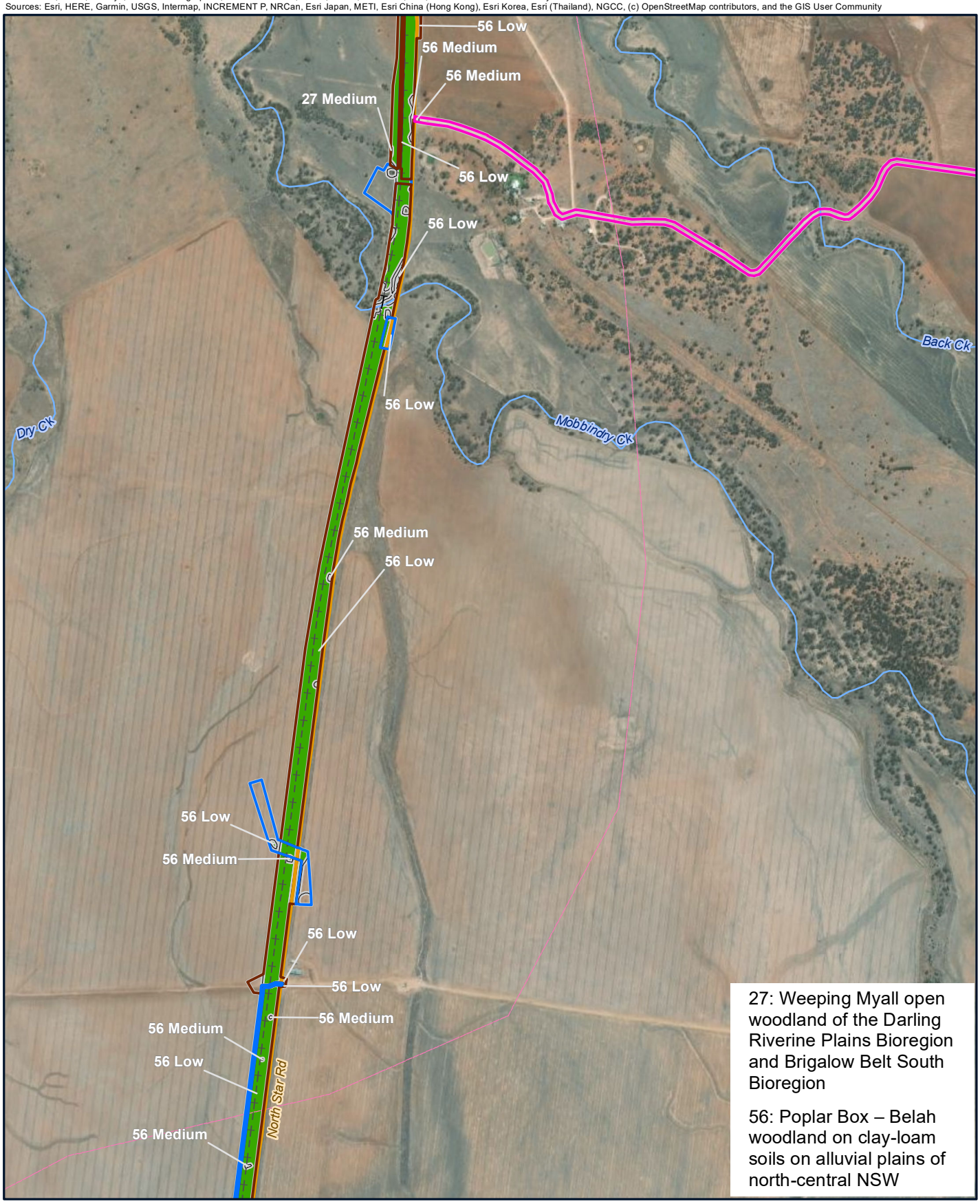
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9e: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



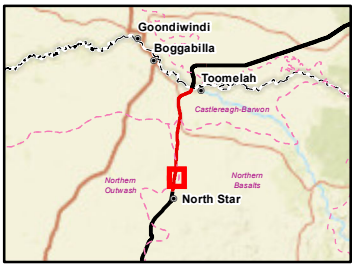
27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

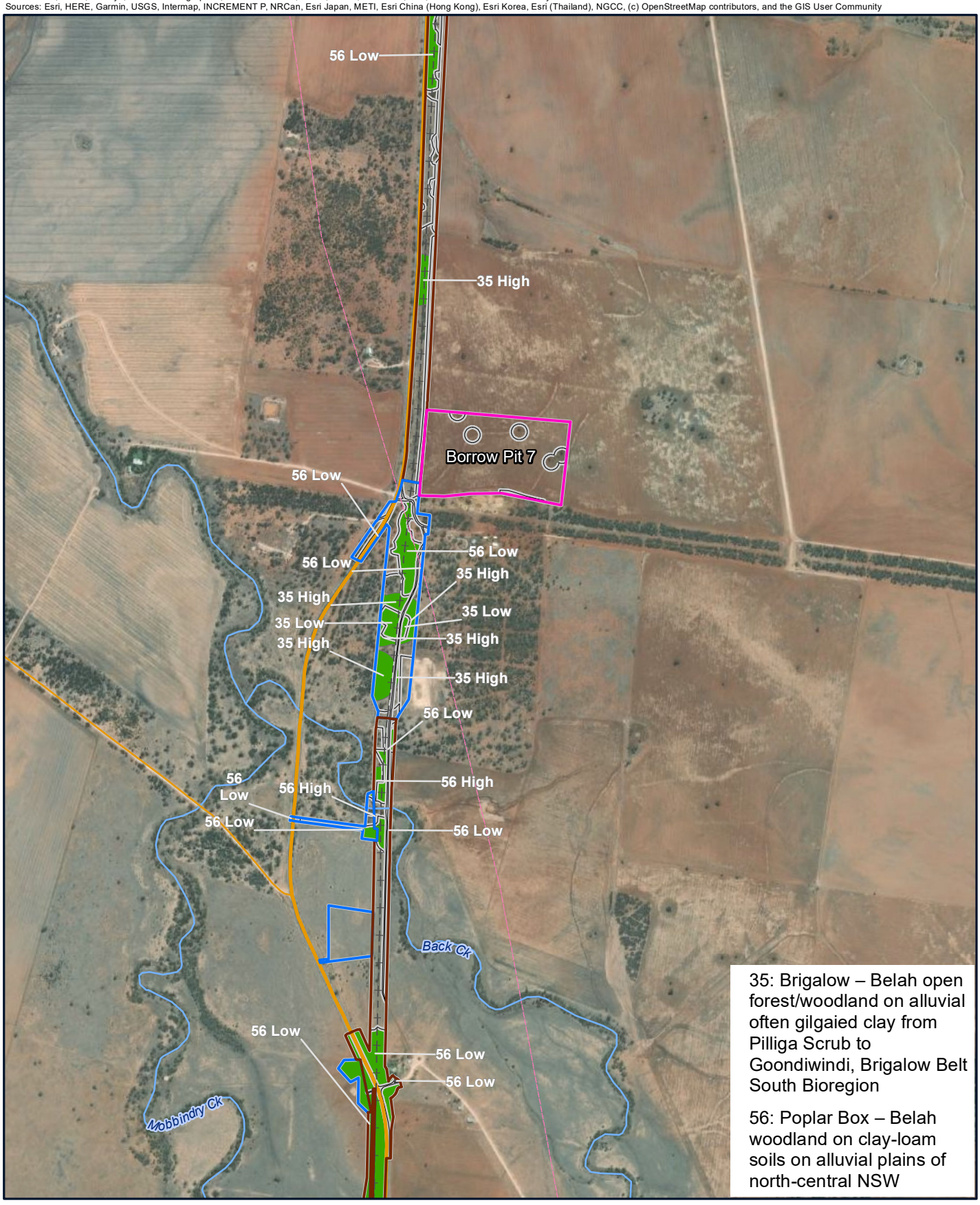
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9f: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



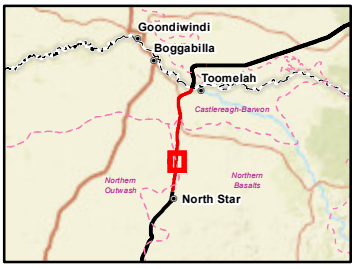
35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

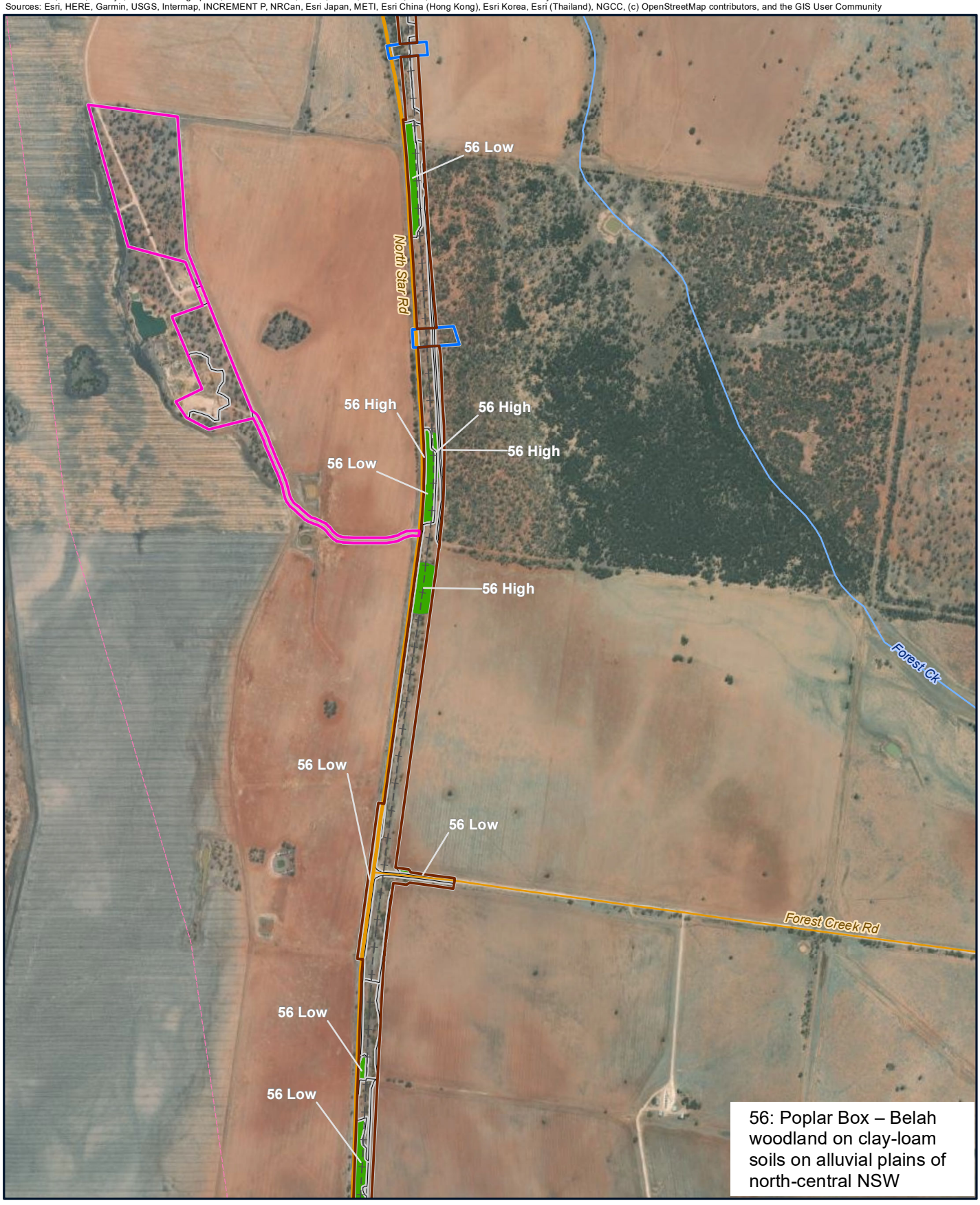
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9g: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

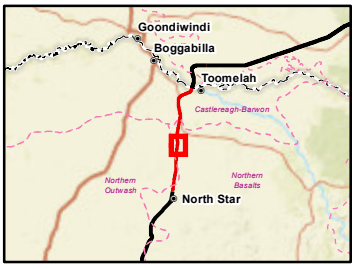


56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

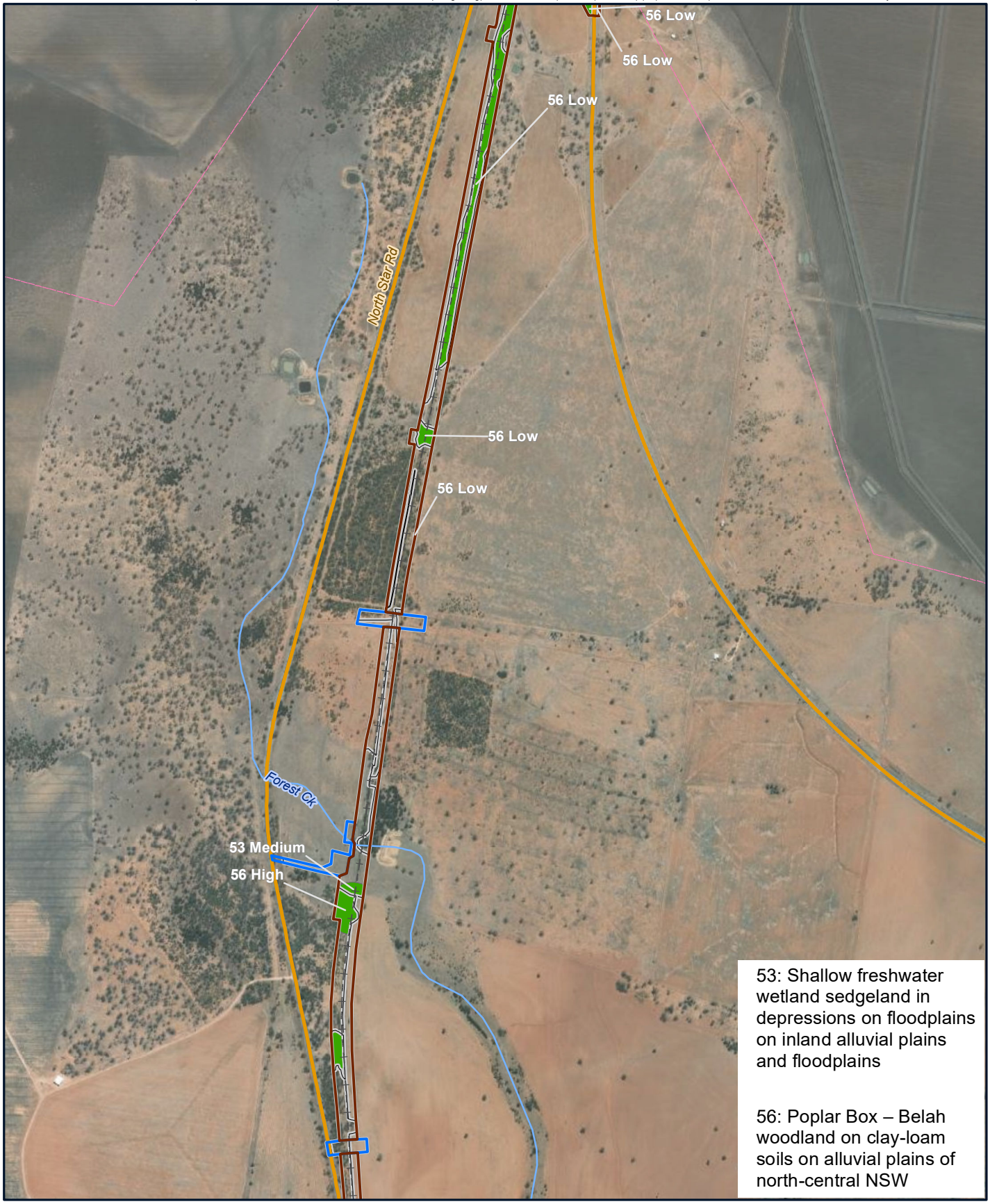
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9h: *Digitaria porrecta* (Finger panic grass)

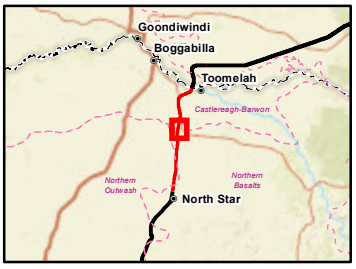
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2BiTask\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:54

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

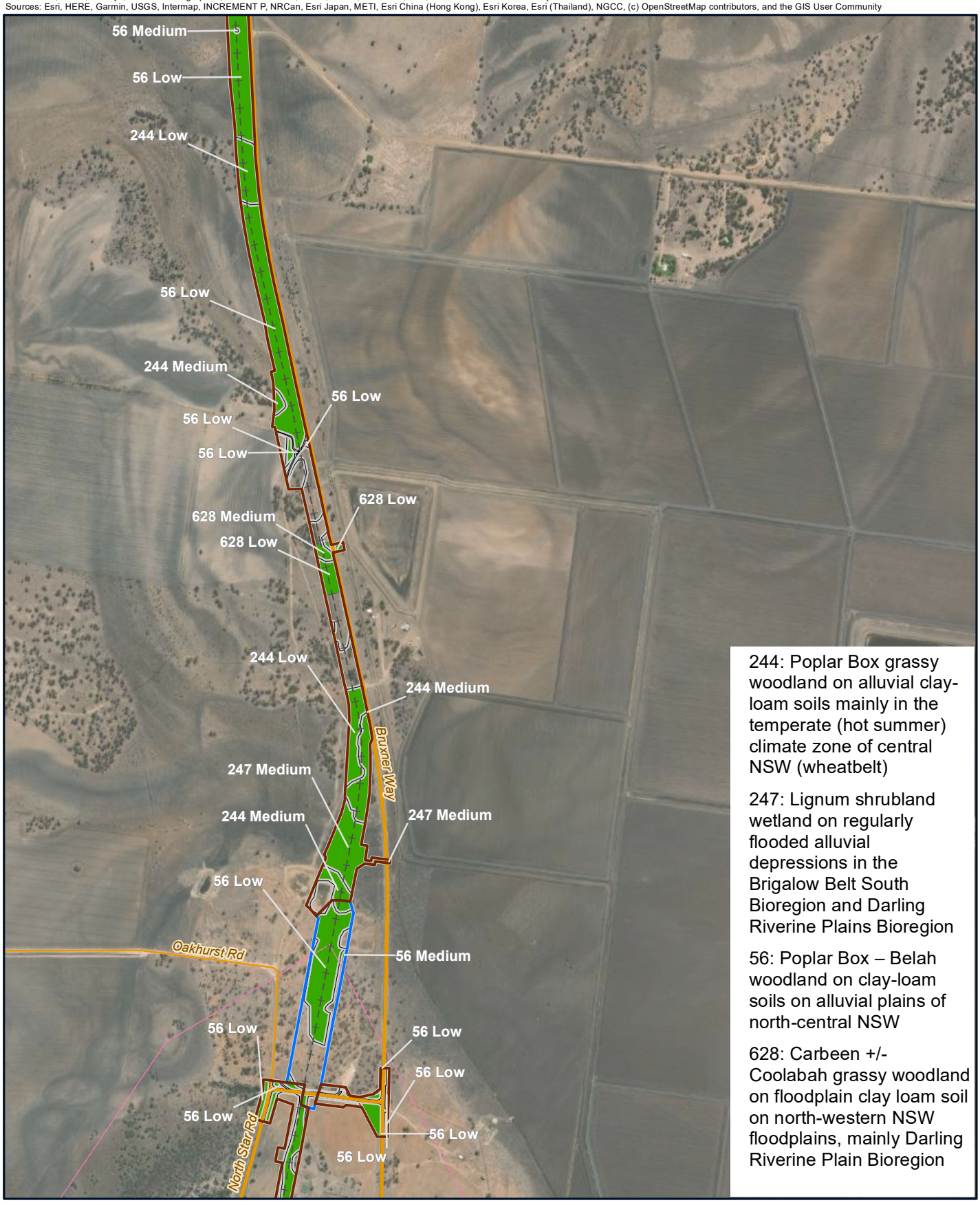
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9i: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

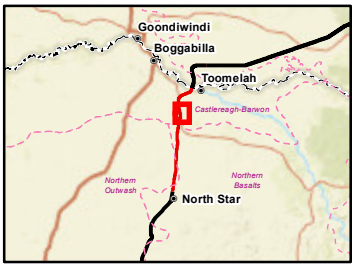
56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

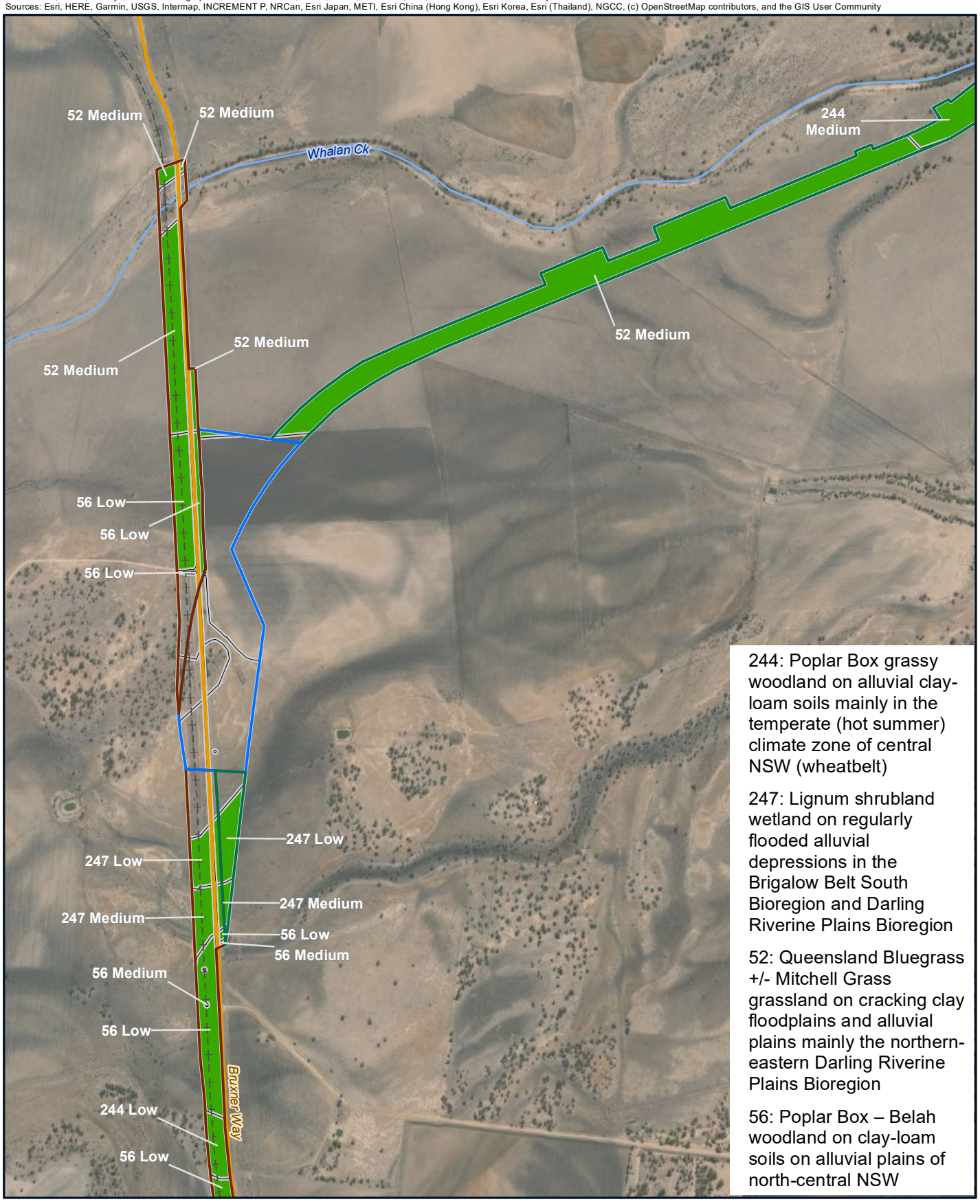
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9j: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

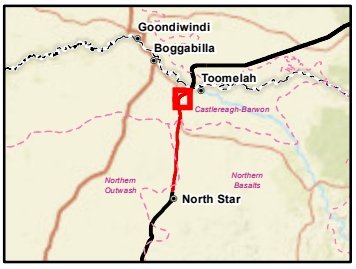
52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

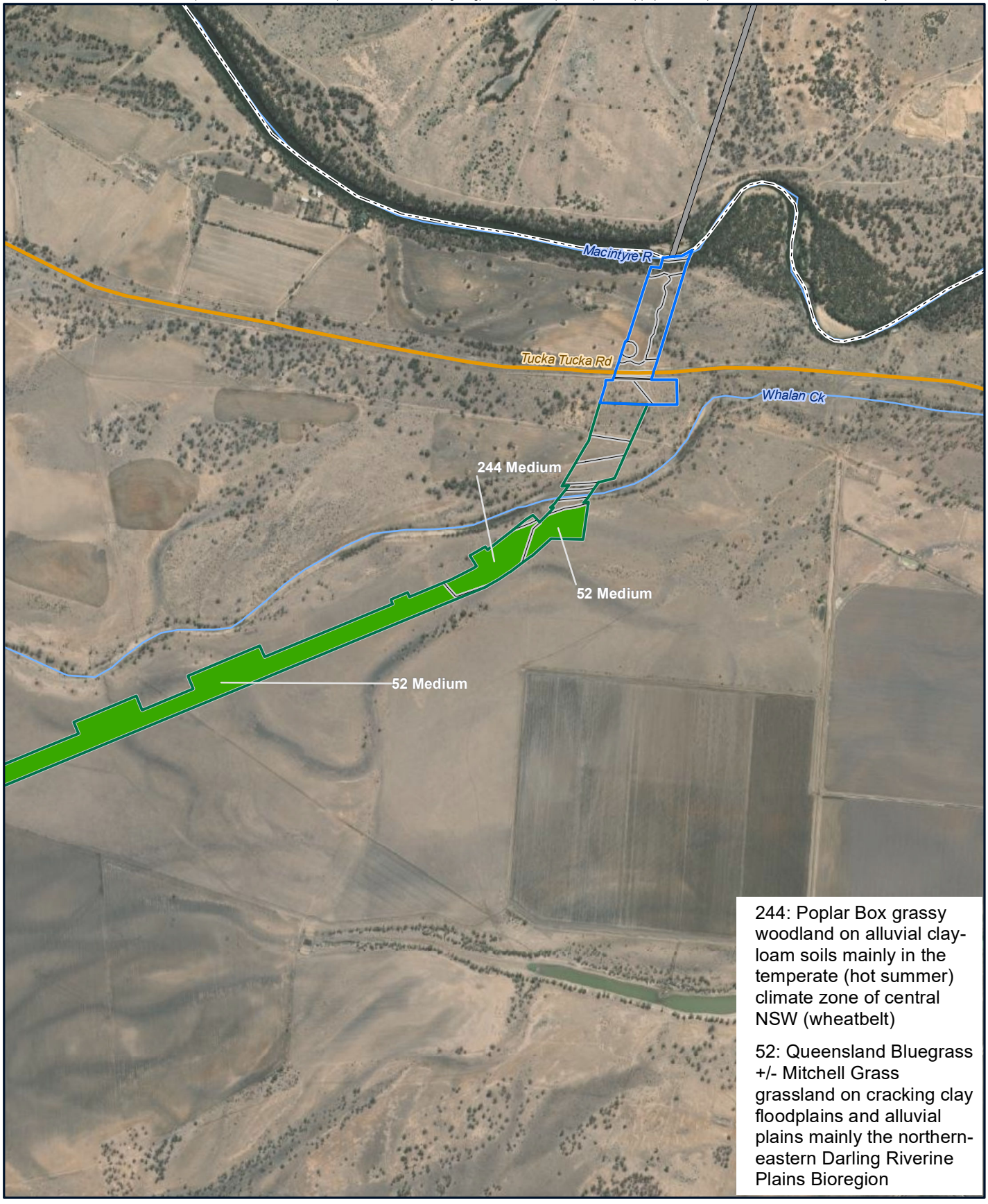
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9k: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



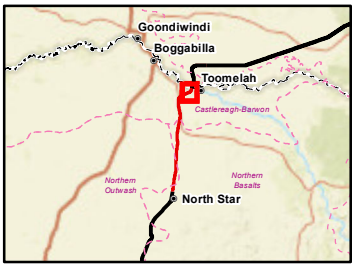
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

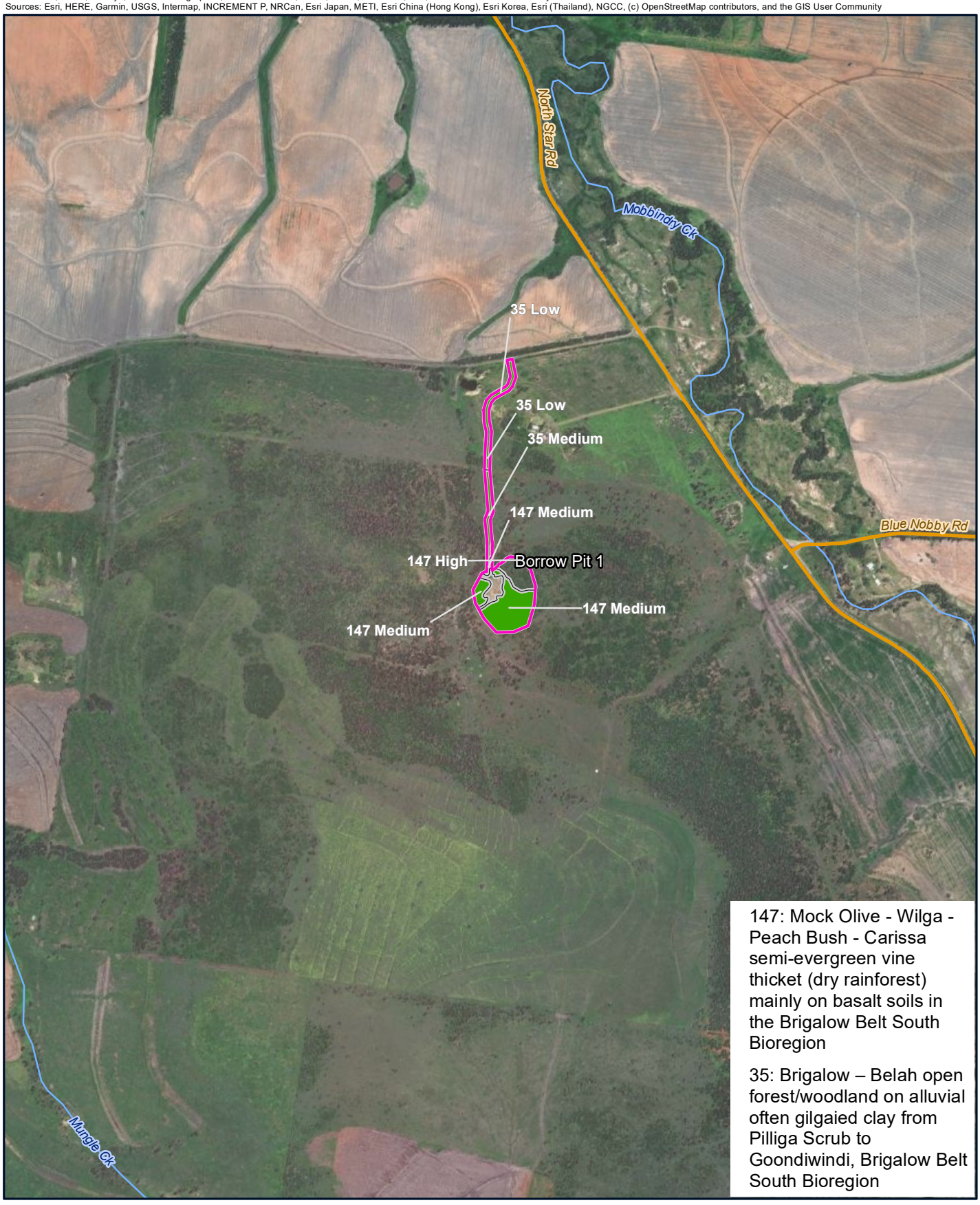
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9I: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



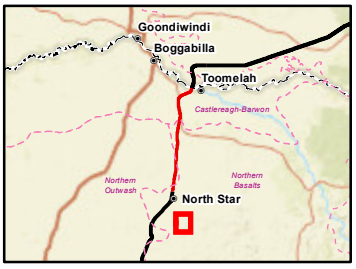
147: Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2BiTask\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

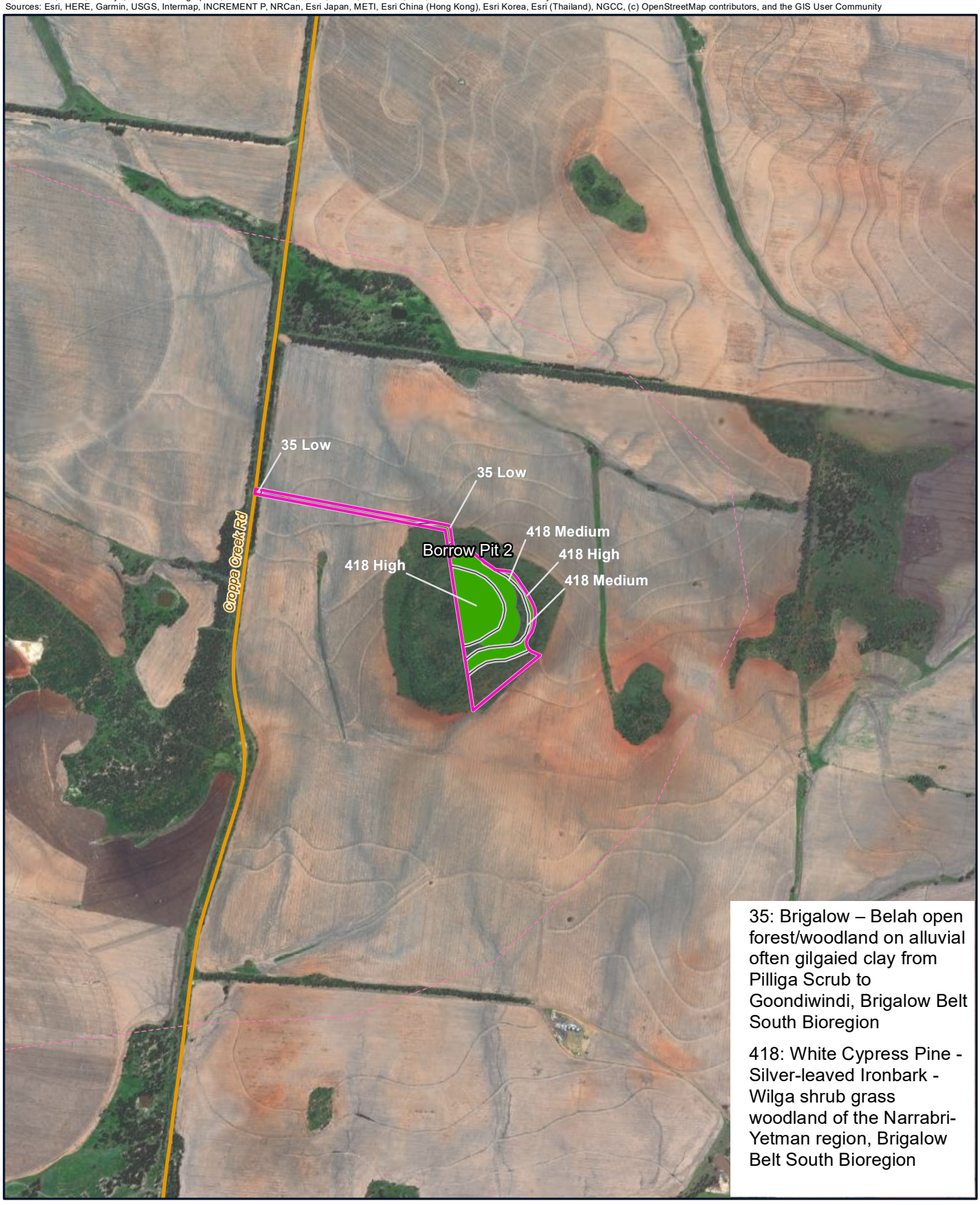
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9m: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



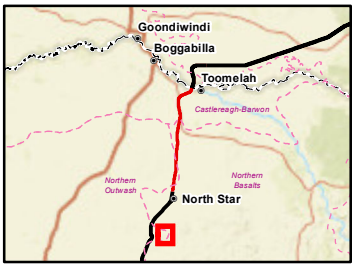
35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Major roads
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9n: *Digitaria porrecta* (Finger panic grass)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

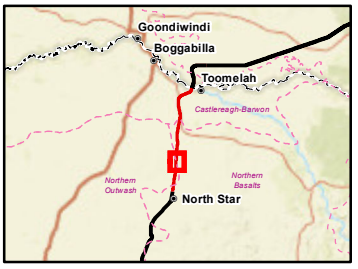


35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

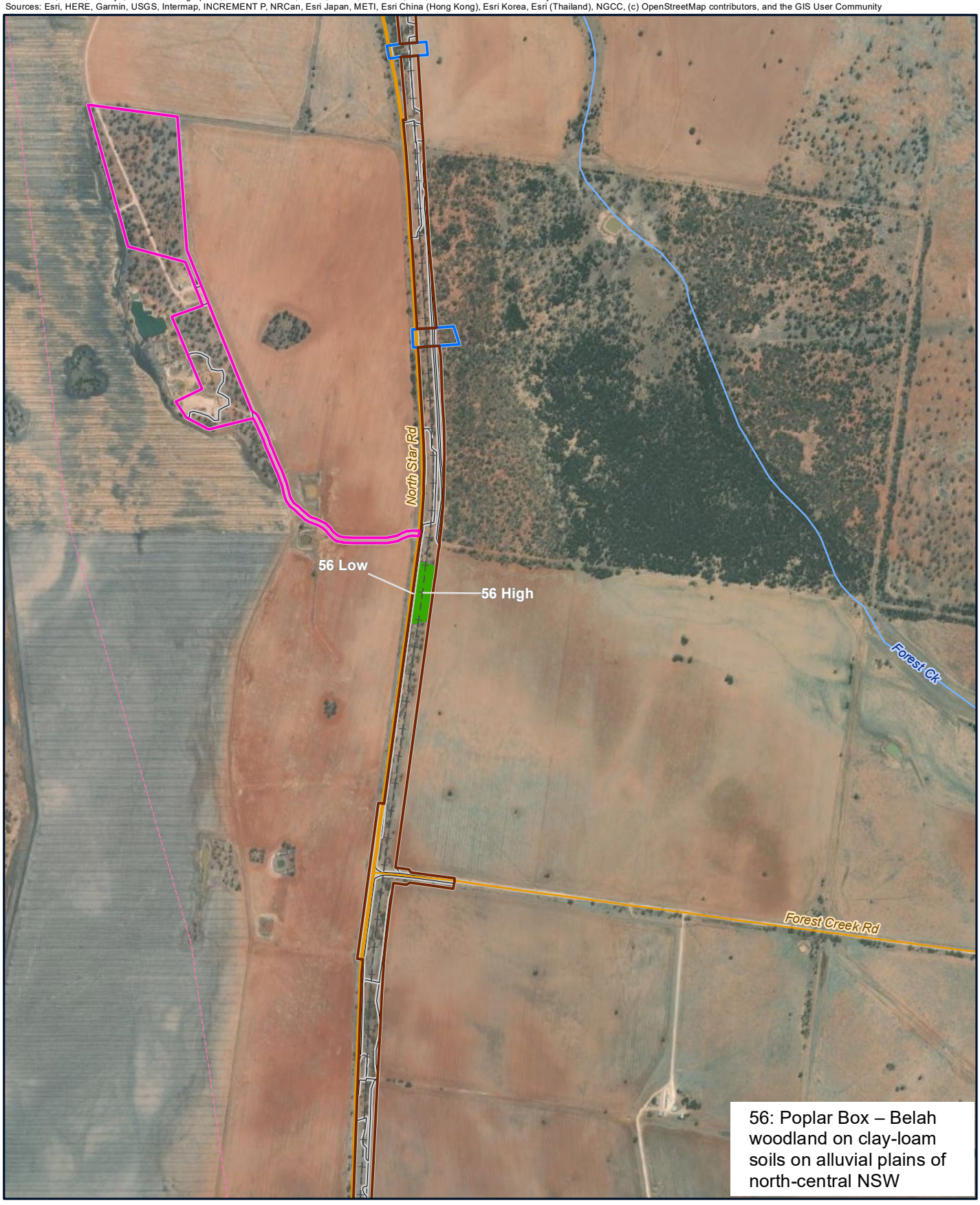
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9o: *Homopholis belsonii* (Belsons panic)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

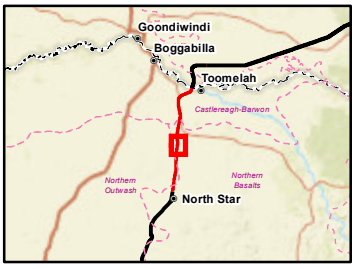


Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

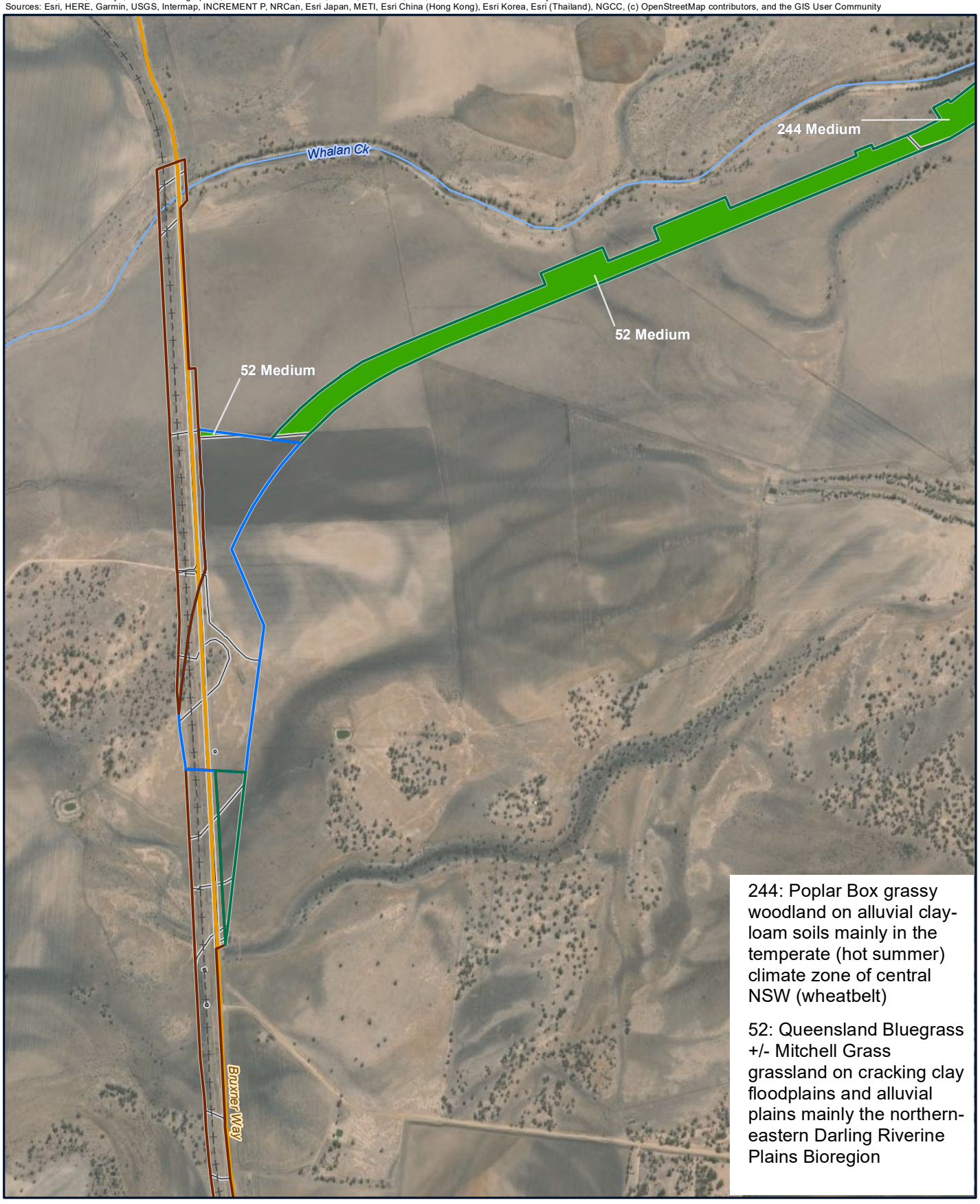
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9p: *Homopholis belsonii* (Belsons panic)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



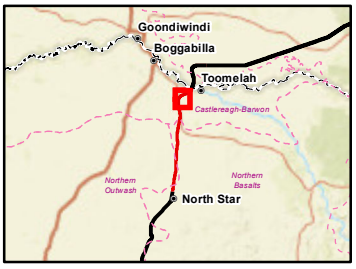
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

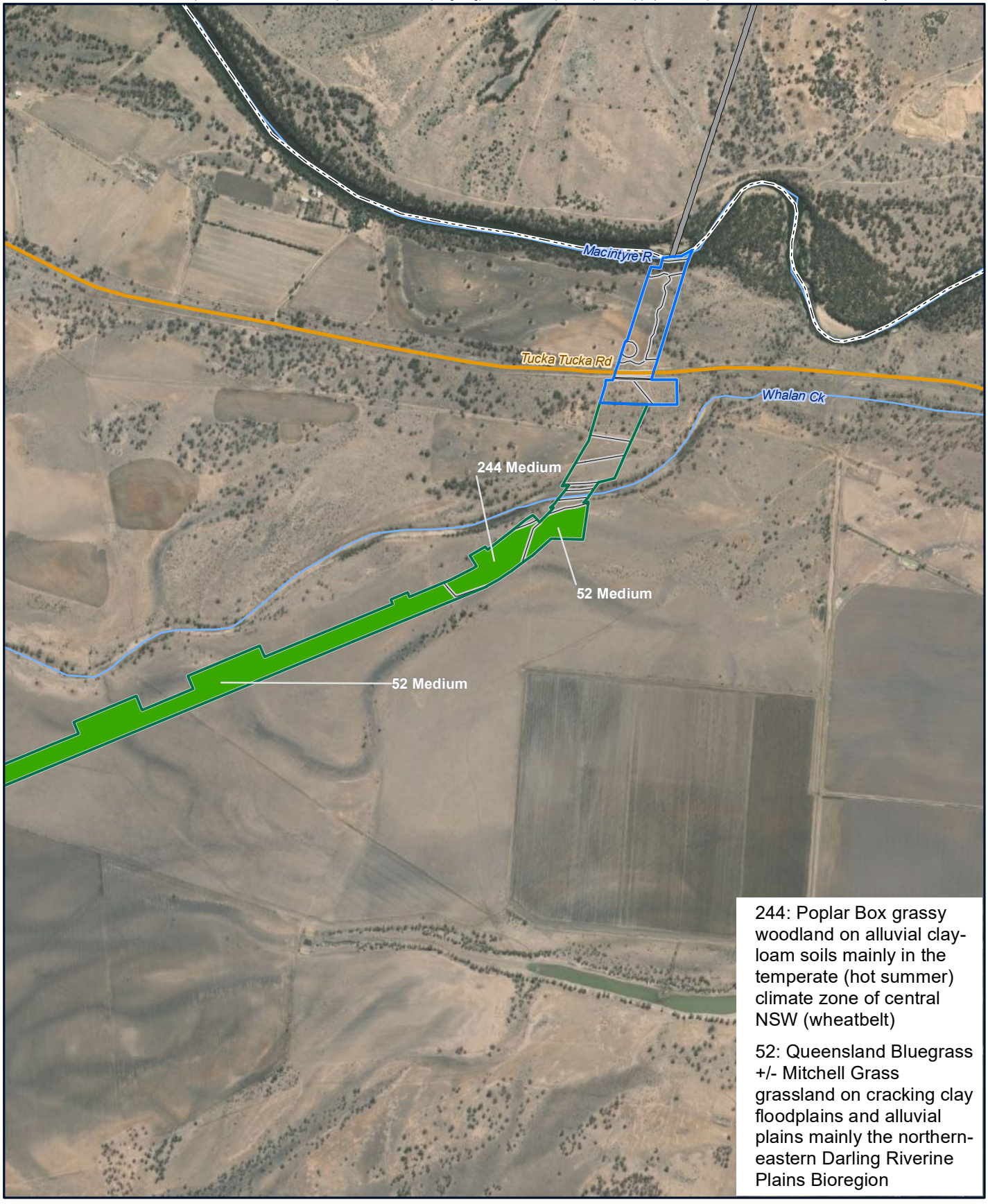
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9q: *Homopholis belsonii* (Belsons panic)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



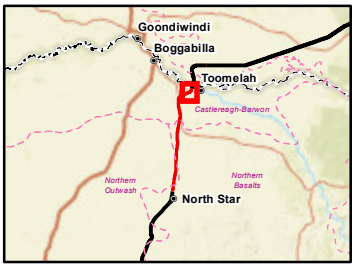
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

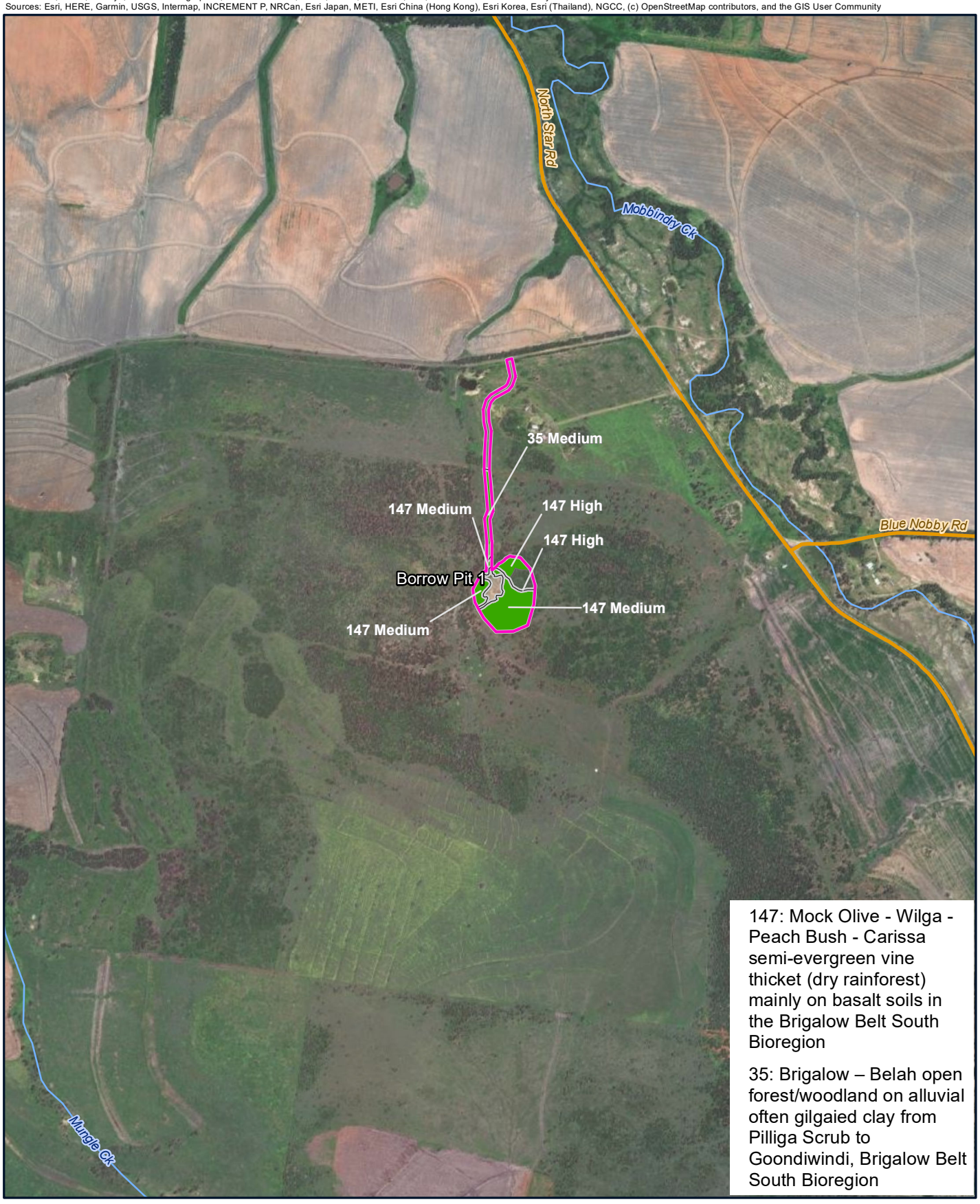
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9r: *Homopholis belsonii* (Belsons panic)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



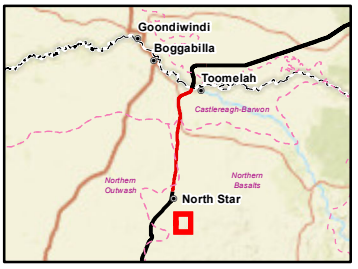
147: Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2BiTask\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:55

Legend

- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

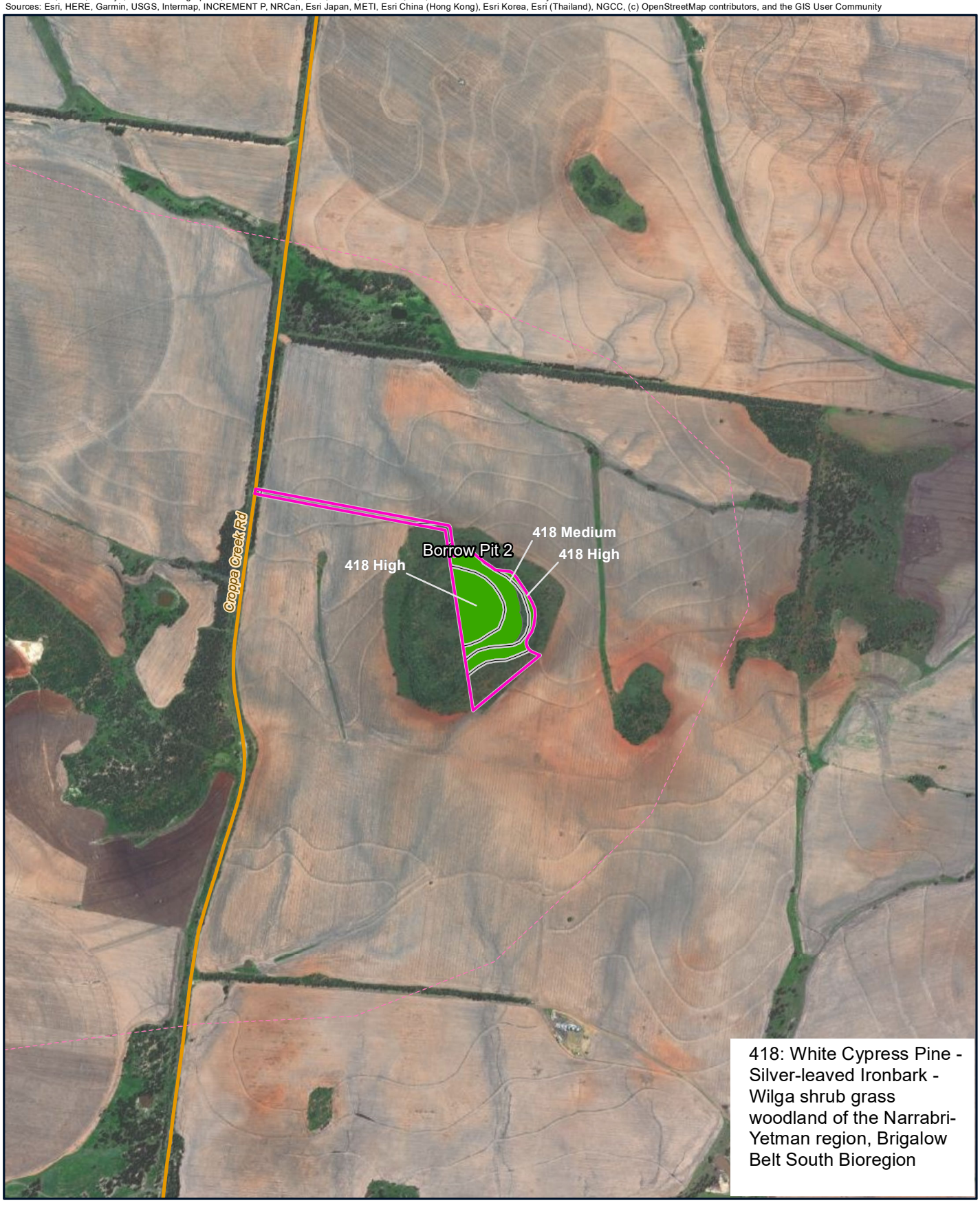
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9s: *Homopholis belsonii* (Belsons panic)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

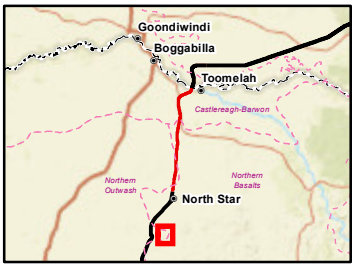


418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:56

Legend

- Major roads
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

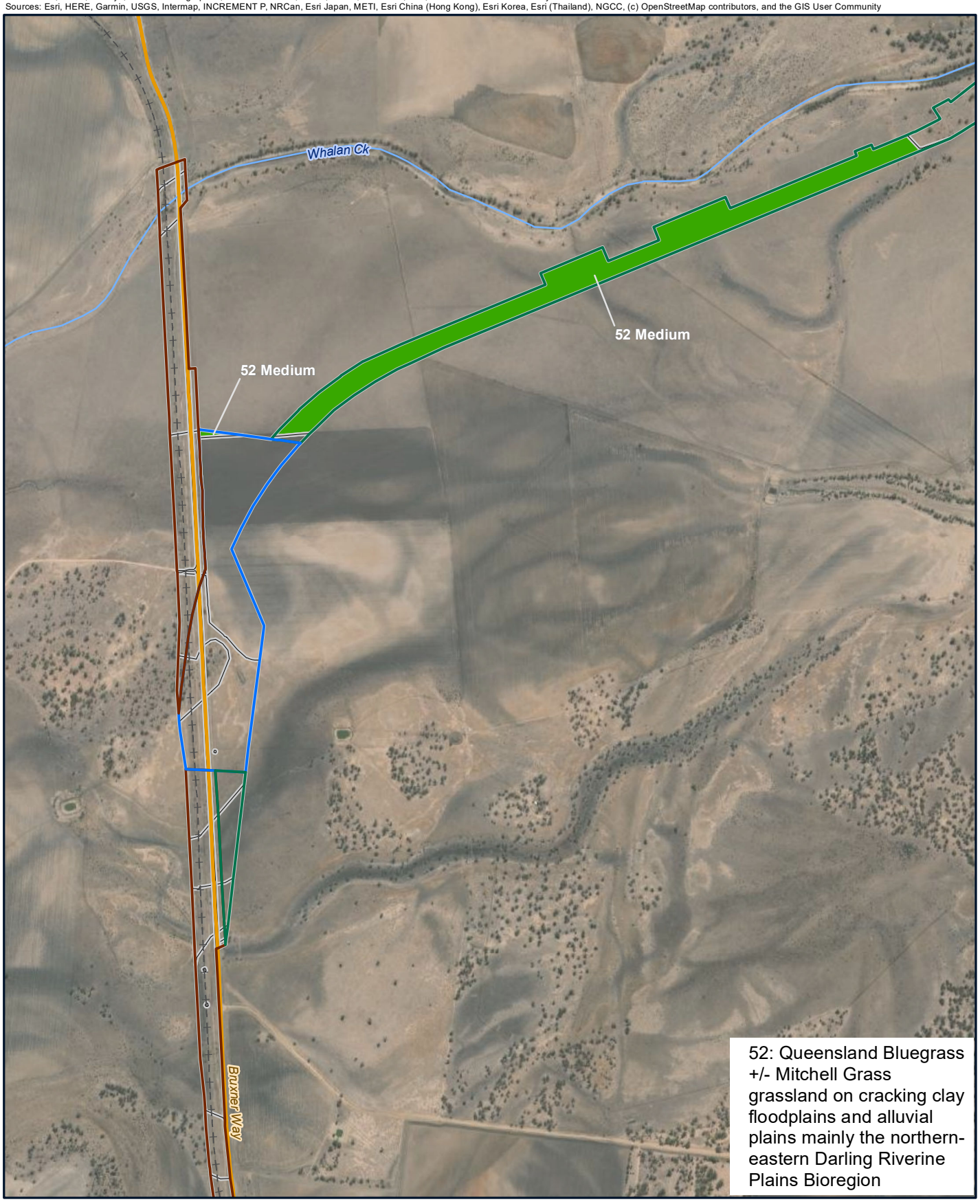
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9t: *Homopholis belsonii* (Belsons panic)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

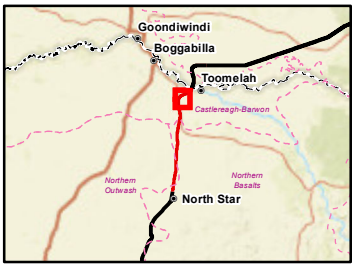


52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:56

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9u: *Lepidium monoplocoides* (Winged peppercress)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

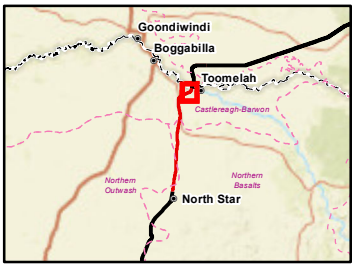


52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:56

Legend

- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

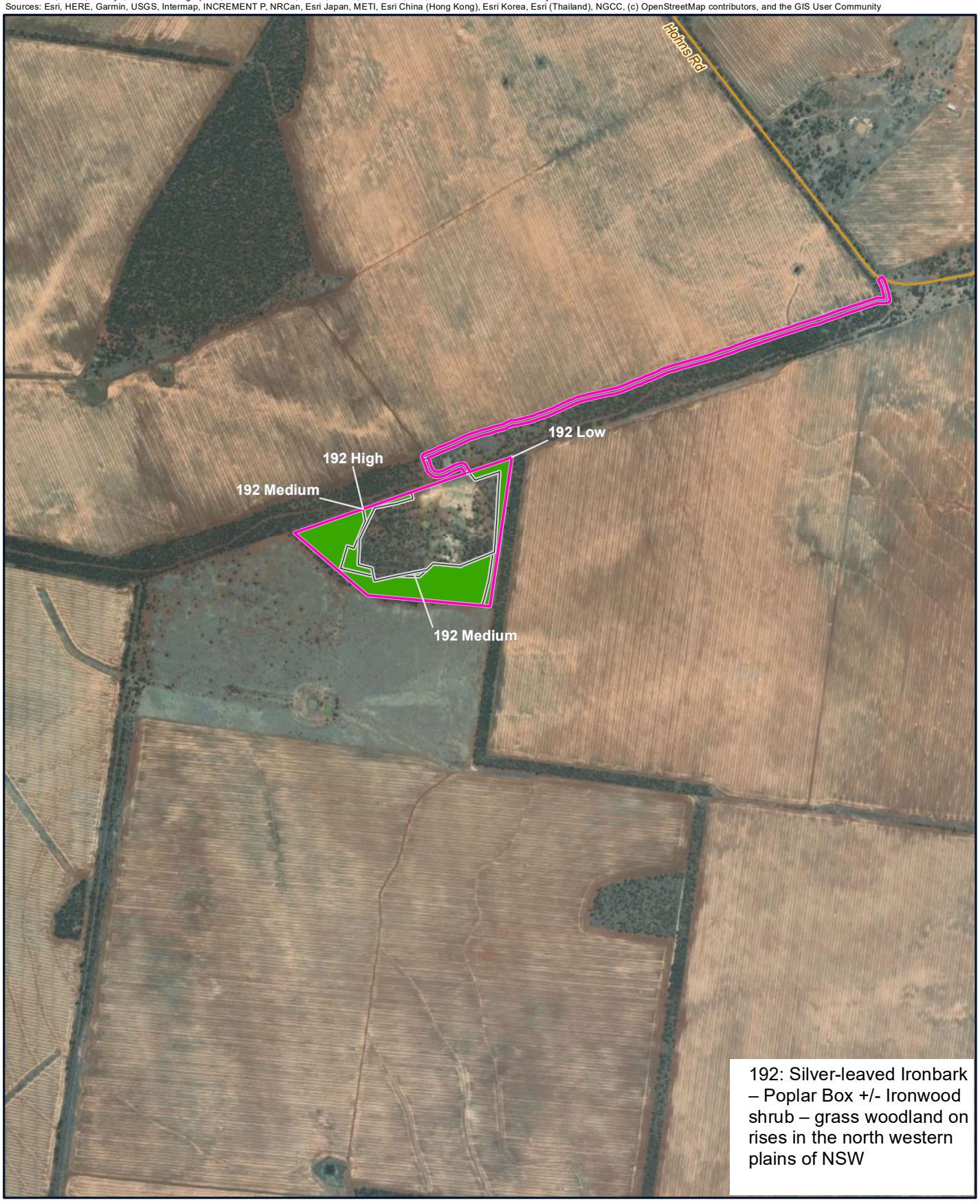
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9v: *Lepidium monoplocoides* (Winged peppercress)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

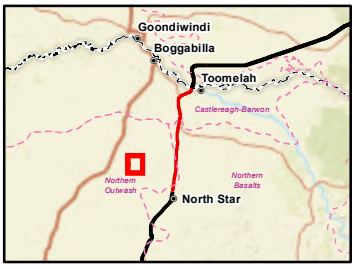


192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2BiTask\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:56

Legend

- Minor roads
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

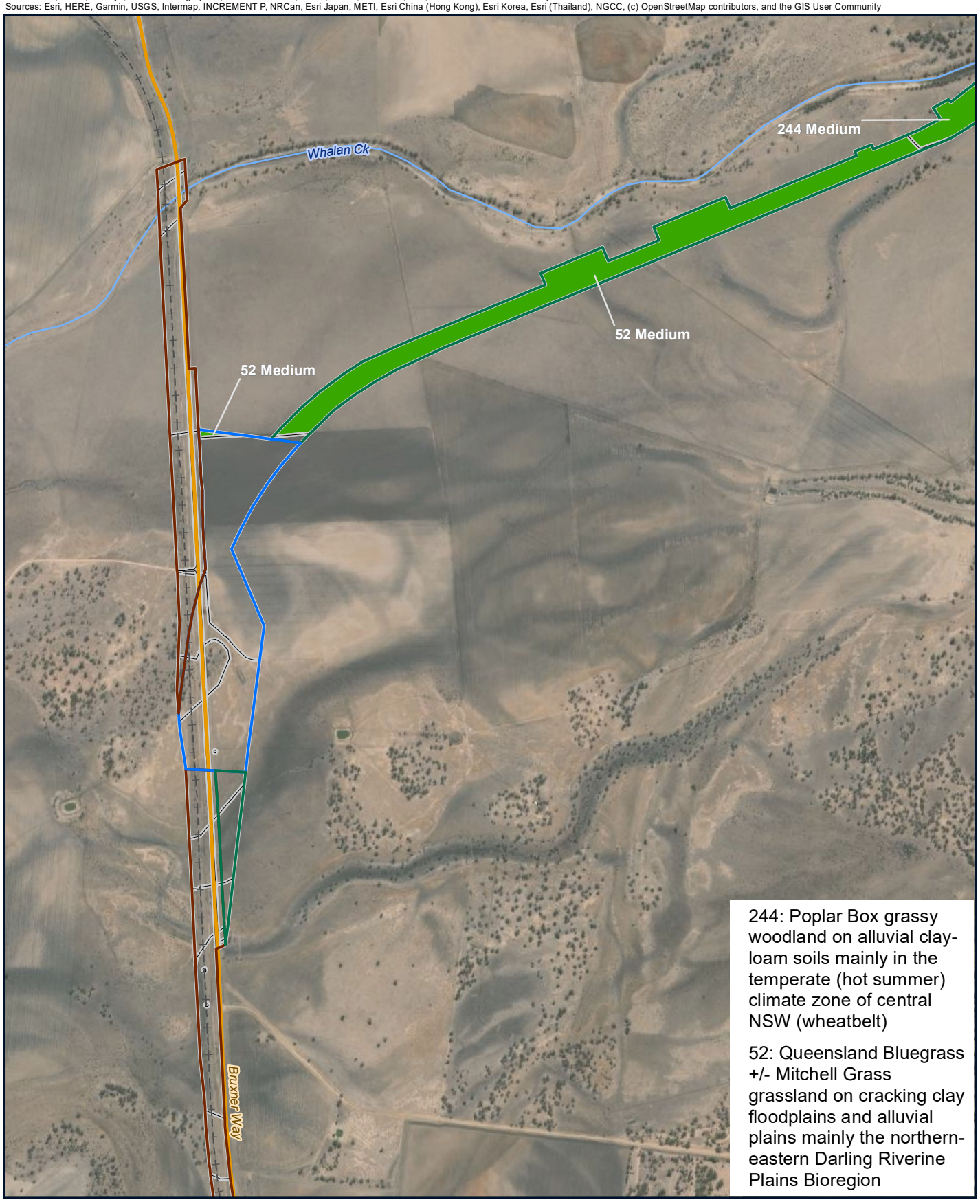
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9w: *Polygala linarifolia* (Native milkwort)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



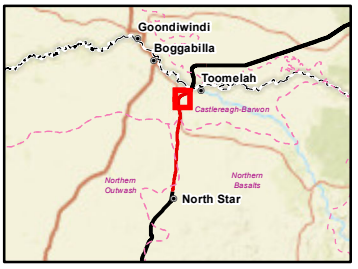
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:56

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9x: *Swainsona murrayana* (Slender darling-pea)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



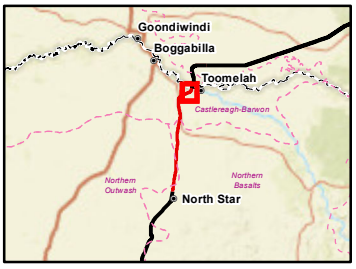
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.9_SCS_flora_v8.mxd Date: 21/07/2021 11:56

Legend

- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Species credit species present



A4 scale: 1:20,000
0 100 200 300 400 500 m

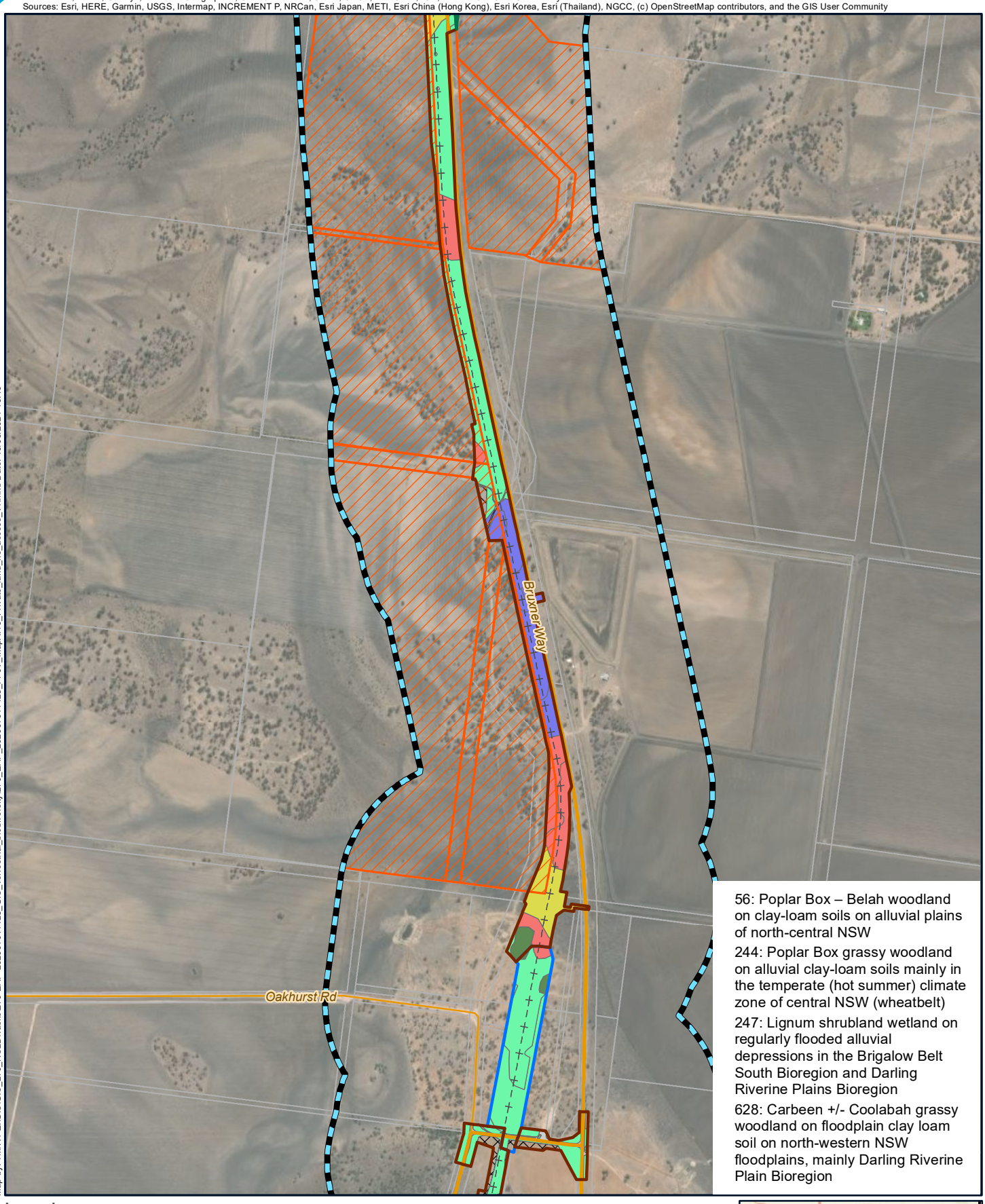
Future Freight
Integrating Community, Environment and Engineering

Date: 21/07/2021 Version: 0
Coordinate system: MGA56

NORTH STAR TO NSW/QLD BORDER

Map A.9y: *Swainsona murrayana* (Slender darling-pea)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

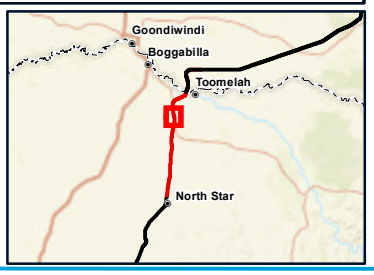
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Area not accessed for survey 2020/21 season
- 56
- 244
- 247
- 628
- Managed Land
- Roads and tracks
- Waterway



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

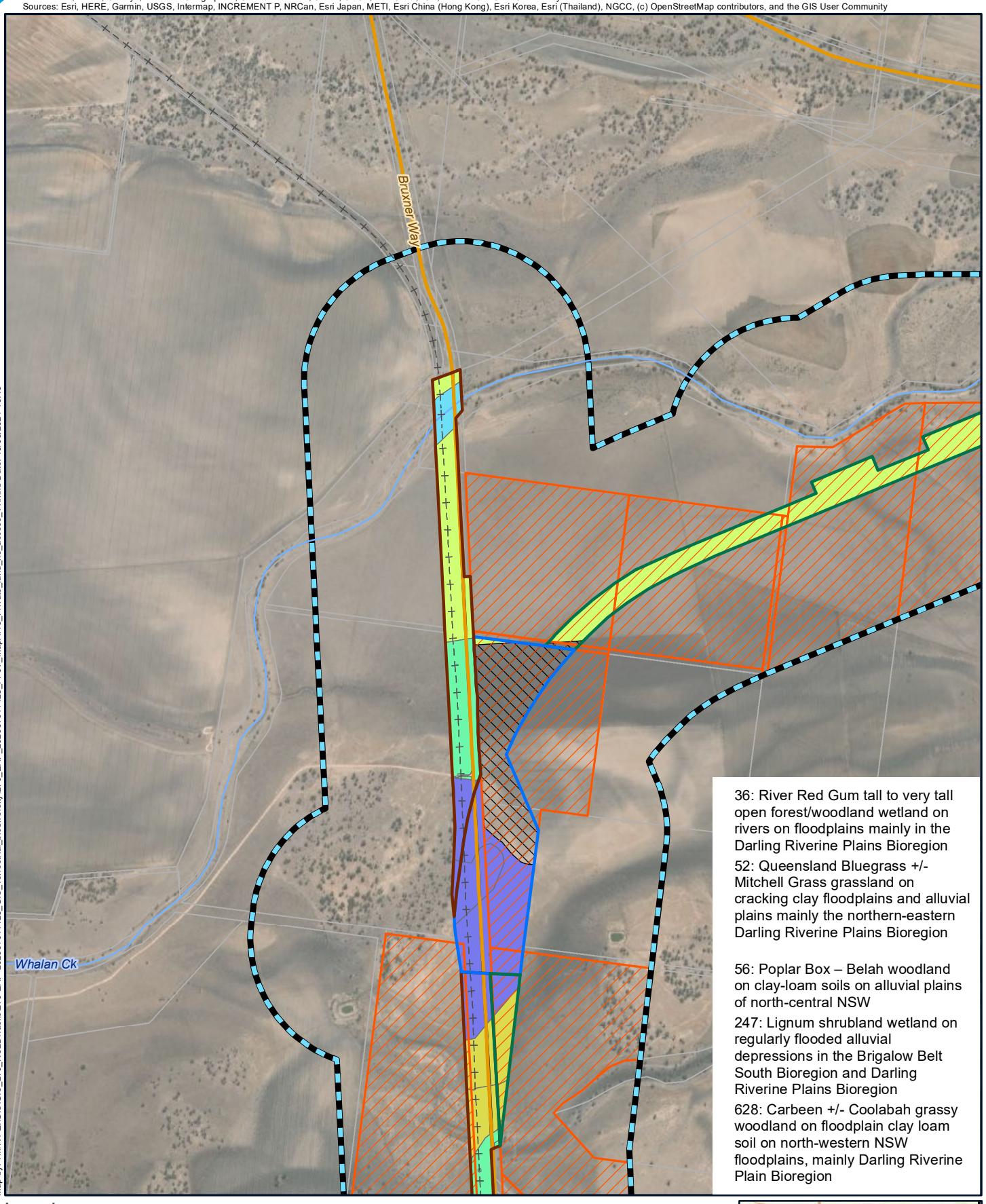
Date: 13/05/2021 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.10a:
Area not accessed for survey 2020/21 season

Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.10_Private_land_no_access_v1.mxd Date: 13/05/2021 16:46

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

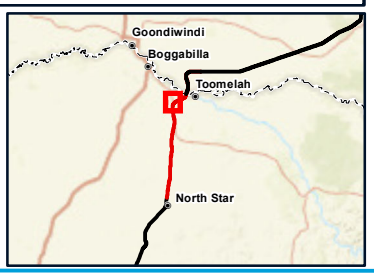
56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Area not accessed for survey 2020/21 season
- 36
- 52
- 56
- 247
- 628
- Managed Land
- Roads and tracks



A4 scale: 1:20,000

0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 0

Coordinate System: GDA 1994 MGA Zone 56

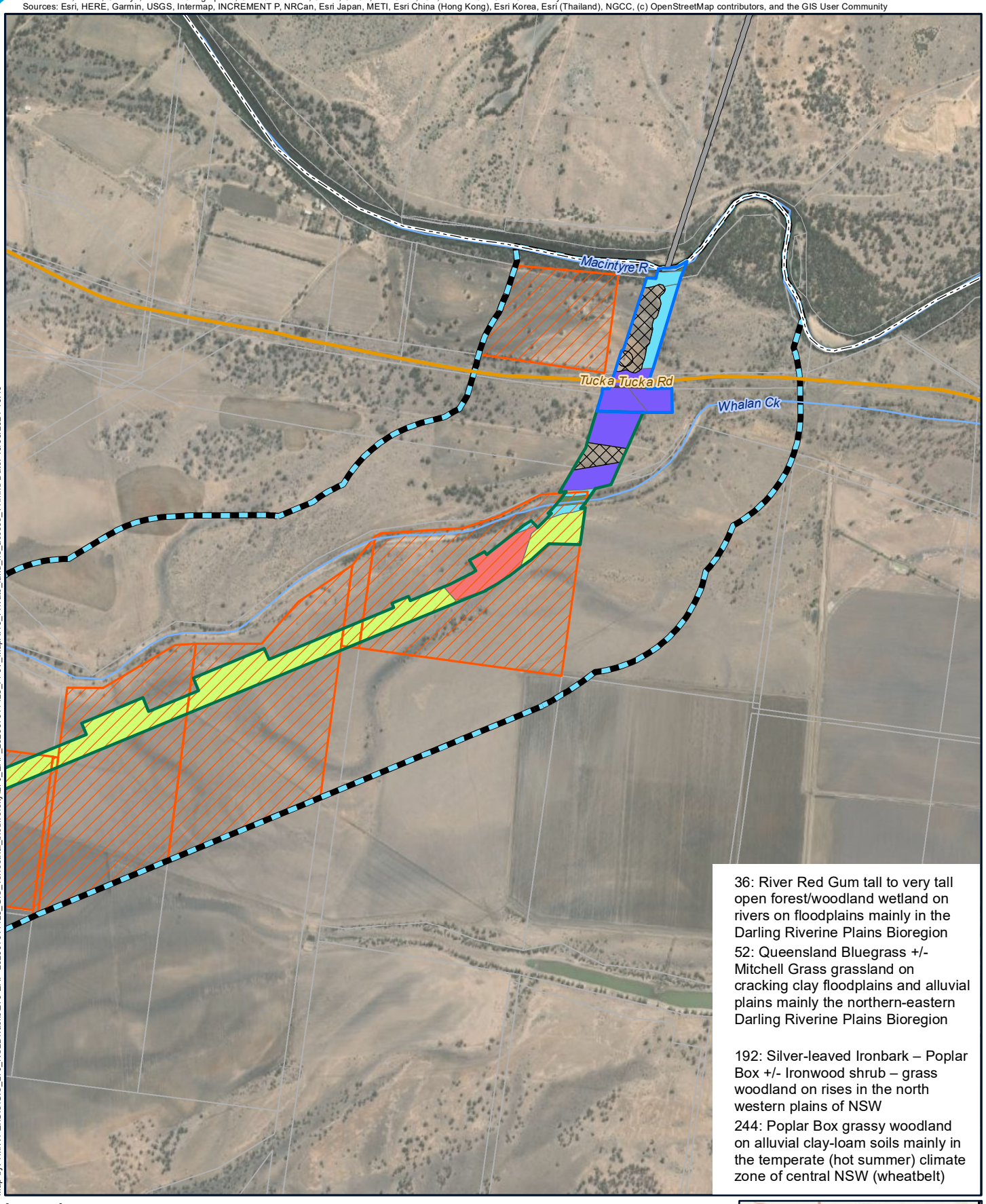
North Star to NSW/QLD border

Map A.10b:

Area not accessed for survey 2020/21 season

Map by: TM/RY Z:\GIS\GIS_270_NS2BiTasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.10_Private_land_no_access_v1.mxd Date: 13/05/2021 16:46

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2BITasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.10_Private_land_no_access_v1.mxd Date: 13/05/2021 16:46

36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

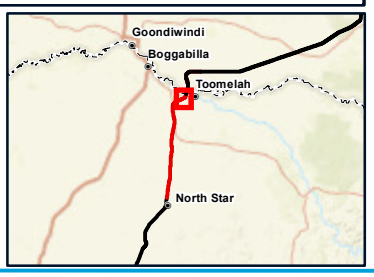
52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Legend

- Major roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (early works)
- Subject land (greenfield)
- Area not accessed for survey 2020/21 season
- 36
- 52
- 192
- 244
- Managed Land
- Roads and tracks
- Waterway



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

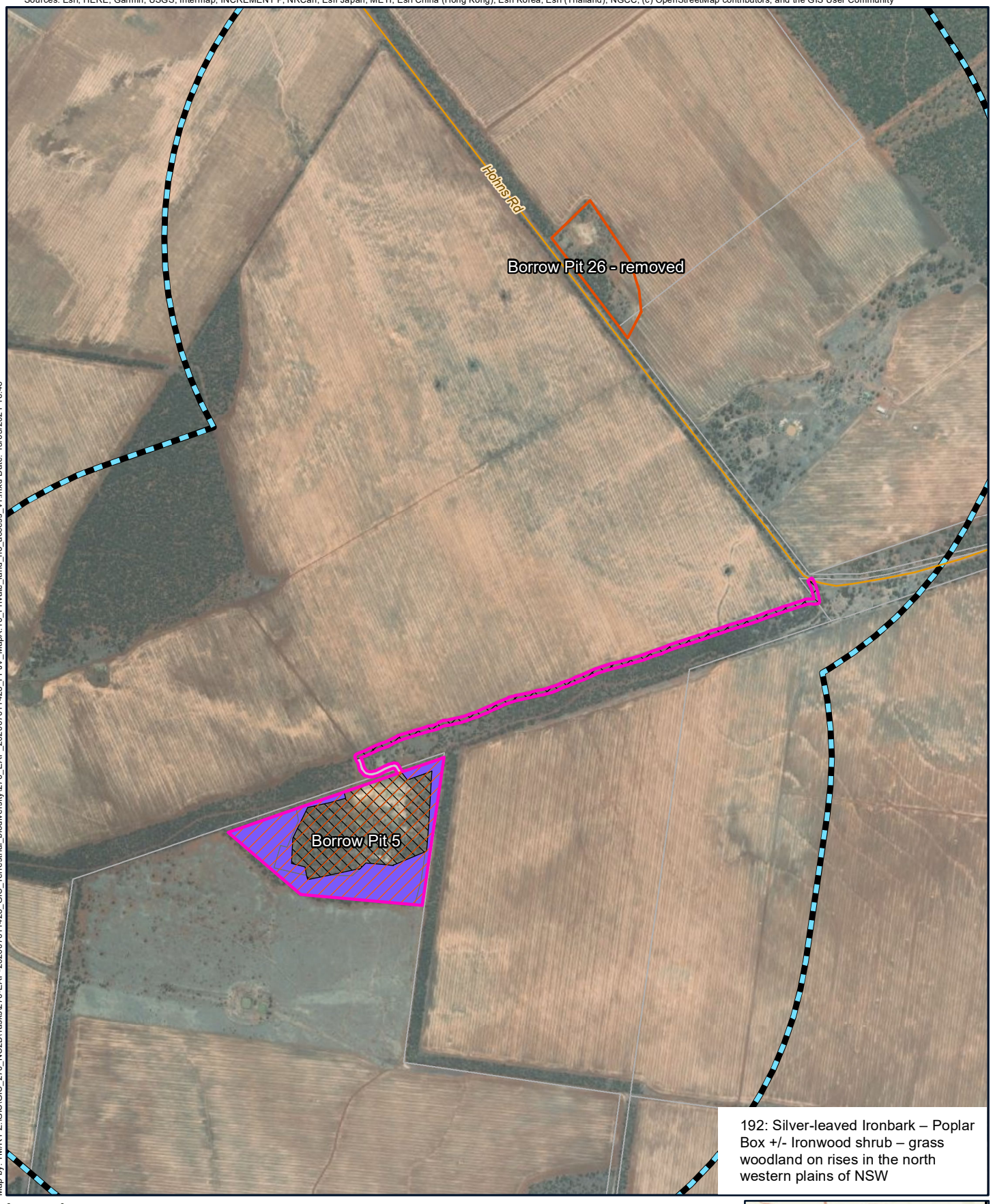
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.10c:
Area not accessed for survey 2020/21 season

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

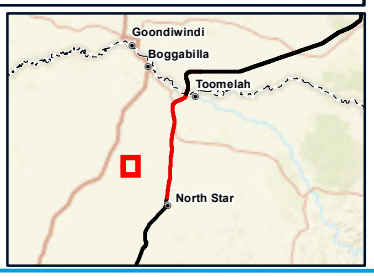


192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

Map by: TM/RY Z:\GIS\GIS_270_NS2BITasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapA.10_Private_land_no_access_v1.mxd Date: 13/05/2021 16:46

Legend

- Minor roads
- Study area
- Borrow pit removed to limit impacts on Brigalow
- Subject land (borrow pit)
- Area not accessed for survey 2020/21 season
- 192
- Managed Land
- Roads and tracks



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

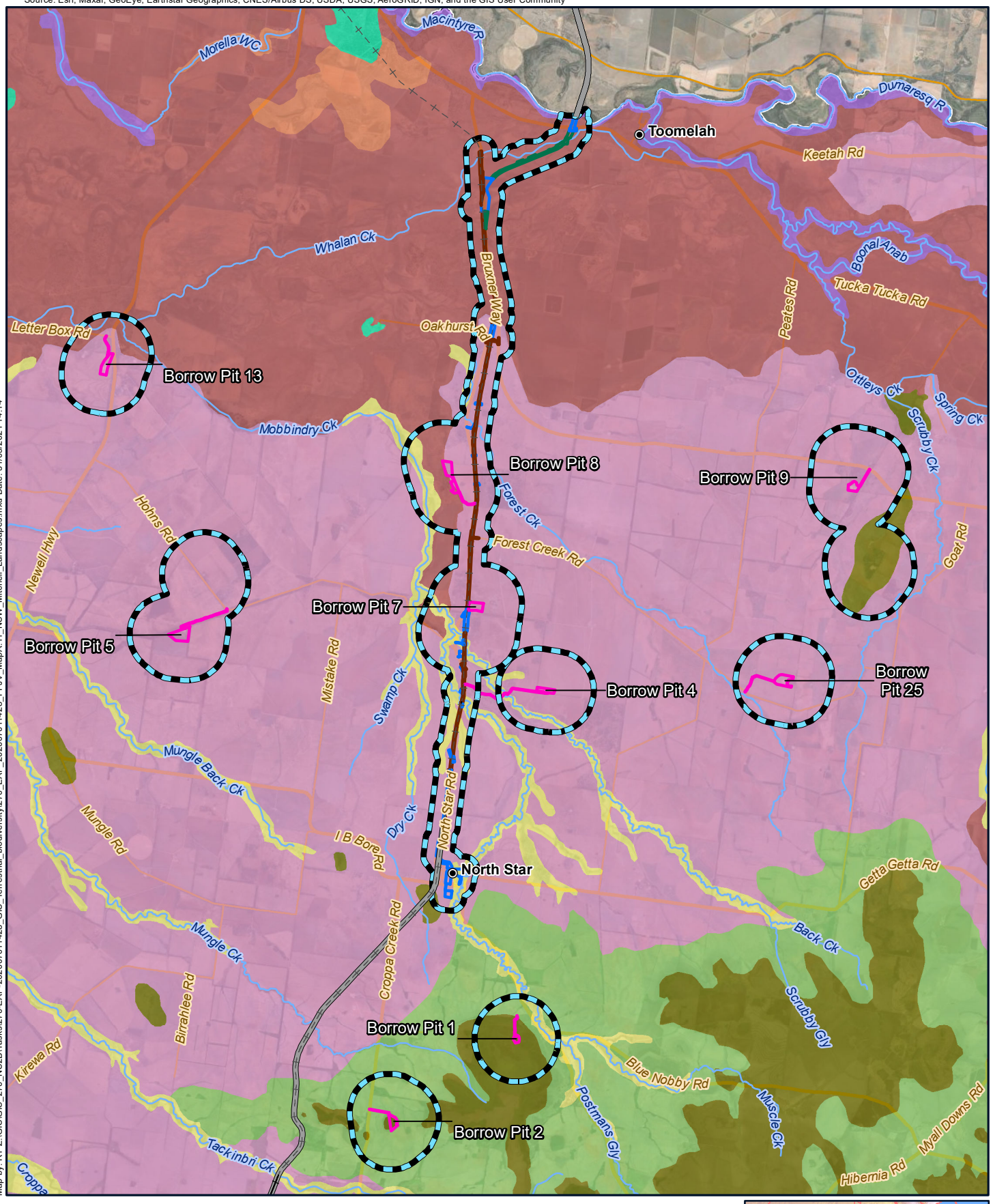
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.10d:
Area not accessed for survey 2020/21 season

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



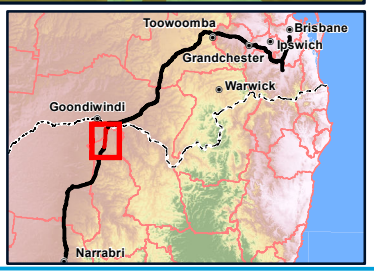
Map by: RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapA.11_NSW_Mitchell_Landscapes.mxd Date: 31/05/2021 14:14

Legend

- Localities
- Existing rail (operational)
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)

Mitchell Landscape

- Barwon Channels and Floodplains
- Croppa Clay Plains
- Croppa Creek Channels and Floodplains
- Macintyre Aeolian Sands
- Macintyre Alluvial Plains
- Macintyre Swamps and Lagoons
- Strathmore Sandstones
- Yallaroi Basalts



A4 scale: 1:200,000

0 1 2 3 4 5km

Future Freight
Integrating Community, Environment and Engineering

Date: 31/05/2021 Version: 1

Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map A.11:
NSW (Mitchell) Landscapes

Appendix B
Flora data

BAM Flora Plot Locations

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
Alignment				
36_CB_High_P1	150.45290050	-28.66637382	Castlereagh-Barwon	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_CB_High_P2	150.45219300	-28.6662402	Castlereagh-Barwon	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_CB_Medium_P1	150.44420058	-28.67538242	Castlereagh-Barwon	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_CB_Medium_P2	150.44919653	-28.67429122	Castlereagh-Barwon	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
39_CB_Medium_P1 (changed to 36)	150.43357937	-28.6793642	Castlereagh-Barwon	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
39_CB_Medium_P10 (changed to 36)	150.41441373	-28.67873463	Castlereagh-Barwon	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
39_CB_Medium_P2 (changed to 36)	150.43655855	-28.67809715	Castlereagh-Barwon	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
39_CB_Medium_P3 (changed to 36)	150.44325317	-28.67629076	Castlereagh-Barwon	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
39_CB_Medium_P4	150.45325790	-28.66843814	Castlereagh-Barwon	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
52_CB_Medium_P1	150.41824778	-28.68562288	Castlereagh-Barwon	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
52_CB_Medium_P10	150.42916822	-28.681344	Castlereagh-Barwon	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
56_CB_Medium_P12	150.42494542	-28.68214896	Castlereagh-Barwon	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
52_CB_Medium_P2	150.42853581	-28.68147711	Castlereagh-Barwon	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
52_CB_Medium_P3	150.43326597	-28.68080995	Castlereagh-Barwon	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
52_CB_Medium_P4	150.43903532	-28.67947333	Castlereagh-Barwon	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
52_CB_Medium_P5	150.41471690	-28.68553575	Castlereagh-Barwon	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
56_CB_Low_P1	150.41873787	-28.73054976	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Low_P10	150.41471690	-28.68553575	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Low_P2	150.41802482	-28.72680279	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Low_P3	150.41767152	-28.72582069	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Medium_P2	150.44228760	-28.67881553	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Medium_P2	150.44228230	-28.67881066	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Medium_P3	150.41810621	-28.73013636	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Medium_P4	150.41836646	-28.73140534	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Medium-P1	150.41493265	-28.71127934	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_CB_Medium_P10	150.42916822	-28.68134400	Castlereagh-Barwon	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
192_CB_Low_P1	150.45196591	-28.67034908	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Low_P2	150.44951948	-28.67012822	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Low_P3	150.44942938	-28.67328472	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north western plains of NSW
192_CB_Medium_P1	150.45142670	-28.67204276	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Medium_P2	150.44953105	-28.67137855	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Medium_P3	150.45110932	-28.6707484	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Low_P1	150.45196591	-28.67034908	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Low_P2	150.44951948	-28.67012822	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
192_CB_Low_P3	150.44942938	-28.67328472	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north western plains of NSW
192_CB_Medium_P1	150.45142670	-28.67204276	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Medium_P2	150.44953105	-28.67137855	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
192_CB_Medium_P3	150.45110932	-28.6707484	Castlereagh-Barwon	Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW
244_CB_Low_P1	150.41831349	-28.73827754	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_CB_Low_P2	150.41887994	-28.73713869	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_CB_Low_P3	150.41975308	-28.73924133	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_CB_Low_P4 (not used mapping change)	150.41631759	-28.71622131	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_CB_Medium_P2	150.41882546	-28.73743403	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_CB_Medium_P3	150.41531269	-28.71677037	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_CB_Medium_P4 (not required due to mapping changes)	150.41528653	-28.71899576	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_CB_Medium_P4 (not required due to mapping changes)	150.41527740	-28.7181241	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244-CB_Medium_P1	150.41717028	-28.7385761	Castlereagh-Barwon	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
247_CB_High_P1	150.41978470	-28.73685593	Castlereagh-Barwon	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
247_CB_High_P2	150.41963340	-28.73568623	Castlereagh-Barwon	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
247_CB_High_P3	150.41857830	-28.73495473	Castlereagh-Barwon	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
247_CB_High_P4	150.41786100	-28.733778	Castlereagh-Barwon	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion
247_CB_Low_P1	150.42054643	-28.73389225	Castlereagh-Barwon	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt
247_CB_Medium_P1	150.44840469	-28.67684355	Castlereagh-Barwon	South Bioregion and Darling Riverine Plains Bioregion
247_CB_Medium_P2	150.44706557	-28.67591069	Castlereagh-Barwon	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt
247_CB_Medium_P3	150.44910564	-28.67506835	Castlereagh-Barwon	Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt
628_CB_Low_P1	150.41444139	-28.70214826	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
628_CB_Low_P3	150.41449780	-28.70488014	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
628_CB_Low_P4	150.41407451	-28.698969	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
628_CB_Low-P2	150.41347400	-28.70922519	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
628_CB_Medium_P1	150.41893730	-28.72919313	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
628_CB_Medium_P2	150.41724670	-28.72406798	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
628_CB_Medium_P3	150.41428530	-28.69565085	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
628_CB_Medium_P4	150.41358440	-28.69535112	Castlereagh-Barwon	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
Northern Outwash				
35_NO_High_P1	150.4049451	-28.84571148	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
35_NO_High_P2	150.4039553	-28.84356353	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
35_NO_High_P3	150.4023914	-28.83953938	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
35_NO_Low_P1	150.394886	-28.908185	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
35_NO_Low_P2	150.3941876	-28.9120942	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
36_NO_High_P1	150.4036432	-28.84862325	Northern Outwash	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_NO_High_P2	150.4035196	-28.84700704	Northern Outwash	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_NO_High_P2** (not used due to mapping change)	150.403252	-28.84700704	Northern Outwash	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_NO_Medium_P1	150.4014232	-28.86838263	Northern Outwash	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_NO_Medium_P2	150.4047962	-28.8533504	Northern Outwash	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
36_NO_Medium_P3	150.4044873	-28.8487706	Northern Outwash	River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion
56_NO_High_P1	150.4008454	-28.86875405	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_High_P2	150.403955	-28.843564	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_High_P3	150.402391	-28.839539	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Low_P1	150.4019554	-28.86547475	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Low_P10	150.4035231	-28.86327925	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Low_P2	150.4015687	-28.84762499	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Low_P3	150.40282	-28.859851	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Low_P4	150.4041342	-28.85449866	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Low_P5	150.4034097	-28.85160858	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Medium_P1	150.4023231	-28.86756263	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Medium_P2	150.4053259	-28.86507828	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NO_Medium_P3	150.4080043	-28.84510278	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
244_NO_Low_P10	150.4194274	-28.74357993	Northern Outwash	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
Northern Basalts				
27_NB_Medium_P1	150.402641	-28.86463513	Northern Basalts	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
27_NB_Low_P3	150.402338	-28.865925	Northern Basalts	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
35_NB_High_P1	150.404974	-28.82999737	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
35_NB_High_P2	150.4054865	-28.82551443	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
35_NB_High_P3	150.4056565	-28.82491483	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
35_NB_Low_P1	150.4057888	-28.83135685	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
53_NB_Medium_P1	150.4103783	-28.77480453	Northern Basalts	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
53_NB_Medium_P2	150.4106277	-28.77023536	Northern Basalts	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
53_NB_Medium_P3	150.4089287	-28.77175165	Northern Basalts	Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains
55_NB_High_P1	150.4110052	-28.77182693	Northern Basalts	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
55_NB_High_P2	150.4108453	-28.77285568	Northern Basalts	Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
56_NB_High_P1	150.406924	-28.829079	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_High_P2	150.4073296	-28.81398712	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_High_P3	150.407922	-28.8104767	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_High_P4	150.4092044	-28.78359437	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_High_P5	150.4123487	-28.7608752	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_High_P6 (not used due to mapping changes)	150.4115745	-28.7640265	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_High_P7 ((NB56HS1) not used due to mapping changes)	150.4095685	-28.79533399	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
56_NB_Low_P1	150.409348	-28.795323	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Low_P10	150.3958731	-28.93450409	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Low_P11	150.398349	-28.92910837	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Low_P2	150.40925299	-28.80126431	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Low_P3	150.40924192	-28.78950404	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Low_P4	150.4095301	-28.78859071	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Low_P5	150.4131051	-28.76257718	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Low_P6 (not used due to mapping changes)	150.4084195	-28.81240298	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Medium_P1	150.4112215	-28.77066673	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Medium_P10	150.3972509	-28.92815663	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Medium_P2	150.4119937	-28.76904295	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Medium_P3	150.415686	-28.75024018	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
56_NB_Medium_P4	150.4158318	-28.74953043	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
98_NB_High_P1	150.406924	-28.81756672	Northern Basalts	Poplar Box - White Cypress Pine - Wilga - Ironwood shrubby woodland on red sandy-loam soils_DRP and BBS
244_NB_High_P1	150.4107944	-28.80051358	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_NB_High_P2	150.4107701	-28.79907168	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_NB_High_P3	150.4105351	-28.79165267	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_NB_High_P4	150.4105868	-28.78899397	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_NB_Medium_P1	150.4183716	-28.74225478	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_NB_Medium_P2	150.4184587	-28.7418108	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)
244_NB_Medium_P3	150.4164754	-28.74138605	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
244_NB_Low_P10	150.4194207	-28.74357993	Northern Basalts	Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
Borrow pit data				
Northern outwash				
Borrow pit 2				
BP2_35_Low_P1	150.37199	-29.01344	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP2_35_Low_P2	150.37381	-29.01531	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP2_418_Medium_P1	150.3716037	-29.01414462	Northern Outwash	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP2_418_Medium_P3	150.37129	-29.01793	Northern Outwash	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP2_418_Medium_P4	150.37137	-29.01373	Northern Outwash	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP2_418_High_P1	150.3710483	-29.01584908	Northern Outwash	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP2_418_High_P3	150.3730063	-29.0150686	Northern Outwash	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
Borrow pit 5				
BP5_192_High_P1	150.2879864	-28.84455794	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
BP5_192_High_P2	150.28798641	-28.84455794	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
BP5_192_High_P3	150.2933224	-28.8454622	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
BP5_192_Medium_P1	150.28946528	-28.84448874	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
BP5_192_Medium_P1a	150.2894653	-28.84448874	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
BP5_192_Medium_P3	150.2901117	-28.84333774	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
BP5_192_Low_P2	150.294542	-28.84282682	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
BP5_192_Low_P1	150.29515	-28.84132	Northern Outwash	Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW
Borrow pit 7				
BP7_35_High_P1	150.40695	-28.84439	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP7_35_High_P2	150.40732	-28.84223	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP7_35_High_P4	150.40807	-28.8422	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP7_35_Low_P3	150.40173	-28.84517	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP7_35_High_P5	150.40419	-28.84129	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP7_35_Low_P7	150.4045	-28.84269	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP7_35_Low_P8	150.40416	-28.8455	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP7_56_High_P1	150.409269	-28.84164535	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
BP7_56_High_P2	150.4078073	-28.84111297	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
BP7_56_High_P3	150.4094735	-28.84406055	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
BP7_56_Low_P6	150.40546	-28.83992	Northern Outwash	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
Borrow pit 13				
BP13_418_High_P3 (1)	150.3730063	-29.0150686	Northern Outwash	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP13_418_Low_P2	150.26262	-28.75122	Northern Outwash	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
Borrow pit 26				
BP26_35_High_P1	150.30104	-28.82442	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP26_35_Medium_P2	150.30142	-28.82379	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
BP26_35_Medium_P3	150.30212	-28.82292	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP26_35_Low_P4	150.30081	-28.82377	Northern Outwash	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
Northern Basalts				
Borrow pit 1				
BP1_Track1_	150.420694	-28.98510	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP1_Track2	150.427457	-28.985611	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP1_Track3	150.420604	-28.981977	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP1_147_High_P1	150.42126	-28.98684	Northern Basalts	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion
BP1_147_Medium_P1	150.4212876	-28.98852164	Northern Basalts	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion
BP1_417_Medium_P2	150.4200313	-28.98747512	Northern Basalts	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion
Borrow pit 8				
BP8_56_Medium_P1	150.39861	-28.78641	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
BP8_56_Meidum_P2	150.40111	-28.79309	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
BP8_244_Medium_P1 (mapped as 56)	150.9759443	-28.78825183	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
BP8_244_Medium_P2 (mapped as 56)	150.4023953	-28.79516744	Northern Basalts	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
Borrow pit 9				
BP9_35_High_P1 (recorded Medium)	150.55855	-28.79179	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP9_35_High_P2 (recorded Medium)	150.5615657	-28.7913367	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP9_35_High_P3 (recorded Medium)	150.559469	-28.79396539	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
BP9_35_High_P4 (recorded Medium)	150.5600221	-28.79077926	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP9_418_High_P1	150.5643336	-28.79191028	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP9_418_High_P2	150.5629514	-28.79312096	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP9_418_High_P3	150.56309	-28.7948944	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP9_418_High_P3b	150.5629623	-28.79256758	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP9_418_Medium_P1	150.5607599	-28.7968128	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP9_4185_Medium_P2	150.5602222	-28.79569349	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP9_418_Medium_P3	150.5592573	-28.79522217	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP9_418_Low_P1	150.557488	-28.798349	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
Borrow pit 11				
BP11_35_High_P2	150.56552	-28.82442	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP11_35_High_P3	150.56532	-28.82837	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP11_35_High_P4	150.56544	-28.82671	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP11_35_Low_P1	150.56311	-28.82548	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
Borrow pit 25				
BP25_35_Medium_P1	150.5334	-28.86585	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

Plot identifier	Latitude	Longitude	IBRA subregion	PCT Description
BP25_35_Medium_P2	150.53308	-28.86543	Northern Basalts	Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion
BP25_418_Low_P1	150.532662	-28.864164	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP25_418_Low_P3	150.53375	-28.86402	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion
BP25_418_Medium_P1	150.5318457	-28.86539287	Northern Basalts	White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Flora species observed

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Amaranthaceae	*Ptilotus exaltatus var. semilanatus*	Tall mulla mulla	Protected	-	F	Forb (FG)
Asteraceae	*Calocephalus spp.*	Beauty-heads	Protected	-	F	Forb (FG)
Asteraceae	*Crassocephalum crepidioides*	Thickhead	Exotic	-	-	-
Capparaceae	*Capparis sarmentosa*	-	Protected	-	Vine	Other (OG)
Celastraceae	*Cassine australis var. angustifolia*		Protected	-	Shrub	Shrub (SG)
Crassulaceae	*Bryophyllum spp.*	Mother of millions	Protected	-	ZZ	High Threat Exotic
Lamiaceae	*Spartothamnella juncea*	Bead bush	Protected	-	Shrub	Shrub (SG)
Meliaceae	*Melia azedarach*	White cedar	Protected	-	T	Tree (TG)
Poaceae	*Austrodanthonia spp.*	Wallaby grass	Protected	-	TG	Grass & Grasslike (GG)
Poaceae	*Eragrosits pilosa*	Soft lovegrass	Exotic (Naturalised)	-	E	Naturalised
Acanthaceae	*Brunoniella australis*	Blue trumpet	Protected	-	F	Forb (FG)
Acanthaceae	*Rostellularia adscendens*	Pink tongues	Protected	-	F	Forb (FG)
Aizoaceae	*Tetragonia tetragonioides*	New Zealand spinach	Protected	-	F	Forb (FG)
Amaranthaceae	*Alternanthera denticulata*	Lesser joyweed	Protected	-	F	Forb (FG)
Amaranthaceae	*Alternanthera spp.*	Joyweed	Protected	-	F	Forb (FG)
Amaranthaceae	*Gomphrena celosioides*	Gomphrena weed	Exotic	-	E	Naturalised
Amaranthaceae	*Ptilotus nobilis*	Yellowtails	Protected	-	F	Forb (FG)
Amaryllidaceae	*Crinum flaccidum*	Darling lily	Protected	-	F	Forb (FG)
Anthericaceae	*Arthropodium milleflorum*	Pale vanilla-lily	Protected	-	F	Forb (FG)
Anthericaceae	*Arthropodium spp.*	-	Protected	-	F	Forb (FG)
Anthericaceae	*Tricoryne elatior*	Yellow autumn-lily	Protected	-	F	Forb (FG)
Apiaceae	*Ammi majus*	Bishop's weed	Exotic	-	E	Naturalised
Apiaceae	*Daucus glochidiatus*	Native carrot	Protected	-	F	Forb (FG)
Apiaceae	*Eryngium paludosum*	Long eryngium	Protected	-	F	Forb (FG)
Apiaceae	*Hydrocotyle spp.*	Hydrocotyle	Protected	-	F	Forb (FG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Apocynaceae	*Alstonia constricta*	Quinine bush	Protected	-	T	Tree (TG)
Apocynaceae	*Carissa ovata*	Current bush	Protected	-	Vine	Other (OG)
Apocynaceae	*Gomphocarpus physocarpus*	Balloon cotton bush	Exotic	-	E	Naturalised
Apocynaceae	*Parsonsia eucalyptophylla*	Gargaloo	Protected	-	V	Other (OG)
Apocynaceae	*Parsonsia sp.*	-	Protected	-	V	Other (OG)
Apocynaceae	*Parsonsia strainea*	-	Protected	-	Vine	Other (OG)
Asphodelaceae	*Bulbine bulbosa*	Bulbine lily	Protected	-	F	Forb (FG)
Asphodelaceae	*Bulbine semibarbata*	Wild onion	Protected	-	F	Forb (FG)
Asteraceae	*Brachyscome ciliaris*	Variable daisy	Protected	-	F	Forb (FG)
Asteraceae	*Brachyscome curvicarpa*	-	Protected	-	F	Forb (FG)
Asteraceae	*Brachyscome sp.*	-	Protected	-	F	Forb (FG)
Asteraceae	*Calendula arvensis*	Field marigold	Exotic	-	E	Naturalised
Asteraceae	*Calotis cuneata*	Mountain burr-daisy	Protected	-	F	Forb (FG)
Asteraceae	*Calotis dentex*	Burr-daisy	Protected	-	F	Forb (FG)
Asteraceae	*Calotis lappulacea*	Yellow burr-daisy	Protected	-	F	Forb (FG)
Asteraceae	*Calotis scapigera*	Tufted burr-daisy	Protected	-	F	Forb (FG)
Asteraceae	*Calotis spp.*	Burr-daisy	Protected	-	F	Forb (FG)
Asteraceae	*Cassinia spp.*	Cassinia	Protected	-	S	Shrub (SG)
Asteraceae	*Chrysocephalum apiculatum*	Common everlasting	Protected	-	F	Forb (FG)
Asteraceae	*Flaveria australasica*	Speedy weed	Protected	-	F	Forb (FG)
Asteraceae	*Hypochaeris radicata*	Catsear	Exotic	-	-	-
Asteraceae	*Leiocarpa panaetioides*	Woolly buttons	Protected	-	F	Forb (FG)
Asteraceae	*Leucochrysum albicans*	Everlasting	Protected	-	F	Forb (FG)
Asteraceae	*Pycnosorus globosus*	Drumsticks	Protected	-	F	Forb (FG)
Asteraceae	*Rhodanthe floribunda*	Common white sunray	Protected	-	F	Forb (FG)
Asteraceae	*Sonchus oleraceus*	Sowthistle	Exotic	-	E	Naturalised

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Asteraceae	*Vittadinia cervicularis*	Daisy	Protected	-	F	Forb (FG)
Asteraceae	*Vittadinia dissecta*	Disected New Holland daisy	Protected	-	F	Forb (FG)
Asteraceae	*Vittadinia gracilis*	Woolly New Holland daisy	Protected	-	F	Forb (FG)
Asteraceae	*Vittadinia spp.*	Fuzzweed	Protected	-	F	Forb (FG)
Asteraceae	*Xanthium occidentale*	Noogoora burr	Exotic	-	ZZ	High Threat Exotic
Bignoniaceae	*Pandorea pandorana*	Wonga wonga vine	Protected	-	Vine	Other (OG)
Boraginaceae	*Ehretia membranifolia*	Peach bush	Protected	-	Shrub	Shrub (SG)
Brassicaceae	*Brassica sp.*	-	Exotic	-	E	Naturalised
Brassicaceae	*Brassica x juncea*	Indian mustard	Exotic (Naturalised)	-	E	Naturalised
Brassicaceae	*Capsella bursa-pastoris*	Shepherd's purse	Exotic	-	E	Naturalised
Brassicaceae	*Lepidium africanum*	Peppercress	Exotic	-	E	Naturalised
Brassicaceae	*Lepidium bonariense*	Argentine peppercress	Exotic	-	E	Naturalised
Brassicaceae	*Lepidium fasciculatum*	Bundled peppercress	Protected	-	F	Forb (FG)
Brassicaceae	*Lepidium sp.*	A Peppercress -			F	Forb (FG)
Brassicaceae	*Lepidium sp.2*	Peppercress	Protected	-	F	Forb (FG)
Brassicaceae	*Rapistrum rugosum*	Turnip weed	Exotic	-	E	Naturalised
Cactaceae	*Harrisia martinii*	Moonlight cactus	Exotic	-	ZZ	High Threat Exotic
Cactaceae	*Opuntia aurantiaca*	Tiger pear	Exotic	-	ZZ	High Threat Exotic
Cactaceae	*Opuntia stricta*	Common prickly pear	Exotic	-	ZZ	High Threat Exotic
Cactaceae	*Opuntia tomentosa*	Velvet tree pear	Exotic	-	ZZ	High Threat Exotic
Campanulaceae	*Lobelia spp.*	Lobelia	Protected	-	F	Forb (FG)
Campanulaceae	*Wahlenbergia communis*	Tufted bluebell	Protected	-	F	Forb (FG)
Campanulaceae	*Wahlenbergia gracilis*	Sprawling bluebell	Protected	-	F	Forb (FG)
Campanulaceae	*Wahlenbergia spp.*	Bluebell	Protected	-	F	Forb (FG)
Capparaceae	*Apophyllum anomalum*	Warrior bush	Protected	-	S	Shrub (SG)
Capparaceae	*Capparis lasiantha*	Nepine	Protected	-	V	Other (OG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Capparaceae	*Capparis loranthifolia*	Narrow-leaf bumble tree	Protected	-	Tree	Tree (TG)
Capparaceae	*Capparis mitchellii*	Native orange	Protected	-	S	Shrub (SG)
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak	Protected	-	T	Tree (TG)
Casuarinaceae	*Casuarina cristata*	Belah	Protected	-	T	Tree (TG)
Celastraceae	*Denhamia cunninghamii*	-	Protected	-	S	Shrub (SG)
Chenopodiaceae	*Atriplex crassipes*	Saltbush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Atriplex leptocarpa*	Slender-fruit saltbush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Atriplex muelleri*	Mueller's saltbush	Protected	-	F	Forb (FG)
Chenopodiaceae	*Atriplex semibaccata*	Creeping saltbush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Atriplex spp.*	-	Protected	-	F	Forb (FG)
Chenopodiaceae	*Chenopodium desertorum*	Desert goosefoot	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Einadia hastata*	Berry saltbush	Protected	-	F	Forb (FG)
Chenopodiaceae	*Einadia nutans*	Climbing saltbush	Protected	-	F	Forb (FG)
Chenopodiaceae	*Enchylaena tomentosa*	Ruby saltbush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Maireana coronata*	Crown fissure-weed	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Maireana decalvans*	Black cotton bush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Maireana microphylla*	Small-leaf bluebush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Maireana pentagona*	Hairy bluebush	Protected	-	F	Forb (FG)
Chenopodiaceae	*Maireana spp.*	Cotton bush	Protected	-	S	Shrub (SG)
Chenopodiaceae	*Maireana villosa*	Silky bluebush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Rhagodia spinescens*	Thorny saltbush	Protected	-	Chenopod	Shrub (SG)
Chenopodiaceae	*Salsola kali*	Buckbush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Salsola kali var. kali*	Buckbush	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena anisacanthoides*	Yellow Burr	Protected	-	Chenopod	Shrub (SG)
Chenopodiaceae	*Sclerolaena bicornis*	Goathead burr	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena birchii*	Galvanized burr	Protected	-	C	Shrub (SG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Chenopodiaceae	*Sclerolaena divaricata*	Tangled copperburr	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena muricata*	Black roly-poly	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena muricata var. villosa*	Black roly-poly	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena spp.*	Copperburr	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena tetracuspis*	Brigalow burr	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena tricuspis*	Giant redburr	Protected	-	C	Shrub (SG)
Chenopodiaceae	*Sclerolaena ventricosa*	Salt copperburr	Protected	-	C	Shrub (SG)
Commelinaceae	*Commelina ensifolia*	Scurvy grass	Protected	-	F	Forb (FG)
Commelinaceae	*Commelina diffusa*	Commelina diffusa	Protected	-	F	Forb (FG)
Convolvulaceae	*Convolvulus erubescens*	Pink bindweed	Protected	-	L	Other (OG)
Convolvulaceae	*Dichondra repens*	Kidney weed	Protected	-	F	Forb (FG)
Cucurbitaceae	*Cucumis myricoarpus*	Paddy mellon	Exotic (Naturalised)	-	E	Naturalised
Cupressaceae	*Callitris glaucophylla*	White cypress pine	Protected	-	T	Tree (TG)
Cyperaceae	*Carex inversa*	Knob sedge	Protected	-	V	Grass & grasslike (GG)
Cyperaceae	*Carex spp.*	Sedge	Protected	-	V	Grass & grasslike (GG)
Cyperaceae	*Cyperus bifax*	Downs nutgrass	Protected	-	Se	Grass & grasslike (GG)
Cyperaceae	*Cyperus concinnus*	Trim flat-sedge	Protected	-	Se	Grass & grasslike (GG)
Cyperaceae	*Cyperus exaltatus*	-	Protected	-	Se	Grass & grasslike (GG)
Cyperaceae	*Cyperus gracilis*	Slender flat-sedge	Protected	-	Se	Grass & grasslike (GG)
Cyperaceae	*Cyperus spp.*	-	Protected	-	Se	Grass & grasslike (GG)
Cyperaceae	*Eleocharis acuta*	Spike-rush, Spike-sedge	Protected	-	Se	Grass & grasslike (GG)
Cyperaceae	*Eleocharis pusilla*	Spike-sedge	Protected	-	Se	Grass & grasslike (GG)
Cyperaceae	*Eleocharis spp.*	Spike-rush, Spike-sedge	Protected	-	Se	Grass & grasslike (GG)
Euphorbiaceae	*Beyeria viscosa*	Sticky wallaby bush	Exotic	-	Shrub	Shrub (SG)
Euphorbiaceae	*Croton phebalioides*		Protected	-	Shrub	Shrub (SG)
Euphorbiaceae	*Euphorbia drummondii*	Caustic weed	Protected	-	F	Forb (FG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Euphorbiaceae	*Euphorbia tannensis*		Protected	-	Shrub	Shrub (SG)
Euphorbiaceae	*Euphorbia tannensis sub sp eremophila*	-	Protected	-	Shrub	Shrub (SG)
Fabaceae	*Lotus spp.*	Trefoil	Exotic	-	E	Naturalised
Fabaceae	*Medicago scutellata*	Snail medic	Exotic	-	E	Naturalised
Fabaceae	*Trifolium spp.*	A clover	Exotic	-	E	Naturalised
Fabaceae	*Acacia decora*	Western silver wattle	Protected	-	S	Shrub (SG)
Fabaceae	*Acacia excelsa*	Ironwood	Protected	-	T	Tree (TG)
Fabaceae	*Acacia hakeoides*	Hakea wattle	Protected	-	S	Shrub (SG)
Fabaceae	*Acacia harpophylla*	Brigalow	Protected	-	T	Tree (TG)
Fabaceae	*Acacia pendula*	Weeping myall, Boree	Protected	-	T	Tree (TG)
Fabaceae	*Acacia salicina*	Cooba	Protected	-	T	Tree (TG)
Fabaceae	*Cullen tenax*	Emu-foot	Protected	-	F	Forb (FG)
Fabaceae	*Desmodium brachypodum*	Large tick-trefoil	Protected	-	F	Forb (FG)
Fabaceae	*Desmodium spp.*	Tick-trefoil	Protected	-	F	Forb (FG)
Fabaceae	*Desmodium varians*	Slender tick-trefoil	Protected	-	L	Other (OG)
Fabaceae	*Glycine clandestina*	Twining glycine	Protected	-	L	Other (OG)
Fabaceae	*Glycine spp.*	-	Protected	-	F	Forb (FG)
Fabaceae	*Indigofera australis*	Australian indigo	Protected	-	S	Shrub (SG)
Fabaceae	*Indigofera spp.*	Indigo	Protected	-	S	Shrub (SG)
Fabaceae	*Medicago arabica*	Spotted burr medic	Exotic	-	E	Naturalised
Fabaceae	*Medicago polymorpha*	Burr medic	Exotic	-	E	Naturalised
Fabaceae	*Neptunia gracilis*	Sensitive plant	Protected	-	F	Forb (FG)
Fabaceae	*Senna artemisioides subsp. zygophylla*	Silver cassia	Protected	-	S	Shrub (SG)
Fabaceae	*Senna circinnata*	Coiled cassia	Protected	-	S	Shrub (SG)
Fabaceae	*Swainsona greyana*		Protected	-	Forb	Forb (FG)
Fabaceae	*Trifolium spp.*	Clover	Exotic	-	F	Naturalised

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Fabaceae	*Vachellia farnesiana*	Mimosa bush	Exotic	-	ZZ	High Threat Exotic
Fabaceae	*Vicia sativa*	Common vetch	Exotic	-	E	Naturalised
Fabaceae (Faboideae)	*Glycine canescens*	Silky glycine	Protected	-	V	Other (OG)
Geraniaceae	*Erodium crinitum*	Blue crowfoot	Protected	-	F	Forb (FG)
Goodeniaceae	*Brunonia australis*	Blue pincushion	Protected	-	F	Forb (FG)
Goodeniaceae	*Goodenia fascicularis*	Mallee goodenia	Protected	-	F	Forb (FG)
Goodeniaceae	*Goodenia spp.*	Goodenia	Protected	-	F	Forb (FG)
Haloragaceae	*Gonocarpus spp.*	Gonocarpus	Protected	-	F	Forb (FG)
Haloragaceae	*Haloragis heterophylla*	Rough raspwort	Protected	-	F	Forb (FG)
Hypoxidaceae	*Hypoxis hygrometrica*	Golden weather-grass	Protected	-	F	Forb (FG)
Jasminum	*Jasminum lineare*	Jasminum	Protected	-	Vine	Other (OG)
Juncaceae	*Juncus spp.*	Rush	Protected	-	R	Grass & grasslike (GG)
Juncaceae	*Juncus spp. 2*	Rush	Protected	-	R	Grass & grasslike (GG)
Juncaceae	*Juncus usitatus*	Rush	Protected	-	R	Grass & grasslike (GG)
Lamiaceae	*Clerodendrum spp.*	-	Protected	-	T	Tree (TG)
Lamiaceae	*Mentha satureioides*	Native pennyroyal	Protected	-	F	Forb (FG)
Lamiaceae	*Prostanthera crypotandroides*	Mint bush	Protected	-	Shrub	Shrub (SG)
Lamiaceae	*Teucrium junceum*	Red berry stick plant	Protected	-	S	Shrub (SG)
Lomandraceae	*Lomandra filiformis*	Wattle matt-rush	Protected	-	R	Grass & grasslike (GG)
Loranthaceae	*Amyema quandang*	Grey mistletoe	Protected	-	K	Other (OG)
Loranthaceae	*Lysiana exoparpi sub exocarpi*	Mistletoe	Protected	-	Epiphyte	Other (OG)
Luzuriagaceae	*Eustrephus latifolius*	Wombat berry	Protected	-	L	Other (OG)
Lycopodiaceae	*Lycopodium spp.*	-	Protected	-	LYCO	Other (OG)
Malvaceae	*Grewia latifolia*	Dysentery bush	Protected	-	S	Shrub (SG)
Malvaceae	*Malva parviflora*	Small flowered mallow	Exotic	-	E	Naturalised
Malvaceae	*Malvastrum americanum*	Spiked malvastrum	Exotic	-	E	Naturalised

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Malvaceae	*Modiola caroliniana*	Red-flowered mallow	Exotic	-	-	-
Malvaceae	*Sida cordifolia*		Protected	-	F	Forb (FG)
Malvaceae	*Sida corrugata*	Corrugated sida	Protected	-	F	Forb (FG)
Malvaceae	*Sida filiformis*	Fine sida	Protected	-	F	Forb (FG)
Malvaceae	*Sida goniocarpa*	-	Protected	-	F	Forb (FG)
Malvaceae	*Sida platycalyx*	Lifesaver burr	Protected	-	F	Forb (FG)
Malvaceae	*Sida rhombifolia*	Paddy's lucerne	Exotic	-	E	Naturalised
Malvaceae	*Sida spp.*	Sida	Protected	-	F	Forb (FG)
Malvaceae	*Sida trichopoda*	High sida/Hairy sida	Protected	-	F	Forb (FG)
Marsileaceae	*Marsilea drummondii*	Common nardoo	Protected	-	F	Fern (EG)
Marsileaceae	*Marsilea hirsuta*	Short-fruited nardoo	Protected	-	F	Fern (EG)
Myoporaceae	*Eremophila debilis*	Amulla	Protected	-	S	Shrub (SG)
Myoporaceae	*Eremophila deserti*	Turkeybush	Protected	-	S	Shrub (SG)
Myoporaceae	*Eremophila longifolia*	Emubush	Protected	-	S	Shrub (SG)
Myoporaceae	*Eremophila mitchellii*	Budda	Protected	-	S	Shrub (SG)
Myoporaceae	*Myoporum montanum*	Western boobialla	Protected	-	S	Shrub (SG)
Myoporaceae	*Myoporum spp.*	Boobialla	Protected	-	S	Shrub (SG)
Myrtaceae	*Corymbia tessellaris*	Carbeen	Protected	-	T	Tree (TG)
Myrtaceae	*Eucalyptus camaldulensis*	River red gum	Protected	-	T	Tree (TG)
Myrtaceae	*Eucalyptus melanophloia*	Silver-leaved ironbark	Protected	-	T	Tree (TG)
Myrtaceae	*Eucalyptus populnea*	Poplar box	Protected	-	T	Tree (TG)
Myrtaceae	*Eucalyptus populnea ex. camaldulensis*	Gum tree	Protected	-	T	Tree (TG)
Myrtaceae	*Eucalyptus populnea subsp. bimbil*	Bimble box	Protected	-	T	Tree (TG)
Myrtaceae	*Eucalyptus tereticornis*	Forest red gum	Protected	-	T	Tree (TG)
Nyctaginaceae	*Boerhavia coccinea*	-	Protected	-	F	Forb (FG)
Nyctaginaceae	*Boerhavia dominii*	Tarvine	Protected	-	F	Forb (FG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Nyctaginaceae	*Boerhavia pubescens*	-	Protected	-	F	Forb (FG)
Nyctaginaceae	*Boerhavia spp.*	-	Protected	-	F	Forb (FG)
Oleaceae	*Jasminum simplicifolium*		Protected	-	Vine	Other (OG)
Oleaceae	*Jasminum suavissimum*	Jasminum	Protected	-	L	Other (OG)
Oleaceae	*Notelaea microcarpa var. microcarpa*	Native olive	Protected	-	T	Tree (TG)
Oxalidaceae	*Oxalis corniculata*	Creeping oxalis	Exotic	-	E	Exotic/ Declared Noxious
Oxalidaceae	*Oxalis perennans*	Oxalis	Protected	-	F	Forb (FG)
Oxalidaceae	*Oxalis spp.*	-	Protected	-	F	Forb (FG)
Papaveraceae	*Eschscholzia californica*	California poppy	Exotic	-	E	Exotic
Pedaliaceae	*Harpagophytum spp.*	Devils claw	Exotic	-	E	Exotic
Phormiaceae	*Dianella revoluta*	Blueberry lily	Protected	-	F	Forb (FG)
Phyllanthaceae	*Phyllanthus maderaspatensis*	-	Protected	-	S	Shrub (SG)
Pittosporaceae	*Bursaria incana*	Native blackthorn	Protected	-	Shrub	Shrub (SG)
Pittosporaceae	*Pittosporum angustifolium*	Butterbush	Protected	-	S	Shrub (SG)
Pittosporaceae	*Pittosporum spinescens*	Wallaby apple	Protected	-	Shrub	Shrub (SG)
Plantaginaceae	*Plantago debilis*	Shade plantain	Protected	-	F	Forb (FG)
Plantaginaceae	*Plantago lanceolata*	Lamb's tongues	Exotic	-	E	Naturalised
Plantaginaceae	*Stemodia glabra*	Smooth bluerod	Protected	-	F	Forb (FG)
Poaceae	*Ancistrachne uncinulata*	Hooked-hairy panic grass	Protected	-	TG	Grass & grasslike (GG)
Poaceae	*Aristida calycina*	Dark wiregrass	Protected	-	TG	Grass & grasslike (GG)
Poaceae	*Aristida caput-medusae*	Many-headed wiregrass	Protected	-	Tussock Grass	Grass & grasslike (GG)
Poaceae	*Aristida contorta*	Bunched kerosene grass	Protected	-	TG	Grass & grasslike (GG)
Poaceae	*Aristida holathera*	Kerosene grass	Protected	-	TG	Grass & grasslike (GG)
Poaceae	*Aristida jerichoensis*	Jericho wiregrass	Protected	-	TG	Grass & grasslike (GG)
Poaceae	*Aristida latifolia*	Feathertop grass	Protected	-	TG	Grass & grasslike (GG)
Poaceae	*Aristida leptopoda*	White speargrass	Protected	-	TG	Grass & grasslike (GG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Poaceae	*Aristida ramosa*	Purple wiregrass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Aristida spp.*	-	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Astrebla lappacea*	Curly mitchell grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Austrostipa ramosissima*	Stout bamboo grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Austrostipa scabra*	Speargrass	Protected	-	TG	Grass and Grasslike (GG)
Poaceae	*Austrostipa spp.*	Speargrass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Austrostipa verticillata*	Slender bamboo grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Avena fatua*	Wild oats	Exotic	-	E	Naturalised
Poaceae	*Bothriochloa bladhii subsp. bladhii*	Forest bluegrass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Bothriochloa decipiens*	Red grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Bothriochloa pertusa*	-	Exotic	-	zz	Naturalised
Poaceae	*Cenchrus ciliaris*	Buffel grass	Exotic	-	ZZ	High Threat Exotic
Poaceae	*Chloris divaricata*	Slender chloris	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Chloris divaricata var. divaricata*	-	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Chloris gayana*	Rhodes grass	Exotic	-	ZZ	High Threat Exotic
Poaceae	*Chloris sp.*	-	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Chloris truncata*	Windmill grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Chloris ventricosa*	Tall chloris	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Cymbopogon spp.*	-	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Cynodon dactylon*	Common couch	Protected	-	G	Grass and grasslike (GG)
Poaceae	*Dactyloctenium radulans*	Button grass	Protected	-	Tussock Grass	Grass and grasslike (GG)
Poaceae	*Dichanthium sericeum*	Queensland bluegrass	Protected	-	G	Grass and grasslike (GG)
Poaceae	*Digitaria brownii*	Cotton panic grass	Protected	-	OG	Grass and grasslike (GG)
Poaceae	*Digitaria divaricatissima*	Umbrella grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Digitaria porrecta*	Finger panic Grass	Endagnered	-	TG	Grass and grasslike (GG)
Poaceae	*Digitaria spp.*	-	Protected	-	TG	Grass and grasslike (GG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Poaceae	*Echinochloa colona*	Awnless barnyard grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Enneapogon avenaceus*	Bottle washers	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Enneapogon spp.*	Nineawn grass, Bottlewashers	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Enteropogon acicularis*	Curly windmill grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Enteropogon ramosus*	Twirly windmill grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Enteropogon spp.*	-	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Eragrostis brownii*	Brown's lovegrass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Eragrostis lacunaria*	Purple lovegrass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Eragrostis spp.*	Lovegrass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Eragrostis spp. 2*	Lovegrass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Eriachne spp.*	Wanderrie grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Eriachne spp. 2*	Wanderrie grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Homopholis belsonii*	Belson’s panic	Endangered	-	TG	Grass and grasslike (GG)
Poaceae	*Megathyrsus maximus*	Guinea grass	Exotic	-	ZZ	High Threat Exotic
Poaceae	*Nassella trichotoma*	Serrated tussock	Exotic	-	ZZ	High Threat Exotic
Poaceae	*Panicum decompositum*	Native millet	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Panicum effusum*	Hairy panic	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Panicum maximum*	Guinea grass	Exotic	-	ZZ	High Threat Exotic
Poaceae	*Panicum queenslandicum*	Yadbila grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Panicum spp.*	Panicum	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Paspalidium caespitosum*	Brigalow grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Paspalidium constrictum*	Knottybutt grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Paspalidium distans*	-	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Paspalidium globoideum*	Shotgrass	Protected	-	Tussock Grass	Grass and grasslike (GG)
Poaceae	*Paspalidium gracile*	-	Protected	-	Tussock Grass	Grass and grasslike (GG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Poaceae	*Paspalidium jubiflorum*	Warrego summer grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Paspalidium sp.*	-	Protected		TG	Grass and grasslike (GG)
Poaceae	*Paspalum distichum*	Water couch	Protected	-	OG	Grass and grasslike (GG)
Poaceae	*Poa annua*	Winter grass	Exotic	-	E	Naturalised
Poaceae	*Rytidosperma setaceum*	Small-flowered wallaby-grass	Protected	-	G	Grass and grasslike (GG)
Poaceae	*Rytidosperma spp.*	Wallaby grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Sorghum halepense*	Johnson grass	Exotic	-	E	Naturalised
Poaceae	*Sporobolus actinocladus*	Katoora grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Sporobolus caroli*	Fairy grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Sporobolus creber*	Western rat-tail grass/Slender rat's tail grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Sporobolus spp.*	Rat's tail couch	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Themeda triandra*	Kangaroo grass	Protected	-	TG	Grass and grasslike (GG)
Poaceae	*Tragus australianus*	Small burrgrass	Protected	-	HG	Grass and grasslike (GG)
Poaceae	*Urochloa panicoides*	Liverseed grass	Exotic	-	E	Naturalised
Polygonaceae	*Duma florulenta*	Lignum	Protected	-	S	Shrub (SG)
Polygonaceae	*Persicaria spp.*	Knotweed	Protected	-	F	Forb (FG)
Polygonaceae	*Rumex brownii*	Swamp dock	Protected	-	F	Forb (FG)
Polygonaceae	*Rumex crispus*	Curled dock	Exotic	-	E	Naturalised
Polygonaceae	*Rumex sp.*	-	Protected	-	F	Forb (FG)
Polygonaceae	*Rumex tenax*	Shiny dock	Protected	-	F	Forb (FG)
Portulacaceae	*Portulaca bicolor var. rosea*	Portulaca bicolor	Protected	-	F	Forb (FG)
Portulacaceae	*Portulaca oleracea*	Pigweed	Protected	-	F	Forb (FG)
Portulacaceae	*Portulaca pilosa*	Akulikuli	Exotic	-	E	Naturalised
Portulacaceae	*Portulaca sp.*	-	Protected	-	F	Forb (FG)
Proteaceae	*Hakea leucoptera*	Needlewood	Protected	-	S	Shrub (SG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Pteridaceae	*Cheilanthes distans*	Bristly cloak fern	Protected	-	F	Fern (EG)
Pteridaceae	*Cheilanthes sieberi*	Rock fern	Protected	-	F	Fern (EG)
Rhamnaceae	*Ventilago viminalis*	Supple jack	Protected	-	T	Tree (TG)
Rubiaceae	*Asperula conferta*	Common woodruff	Protected	-	F	Forb (FG)
Rubiaceae	*Canthium oleifolia*	Hat-stand tree	Protected	-	Shrub	Shrub (SG)
Rubiaceae	*Psydrax oleifolia*	Brush myrtle	Protected	-	S	Shrub (SG)
Rutaceae	*Citrus australis*	Round lime	-	-	-	-
Rutaceae	*Citrus glauca*	Desert lime	Protected	-	S	Shrub (SG)
Rutaceae	*Geijera parviflora*	Wilga	Protected	-	S	Shrub (SG)
Santalaceae	*Exocarpos aphyllus*	Leafless ballarat	Protected	-	S	Shrub (SG)
Santalaceae	*Santalum lanceolatum*	Northern sandalwood	Protected	-	S	Shrub (SG)
Sapindaceae	*Alectryon diversifolius*	Scrub boonaree	Protected	-	Shrub	Shrub (SG)
Sapindaceae	*Alectryon oliefolius*	Western rosewood	Protected	-	Tree	Tree (TG)
Sapindaceae	*Atalaya hemiglauca*	Whitewood	Protected	-	T	Tree (TG)
Sapindaceae	*Cardiospermum grandiflorum*	Balloon vine	Exotic	-	ZZ	High Threat Exotic
Sapindaceae	*Dodonaea viscosa*	Hop bush	Protected	-	Shrub	Shrub (SG)
Sapotaceae	*Planchonella pubescens*	-	Protected	-	Tree	Tree (TG)
Sapotaceae	*Pouteria cotinifolia var pubescens*	-	Protected	-	Tree	Tree (TG)
Scrophulariaceae	*Myoporum acuminatum*	Boobialla	Protected	-	S	Shrub (SG)
Scrophulariaceae	*Stemodia glabella*	Smooth bluerod	Protected	-	TG	Grass and grasslike (GG)
Solanaceae	*Lycium ferocissimum*	African boxthorn	Exotic	-	ZZ	High Threat Exotic
Solanaceae	*Solanum americanum*	Glossy nightshade	Protected	-	F	Forb (FG)
Solanaceae	*Solanum esuriale*	Quena	Protected	-	F	Forb (FG)
Solanaceae	*Solanum ferocissimum*	Spiny potato-bush	Protected	-	Shrub	Shrub (SG)
Thymelaeaceae	*Pimelea linifolia*	Slender rice flower	Protected	-	S	Shrub (SG)
Thymelaeaceae	*Pimelea sp.*	Pimelia	Protected	-	S	Shrub (SG)

Family	Scientific name	Common name	Conservation status		Primary growth form	Primary growth form group/Exotic/HTE
			BC Act	EPBC Act		
Urticaceae	*Urtica incisa*	Stinging nettle	Protected	-	F	Forb (FG)
Verbenaceae	*Glandularia aristigera*	Mayne's pest	Exotic	-	E	Naturalised
Verbenaceae	*Phyla canescens*	Lippia	Exotic	-	ZZ	High Threat Exotic
Verbenaceae	*Silybum marianum*	Variegated thistle	Exotic	-	E	Naturalised
Zygophyllaceae	*Tribulus micrococcus*	Spineless caltrop	Protected	-	F	Forb (FG)
Zygophyllaceae	*Tribulus terrestris*	Cat-head	Exotic	-	E	Naturalised
Zygophyllaceae	*Zygophyllum apiculatum*	Common twinleaf	Protected	-	F	Forb (FG)

Table notes:

Growth Form C=Chenopod, E=Exotic, F=Forb, K=Mistletoe, TG= Tussock Grass, O=Other, OG=Other Grass, R=Rush,Se= Sedge, S=Shrub, T= Tree, V=Vine

BAM plot data

Plot ID	PCT No.	Condition / Class	Latitude	Longitude	Bearing	Composition						Structure (% cover)						Function										
						Tree	Shrub	Grass	Forb	Ferns	Other	Tree	Shrub	Grass	Forbs	Ferns	Other	LT >50cm	HT	L%	FL (m)	TS 5-10 cm	TS 10-20 cm	TS 20-30 cm	TS 30-40 cm	TS 50-80 cm	TR <5 cm	E %
BP1135HP2	35	High	-28.8244	150.5655	South	1	10	5	1	0	23	15	24.5	5	0.2	0	5.1	0	0	43	55	7	8	3	0	0	14	0.1
BP1135HP3	35	High	-28.8284	150.5653	South-west/west	2	8	1	1	0	1	21	26.8	1	0.1	0	0.2	0	0	40	47.5	14	10	6	3	0	49	5
BP1135HP4	35	High	-28.8267	150.5654	South-west/ South-south-west	2	7	1	0	0	2	22	9.7	5	0	0	15.1	0	0	41	11.5	43	25	2	1	0	51	5
BP1135LP1	35	Low	-28.8255	150.5631	North	0	6	6	4	0	0	0	14.4	39.2	15.7	0	0	0	0	27	0	0	0	0	0	0	0	4.1
BP1 Track 1	35	Medium	-28.9851	150.4206	345	1	7	11	8	0	4	15	8	10.3	2.7	0	0.9	0	0	31.8	0	0	0	1	0	0	1	0.7
BP1 Track 2	35	Medium	-28.9856	150.4274	269	3	7	10	7	0	5	1.2	10.4	47.4	1.7	0	1.6	0	0	48	0	0	0	0	0	0	1	0.6
BP1 Track 3	35	Low	-28.9819	150.4206	180	0	5	9	4	0	0	0	1.4	6.3	7.7	0	0	0	0	9.2	0	0	0	0	0	0	0	45.1
BP1147HP1	147	High	-28.9868	150.4213	North to North-east	4	8	3	6	0	5	22	13.2	3	4.7	0	36.2	0	0	44	24.5	0	0	0	0	0	0	0.1
BP1147MP1	147	Medium	-28.9885	150.4213	0 North	5	8	4	5	0	4	15.1	99.2	0.6	4.2	0	46.7	0	0	61	36	2	11	1	4	1	41	0.1
BP1147MP2	147	Medium	-28.9875	150.4200	133	3	9	8	4	0	3	19	27.1	1.7	0.4	0	4.2	0	1	76	16	15	10	0	1	0	46	0
BP1398HP1	98	High	-28.7484	150.2652	Due south	3	7	4	3	1	2	45.5	33.6	0.6	2.3	0.1	0.6	0	0	72	0	9	1	0	0	0	8	9
BP1398LP2	98	Low	-28.7512	150.2626	Due north	1	4	5	2	0	0	0.1	3.3	0.9	2	0	0	0	0	9	0	1	2	0	0	0	5	0
BP235LP1	35	Low	-29.0134	150.3720	South-east from 0	1	5	0	2	0	0	0.1	39.1	0	4	0	0	0	0	47	0	0	0	0	0	0	0	0.1
BP235LP2	35	Low	-29.0153	150.3738	South	1	6	0	2	0	2	0.5	9.6	0	0.3	0	1.1	0	0	46	0	0	0	0	0	0	0	0.1
BP2418HP1	418	High	-29.0158	150.3710	9	2	10	6	2	0	5	3	28.3	3.4	0.6	0	35.1	0	0	69	0	0	1	1	0	0	1	1
BP2418HP3	418	High	-29.0151	150.3730	4	7	7	5	0	5	7	85.3	0.7	2.5	0	87.1	0	0	0	44	8	0	0	3	0	0	0	0
BP2418HP4	418	High	-29.0137	150.3714	North-west	4	10	4	4	0	5	6.2	44.8	4.3	0.9	0	50.4	0	0	15	20	0	0	0	1	0	0	0.1
BP2418MP1	418	Medium	-29.0141	150.3716	343	0	6	5	2	0	3	0	2.7	7.3	0.2	0	0.3	0	0	31	0	0	0	0	1	0	1	15.1
BP2418MP3	418	Medium	-29.0179	150.3713	South	0	3	3	0	0	1	0	35.5	1.3	0	0	0.1	0	0	34	0	0	0	0	0	0	0	1
BP2535MP1	35	Medium	-28.8659	150.5334	West	1	7	5	2	0	2	0.1	23.2	7.4	0.2	0	0.2	0	0	37	1.5	0	0	0	1	0	0	0.2
BP2535MP2	35	Medium	-28.8654	150.5331	North	0	6	3	5	0	0	0	29.1	25.5	2.4	0	0	0	0	37	1	0	0	0	0	0	0	0.1
BP25418LP1	418	Low	-28.8642	150.5327	112	2	3	8	5	1	0	4	1.2	11.9	0.6	0.1	0	0	0	62	0	0	0	0	0	0	20	40
BP25418LP3	418	Low	-28.8640	150.5338	South-west	1	3	2	1	1	0	1	3.1	5.1	1	0.5	0	0	0	30	1	0	0	0	1	0	0	0
BP25418MP1	418	Medium	-28.8654	150.5318	350	1	4	7	6	1	0	23	4.7	10.7	0.6	0.1	0	0	0	40	21	15	0	0	1	0	19	0.2
BP2635HP1	35	High	-28.8244	150.3010	South-east from 0	3	7	2	3	0	8.2	16.1	57.7	15.1	0.4	0	8.2	0	0	38	74.25	1	1	4	11	0	0	2
BP2635LP4	35	Low	-28.8238	150.3008	North-west	1	5	2	2	1	0	0.1	2.4	50.1	1.1	0.1	0	0	0	29	0	5	6	3	0	0	1	0
BP2635MP2	35	Medium	-28.8238	150.3014		2	5	4	4	1	2	3	31	2.3	2.4	0.1	2.8	0	0	39		6	12	6	3	0	5	0.2
BP2635MP3	35	Medium	-28.8229	150.3021	South	4	4	3	2	0	2	21	3.2	0.7	1.1	0	2.1	0	0	17	2	3	8	11	2	0	8	1.1
BP5192HP1	192	High	-28.8446	150.2880	250	5	5	1	4	0	3	14	55.4	0.1	1.3	0	11.1	0	7	33	29	0	1	2	2	0	0	0.6
BP5192HP3	192	High	-28.8455	150.2933	202	3	8	7	8	0	5	9.5	44.4	6	3.7	0	3.5	3	1	40	49	0	0	0	1	0	0	1.1
BP5192LP1	192	Low	-28.8413	150.2952	South	1	4	0	3	0	0	2	10.2	0	0.2	0	0	0	0	28	5	3	3	1	0	0	2	0
BP5192LP2	192	Low	-28.8428	150.2945	109	1	6	4	7	0	2	15	27.3	4.7	1.7	0	0.2	0	0	51	2.4	0	2	4	0	0	0	20.1

Plot ID	PCT No.	Condition / Class	Latitude	Longitude	Bearing	Composition						Structure (% cover)						Function										
						Tree	Shrub	Grass	Forb	Ferns	Other	Tree	Shrub	Grass	Forbs	Ferns	Other	LT >50cm	HT	L%	FL (m)	TS 5-10 cm	TS 10-20 cm	TS 20-30 cm	TS 30-40 cm	TS 50-80 cm	TR <5 cm	E %
BP5192MP1	192	Medium	-28.8445	150.2895	318	3	6	3	5	1	3	20	20.5	6.1	2.7	0.1	0.4	0	0	45	7	0	0	0	0	0	0	0.2
BP5192MP2	192	Medium	-28.8444	150.2904	110	1	8	7	11	1	2	6	57.7	8.3	10.7	1	2.3	0	0	44	6	1	1	0	0	0	0	13.2
BP5192MP3	192	Medium	-28.8433	150.2901	319	4	6	3	5	1	4	15	90.3	2.3	10.4	0.1	23.1	0	0	27	8	0	0	0	0	0	0	1.2
BP735HP1	35	High	-28.8444	150.4070	North to north north-east	3	7	1	4	0	0	22.5	11.4	0.5	0.5	0	0	0	0	49	27.3	0	5	5	3	0	4	0.1
BP735HP2	35	High	-28.8422	150.4070	North	2	7	3	1	0	0	17	13.7	0.7	0.1	0	0	0	0	51	5.75	4	16	2	2	0	13	0.1
BP735HP5	35	High	-28.8413	150.4042	North-east	1	7	4	2	0	0	20	39.1	10.1	2.1	0	0	0	0	34	8	4	24	5	0	0	2	1
BP735LP3	35	Low	-28.8452	150.4017	North	0	7	2	7	0	0	0	12.3	15.1	1.7	0	0	0	0	24	23.25	0	0	0	0	0	0	0
BP735LP7	35	Low	-28.8427	150.4045	North	0	8	1	6	0	0	0	22.3	5	0.7	0	0	0	0	18	0	0	0	0	0	0	0	0
BP735LP8	35	Low	-28.8455	150.4042	North	0	7	3	5	0	0	0	18.1	20.2	1.1	0	0	0	0	18	0	0	0	0	0	0	0	0.1
BP756HP1	56	High	-28.8416	150.4093	140	1	7	4	2	0	1	10	55.5	27.2	0.2	0	0.3	0	0	25	31	0	0	0	0	0	0	1
BP756HP2	56	High	-28.8411	150.4078	348	1	6	3	4	0	3	30	72.4	14	0.4	0	2.5	0	1	70	16	0	5	1	0	0	3	3
BP756HP3	56	High	-28.8441	150.4095	132	2	6	2	4	0	0	2.5	16.3	5.2	0.4	0	0	0	1	22	0	2	7	2	0	0	2	0.1
BP756HP4	56	High	-28.8422	150.4081	North	1	6	2	3	1	1	10	80.4	5.1	0.3	0.2	0.1	0	0	22	11.25	0	0	0	0	1	0	1
BP756LP6	56	Low	-28.8399	150.4055	South	1	3	5	5	0	0	0.5	0.9	16.1	2.8	0	0	0	0	24	0	0	0	0	0	0	0	0
BP8244MP1	244	Medium	-28.7883	150.9759	122	1	7	8	9	1	1	30	17.9	48.3	2.5	0.1	3	0	1	14	9.5	0	0	0	1	0	0	40.1
BP8244MP2	244	Medium	-28.7952	150.4024	160	1	9	9	9	0	3	30	9.5	63.3	2.8	0	0.8	0	5	38	0	0	0	0	4	0	14	7
BP856MP1	56	Medium	-28.7864	150.3986	East	1	3	3	5	0	2	15	5.6	1.4	7.4	0	11	0	0	34	19.5	2	1	4	0	1	2	26
BP856MP2	56	Medium	-28.7931	150.4011	South South-east	1	5	3	3	0	0	15	6.8	50.1	6.1	0	0	0	0	22	1	0	0	0	2	2	0	6.1
BP935HP1	35	High	-28.7918	150.5586	North-east	2	10	2	2	1	2	35	31.2	11	0.3	0.1	10.1	0	0	76	12.25	0	8	12	12	1	2	1
BP935HP2	35	High	-28.7913	150.5616	249	3	7	3	4	1	3	65.2	25.3	7.2	0.6	0.1	2.6	0	0	58	0	30	63	11	0	0	0	0.5
BP935HP3	35	High	-28.7940	150.5595	343	3	8	5	2	1	2	41.5	56.4	15.4	0.2	0.5	4	0	0	87	16	0	44	15	2	0	1	1
BP935HP4	35	High	-28.7908	150.5600	120	3	7	3	3	0	3	46	46	10.3	0.6	0	0.7	0	0	95	51	4	71	14	5	0	0	1
BP9418HP1	418	High	-28.7919	150.5643	337	4	5	4	2	1	3	19.1	32.8	11.1	0.2	1.2	10.3	0	0	76	47.5	0	5	12	5	0	14	7
BP9418HP2	418	High	-28.7931	150.5630	South-west	3	2	5	5	1	2	65.1	6.5	8.2	1.1	0.3	2.1	1	87	19	7	74	6	0	0	0	0	0.1
BP9418HP3	418	High	-28.7949	150.5631	33	4	5	8	2	0	6	41	5.2	10.6	0.2	12.3	0.5	0	1	0	45	0	48	6	5	1	11	0
BP9418HP3B	418	High	-28.7926	150.5630	205	3	7	6	0	0	2	63	23.6	5	0	0	8	0	1	67	41	21	49	5	1	0	0	0.2
BP9418LP1	418	Low	-28.7983	150.5575	North	1	3	3	1	0	0	2	2.2	1.2	2	0	0	0	0	24	0	0	0	0	0	0	0	15
BP9418MP1	418	Medium	-28.7968	150.5608	28	6	2	5	1	0	0	14.3	5.2	13.3	0.1	0	0	0	0	43	38	1	0	2	3	0	4	3
BP9418MP2	418	Medium	-28.7957	150.5602	227	3	1	3	3	0	0	13	1	5.2	0.4	0	0	0	0	33	60	1	1	1	2	1	2	2
BP9418MP3	418	Medium	-28.7952	150.5593	192	4	2	3	2	0	0	53.5	0.3	6.5	0.2	0	0	0	1	38	4.5	62	3	0	1	0	57	0

Plot	Field note name	PCT	Condition class	Easting	Northing	Bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
NB-35-H1	Z2P1	35	High	-28.8300	150.4050	262	2	5	2	4	0	1	30	70.8	15.3	11.2	0	0.5	0	0	40	75	1	1	1	1	0	1	0.8
NB-35-H2	Z2P2	35	High	-28.8255	150.4055	242	1	6	7	5	1	0	35	6.1	10.7	21.4	0.5	0	0	0	30	28	1	1	1	1	0	1	0
NB-35-H3	Z2P3	35	High	-28.8249	150.4057	140	1	6	7	6	0	1	50	3.6	8	55.8	0	0.1	1	0	46	31	1	1	1	1	0		0
NB-53-M1	WETLANDS1	53	Medium	-28.7748	150.4104	58	0	0	7	11	1	0	0	0	132.3	1.3	1	0	0	0	0	0	0	0	0	0	0		0.1
NB-53-M2	WETLANDS2	53	Medium	-28.7702	150.4106	180	0	1	4	7	0	0	0	0.1	67.1	0.9	0	0	0	0	11.75	1	0	0	0	0	0		0
NB-53-M3	WETLANDS3	53	Medium	-28.7718	150.4089	120	0	1	5	13	1	0	0	1	80.6	12.4	2	0	0	0	3.25	0	0	0	0	0	0		0.2
NB-55_S1	Z5P1	55	Medium	-28.7718	150.4110	180	1	0	0	0	0	0	60	0	0	0	0	0	0	0	39	0	1	1	1	1	1		70.7
nb_55_S2	Z5P2	55	Medium	-28.7729	150.4108	182	1	0	3	5	1	0	45	0	0.3	0.5	0.1	0	1	0	30	1	1	1	1	0	1	0	0
NB-56-L1	NB56LS1	56	Low	-28.7895	150.4092	355	1	2	5	17	0	1	1	0.2	11.6	16.5	0	2.1	0	0	11.5	4.5	0	0	0	0	0		50.1
NB_56Low	NB35LS1					68	1	8	5	12	0	3	25	1.6	4.3	22.5	0	0.4	0	0	38.75	0.5	0	0	0	0			13.1
nb-56_L3	NB56LS3	56	Low	-28.7895	150.4092	355	1	2	8	18	0	2	1	0.2	10.4	46.5	0	2.1	0	0	11.25	4.5	0	0	0	0		0	72.5
NB-56-L4	NB56LS4	56	Low	-28.7886	150.4095	351	0	2	17	18	0	1	0	3.5	30.9	12.5	0	1	0	0	12.5	0	0	1	0	0	0		15.2
nb-56_L5	NB56LS5	56	LOW	-28.7626	150.4132	357	0	4	6	18	0	1	0	0.7	3.8	6.3	0	0.1	0	0	13.75	0	0	0	0	0	0	0	80.5
NB56M10		56	Low	-28.9281466	150.3972509	56	3	9	6	3	0	0	13	25.9	14.7	4.6	0	0	1	0	48	0	0	0	0	1	1	0	0
NB56LP11		56	Low	-28.9291084	150.398349	56	3	6	12	8	1	0	20.1	0.6	14	1.7	0.5	0	1	1	30	0	0	0	0	0	0	1	0.2
NB56LP10		56	Low	-28.9345041	150.3958731	79	1	6	3	4	0	0	25	8.6	5.2	12.2	0	0	2	4	57	0	1	0	0	0	1	0	0.1
NB-56-M1	Z7P1	56	Medium	-28.7707	150.4112	64	3	6	7	15	0	0	23.2	4.1	31.8	4.1	0	0	0	0	29.2	2.5	0	1	0	1	0	1	0.8
NB-56-M2	Z7P2	56	Medium	-28.7690	150.4120	77	1	11	9	11	1	3	2	7.5	8.4	3.3	0.5	0.3	0	0	13	0	0	1	0	1	0		2.1
NB-56-M3	Z7P3	56	Medium	-28.7502	150.4157	96	2	7	6	9	0	1	23	1.9	26.3	11.3	0	0.5	1	1	60	12	1	1	0	0	0	1	0.3
NB-56-M4	Z7P4	56	Medium	-28.7495	150.4158	92	1	8	4	6	0	0	10	5.5	6.1	6.6	0	0.1	2	2	23.6	3.5	0	1	0	0	0		0.1
NB-56-H1	Z6P3	56	High	-28.8105	150.4079	30	1	6	5	3	0	1	40	28.8	24	7	0	1	3	2	73	37	1	1	1	0	1	1	0.6
NB-56-H2	Z6P1	56	High	-28.8140	150.4073	102	1	5	4	3	0	0	40	48.1	2.2	25.2	0	0	3	0	23	0	1	1	0	1	1	1	3
NB-56-H3	Z6P2	56	High	-28.8105	150.4079	30	1	8	1	2	0	1	25	72.1	0.5	15.1	0	0.5	1	0	34	28	1	1	0	1	1	1	0.2
NB-56-H4	Z6P4	56	High	-28.7836	150.4092	348	2	6	2	13	0	3	60.5	11.7	15.1	1.8	0	0.4	1	1	70	9	1	1	1	1	0	1	0.5
NB-56-H5	Z6P5	56	High	-28.7609	150.4123	265	4	7	6	4	1	3	12.6	63.7	21.4	4.2	0.2	1.2	0	1	25	32.5	1	1	1	1	0		0.6
NB-56-H6	Z6P6	56	High	-28.7640	150.4116	270	3	5	5	4	1	3	24	50.3	8.8	16.2	2	1.4	0	2	48	65	0	0	0	1	1		0.3
NB-56-H7	NB56HS1	56	High	-28.7953	150.4096	350	2	6	5	14	1	3	55	29.6	2.8	6.5	0.1	1.6	3	3	61.75	14	1	1	1	1	1		2.1
NB-244-M1	Z10P1	244	Medium	-28.7423	150.4184	187	1	5	11	12	0	0	0.5	3.8	57.6	2.6	0	0	0	0	21.6	12	0	1	0	1	0	1	0.1
NB-244-M2	Z10P2	244	Medium	-28.7418	150.4185	336	3	7	10	8	1	1	36.1	1.8	6.1	10.7	0.1	0.1	0	1	25	0	0	1	1	1	0		1
NB-244-H1	Z9P1	244	High	-28.7991	150.4108	334	2	7	5	4	1	0	4	57.3	28.1	4.2	1	0	0	1	42	29	0	0	1	1	0		10
NB-244-H3	Z9P3	56	High	-28.7917	150.4105	330	3	9	2	5	1	0	18	25	10.1	2.8	1	0	1	1	60	4	1	1	1	1	1	1	1.5
NB-244-H2	Z9P2	56	High	-28.7991	150.4108	358	1	6	3	4	1	0	15	29.2	20.3	0.4	1	0	1	1	39	10	1	1	0	0	0	1	30.3
NB-244-H4	Z9P4	56	?	-28.7890	150.4106	320	1	5	3	7	1	2	20	27.1	3.6	4.5	0.5	0.2	0	0	60	17	1	1	1	0	0	1	0
NB-35-L1	NB35LS1	35	Low	-28.8314	150.4053	250	1	5	4	9	0	1	0.2	30.2	0.4	1.3	0	0.1	0	0	6.5	0	0	0	0	0	0		35.1
NO-35-L1	Z4P1	56	Low	-28.9082	150.3949	178	0	3	6	5	0	0	0	0.4	7	0.5	0	0	0	0	17.8	0	0	0	0	0	0		0.6
NO-35-L2	NO35LS2	56	Low	-28.9120372	150.3941876	355	0	1	7	8	0	0	0	0.1	16.4	4.1	0	0	0	0	21.25	0	0	0	0	0	0		25
NO-36-H1	Z13P1	36	High	-28.848623	105.403643	252	1	8	3	2	0	1	30	7.6	10.4	4.1	0	0.5	1	1	38	10	1	1	1	1	1		1

Plot	Field note name	PCT	Condition class	Easting	Northing	Bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
NO-36-H2	NO36HS2hs2	36	High	-28.847007	150.1035196	270	2	8	8	14	0	2	52	29.5	21.9	7.9	0	0.2	5	8	42.5	31	1	1	1	1	1		10.1
NO-35-H1	Z12P1	36	High	-28.84711	150.404945	100	2	5	4	5	0	1	10	10.6	17	13.6	0	0.3	0	1	19.6	0	1	1	0	1	0		0.3
NO-35-H2	Z12P2	35	High	-28.8436	150.4040	319	1	6	6	6	1	1	60	2.8	11.3	2.9	0.1	0.5	0	1	36.2	9	1	1	1	0	0		1.1
NO-35-H3	Z12P3	35	High	1502411	285019	182	2	5	9	7	0	1	32	6	59.2	2.5	0	1	0	1	48	6	1	1	1	1	0		2
NO-36-M1	Z14P1	36	Medium	-28.868388	150.401423	137	0	4	5	4	0	0	2.2	0.7	60.8	3.4	0	0	1	2	47	33.5	0	0	1	1	1		0.1
NO-36-M2	Z14P2	36	Medium	-28.85335	150.404796	131	2	8	6	5	0	0	35	7.5	1.7	11.3	0	0	1	0	37	28	1	1	1	1	0		10.5
NO-36-M3	Z14P3	36	Medium	-28.8488	150.4045	80	2	7	10	12	1	0	41	3.8	9.9	4.3	0.1	0	3	0	71	19	1	1	1	1	1		3.1
NO-56-L1	Z17P1	27	Low	1502407	285156	111	0	3	5	2	0	0	0	0.3	50.3	0.2	0	0	0	0	17	0	0	0	0	0	0		0
NO-56-L2	V4LO2	56	Low	-28.8476299	150.4015687	5	0	3	8	10	0	1	0	16.5	6.2	3.2	0	0.5	0	0	45	0	0	0	0	0	0		0
NO-56-L3	V4LO3	56	Low	-28.7729	150.4261	165	0	4	10	11	1	0	0	4.5	11.4	5.4	0.1	0	0	0	0.8	0	0	0	0	0	0		70.5
BP756LS6		56	Low	28.83992	150.40546		1	3	5	5	0	0	0.5	0.9	16.1	2.8	0	0	0	0	24	0	0	0	0	0	0	0	0
NO_56L_P10		56	Low	-28.8322793	150.4032531	180	0	5	9	12	0	0	0	4.7	57.7	2.6	0	0	0	0	21.8	0.5	0	0	0	0	0	0	0
NO-56-L4	NO56LS4	27	Low	-28.8544987	150.4041342	73	1	4	8	13	0	1	0.2	2.2	63.5	7.6	0	0.5	0	0	16.25	0	0	0	0	0	0	1	0
NO-56-L5	NO56LS5	27	Low	-28.8516086	150.40341	352	0	2	9	12	0	1	0	2.2	46.9	4	0	0.1	0	0	18.75	0	0	0	0	0	0		0.1
NO-56-H1	Z15P1	56	High	-28.86954	150.400845	162	2	4	7	3	0	0	21.5	9.7	37.8	15.5	0	0	2	2	34	12.6	0	0	1	1	1		1.4
NO-56-H2	Z15P2	56	High	-28.843564	150.403955	300	2	6	2	5	0	0	3	64	90	47	0	0	1	1	21	0	0	0	0	1	1		1
NO-56-H3	Z15P3	56	High	-28.839539	150.402391	10	1	10	4	0	0	2	5	58.3	3.7	0	0	1	0	1	12.8	43.5	1	0	0	1	0		0.7
NO-27_M1	z101p1	27	medium	-28.8646	150.4026	294	1	5	7	2	0	1	30	5.8	23.1	2.2	0	10	0	1	31	82	1	0	1	1	0		5
NO-56-M1	Z16P1	56	Medium	-28.867653	150.402323	225	1	6	5	5	0	0	2	1.5	20.8	5.4	0	0	0	0	17	5	0	0	0	0	0		0.9
NO-56-M2	Z16P2	56	Medium	-28.865078	150.405326	208	1	7	7	6	0	0	20	1.3	7.7	0.8	0	0	2	2	14.8	0	0	1	0	0	1		0.2
NB56LP11		56	low	-28.9291084	150.398349	46	3	6	12	8	1	0	20.1	0.6	14	1.7	0.5	0	1	1	30	0	0	0	0	0	0	0	0.2
NO-244LP10		56		-28.7435799	150.419421	36	1	7	3	6	0	0	5	3	10.2	0.7	0	0	0	0	12	0	0	1	1	0	0	0	25.1
CB-36-H1	Z19-P1	36	High	150.453156	-28.66633	66	3	2	2	5	0	4	20.5	0.2	22	4.3	0	1.4	6	5	47	53	0	0	1	0	1	1	11.1
CB-36-H2	Z19P2	36	High	150.451938	-28.666171		3	0	3	6	0	0	56	0	4.1	0.6	0	0.2	2	2	41	85.5	0	0	0	0	0		38
CB-36-M1		36	Medium	-28.6753	150.4442	76	3	3	7	13	0	1	31	0.7	21	6.3	0	0.1	4	3	33.75	233	0	0	1	1	1	0	30.8
CB-36-M2		36	Medium	150.449796	-28.6749122	68	2	3	6	10	1	0	7.1	0.3	1	1.1	0.1	0	3	1	26.25	39	0	0	1	0	0	0	2.7
CB-39-M1		36	Medium	150.4335794	-28.6793642	58	1	4	3	8	0	0	10	3.4	56	16.7	0	0	0	2	26.25	9.5	0	0	0	2	0	0	0.1
CB-39-M2		36	Medium	150.4365586	-28.6780972	74	1	4	4	8	0	0	15	0.6	40.3	2.8	0	0	0	3	30	36	0	0	0	1	3		45
CB-39-M3		36	Medium	150.4432532	-28.6762908	124	0	3	6	19	0	1	0	1.6	66.1	7.4	0	0.1	1	1	36.25	10	0	0	0	0	0		6.1
CB-39-M4		36	Medium	150.4532257	-28.6684381	355	1	2	9	12	1	2	10	2.1	4	7.7	0.3	0.2	1	1	80	10	0	1	1	0	0		13.2
CB-52-M1	CB56LS3	52	Medium	150.418247	-28.6856229		0	1	3	7	1	0	0	0.1	61	15.7	0.1	0	0	0	17.5	0	0	0	0	0	0		0.1
CB-52-M2	CB56LS4	52	Medium	150.4285358	-28.6814771	110	0	2	3	7	0	0	0	0.2	11.1	1.1	0	0	0	0	12.25	0	0	0	0	0	0		0.1
CB-52-M3	CB56LS5	52	Medium	150.433266	-28.68081	98	0	4	3	10	1	0	0	0.5	50.2	1.3	0.1	0	0	0	23.75	0	0	0	0	0	0		0.1
CB-52-M4	CB56LS6	52	Medium	150.4390353	-28.6794733	160	0	2	6	14	1	0	0	0.2	33.2	17.1	0.1	0	0	0	27.5	0	0	0	0	0	0		0.3
CB-56-M1	CB56MS1	244	Medium	150.4149327	-28.7112793	314	1	3	12	20	1	1	8	7.3	34	10.4	0.2	0.1	1	2	18.75	45	0	0	0	1	1		13.4
CB-56-M2	CB56MS2	36	Medium	150.4422823	-28.6788107	45	2	3	5	10	0	0	16	0.4	4.4	6.5	0	0	2	1	35	34	0	0	0	0	0		9
CB-56-M3	CB56MS3	628	Medium	150.4181062	-28.7301364	82	2	2	12	17	0	1	10.1	3.1	77.7	5.9	0	0.1	1	1	42.5	1	1	1	1	0	1		1.3

Plot	Field note name	PCT	Condition class	Easting	Northing	Bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
CB-56-M4	CB56MS2	244	Medium	150.4183665	-28.7314053	41	0	6	14	17	0	1	0	3.5	47.3	19.9	0	0.1	4	6	48.75	28	0	0	1	1	1		0.3
CB-56-M5	CB56MS1	56	Medium	150.4183518	-28.7322353	249	1	4	6	22	1	1	30	3.1	3.3	12.3	0.1	0.2	2	4	66.25	39	0	1	1	1	1		30.4
CB-56-L1	CB56LS1	244	Low	150.4187379	-28.7305297	171	1	3	12	13	1	1	5	2.2	57.5	6.8	1	0.1	1	2	42.5	30.5	0	0	0	1	0		3.4
CB-56-L2	CB56LS2	244	Low	150.4180248	-28.7268028	48	0	3	5	10	1	0	0	10.2	13.2	9.7	0.1	0	0	0	10.5	0.5	0	0	0	0	0		0
CB-56-L3	CB56LS3	628	Low	150.4176415	-28.7258207	59	0	2	14	19	1	0	0	1.1	22.1	6.8	0.1	0	0	0	13.75	0	0	0	0	0	0		0
CB-192-M1	CB192MS1	192	Medium	150.4514267	-28.6720476	349	1	4	5	8	0	0	2	1.4	90.5	2.9	0	0	1	1	30	0.5	0	0	0	0	1		1
CB-192-M2	CB192MS2	192	Medium	150.4495311	-28.6713786	315	2	4	9	13	0	0	5.5	1.4	64.2	2.9	0	0	3	2	36.25	1	0	0	0	1	1		14
CB-192-M3	CB192MS3	192	Medium	150.4510932	-28.6707484	210	1	4	5	12	0	1	2	1.2	75.4	3.9	0	0.1	1	1	31.25	14	0	0	0	0	1		17.3
CB-192-L1	CB192LS1	192	Low	150.451965	-28.6703491	138	0	3	5	15	0	0	0	1.4	60.5	10.1	0	0	0	0	12.5	0	0	0	0	0	0		15.1
CB-192-L2	CB192LS2	192	Low	150.449548	-28.6701282	242	0	3	11	7	0	0	0	0.3	3.5	0.9	0	0	2	2	23.75	0	0	0	0	0	1		45.4
CB-192-L3	CB192LS3	192	Low	150.4494294	-28.6732847	261	0	3	7	11	0	0	0	0.5	30.5	3.4	0	0	0	0	18.75	0	0	0	0	0	0		0.2
CB-244-M1	CB244MS1	56	Medium	150.4171703	-28.7385761	286	1	4	15	19	0	1	30	0.5	62.5	9.2	0	0.2	1	2	20	6	0	1	1	0	1		0.4
CB-244-M2	CB244MS2	56	Low	150.4188255	-28.739434	83	2	2	12	18	0	1	10.1	2.1	16.2	3.3	0	0.1	0	1	16.25	0	1	1	1	0	0		0.8
CB-244-M3	cb244ms3	56	Low	150.4153126	-28.7167704	296	2	3	12	22	1	0	15.1	0.9	4.6	9.6	0.1	0	2	2	37.5	43	0	0	1	1	1		4.6
CB-244-M4	CB1179LS3	244	Medium	150.4152865	-28.7189958	90	2	5	7	15	0	1	7.1	3.3	8.3	4.8	0	0.1	3	2	56.25	74	0	1	1	1	1		16.4
CB-244-M5	CB1179MS1	244	Medium	150.4152774	-28.7181241	153	1	2	5	7	0	0	25	0.6	60.4	5.6	0	0	1	2	8.75	17	0	0	0	1	1		0.3
CB-244-L1	CB244LS1	56	Low	150.418313	-28.7382775	4	0	3	11	13	0	1	0	8.1	26.3	5.2	0	0.1	0	0	15	20	0	0	0	0	0		15.2
CB-244-L2	CB244LS3	244	Medium	150.4188799	-28.7371387	345	2	6	9	21	0	1	4.1	11.4	7.5	3.4	0	0.1	0	1	15	0	1	1	1	1	0		4.3
CB-244-L3	CB244LS2	244	Medium	150.419753	-28.7392413	350	0	4	14	11	1	0	0	5.3	12	2.2	0.2	0	0	0	27.5	0	0	0	0	0	0		0
CB-244-L4	CB244LS4	56	Low	150.4163176	-28.7162213	337	0	2	10	7	1	0	0	4.2	11.1	15.5	0.1	0	0	0	13.75	0	0	0	0	0	0		0.1
CB-247-H1	Z30P1	247	medium	-28.7369	150.4198	1	0	2	1	5	0	0	0	0.2	20	25.4	0	0	0	0	21	0	0	0	0	0	0		5.7
CB-247-H2	Z30P2	247	Medium	-28.7357	150.4196	0	0	2	3	5	0	0	0	0.2	20.6	45.3	0	0	0	0	0	29.4	0	0	0	0	0		7.1
CB-247-H3	Z30P3	247	Medium	-28.7350	150.4186	353	0	1	4	5	0	0	0	0.7	10.4	17.3	0	0	0	0	10	0	0	0	0	0	0		2
CB-247-M1	CB247MS1	247	Medium	150.4484047	-28.6768436	271	0	4	3	11	0	0	0	0.4	15.2	6.1	0.1	0	0	0	7.5	0	0	0	0	0	0		1.1
CB-247-M2	CB247MS2	52	Medium	150.4470656	-28.6759707	83	0	3	5	12	0	0	0	0.3	40.3	2	0	0	0	0	26.25	0	0	0	0	0	0		0.1
CB-247-M3	CB247MS3			150.4491057	-28.6750684		0	1	3	12	1	0	0	0.1	40.5	2.1	0.1	0	0	0	33.75	0	0	0	0	0	0		1.6
CB-628-M1	Z23P1	628	Medium	-28.7292	150.4189	339	2	4	10	13	0	2	25	2.8	34.7	2	0	1.1	1	1	27.6	0	0	1	1	0	0		0.6
CB-628-M2	Z32P2	628	Medium	-28.7241	150.4172	63	4	2	9	15	0	2	24.1	0.5	6.6	4	0	0.3	2		44	16	0	1	1	1	1		0.4
CB-628-M3	Z32P3	628	Medium	-28.6957	150.4143	258	2	3	9	12	0	1	20	15.5	8.1	2.8	0	0.1	3	3	21	96	0	0	0	1	1		5.1
CB-628-M4	Z32P4	628	Medium	-28.6954	150.4136	328	2	2	8	8	1	2	10	0.8	4.9	1.6	0.3	0.3	4	4	50	34.5	0	0	0	0	1		10.3
CB-628-L1	CB628LS4	247	Low	150.4144414	-28.7021483	350	0	3	10	13	1	0	0	2.2	15.5	10	0.1	0	0	0	11.25	0	0	0	0	0	0		3.1
CB-628-L2	CB628LS2	247	Low	150.4131474	-28.7092252	340	0	3	3	6	1	0	0	1.1	14	30.4	0.1	0	0	0	11.25	1	0	0	0	0	0		0
CB-628-L3	CB628LS3	247	Low	150.4144978	-28.7048801	271	0	1	5	5	0	0	0	0.5	10.4	5.4	0	0	0	0	8.5	0	0	0	0	0	0		6
CB-628-L4	CB628LS4	247	Low	150.4140745	-28.6989869	249	0	2	12	11	0	0	0	1.3	14.7	4.3	0	0	0	0	16.25	0	0	0	0	0	0		0.5
BP1_35L_T1		35	Medium	150.4202645	28.985105	345	1	7	11	8	0	4	15	8	40.3	2.7	0	0.9	0	0	31.8	0	0	0	1	0	0	1	0.7
BP1_35L_T2		35	Medium	150.427457	28.985611	269	3	7	10	7	0	5	1.2	10.4	47.4	1.7	0	1.6	0	0	48	0	0	0	0	0	0	1	0.6
BP1_35L_T3		35	Low	150.420604	28.981977	180	0	5	9	4	0	0	0	1.4	6.3	7.7	0	0	0		0	0	0	0	0	0	0	0	45.1

Plot	Field note name	PCT	Condition class	Easting	Northing	Bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
NO_27L_P3		27	Low	150.402338	-28.865925	17	0	4	11	4	0	1	0	5.2	4.1	19.5	0	0.1	0	0	21	0	0	0	0	0	0	0	0.5
BP25_418_L3				150.53375	-28.86402	SW	1	3	2	1	1	0	1	3.1	5.1	1	0.5	0	0	0	30	0	1	1	1	1	0	0	40
BP25_418M1				150.5138457	-28.8653929	350	1	4	7	6	1	0	23	4.7	10.7	0.6	0.1	0	0	0	40	21	1	0	0	1	0	1	0.2
BP25_418_L1						112	2	3	8	5	1	4	1.2	11.9	0.6	0.1	0	0	0	0	62	0	0	0	0	0	0	1	40

Table notes:

LT >50 cm = Large Tree >50 cm, HT = Hollow Tree, FL (m) = Fallen Log (m), TS 5-10 cm = Tree Stem 5-10 cm, TS 10-20 cm = Tree Stem 10-20 cm, TS 20-30 cm = Tree Stem 20-30 cm, TS 30-40 cm = Tree Stem 30-40 cm, TS 50-80 cm = Tree Stem 50-80 cm, TR <5 cm = Tree Regen <5 cm, E% = Exotic % cover

Appendix C
EPBC and BC – TEC criteria and thresholds

Key diagnostic characteristics and condition thresholds

Artesian Springs Ecological Community in the Great Artesian Basin		Assessment	Result
EPBC Listing - The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin			
Key diagnostic characteristics			
Criteria type	**Criteria**	**Assessment**	**Result**
Description	Includes springs within the GAB discharge area that are the natural surface discharge points of aquifers in the Triassic, Jurassic and Cretaceous sedimentary sequence of the Great Artesian Basin (Habermehl, 1982). Not included are those springs arising from Tertiary sediments and basalts. Natural discharge from the Great Artesian Basin may occur as springs, mound springs, mud springs, boggomoss springs, spring pools or groundwater seeps.	There were no springs or spring pools located within the subject land	No
NSW Listing - Artesian Springs Ecological Community in the Great Artesian Basin			
Key diagnostic characteristics			
Criteria type	**Criteria**	**Assessment**	**Result**
Analogous PCTs	PCTs:24,27,35,36,37,39,40,43,45,49,50,53,56,87,144,145,158,160,168,181, 182,195, 204,211,212,214,238,241,242,244,247,249,271	PCT 27,36,53,56,244,and 247 are present within the subject land.	Yes
Description	Naturally restricted to the artesian springs of the Great Artesian Basin in north-western NSW. The springs occur where artesian water emerges at the surface through fault-lines in the overlying rock and produce mounds from the salts and sediments as the water evaporates. The vegetation within the community frequently consists of sedges or similar vegetation, however, trees and shrubs may be adjacent to the springs or nearby	There were no springs evident within the subject land, areas which are mapped as PCT 27,53,56,244 and 247 displayed signs of water stress during the drought which are not considered likely to occur if those communities were being supported by Artesian springs. PCT 36 located within the banks of the Macintyre River and several creeks also showed signs of drought stress and water reduction during 2018 to December 2020.	No No springs are located within the subject land.

Artesian Springs Ecological Community in the Great Artesian Basin		Assessment	Result
		There is likely to be a spring feeding into Mobbindry Creek downstream of the subject land within the Travelling Stock Reserve adjacent to North Star Road just upstream of the confluence of Mobbindry and Back Creeks. There is a small pool of water located here which did not dry during the drought. TSRs are often located on creeks which are spring fed to allow for reliable watering of stock.	
Distribution	Occurs at the edges of the Great Artesian Basin. Mostly found in Queensland and South Australia, however, a few occur in the Mulga Lands, Darling Riverine Plains and Cobar Peneplain Bioregions of New South Wales.	The subject land is located within the Brigalow Belt South IBRA region	Yes
Habitat and ecology	Flow rates, water depth, water temperature and chemistry vary within and between springs; this provides a variety of habitat types. Vegetation structure and floristics may be influenced by grazing pressure; the persistence of some species is dependent upon grazing by native herbivores to control competitors. Though further study is required, it is thought that fire may assist in maintaining or increasing flows from the vent and may help control the dominant plant species that out compete other plant species of conservation concern (e.g., *Eriocaulon carsonii*).	The abiotic features required for this TEC are not found within the study area.	No.

Brigalow community			
EPBC listing - Brigalow (*Acacia harpophylla*) dominant and co-dominant) community			
Key diagnostic characteristics			
Criteria type	Criteria	Assessment	Result
Landscape	Equates to three NSW VCA Communities: ■ VCA ID 29: Brigalow open woodland on red earth and clay plains mainly in the Mulga Lands Bioregion; ■ VCA ID 31: Brigalow – Gidgee open woodland on clay plains west of the Culgoa River, Mulga Lands Bioregion; and ■ VCA ID 35: Brigalow-Belah woodland on alluvial often gilgaied clay soil mainly in the Brigalow Belt South Bioregion	VCA ID 35 Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion observed to be located within the subject land. VCA ID 29 and 31 do not occur within the subject land.	Yes PCT 35 (VCA ID 35) which synonymous with Brigalow (*Acacia harpophylla*) dominant and co-dominant community TEC is located within the subject land.

Brigalow community			
	Also corresponds to: 1. Brigalow-Gidgee woodland/shrubland in the Mulga Lands and Darling Riverine Plains Bioregions (Gazetted in 2005); and Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Gazetted in 2002).		
Biota	The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch. It is either a dominant tree layer, or co-dominant with other species notably *Casuarina cristata,* other species of *Acacia*, or species of *Eucalyptus*	Brigalow is generally the dominant tree species within PCT 35 and in some instances is co-dominant with *Eucalyptus populnea*. Low quality occurrences of PCT 35 comprise few scattered or no trees and are not considered part of the EPBC-listed TEC.	Yes PCT 35 High and Medium High and Medium quality PCT 35 occur within the subject land and *Acacia harpophylla* is the most abundant and dominant tree species in those mapped patches. No PCT 35 Low Low quality PCT 35 does not have *Acacia harpophylla* present within the mapped patches. While potentially it was present in the past there is no longer regeneration of the species occurring in these areas.
and/or	The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified NSW vegetation communities (although the density may be reduced). Condition requirements: ▪ The patch is greater than 0.5 ha, and ▪ Vegetation in which exotic perennial plants have less than 50% cover, assessed in a minimum area of 0.5 ha (100 m by 50 m); and ▪ Where it has not been comprehensively cleared (nor just thinned) within the last 15 years; unless direct evidence proves otherwise.	Vegetation within PCT 35 is synonymous with VCA ID 35: Brigalow-Belah woodland on alluvial often gilgaied clay soil mainly in the Brigalow Belt South Bioregion. Vegetation within Vegetation The patches of PCT 35 High and PCT 35 Medium are larger than 0.5 ha , have a native % cover of over 50% and are considered to be older than 15 years due to the presence of multiple vegetation strata. Areas of PCT 35 Low do not contain Brigalow, there are very few if any trees present within the Low mapping category. PCT 35 Low at Borrow pit 1 has been comprehensively cleared within the last 15 years as determined by aerial images.	Yes The vegetation associated with PCT 35 listed as condition class High are likely to be patches of vegetation that have not experienced clearing in the last 15 years. Some vegetation patches of PCT 35 Medium may have experienced clearing in the last 15 years however the community is recovering with dense stands of Brigalow suckers. The ground layer species and other elements meet the condition thresholds. No PCT 35 :Low does not contain remnant or regrowing stands of Brigalow

Brigalow community			
		PCT 35 Low at Borrow pit 2 does not contain any remnant Brigalow plants however it was once a Brigalow community	
NSW Listing - Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions			
Key diagnostic characteristics			
Analogous PCTs	Seven PCTs as listed in the Bionet threatened ecological community to plant community type association data within the Brigalow Belt South IBRA: ■ PCT35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion ■ PCT56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW ■ PCT87 - Poplar Box - Coolabah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion ■ PCT101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion ■ PCT244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt). ■ PCT445 - Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion ■ PCT629 - Brigalow - Bladder Saltbush open woodland to tall open shrubland in the Come-By-Chance region, Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	PCT 35 Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion observed to be located within the subject land. PCT 56 and 244 occur within the subject land and border areas that transition into Brigalow dominated PCT. Where these transitions occur the area containing Brigalow has been mapped as PCT 35 Medium or High. No PCT 87, 101, 445 or 629 has been recorded within the subject land.	Yes PCT 35 No PCT 56 and 244 – where these PCTs grade into Brigalow dominant community are analogous to the NSW PCTs in association with EPBC TECs they have been mapped as PCT 35.
Condition thresholds			
Step A1	The patch is 0.5 ha or more in size	Sub-zones within Vegetation Zones 35_NO_High and 35_NB_High that are >0.5 ha and that contain <50% total cover of exotic perennial plants within a sample area of 0.5 ha are shown in Appendix A.	Yes Patches of vegetation containing PCT 35 larger than 0.5ha are located within the subject land.

Brigalow community			
Step A2 **(EWH&A Listing Advice)**	Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha that is representative of the patch.	Sub-zones within Vegetation Zones 35_NO_High and 35_NB_High that are >0.5 ha and that contain <50% total cover of exotic perennial plants within a sample area of 0.5 ha are shown in Appendix A.	Yes Brigalow (*Acacia harpophylla*) dominant and co-dominant) community is considered present within the subject land as shown in Appendix B. 11.81 ha of Brigalow TEC was observed within the alignment and 0.68 ha of Brigalow TEC within two proposed borrow pits.

Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions		**Assessment**	**Result**
NSW Listing - Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions			
Key diagnostic characteristics			
Criteria type	**Criteria**		
Analogous PCTs	Seven PCTs within the Brigalow Belt South IBRA ▪ PCT35 - Brigalow - Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion ▪ PCT56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW ▪ PCT87 - Poplar Box - Coolabah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion ▪ PCT101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion ▪ PCT244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt). ▪ PCT628 - Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion	PCTs 35,56,244 and 628 are present within the subject land.	Yes

Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions		Assessment	Result
Description	This was previously an open forest community of flora and fauna may now exist as woodland or as remnant trees. Characteristic tree species are Carbeen (*Corymbia tessellaris*) and White Cypress Pine (*Callitris glaucophylla).* Associated trees include *Corymbia dolichocarpa, Eucalyptus populnea, E. camaldulensis, Casuarina cristata* and *Allocasuarina leuhmannii*.	Isolated pockets of Carbeen are associated with Poplar Box and *Eucalyptus tereticornis* tin the northern section of the subject land in the Darling Riverine Plains bioregion. These areas are associated with PCT 628 and are assigned to PCT 628 Medium as shown in Appendix A. PCT 628 Low does not contain trees therefore does not meet the description for the TEC which does not include derived grasslands. Areas of PCT 35, 56 and 244 do not contain the key diagnostic species required to characterise a Carbeen community.	Yes PCT 628 Medium No PCT 35,56, 244
Distribution	Carbeen Open Forest Community is a distinctive plant community on the riverine plains of the Meehi, Gwydir, MacIntyre and Barwon Rivers and in small remnants farther south.	Carbeen Open Forest was observed within the extended floodplains of the MacIntyre River.	Yes
Habitat and ecology	Occurs on siliceous sands, earthy sands and clayey sands It is found on flats and gentle rises of alluvial or aeolian sandy soils derived from ancient watercourses (it also occurs on some clay alluvial soils but is mostly restricted to well-drained sandy sites) These rises or lenses are remnants of prior streams and are often distant from existing rivers The structure of the community was previously open forest, but extensive clearing and grazing disturbances have reduced it to a mid-high or tall woodland of isolated remnant stands	PCT 628 is generally located on slightly elevated crests adjoining low-lying areas that formally supported Lignum wetlands which have been modified for cropping land uses. This community has been modified by grazing and generally supports a canopy layer with trees of varying ages and a ground layer consisting of chenopod shrubs and grass species.	Yes – PCT 628 Medium is considered to met the condition description for Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions and therefore the community is considered present within the subject land as shown in Appendix A.

Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland			
EPBC Listing - Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland			
Key diagnostic characteristics			
Criteria type	**Criteria**	**Assessment**	**Result**
Landscape	Corresponds closest to two NSW PCTs: ▪ PCT 52 Queensland bluegrass- cup grass- Mitchell grass-native millet alluvial plains grassland ▪ PCT 102 Plains grass grasslands on basaltic black earth soils mainly on the Liverpool Plains in the Brigalow Belt South bioregion (Benson unpublished).	PCT 52 Queensland bluegrass- cup grass- Mitchell grass-native millet alluvial plains grassland is located within the subject land which synonymous with the community TEC. PCT 102 is not found within the subject land.	Yes PCT 52 which synonymous with Natural Grasslands on Basalt and Fine-textured Alluvial Plains is located within the subject land.
Biota	Trees absent or sparse such that the projective foliage cover of trees in the patch is 10% or less?	Yes BAM plots identified patches of grassland with less than 10% project foliage cover of trees.	Yes Trees were absent or less than 10% of the canopy cover.
and/or	Are there at least 200 native grass tussocks in the patch?	Vegetation within PCT 52 contains at least 200 native grass tussocks as identified by the BAM plots.	Yes There were more than 200 native grass tussocks within the identified PCT 52 patches.
Condition thresholds - Best quality			
Step A1	The patch is 0.5 ha or more in size	Sub-zones within Vegetation Zone 52_CB Medium_ are >0.5 ha and are likely to meet the additional criteria in non-drought years with one Plot meeting the criteria at the time of assessment. See mapping contained in Appendix A.	Yes Patches of vegetation containing PCT 52 larger than 0.5ha were located within the subject land.
Step A2 **(EWH&A Listing Advice)**	**AND** are there at least 4 perennial native grass indicator species present? **AND** is the total projective foliage cover of shrubs less than 30%? **AND** do perennial non-woody introduced species make up less than 5% of the total perennial projective foliage cover?	Sub-zones within Vegetation Zone 52_CB Medium_ are >0.5 ha and are likely to meet the additional criteria in non-drought years. See mapping contained in Appendix A.	Yes There were patches of vegetation classified as PCT 52 that were observed to contain at least 4 perennial native grasses indicator species, with total projective foliage cover of shrubs less than 30% and perennial non-woody introduced species making up less than 5% of the total perennial projective foliage cover.

Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland			
Condition thresholds - Good quality			
Step B1	The patch is at least 2 ha in size	Yes	Yes Patches of vegetation containing PCT 52 that are larger than 2ha are located within the subject land.
Step B2	**AND** are there at least 3 perennial native grass indicator species present? AND is the total projective foliage cover of shrubs less than 50%? AND do perennial non-woody introduced species make up less than 30% of the total perennial projective foliage cover?	As above it is considered that in non-drought years the mapped PCT 52 will meet the condition thresholds of best quality Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales	Yes There are patches of vegetation classified as PCT 52 that contain at least 3 perennial native grasses indicator species, with total projective foliage cover of shrubs less than 50% and perennial non-woody introduced species making up less than 30% of the total perennial projective foliage cover. There is 33.5 ha of Natural Grasslands TEC within the subject land

Coolibah – Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South Bioregions			
EPBC Listing - Coolibah – Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South Bioregions			
Key diagnostic characteristics			
Criteria type	**Criteria**	**Assessment**	**Result**
Landscape	Open eucalypt woodlands formerly occurred across a range of climatic regions of Australia, including semi-arid and humid subtropical zones. The position in the landscape of these woodlands can determine the vegetation structure of the woodlands such as if they occur on the floodplains or uplands and consequently, whether they have a more shrubby or more grassy understorey (Keith, 2004).	The subject land is located within both the Darling Riverine Plains and the Brigalow Belt South bioregions.	Yes The subject land is located in the humid subtropical zone and within floodplains.
	The ecological community is associated with the floodplains and drainage areas of the Darling Riverine Plains and the Brigalow Belt South bioregions (Bioregions are defined based on the Interim Biogeographic Regionalisation for Australia (IBRA) version 6.1).	The subject land contains landscape features that match the location description of the community.	Yes The subject land is located within both the Darling Riverine Plains and the Brigalow Belt South bioregions.

Coolibah – Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South Bioregions			
Biota	The key diagnostic attributes for the Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions ecological community are as follows: ▪ Distribution is limited to the Darling Riverine Plains and the Brigalow Belt South bioregions (IBRA v6.1). It typically occurs on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream levees. A tree canopy layer is present that must show these features: ▪ *Eucalyptus coolabah* subsp. *coolabah* (Coolibah) must be present in the tree canopy; ▪ Coolibah typically is dominant (≥50% of tree crown cover); ▪ Where Coolibah and *E. largiflorens* (Black Box) co-occur, together they make up the dominant species in the tree canopy layer (≥50% of tree crown cover); ▪ Hybrids of Coolibah or Black Box with each other and other *Eucalyptus* species (typically Bimble Box) are included as dominant tree species.	The required dominant canopy species *E.coolabah* and *E. largiforens* are not present within or adjacent to the study area, nor does it appear that these species have been removed from the landscape. The dominant riparian eucalypt species within the subject land is *E. camaldulensis* (River red gum)	No The listed vegetation community is not present within the study area.
	The mid or shrub layer may or may not be present. When present it is typically sparse or clumped and is of variable composition The ground layer is of variable composition and cover ranging from sparse to dense. Ground cover lifeforms typically comprise native graminoids, other herbs, chenopods and other low shrubs that are typically under 50 cm tall.	N/A as canopy species are not present	N/A
Condition thresholds			
	Minimum patch size is 5 ha. This may include areas of native vegetation that may be naturally open or contain regrowth.	N/A Key species not present	N/A
AND	The crown cover of canopy trees in the patch is ≥8% of trees in the patch must be ≥8%; AND Coolibah and/or Black Box in the tree canopy must be present in the patch that are either: o mature trees with a main stem that has a dbh8of ≥30 cm; OR hollow-bearing trees (live or dead); OR coppiced trees with a main stem that has a dbh of ≥20 cm.	There is no Coolibah or Back Box present within the study area	No Crown cover in woodlands present within the subject area greater than 8% however the composition of the crown cover did not contain Coolibah or Black box, as either mature trees or a main stem of greater or equal to 30dbh. .

Coolibah – Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South Bioregions			
AND	Exotic species: ■ In the ground layer, the percentage cover of non-native perennial plant species10 does not exceed the percentage cover of native plant species (annual or perennial).	N/A	No Not applicable no Coolibah and Black box observed to occur within the canopy structure.
NSW Listing – Coolibah – Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions			
Key diagnostic criteria			
Analogous PCTs	Equates to four PCTs as listed in the Bionet threatened ecological community to plant community type association data: ■ PCT37 - Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion. ■ PCT39 - Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion ■ PCT40 – Coolabah open woodland wetland with chenopod/grassy ground cover on grey and brown clay floodplains ■ PCT55 - Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	PCT 55 occurs within the subject land. It is likely that this patch is a result of changed flood regimes as a result of the existing rail infrastructure and not the result of clearing of Coolibah – Black box woodlands. The required dominant canopy species *E.coolabah* and *E. largiforens* are not present within or adjacent to the study area, nor does it appear that these species have been removed from the landscape. PCTs 37, 39 and 40 do not occur within the subject land.	Yes analogous PCT present PCT 55 occurs within the subject land, however it is unlikely that this patch was derived from Coolibah – Black box woodlands
Biota	*Eucalyptus coolabah* (Coolibah) is typically the dominant or subdominant tree species in Coolibah – Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions, and it may occur with or without *Acacia stenophylla* (River Cooba), *Acacia salicina* (Cooba), *Casuarina cristata* (Belah), *Eremophila bignoniiflora* (Eurah), *Eucalyptus largiflorens* (Black Box), *Eucalyptus camaldulensis* (River Red Gum) and *Eucalyptus populnea* subsp. *bimbil* (Bimble Box). *Eucalyptus largiflorens* (Black Box) may become the dominant tree species in parts of the distribution of the community (eg. central-northern riverine plains of NSW, western parts of Darling Riverine Plains Bioregion)	The required dominant canopy species *E.coolabah* and *E. largiflorens* are not present within or adjacent to the study area, nor does it appear that these species have been removed from the landscape. PCT 55 is present however only contains Belah. This PCT appears to have developed as a result of changed flood regimes associated with the existing rail infrastructure slowing the drainage of Back creek. There is no evidence of Coolibah or Black box within or adjacent to the subject land.	No PCT 55 within the subject land contains only Belah as a monoculture with no other tree species present.

Weeping Myall Woodlands			
EPBC – Weeping Myall Woodlands			
Key diagnostic characteristics			
Criteria type	**Criteria**	**Assessment**	**Result**
Location	Often occur in monotypic stands however other vegetation may also occur although not as dominant species. These species include Western Rosewood (*Alectryon oleifolius* subsp. *elongatus*); Poplar Box (*Eucalyptus populnea*); or Black Box (*Eucalyptus largiflorens*). Grey Mistletoe *(Amyema quandang*) commonly occurs.	PCT 27 Medium - Weeping Myall forms a monotypic stand of vegetation which contained Grey Mistletoe *Amyema quandang* throughout. PCT 27 Low – contains no remnant Weeping myall.	Yes PCT 27 Medium Weeping Myall occurs within the subject land.as monotypic stands with Grey Mistletoe *Amyema quandang,* adhering to the criteria of canopy species assemblages No PCT 27 Low
	The understorey often includes an open layer of shrubs above an open layer of grasses and herbs. The ground layer includes a diversity of grasses and forbs and varies in species composition and cover. The community may contain chenopods including saltbushes, native cotton bushes, bluebushes, goosefoots and copperburrs or alternatively winter-growing grasses including Mitchell Grass (*Astrebla* spp.) and Queensland Blue Grass (*Dichanthium sericeum*) may also be common.	Weeping Myall Woodlands woodland TEC is synonymous with PCT 27 within the subject land which contains a grazed grassy understory of *Einadia nutans subsp. Nutans*, *Atriplex leptocarpa* and grasses, *Enteropogon acicularis, Aristida leptopoda and Aristida jerichoensis.*	Yes PCT 27 Medium A single stand of Weeping Myall woodland was observed to contain a diverse understorey of native chenopods and grass species, fulfilling the requirements for groundcover species assemblages. A total of 5 shrubs and 7 grasses were recorded during a time of drought when the area had been grazed.
Soils and landscape	The community tends to occur on flat areas, shallow depressions or gilgais on raised (relict) alluvial plains. These areas are not associated with active drainage channels and are rarely, if ever, flooded.	Vegetation Zone 27_NB_Medium which consists of PCT 27 Weeping Myall open woodland occurs in a shallow depression within a flat alluvial plan adjacent to Mobbindry Creek.	Yes The landscape of the Weeping Myall woodland was observed within flat alluvial plain, matching the criteria for soils and landscape.
Condition thresholds (EWH&A Listing Advice)			
Step A1	The tree canopy is dominated (at least 50% of trees present) by living, dead or defoliated Weeping Myall trees; and	In Vegetation Zone 27_NB_Medium Weeping Myall forms a monotypic stand of vegetation which includes ~90% of canopy species present. In vegetation zone PCT 27 Low no remnant Weeping myall remains PCT 55 Medium contained no Weeping myall nor is it considered likely that Myall had bee removed from the landscape at this location.	Yes PCT 27 Medium Weeping Myall was observed to constitute 90% canopy cover for patches of Weeping Myall woodland meeting the condition threshold of step A1. No PCT 27 Low NO PCT 55 Medium

Weeping Myall Woodlands			
Step A2	The overstorey must have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees/ha; and	In Vegetation Zone 27_NB_Medium Weeping Myall has a canopy cover of ~30 – 40%.	Yes PCT 27 Medium Weeping Myall woodland had a canopy cover of over 5%, meeting the condition threshold of step A1
Step A3	The area is at least 0.5 ha in size; and	The total patch of Weeping Myall Woodland associated with Vegetation Zone 27_NB_Medium is 2.75 ha.	Yes
Step A4	The patch has either: more than two layers of regeneration of Weeping Myall present; **or** the tallest layer of living, dead or defoliated Weeping Myall trees is at least 4 m tall and of the vegetative cover present, 50% is comprised of native species.	Vegetation Zone 27_NB_Medium contains just one cohort of Weeping Myall regeneration The tallest layer of Weeping Myall is 7 to 10 m and >50% cover of vegetation is made up of native species.	Yes Weeping Myall Open Woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions is not considered present within the subject land due to the small patch size and lack of regeneration present.
NSW Listing - Myall woodland in the Darling Riverine Plains, Brigalow Belts South, Cobar, Peneplain, Murry-Darling Depression, Riverina and NSW South Western Slopes Bioregions			
Key diagnostic characteristics			
Analogous PCTs	Equates to six PCTs occurring within the three IBRA subregions found within the subject land (Castlereagh-Barwon, Northern Outwash, Northern Basalt), as listed in the Bionet threatened ecological community to plant community type association data: ■ PCT27 - Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion ■ PCT37 - Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion. ■ PCT43 - Mitchell Grass grassland - chenopod low open shrubland on floodplains in the semi-arid (hot) and arid zones ■ PCT49 – Partly derived Windmill Grass - copperburr alluvial plains shrubby grassland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion ■ PCT55 - Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions. ■ PCT145 – Western Rosewood - Wilga - Wild Orange - Belah low woodland of the Brigalow Belt South Bioregion and eastern Darling Riverine Plains Bioregion	PCT 27 and 55 were recorded within the subject land. PCTs 37, 43, 49, 145 were not recorded within the subject land	Yes PCT 27 and 55

Weeping Myall Woodlands			
Landscape	Typically, it occurs on red-brown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving between 375 and 500 mm mean annual rainfall.	The subject land is located on suitable soils within the climatic belt receiving between 375 and 500 mm mean annual rainfall	Yes
Biota	The tree layer grows up to a height of about 10 m and invariably includes Acacia pendula (Weeping Myall or Boree) as one of the dominant species or the only tree species present. The understorey includes an open layer of chenopod shrubs and other woody plant species and an open to continuous groundcover of grasses and herbs. The structure and composition of the community varies, particularly with latitude, as chenopod shrubs are more prominent south of the Lachlan River district, while other woody species and summer grasses are more common further north	Yes PCT 27 Medium contains Weeping myall as the dominant tree species with suitable ground layer assemblages. No PCT 27 Low does not contain any tree species.	Yes PCT 27 Medium

White Box – Yellow Box Blakely's Red Gum Woodland		Assessment	Result
EPBC Listing – White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland			
Key diagnostic characteristics			
Criteria type	**Criteria**		
Description	Box-Gum Woodland is characterised by the presence or prior occurrence of *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and/or *E. blakelyi* (Blakely's Red Gum). The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees such as *E. bridgesiana* (Apple Box), *E. microcarpa* (Grey Box), *E. mannifera* (Brittle Gum), *E. rubida* (Candlebark), *E. cinerea* (Argyle Apple) and *E. macrorrhyncha* (Red Stringybark).	This EEC is associated with the following PCTs: 435,496,281,434,433,421 and 437 none of which were found within the study area during field assessments	No The key diagnostic Eucalypt species were not observed to occur within or adjacent to the subject land.
Distribution	Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.	Box-Gum woodland was not observed within the study area however it is recorded within the IBRA region	Yes ecological community present within the IBRA region but not within the subject land

White Box – Yellow Box Blakely's Red Gum Woodland		Assessment	Result
Habitat and ecology	Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles. Commonly co-occurring eucalypts include Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), Candlebark (*E. rubida*), Snow Gum (*E. pauciflora*), Argyle Apple (*E. cinerea*), Brittle Gum (*E. mannifera*), Red Stringybark (*E. macrorhyncha*), Grey Box (*E. microcarpa*), Cabbage Gum (*E. amplifolia*) and others. The understorey in intact sites is characterised by native grasses and a high diversity of herbs Shrubs are generally sparse or absent, though they may be locally common. Remnants generally occur on fertile lower parts of the landscape where resources such as water and nutrients are abundant.	The dominant and co-dominant tree species for this EEC were not present within study area nor were they considered likely to have been historically removed from the study area	No – Box-Gum woodland is not considered present within the study area.
NSW Listing – White box – Yellow box Blakely's Red Gum Woodland			
Analogous PCTs within Brigalow belt south	Equates to 48 PCTs 250,266, 267, 268, 281, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 511, 544, 563, 589, 590, 597, 599, 618, 619, 622, 702, 710, 796, 921, 1307, 1324, 1329, 1383, 1606, 1608, 1611, 1693, 1695, 1698	None of these PCTs are present within the subject land	No
Location	The vegetation community is known to occur within NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.	The subject land is within the Brigalow Belt South	Yes
Biota	It is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: ■ Dominance or co-dominance of White Box *Eucalyptus albens,* Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi.* ■ Commonly co-occurring eucalypts include Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), Brown stringybark (*E. macrorhyncha*), Coastal Grey Box (*E. moluccana*), Candlebark (*E. rubida*), Bundy (*E. goniocalyx*), Broad-leaved Stringybark (*E. goniocalyx*), Youman's Stringybark (*E. youmanii*) Understorey in intact sites is characterised by native grasses and a high diversity of herbs; the most commonly encountered include Kangaroo Grass (*Themeda australis*), Poa Tussock (*Poa sieberiana*), wallaby grasses (*Rytidosperma* spp.), spear-grasses (*Austrostipa* spp.), Common Everlasting (*Chrysocephalum apiculatum*), Scrambled Eggs (*Goodenia pinnatifida*), Small St John's Wort (*Hypericum gramineum*), Narrow-leafed New Holland Daisy (*Vittadinia muelleri*) and blue-bells (*Wahlenbergia* spp.).	No recordings of the key diagnostic species Yellow box, White box or Blakely's red gum within the subject land.	No - Ecological community not present

Semi-evergreen Vine Thicket in the Brigalow Belt (North and South) and Nandewar Bioregions		Assessment	Result
EPBC Listing - Semi-evergreen Vine Thicket in the Brigalow Belt (North and South) and Nandewar Bioregions			
Key diagnostic characteristics			
Criteria type	**Criteria**		
Description	The semi-evergreen vine thickets (SEVT) in New South Wales are part of the *Notelaea microcarpa-Ehretia membranifolia-Geijera parviflora* vine thicket sub-alliance of Floyd (1990).The vegetation (particularly in northern areas of its distribution) is similar to that in the southern part of the 'central SEVT' area in Queensland (Curran 2003; see also Nix et al. 1992). Relative to the small size of the vine thicket patches, the vegetation is floristically rich in shrubs, small trees and vines (Williams 1999). The plant species diversity of the vine thickets is, however, much lower than the floristic diversity of the vine thickets in Queensland. Vine thickets in New South Wales are also generally more open than those in Queensland (Floyd 1990), often comprising local thickets of densely spaced trees and shrubs frequently alternating with gaps in which trees and shrubs are absent or sparsely scattered, and in extreme cases occurring just as scattered individuals (Williams 2003).	The following PCTs are associated with this EEC within the Brigalow Belt South Bioregion, 147,228,378,442,452,547,628 and 1124 PCT 417 is mapped and considered present within Borrow pit 1 (BP1)	Yes PCT 147 PCT analogous with the criteria for the TEC were observed to occur within the subject land .
Distribution	Semi-evergreen vine thickets are widely scattered with a common structure (architecture) but considerable regional variation in floristic associations. Semi-evergreen vine thickets occur within Queensland, New South Wales, the Northern Territory and Western Australia. The vine thickets occur mainly on hills on light clay soils derived from basalt (Benson et al. 1996) but also occur in areas with sandy loams derived from sediments (Williams 1999). Within the Brigalow Belt Bioregions, semi-evergreen vine thickets have been fragmented, reduced in area and degraded through land clearing and agricultural/grazing practices.	SEVT was observed within the study area and is recorded within the IBRA region	Yes PCT 147 at proposed Borrow Pit 1 The distribution for the TEC occurs within the subject land.
Habitat and ecology	The vine thickets are dominated by a variety of low tree and shrub species, with the species composition varying from north to south, possibly due to rainfall differences (Benson et al. 1996). Characteristic canopy species include *Elaeodendron australe* var. *integrifolium* (Red Olive Plum), *Ehretia membranifolia* (Peach Bush), Geijera parviflora (Wilga), *Notelaea microcarpa* (Native Olive*), Pouteria cotinifolia* var. *pubescens* (Yellow Lemon) and *Pittosporum spinescens* (Wallaby Apple, Large-fruited Orange Thorn). The trees and tall shrubs are usually 2–10 m tall (Floyd 1990).	The dominant and co-dominant species for this EEC were present within study area. Key species recorded include but were not limited to Wilga, Peach bush, Native olive and Wallaby apple. Emergent Silver-leaved ironbark was also present.	Yes PCT 147 is considered present within the subject land as shown in Appendix A. There is 4.6 ha of SEVT TEC within the subject land of Borrow pit 1

Semi-evergreen Vine Thicket in the Brigalow Belt (North and South) and Nandewar Bioregions		Assessment	Result
	Emergent trees often associated with the vine thickets include *Eucalyptus* spp., *Callitris glaucophylla* (White Cypress Pine), *Casuarina cristata* (Belah) and *Brachychiton populneus* (Kurrajong). These trees are usually dominant in adjacent woodlands. Vines frequently present include *Parsonsia* spp, *Pandorea pandorana* (Wonga Wonga Vine) and *Jasminum didymum* subsp. *lineare* (Desert Jasmine). *Cadellia pentastylis* (Ooline) which is associated with vine thickets in Queensland may be locally dominant in vegetation in northern New South Wales and occurs in similar areas to vine thickets (Floyd 1990; Benson 1993; McDonald 1996). Ooline vegetation is not however included as part of the listed SEVT ecological community in New South Wales (based on New South Wales Scientific Committee (1999); see Threatened Species Scientific Committee 2001).		
NSW Listing - Semi-evergreen Vine Thicket in the Brigalow Belt (North and South) and Nandewar Bioregions			
Analogous PCTs	Six PCTs occurring within the three IBRA subregions found within the subject land (Castlereagh-Barwon, Northern Outwash, Northern Basalt), as listed in the Bionet threatened ecological community to plant community type association data: ▪ PCT55 - Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions. ▪ PCT147 – Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion ▪ PCT228 - Semi-mesic woodland on basalt hills of the dry subtropical climate zone, north western slopes of NSW ▪ PCT378 - Belah - Wilga +/- White Box dry viney scrub woodland the NSW Brigalow Belt South Bioregion ▪ PCT442 - Carbeen tall open woodland - Mock Olive tall closed vine thicket on basalt hills in the Northern Basalt sub-region, Brigalow Belt South Bioregion ▪ PCT452 – Mixed vine thicket low eucalypt woodland of the northern-western Brigalow Belt South Bioregion	PCT 55 and 147 were observed within the subject land. PCTs 288, 378, 442 and 452 are not present within the subject land	Yes PCT 55 and 147 were recorded within the subject land
Description	Low, dense form of dry rainforest or ‘scrub’ made up of vines, some shrub species and tree species that are related to coastal subtropical rainforest trees. Some of the trees are either regularly deciduous or sporadically shed their leaves in response to prevailing weather conditions. Taller eucalypts and cypress pines from surrounding woodland vegetation often emerge above the rainforest tree layer	The vegetation community PCT 147 Medium at Borrow pit 1 matches this description PCT 55 Medium within the alignment does not match this description. Only one tree species (Belah) is present at an average height of 12 m and there were no shrub or vine species within that patch of vegetation.	Yes PCT 147 Medium No PCT 55 Medium

Semi-evergreen Vine Thicket in the Brigalow Belt (North and South) and Nandewar Bioregions		Assessment	Result
Soils	Occurs on deep, loamy high-nutrient soils derived from basalt or other volcanic rocks, on sites that are relatively protected from fire and that have an annual average rainfall of around 750 mm.	PCT 147 at Borrow pit 1 is located on deep soils on a volcanic plug.	Yes PCT 147 Medium
Biota	Characteristic tree species are red olive plum (*Cassine australis* var. *angustifolia*), wilga (*Geijera parvifolia*), native olive (*Notelaea microcarpa* var. *microcarpa*) and peach bush (*Ehretia membranifolia*). Other tree species include quinine bush (*Alstonia constricta*), hard alectryon (*Alectryon subdentatus*) and *Planchonella cotinifolia* var. *pubescens*. There is often a taller layer of emergent trees typical of the surrounding woodlands such as white box (*Eucalyptus albens*), silver-leaved ironbark (*E. melanophloia*), belah (*Casuarina cristata*), kurrajong (*Brachychiton populneus*) and white cypress pine (*Callitris glaucophylla*).	The key plant species recorded in PCT 147 Medium at Borrow pit 1 include Wilga, Native olive and Peach bush. Emergent Silver-leaved iron bark was also present.	Yes PCT 147 Medium within Borrow pit 1 meets the definition of the TEC

National Herbarium of New South Wales

Enquiry No: 20830
Botanical.Is@rbgsyd.nsw.gov.au
Fax No: (02) 9251 1952
Ph. No: (02) 9231 8111
Date: 21 January 2019

Ms Sarah GLAUERT
Aurecon
Suite 6.02, Level 6
14 Moore Street
Canberra City, ACT 2601
AUSTRALIA

Dear Ms GLAUERT,

Thank you for your enquiry of 19-Nov-18. We are happy to provide the following information:

Please do provide a list of your specimens and assign each a unique alpha numeric number

(Lepidium 1) *Lepidium bonariense* det. B.M. Wiecek 17 Jan 2019
(Sida 1) *Sida trichopoda* det. B.M. Wiecek 17 Jan 2019
(Sida 4) *Sida trichopoda* det. B.M. Wiecek 17 Jan 2019
(Sida 5) *Sida trichopoda* det. B.M. Wiecek 17 Jan 2019
(Sida 3) *Sida trichopoda* det. B.M. Wiecek 17 Jan 2019
(Lepidium 3) *Haloragis heterophylla* det. B.M. Wiecek 17 Jan 2019
(Lepidium 2) *Lepidium africanum* det. B.M. Wiecek 17 Jan 2019
(Glycine 1) *Glycine canescens* det. B.M. Wiecek 17 Jan 2019
No number, 31/10/11 at 28.78950404, 150.40924192 *Stemodia glabra* det. B.M. Wiecek 17 Jan 2019
(Maireana sample 1) Fruits very immature possibly *Maireana pentagona* (not previously recorded this far north in NSW but is found over the border in Queensland. det. B.M. Wiecek 17 Jan 2019
(Sporobolus sp.) *Sporobolus creber* det. B.M. Wiecek 17 Jan 2019
(Sporobolus sample 2) *Sporobolus actinocladus* det. B.M. Wiecek 17 Jan 2019
(Maireana 2, long leaf) *Salsola australis* det. B.M. Wiecek 17 Jan 2019
(Maireana woolly) *Maireana coronata* det. B.M. Wiecek 17 Jan 2019

An invoice for $322.00 (incl. GST) will be forwarded to you separately by our finance section to cover cost of identification.
Thank you for your enquiry.

Yours sincerely

Barbara Wiecek
Identification Botanist
Botanical Information Service

Appendix D
Fauna data

Table D1 Threatened species survey effort

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort
Birds				
Barking owl (*Ninox connivens*)	Habitat survey	35 (7 sites) 36, 53,55 and 628 (1 site per PCT) 56 (5 sites) 98, 192, 244 and 418 (2 sites per PCT)	October 2019	22 x habitat assessments
	Pellet survey			42 person-hours
	Spotlighting and call playback			210 person-hours
Black-breasted buzzard (*Hamirostra melanosternon*)	Habitat survey	36, 55 and 98, 247 (1 site per PCT) 56 (2 sites)	October 2019	6 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Bush stone-curlew (*Burhinus grallarius*)	Spotlighting and call playback	35 (5 sites) 36, 192 and 628 (1 site per PCT) 27, 52, 98, 244 and 418 (2 sites per PCT) 56 (4 sites)	October 2019	33 person-hours
	Flushing survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Australasian bustard (*Ardeotis australis*)	Habitat survey	27 (2 sites) 35 (9 sites) 52, 244 (2 sites per PCT) 53, 55, 98, 192 and 628 (1 site per PCT) 56 (4 sites) 418 (3 sites) 247 (1 site)	October 2019	25 x habitat assessments
	Flushing survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Cotton pygmy goose (*Nettapus coromandelianus*)	Habitat survey	53 (1 site)	October 2019	1 x habitat assessment
Glossy black cockatoo (*Calyptorhynchus lathami*)	Habitat survey	35 (2 sites) 55, 244 and 628 (1 site per PCT) 56 (4 sites)	October 2019	9 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort
Little eagle (*Hieraaetus morphnoides*)	Habitat survey	35, 56 (5 sites per PCT) 98 (2 sites per PCT) 244 and 628 (1 site per PCT).	October 2019	10 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
	Active nest search	Above PCTs and; 147 (1 site) 418 (2 sites)	October 2019	9 person-hours
Major Mitchell's cockatoo (*Lophochroa leadbeateri*)	Habitat survey	36 (3 sites) 55, 98,192 and 628 (1 site per PCT) 244 (2 sites)	October 2019	9 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Masked owl (*Tyto novaehollandiae*)	Habitat survey	35 (3 sites) 36, 55, 98 and 628 (1 site per PCT) 56 (5 sites)	October 2019	12 x habitat assessments
	Spotlighting and call playback			120 person-hours
Red-tailed black cockatoo (*Calyptorhynchus banksii samueli*)	Habitat survey	35 (2 sites) 36 (3 sites) 55, 192, 244 and 628 (1 site per PCT) 56 (4 sites)	October 2019	13 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Square-tailed kite (*Lophoictinia isura*)	Habitat survey	35 (7 sites) 36, 55 and 192, 244, 247, 628 (1 site per PCT) 56 (5 sites) 98 and 418 (2 sites per PCT)	October 2019	22 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Squatter pigeon (southern) (*Geophaps scripta scripta*)	Incidental daylight surveys	35 (9 sites) 36, 53, 147, 192, 247 and 628 (1 site per PCT) 52, 98 and 244 (2 sites per PCT) 56 and 418 (3 sites)	Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Superb parrot (*Polytelis swainsonii*)	Habitat survey	36 (3 sites) 98,192 (1 site per PCT) 52, 244 (2 sites) 56 (5 sites)	October 2019	11 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Swift parrot (*Lathamus discolor*)	Habitat survey	35 and 418 (1 site per PCT)	October 2019	2 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort
White-bellied sea-eagle (*Haliaeetus leucogaster*)	Habitat survey	35 (7 sites) 36 (3 sites) 27, 98, 192, 247 and 628 (1 site per PCT) 56 (5 sites) 244 and 418 (2 sites)	October 2019	24 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Mammals				
Bristle-faced free-tailed bat (*Setirostris eleryi*)	Anabat call detector	35, 36, 55, 98, 192, 244, and 628 (1 site per PCT) 56 (2 sites)	October 2019	18 x detector nights
	Harp trapping	35 (adjacent to 418), 36, 56 and 244 (1 site per PCT)	February 2021	64 x trap nights
Eastern bent-wing bat (*Miniopterus orianae oceanensis*)	Anabat call detector	147 (1 site) 35 and 418 (2 sites per PCT)	October 2019	10 x detector nights
Eastern cave bat (*Vespadelus troughtoni*)	Anabat call detector	35 and 56 (2 sites per PCT) 147, 192 and 418 (1 site per PCT).	October 2019	14 x detector nights
Eastern pygmy possum (*Cercartetus nanus*)	Spotlighting	244 and 418 (1 site per PCT)	February 2021	13 person-hours
	Camera traps			92 x trap nights
Grey-headed flying-fox (*Pteropus poliocephalus*)	Habitat survey	35 (6 sites) 36 (2 sites) 55 (1 site) 56 (3 sites) 147 (1 site) 418 (2 sites)	October 2019	15 x habitat assessments
	Diurnal survey		Throughout all survey periods (2018, 2019 and 2020)	Incidental driving and walking transects across all survey periods
Koala (*Phascolarctos cinereus*)	Spotlighting and call playback	36 (1 site)	October 2018	2 x persons for 3 nights
	Scat search, spotlighting and call playback	35 (9 sites) 36 (3 sites) 55, 192, 244 and 628 (1 site per PCT) 56 (5 sites) 98 (2 sites) 418 (3 sites)	October 2019	25 person-hours Scat sent to B.Triggs for analysis
	Spotlighting	244 and 628 (1 site per PCT)	February 2021	8 person-hours

Threatened species	Survey techniques	PCTs surveyed (number of sites)	Survey times	Survey effort
Large-eared pied bat *Chalinolobus dwyeri*	Anabat call detector	147 (1 site)	October 2019	10 x detector nights
	Harp trapping (completed with Bristle-faced free-tailed bat *(Setirostris eleryi)* survey)	35, 36, 56 and 244 (1 site per PCT) 418 directly adjacent to 35 harp trap location	February 2021	64 x trap nights (four separate locations within study area less than 10 km apart)
Rufous bettong (*Aepyprymnus rufescens*)	Habitat survey	35 and 55 (1 site per PCT)	October 2019	2 x habitat assessments
	Camera traps			12 x trap nights
Squirrel glider (*Petaurus norfolcensis*)	Habitat survey	35 and 418 (2 sites per PCT) 36 and 192 (1 site per PCT)	October 2019	6 x habitat assessments
	Spotlighting and stage watching			8 person-hours
	Camera traps	192 (1 site)		4 x trap nights
Reptiles				
Border thick- tailed gecko *(Uvidicolus sphyrurus)*	Habitat survey	192 (1) 418 (2 sites)	October 2019	3 x habitat assessments
	Spotlighting	192 (1 site) 418 (2 sites)	October 2019 February-March 2021	14 person hours
Dunmalls snake *(Furina dunmalli)*	Habitat survey	35 (2 sites)	October 2019	2 x habitat assessments
	Spotlighting	35 (2 sites)	February-March 2021	17 person hours
Pale-headed snake (*Hoplocephalus bitorquatus*)	Habitat survey	35 (1 site) 56 (2 sites)	October 2019	3 x habitat assessments
	Spotlighting	36, 56, 192, 244, 628 and 418	February-March 2021	82 person-hours
Zigzag velvet gecko (*Amalosia rhombifer*)	Habitat survey	35 (2 sites) 418 (2 sites)	October 2019	4 x habitat assessments
Invertebrates				
Pale imperial hairstreak (*Jalmenus eubulus*)	Habitat survey	35 (3 sites) 418 (1 site)	October 2019	4 x habitat assessments
	Active search	35 (9 sites)	February-March 2021	95 person hours

Table D2 Location of fauna assessments

PCT Type and IBRA subregion	Latitude	Longitude	Survey start date	Habitat assessment	Morning chorus	Spotlighting and call playback	Ultrasonic recorder	Camera traps
147_BP1_High	-28.987	150.4216	23/10/2019	x	3 x 20 min surveys	3 nights	5 nights	N/A
192_BP5_High	-28.8438	150.2886	23/10/2019	x	3 x 20 min surveys	1 night	N/A	7 nights
192_CB_Low	-28.6736	150.4489	3/10/2018	x	N/A	N/A	N/A	N/A
192_CB_Med	-28.6712	150.451	26/10/2019	x	N/A	2 nights	N/A	14 nights
244_CB_Med	-28.7291	150.4192	27/10/2019	x	3 x 20 min surveys	3 nights	N/A	12 nights
244_NB_High	-28.7938	150.4117	2/10/2018, 28/10/2019	x	3 x 20 min surveys	5 nights	4 nights	12 nights
244_NB_Med	-28.7412	150.4166	27/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
247_CB_Med	-28.7357	150.4199	26/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
35_BP11_High	-28.8271	150.5652	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
35_BP2_Low	-29.0151	150.373	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
35_BP25_High	-28.8652	150.5328	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	14 nights
35_BP26_High	-28.8242	150.3016	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
35_BP7_High	-28.8446	150.4071	23/10/2019	x	3 x 20 min surveys	3 nights	5 nights	36
35_BP9_High	-28.7915	150.5603	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	14 nights
35_NB_High	-28.8282	150.4058	28/10/2019	x	3 x 20 min surveys	3 nights	7 nights	14 nights
35_NB_Low	-28.9084	150.3949	2/10/2018	x	N/A	N/A	N/A	N/A
35_NO_High	-28.8417	150.4067	5/10/2018	x	N/A	N/A	N/A	N/A
36_CB_High	-28.6662	150.4526	5/10/2018, 26/10/2019	x	3 x 20 min surveys	6 nights	4 nights	31 nights
36_NO_High	-28.8485	150.404	4/10/2018	x	N/A	2 nights	4 nights	N/A
418_BP2_High	-29.0155	150.3714	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
418_BP9_High	-28.7957	150.5625	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	10 nights
52_CB_Med	-28.6788	150.4393	5/10/2018, 26/10/2019	x	3 x 20 min surveys	4 nights	N/A	N/A
52_CB_Med	-28.6832	150.4243	26/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A

PCT Type and IBRA subregion	Latitude	Longitude	Survey start date	Habitat assessment	Morning chorus	Spotlighting and call playback	Ultrasonic recorder	Camera traps
53_NB_Med	-28.7747	150.4097	28/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
55_NB_High	-28.7725	150.4111	28/10/2019	x	3 x 20 min surveys	3 nights	N/A	14 nights
56_BP7_High	-28.842	150.4095	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
56_BP8_Med	-28.793	150.4012	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
56_NB_High	-28.7614	150.4123	27/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
56_NB_High	-28.7816	150.4091	27/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
56_NB_Med	-28.9282	150.3973	23/10/2019	x	3 x 20 min surveys	3 nights	4 nights (Oct 2018)	4 nights (Oct 2018)
56_NO_Med	-28.8697	150.4023	4/10/2018	x	N/A	2 nights	4 nights (Oct 2018)	5 nights
628_CB_Med	-28.6949	150.4132	27/10/2019	x	3 x 20 min surveys	3 nights	4 nights (Oct 2018)	N/A
98_BP13_High	-28.7487	150.2648	23/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A
98_NB_High	-28.8169	150.407	28/10/2019	x	3 x 20 min surveys	3 nights	N/A	N/A

Table D3 Ultrasonic bat call detectors

PCT	Detector unit	Location	Number of nights	Habitat notes
244_NB_High	SM1	-28.793363, 150.411567	4	*Eucalyptus populnea* woodland on alluvial clay-loam soils with a shrub layer of *Geijera parviflora* and *Eremophila mitchellii*. *Harrisia* sp. occurred in the ground layer. This site contained both small and large tree hollows, fallen logs and course litter. Occasional large trees remained (10%); however the site was dominated by trees of <15 cm diameter at breast height (DBH) (80 per cent).
36_CB_High	SM2	-28.666403, 150.452838	4	Tall *Eucalyptus camaldulensis* riparian forest along the Macintyre River. The site contained an abundance of old-growth *Eucalyptus camaldulensis* trees, each with numerous large hollows. The shrub layer was dominated by the exotic species *Vachellia farnesiana* and *Abutilon* sp; both of which provided dense cover and habitat for birds and mammals. Fallen logs, stags and ground litter occurred within the site.
628_CB_High	SM3	-28.694566, 150.414270	4	*Eucalyptus populnea* and *Eucalyptus camaldulensis* grassy woodland on floodplain clay-loam soil. The site was heavily impacted by cattle and had a bare shrub layer. The remnant trees, though scattered, all contained both large and small tree hollows, and fallen logs and stags were common. Ground litter and grass also occurred.
36_NO_High	SM4	-28.868073, 150.401201	4	Tall *Eucalyptus camaldulensis* fringing woodland along Mobbindry Creek. The site contained old-growth *Eucalyptus camaldulensis* trees, with an abundance of large tree hollows and stags. The understorey was disturbed and contained an open shrub layer and a ground layer of both native and exotic grass species. Large fallen logs and fine and course litter occurred within the riparian zone and small stones and soil cracks occurred within the dry creek bed.
56_NO_Med	SM5	-28.844672, 150.399298	5	*Acacia harpophylla*, *Casuarina cristata* and *Eucalyptus populnea* woodland on alluvial. *Eremophila mitchellii* occurred in the shrub layer. The site contained occasional tree hollows and fallen timber, and soil cracks. Historic clearing may have occurred in the site as the majority of trees (95 per cent) had a DBH of <15 cm.
35_NB_High	N/A	-28.8282, 150.4058	7	*Geijera parviflora, Eremophila mitchellii* with apparent historical clearing due to lack of hollow trees and ground timber. Areas with bare ground were abundant with ground layer vegetation consisting of *Ancistrachne uncinulata, Enteropogon acicularis and Rhagodia spinescens*.
35_NO_High	N/A	-28.8446, 150.4071	5	*Acacia harpophylla, Geijera parviflora, Eremophila mitchellii* with apparent historical clearing due to lack of hollow trees and ground timber. Areas with bare ground were abundant with ground layer vegetation consisting of *Ancistrachne uncinulata, Enteropogon acicularis and Rhagodia spinescens*.
147_NB_High	NA	-28.987, 150.4216	5	*Eucalyptus melanophloia* woodland with *Geijera parviflora, Croton phebalioides* and *Carissa ovata* shrub layer. Historical clearing and severe grazing evident. Few trees with hollows 1-5 cm at a height of 4 m and 10-20 cm hollows at 5 m.
244_NB_High	NA	-28.7911, 150.412122	5	*Eucalyptus populnea* woodland on alluvial clay-loam soils with a shrub layer of *Geijera parviflora* and *Eremophila mitchellii*. *Harrisia* sp. occurred in the ground layer. This site contained both small and large tree hollows, fallen logs and course litter. Occasional large trees remained (10%); however the site was dominated by trees of <15 cm diameter at breast height (DBH) (80 per cent).

PCT	Detector unit	Location	Number of nights	Habitat notes
418_High	NA	-28.7936, 150.563320	4	Tall woodland to open forest dominated by White Cypress Pine (*Callitris glaucophylla*) and Silver-leaved Ironbark (*Eucalyptus melanophloia*) interspersed with Poplar box (*Eucalyptus populnea)* . Tall shrubs include Wilga (*Geijera parviflora*). Hollows present within the Poplar box and multiple fallen logs.
Total			**47**	

Table D4 Camera trap locations

PCT	Location	Number of camera traps	Number of nights	Habitat notes
244_NB_High	-28.793824, 150.411777	3	2	*Eucalyptus populnea* woodland on alluvial clay-loam soils with a shrub layer of *Geijera parviflora* and *Eremophila mitchellii*. *Harrisia* sp. occurred in the ground layer. This site contained both small and large tree hollows, fallen logs and course litter. Occasional large trees remained (10 per cent); however the site was dominated by trees of <15 cm diameter at breast height (DBH) (80 per cent).
Non-remnant vegetation (dam) adjacent to 244 High	-28.790266, 150.418004	3	2	Non-remnant, freshwater dam. The edges of the dam were heavily cattle tramped; however aquatic macrophytes and fallen timber surrounded the water's edge which provided cover for small birds and mammals.
36_NO_Med	-28.867995, 150.401294	3	4	Tall *Eucalyptus camaldulensis* fringing woodland along Mobbindry Creek. The site contained old-growth *Eucalyptus camaldulensis* trees, with an abundance of large tree hollows and stags. The understorey was disturbed and contained an open shrub layer and a ground layer of both native and exotic grass species. Large fallen logs and fine and course litter occurred within the riparian zone and small stones and soil cracks occurred within the dry creek bed.
36_CB_High	-28.665560, 150.454566	5	3	Tall *Eucalyptus camaldulensis* riparian forest along the Macintyre River. The site contained an abundance of old-growth *Eucalyptus camaldulensis* trees, each with numerous large hollows. The shrub layer was dominated by the exotic species *Vachellia farnesiana* and *Abutilon* sp; both of which provided dense cover and habitat for birds and mammals. Fallen logs, stags and ground litter occurred within the site.
36_CB_High	-28.6662, 150.4526	2	7	Riparian area dominated by *Eucalyptus camaldulensis* with an abundance of flowers and hollows 1-10 cm in size and occasional to common occurrence of hollows 10-20 cm+ at 10 m in height. Fallen logs and decorticating bark were also common. Other trees include *Melaleuca bracteate* and a shrub layer included *Acacia floribunda* and *Vachellia farnesiana*. Site located along the Macintyre River. Camera traps located above 1.5 m facing tree trunk aiming to target squirrel glider and pygmy possum
192_CB_Med	-28.6712, 150.4510	2	7	Grassy woodland containing scattered trees including *Eucalyptus camaldulensis* and *Eucalyptus melanophloia* containing occasional hollows 1-20 cm in size at heights of 5-8 m. Shrubs include *Acacia salisina* and *Vechellia farnesiana* with a ground layer of exotic grass species, *Rhagodia spinescens* and *Harrisia* sp. Camera traps located above 1.5 m facing tree trunk aiming to target squirrel glider and pygmy possum

PCT	Location	Number of camera traps	Number of nights	Habitat notes
55_NB_High	-28.7725, 150.4111	2	7	Site with a high abundance of bare ground. Hollows rare for all size categories occurring at above 5 m. Ground cover of *Harrisia* sp. and *Vachellia farnesiana*. Camera traps located below 50 cm targeting Rufous bettong.
35_NB_High	-28.8282, 150.4058	2	7	Trees comprised primarily of *Geijera parviflora* and *Eremophila mitchellii* with ground vegetation consisting of *Enteropogon acicularis* and *Rhagodia spinescens*. The site had undergone clearing 10+ years previously. Tree hollows were scarce, and the site comprised of bare open ground. Camera traps located below 50 cm targeting Rufous bettong
35_NO_High	-28.8446, 150.4071	1	5	Mature trees consisted of *Eucalyptus populnea, Acacia harpophylla* and *Geijera parviflora*. There was a moderate abundance of hollows from 1-20 cm with hollows larger than 20 cm being scarce. There was a moderate abundance of fallen logs and tussock grasses providing microhabitat for small terrestrial fauna. Much of the site was bare ground with evidence of previous clearing and grazing.
192_BP5_Med	-28.8438, 150.2886	1	7	Grassy woodland with tree species including *Eucalyptus populnea, Eucalyptus melanophloia*, *Geijera parviflora* and *Acacia excelsa*. The predominant small tree/large shrubs were *Apophyllum anomalum* and *Santalum lanceolatum.* There was a moderate to high abundance of hollows 1-20 cm in size and high abundance of mistletoe.
35_BP9_High	-28.7915, 150.5603	2	7	Open brigalow – belah woodland consisting of *Acacia harpophylla, Casuarina cristata, Geijera parviflora* and *Santalum lanceolatum* as the dominant tree species. The dominant shrub was *Carissa ovata* and ground cover of *Ancistrachne uncinate*. No tree hollows were present, decorticating bark was in moderate abundance and fallen logs were rare. Camera traps located at the site were placed above 1.5 m facing tree trunk aiming to target squirrel glider and pygmy possum.
418_BP9_High	-28.7957, 150.5625	2	5	Camera traps located above 1.5 m facing tree trunk aiming to target squirrel glider and pygmy possum
35_BP25_High	-28.8652, 150.5328	2	7	Open woodland with trees including *Geijera parviflora, Callitris glaucophylla, Capparis mitchellii, Santalum lanceolatum* and ground cover of *Ancistrachne uncinate, Cenchrus ciliaris,* and *Aristida* sp. There was a low severity of historic clearing although grazing had been moderately severe within the last year. Hollows, fallen logs and decorticating bark was rare. Camera traps located above 1.5 m facing tree trunk aiming to target squirrel glider and pygmy possum.
Total			**145**	

Table D5 Fauna species list

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and *Casuarina cristata* woodland on alluvial plains** **35,55**	***Corymbia tessellaris* +/- *E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Amphibians												
Crinia signifera	Clicking froglet							x				
Cyclorana alboguttata	Striped burrowing frog		x					x				x
Cyclorana cultripes	Knife-footed frog							x				
Cyclorana platycephala	Eastern water-holding frog							x				
Cyclorana verrucosa	Rough frog		x									x
Limnodynastes fletcheri	Barking frog		x									
Limnodynastes salmini	Salmon-striped frog		x									
Limnodynastes tasmaniensis	Spotted marsh frog		x					x				
Litoria brevipalmata	Green-thighed frog		x									
Litoria caerulea	Green tree frog	x	x								x	
Litoria latopalmata	Broad-palmed rocket frog		x									
Litoria nasuta	Striped rocket frog		x									
Litoria peronii	Emerald-spotted tree frog	x	x									
Litoria rubella	Desert tree frog		x									

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Notaden bennetti	Holy cross frog		x					x				
Platyplectrum ornatum	Ornate burrowing frog	x	x									
Uperoleia rugosa	Chubby toadlet		x									
Birds												
Acanthagenys rufogularis	Spiny-cheeked honeyeater	x	x	x							x	x
Acanthiza apicalis	Inland thornbill		x	x								
Acanthiza chrysorrhoa	Yellow-rumped thornbill		x	x							x	
Acanthiza nana	Yellow thornbill		x	x					x			
Acanthiza pusilla	Brown thornbill		x	x					x			
Acanthiza reguloides	Buff-rumped thornbill		x									
Acanthiza uropygialis	Chestnut-rumped thornbill		x									
Aegotheles cristatus	Owlet nightjar		x	x	x		x	X				
Alcedo azurea	Azure kingfisher	x										
Anas gracilis	Grey teal	x	x								x	
Anas superciliosa	Pacific black duck	x	x								x	
Anhinga novaehollandiae	Australasian darter	x									x	
Anthus novaeseelandiae	Australasian pipit					x	x					

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/- E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Aprosmictus erythropterus	Red-winged parrot	x	x	x		x		x			x	
Aquila audax	Wedge-tailed eagle	x	x	x			x				x	
Ardea intermedia	Intermediate egret	x									x	
Ardea modesta	Eastern great egret											
Artamus leucorynchus	White-breasted woodswallow	x	x	x							x	
Artamus superciliosus	White-browed Woodswallow										X	
Aythya australis	Hardhead		x								x	
Barnardius zonarius	Australian ringneck		x	x				x	x		x	
Bubulcus ibis	Cattle egret	x									x	
Cacatua galerita	Sulphur-crested cockatoo	x	x	x	x	x	x		x		x	
Cacatua sanguinea	Little corella	x	x	x							x	
Calyptorhynchus banksia	Red-tailed black cockatoo		x									
Calyptorhynchus lathami	Glossy black cockatoo			x								
Cacomantis pallidus	Pallid cuckoo		x								x	
Centropus phasianinus	Pheasant coucal	x										

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Chalcites basalis	Horsefield's bronze-cuckoo			x								
Chenonetta jubata	Australian wood duck	x	x	x				x			x	
Circus assimilis	Spotted harrier			x							x	
Columbia livia	Rock dove		x									
Colluricincla harmonica	Grey shrike-thrush	x	x									
Columbia livia *	Rock dove		x									
Coracina novaehollandiae	Black-faced cuckoo-shrike	x	x	x					x		x	
Corcorax melanorhamphos	White-winged chough	x	x	x							x	x
Corvus coronoides	Australian raven	x	x					x				
Corvus orru	Torresian crow	x	x	x	x		x				x	
Coturnix ypsilophora	Brown Quail										x	
Cracticus nigrogularis	Pied butcherbird	x	x	x	x	x	x		x		x	
Cracticus tibicen	Australian magpie	x	x	x	x		x	x	x		x	x
Cracticus torquatus	Grey butcherbird	x	x	x	x				x		x	
Dacelo novaeguineae	Laughing kookaburra	x	x	x	x						x	x
Daphoenositta chrysoptera	Varied sittella			x								

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris*** **+/-** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Dendrocygna eytoni	Plumed whistling duck		x									
Dicaeum hirundinaceum	Mistletoebird		x	x				x			x	
Dendrocygna eytoni	Plumed whistling-duck											x
Dromaius novaehollandiae	Emu		x	x			x				x	
Egretta novaehollandiae	White-faced heron	x										
Elseyornis melanops	Black-fronted dotterel		x								x	
Entomyzon cyanotis	Blue-faced honeyeater		x	x	x							x
Eolophus roseicapillus	Galah	x	x	x	x	x	x	x			x	x
Eopsaltria australis	Eastern yellow robin		x	x					x			
Erythrogonys cinctus	Red-kneed dotterel		x									
Eudynamys orientalis	Eastern koel		x									
Eurystomus orientalis	Dollarbird	x	x									
Falco berigora	Brown falcon										x	x
Falco cenchroides	Nankeen kestrel		x								x	x
Falco longipennis	Australian hobby	x										

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/- E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Falcunculus frontatus	Crested shrike-tit	x										
Gallinago hardwickii	Latham's snipe										x	
Geopelia humeralis	Bar-shouldered dove	x	x	x					x		x	
Geopelia striata	Peaceful dove	x	x	x								x
Gerygone albogularis	White-throated gerygone	x	x									
Gerygone fusca	Western gerygone	x	x	x				x				
Gerygone olivacea	White-throated gerygone	x										
Grallina cyanoleuca	Magpie-lark	x	x	x		x			x		x	x
Grantiella picta	Painted honeyeater		x									
Haliaeetus leucogaster	White-bellied sea-eagle	x										
Haliastur sphenurus	Whistling kite	x	x			x	x				x	
Himantopus himantopus	Black-winged stilt		x	x								
Hirundo neoxena	Welcome swallow	x	x		x						x	
Hydroprogne caspia	Caspian tern	x										
Lalage sueurii	White-winged triller		x					x			x	x

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Lichenostomus penicillatus	White-plumed honeyeater	x									x	
Lichenostomus virescens	Singing honeyeater		x	x					x		x	
Lichmera indistincta	Brown honeyeater	x		x								
Malacorhynchus membranaceus	Pink-eared duck	x									x	
Malurus cyaneus	Superb fairy-wren	x	x	x					x		x	
Malurus lamberti	Variegated fairy-wren	x	x	x							x	
Malurus leucopterus	White-winged fairy-wren		x			x						
Manorina flavigula	Yellow-throated miner		x	x		x					x	
Manorina melanocephala	Noisy miner	x	x	x	x	x	x	x				
Megalurus cruralis	Brown songlark						x					
Megalurus gramineus	Little grassbird		x									
Melithreptus albogularis	White-throated honeyeater	x										
Melopsittacus undulatus	Budgerigar										x	
Merops ornatus	Rainbow bee-eater			x								

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/- E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Mirafra javanica	Horsfield's Bushlark										x	
Microcarbo melanoleucos	Little pied cormorant	x										
Microeca fascinans	Jacky winter		x						x			
Milvus migrans	Black kite		x			x						x
Myiagra cyanoleuca	Satin flycatcher	x										
Myiagra inquieta	Restless flycatcher	x		x								
Myiagra rubecula	Leaden flycatcher		x	x							x	
Neochmia temporalis	Red-browed finch	x	x									
Ninox novaeseelandiae	Southern boobook	x	x					x			x	
Northiella haematogaster	Blue bonnet			x		x					x	
Nycticorax caledonicus	Nankeen night-heron	x										
Nymphicus hollandicus	Cockatiel	x	x	x		x	x	x			x	
Ocyphaps lophotes	Crested pigeon	x	x	x				x	x		x	x
Oreoica gutturalis	Crested bellbird			x								
Oriolus sagittatus	Olive-backed oriole		x	x					x			

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Pachycephala rufiventris	Rufous whistler	x	x	x				x	x			
Pardalotus striatus	Striated pardalote	x									x	
Pelecanus conspicillatus	Australian pelican		x	x							x	x
Petrochelidon ariel	Fairy martin	x				x						
Petrochelidon nigricans	Tree martin			x			x					
Petroica boodang	Scarlet robin								x			
Petroica goodenovii	Red-capped robin		x	x								
Phalacrocorax sulcirostris	Little black cormorant	x									x	
Phalacrocorax varius	Pied cormorant										x	
Philemon citreogularis	Little friarbird	x	x	x								
Philemon corniculatus	Noisy friarbird	x	x	x								x
Platea flavipes	Yellow-billed spoonbill			x								
Platalea regia	Royal spoonbill		x								x	
Platycercus adscitus	Pale-headed rosella	x	x	x		x						
Platycercus eximius	Eastern rosella	x										

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Plectorhyncha lanceolata	Striped honeyeater	x	x	x					x		x	
Podargus strigoides	Tawny frogmouth	x	x	x				x				
Pomatostomus temporalis	Grey-crowned babbler	x	x	x	x	x		x				x
Psephotus haematonotus	Red-rumped parrot		x	x		x		x				x
Ptilonorhynchus maculatus	Spotted bowerbird		x	x							x	
Rhipidura albiscapa	Grey fantail		x	x								x
Rhipidura leucophrys	Willie wagtail	x	x	x				x	x		x	
Scythrops novaehollandiae	Channel-billed cuckoo	x	x					x				
Smicrornis brevirostris	Weebill	x	x	x				x	x		x	
Strepera gaculina	Pied currawong		x	x					x			
Struthidea cinerea	Apostlebird	x	x	x	x							x
Sturnus tristis *	Common myna		x	x							x	x
Sturnus vulgaris *	Common starling										x	
Tachybaptus novaehollandiae	Australasian grebe		x								x	
Taeniopygia bichenovii	Double-barred finch		x	x							x	

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/- E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Taeniopygia guttata	Zebra finch			x								
Threskiornis molucca	Australian white ibis	x		x								x
Threskiornis spinicollis	Straw-necked ibis	x		x		x						
Todiramphus pyrrhopygius	Red-backed kingfisher				x							
Todiramphus sanctus	Sacred kingfisher	x	x	x								x
Trichoglossus haematodus	Rainbow lorikeet			x		x						x
Tyto javanica	Eastern barn owl								x			
Vanellus miles	Masked lapwing		x	x				x			x	
Vanellus tricolor	Banded lapwing			x								
Zosterops lateralis	Silvereye	x		x								
Mammals												
Austronomus australis	White-striped free-tailed bat	x	x			x						
Camelus dromedaries	Camel			x								
Canis lupus *	Dog	x										
Chalinolobus gouldii	Gould's wattled bat	x	x			x						
Chalinolobus picatus	Little pied bat	x	x			x						
Felis catus *	Cat	x	x	x				x	x		x	x

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Lepus europaeus *	Brown hare		x	x	x						x	
Macropus dorsalis	Black-striped Wallaby										x	
Macropus giganteus	Eastern grey kangaroo	x	x	x	x	x	x		x		x	x
Macropus robustus	Common Wallaroo										x	
Macropus rufogriseus	Red-necked wallaby			x							x	x
Macropus rufus	Red kangaroo						x				x	
Miniopterus schreibersii oceanensis	Eastern bent-wing bat	x	x			x						
Mormopterus lumsdenae	Northern free-tailed bat	x	x			x						
Mormopterus petersi	Inland free-tailed bat		x									
Mormopterus ridei	Ride's free-tailed bat	x	x			x						
Mus musculus	House Mouse		x								x	
Nyctophilus sp.	Nyctophilus species	x	x			x						
Nyctophilus geoffroyi	Lesser Long-eared Bat		x									
Nyctophilus gouldi	Gould's Long-eared Bat		x	x								

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/- E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Oryctolagus cuniculus *	Rabbit											x
Osphranter robustus erubescens	Euro		x	x							x	
Ozimops ridei	Ride's Free-tailed Bat			x								
Petaurus norfolcensis	Squirrel glider	x	x									
Phascolarctos cinereus	Koala	x										
Pteropus poliocephalus	Grey-headed flying fox	x	x									
Pteropus scapulatus	Little red flying fox											
Saccolaimus flaviventris	Yellow-bellied sheathtail-bat	x	x			x						
Scotorepens balstoni	Inland broad-nosed bat	x	x			x						
Scotorepens greyii	Little broad-nosed bat	x	x	x								
Sus scrofa *	Pig	x	x	x	x				x		x	
Tachyglossus aculeatus	Short-beaked echidna	x							x			
Trichosurus vulpecula	Common brushtail possum	x	x	x	x	x			x		x	

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Vespadelus regulus/V. vulturnus	Vesper bat species	x	x									
Vespadelus vulturnus	Little Forest Bat			x								
Vulpes vulpes *	Fox	x	x	x	x		x	x			x	
Wallabia bicolor	Swamp wallaby	x	x	x							x	
Capra hircus	Goat			X							x	
Reptiles												
Chelodina longicollis	Eastern long-necked turtle		x								x	
Diplodactylus tessellatus	Tesselated gecko		x								x	
Diplodactylus vittatus	Eastern stone gecko		x	x								
Egernia striolata	Tree-crevice skink		x	x								
Emydura maquarii	Macquarie turtle	x										
Furina diadema	Red-naped snake				x							
Gehyra dubia	Dubious dtella	x	x	x	x							
Heteronotia binoei	Bynoe's gecko	x	x	x	x		x					
Hoplocephalus bitorquatus	Pale-headed snake	x										
Intellagama lesueurii	Eastern water dragon	x										

Species name	Common name	Fauna habitat type/PCT										
		Eucalyptus camaldulensis **tall open forest/ woodland** **36**	***Eucalyptus populnea*** **woodland on alluvial plains** **27,56,98, 244,192**	***Eucalyptus populnea*** **and** ***Casuarina cristata*** **woodland on alluvial plains** **35,55**	***Corymbia tessellaris +/-*** ***E. coolabah*** **grassy woodland on floodplain** **628**	**Lignum swamp** **247**	**Qld bluegrass +/- Mitchell grass on cracking clay floodplains** **52**	**Shallow wetland in depression on floodplain** **53**	**Evergreen vine thicket on basalt soils** **147**	**Managed land**	**White cypress pine – Silver-leaved ironbark – Wilga shrub grass woodland** **418**	**Incidental**
Lerista punctatovittata	Eastern robust slider			x								
Lucasium steindachneri	Box-patterned gecko		x	x								
Morelia spilota	Carpet python	x									x	
Morethia boulengeri	Boulenger's snake-eyed skink		x									
Nebulifera robusta	Robust velvet gecko		x									
Pogona barbata	Eastern bearded dragon		x									
Pseudechis guttatus	Spotted black snake		x									
Pseudechis porphyriacus	Red-bellied black snake			x								
Varanus varius	Lace monitor	x									x	
Strophurus williamsi	Eastern spiny-tailed gecko		x	x								x
Suta suta	Curl snake		x									
Tiliqua rugosa	Shingleback lizard						x					
Vemicella annulate	Bandy-bandy		x									

Table note:

* non-native

Appendix E
Desktop search results

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

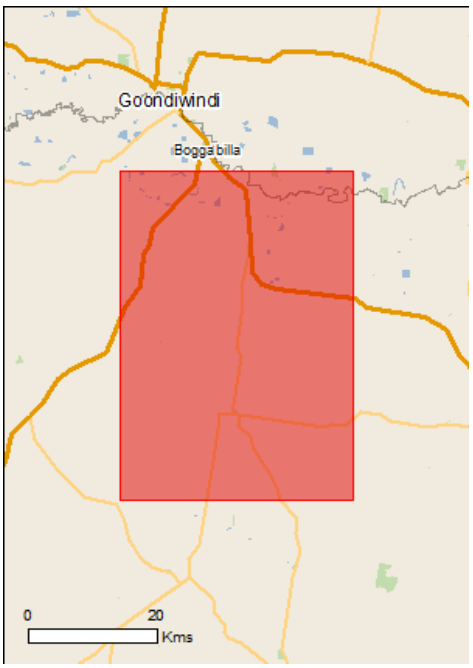
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 05/08/19 14:34:54

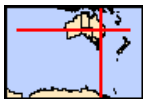
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	28
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	30
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	1000 - 1100km
Riverland	1000 - 1100km
The coorong, and lakes alexandrina and albert wetland	1200 - 1300km

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community likely to occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Androcalva procumbens [87153]	Vulnerable	Species or species habitat likely to occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Westringia parvifolia [4822]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Reptiles		
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat may occur within area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Telstra Corporation Limited

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Planchonella	NSW

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus africanus Climbing Asparagus, Climbing Asparagus Fern [66907]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Morella Watercourse / Boobera Lagoon / Pungbougal Lagoon	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-28.63379 150.23647,-28.63379 150.56056,-29.0356 150.56056,-29.0356 150.23647,-28.63379 150.23647

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

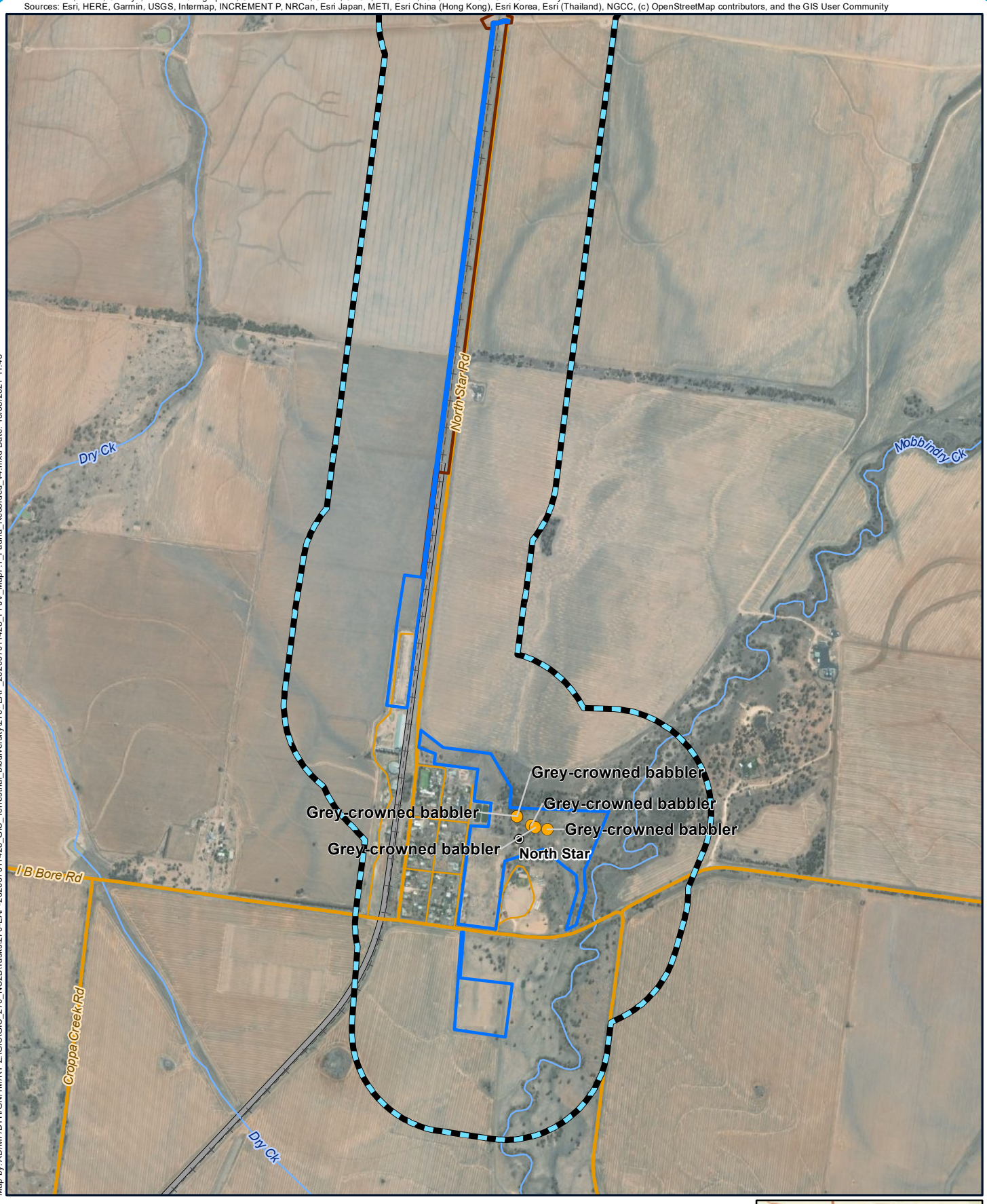
Please feel free to provide feedback via the Contact Us page.

© Commonwealth of Australia
Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

KingdomName	ClassName	FamilyName	ScientificName	CommonName	NSWStatus	CommStatus
Fauna	Aves	Acanthizidae	*Chthonicola sagittata*	Speckled Warbler	V,P	
Fauna	Aves	Accipitridae	*Circus assimilis*	Spotted Harrier	V,P	
Fauna	Aves	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V,P	C
Fauna	Aves	Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V,P	
Fauna	Aves	Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V,P,3	
Fauna	Aves	Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P	C,J,K
Fauna	Aves	Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork	E1,P	
Fauna	Aves	Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V,P	
Fauna	Aves	Meliphagidae	*Grantiella picta*	Painted Honeyeater	V,P	V
Fauna	Aves	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V,P	
Fauna	Aves	Petroicidae	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	V,P	
Fauna	Aves	Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V,P	
Fauna	Aves	Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	P	C,J,K
Fauna	Aves	Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	P	C
Fauna	Insecta	Lycaenidae	*Jalmenus eubulus*	Pale Imperial Hairstreak	E4A,2	
Fauna	Mammalia	Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V,P	
Fauna	Mammalia	Macropodidae	*Macropus dorsalis*	Black-striped Wallaby	E1,P	
Fauna	Mammalia	Phascolarctidae	*Phascolarctos cinereus*	Koala	V,P	V
Flora	Flora	Cyperaceae	*Cyperus conicus*		E1	
Flora	Flora	Poaceae	*Dichanthium setosum*	Bluegrass	V	V
Flora	Flora	Poaceae	*Homopholis belsonii*	Belson's Panic	E1	V

Appendix F
Fauna maps

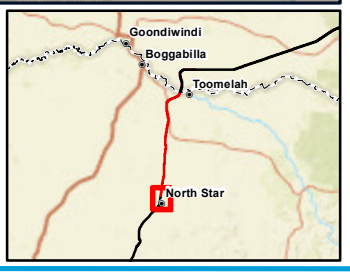
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Localities
- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Adjoining alignments
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

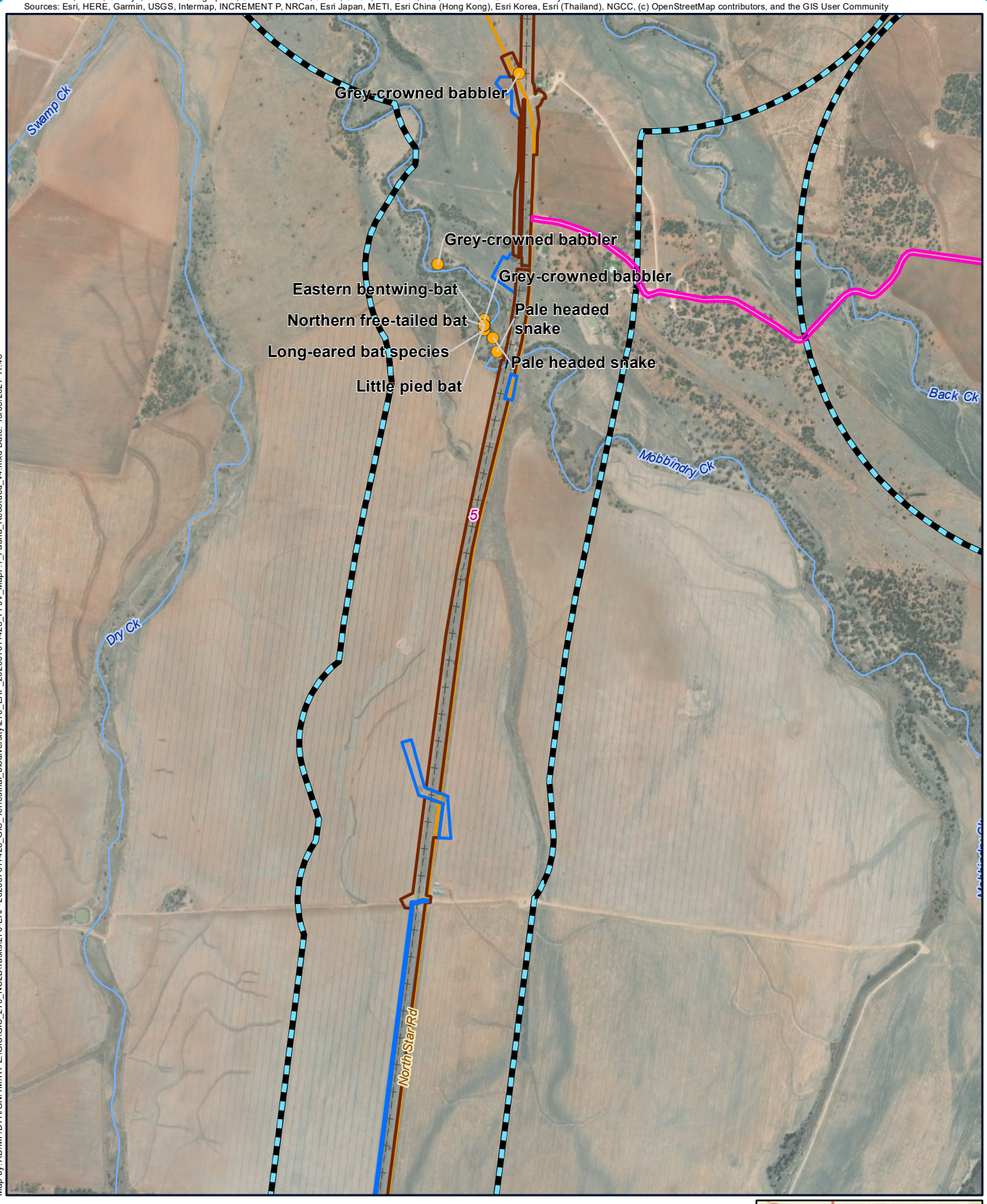
Date: 13/05/2021 Version: 3

Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1a:
Recorded observations of threatened fauna species

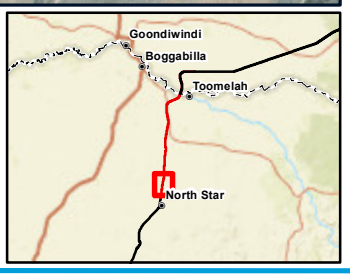
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

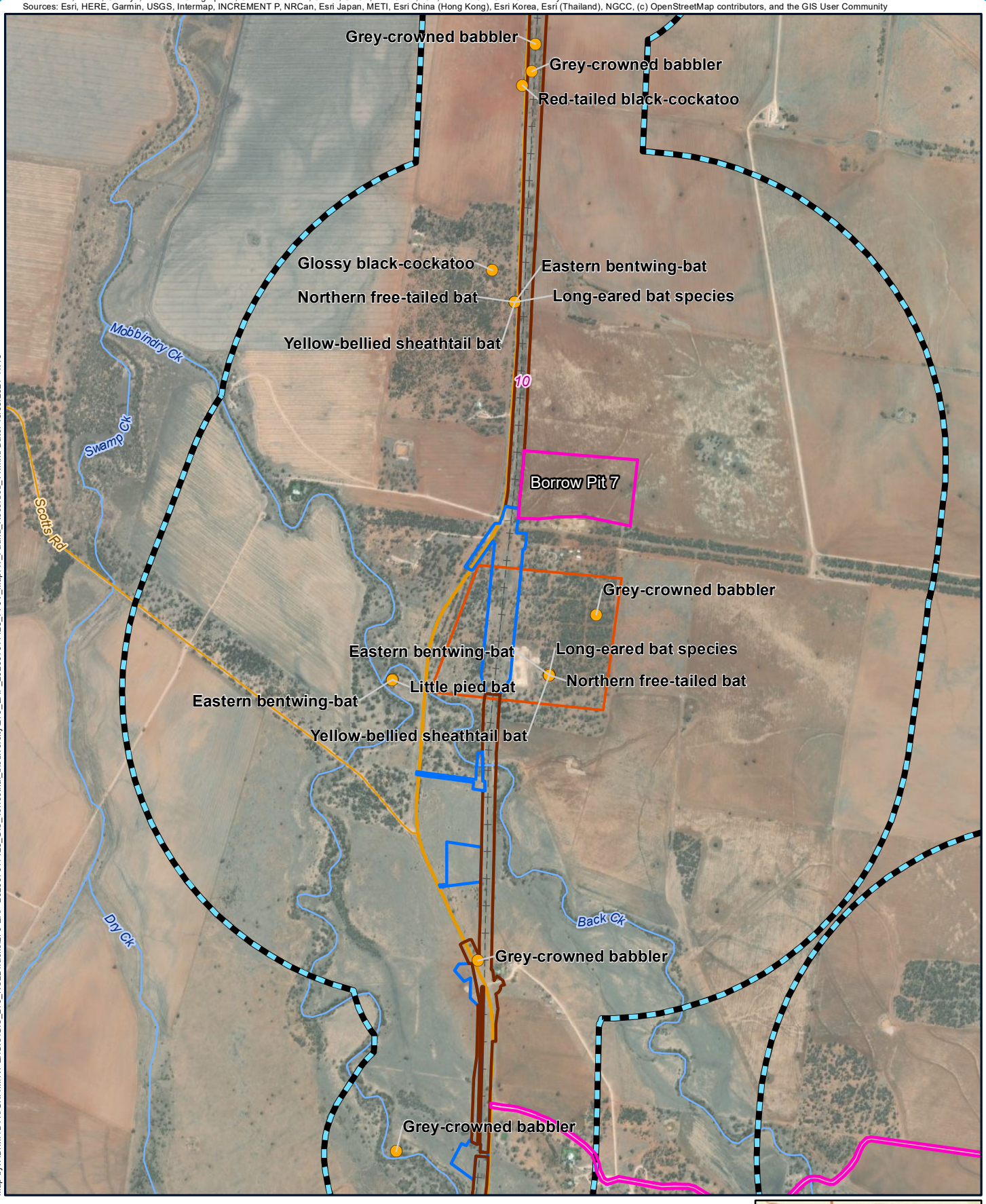
Date: 13/05/2021 Version: 3

Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1b:
Recorded observations of threatened fauna species

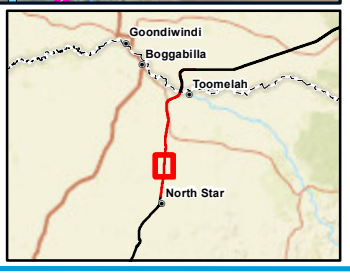
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Borrow pit removed to limit impacts on Brigalow



A4 scale: 1:25,000
0 100 200 300 400 500 m

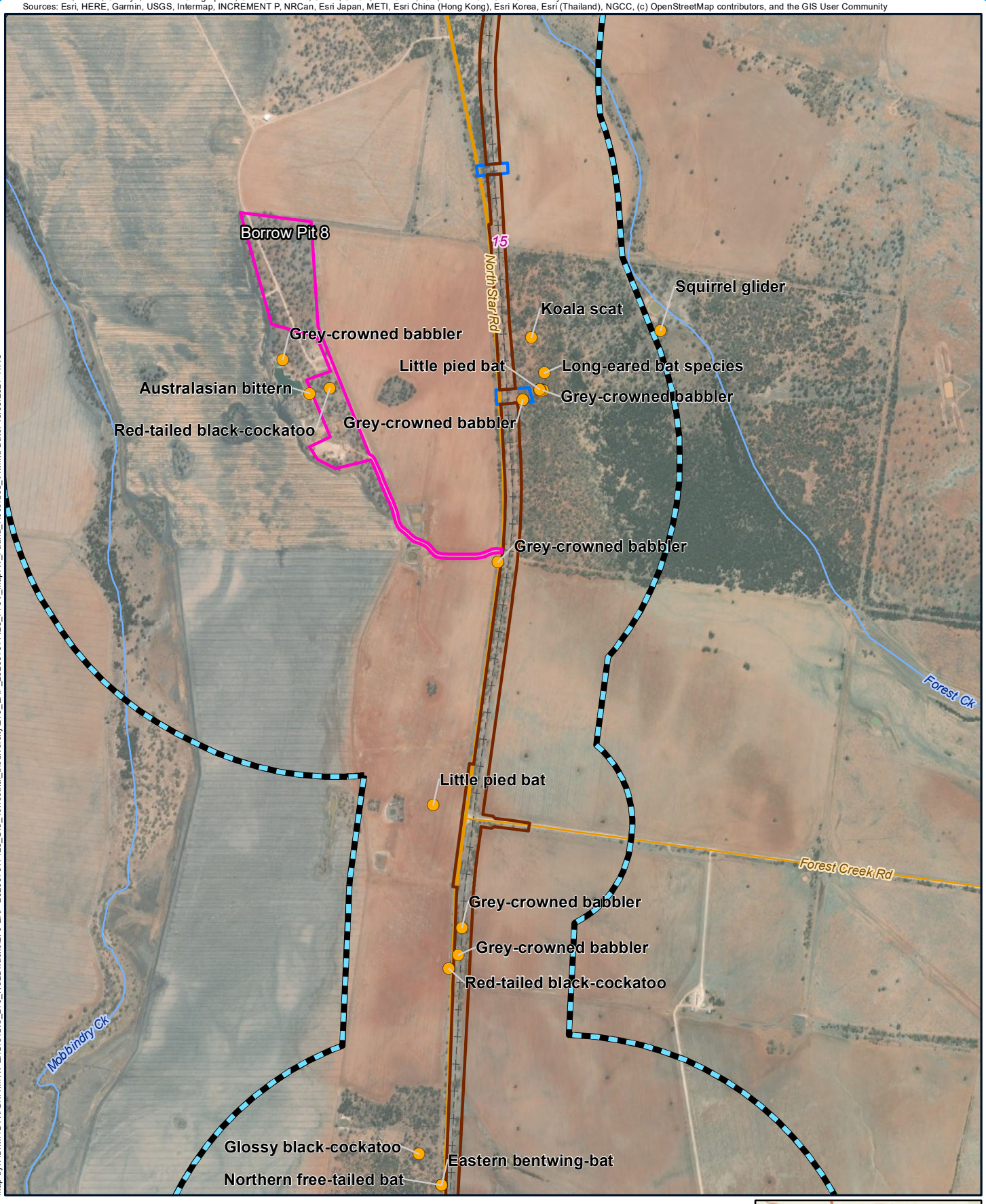
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1c:
Recorded observations of threatened fauna species

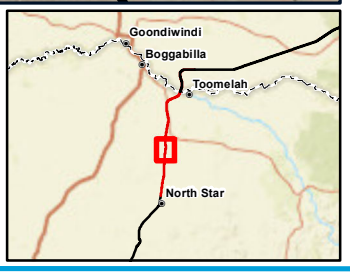
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

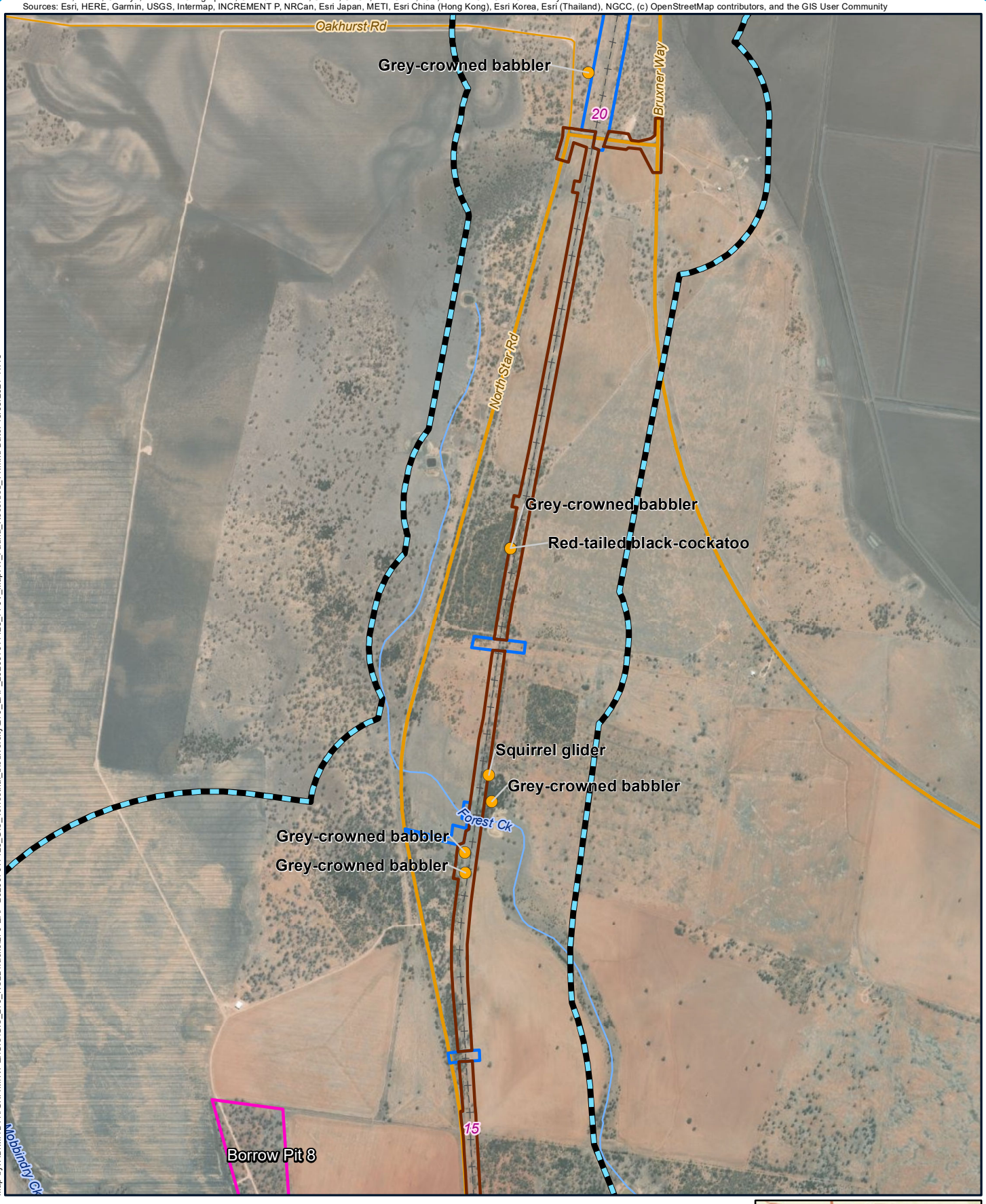
Date: 13/05/2021 Version: 3

Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1d:
Recorded observations of threatened fauna species

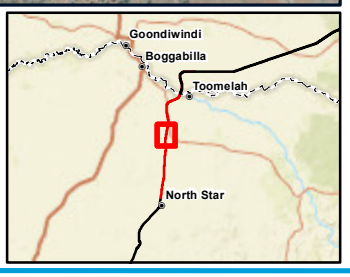
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:25,000
0 100 200 300 400 500 m

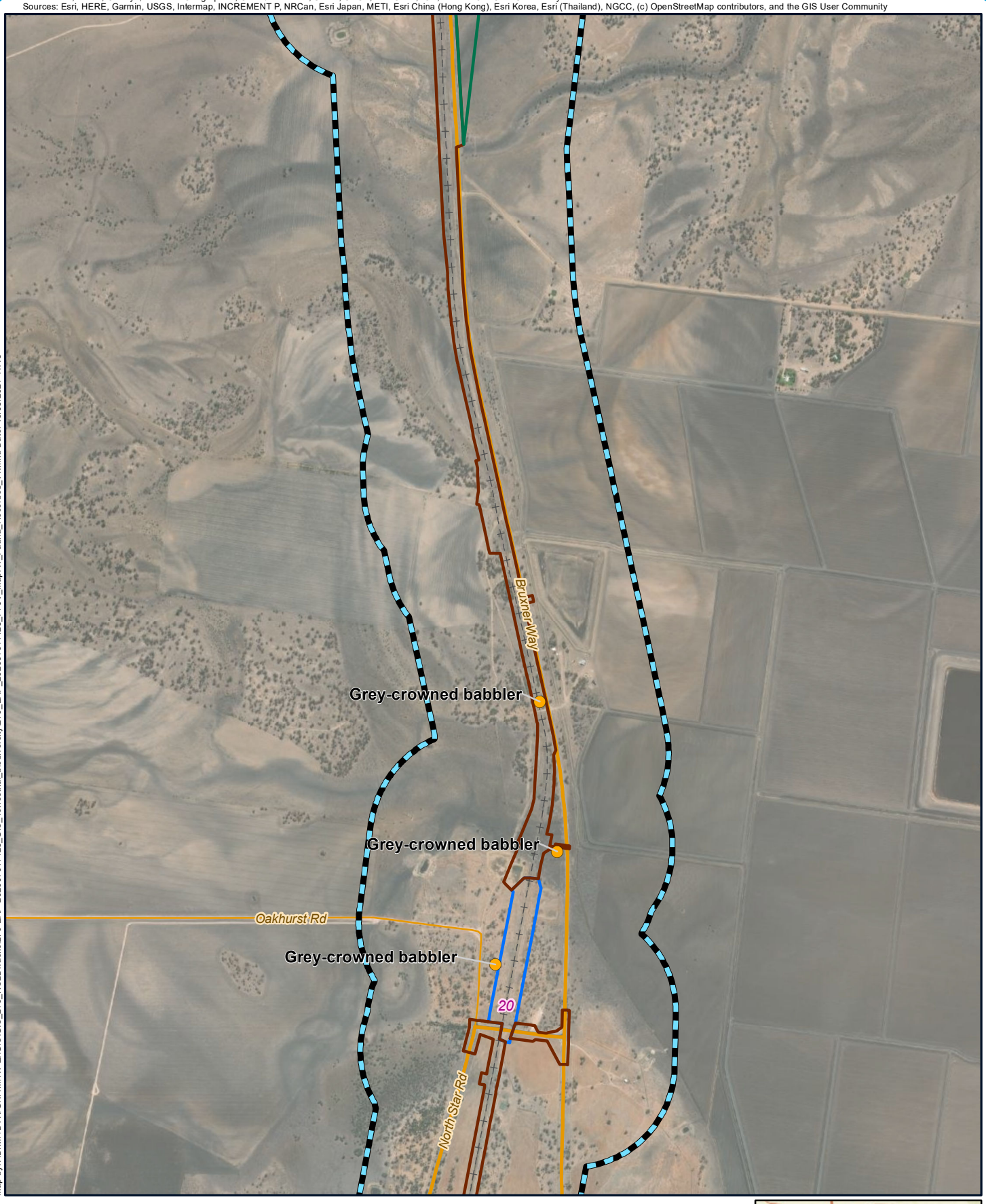
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1e:
Recorded observations of threatened fauna species

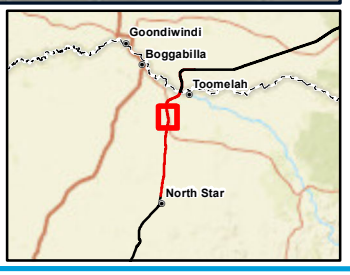
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- Minor roads
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

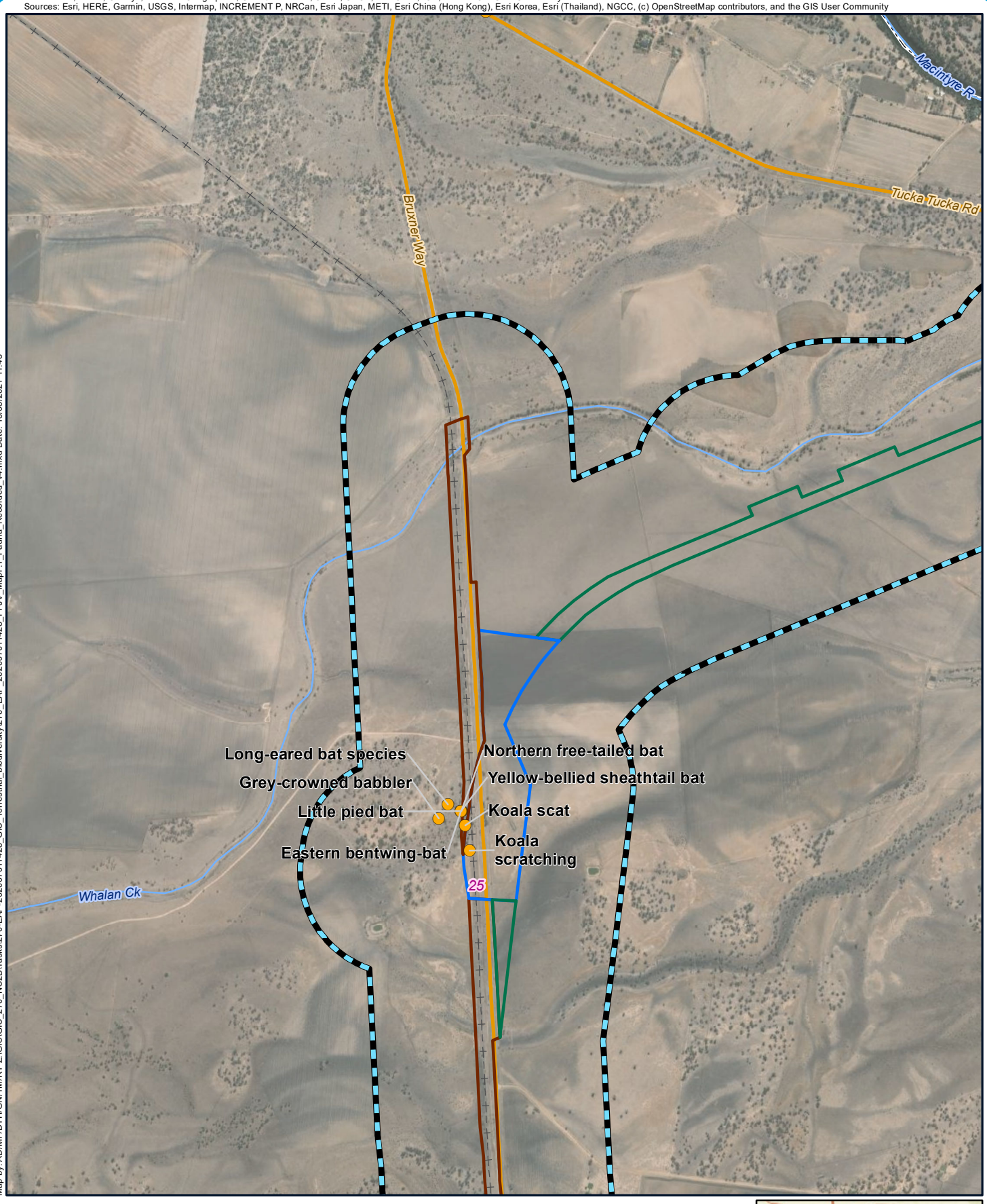
Date: 13/05/2021 Version: 3

Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1f:
Recorded observations of threatened fauna species

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Existing rail (non-operational)
- Major roads
- NSW/QLD border
- Watercourses
- Study area
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:25,000
0 100 200 300 400 500 m

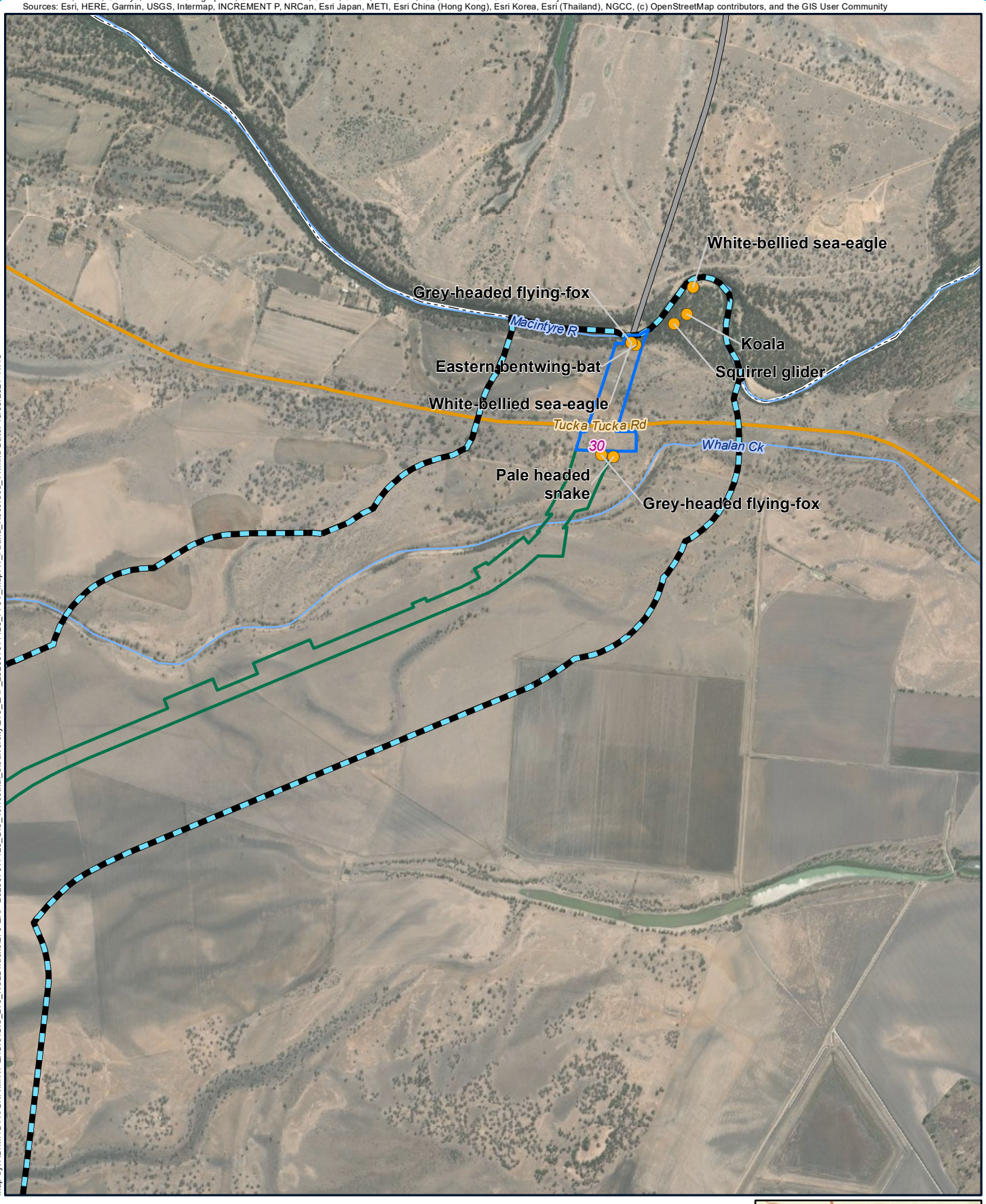
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1g:
Recorded observations of threatened fauna species

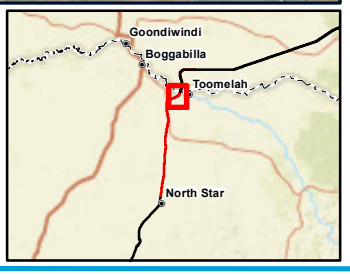
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Major roads
- Adjoining alignments
- NSW/QLD border
- Watercourses
- Study area
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:25,000
0 100 200 300 400 500 m

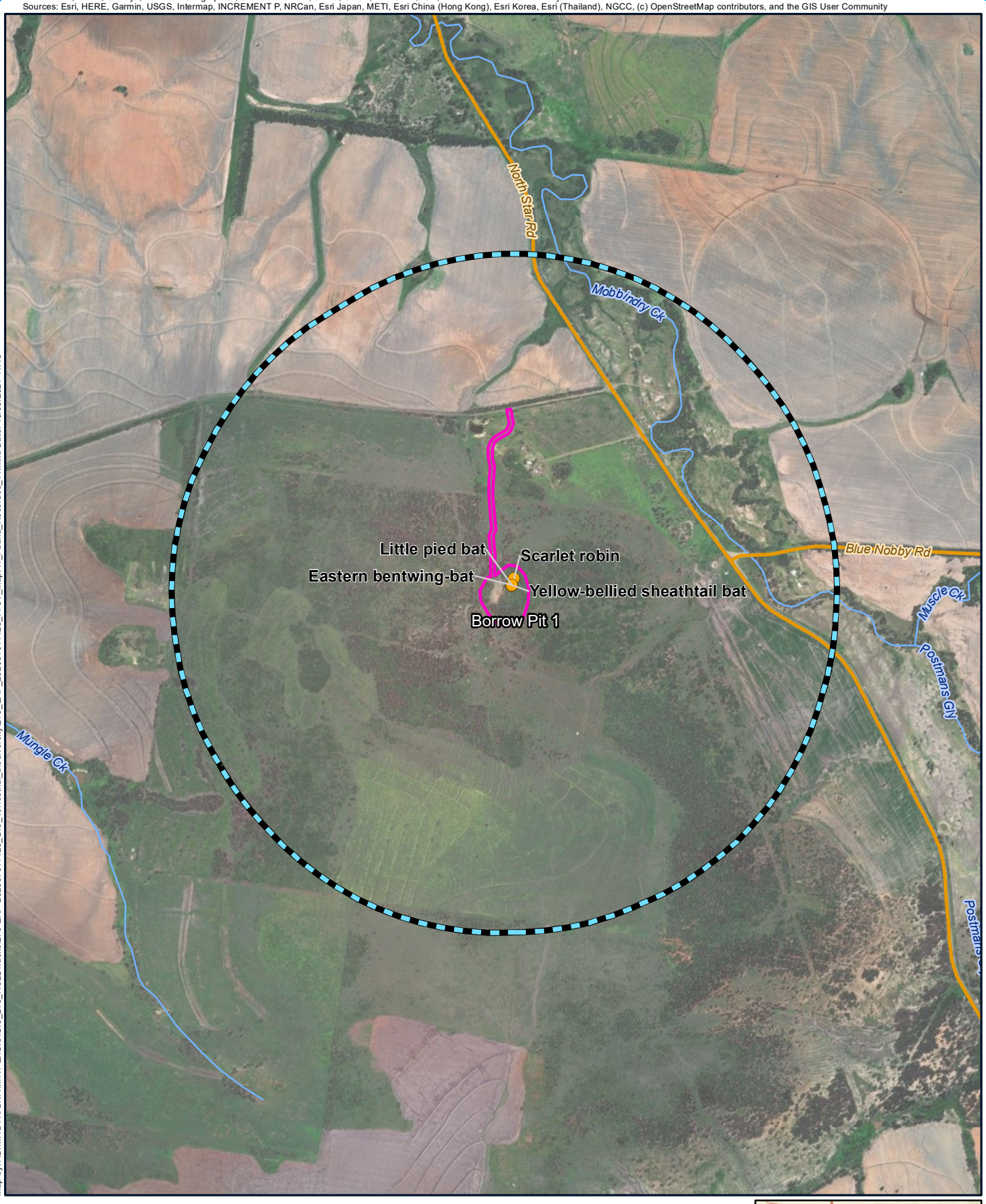
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1h:
Recorded observations of threatened fauna species

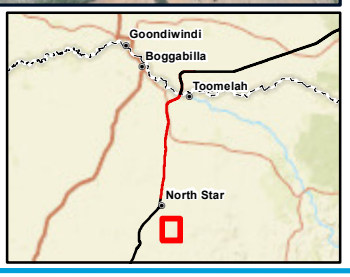
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:25,000
0 100 200 300 400 500 m

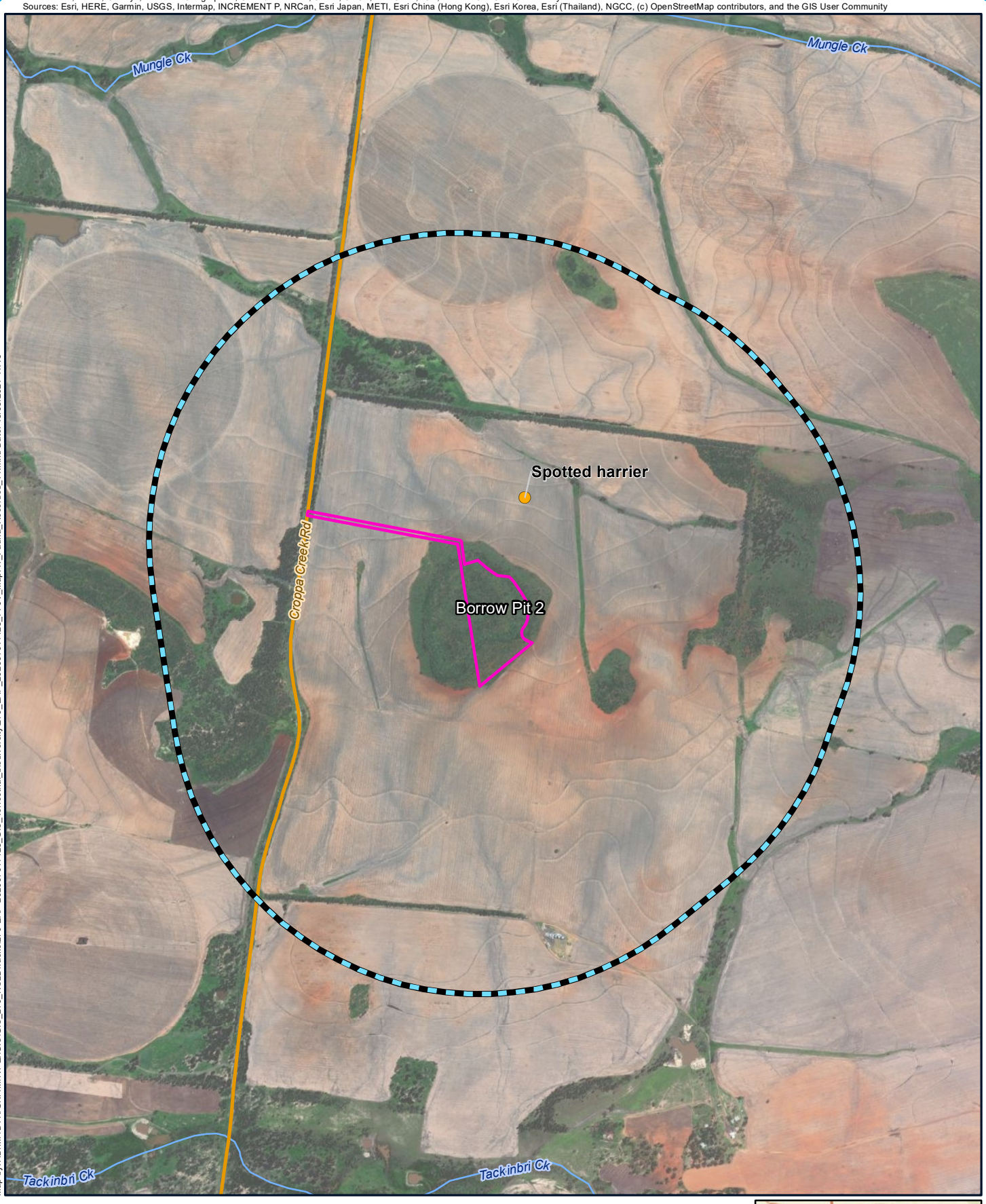
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1i:
Recorded observations of threatened fauna species

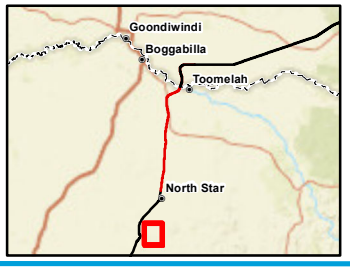
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:25,000
0 100 200 300 400 500 m

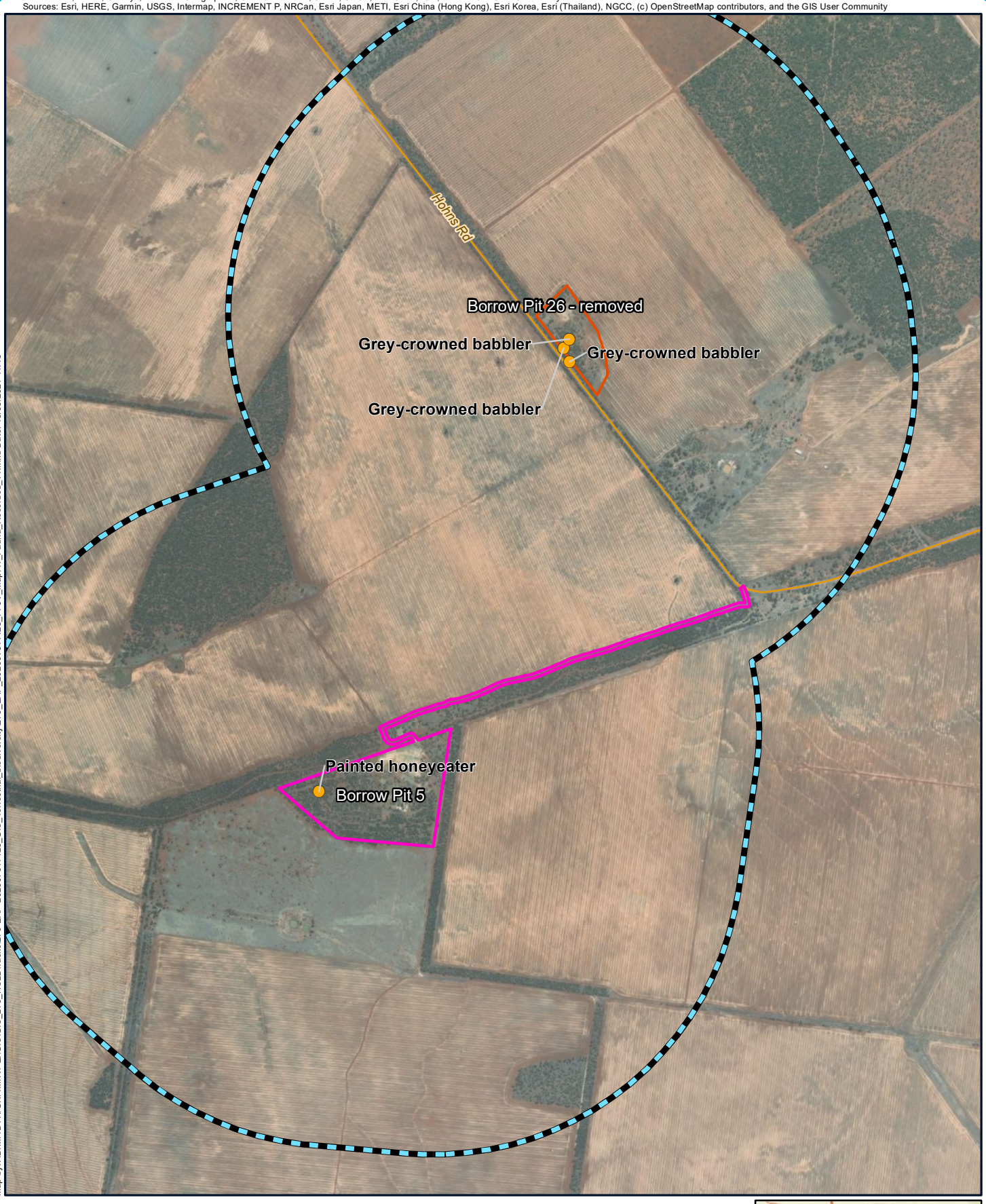
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1j:
Recorded observations of threatened fauna species

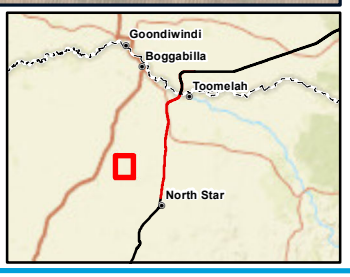
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701142 8_GIS_Terrestrial_biodiversity\270_EAP_20200701142 8_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Minor roads
- Study area
- Subject land (borrow pit)
- Borrow pit removed to limit impacts on Brigalow



A4 scale: 1:25,000
0 100 200 300 400 500 m

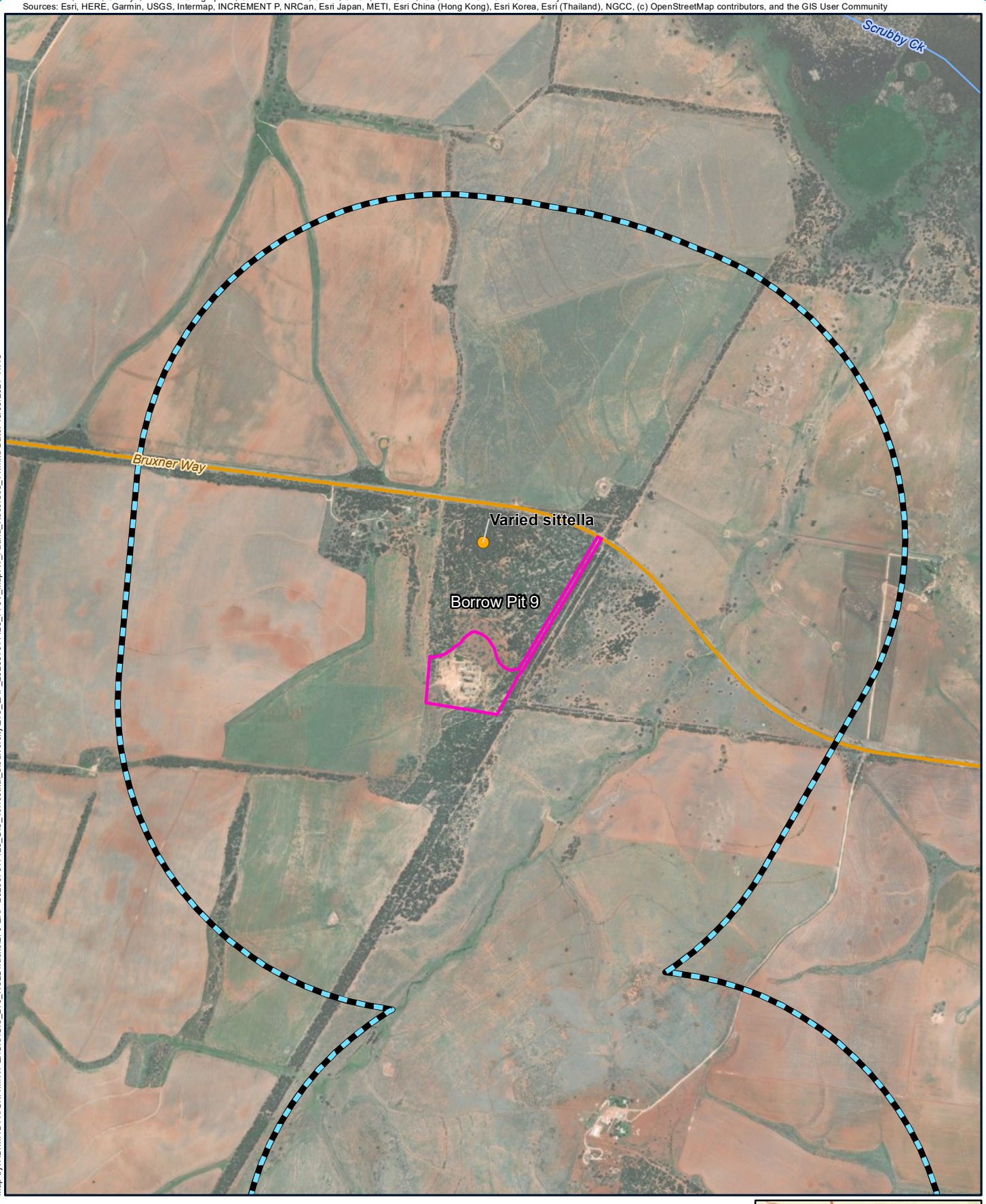
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1l:
Recorded observations of threatened fauna species

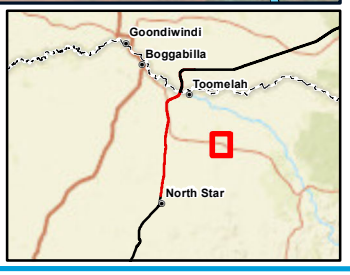
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

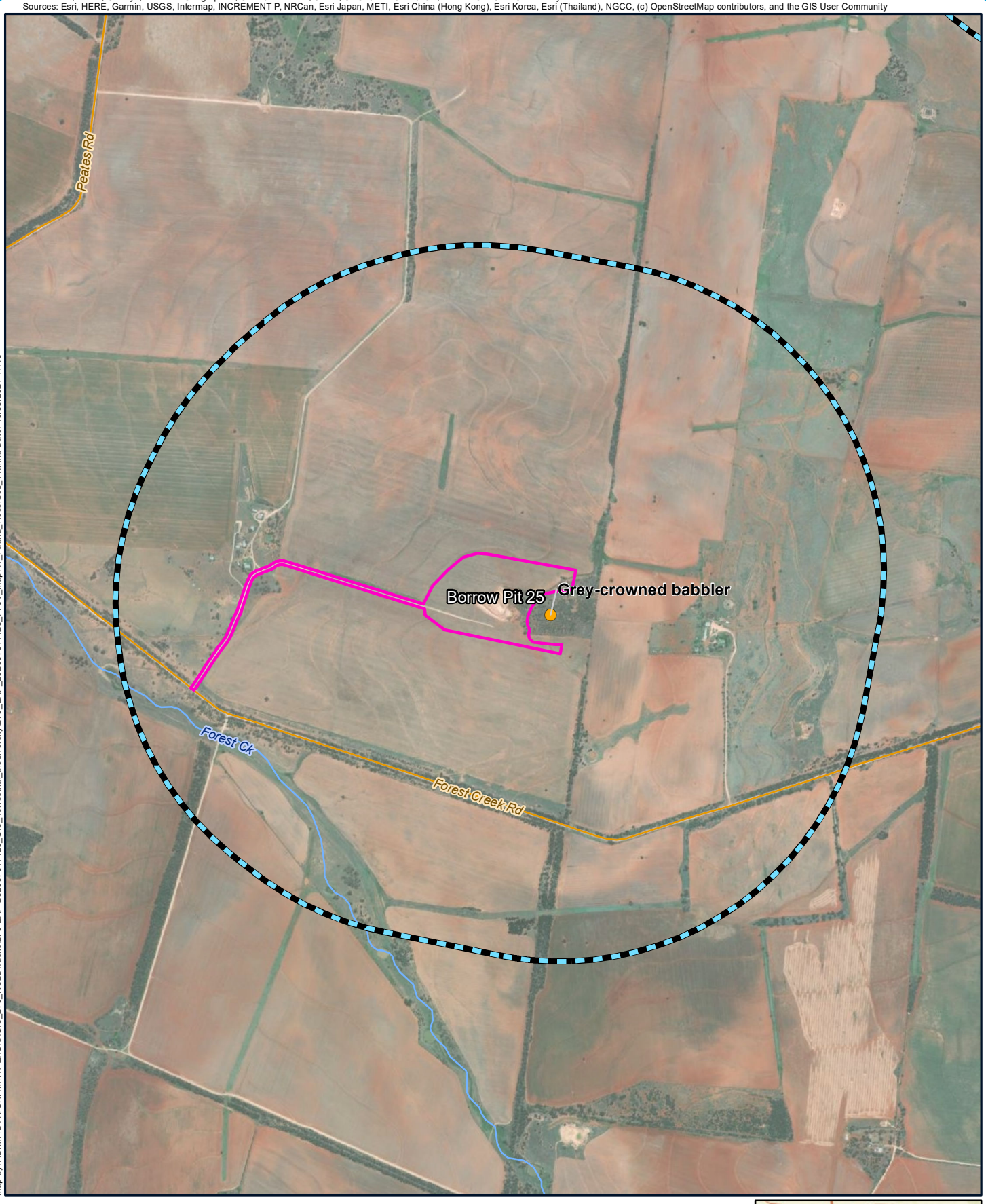
Date: 13/05/2021 Version: 3

Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1m:
Recorded observations of threatened fauna species

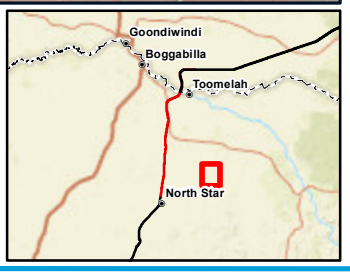
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: AD/MF/DTH/GN/TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.1_Fauna_Recorded_v4.mxd Date: 13/05/2021 11:48

Legend

- Fauna observations
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 3
Coordinate system: GDA 1994 MGA Zone 56

North Star to QLD/NSW Border

Map F.1n:
Recorded observations of threatened fauna species

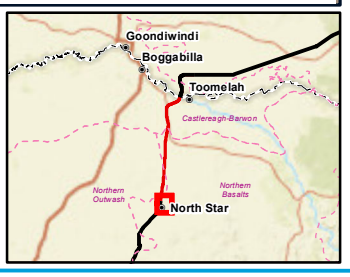
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:03

Legend

- Localities
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

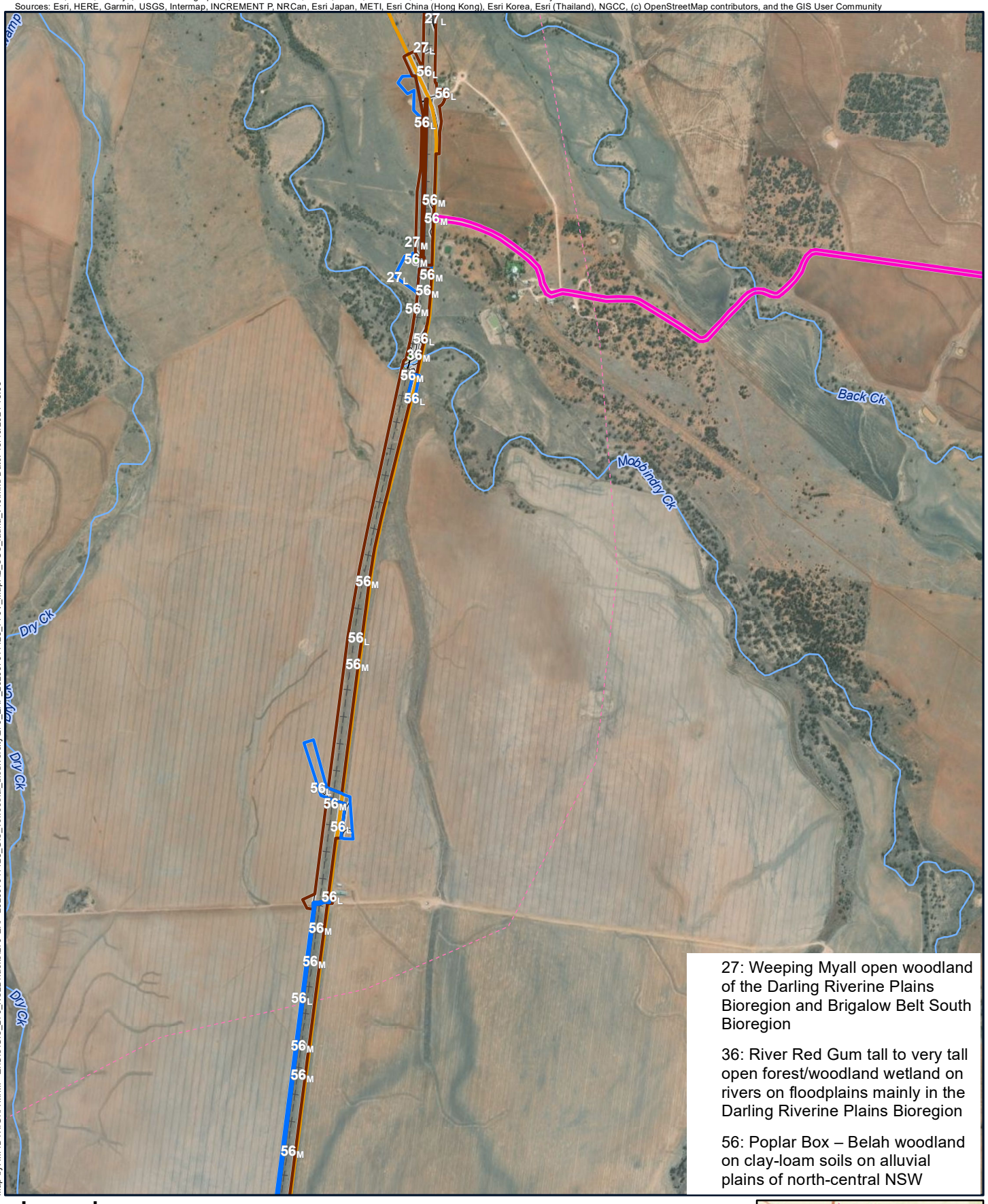
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2a: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



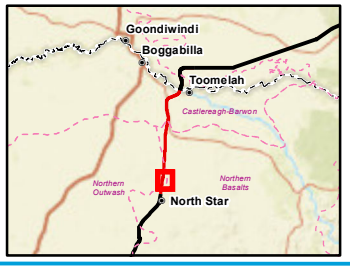
27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

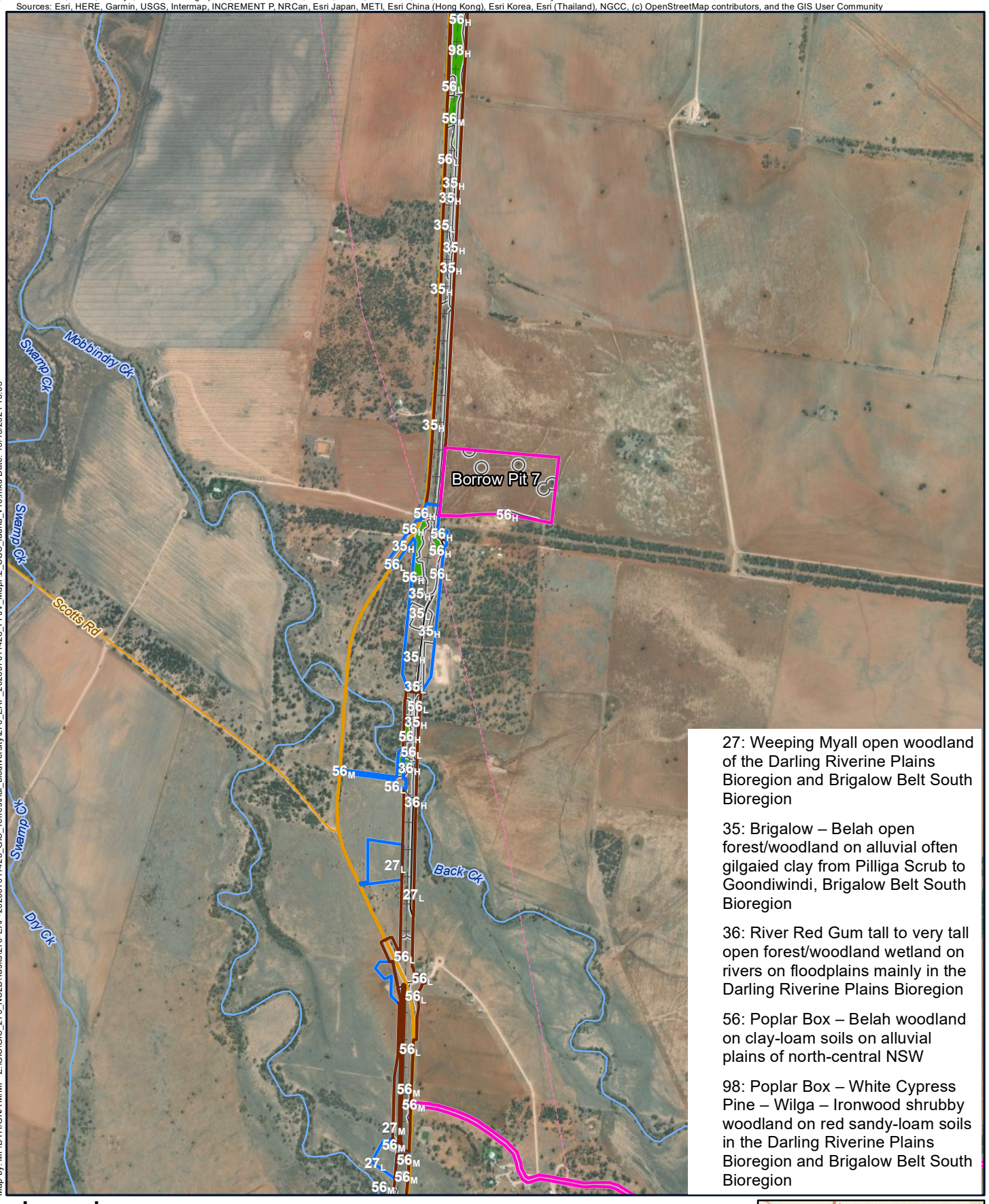
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2b: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:03

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:03

27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

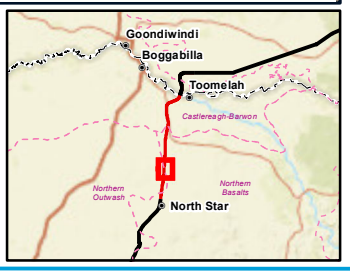
36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

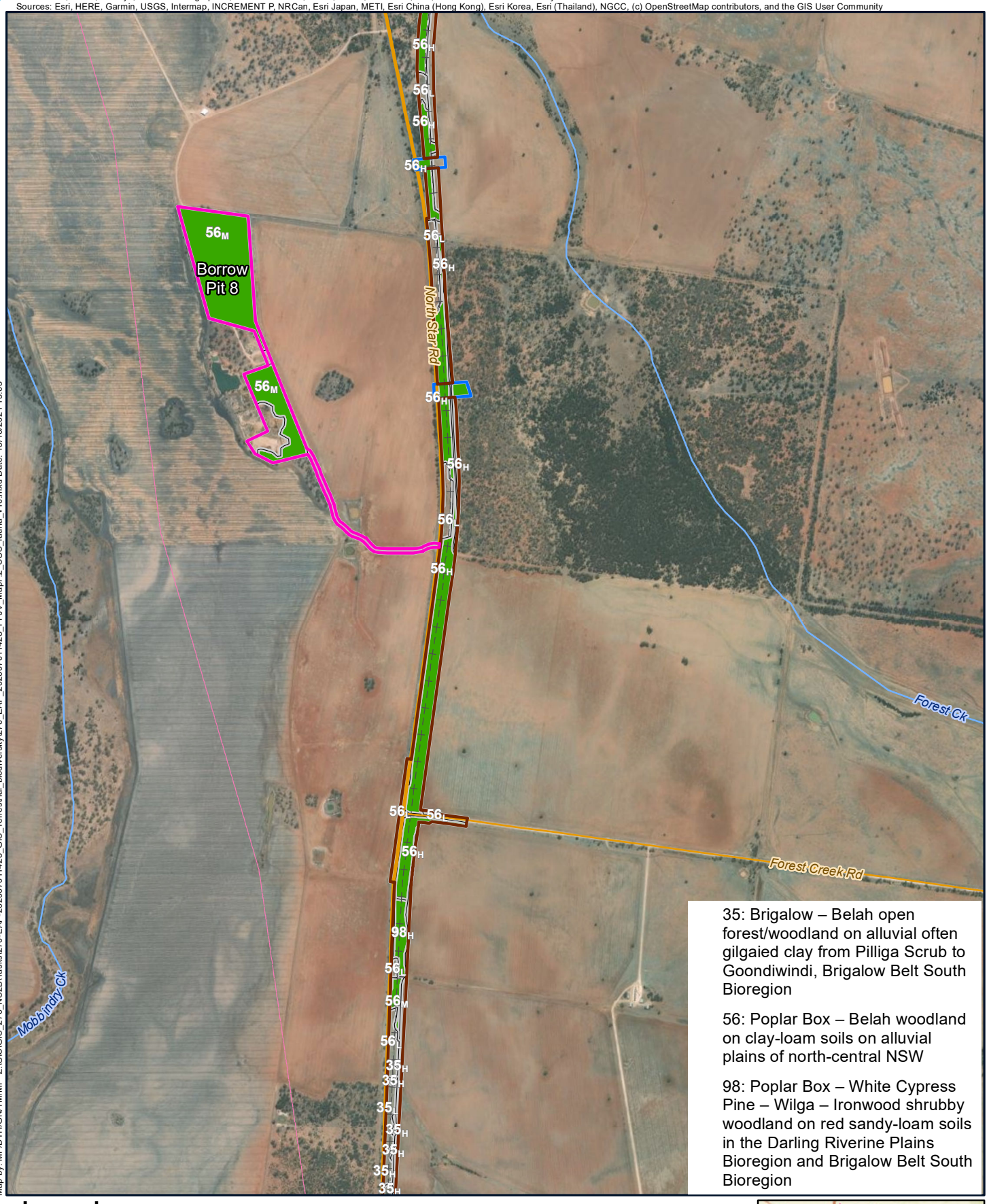
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2c: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



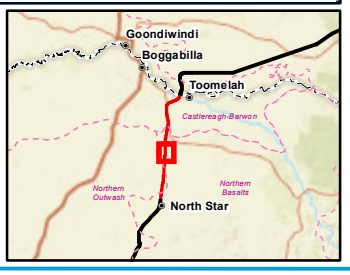
35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

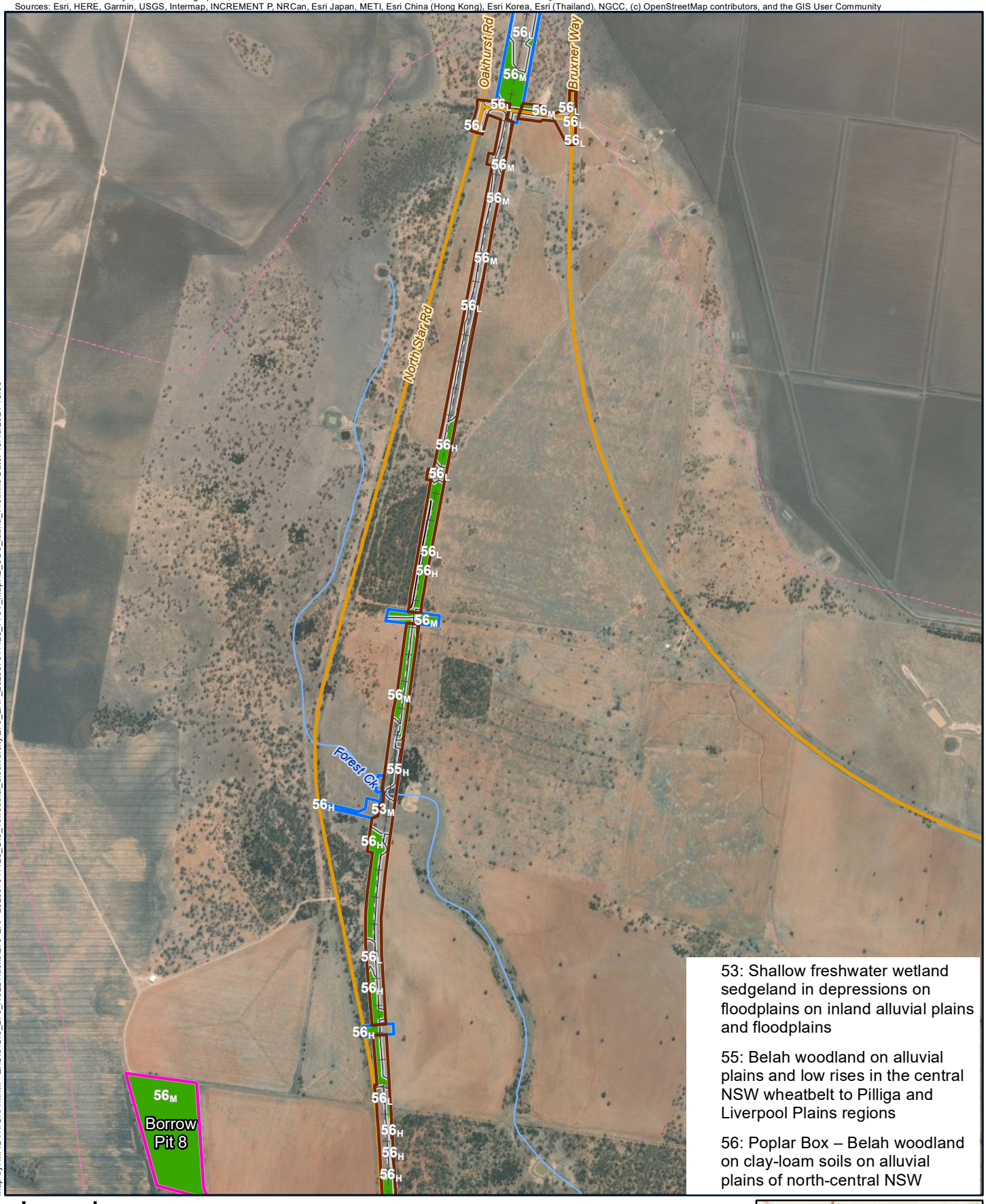
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:03

North Star to QLD/NSW Border

Map F.2d: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



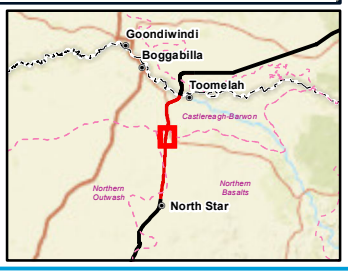
53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0

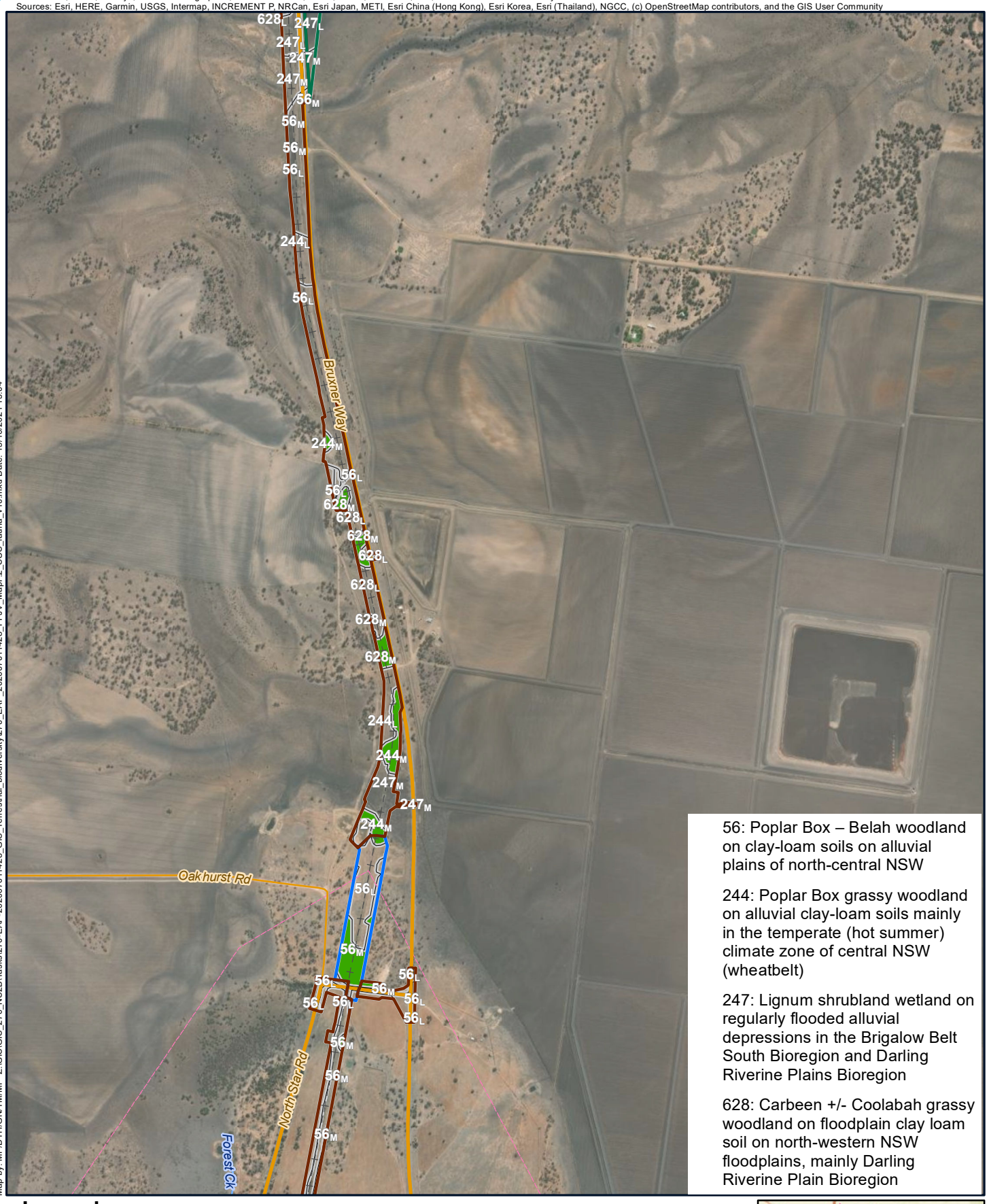
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2e: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:03

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

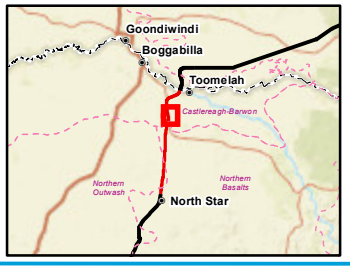
247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:04

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

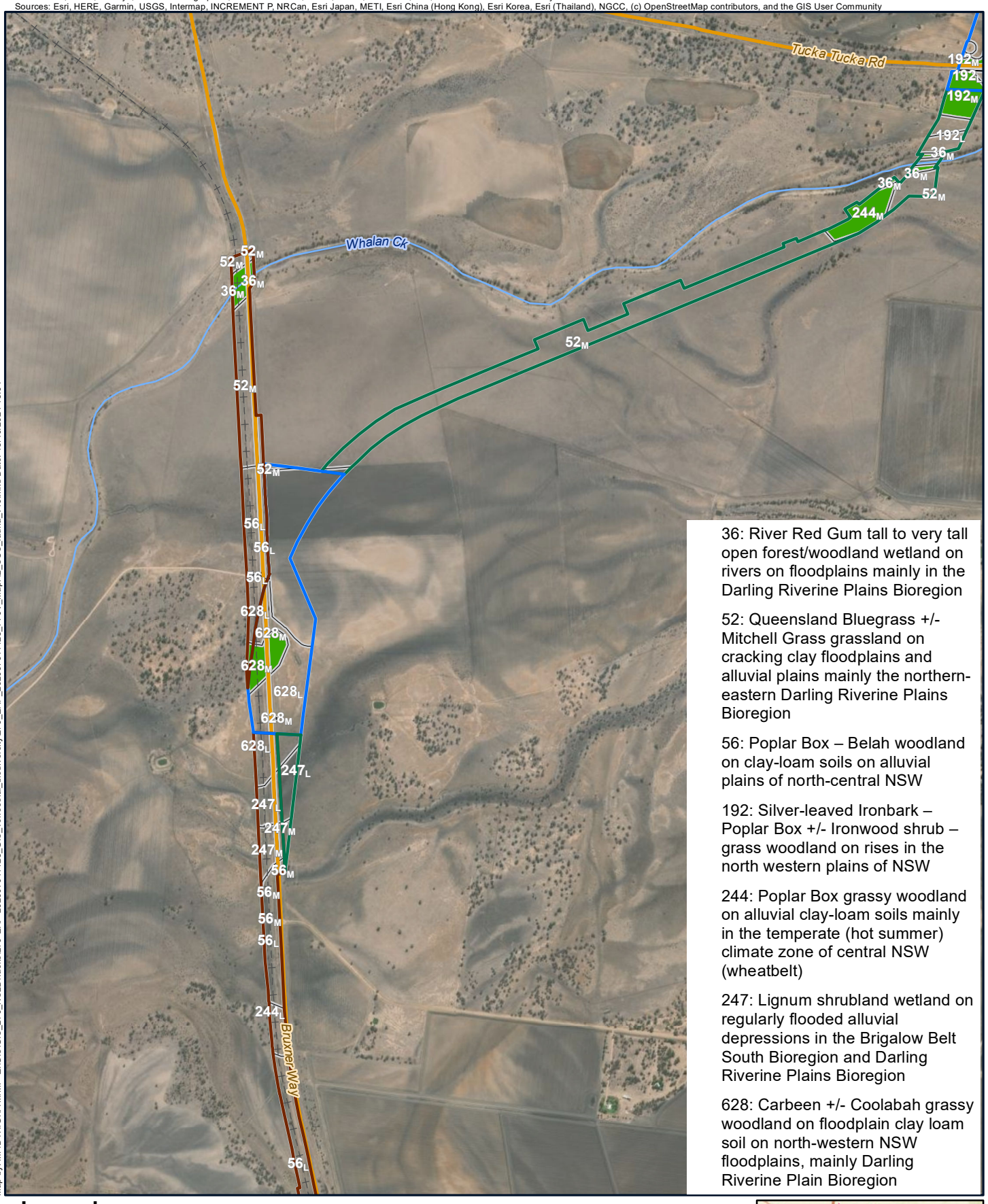
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2f: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

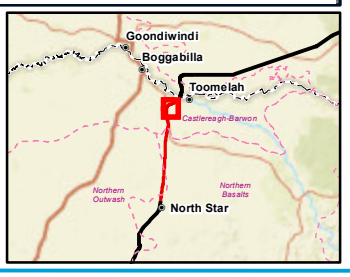
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

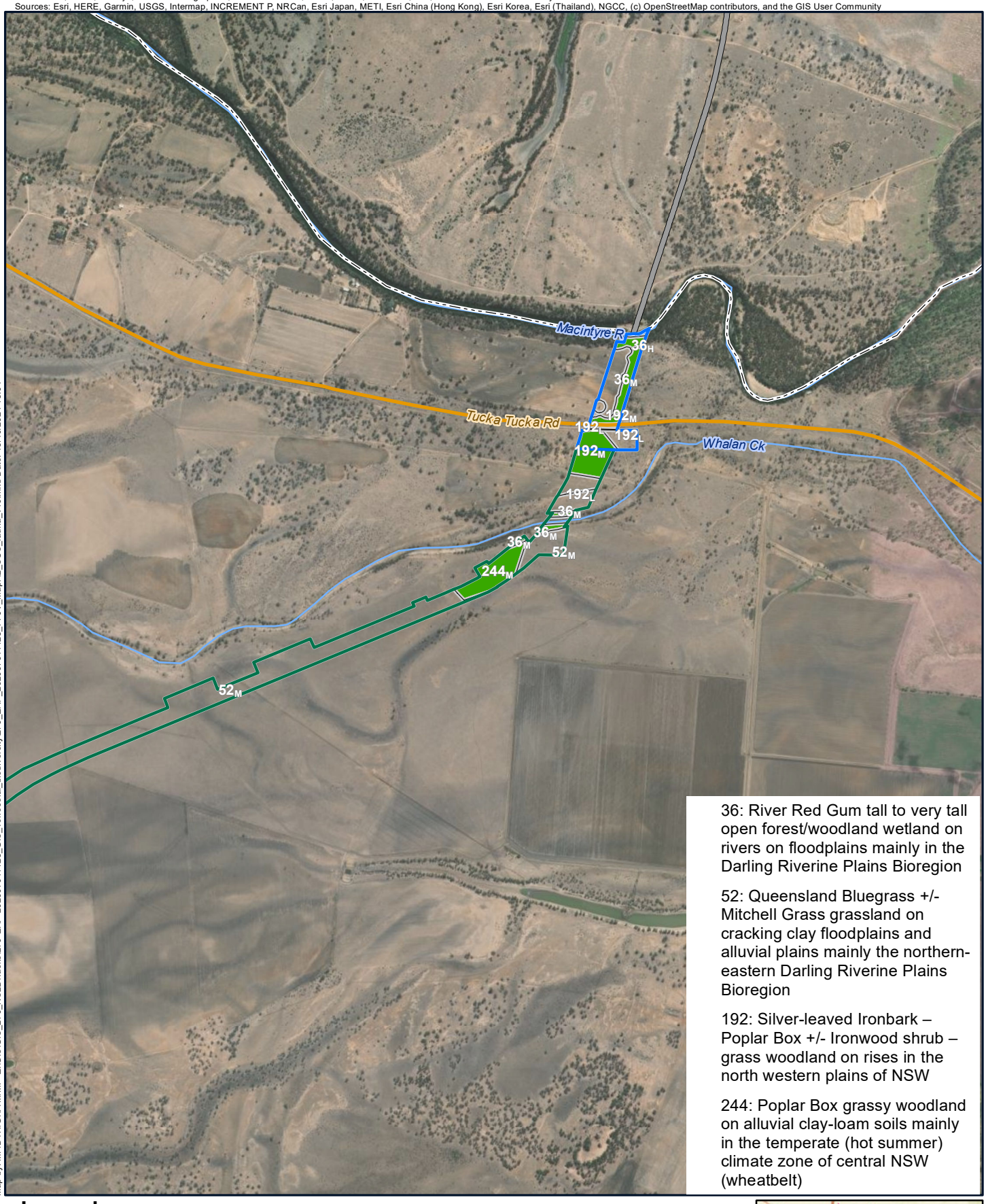
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2g: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:04

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

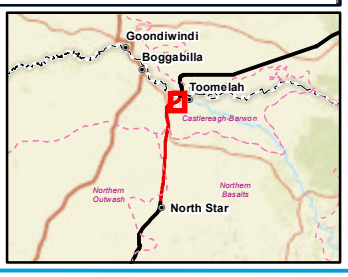
192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:04

Legend

- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

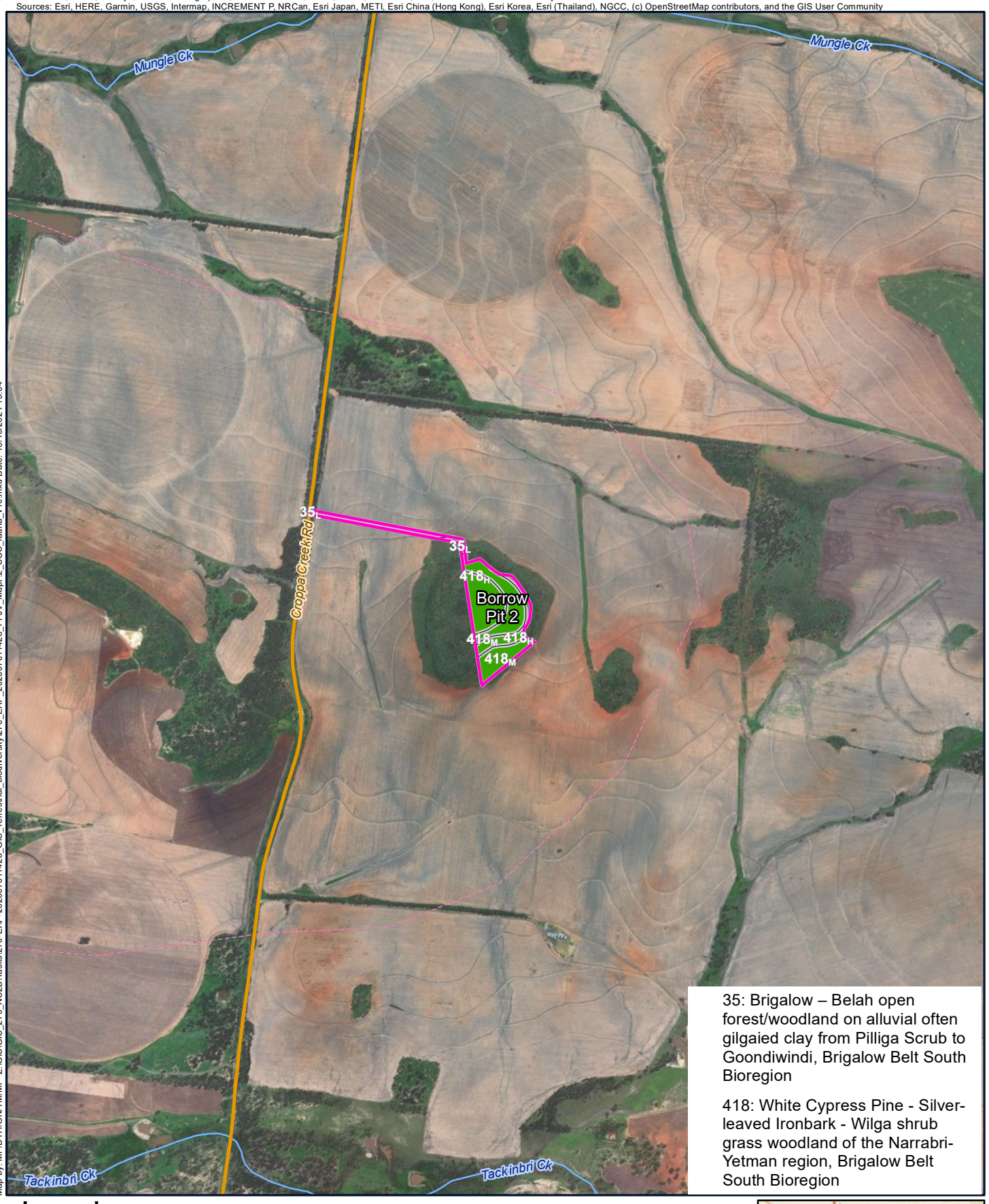
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2h: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

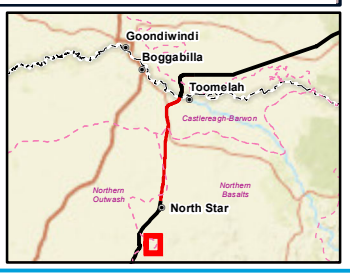


35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Legend

- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

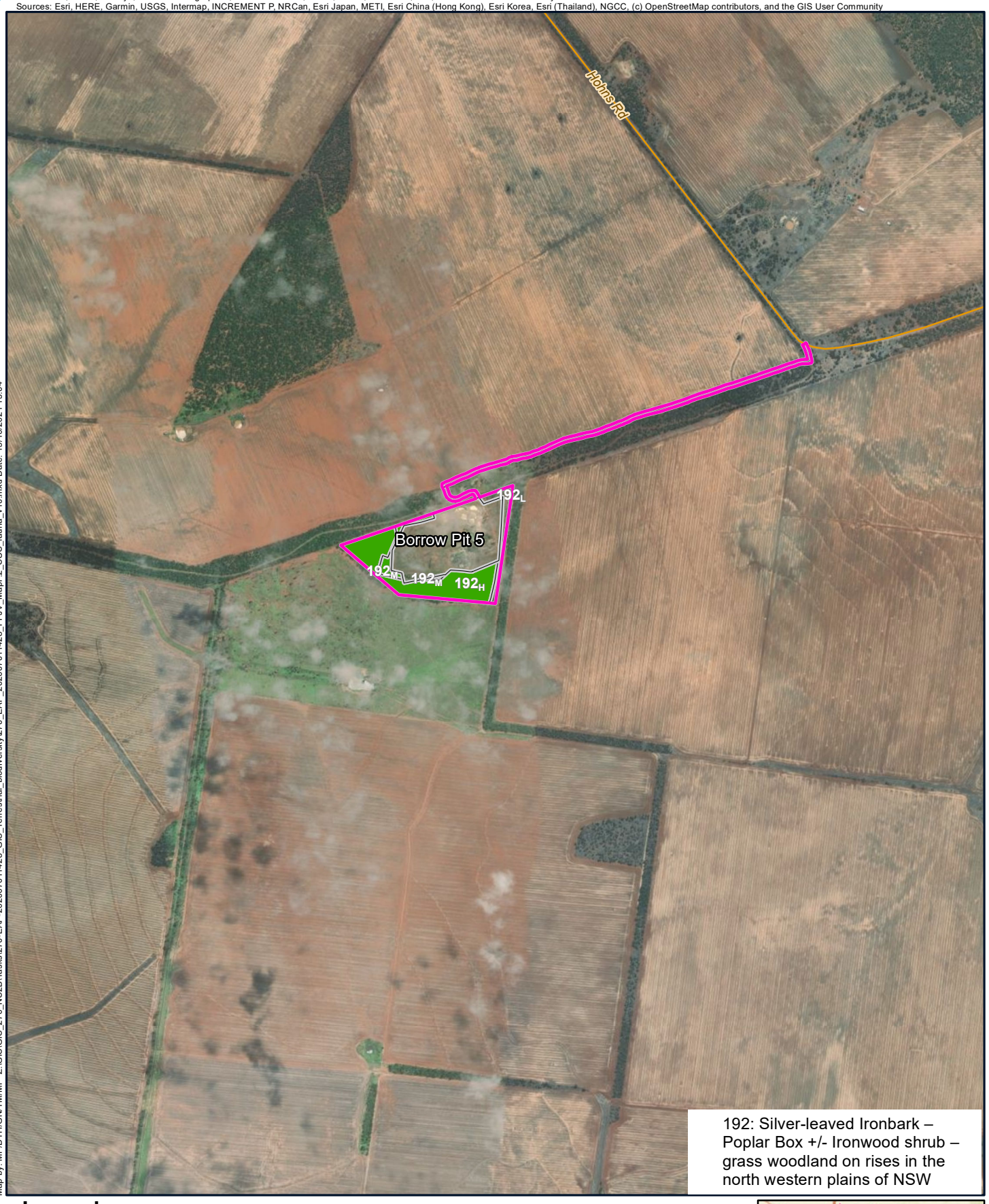
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2i: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:04

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

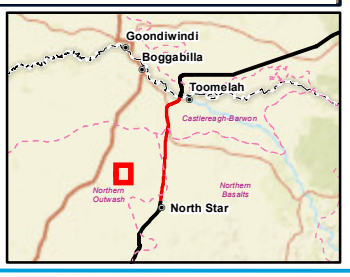


192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:04

Legend

- Minor roads
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2j: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

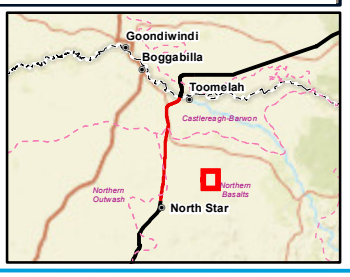


418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:04

Legend

- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

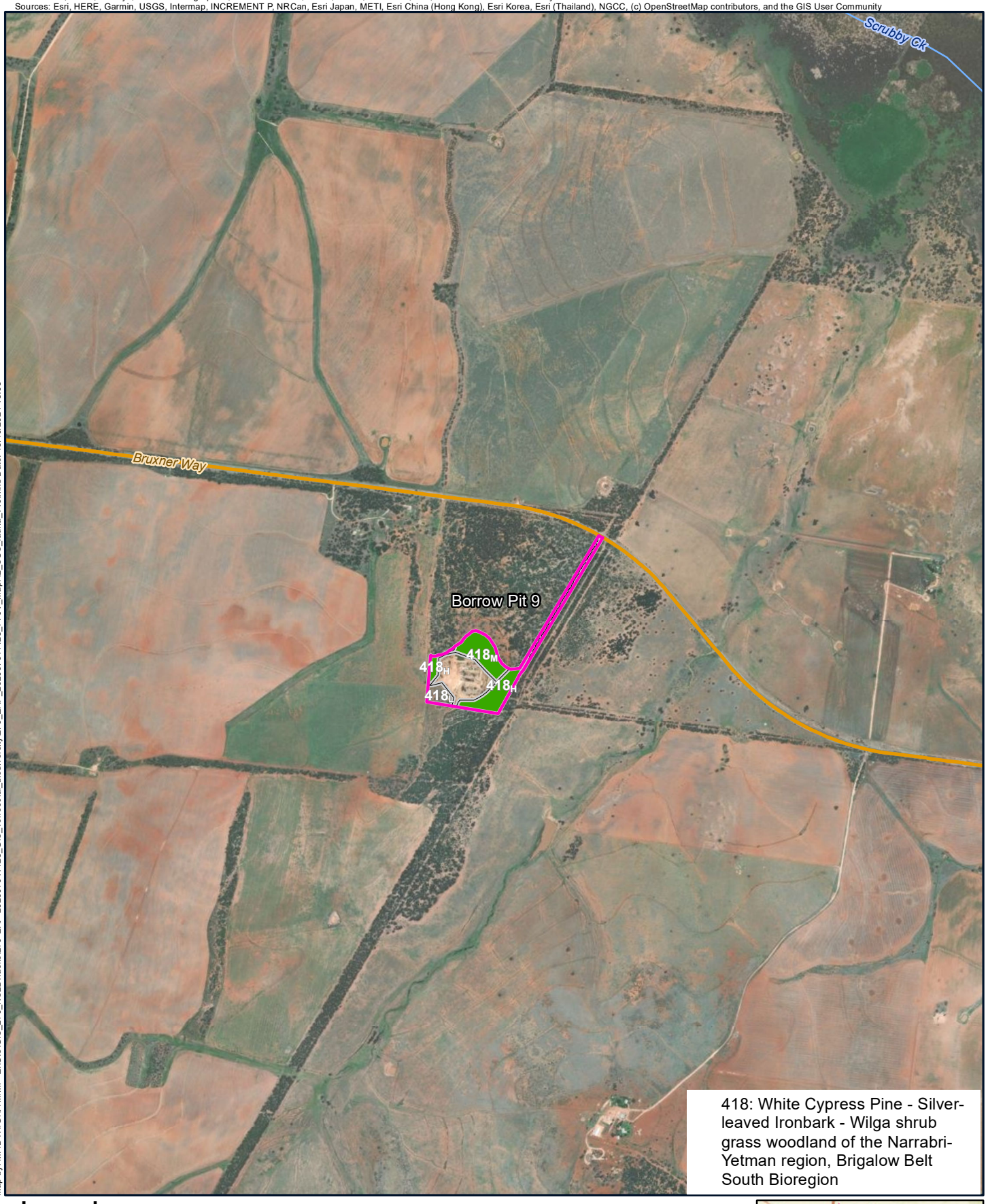
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2k: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

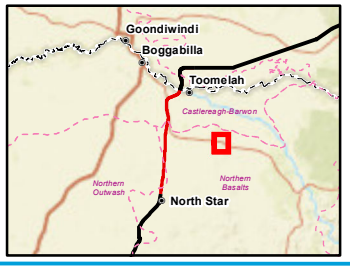


418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:05

Legend

- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

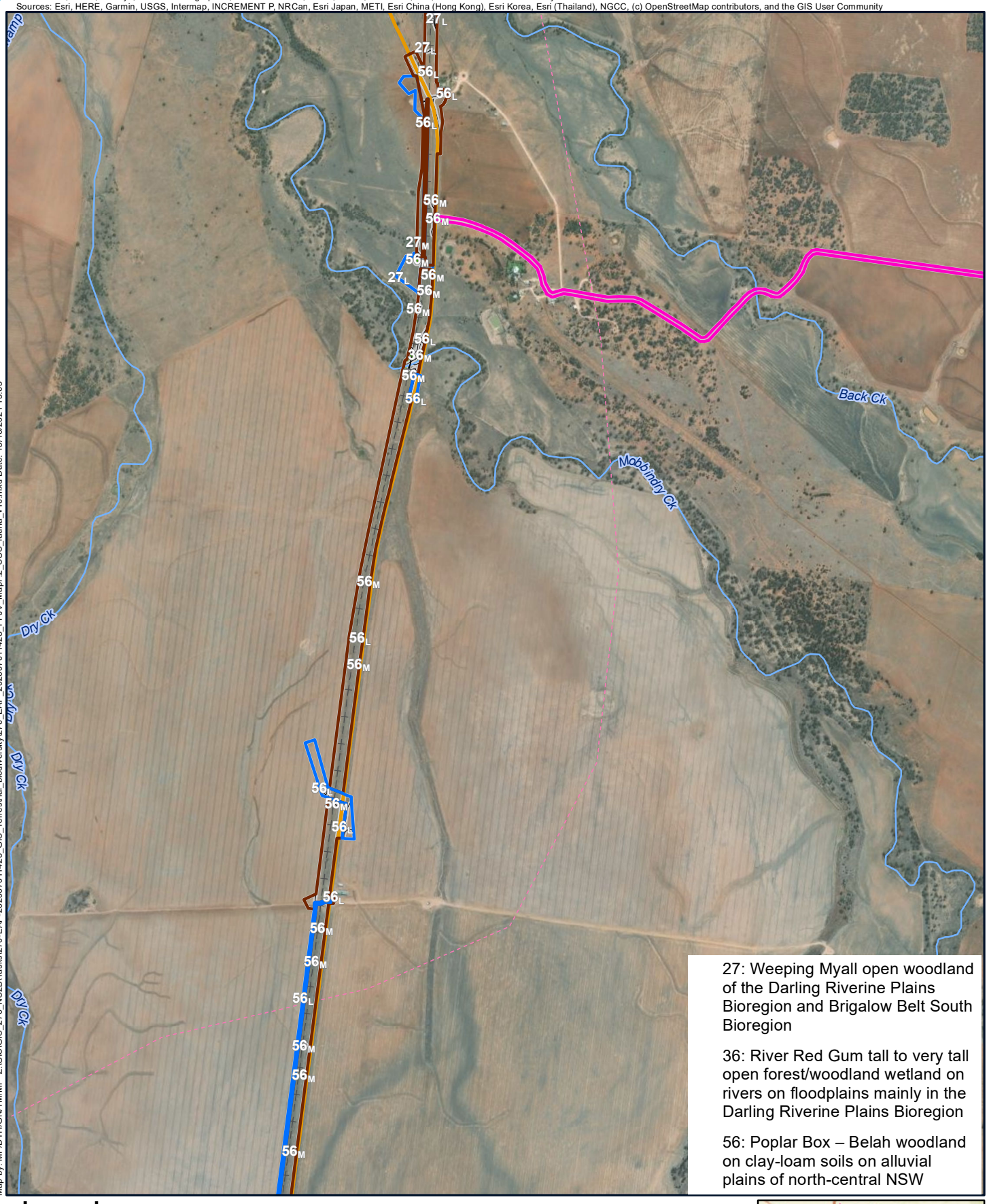
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2l: Glossy black-cockatoo (*Calyptorhynchus lathami*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

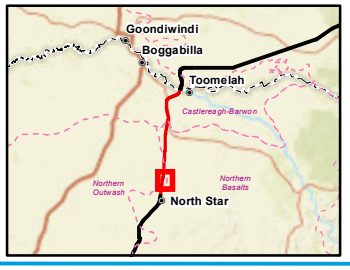
36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:05

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

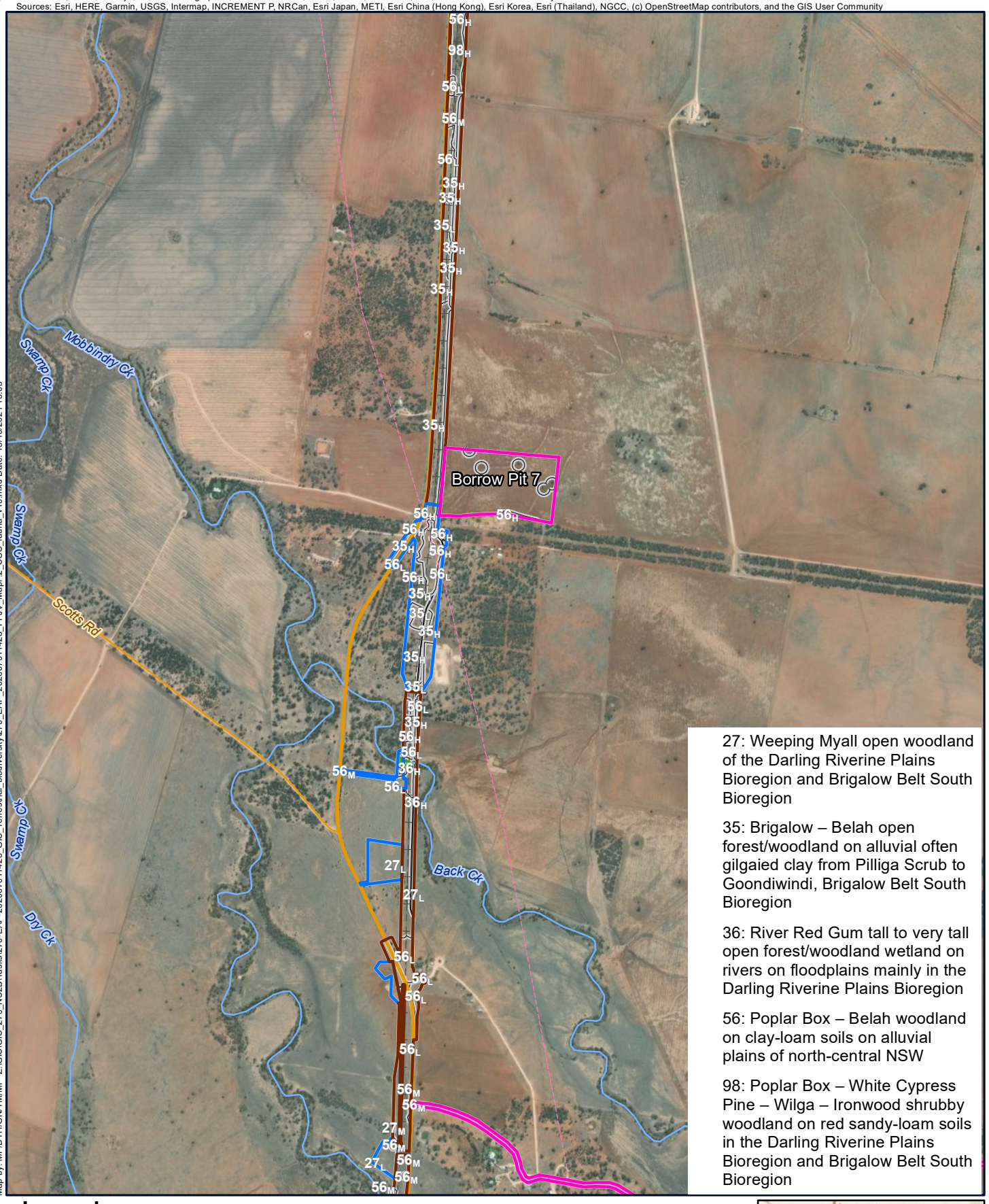
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2m: Pale-headed snake (*Hoplocephalus bitorquatus*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

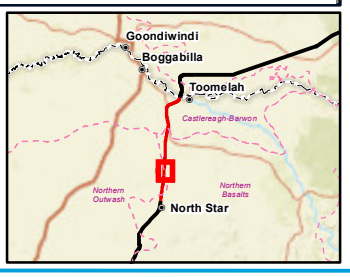
36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

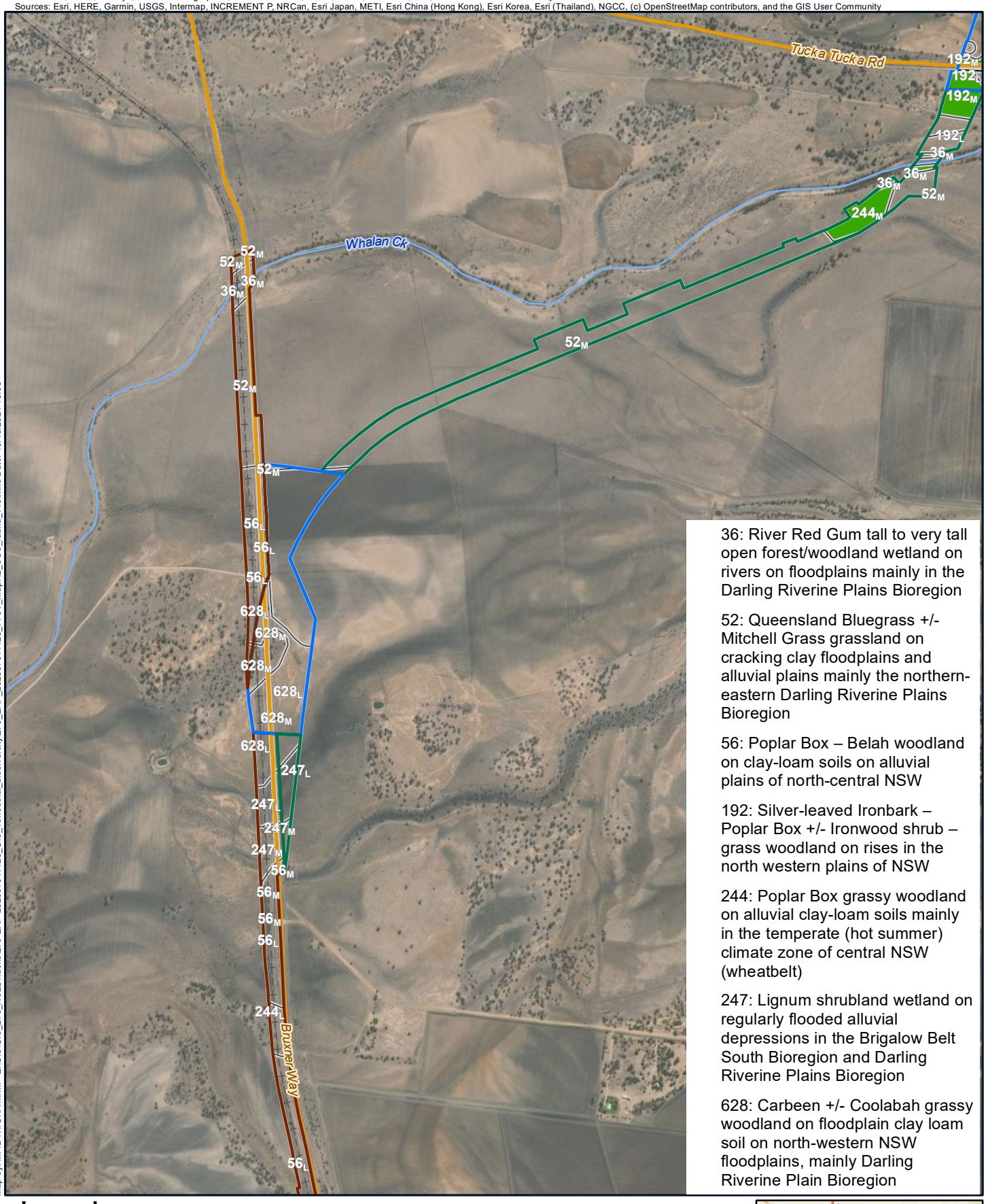
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2n: Pale-headed snake (*Hoplocephalus bitorquatus*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:05

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

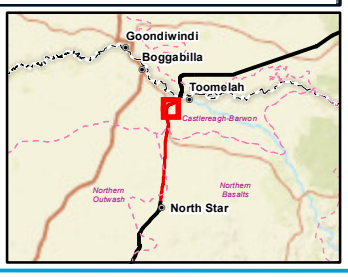
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

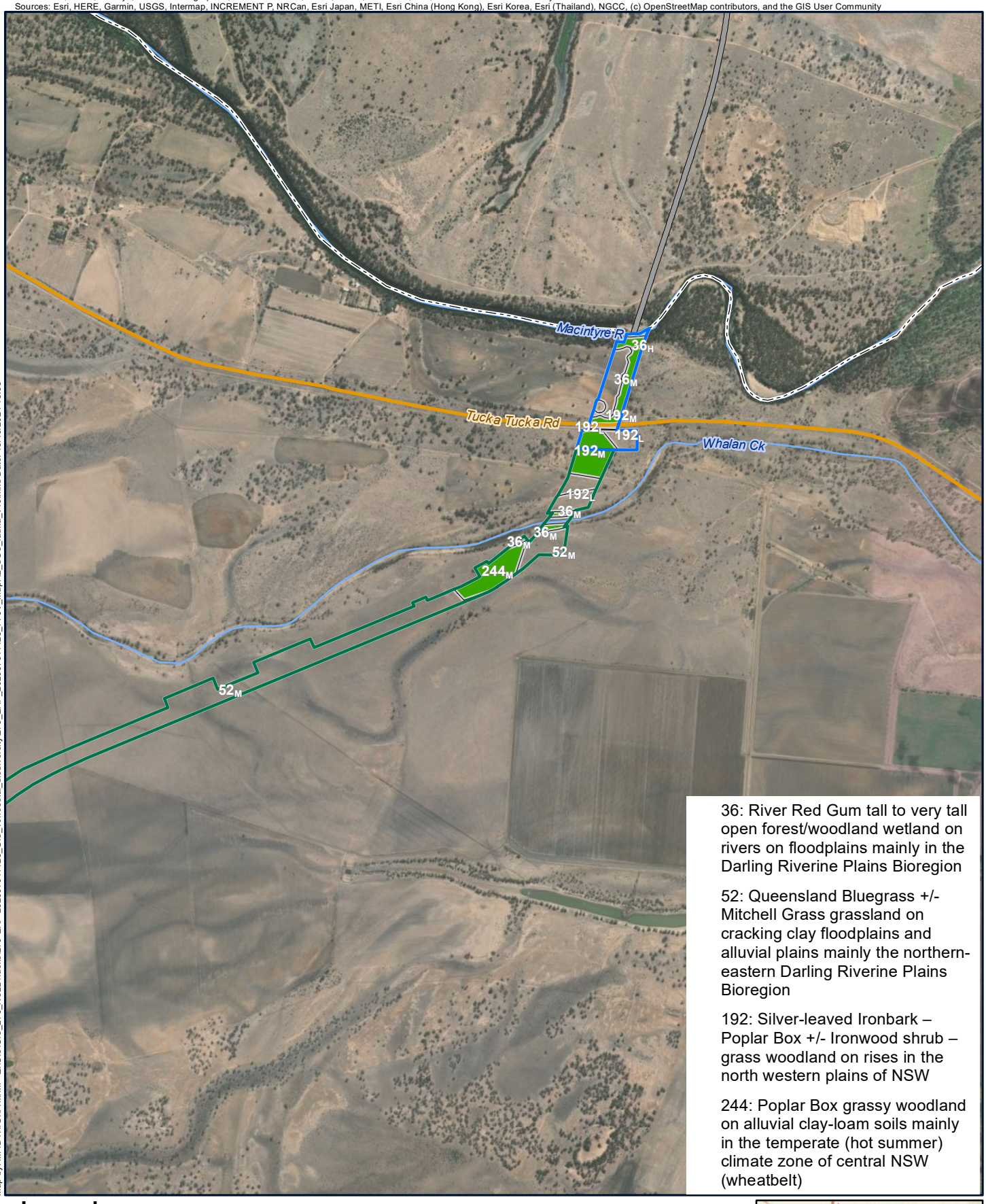
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2o: Pale-headed snake (*Hoplocephalus bitorquatus*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:05

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

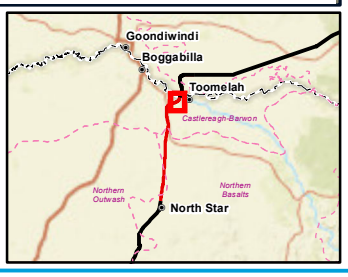
52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Legend

- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

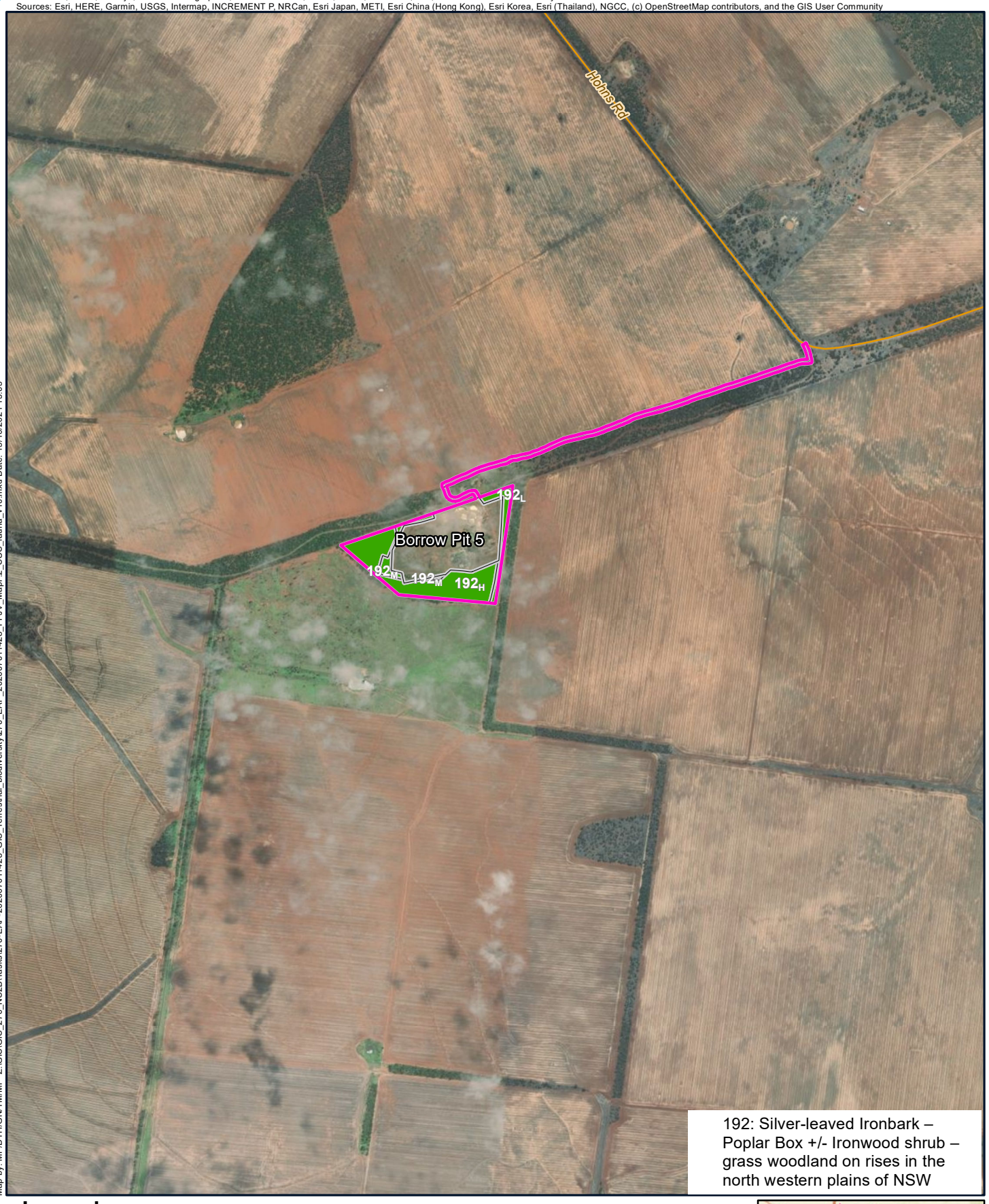
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2p: Pale-headed snake (*Hoplocephalus bitorquatus*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:05

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

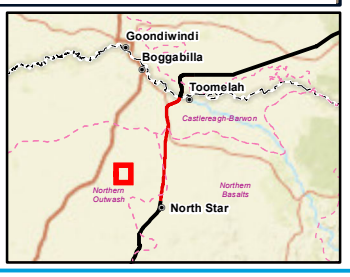


192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:05

Legend

- Minor roads
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

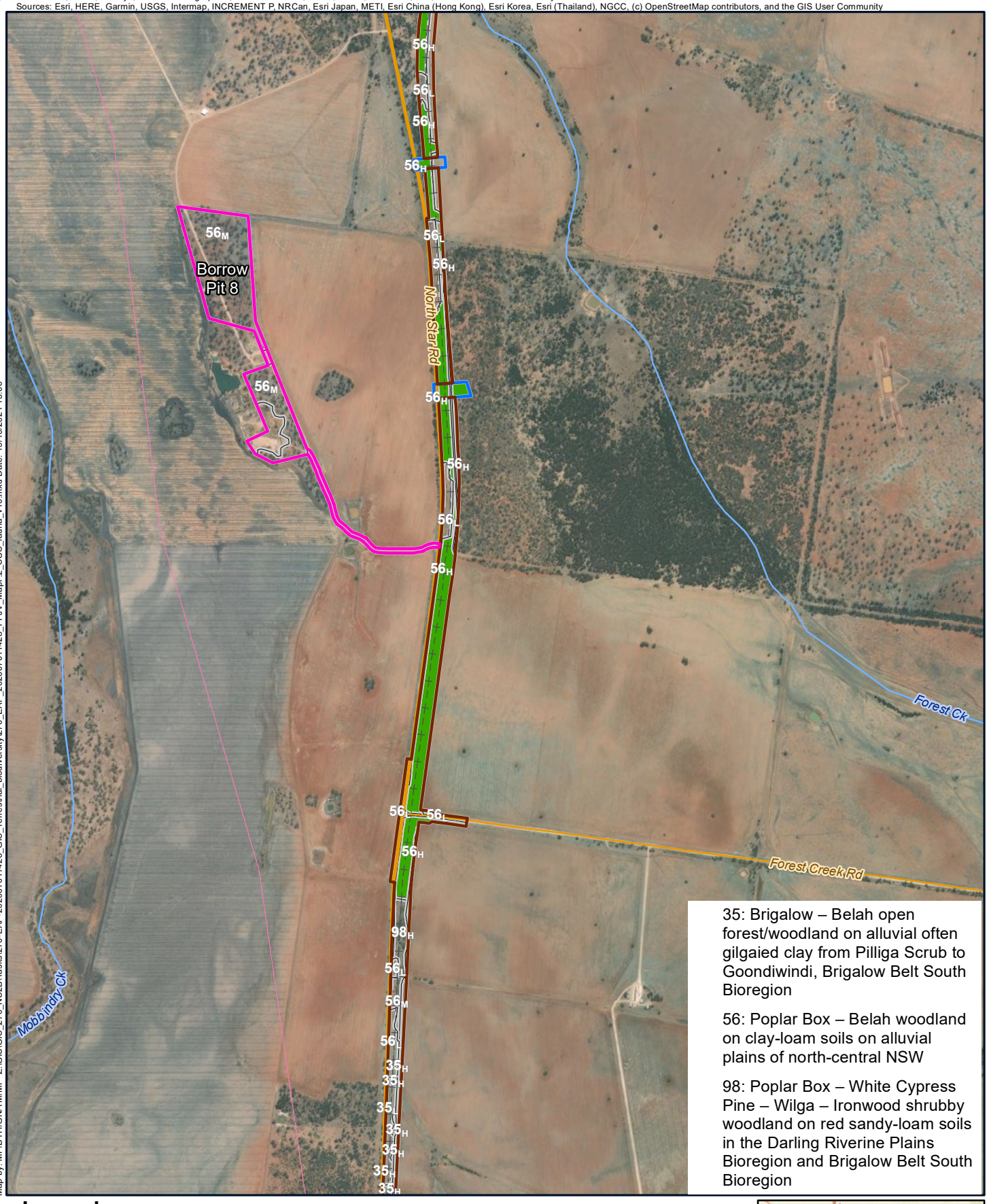
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2q: Pale-headed snake (*Hoplocephalus bitorquatus*)

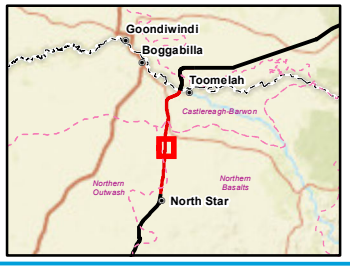
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:06

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

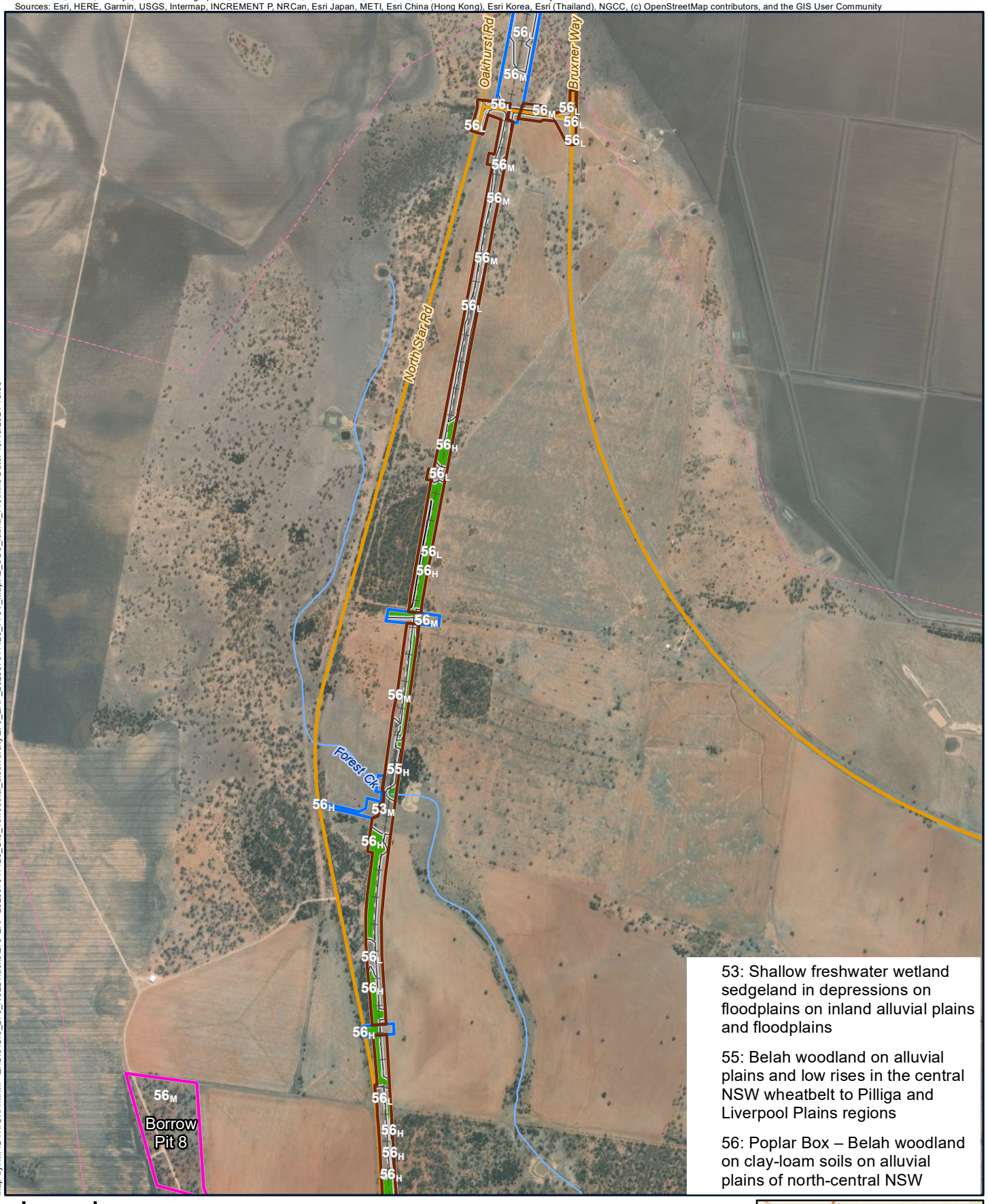
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2r: Squirrel glider (*Petaurus norfolcensis*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

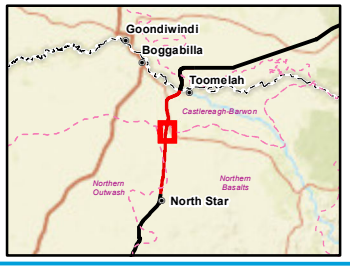
55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:06

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

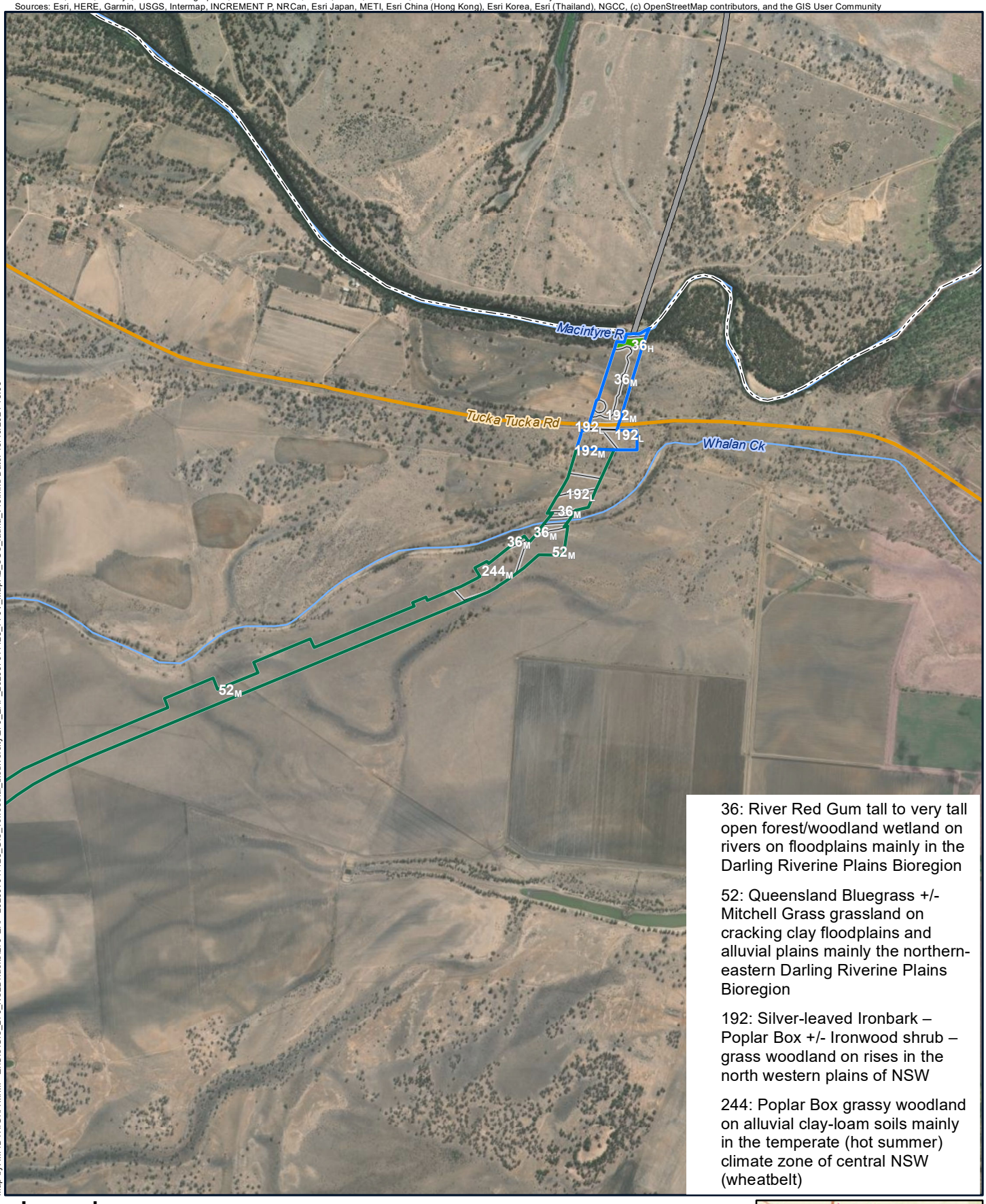
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2s: Squirrel glider (*Petaurus norfolcensis*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

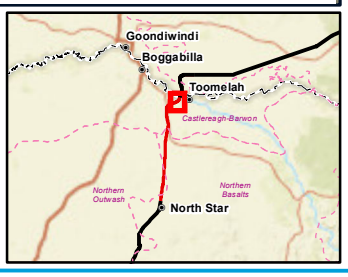
52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Legend

- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0

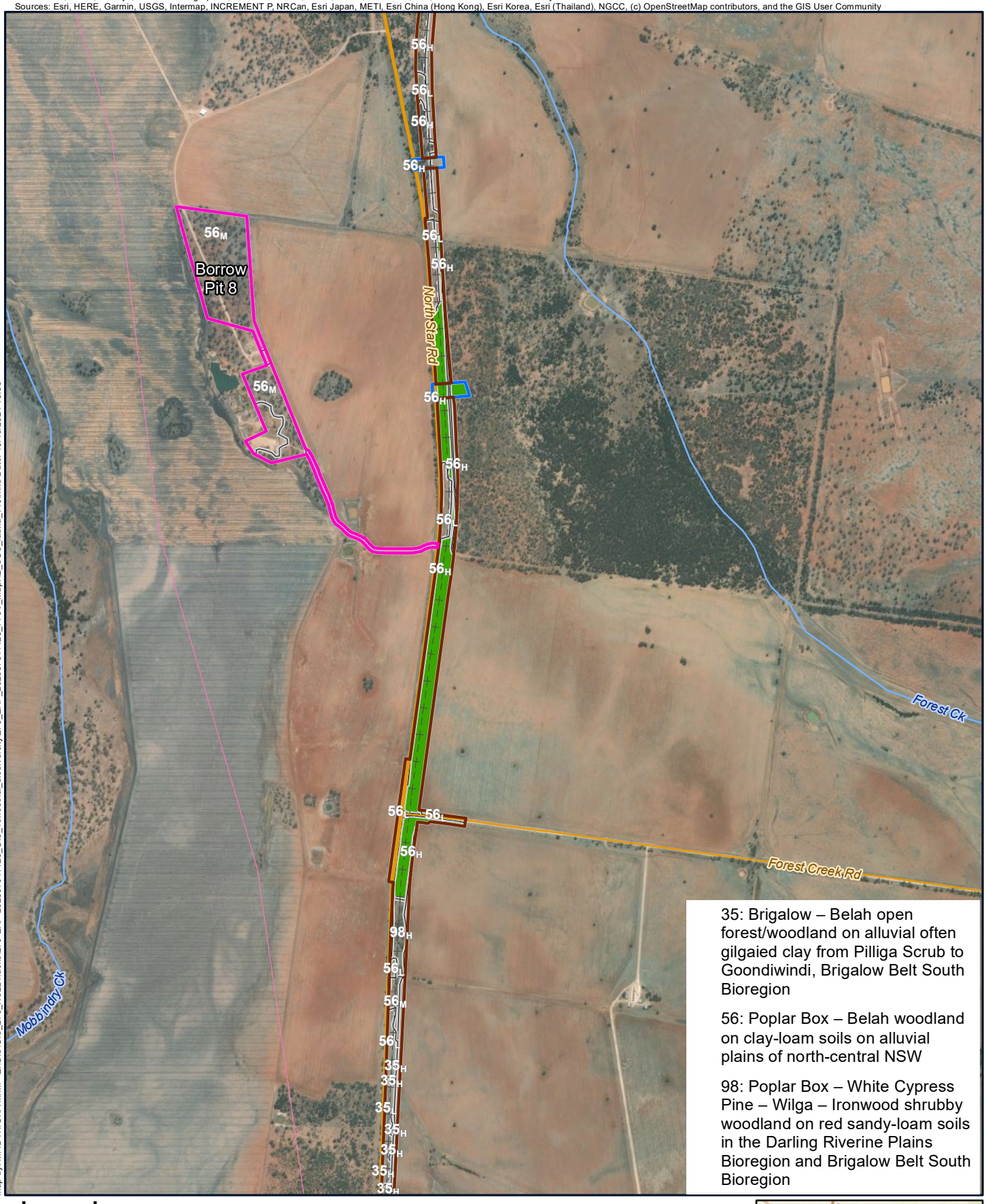
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2t: Squirrel glider (*Petaurus norfolcensis*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:06

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



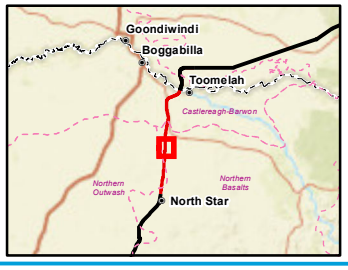
35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

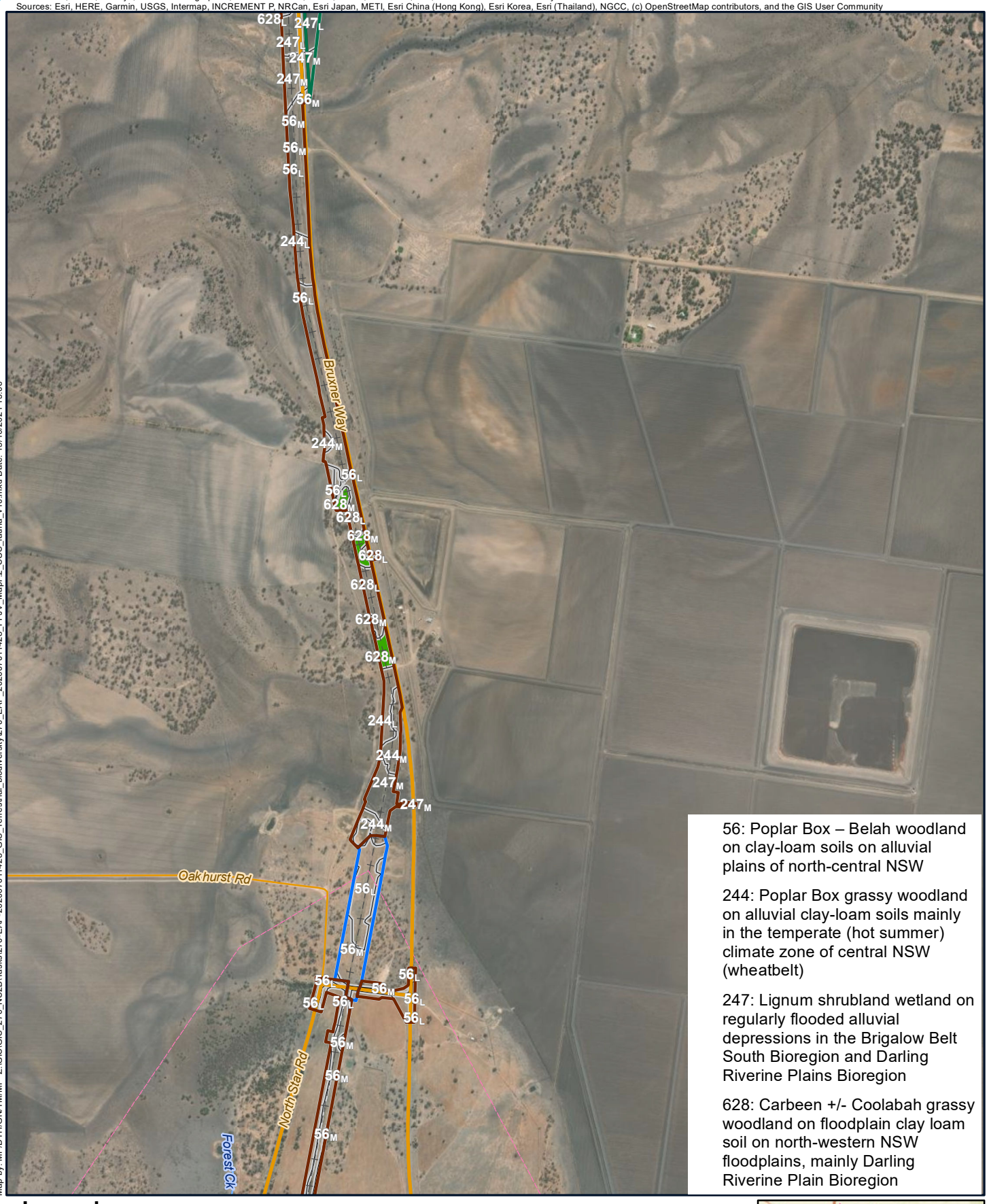
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2u: Koala (*Phascolarctos cinereus*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:06

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

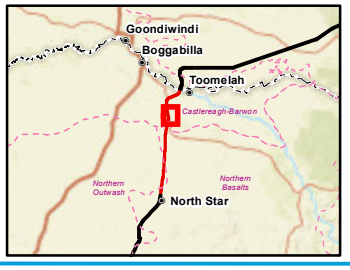
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

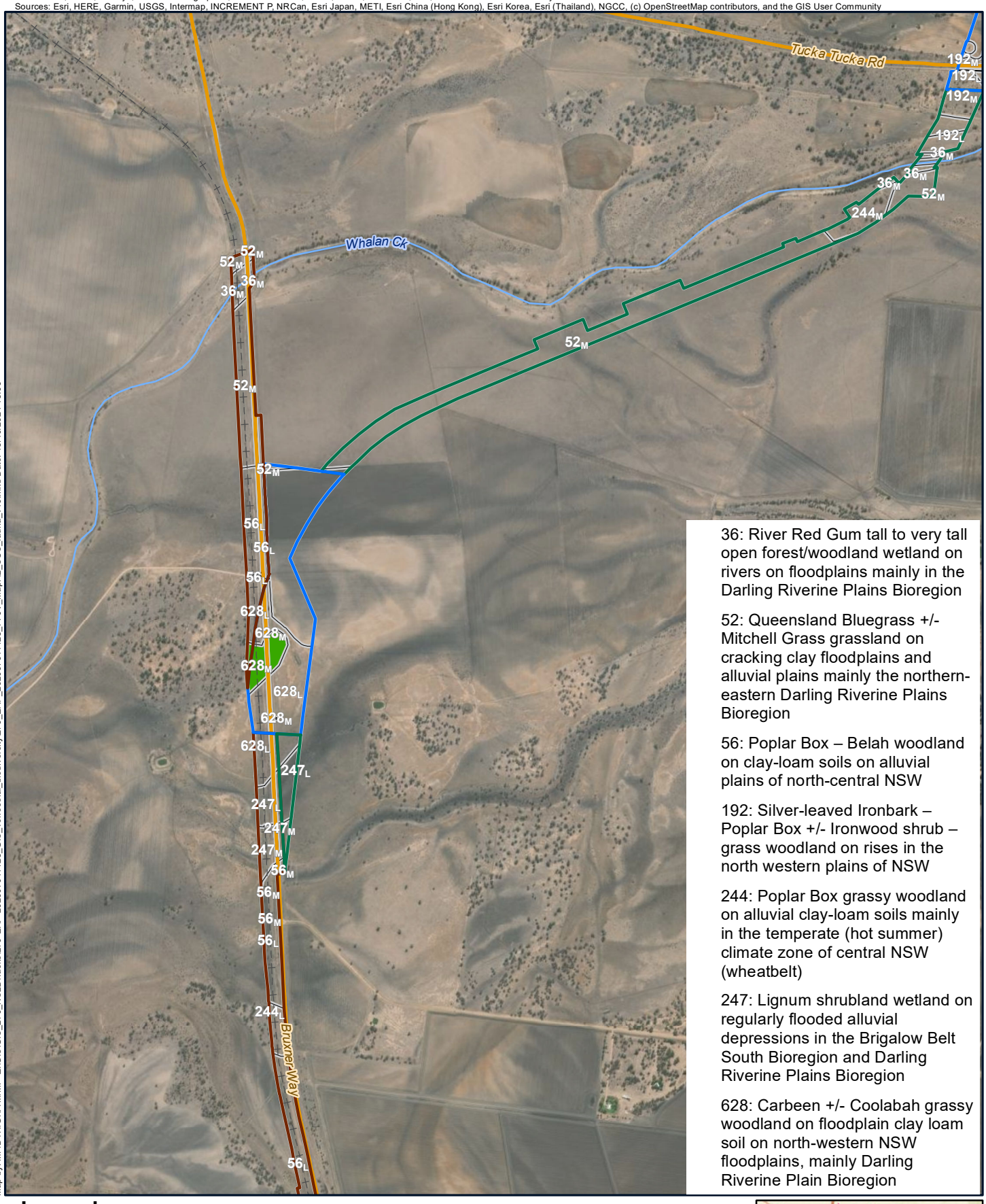
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2v: Koala (*Phascolarctos cinereus*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:06

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

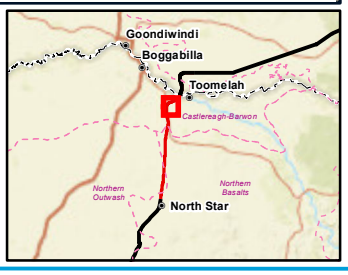
244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

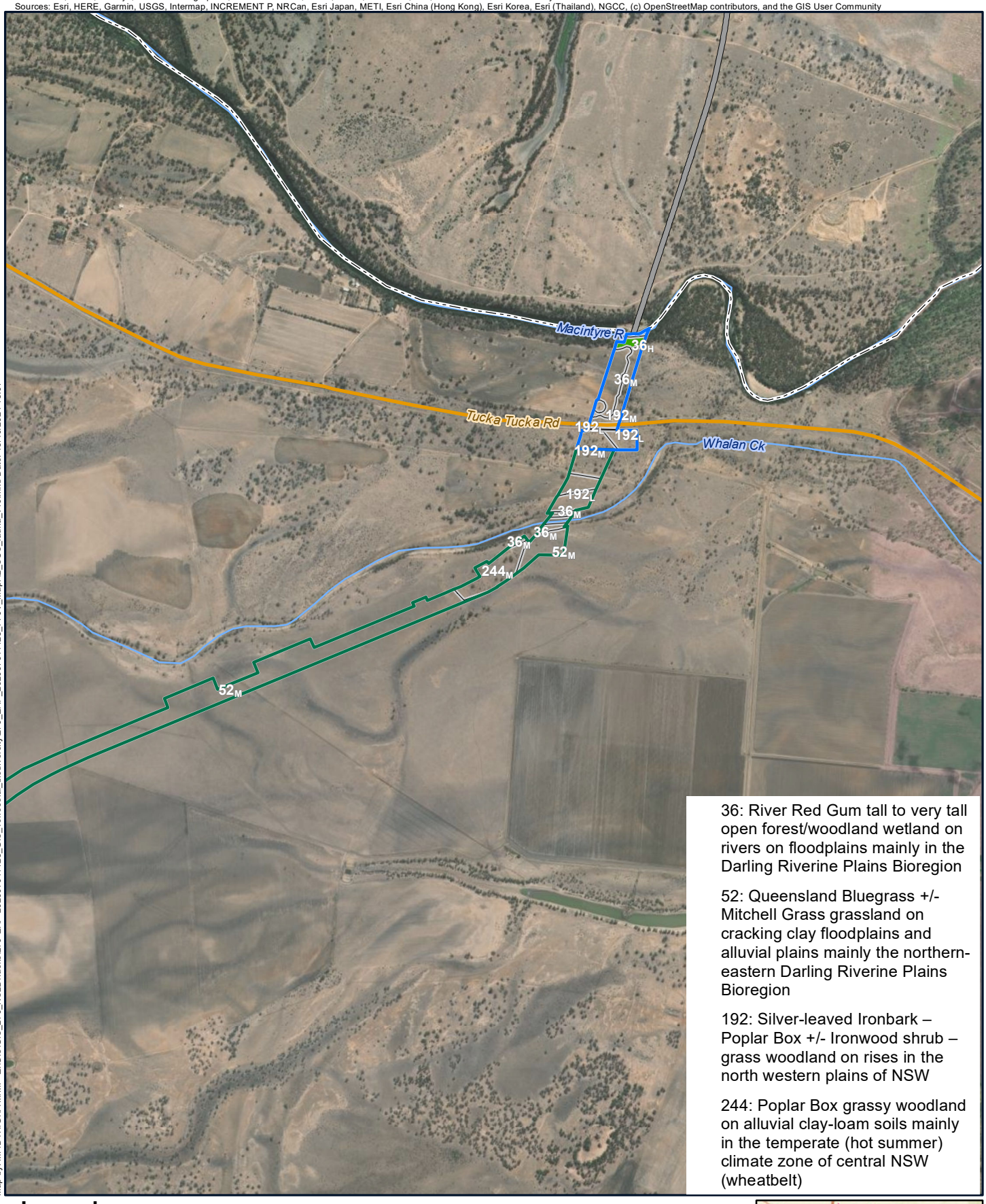
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2w: Koala (*Phascolarctos cinereus*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:06

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

52: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

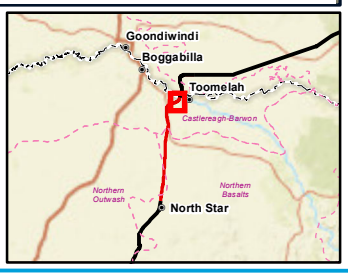
192: Silver-leaved Ironbark – Poplar Box +/- Ironwood shrub – grass woodland on rises in the north western plains of NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:07

Legend

- Adjoining alignments
- Major roads
- NSW/QLD border
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2x: Koala (*Phascolarctos cinereus*)

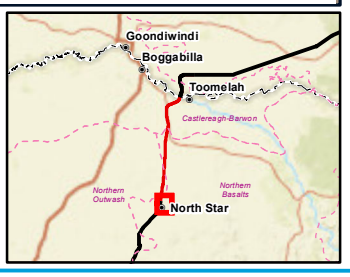
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:07

Legend

- Localities
- Existing rail (non-operational)
- Adjoining alignments
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

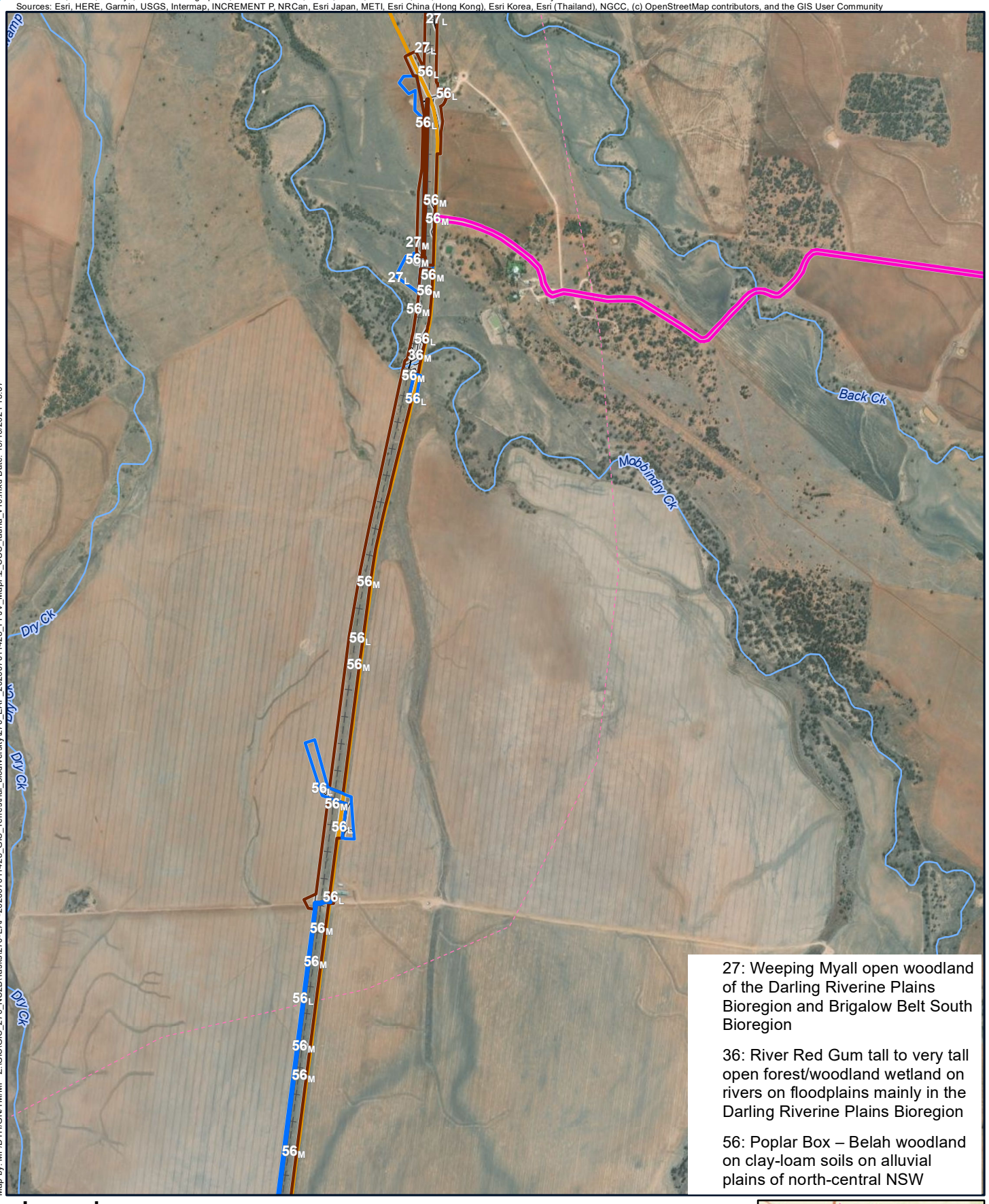
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2y: Masked owl (*Tyto novaehollandiae*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



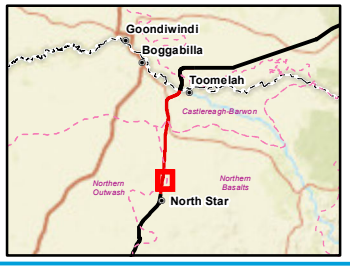
27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Legend

- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

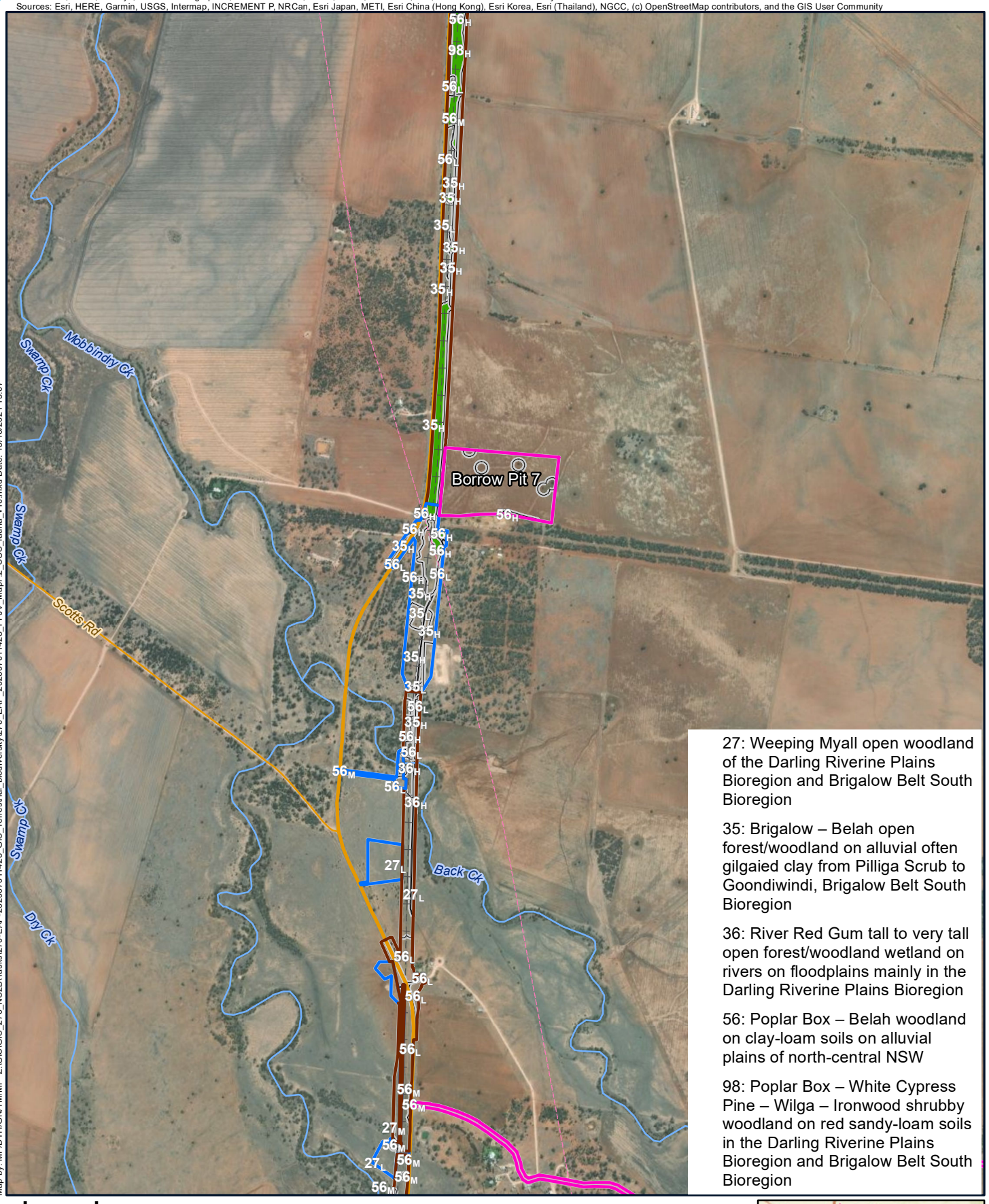
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2z: Masked owl (*Tyto novaehollandiae*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:07

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



27: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

36: River Red Gum tall to very tall open forest/woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion

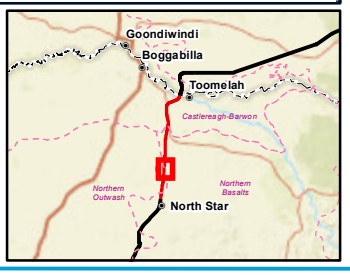
56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:07

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

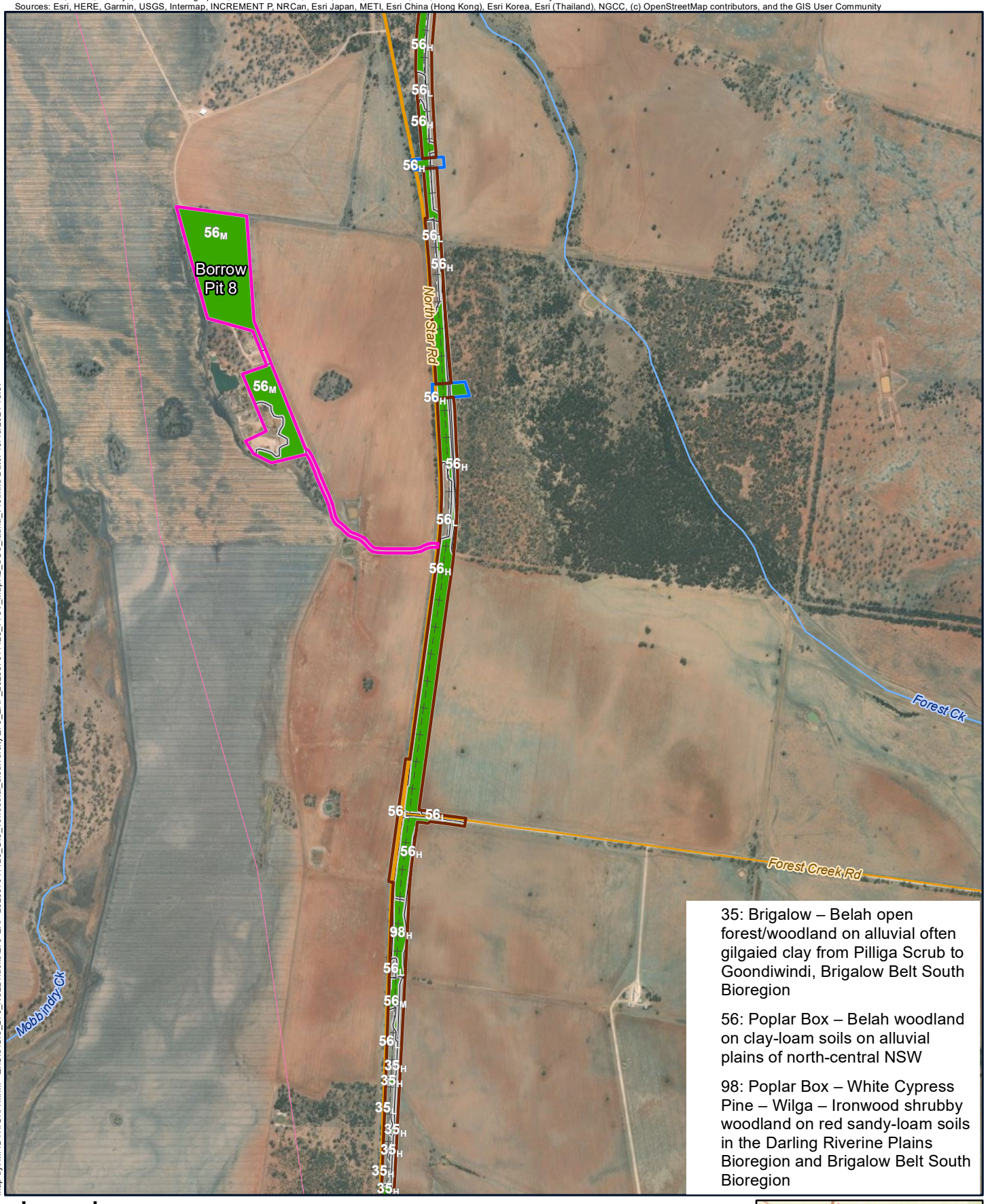
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2aa: Masked owl (*Tyto novaehollandiae*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



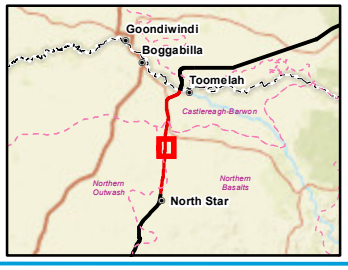
35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

98: Poplar Box – White Cypress Pine – Wilga – Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000

0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0

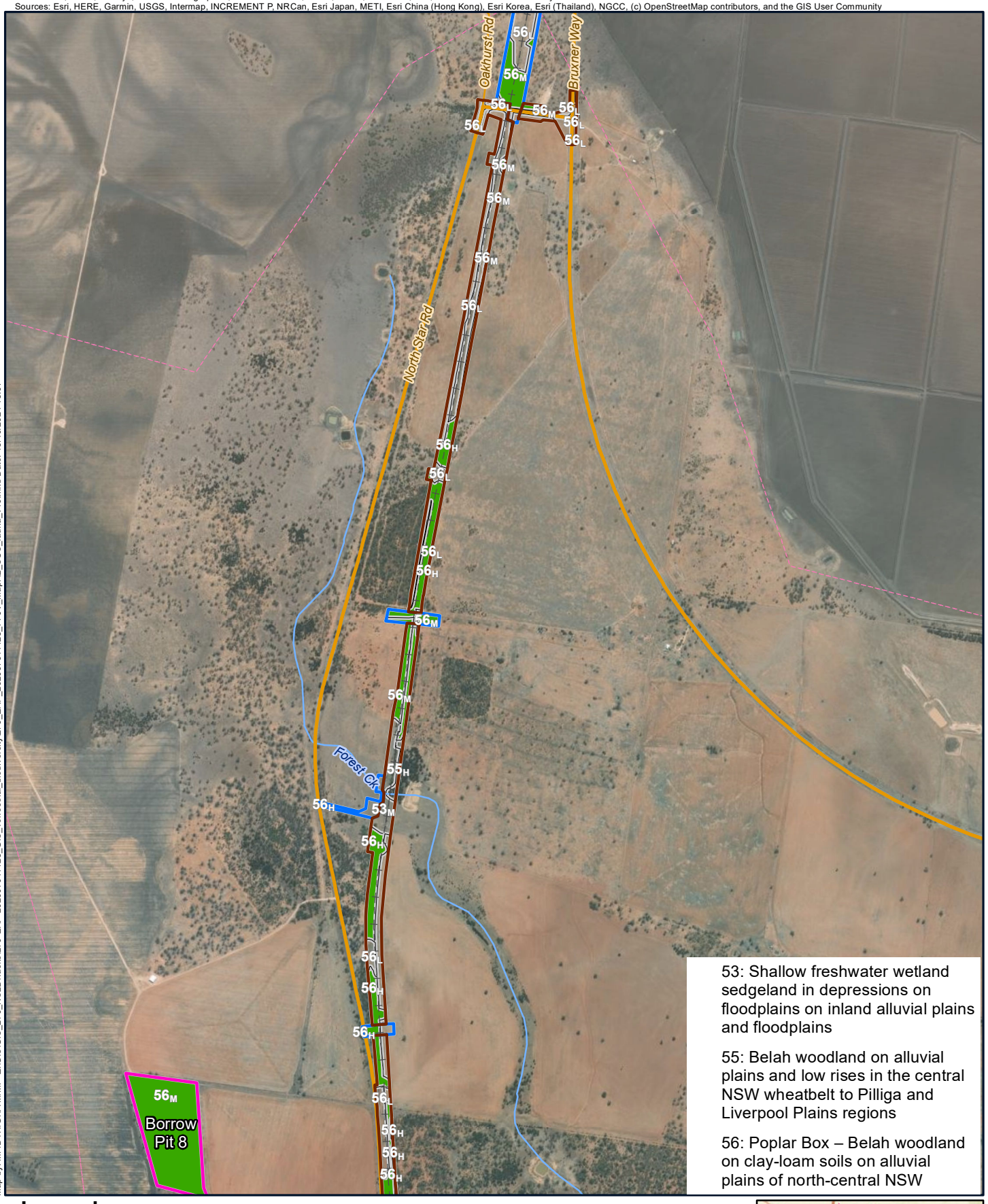
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2ab: Masked owl (*Tyto novaehollandiae*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:07

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



53: Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains

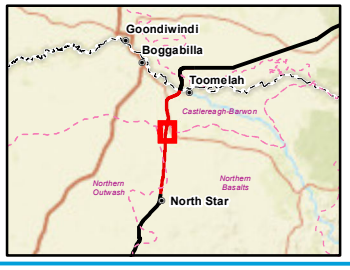
55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions

56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:07

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

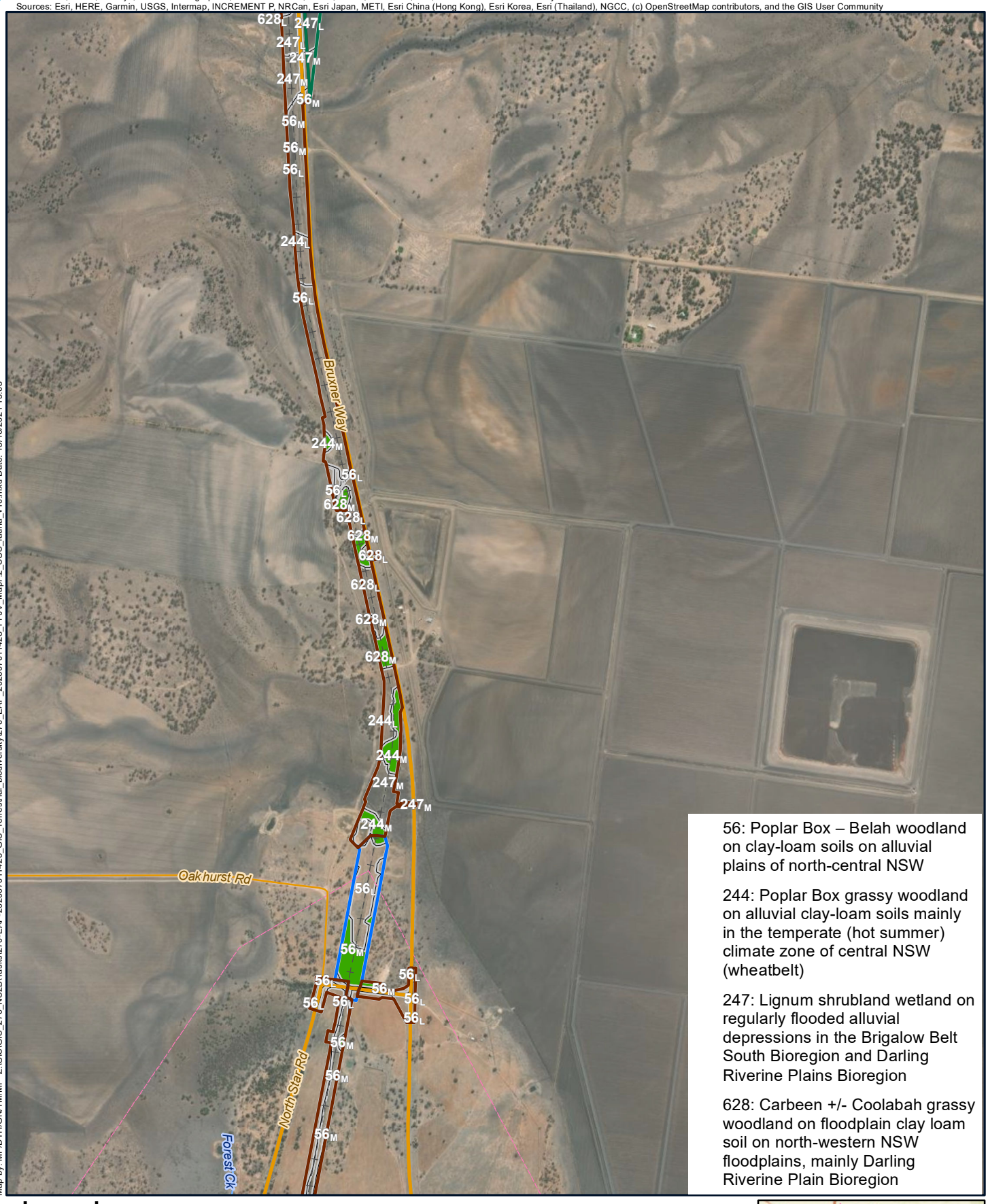
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2ac: Masked owl (*Tyto novaehollandiae*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



56: Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW

244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

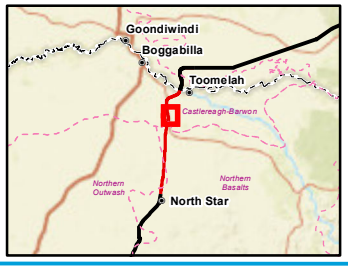
247: Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion

628: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF.2_SCS_fauna_v10.mxd Date: 15/10/2021 15:08

Legend

- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (brownfield)
- Subject land (early works)
- Subject land (greenfield)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

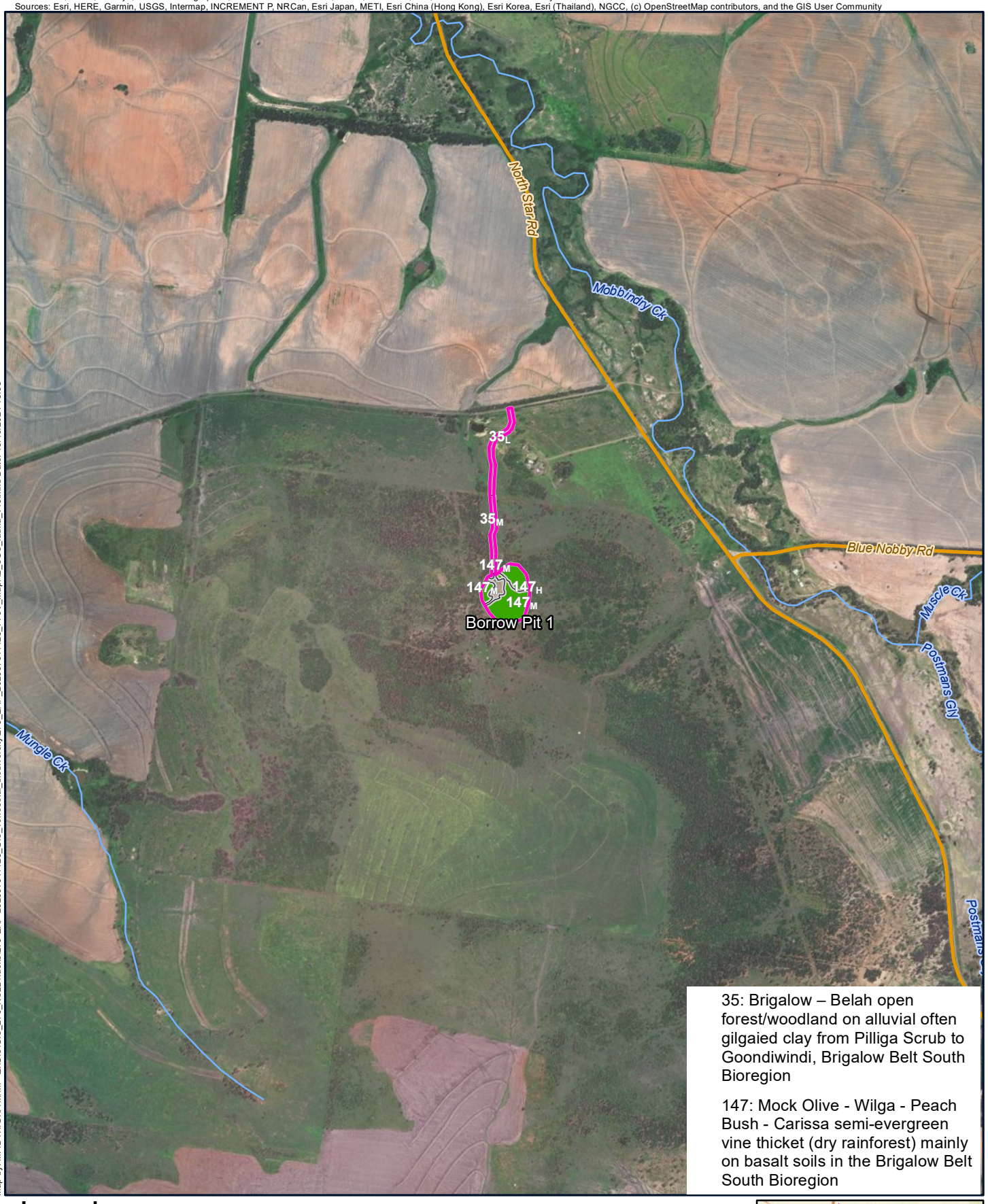
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2ad: Masked owl (*Tyto novaehollandiae*)

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

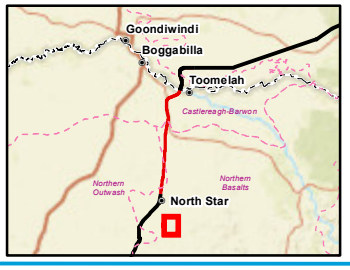


35: Brigalow – Belah open forest/woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion

147: Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion

Legend

- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

Future Freight
Integrating Community, Environment and Engineering

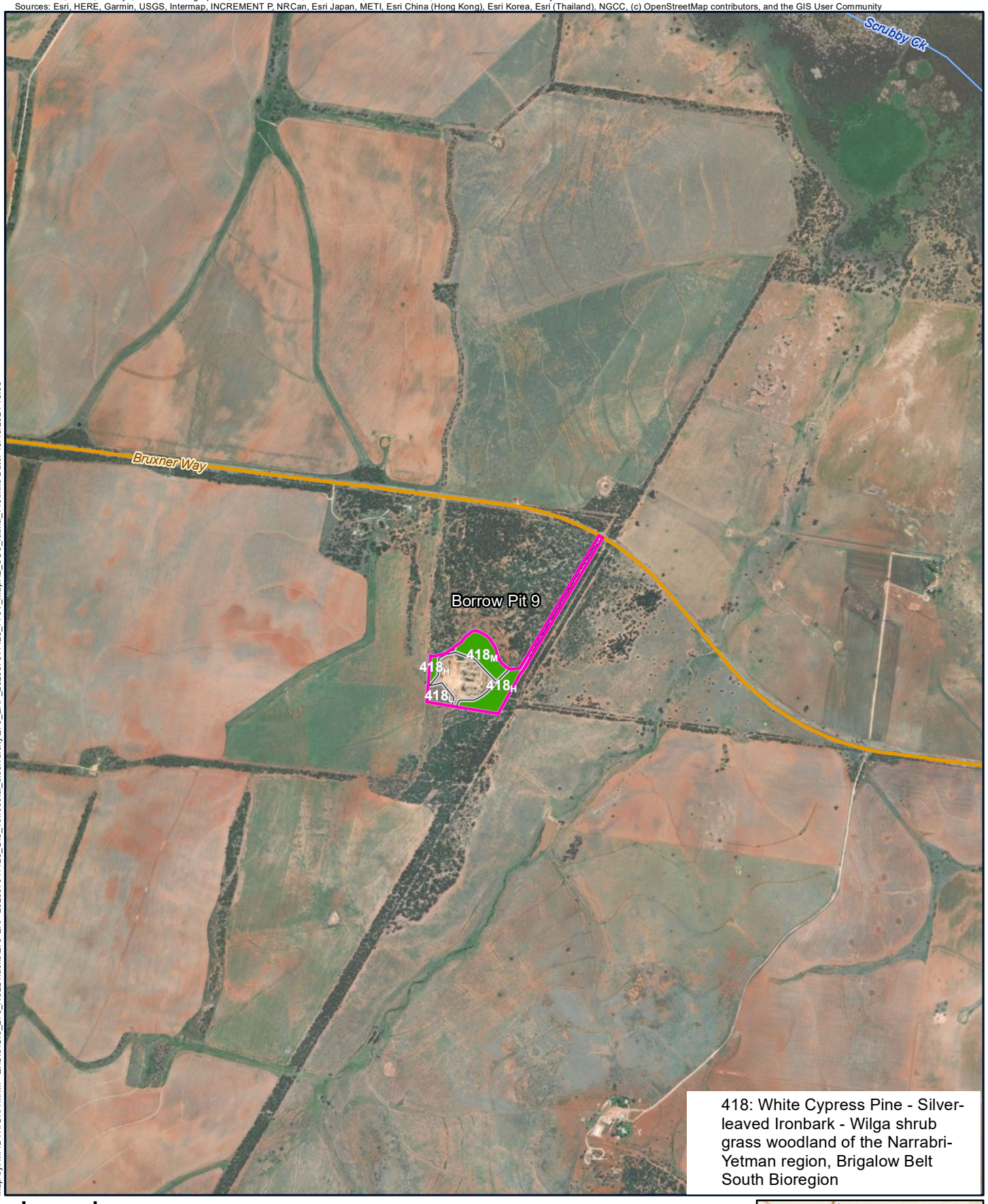
Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2ae: Masked owl (*Tyto novaehollandiae*)

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:08

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

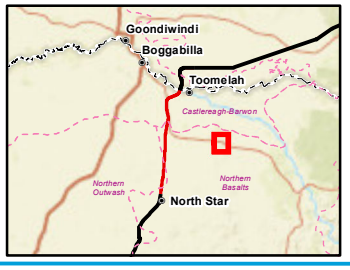


418: White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion

Map by: MF/DTH/GN/TM/MF Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FFJV_MapF2_SCS_fauna_v10.mxd Date: 15/10/2021 15:08

Legend

- Major roads
- Watercourses
- IBRA 7 sub-region boundary
- Subject land (borrow pit)
- Fieldwork PCT (to fieldwork extent)



A4 scale: 1:25,000
0 100 200 300 400 500 m

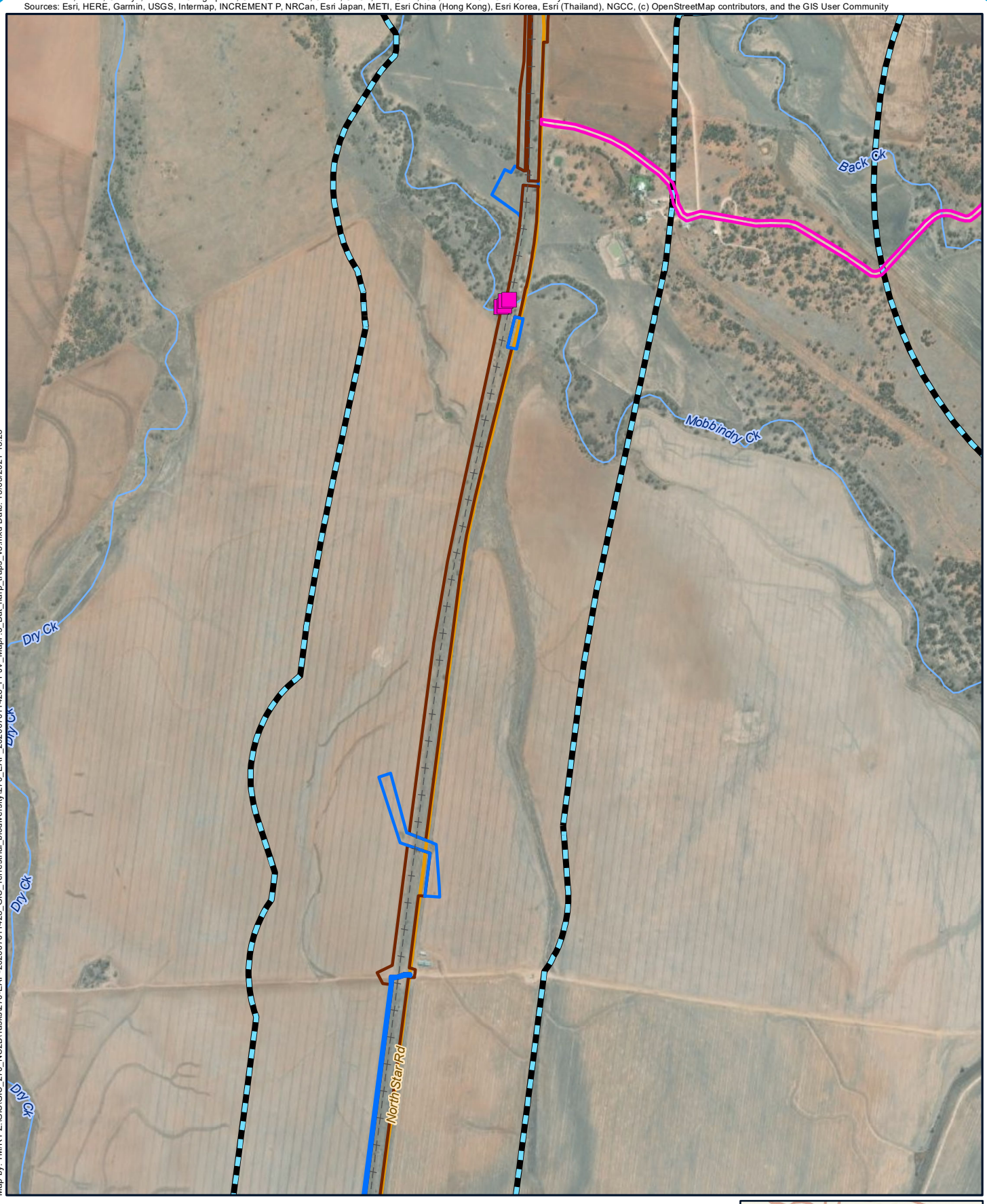
Future Freight
Integrating Community, Environment and Engineering

Date: 15/10/2021 Version: 0
Coordinate system: MGA56

North Star to QLD/NSW Border

Map F.2af: Masked owl (*Tyto novaehollandiae*)

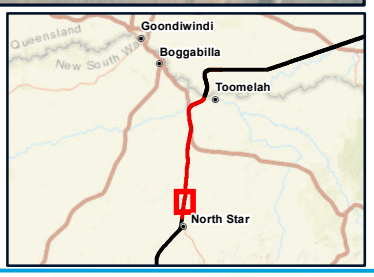
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF.3_Bat_harp_traps_v5.mxd Date: 13/05/2021 13:23

Legend

- Harp trap
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

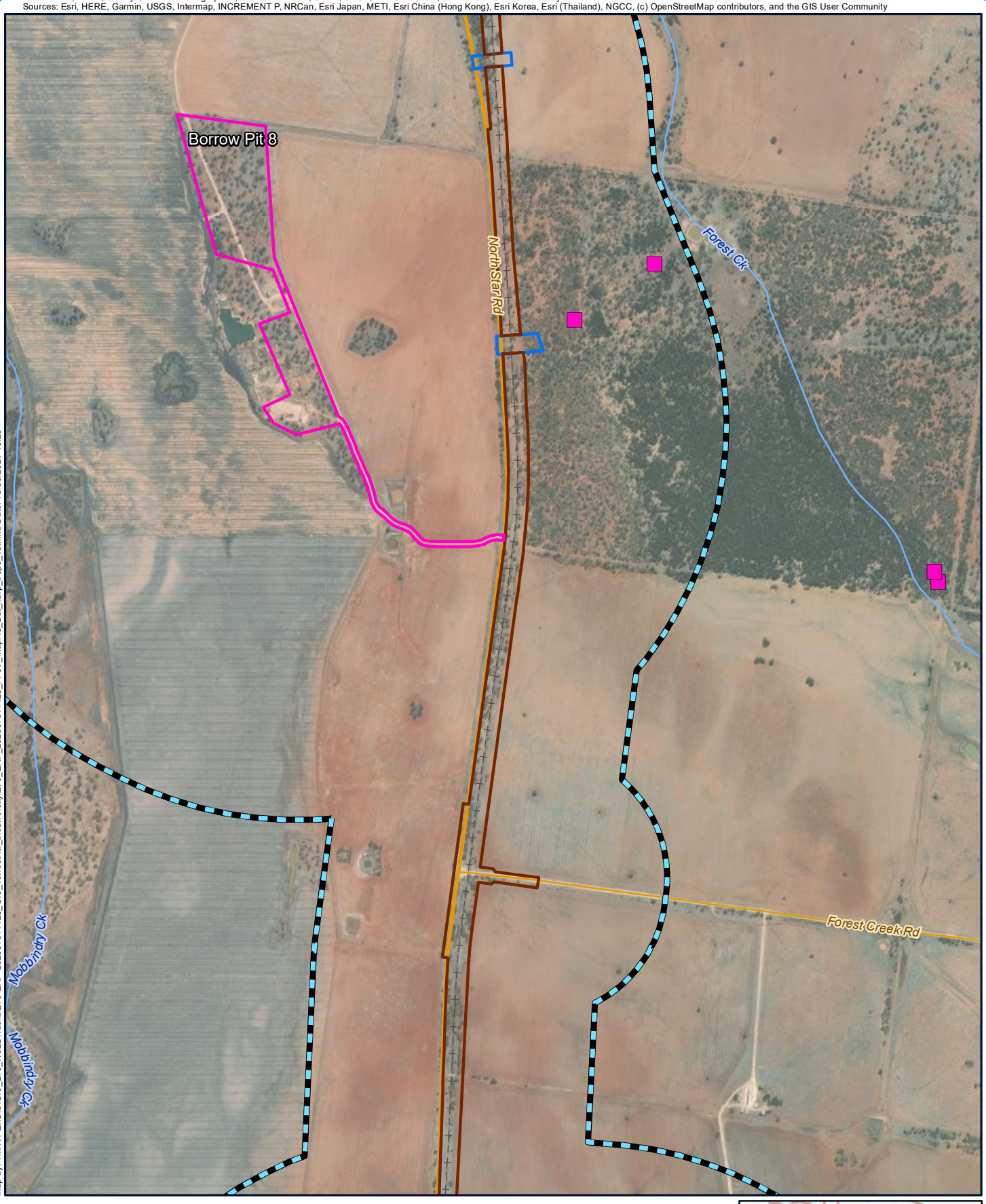
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 2
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map F.3a: Location of Harp traps

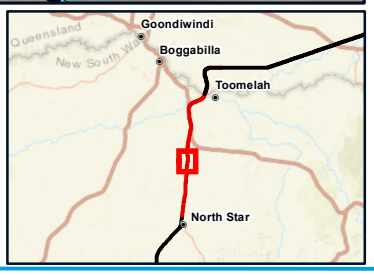
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF_JV_MapF.3_Bat_harp_traps_v5.mxd Date: 13/05/2021 13:23

Legend

- Harp trap
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Study area
- Subject land (borrow pit)
- Subject land (brownfield)
- Subject land (early works)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

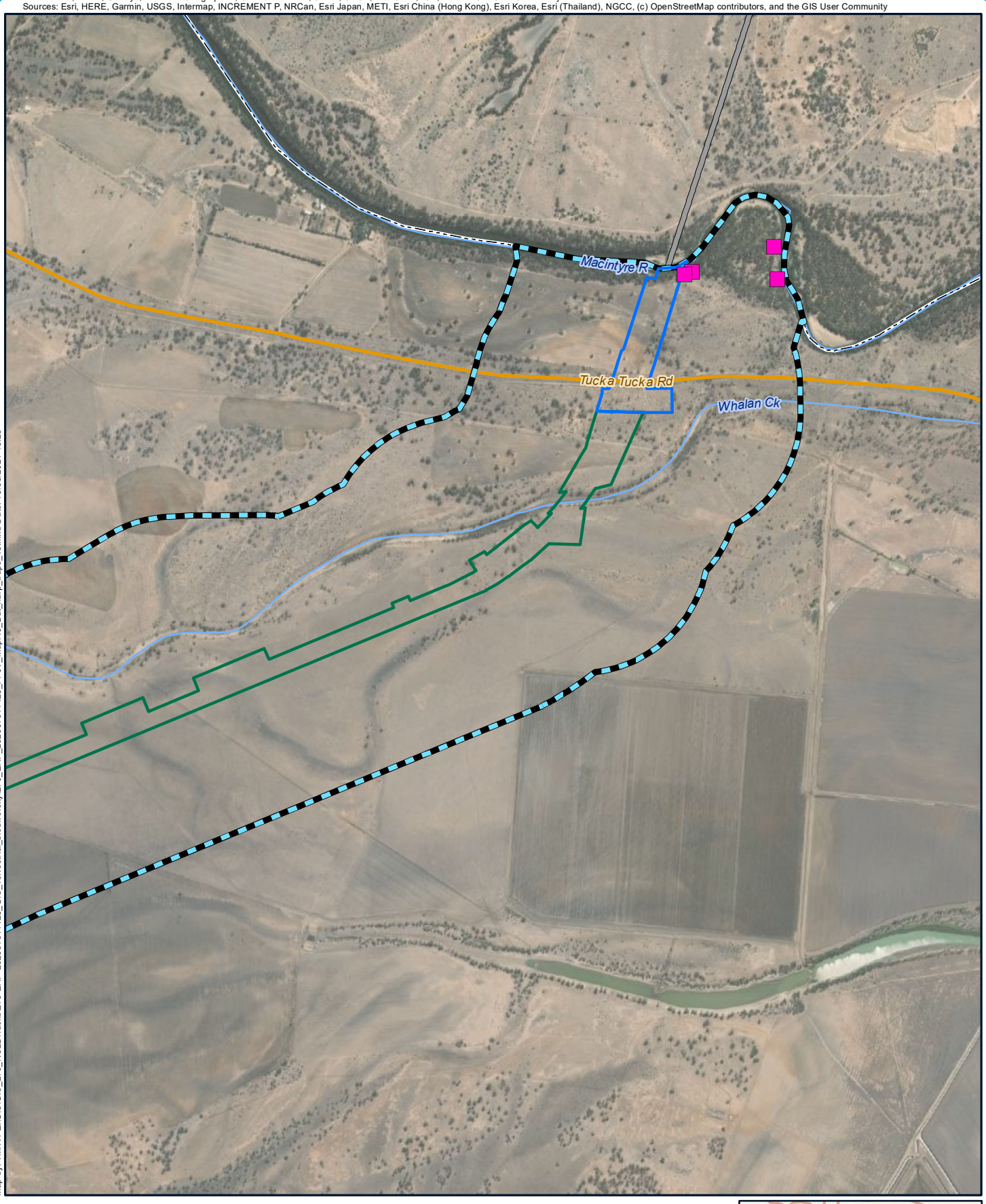
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 2
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map F.3b:
Location of Harp traps

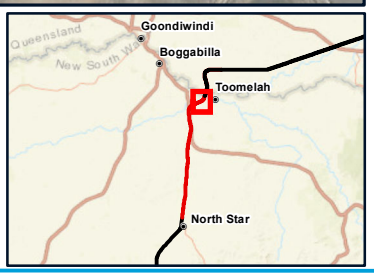
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF-JV_MapF.3_Bat_harp_traps_v5.mxd Date: 13/05/2021 13:23

Legend

- Harp trap
- Major roads
- Watercourses
- NSW/QLD border
- Study area
- Subject land (early works)
- Subject land (greenfield)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

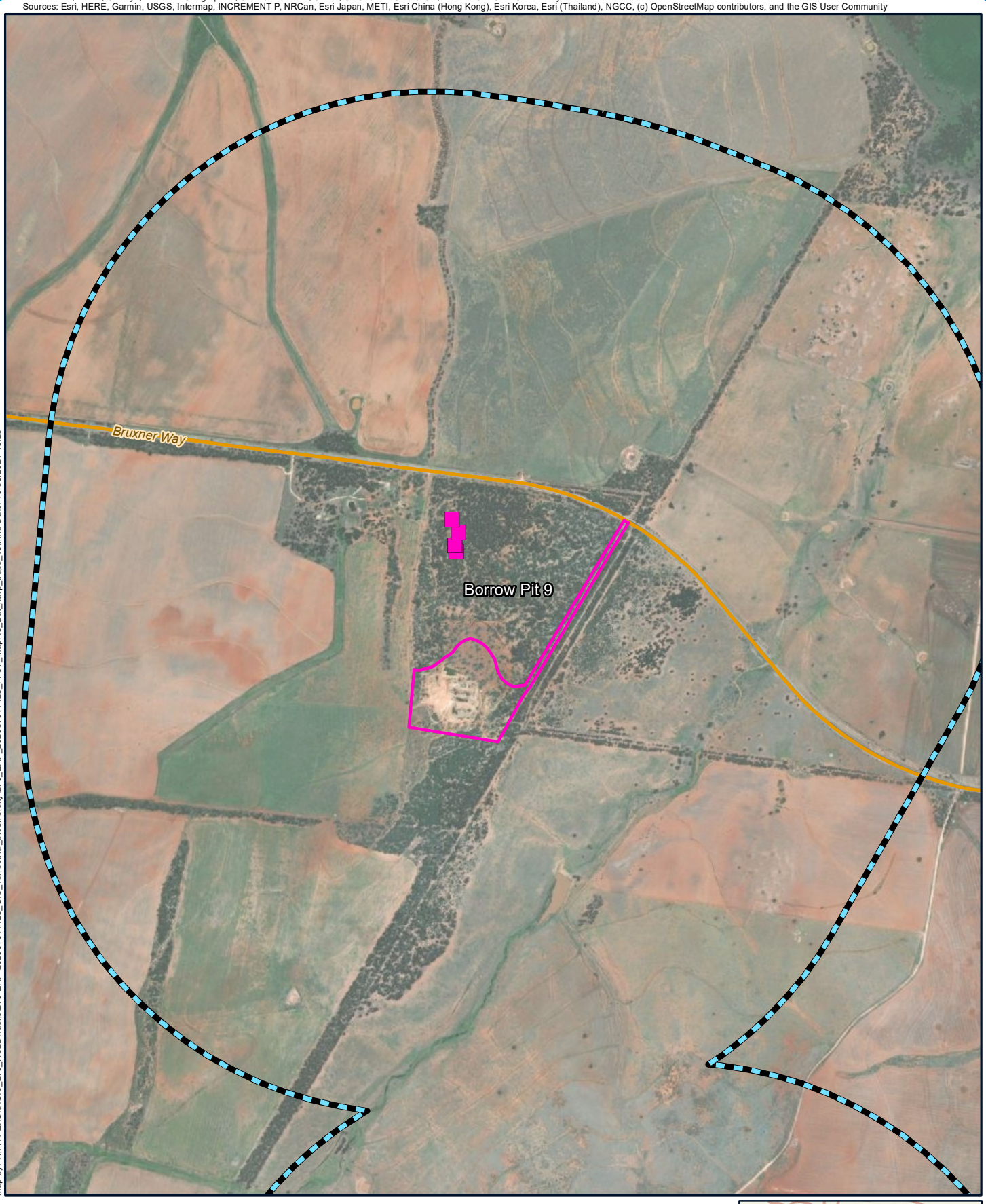
Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 2
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map F.3c: Location of Harp traps

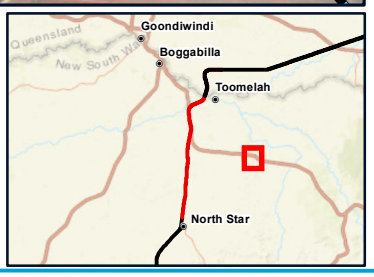
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map by: TM/RY Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-20200701428_GIS_Terrestrial_biodiversity\270_EAP_20200701428_FF JV_MapF 3_Bat_harp_traps_v5.mxd Date: 13/05/2021 13:23

Legend

- Harp trap
- Major roads
- Study area
- Subject land (borrow pit)



A4 scale: 1:20,000
0 0.1 0.2 0.3 0.4 0.5km

Future Freight
Integrating Community, Environment and Engineering

Date: 13/05/2021 Version: 2
Coordinate System: GDA 1994 MGA Zone 56

North Star to NSW/QLD border

Map F.3d:
Location of Harp traps

Appendix G
BAM credits - species profiles

Appendix G: Threatened species information summaries and polygon justification

Contents

Threatened species information summaries – ecosystem credit species 3
Threatened species information summaries – species credit flora species 9
Threatened species information summaries – species credit fauna species 26

Tables

Fauna

Table 1 Threatened species summary – *Phaps histrionica* | Flock bronzewing
Table 2 Threatened species summary – *Stictonetta naevosa* | Freckled duck
Table 3 Threatened species summary – *Falco hypoleucos* | Grey falcon
Table 4 Threatened species summary – *Antechinomys laniger* | Kultarr
Table 5 Threatened species summary - *Grantiella picta* | Painted Honeyeater
Table 6 Threatened species summary – *Aspidites ramsayi* | Woma
Table 7 Threatened species summary - *Homopholis belsonii* | Belson's panic
Table 8 Threatened species summary - *Dichanthium setosum* | Bluegrass
Table 9 Threatened species summary - *Platyzoma microphyllum* | Braid fern
Table 10 Threatened species summary - *Desmodium campylocaulon* | Creeping tick-trefoil
Table 11 Threatened species summary - *Cyperus conicus*
Table 12 Threatened species summary - *Digitaria porrecta* | Finger panic grass
Table 13 Threatened species summary - *Polygala linariifolia* | Native milkwort
Table 14 Threatened species summary - *Phyllanthus maderaspatensis*
Table 15 Threatened species summary - *Diuris tricolor* | Pine donkey orchid
Table 16 Threatened species summary - *Pomaderris queenslandica* | Scant pomaderris
Table 17 Threatened species summary - *Sida rohlenae* | Shrub sida
Table 18 Threatened species summary - *Swainsona sericea* | Silky swainson-pea
Table 19 Threatened species summary - *Swainsona murrayana* | Slender darling pea
Table 20 Threatened species summary - *Lepidium aschersonii* | Spiny peppercress
Table 21 Threatened species summary - *Tylophora linearis* | Slender tylophora
Table 22 Threatened species summary - *Lepidium monoplocoides* | Winged peppercress
Table 23 Threatened species summary - *Acacia jucunda* | Yetman wattle
Table 24 Threatened species summary - *Ardeotis australis* | Australian bustard
Table 25 Threatened species summary - *Ninox connivens* | Barking owl
Table 26 Threatened species summary - *Hamirostra melanosternon* | Black-breasted buzzard
Table 27 Threatened species summary - *Limosa limosa* | Black-tailed godwit (foraging)
Table 28 Threatened species summary - *Uvidicolus sphyrurus* | Border thick-tailed gecko
Table 29 Threatened species summary - *Setirostris eleryi* | Bristle-faced free-tailed bat, Hairy-nosed freetail Bat
Table 30 Threatened species summary - *Burhinus grallarius* | Bush stone-curlew
Table 31 Threatened species summary - *Nettapus coromandelianus* | Cotton pygmy-Goose
Table 32 Threatened species summary - Miniopterus orianae oceanensis | Large bentwing-bat
Table 33 Threatened species summary - *Vespadelus troughtoni* | Eastern cave bat
Table 34 Threatened species summary - *Cercartetus nanus* | Eastern pygmy-possum
Table 35 Threatened species summary - *Calyptorhynchus lathami* | Glossy black-cockatoo
Table 36 Threatened species summary - *Pteropus poliocephalus* | Grey-headed flying-fox
Table 37 Threatened species summary - *Phascolarctos cinereus* | Koala

Table 38 Threatened species summary - *Chalinolobus dwyeri* | Large-eared pied bat
Table 39 Threatened species summary - *Hieraaetus morphnoides* | Little eagle
Table 40 Threatened species summary - *Lophochroa leadbeateri* | Major Mitchell's cockatoo
Table 41 Threatened species summary - *Tyto novaehollandiae* | Masked owl
Table 42 Threatened species summary - *Hoplocephalus bitorquatus* | Pale-headed snake
Table 43 Threatened species summary - *Jalmenus eubulus* | Pale imperial hairstreak
Table 44 Threatened species summary - *Calyptorhynchus banksii samueli* | Red-tailed black-cockatoo
Table 45 Threatened species summary - *Aepyprymnus rufescens* | Rufous bettong
Table 46 Threatened species summary - *Crinia sloanei* | Sloane's froglet
Table 47 Threatened species summary - *Lophoictinia isura* | Square-tailed Kite
Table 48 Threatened species summary - *Geophaps scripta scripta* | Squatter pigeon
Table 49 Threatened species summary - *Petaurus norfolcensis* | Squirrel glider
Table 50 Threatened species summary - *Polytelis swainsonii* | Superb parrot
Table 51 Threatened species summary - *Lathamus discolor* | Swift parrot
Table 52 Threatened species summary - *Haliaeetus leucogaster* | White-bellied sea-eagle
Table 53 Threatened species summary - *Amalosia rhombifer* | Zigzag velvet gecko

Threatened species information summaries – ecosystem credit species

Table 1 Threatened species summary – *Phaps histrionica* | Flock bronzewing

Aspect	Description
Species name	■ Flock bronzewing
Scientific name	■ *Phaps histrionica*
BC Act	■ E
EPBC Act	■ -
Credit Type	■ Ecosystem
Habitat Requirements	■ Observed in a variety of vegetation types, including grassy plains, saltbush, spinifex and open mulga. Its preferred habitat is tussock grassland, particularly Mitchell grassland. They need to drink daily and may be seen adjacent to water, e.g. at stock tanks, bore drains and pools in water courses. Rest on the ground during the day and nest in a simple scrape on the ground in the cover of a bush, low branch, grass tussock, or in dust on bare ground around bores, often in close proximity to many others of the same species. Fairly common but highly nomadic ■ Patchily distributed and rarely observed in NSW. It is likely to occur north of Broken Hill and west of Cobar when conditions are right. The extensive Mitchell grasslands around Brewarrina and Goodooga should also provide suitable habitat (OEH 2017).
Potential habitat in study area	■ PCT 52 ■ There is potential grassland habitat within the study area
Survey requirements	■ N/A
Survey effort	■ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (six surveys carried out in nominated PCT).
Presence in the study area	■ No records of the species during the October 2018 or other surveys and the species is easy to locate where present in grassland areas. ■ There are few scattered database records (AoLA 2021) in the wider region, all located west and south of the proposal. Almost all records in the region are older (<1976). The most recent record (1993) in the wider area is located 150 km south-west of North Star ■ BioNet has no record of the species within 75km of the proposal
Polygon justification	■ Vagrant ■ Remove from all areas. The study area is outside of the species current distribution. Any occurrence of the species would be considered as vagrant to the area.
IBRA subregions	■ Castlereagh-Barwon
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Office of Environment and Heritage (2017) Flock bronzewing – profile (last updated 1 December 2017). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10612 [accessed 12 January 2021]

Table 2 Threatened species summary – *Stictonetta naevosa* | Freckled duck

Aspect	Description
Species name	▪ Freckled duck
Scientific name	▪ *Stictonetta naevosa*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Ecosystem
Habitat Requirements	▪ Freckled ducks occurs primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system. The species disperses during extensive inland droughts when wetlands in the Murray River basin provide important habitat (OEH 2017). ▪ In the south-east the species breeds in permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds (OEH 2017).
Potential habitat in study area	▪ PCT 53,247 ▪ Species may occur on larger farm dams in the wider area following dispersal from drought conditions in south-east Australia.
Survey requirements	▪ N/A
Survey effort	▪ Daylight surveys at farm dams carried out during October 2019 surveys. Six bird surveys carried out in nominated PCTs but little water present.
Presence in the study area	▪ Species was not recorded during any surveys ▪ There are scattered database records (AoLA 2021) in the wider area, some of which are in close vicinity to the proposal. There are six records of the species scattered to the immediate west between the northern extent of the proposal and Goondiwindi (within 18 km) ranging in age from 1999 to 2019. There is also a record from 2007 located 13 km west of North Star.
Polygon justification	▪ Vagrant ▪ Remove from BAM-C
PCTs	▪ 36, 53, 247
IBRA subregions	▪ Northern Basalts ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2017). Freckled duck - profile. Updated 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10771 [Accessed 28 January 2021]

Table 3 Threatened species summary – *Falco hypoleucos* | Grey falcon

Aspect	Description
Species name	▪ Grey falcon
Scientific name	▪ *Falco hypoleucos*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Ecosystem
Habitat Requirements	▪ Grey falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The breeding range has contracted since the 1950s with most breeding now confined to arid parts of the range (OEH 2017). ▪ Grey falcon is considered to occupy the arid and semi-arid zone of Australia where annual rainfall is <500 mm. Younger individuals may disperse outside of this habitat in drought years that follow wet years in inland Australia. The total population size is now generally accepted to be <1,000 mature individuals (Schoenjahn 2018, DAWE 2021). Known breeding sites in NSW are all in the arid zone well west of the proposal (refer Schoenjahn 2018). The species appears to be partially nomadic, responding to local drought conditions. Preferred habitat including sparsely timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter (DAWE 2021). ▪ It is noted average annual rainfall in the region in which the proposal occurs is >600 mm (BoM 2021) which is outside the generally accepted range of the species as identified above.
Potential habitat in study area	▪ PCT 35, 36, 52, 56, 192, 244, 247, 628 ▪ Much of the study area could be considered suitable foraging habitat for the species.
Survey requirements	▪ N/A
Survey effort	▪ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (54 surveys carried out in nominated PCTs). Searches for raptor nests also carried out at all sites during bird surveys and habitat assessments.
Presence in the study area	▪ No breeding pairs or individuals recorded during October 2018 and 2019 surveys ▪ There are few sparsely scattered database records (AoLA 2021) in the wider region surrounding the proposal. These are largely to the west and south-west of the study area. There are no records within 140 km to the north and east. The nearest records are 40 km and 60 km west of North Star and are older (<1976). The nearest recent records (2009 and 2013) are located north-west of Moree (75 km south-west of the study area).
Polygon justification	▪ Vagrant ▪ Remove from BAM-C ▪ The species core range is in the arid zone to the west of the proposal and it is not known to occur more than sporadically in the wider region to the west and south of the proposal.
IBRA subregions	▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Bureau of Meteorology (BoM) (2021). *Climate data online.* Available from: www.bom.gov.au ▪ Department of Agriculture, Water and Environment (DAWE) (2021). Grey falcon in Species Profile and Threats Database, DAWE, Canberra. Available from: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=929 [Accessed 21 January 2021] ▪ Office of Environment and Heritage (2017) Grey falcon – Profile (last updated 1 December 2017). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10330 [accessed 14 January 2021] ▪ Schoenjahn, J (2018). *Adaptations of the rare endemic Grey Falcon Falco hypoleucos that enable its permanent residence in the arid zone of Australia.* PhD Thesis, University of Queensland, Brisbane.

Table 4 Threatened species summary – *Antechinomys laniger* | Kultarr

Aspect	Description
Species name	▪ Kultarr
Scientific name	▪ *Antechinomys laniger*
BC Act	▪ E
EPBC Act	▪ -
Credit Type	▪ Ecosystem
Habitat Requirements	▪ Widespread across arid and semi-arid NSW but present in very low numbers. Inhabits open country, especially claypans among Acacia woodlands. Nocturnal, sheltering by day in hollow logs or tree-stumps, beneath saltbush and spinifex tussocks, in deep cracks in the soil and in the burrows of other animals. Populations appear to fluctuate seasonally in response to environmental stresses, including declines following periods of drought and intensive flooding (OEH 2017)
Potential habitat in study area	▪ PCT 52, 56, 192, 244, 247 ▪ No potential arid or semi-arid habitat present for this species. Habitat within identified subregion has been heavily impacted by land use and is largely cleared of native vegetation.
Survey requirements	▪ N/A
Survey effort	▪ No specific surveys targeting this species. Spotlighting surveys in October 2018 and 2019 including 85 site surveys throughout study area (18 surveys in nominated PCTs). Camera trap surveys included baited ground based camera traps.
Presence in the study area	▪ No record from proposal surveys in study area ▪ There are no database records (AoLA 2021) of the species in the region surrounding the study area. The nearest record is 390 km north of the proposal (in Qld) and is not dated. The nearest record in NSW is from 1900 and located 450 km west of the proposal. The nearest recent record is from 2002 and located 800 km west of the proposal. The study area is located well outside of the known occurrence of the species. ▪ There are no BioNet records of the species between Booni, Moree and Yetman
Polygon justification	▪ Geographic limitation ▪ Exclude all PCTs – study area is located outside of the species known and historical distribution.
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2017) Kultarr – Profile (last updated 27 October 2017). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10057 [Accessed 30 November 2020]

Table 5 Threatened species summary - *Grantiella picta* | Painted Honeyeater

Aspect	Description
Species name	▪ Painted Honeyeater
Scientific name	▪ *Grantiella picta*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Ecosystem
Habitat Requirements	▪ The Painted honeyeater inhabits mistletoes in eucalypt forests/woodlands, riparian woodlands of black box and River red gum, box-ironbark-Yellow gum woodlands, Acacia-dominated woodlands, paperbarks, casuarinas, Callitris, and trees on farmland or gardens. The species is often associated with following tree species: *Acacia harpophylla, Acacia homalophylla, Acacia pendula, Allocasuarina luehmannii, Eucalyptus largiflorens* and *Eucalyptus camaldulensis* (Department of the Environment, Australian Government (2015), Conservation NSW Environment, Energy and Science (2019)).
Potential habitat in study area	▪ Mistletoes are more likely to be present in higher quality woodland PCTs with a higher density of large trees. It is more common in wider blocks of remnant woodland than in narrower strips, although it has been observed to breed in relatively narrow roadside strips when ample mistletoe fruit is available.
Survey requirements	▪ N/A
Survey effort	▪ Bird surveys carried out in October 2018 and 2019 including call playback and spotlighting including 75 site surveys throughout study area (42 surveys in nominated PCTs).
Presence in the study area	▪ Single bird recorded during October 2019 surveys in Poplar box woodlands ▪ There are numerous database records (AoLA 2021) in the wider area surrounding the proposal including a 2006 record less than 1 km from the central portion of the alignment. There is a cluster of records between the Newell Highway and the alignment (6 to 18 km from the proposal) to the north-west of North Star ranging in age from 1986 to 2019.
Polygon justification	▪ Microhabitat requirements – mistletoes ▪ Remove from low quality PCTs. The species is a specialist feeder on the fruit of mistletoes which require larger trees to grow on. The low-quality PTCs contain no trees therefore there is little or no habitat for mistletoes and henceforth no suitable habitat for the Painted honeyeater in low-quality PCTs. ▪ Species recorded in study area ▪ Medium to high PCTs are considered habitat
PCTs	▪ 27, 35, 36, 55, 56, 98, 147, 192, 244, 628 (medium and high quality)
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Department of the Environment, Australian Government (2015). Conservation Advice: *Grantiella picta* painted honeyeater. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf [Accessed on 16 October 2019]. ▪ NSW Environment, Energy and Science (2019). BioNet Atlas. Office of Environment and Heritage. Available from: http://www.bionet.nsw.gov.au/ [Accessed 12 September 2019].

Table 6 Threatened species summary – *Aspidites ramsayi* | Woma

Aspect	Description
Species name	▪ Woma
Scientific name	▪ *Aspidites ramsayi*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Ecosystem
Habitat Requirements	▪ Terrestrial, inhabiting subtropical to temperate deserts and sandy plains, as well as dunefields and deep cracking black soil plains in semi-arid areas. Occurs in hummock grasslands, shrublands or woodlands and shelters in animal burrows, hollow logs or under grass hummocks. Feeds at night on lizards, snakes, birds and small mammals, which it captures using a range of strategies (OEH 2017).
Potential habitat in study area	▪ PCT 36, 56, 192, 247 ▪ No potential arid or semi-arid habitat present for this species. Habitat within identified subregion has been heavily by land use and is largely cleared of native vegetation.
Survey requirements	▪ N/A
Survey effort	▪ No specific surveys targeting this species. Spotlighting surveys in October 2018 and 2019 including 85 site surveys throughout study area (18 surveys in nominated PCTs).
Presence in the study area	▪ No record from proposal surveys in study area ▪ There are no database records (AoLA 2021) of the species in NSW in the region surrounding the study area. There are no records to the north of the study area. The nearest record is from 2004 and is located over 190 km north-west of the study area (in Qld). The nearest record in NSW is over 900 km west of the study area. There is no evidence to suggest the species will occur or has ever occurred in the area.
Polygon justification	▪ Geographic limitations ▪ All PCTs excluded - study area is located well outside of the known range of the species. ▪ BioNet has no record of the species between Boomi, Moree, Yetman and Boggabilla ▪ Well outside of the species know range and habitat
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/. ▪ Office of Environment and Heritage, NSW (2017). Woma - profile (updated 7 September 2017*)*. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10069 [Accessed 11 February 2021].

Threatened species information summaries – species credit flora species

Table 7 Threatened species summary - *Homopholis belsonii* | Belson's panic

Aspect	Description
Species name	■ Belson's panic
Scientific name	■ *Homopholis belsonii*
BC Act	■ E1
EPBC Act	■ V
Credit Type	■ Species
Habitat Requirements	■ Belson's panic has been known to grow often in poor soils in dry woodlands especially in NSW as well as in areas which receive irregular or intermittent flooding, where Belson's panic can be found on higher, well-drained rises. An elevation level of 200 to 520 m is required for the species in NSW whilst in Queensland, the species range from 342 to 500 m elevation (DAWE 2021). ■ The species can be classified to grow in three specific habitats which include: – Rocky and basaltic hills featuring White Box (*Eucalyptus albens*) and Wilga (*Geijera parviflora*) woodlands with various shrub and grass species – Flat to gently undulating alluvial areas featuring Belah (*Casuarina cristata*) forests and occasionally Brigalow (*Acacia harpophylla*) forests – Drainage lines featuring Belah and sandy country dominated by Cypress Pine-Bloodwood-Ironbark-She-Oak Forest (TSSC 2008).
Potential habitat in study area	■ A total of up to 359 ha of potential habitat
Survey requirements	■ December to April
Survey effort	■ 170 hours of transect surveys completed in January 2021 ■ Transects of 10m in open vegetation or 5m transects in dense vegetation
Presence in the study area	■ Recorded in January 2021 surveys – the survey findings increased the extent of the species into the Castlereagh-Barwon IBRA subregion. ■ 46 ha of calculated habitat
Polygon justification	■ Mapped in all locations where the species was recorded.
PCTs	■ Associated PCTs in which species is predicted to occur: 27, 35, 52 ,55, 56, 98, 147, 244
IBRA subregions	■ Castlereagh-Barwon – added post survey findings ■ Northern Basalts ■ Northern Outwash
References	■ Department of the Environment (2019). *Homopholis belsonii* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat. [Accessed 17 September 2019]. ■ Threatened Species Scientific Committee (2008). Commonwealth Conservation Advice on *Homopholis belsonii*. Available from http://www.environment.gov.au/biodiversity/threatened/species/pubs/2406-conservation-advice.pdf [Accessed 18 September 2019].

Table 8 Threatened species summary - *Dichanthium setosum* | Bluegrass

Aspect	Description
Species name	▪ Bluegrass
Scientific name	▪ *Dichanthium setosum*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Species
Habitat Requirements	▪ Bluegrass is associated with heavy basaltic black soils and red-brown loam with clay subsoil and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture. The extent to which this species tolerates disturbance is unknown (OEH 2020). ▪ The species occurs within the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland (OEH 2020).
Potential habitat in study area	▪ Up to 430 ha of potential habitat
Survey requirements	▪ Use seed-head to identify. ▪ November to May 3 to 4 weeks after effective rainfall
Survey effort	▪ 260 hours of targeted transect surveys completed in January 2021 ▪ One person @ 1.5 km per hour 10m transects open vegetation or 5m transect in dense vegetation ▪ Targeted survey was conducted in January 2021 after the region had experienced 184 mm of rain in December 2020 and the first week of January 2021. This was following a significant period of drought, and as such late January 2021 was considered and ideal survey window for the species.
Presence in the study area	▪ BioNet record within 10km <10 years old - 1 record 2018
Polygon justification	▪ Removed from areas which received targeted survey as no individuals were recorded during the targeted survey in January 2021 or in any other surveys within the project area. Mapping remains in place for PCT52 as access was not available to this area for survey.
PCTs	▪ Associated PCTs in which species is predicted to occur: 27, 35, 52, 55, 56, 418, 628
IBRA subregions	▪ Castlereagh-Barwon ▪ Northern Basalts ▪ Northern Outwash
References	▪ Ayers, D, Nash, S, and Baggett, K (Eds) (1996), Threatened Species of Western New South Wales, New South Wales National Parks and Wildlife Service, Hurstville ▪ NSW Office of Environment and Heritage (2020), *Dichanthium setosum* – Profile, viewed 8 December 2020 at https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10221

Table 9 Threatened species summary - *Platyzoma microphyllum* | Braid fern

Aspect	Description
Species name	■ Braid fern
Scientific name	■ *Platyzoma microphyllum*
BC Act	■ E
EPBC Act	■ -
Credit Type	■ Species
Habitat Requirements	■ Braid fern grows in sandy or swampy soils, or in clay soils adjacent to water where it is subject to periodic flooding. Associated species include *Hakea dactyloides, Brachyloma daphnoides, Jacksonia scoparia, Xylomelum cunninghamii, Calytrix tetragona, Leptospermum species, Brachyloma daphnoides* and *Lomandra* species. It has also been found in Callitris woodland in sandy soil (OEH 2018).
Potential habitat in study area	■ Up to 17 ha of potential habitat ■ In NSW, this species is only known from Dthinna Dthinnawan National Park to the east of the study area (OEH 2018a).
Survey requirements	■ All year (rainfall dependant)
Survey effort	■ 11 hours of transect surveys completed in January 2021 ■ Maximum distance of 10m slow transects in wet conditions ■ Targeted survey was conducted in January 2021 after the region had experienced 184 mm of rain in December 2020 and the first week of January 2021. This was following a significant period of drought, and as such late January 2021 was considered and ideal survey window for the species.
Presence in the study area	■ No BioNet record within 10km <10 years old
Polygon justification	■ Remove from mapping – No individuals were recorded during the targeted survey in January 2021 or noted in late October 2019 when the sites were also waterlogged/wet.
PCTs	■ Associated PCTs in which species is predicted to occur: 53, 247
IBRA subregions	■ Northern Basalts ■ Castlereagh-Barwon
References	■ Office of Environment and Heritage, NSW (2018). Braid fern - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10636 [Accessed 26 October 2018]

Table 10 Threatened species summary - *Desmodium campylocaulon* | Creeping tick-trefoil

Aspect	Description
Species name	■ Creeping tick-trefoil
Scientific name	■ *Desmodium campylocaulon*
BC Act	■ *E1*
EPBC Act	■ -
Credit Type	■ Species
Habitat Requirements	■ Usually found in clay soils with *Astrebla* and *Iseilema* species. In New South Wales it grows on cracking black soils in the Narrabri, Moree and Walgett regions. Other associated species include *Acacia harpophylla, Astrebla pectinata* and *Sorghum, Dichanthium* and *Panicum* species (OEH 2019). ■ Grows in grassland on brown soil plains, chiefly in the Collarenebri district. (BioNet 2021).
Potential habitat in study area	■ Up to 147 ha of potential habitat
Survey requirements	■ December to April
Survey effort	■ 70 hours of transect surveys completed in January 2021 ■ No access granted to PCT 52 ■ Transects completed at 1.5 per hour 10m transects open vegetation or 5m transect in closed vegetation ■ The species was sighted by the survey team in Moree prior to starting the survey effort.
Presence in the study area	■ No BioNet record within 10km <10 years old ■ None recorded within the field survey areas however may be present within PCT52
Polygon justification	■ Removed from areas which have been subject to targeted survey however has remained mapped in PCT52 and PCT 244 where survey has not occurred due to land access being not available during survey window.
PCTs	■ Associated PCTs in which species is predicted to occur: 27, 35, 52
IBRA subregions	■ Northern Basalts ■ Northern Outwash ■ Castlereagh-Barwon
References	■ Office of Environment and Heritage (2019). Creeping Tick-trefoil - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10219 [Accessed 19 September 2019]

Table 11 Threatened species summary - *Cyperus conicus*

Aspect	Description
Species name	▪ Cyperus conicus
Scientific name	▪ *Cyperus conicus*
BC Act	▪ E1
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Associated with vegetation communities including Melaleuca swamps, open Box woodland and sedgelands. Habitat features include floodplains, creed beds and banks, swamps, run-on areas and various watercourses along with bores and dams. This species is also associated with *C.victoriensis, C.difformis, C.iria, C.compressus, C.nervulosus, C.dactylotes, Fimbristylis* species *and C.fulvus*.. ▪ The population status of *Cyperus conicus* ranges from very rare and occasional, to common and abundant in some populations (OEH 2019).
Potential habitat in study area	▪ Up to 160 ha of potential habitat
Survey requirements	▪ January to May after rain ▪ Use flowers to identify. Can identify by flower head.
Survey effort	▪ 106 hours of transect surveys completed in January 2021 ▪ 10m transects open vegetation or 5m transect in closed vegetation ▪ Targeted survey was conducted in January 2021 after the region had experienced 184 mm of rain in December 2020 and the first week of January 2021. This was following a significant period of drought, and as such late January 2021 was considered and ideal survey window for the species.
Presence in the study area	▪ BioNet record within 10km <10 years old - 1 record 2018
Polygon justification	▪ Removed from mapping - None were noted during the targeted survey nor during any previous survey efforts
PCTs	▪ Associated PCTs in which species is predicted to occur: PCT 55, 56, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Office of Environment and Heritage (2018). *Cyperus conicus* - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10198 [Accessed 25 October 2018].

Table 12 Threatened species summary - *Digitaria porrecta* | Finger panic grass

Aspect	Description
Species name	▪ Finger panic grass
Scientific name	▪ *Digitaria porrecta*
BC Act	▪ E1
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Most frequently recorded within native grassland, woodlands or open forest with a grassy understorey, on richer soils. Associated overstorey species most commonly include *Eucalyptus albens* and *Acacia pendula,* and associated grasses and forbs may include *Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum* and *Neptunia gracilis.* Often found along roadsides and travelling stock routes where there is light grazing and occasional fire (OEH 2021).
Potential habitat in study area	▪ Up to 412 ha of potential habitat
Survey requirements	▪ January to February
Survey effort	▪ 275 hours of transect surveys completed in January 2021 ▪ One person @ 1.5km per hour 10m transects open vegetation or 5m transect in closed vegetation
Presence in the study area	▪ Recorded in January 2021 surveys – total of 167 ha ▪ No BioNet record within 10km <10 years old
Polygon justification	▪ Mapped in all areas where the species was recorded (167 ha).
PCTs	▪ Associated PCTs in which species is predicted to occur: 27, 35, 52, 55, 56, 244, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Office of Environment and Heritage, NSW (2021) Finger Grass Panic – Profile – Available from https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10222#:~:text=Finger%20Panic%20Grass%20is%20a,stalk%20in%20a%20cylinder%20shape [Accessed 11 January 2021]

Table 13 Threatened species summary - *Polygala linariifolia* | Native milkwort

Aspect	Description
Species name	▪ Native milkwort
Scientific name	▪ *Polygala linariifolia*
BC Act	▪ E
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ *Polygala linariifolia* grows in sandy soils in dry eucalypt forest and woodland with a sparse understorey. It has also been recorded growing in dark sandy loam on granite at Inverell and Torrington districts in shrubby forests of *Eucalyptus caleyi, E.dealbata* and *Callitris*, along with yellow podsolic soil on granite in layered open forest (OEH 2019).
Potential habitat in study area	▪ Up to 66 ha of potential habitat
Survey requirements	▪ October to January ▪ Use flowers to identify, as easily confused with Polygala japonica. Reliably flowering, Oct - Feb, but will flower sporadically at other times throughout the year. (BioNet 2021) ▪ Senescence: May persist longer than 5 years, but in some circumstances acts as a short-lived perennial or annual.
Survey effort	▪ 44 hours of transect surveys completed in January 2021 ▪ One person @ 1.5km per hour 10m transects open vegetation
Presence in the study area	▪ None recorded during targeted surveys in January 2021 ▪ No BioNet record within 20km <10 years old
Polygon justification	▪ Assumed presence in PCT 192 in Borrow Pit 5 due to survey exclusion ▪ Removed from all other mapping as not recorded during targeted surveys
PCTs	▪ Associated PCTs in which species is predicted to occur: 192, 418
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Office of Environment and Heritage, NSW (2019). *Polygala linariifolia.* Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10643 . [Accessed: 25 September 2019]

Table 14 Threatened species summary - *Phyllanthus maderaspatensis*

Aspect	Description
Species name	▪ Phyllanthus maderaspatensis
Scientific name	▪ *Phyllanthus maderaspatensis*
BC Act	▪ E1
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Occurs in floodplain areas on heavy soils and may rely on appropriate and intermittent rainfall and flooding events. It is often associated with open grasslands and eucalypt woodlands in or near creek beds, and grassy flats and levees near watercourses (OEH 2017).
Potential habitat in study area	▪ Up to 19 ha of potential habitat
Survey requirements	▪ September to March, 4 weeks after above average rainfall ▪ Use flowers and or seeds to identify as easily confused with Phyllanthus lacerosus. Generally flowers in spring and summer and sets seeds in March under appropriate conditions. ▪ Easily confused with Phyllanthus lacerosus, differing in seeds and stipules.
Survey effort	▪ 13 hours of targeted transect surveys completed in January 2021 ▪ One person @ 1.5 km per hour 10m transects open vegetation or 5m transect in closed vegetation ▪ Targeted survey was conducted in January 2021 after the region had experienced 184 mm of rain in December 2020 and the first week of January 2021. This was following a significant period of drought, and as such late January 2021 was considered and ideal survey window for the species.
Presence in the study area	▪ Not found ▪ No BioNet record within 10km <10 years old
Polygon justification	▪ Remove from all areas as not recorded during targeted survey effort in January 2021 or in any other survey period.
PCTs	▪ Associated PCTs in which species is predicted to occur: 36, 247
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Office of Environment and Heritage, NSW (2018). *Phyllanthus maderaspatensis* - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10623 [Accessed 26 October 2018

Table 15 Threatened species summary - *Diuris tricolor* | Pine donkey orchid

Aspect	Description
Species name	▪ Pine donkey orchid
Scientific name	▪ *Diuris tricolor*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Usually recorded in disturbed habitats. It is associated with species such as *Callitris glaucophylla, Eucalyptus populnea, E. intertexta* as well as Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine species. It is found in sandy soils, either on flats or small rises (OEH 2018)
Potential habitat in study area	▪ Up to 202 ha of potential habitat
Survey requirements	▪ September to October
Survey effort	▪ 135 hours of transect surveys completed in September 2020 ▪ One person @ 1.5km per hour 10m transects open vegetation
Presence in the study area	▪ Not recorded in study area during targeted surveys ▪ There are no database records of the species (AoLA 2021) within 50 km of the proposal. The nearest records are located 66 km north-east of the Macintyre River crossing area (1992 and 1996 in QLD) and over 65 km south of North Star near Warialda (1992 and other undated records).
Polygon justification	▪ Species credit exclusion: The species was not recorded during targeted surveys in September 2020 (when the species is in flower) or during any other survey for the proposal. An email from DPIE just prior to 2020 survey effort confirmed that it was a suitable window for the survey to occur as the species was present at other known locations. Species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 56
IBRA subregions	▪ Northern Basalts
References	▪ Office of Environment and Heritage, NSW (2018). Pine donkey orchid - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10243 [Accessed 25 October 2018].

Table 16 Threatened species summary - *Pomaderris queenslandica* | Scant pomaderris

Aspect	Description
Species name	▪ Scant pomaderris
Scientific name	▪ *Pomaderris queenslandica*
BC Act	▪ E
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Mostly found in moist eucalypt forest or sheltered woodlands with a shrubby understory, and occasionally along creeks (OEH 2019).
Potential habitat in study area	▪ Up to 47 ha of potential habitat
Survey requirements	▪ September to March (BioNet 2021). ▪ Flowers are useful to identify, as easily confused with P. intermedia, however species can be distinguished by leaf morphology - P. intermedia generally has a much larger leaf compared to P. queenslandica. (BioNet 2021). ▪ Species has a large range. (BioNet 2021).
Survey effort	▪ 60 hours of targeted survey during September 2020 and January 2021 ▪ No BioNet record within 10km <10 years old
Presence in the study area	▪ Not found during either targeted survey effort in 2020 or 2021 both within the survey window.
Polygon justification	▪ Species credit exclusion: The species was not recorded during targeted surveys in September 2020 or January 2021 (when the species is in flower) or during any other survey for the proposal. Species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 418
IBRA subregions	▪ Northern Basalts
References	▪ Office of Environment and Heritage (2017). *Pomaderris queenslandica* (Scant pomaderris). Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10656 [Accessed 25 September 2019]

Table 17 Threatened species summary - *Sida rohlenae* | Shrub sida

Aspect	Description
Species name	▪ Shrub sida
Scientific name	▪ *Sida rohlenae*
BC Act	▪ E1
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Grows on flood-out areas, creek banks and at the base of rocky hills. In NSW it is recorded from roadsides in hard red loam to sandy-loam soils and is often more common in disturbed sites (OEH 2020).
Potential habitat in study area	▪ Up to 265 ha of potential habitat
Survey requirements	▪ September to February ▪ Flowering and fruiting across whole distribution should occur between Sep - Feb. ▪ Survey multiple times over the specified months if not found during the first survey.
Survey effort	▪ Multiple survey efforts during September and October 2018 as part of BAM plot data collection including early meandering transects which produced several Sida samples which were sent to the herbarium for identification. None returned as *S.rohlenae*. Since then over 1,000 hours of targeted surveys for other species have not resulted in any observation of unidentified Sida sp.
Presence in the study area	▪ Not found during targeted survey effort within defined survey period. Samples of Sida sp. were sent to the herbarium for identification and were returned as other sida species. The single record of the species (just north of North Star) in the Bionet database is a misidentification from earlier ARTC surveys. This is the only record within 50km in more than 50 years.
Polygon justification	▪ Species credit exclusion: The species was not recorded during targeted surveys in 2018, 2019 or in multiple other nontarget surveys in 2020 and 2021 (when the species is in flower) or during any other survey for the proposal. Species excluded from further assessment under the BAM. ▪ Geographic limitation: Areas of PCT 98 within the subject land are only located within the Northern Basalts and Northern Outwash IBRA subregions. As the species is only associated with Castlereagh-Barwon IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), PCT 98 has been excluded from polygon mapping.
PCTs	▪ Associated PCTs in which species is predicted to occur: 56, 244, 628 ▪ Associated PCTs located outside of known geographic range of species: 98
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Office of Environment and Heritage (2020) Shrub Sida – Profile (last updated 15 June 2020) https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10756 [Accessed 12 January 2021]

Table 18 Threatened species summary - *Swainsona sericea* | Silky swainson-pea

Aspect	Description
Species name	▪ Silky swainson-pea
Scientific name	▪ *Swainsona sericea*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Found in Box-gum woodland in the southern tablelands and south west slopes. It is sometimes found in association with cypress-pines *Callitris* spp. (OEH 2018).
Potential habitat in study area	▪ Up to 275 ha of potential habitat
Survey requirements	▪ Targeted survey between September and November ▪ Survey months differ based on location. Survey Oct - Nov on Monaro. Survey Sep - Oct in the Riverina. (BioNet 2021). ▪ Dispersal not well known, selection of category based on expert assumptions based on other life history characteristics. (BioNet 2021).
Survey effort	▪ Targeted surveys carried out in September 2020 including no less than 184 hours of parallel transect surveys no more than 10m apart walking at 1.5 km per hour.
Presence in the study area	▪ Not recorded in study area during targeted surveys ▪ All database records of the species (AoLA 2021) in the vicinity of the proposal are located to the east and south. The nearest records (1995 to 2003) are located in and around Kwiambal National Park and are over 50 km south-east of North Star. There is a 2003 record located to the north of Warialda (60km south of North Star).
Polygon justification	▪ Species credit exclusion: The species was not recorded during targeted surveys in September 2020 (when the species is in flower) or during any other survey for the proposal. Species excluded from further assessment under the BAM. ▪ Geographic limitation: Areas of PCT 628 within the subject land are only located within the Castlereagh-Barwon IBRA subregion. As the species is only associated with Northern Basalts and Northern Outwash IBRA subregions within the subject land (as per Threatened Biodiversity Database Collection), PCT 628 has been excluded from polygon mapping, it should be noted however that this area was surveyed during the September 2020 targeted survey.
PCTs	▪ Associated PCTs in which species is predicted to occur: 27, 56, 98, 244, 418 ▪ Associated PCTs located outside of known geographic range of species: 27, 628
IBRA subregions	▪ Northern Basalts
References	▪ Office of Environment and Heritage, NSW (2017). Silky swainson-pea - Profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10783 [Accessed 26 October 2018].

Table 19 Threatened species summary - *Swainsona murrayana* | Slender darling pea

Aspect	Description
Species name	▪ Slender darling pea
Scientific name	▪ *Swainsona murrayana*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Species
Habitat Requirements	▪ The Slender darling pea has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. It grows in a variety of vegetation types including Bladder saltbush, Black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated (OEH 2017).
Potential habitat in study area	▪ Up to 401 ha of potential habitat within the study area
Survey requirements	▪ September ▪ Plants produce winter-spring growth, flower in spring to early summer and then die back after flowering. They re-shoot readily and often carpet the landscape after good cool-season rains (OEH 2021)
Survey effort	▪ Based on the NSW updated survey requirements a minimum requirement of 215 hours of survey work across 401 hectares completed over 10 survey days in September 2020. Walking at 1.5km hour at a maximum distance between surveyors of 10m in open vegetation and 5 m in closed vegetation.
Presence in the study area	▪ Not recorded in study area during targeted surveys (in accessible areas surveyed) ▪ There are few database records of the species (AoLA 2021) in the wider area surrounding the proposal. The nearest record (2003) is located 21 km south-east of North Star. There is an older record (1955) located to the north-west of Warialda (57 km south of North Star). There are a number of records further south in the Moree area.
Polygon justification	▪ Species credit polygon exclusion: The species was not recorded during targeted surveys in September 2020 (when the species is in flower) or during any other survey for the proposal. Species excluded from further assessment under the BAM in the areas surveyed. ▪ For the northern part of the alignment which not accessible for survey presence is assumed in PCT 52 and PCT 244 (29.9 hectares)
PCTs	▪ Associated PCTs in which species is predicted to occur: 27, 35, 52, 55, 56 ,244, 247, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Office of Environment and Heritage, NSW (2017). Slender darling pea - Profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10779 [Accessed 13 September 2019].

Table 20 Threatened species summary - *Lepidium aschersonii* | Spiny peppercress

Aspect	Description
Species name	▪ Spiny peppercress
Scientific name	▪ *Lepidium aschersonii*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Species
Habitat Requirements	▪ Found on ridges of gilgai clays dominated by Brigalow, Belah, Buloke and Grey box. Often the understorey is dominated by introduced plants. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter (OEH 2018).
Potential habitat in study area	▪ Up to 310ha of potential habitat
Survey requirements	▪ November to April ▪ Use fruits to identify, usually during warmer months. (DPIE 2020) ▪ Typically found in gilgais
Survey effort	▪ 206 hours of targeted survey effort. Waking transects at 1.5km per hour up to 10m apart in open country and 5 m apart in closed country.
Presence in the study area	▪ None recorded during targeted survey effort in January 2021
Polygon justification	▪ Species credit exclusion: The species was not recorded during targeted surveys in January 2021 (when the species should be in fruit) or during any other survey for the proposal. Multiple other Lepidum species were found during the survey effort. Species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 35, 53, 55, 56
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash
References	▪ Office of Environment and Heritage, NSW (2018). Spiny Peppercress - Profile. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10461 [Accessed 25 October 2018]

Table 21 Threatened species summary - *Tylophora linearis* | Slender tylophora

Aspect	Description
Species name	▪ Slender tylophora
Scientific name	▪ *Tylophora linearis*
BC Act	▪ V
EPBC Act	▪ E
Credit Type	▪ Species
Habitat Requirements	▪ Grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata, Eucalyptus fibrosa, E.sideroxylon, Eucalyptus albens, Callitris endlicheri, C. glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, A. lineata, Myoporum* spp., and *Casuarina* spp. (OEH 2020)
Potential habitat in study area	▪ Up to 47 ha of potential habitat
Survey requirements	▪ October to May ▪ Use flowers and fruit to locate and identify. Easily confused with other climbers when not in flower or fruit. ▪ Flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later.
Survey effort	▪ 31 hours of targeted transect walking at 1.5km hour at maximum distance of 10 m apart in open vegetation and 5 m in dense vegetation, checking each vine within suitable habitat.
Presence in the study area	▪ None recorded during targeted survey in January 2021 ▪ Majority of records occur in the central western region. Records from Goonoo, Pillaga West, Pillaga East, Bibblewindi, Cumbil and Eura State Forests, Coolbaggie NR, Goobang NP and Beni SCA. Also has been recorded Hiawatha State Forest near West Wyalong in the south and there are old records as far north as Crow Mountain near Barraba and near Glenmorgan in the western Darling Downs. (BioNet 2021)
Polygon justification	▪ Species credit exclusion: The species was not recorded during targeted surveys in January 2021 (when the species should be in fruit) or during any other survey for the proposal, Species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 418
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash
References	▪ Office of Environment and Heritage (2020) *Tylophora linearis* – profile (last updated 15 June 2020) Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10815 [accessed 13 January 2021]

Table 22 Threatened species summary - *Lepidium monoplocoides* | Winged peppercress

Aspect	Description
Species name	▪ Winged peppercress
Scientific name	▪ *Lepidium monoplocoides*
BC Act	▪ E1
EPBC Act	▪ E
Credit Type	▪ Species
Habitat Requirements	▪ The species occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by *Allocasuarina luehmannii (*Bulloak) and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. It has been recorded in a wetland-grassland community comprising *Eragrostis australasicus*, *Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma* and *Pycnosorus globosus,* on waterlogged grey-brown clay. Also recorded from a *Maireana pyramidata* shrubland (OEH 2019).
Potential habitat in study area	▪ Up to 128 ha of potential habit
Survey requirements	▪ November to February ▪ Use seed-heads to identify. Survey about 1 month after significant rain. Plants emerge about 1 month after rain and only persist for a few months. ▪ Mostly restricted to seasonally moist sites.
Survey effort	▪ Targeted survey was conducted in January 2021 after the region had experienced 184 mm of rain in December 2020 and the first week of January 2021. This was following a significant period of drought, and as such late January 2021 was considered and ideal survey window for the species. ▪ 85 hours of targeted transects walking at 1.5km hour up to 10m apart in open country and 5 m apart in more dense vegetation
Presence in the study area	▪ None were recorded during targeted survey in January 2021 or in any other survey events. ▪ Two lepidum samples were sent to the NSW herbarium for identification in November 2018 neither were a listed species. A copy of the report is appended to this BDAR.
Polygon justification	▪ Species credit exclusion: The species was not recorded during targeted surveys in January 2021 (when the species should be in fruit) or during any other survey for the proposal. Samples sent to the herbarium in 2018 were not the listed species. Species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 52, 56, 244, 247, 628
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Office of Environment and Heritage, NSW (2019). Winged Peppercress - profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10463 [Accessed 19 September 2019].

Table 23 Threatened species summary - *Acacia jucunda* | Yetman wattle

Aspect	Description
Species name	▪ Yetman wattle
Scientific name	▪ *Acacia jucunda*
BC Act	▪ E1
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Mainly restricted to dry eucalypt woodland communities on sandy to sandy-loam soils. In Queensland, the species is found in dry ranges on loams or clay-loams in eucalypt communities. Associated species at the NSW sites include *Acacia polybotrya* and *Callitris endlicheri. (OEH 2021)* ▪ Grows in sand, loam or clay loam in open eucalypt woodland or forest, often adjacent to Brigalow forest (Acacias of Australia 2021) ▪ *Acacia jucunda* abundance in populations has been recorded as locally occasional, locally common and frequent, with one population noted as being about one acre in extent. (OEH 2018)
Potential habitat in study area	▪ A total of 124 ha of potential vegetation ▪ Potential habitat includes brigalow and silver leaved ironbark vegetation communities
Survey requirements	▪ The species flowers irregularly between July and September ▪ Identified by foliage year round
Survey effort	▪ Up to 200 hours of active searches ▪ Multiple targeted surveys have been conducted in PCT35 for Pale Imperial Hairstreak and threatened plants, one round of targeted survey for threated plants has occurred in PCT 418 and 55. No individuals of this species have been recorded to date.
Presence in the study area	▪ The nearest record of the species is 25km south west of Borrow pit 25. ▪ None have been recorded during multiple survey efforts
Polygon justification	▪ Excluded - Not found during targeted survey effort within defined survey period and the study area. ▪ Email from the BCSD officer in charge of the species states that the project is outside of the known geographic range of the species. A copy of the email is located in Appendix D.
PCTs	▪ Associated PCTs in which species is predicted to occur: 35, 55
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash
References	▪ Office of Environment and Heritage (2018) Yetman Wattle – Profile (last updated 19 November 2018). Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10016 [Accessed 12 January 2021]

Threatened species information summaries – species credit fauna species

Table 24 Threatened species summary - *Ardeotis australis* | Australian bustard

Aspect	Description
Species name	■ Australian bustard
Scientific name	■ *Ardeotis australis*
BC Act	■ E1
EPBC Act	■ -
Credit Type	■ Species
Habitat Requirements	■ Tussock and hummock grasslands with a preference to tussock grasses. They are also associated with low shrublands or low open grassy woodlands. ■ The dispersive nature of this bird species sees them move across long distances with irregular widespread movement. These movements seem to be determined by climatic conditions and prey availability, particularly where mice numbers are high and in recently burnt areas (OEH 2017).
Potential habitat in study area	■ Much of the study area comprises grazing lands, native grasslands and some grassy woodlands which would likely comprise habitat for the species. A number of the nominated PCTs for the species do not comprise habitat for the species as they are too heavily wooded – the species prefers open grassy areas often without trees at all.
Survey requirements	■ All year suitable ■ Daylight flushing survey
Survey effort	■ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (60 surveys carried out in nominated PCTs). ■ Additionally over 1000 hours of non-targeted survey have not revealed the presence of the species within or adjacent to the subject land.
Presence in the study area	■ Not recorded during targeted surveys ■ Database records (AoLA 2021) include a May 2020 record of the species within 2 km of the proposal alignment. There are several recent records to the north of the Macintyre River crossing area. All other records of the species in the region surrounding the study area are located west and south-west of North Star. Of these the most recent record is from 2020 and located 48 km south-west of North Star.
Polygon justification	■ Species exclusion: Remove from BAM-C ■ Targeted surveys for this species did not record this species in October 2019 or during any other surveys for the proposal. Therefore, the species is excluded from further assessment.
PCTs	■ Associated PCTs in which species is predicted to occur: 27, 35, 52, 53, 55, 56 ,244, 247, 628
IBRA subregions	■ Northern Basalts ■ Northern Outwash ■ Castlereagh-Barwon
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Office of Environment and Heritage, NSW (2017). Species Profile: Australian bustard (*Ardeotis australis*) - profile. Updated 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10063 [Accessed 30 September 2019]

Table 25 Threatened species summary - *Ninox connivens* | Barking owl

Aspect	Description
Species name	▪ Barking owl (Breeding)
Scientific name	▪ *Ninox connivens*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ Woodland and open forest utilising fragmented remnants and partially cleared farmland. The fertility of riparian areas is able to support higher densities of prey. They prefer to roost in shaded portions of preferably dense tree canopies, such as Acacia and Casuarina species (OEH 2021). ▪ Preferred breeding sites occur in or near riparian or gully areas in tall trees (often in red gum species in riparian habitats) with large hollows (>20 cm entrance size) and 4 m above the ground.
Potential habitat in study area	▪ Potential habitat within the proposal area is highly fragmented and impacted by clearing for grazing. Large trees with suitable hollows within substantial tracts of woodland are limited in the study area. ▪ A number of the nominated PCTs for this species will not comprise breeding habitat elements (large hollows) including PCT 53, 55, 247 and 418.
Survey requirements	▪ Breeding season - May to December ▪ Based on EBPC threatened owl guidelines and included 3 nights of call playback, spotlighting, stag watching at each potential location. ▪ Pellet survey
Survey effort	▪ Targeted surveys carried out 3 times in 21 locations in October 2019 including call playback and spotlighting a total of 63 survey efforts throughout study area. ▪ Targeted pellet survey in 21 locations in October 2019 ▪ Additional non-targeted spotlighting has occurred in October 2018 and February and March 2021 ▪ Dusk stag watching where large hollows observed in survey area.
Presence in the study area	▪ Not recorded during October 2018 or 2019 spring surveys or any other field surveys for the proposal ▪ The species is widespread in the region. There are a number of recent (>2014) database records (AoLA 2021) of Barking owl from the Macintyre River area all in relatively close proximity to the study area including around Goondiwindi to Boggabilla and east of the proposal crossing area. Outside of this area the nearest records to the proposal are a 1997 record located 32 km south-west of North Star and 2014 records near Yetman (37 km east of North Star).
Polygon justification	▪ Species credit exclusion (breeding): Remove from BAM-C ▪ Species was not detected despite targeted surveys carried out at a suitable time of year in October 2019. Therefore, species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 35, 36, 53, 55, 56, 98, 192, 244, 247, 418, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage, NSW (2021). Barking owl (*Ninox connivens*) - profile. Updated 19 January 2021. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10561 [Accessed 30 January 2021]. ▪ NSW National Parks and Wildlife Service (2003) Draft recovery plan for the Barking Owl (*Ninox connivens)* Available online at: Barking owl - draft recovery plan (PDF - 735KB) (nsw.gov.au)

Table 26 Threatened species summary - *Hamirostra melanosternon* | Black-breasted buzzard

Aspect	Description
Species name	▪ Black-breasted buzzard (Breeding)
Scientific name	▪ *Hamirostra melanosternon*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall. Inhabits a range of habitats across inland and northern Australia preferring timbered watercourses as breeding habitat, and grasslands and sparsely timbered savanna for hunting. The species tends to choose nest sites in the tallest tree available (Menkhorst et al 2017; OEH 2017). The stick nest is large and flat and lined with green leaves. ▪ Breeding occurs within 100m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts. The species is known to breed in sites with cropping, but also requires retained vegetation. (BioNet 2021)
Potential habitat in study area	▪ Much of the study area could be considered suitable foraging habitat for the species ▪ Suitable breeding habitat occurs along drainage lines in the study area where large trees still occur.
Survey requirements	▪ September to November ▪ Daylight survey, nest survey
Survey effort	▪ Daylight bird surveys occurred at 5 locations in spring October 2018 and October 2019 including 75 x 20 minute surveys throughout study area (39 surveys carried out in nominated PCTs). Searches for raptor nests also carried out at all sites during bird surveys and habitat assessments.
Presence in the study area	▪ No breeding pairs or individuals recorded during targeted October 2019 surveys or during other surveys carried out in the study area for the proposal ▪ Sparsely scattered database records (AoLA 2021) from wider region with nearest records including two records (1950s) from Qld (over 50 km north-east of the Macintyre River crossing) Macintyre River and an older record (<1976) located (over 50 km west of North Star. No records within 50 km of the proposal. ▪ BioNet there is one record of the species over 20km west of Moree
Polygon justification	▪ Species credit (breeding) exclusion: Remove from BAM-C ▪ The species was not recorded during targeted surveys in October 2018 or 2019 or during any other survey for the proposal. Therefore, species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 36, 55, 56, 98, 247
IBRA subregions	▪ Northern Basalts ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Menkhorst, P, Rogers, D, Clarke, R, Davies, J, Marsack, P and Franklin, K (2017). *The Australian bird guide*. CSIRO Publishing, Clayton South. ▪ Office of Environment and Heritage (2017) Black-breasted Buzzard – Profile (last updated 1 December 2017). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10395 [accessed 14 January 2021]

Table 27 Threatened species summary - *Limosa limosa* | Black-tailed godwit (foraging)

Aspect	Description
Species name	▪ Black-tailed godwit (foraging)
Scientific name	▪ *Limosa limosa*
BC Act	▪ V
EPBC Act	▪ M
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ Primarily coastal regions within their range consisting of sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats. Where they occur inland they prefer water less than 10 cm in depth, around muddy lakes and swamps. Some individuals have been found occasionally in wet fields and at sewage treatment plants. Key priority management sites (under the Saving Our Species program) identified for this species are all coastal estuaries (OEH 2019). ▪ The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed (OEH 2019).
Potential habitat in study area	▪ Larger farm dams within or directly adjoining the study area are generally unsuitable as they have steep banks ('turkey nests') which are unsuitable for the species. ▪ Ephemeral wetlands (PCT 53) may provide (highly ephemeral) habitat for the species although the species tends to occur where there is no taller groundcover (ie. much of this PCT will be vegetated following rainfall).
Survey requirements	▪ August to March
Survey effort	▪ Opportunistic daylight surveys at farm dams carried out during October 2019 surveys. 75 bird surveys carried out during October 2018 and 2019 surveys including three bird surveys carried out in nominated PCT but little water present.
Presence in the study area	▪ Not recorded during targeted October 2019 spring surveys or incidentally during any other field surveys for the proposal ▪ The vast majority of database records of the species (AoLA 2021) are coastal or near-coastal. Inland records are few, scattered widely and often associated with large wetland areas or large dams. The nearest records to the study area are to the north of Moree (2014 and 70 km south-west of North Star) and to the north-west of Moree (2015 and 2019 and over 100 km south-west of North Star). ▪ BioNet contains two records of the species over 40km west of Moree at Gwydir wetlands
Polygon justification	▪ Species credit exclusion: nominated PCT is highly ephemeral and unlikely to provide suitable value for the species. The species distribution when in Australia is largely coastal. Inland habitats tend to be restricted to large lakes. Therefore, the species is excluded from further assessment under the BAM.
PCTs	▪ Associated PCT in which species is predicted to occur: 53
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2019). Species Profile: Black-tailed godwit (*Limosa limosa*). Updated 27 March 2019. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10479 [Accessed 30 September 2019].

Table 28 Threatened species summary - *Uvidicolus sphyrurus* | Border thick-tailed gecko

Aspect	Description
Species name	▪ Border thick-tailed gecko
Scientific name	▪ *Uvidicolus sphyrurus*
BC Act	▪ V
EPBC Act	▪ E
Credit Type	▪ Species
Habitat Requirements	▪ As implied by another of its common names (Granite thick-tailed gecko), the species often occurs on steep rocky or scree slopes, especially granite in dry eucalypt forest or woodland. Records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy (often featuring cypress pine) that helps create a sparse understorey (DAWE 2021, OEH 2019) ▪ It is unlikely to attempt to cross cleared land with grass ground cover as it requires litter dominated shrubby open forest or woodland. During the day individuals shelter under boulders, rock slabs and fallen timber, deep in leaf litter, in rotten logs, or under bark at base of standing trees. (BioNet 2021)
Potential habitat in study area	▪ Borrow Pit 9 and Borrow Pit 25 contain potential habitat featuring cypress pine on basalt soils (PCT 418) including leaf litter, rocks and timber.
Survey requirements	▪ November to March ▪ Survey should be undertaken on warm humid nights with good insect activity, or search by day under rocks, bark, logs, or in logs.
Survey effort	▪ Targeted surveys carried out in February and March 2021 at the same time as Pale Headed Snake survey. ▪ Several other gecko species recorded during daylight and nocturnal October 2019 and 2021 habitat surveys.
Presence in the study area	▪ Species not recorded in the study area during any surveys for the proposal. ▪ Mapping of the species potential distribution by DAWE (2021) indicates the study area lies to the west of mapped habitat in which the species 'may occur' (ie. the study area lies outside of the mapped habitat distribution). ▪ Database records (AoLA 2021) indicate the species largely occurs well to the east and south-east of the study area. The closest record is recent (2019) and from rocky elevated habitat 36 km south-east of North Star. A second record from similar habitat in Arakoola Nature Reserve is 58 km south-east of North Star. To the south there is a record of uncertain provenance (both location and collection date are uncertain) from Moree (78km south-west of North Star). All other records are over 100 km from the study area. ▪ BioNet contains 2 records of the species both over 25 km east of the subject land.
Polygon justification	▪ Species credit exclusion: Remove from BAM-C ▪ None recorded during targeted and non-targeted surveys. The study area is located outside of the species known range. ▪ Geographic limitation: Areas of PCT 192 within the subject land are only located within the Castlereagh-Barwon and Northern Outwash IBRA subregions. As the species is only associated with Northern Basalt IBRA subregion within the subject land (as per Threatened Biodiversity Database Collection), PCT 192 has been excluded from polygon mapping
PCTs	▪ Associated PCTs in which species is predicted to occur: 418 ▪ Associated PCTs located outside of known geographic range of species: 192
IBRA subregions	▪ Northern Basalts

Aspect	Description
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Department of Agriculture, Water and the Environment (DAWE) (2021). *Uvidicolus sphyrurus* — Border Thick-tailed Gecko in Species Profile and Threats Database, DAWE, Canberra. Available online at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=84578 [Accessed 21 January 2021] ■ Office of Environment and Heritage (2019) Threatened Species - Border Thick-tailed Gecko – profile. Available online at: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10823 [Accessed 18 September 2019]

Table 29 Threatened species summary - *Setirostris eleryi* | Bristle-faced free-tailed bat, Hairy-nosed freetail Bat

Aspect	Description
Species name	▪ Bristle-faced free-tailed bat, Hairy-nosed freetail Bat
Scientific name	▪ *Setirostris eleryi – Mormopterus eleryi or Mormopterus sp6.*
BC Act	▪ E
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Habitat requirements are not well established but limited evidence suggests it depends on hollows and tree fissures for roosting (species from the same family generally roost in tree hollows and fissures). The species is extremely rare throughout its range across Australia, recorded from only 15 locations (OEH 2019). ▪ The species is thought to prefer riverine habitats and drainage lines and has been recorded on the Macintyre River floodplain upstream of the proposal (from Kwiambal National Park) (Davids 2012). ▪ Potential habitat is riparian areas (including dry river/creek beds) within the PCTs associated with the species. Survey should sample the available range of suitable vegetation along riparian areas on the subject land. Traps or nets should be set near water holes (especially if isolated), under/beside large trees, in/beside creek beds, or in 'flyway' spaces between vegetation. NB. Use of acoustic detection alone is not suitable for this species as the call is difficult to distinguish from other common species. Refer to Threatened Bat Survey Guide. ▪ All habitat on the subject land where the subject land is within 500m of a river, creek or riparian area must be mapped. Use aerial imagery to map river, creek or riparian areas (including dry creek channels, former creek channels, billabongs etc.) on or within 500m of the subject land. Species polygon boundaries should align with PCTs on the subject land to which the species is associated that are within 500m of waterbodies mapped.
Potential habitat in study area	▪ Little is known of the species habitat requirements. Given the species may prefer riverine habitats and has been recorded upstream, the Macintyre River and associated vegetation are likely to be the most suitable habitat in the study area. ▪ Within 500m of watercourses or dams that also contain hollows
Survey requirements	▪ Targeted surveys: Harp traps or mist nets: 16 trap nights over a minimum of 4 nights. Traps or nets should be set near waterholes (especially if isolated), under/beside large trees, in/beside creek beds, or in 'flyway' spaces between vegetation. ▪ Survey should sample the available range of suitable vegetation along riparian areas on the subject land. Traps or nets should be set near water holes (especially if isolated), under/beside large trees, in/beside creek beds, or in 'flyway' spaces between vegetation. NB. Use of acoustic detection alone is not suitable for this species as the call is difficult to distinguish from other common species. Refer to Threatened Bat Survey Guide. ▪ This species may move distances greater than 10km, dispersal distance of 100m - 10km was selected as this is the distance at which females regularly move to establish new colonies in available habitat.
Survey effort	▪ Microbat call recorders deployed in area in August and October 2018 (18 recording nights), and October 2019 (21 recording nights). However, acoustic detection alone is not suitable for this species as the call is difficult to distinguish from other common species. ▪ Harp trapping carried out at four separate locations within study area less than 10km apart in February 2021 – comprising four single harp traps over four nights at each location (64 trap nights total).

Aspect	Description
Presence in the study area	▪ The species was reported as being present during the 2018 SongMeter Bat recordings as identified by Balance Environmental. However this is not considered a suitable method of detection for the species as the call cannot be distinguished from several other bat species. ▪ Targeted harp trapping in the location of the SongMeter record and in other locations did not capture *Setirostris eleryi*. A total of eight other bat species were captured during the harp trapping confirming the suitability of conditions and sampling method. ▪ Database records of this species (AoLA 2021) are scattered sparsely across inland Australia. Nevertheless, there are records to the east and south-east of the study area (in the vicinity of the Macintyre River floodplain) including a 2001 record from Dthinna Dthinnawan National Park (42 km east of the proposal) and records (1997 and 2010) from Kwiambal National Park (over 60 km south-east of the proposal). ▪ BioNet contains two records of the species east of Yetman at the same location as AoLA.
Polygon justification	▪ Remove from BAM-C ▪ Targeted surveys in best quality habitat did record any individuals of the species.
PCTs	▪ Associated PCTs in which species is predicted to occur: 35, 36, 55, 56, 98, 192, 244, 418, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Davids, S (2012). 'A record of the Bristle-faced free-tailed bat *Mormopterus eleryi* from Kwiambal National Park.' *Australian Zoologist*, vol. 36, pp. 49-54. ▪ Office of Environment and Heritage (2019) Bristle-faced Free-tailed Bat – profile (last updated 14 March 2019). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10923 [Accessed 21 January 2021]

Table 30 Threatened species summary - *Burhinus grallarius* | Bush stone-curlew

Aspect	Description
Species name	▪ Bush stone-curlew
Scientific name	▪ *Burhinus grallarius*
BC Act	▪ E
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ A wide range of vegetation communities, typically with an open structure, sparse ground layer and abundant woody debris. Preferred habitat types include open forests and grassy woodlands, grasslands, and mangroves (OEH 2017)
Potential habitat in study area	▪ There is suitable habitat within the study area including open grasslands and grassy woodlands.
Survey requirements	▪ All year ▪ Three nights of spotlighting and call playback of 30 seconds listen 4.5 minute repeated three times using the same call.
Survey effort	▪ Targeted surveys carried out in October 2018 and 2019 including call playback and spotlighting including 85 site surveys throughout study area (67 surveys in nominated PCTs). ▪ Non-target surveys of over 1000 hours have not recorded the species within or adjacent to the subject land
Presence in the study area	▪ No records of the species during the targeted October survey ▪ There are scattered database records (AoLA 2021) in the wider area surrounding the proposal although the nearest record is located 27 km west of North Star and is from 1916. The nearest recent record is from 1997 and located 46 south-west of North Star (north-east of Moree). ▪ BioNet has one record of the species approximately 20 km east of Moree
Polygon justification	▪ Remove from BAM-C ▪ Species has not been recorded during targeted surveys in October 2019 or any other surveys for the proposal. As such, the species is excluded from further assessment.
PCTs	▪ Associated PCTs in which species is predicted to occur: 27, 35, 36, 52, 56, 98, 192, 244, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2017) Bush Stone-curlew – profile (last updated 7 September 2017). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10113 [accessed 12 January 2021]

Table 31 Threatened species summary - *Nettapus coromandelianus* | Cotton pygmy-Goose

Aspect	Description
Species name	▪ Cotton pygmy-Goose
Scientific name	▪ *Nettapus coromandelianus*
BC Act	▪ E
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Freshwater lakes, lagoons, swamps and dams that are vegetated with waterlilies and other aquatic plants. Preferred wetlands are typically deep and include large freshwater lakes and the edges of quiet creeks and rivers, always with waterlilies. Shallow wetlands are not used (OEH 2018)
Potential habitat in study area	▪ Species may occur around larger farm dams and other permanent water bodies within or around the study area although suitable habitat factors (presence of water lilies) not generally observed as present during October 2019 surveys. ▪ PCT 53 is listed for the species as occurring within the study area. This wetland habitat is described as a 'Shallow freshwater wetland sedgeland in depressions and floodplains' and is highly ephemeral in the area. It is unlikely to provide suitable habitat even following substantial rains (ie. the habitat comprises shallow, densely vegetated aquatic habitat which is not suitable for the species).
Survey requirements	▪ Surveys all year. ▪ When water is present such as after summer rains ▪ Wetland survey: A one-hour census at dawn or dusk, for each identified wetland. ▪ Water source survey: A 20-minute census at dawn or dusk, for each identified water source.
Survey effort	▪ Dusk and dawn surveys x 3 at farm dams carried out during October 2019 surveys. Three bird surveys carried out in or near nominated PCT (and nearby farm dam) but little water present.
Presence in the study area	▪ Species not recorded during any survey associated with the proposal ▪ There are limited database records (AoLA 2021) in NSW and the study area is on the southern edge of the species distribution. There is a 1977 record located south of Boggabilla (3 km east of the proposal) and several older records (all <1975) located east and south-east of North Star (at least 27 km from the proposal). There are no recent records in the vicinity of the study area. ▪ BioNet contains one record of the species 30km south east of North Star
Polygon justification	▪ Remove from BAM-C ▪ Habitat constraints: waterbodies; deep permanent fresh waters on floodplains with floating and submergent vegetation. The only deep, permanent waterbody within the study area are farm dams which do not have the required submergent vegetation. ▪ Nominated PCT is highly ephemeral and shallow as occurs in study area. Species not recorded during targeted surveys or any other site surveys. Therefore, species is excluded from further assessment.
PCTs	▪ Associated PCT in which species is predicted to occur: 53
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage, NSW (2018) Cotton pygmy-goose - profile. Updated 12 February 2018. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10557 [accessed 1 October 2019]

Table 32 Threatened species summary - Miniopterus orianae oceanensis | Large bentwing-bat

Aspect	Description
Species name	▪ Large bentwing-bat (Breeding)
Scientific name	▪ *Miniopterus orianae oceanensis*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Caves are their primary choice for roosting habitat but they will also utilise man-made structures that include disused mines, storm-water drainage pipes and buildings. This species is also known to utilise the following habitat types; Australian Alps, Brigalow Belt south, Nandewar, New England Tablelands, New South Wales north coast, New South Wales south western slopes, south east corner, south east highlands and south eastern Queensland (OEH 2019). ▪ The subspecies is widely distributed for much of the year across the east of NSW. Cave sites used for summer maternity colony roosts have highly specific climatic regimes and are limited in number. The species disperses to winter roost sites in the Autumn months.
Potential habitat in study area	▪ While the species evidently occurs in the area there is no habitat available that is suitable for breeding in or near the study area (ie. rocky habitat containing larger caves).
Survey requirements	▪ December to January (breeding) ▪ Habitat assessment – breeding caves/mines ▪ Ultrasonic recorders deployed outside of breeding period
Survey effort	▪ Microbat call recorders deployed in area in August and October 2018 (18 recording nights), and October 2019 (21 recording nights) ▪ Harp trapping carried out at four separate locations within study area less than 10km apart in February 2021 – comprising four single harp traps over four nights at each location (64 trap nights total).
Presence in the study area	▪ No individuals captured during harp trapping. ▪ Species recorded during the October 2018 and 2019 survey periods ▪ Database records from the region (AoLA 2021) indicate the species is evidently on the edge of its distribution in the area. All records are located east of the study area. Nearest records are from the region around and within Kwiambal National Park (ranging from 1997 to 2010) located 50 to 65 km south-east of North Star. ▪ BioNet database contains records from Kwiambal National Park (ranging from 1997 to 2010) located 50 to 65 km south-east of North Star.
Polygon justification	▪ Remove from BAM-C for breeding ▪ Species habitat constraints: Caves; cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500. No records of the species close to the study area. ▪ Species credit exclusion: PCTs associated with this species present in study area. Site assessments observed no suitable rocky roost habitat for this species in patches present or elsewhere in the study area. Therefore, species is excluded from further assessment.
PCTs	▪ Associated PCTs in which species is predicted to occur: 55, 56, 147, 244, 418 ▪ Associated PCTs located outside of known geographic range of species: 192, 628
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2019). Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*). Updated 9 September 2019. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10534 [Accessed 27 September 2019]. ▪ BioNet Species Sighting search. Available from:Environment & Heritage | NSW BioNet [Accessed 19/2/2021]

Table 33 Threatened species summary - *Vespadelus troughtoni* | Eastern cave bat

Aspect	Description
Species name	▪ Eastern cave bat
Scientific name	▪ *Vespadelus troughtoni*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ They roost in caves and rocky overhangs and are associated with a range of habitats including rainforest edges and tropical, temperate and semi-arid forests and woodlands (usually in areas that are close to cliffs and rocky overhangs). They are also known to roost in road culverts, fairy martin nests and occasionally buildings. Colonies consisting of up to 500 individuals have been found in disused mines (OEH 2017).
Potential habitat in study area	▪ The study area comprises patchy tracts of dry woodlands. There is little if any of the preferred rocky roost habitat available within or near the study area. ▪ Culverts are too low to provide habitat ▪ No fairy martin nests observed in culverts or under bridges
Survey requirements	▪ November to January – if breeding habitat present ▪ Habitat assessment, ▪ Ultrasonic recorders deployed
Survey effort	▪ Microbat call recorders deployed in area in August and October 2018 (18 recording nights), and October 2019 (21 recording nights) ▪ Harp trapping carried out at four separate locations within study area less than 10km apart in February 2021 – comprising four single harp traps over four nights at each location (64 trap nights total).
Presence in the study area	▪ No positive call records from 2018 and 2019 surveys. ▪ No individuals captured in harp nets 2021 ▪ Database records from the wider area (AoLA 2021) indicate the nearest occurrences of the species are several records (all from 2001) in or close to Dthinna Dthinnawan National Park (ranging between 26 km and 42 km east of the proposal). The next closest record is 46 km to the south (in Bullala National park) to the east of Moree. ▪ BioNet records contain the same information as AoLA
Polygon justification	▪ Remove from BAM-C ▪ Habitat constraints for species: caves; within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds. No rocky habitat elements (including old mines and tunnels) occur within 2 km of the proposal. ▪ PCTs associated with this species present in study area (56, 147 and 418). Site assessments observed no suitable rocky roost habitat for this species in the patches present or elsewhere in the study area. ▪ Species is readily identified using ultrasonic recorders (at any time of year). Species has not been recorded during surveys, rocky roost habitat is not present, and therefore species is excluded from further assessment.
PCTs	▪ Associated PCTs in which species is predicted to occur: 56, 147, 418 ▪ Associated PCTs located outside of known geographic range of species: 192, 628
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2017). Eastern cave bat (*Vespadelus troughtoni*). Updated 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10829 [Accessed 27 September 2019].

Table 34 Threatened species summary - *Cercartetus nanus* | Eastern pygmy-possum

Aspect	Description
Species name	▪ Eastern pygmy-possum
Scientific name	▪ *Cercartetus nanus*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Range of habitats including rainforest, dry sclerophyll (including Box-ironbark) forest and woodlands to heath. There does however seem to be a preference for woodland and heath apart from where it occurs in north-eastern New South Wales where it is encountered more frequently in rainforest (OEH 2017). ▪ Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (Pseudocheirus peregrinus) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks (OEH 2017) ▪ The species appears to be specialist user of the mid and lower storey of habitats where a shrubby layer is present (Harris 2008).
Potential habitat in study area	▪ There may be suitable woodland habitat for the species in PCT 244 that contain hollow-bearing trees. However, it is noted PCT 244 is described as a woodland to open grassy woodland. Within the study area these habitats have been impacted by land use activities (particularly grazing) and the preferred extensive shrub layer is not present.
Survey requirements	▪ October to March ▪ Spotlighting, baited camera traps
Survey effort	▪ Spring survey occurred in October 2019 consisting of 6 spotlighting hours, 6 stag watching hours and 12 camera trap nights ▪ Based on advice of Threatened Species Officer additional surveys in January 2021 consisting of 12 nights of spotlighting surveys and deployment of camera traps (combined with the Pale-headed snake and Bat survey)
Presence in the study area	▪ No records of the species ▪ There are no database records close to the proposal. The nearest record (AoLA 2021) is from 1978 being located in Qld (approximately 105 km east of North Star). All other nearby records are much further east in the Great Dividing Range or in the Pilliga area (over 180 km south of the study area). ▪ BioNet does not contain any records of the species between Boomi, Moree, Yetman and Boggabilla
Polygon justification	▪ Remove from BAM-C ▪ The species was not recorded during surveys in October 2019 or targeted surveys in February 2021 or during any other survey for the proposal. The available habitat in PCT 244 within the study area does not appear suitable for the species presence. Species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species is predicted to occur: 244, 418 ▪ Associated PCTs located outside of known geographic range of species: 628
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Harris, JM (2008). *Cercartetus nanus* (Diprodontia: Burramyidae). *Mammalian Species*, vol. 815, pp. 1-10. ▪ Office of Environment and Heritage, NSW (2017). Eastern pygmy-possum (Cercartetus nanus) - Profile. Updated 7 September 2017. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10155 [Accessed 27 September 2019]

Table 35 Threatened species summary - *Calyptorhynchus lathami* | Glossy black-cockatoo

Aspect	Description
Species name	■ Glossy black-cockatoo (Breeding)
Scientific name	■ *Calyptorhynchus lathami*
BC Act	■ E
EPBC Act	■ -
Credit Type	■ Species and Ecosystem
Habitat Requirements	■ Open forest and woodlands of the coast and the Great Dividing Range where there are stands of sheoak present. Black sheoak (*Allocasuarina littoralis*) and Forest sheoak (*A. torulosa*) are critical food trees for the species in coastal areas (OEH 2019). In the region the species is well known to feed on Belah (*Casuarina cristata*) and to a much lesser extent on Buloke (*Allocasuarina luehmannii*) (Chapman 2007). ■ Breeding occurs in large hollows in tall trees with a preference for hollows in dead trees. Trees with suitable developed hollows are thought to be at least 100 years old (Garnett et al 2011).
Potential habitat in study area	■ Landscape includes PCTs with Belah and Buloke. Study area comprises highly disturbed and fragmented landscape. Nevertheless, scattered large tree hollows are present in medium to high condition PCTs.
Survey requirements	■ March to August ■ Daylight surveys
Survey effort	■ Not surveyed as per breeding survey requirements – daylight surveys carried out in October 2018 and 2019 including 75 surveys throughout study area.
Presence in the study area	■ Two individuals recorded during October 2019 spring surveys. ■ There are scattered database records (AoLA 2021) throughout region surrounding study area. The closest records include a 1999 sighting north-east of Goondiwindi (13 km north-west of the Macintyre river crossing), an older (<1981) record located 18 km east of the proposal, and a 2007 record located 18 km west of North Star.
Polygon justification	■ Ecosystem species (foraging) exclusion: Low quality PCTs. The species feed almost exclusively on the seeds of *Casuarina* and *Allocasuarina* species neither of which are found within the low-quality PCTs. ■ The following PCTs are not considered to include the necessary foraging habitat for the species as neither of the known forage species (Belah and Buloke) occur (as noted in site observations and the benchmark floristic description (BioNet Vegetation Classification)): PCT 247 and 628. ■ Species credit (breeding) exclusion: Breeding habitat constraints for this species comprises living or dead trees with hollows >15 cm and >5 m above ground level. The species require large tree hollows for breeding and low-quality PCTs do not contain large trees with hollows therefore these areas are not considered habitat for the species. ■ The following PCTs are not considered to include the necessary breeding habitat for the species including: – PCT 55 (Belah dominated habitat which does not form large tree hollows) PCT 247 (Lignum shrubland) ■ As targeted breeding surveys have not occurred for the species all areas which contain potential breeding habitat i.e. living or dead trees with hollows >15 cm and >5 m above ground level remain in the Species polygon.
PCTs	■ Associated PCTs in which species is predicted to occur: – Ecosystem credit – PCT 36, 55, 56, 192, 244, 247, 628 – Species credit – PCT 36, 55, 56, 192, 244, 247, 418, 628
PCTs ecosystem (BAM C)	■ Medium and High 36, 56, 192, 244,
PCTs species (BAM C)	■ High and Medium 36, 56, 192, 244, 418, 628

Aspect	Description
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Chapman, TF (2007) 'Foods of the Glossy black-cockatoo (*Calyptorhynchus lathami*).' *Australian Field Ornithology*, vol. 24, pp. 30-36. ▪ Garnett S.T., Szabo J. and Dutson G. (2011). *The action plan for Australian birds.* CSIRO Publishing, Victoria. ▪ Office of Environment and Heritage (2019). Glossy black-cockatoo (*Calyptorhynchus lathami*). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10140 [accessed 3 October 2019].

Table 36 Threatened species summary - *Pteropus poliocephalus* | Grey-headed flying-fox

Aspect	Description
Species name	▪ Grey-headed flying-fox (Breeding)
Scientific name	▪ *Pteropus poliocephalus*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ The Grey-headed flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. The primary food source is blossom from Eucalyptus and related genera but in some areas it also utilises a wide range of rainforest fruits. None of the vegetation communities used by the Grey-headed Flying-fox produce continuous foraging resources throughout the year. As a result, the species has adopted complex migration traits in response to ephemeral and patchy food resources. ▪ The Grey-headed flying-fox roosts in aggregations of various sizes on exposed branches. Roost sites are typically located near water, such as lakes, rivers or the coast. Roost vegetation includes rainforest patches, stands of Melaleuca, mangroves and riparian vegetation. ▪ Grey-headed flying-foxes commute daily to foraging areas, usually within 15 km of the day roost site. Grey-headed flying-foxes are capable of nightly flights of up to 50 km from their roost to different feeding areas as food resources change (DAWE 2021a).
Potential habitat in study area	▪ The species has relatively flexible foraging habitats but 'breeding' or roost habitat is specific and is almost always in riparian trees over large waterbodies. The Macintyre River provides the only likely roost habitat within the study area.
Survey requirements	▪ Daylight survey for colonies
Survey effort	▪ Spring survey for potential colonies within the study area occurred in October 2019 with a particular focus on the Macintyre River.
Presence in the study area	▪ Individuals recorded along Macintyre River area during surveys for proposal. No roost sites detected close to alignment. Large numbers of Little red flying-fox observed flying upstream past proposal crossing point during dusk survey in October 2019. ▪ No roost sites known close to study area. Nearest monitored flying-fox roost sites include Goondiwindi (19 km north-west of northern extent of alignment - only Little red flying-fox recorded) and Yetman (37 km east of North Star – species previously recorded at roost site) (DAWE 2021b)
Polygon justification	▪ Ecosystem credit exclusion: The species feed and roosts in trees, the low-quality PTCs contain only highly scattered individual or no trees and therefore do not provide suitable foraging habitat for the species. PCT 55 is a pure Belah-dominated community and does not represent foraging habitat for the species. ▪ Species credit (breeding) exclusion: Remove from BAM-C no evidence of breeding (ie. roost sites or large numbers of individuals) recorded in study area during surveys. No colonies of any flying-fox species located within the study area during targeted surveys, colonies tend to be easily recognised by both sight and smell. In addition, only one of the nominated PCTs (36) represent likely 'breeding' habitat for the species which requires dense vegetation adjacent to water.
PCTs	▪ Associated PCTs in which species is predicted to occur: 35, 36, 55, 56, 147, 244, 418 ▪ Associated PCTs located outside of known geographic range of species: 628
PCTs ecosystem (BAM C)	▪ Medium and High 35, 36, 56, 147, 244
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash

Aspect	Description
References	■ Department of Agriculture, Water and Environment (DAWE) (2021a). Grey-headed flying-fox in Species Profile and Threats Database, DAWE, Canberra. Available from: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186 [Accessed 21 January 2021] ■ Department of Agriculture, Water and Environment (DAWE) (2021b). Monitoring flying-fox populations – interactive flying-fox web viewer. Available from: Monitoring Flying-Fox Populations | Department of Agriculture, Water and the Environment

Table 37 Threatened species summary - *Phascolarctos cinereus* | Koala

Aspect	Description
Species name	▪ Koala (Breeding)
Scientific name	▪ *Phascolarctos cinereus*
BC Act	▪ E
EPBC Act	▪ V
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ Suitable habitat for the species includes temperate, sub-tropical and tropical forest, woodland and semi-arid vegetation communities dominated by Eucalyptus spp. (Martin and Handasyde 1999). They feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (OEH 2020). Shelter trees from a range of genera are an important component of Koala habitat and play an essential role in thermoregulation (Crowther et al. 2013).
Potential habitat in study area	▪ The list of preferred Koala use of tree species from the Western Slopes and Plains Koala Management Area (KMA) was reviewed based on *A review of koala tree use across New South Wales* (OEH 2018) (refer Table 22 and Table 23). Relevant tree species from the study area (refer flora data in Appendix B) include the following: – River red gum (*Eucalyptus camaldulensis*) considered as 'regional high use' species. In study area occurs in PCT 36 and 628 – Silver-leaved ironbark (*Eucalyptus melanophloia*) considered as 'significant use' species. In study area occurs in PCT 192 and 418 – White cypress pine (*Callitris glaucophylla*) considered as 'local high use' species. In study area occurs in PCT 98 and 418 – The dominant tree species in the study area is Poplar box (*Eucalyptus populnea*). Poplar box is is considered as 'Local High Use' in the Western Slopes and Plains KMA (Table 23 in OEH 2018). For this KMA other species that are documented as 'low use' and are not considered relevant to the persistence of this species include Wilga (*Geijera parviflora*), Western Silver Wattle (*Acacia decora*), Ironwood (*Acacia excelsa*), Hakea Wattle (Acacia hakeoides), Brigalow (*Acacia harpophylla*) Weeping Myall (*Acacia pendula*) and Cooba (*Acacia salicina*).
Survey requirements	▪ All year ▪ Call playback minimum 2 nights, daylight survey, scat searches, spotlight
Survey effort	▪ Surveys carried out in October 2018 and 2019 including call playback and spotlighting including 85 site surveys throughout study area (69 surveys in nominated PCTs). ▪ Habitat searches throughout the alignment included searches for Koala presence (ie. tree scratches and scat searches) ▪ Scat samples from two locations (PCT36 and PCT 628) sent to B.Triggs returned as large possum.
Presence in the study area	▪ A single Koala was recorded calling in River red gums (PCT 36) along the Macintyre River in October 2019. This habitat area is isolated from potential habitat areas (PCTs) further south by extensive tracts of heavily cleared lands and pure grassland areas (ie. PCT 52). Koala scats and scratches were also found in PCT 56 and 628. No other records of Koala or presence (several scats were sent for analysis and found to be possum scats only). ▪ Database records of Koala in the region (AoLA 2021) are largely located to the south and east of the study area and indicate the following regarding Koala in the wider area: – Three records within 20 km of North Star ranging of indeterminate age and with a high spatial uncertainty (>10,000 m) placed on the location. There are many more records further south to Moree – No other records in close vicinity (within 30 km) to the proposal. There are very few records to the north and west. To the east there are records associated with Dthinna Dthinniwan National Park and the surrounds. ▪ BioNet contains 7 records of the species in the vicinity of the subject land including the project record from October 2019. Four of the records, one from 2015 and three from 2019, are sourced from a Wildlife Rehabilitation Database so may be release sites and not wild sightings.

Aspect	Description
Polygon justification	▪ Species credit (exclusion): Remain mapped in PCT36 Macintyre River location and koala scats and scratches location (PCT 628 and 56) . Removed from other areas as not observed during multiple survey efforts over four years of survey effort.
PCTs	▪ Associated PCTs in which species is predicted to occur: 35, 36, 55, 56, 98, 192, 244, 418, 628
PCTs (BAM C)	▪ High PCT36 on Macintyre River (associated with koala call) ▪ PCT 56 and PCT 628 (area associated with scats and scratches)
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Crowther, M., D. Lunney, J. Lemon, E. Stalenberg, R. Wheeler, G. Madani, K. Ross and M. Ellis (2013). Climate-mediated habitat selection in an arboreal folivore. Ecography. 36:001-008 ▪ Martin, R. and Handasyde, K. (1999). The Koala: Natural history, conservation and management. UNSW Press, Sydney ▪ Office of Environment and Heritage (OEH) (2018). *A review of koala tree use across New South Wales.* OEH, Sydney. ▪ Office of Environment and Heritage (2020) Koala – Profile (last updated 11 June 2020). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10616 [Accessed 30 November 2020]

Table 38 Threatened species summary - *Chalinolobus dwyeri* | Large-eared pied bat

Aspect	Description
Species name	▪ Large-eared pied bat
Scientific name	▪ *Chalinolobus dwyeri*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Species
Habitat Requirements	▪ This species is heavily associated with habitats featuring extensive cliffs and caves for roosting, with adjacent wooded fertile valleys for foraging. In NSW it is known particularly from the Sydney sandstone escarpments and in the Pilliga area. It has been recorded foraging in a range of vegetation types including: dry and wet sclerophyll forest; *Callitris glauca* dominated forest; and tall open eucalypt forest. Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin nests (Woinarski et al 2014; DAWE 2021). ▪ Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes (OEH 2017).
Potential habitat in study area	▪ PCT There is little, if any suitable rocky roost habitat associated with this species within the alignment or the study area which is largely flat or undulating plains. Study area is heavily fragmented and cleared for agriculture and grazing.
Survey requirements	▪ November to January ▪ Acoustic detection – if breeding habitat present ▪ Harp trapping – if breeding habitat present
Survey effort	▪ Microbat call recorders deployed in area in August and October 2018 (18 recording nights), and October 2019 (21 recording nights) ▪ Harp trapping carried out at four separate locations within study area less than 10km apart in February 2021 – comprising four single harp traps over four nights at each location (64 trap nights total).
Presence in the study area	▪ Call not recorded during proposal surveys ▪ Few records in the region surrounding the study area. Nearest records (AoLA 2021) are from 2012 in Bullala National Park (48 km south of North Star) and a 2008 record near Warialda (70 km south of North Star). No records within 100 km to the east and north. ▪ BioNet contains two records of the species to the south east of North Star the closest is 48km south of the town and approx. 40km south of Borrow Pit 1.
Polygon justification	▪ Remove from BAM-C ▪ Habitat constraints are listed as: cliffs; within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels. None of these habitat elements occur within 2 km of the proposal. ▪ Single patch of PCT associated with this species present in study area (147). Site assessments observed no suitable rocky roost habitat for this species in this patch or elsewhere in the study area. Species excluded from further assessment.
PCTs	▪ Associated PCTs in which species is predicted to occur: 147, 418 ▪ Associated PCTs located outside of known geographic range of species: 192
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Department of Agriculture, Water and the Environment (DAWE) (2021). *Chalinolobus dwyeri* in Species Profile and Threats Database, DAWE, Canberra. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=183 [Accessed 21 January 2021] ▪ Wooinarski, JCZ, Burbidge, AA and Harrison, PL (eds.) (2014). *The action plan for Australian mammals 2012.* CSIRO Publishing, Collingwood.

Table 39 Threatened species summary - *Hieraaetus morphnoides* | Little eagle

Aspect	Description
Species name	▪ Little eagle (Breeding)
Scientific name	▪ *Hieraaetus morphnoides*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ Species is sparsely distributed across much of Australia. Open eucalypt forest, woodland or open woodland, including Sheoak or Acacia woodlands and riparian woodlands in inland NSW. Tall living trees within a remnant patch are used for nest, where pairs build a large stick nest in winter (OEH 2017).
Potential habitat in study area	▪ Species is widespread. Suitable habitat may occur in medium to high condition PCT types which contain large trees suitable for nesting.
Survey requirements	▪ August to October ▪ Daylight survey, nest survey
Survey effort	▪ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (66 surveys carried out in nominated PCTs). Searches for raptor nests carried out at all sites during habitat assessments. ▪ Non targeted surveys throughout 2018,2019,2020 and 2021
Presence in the study area	▪ No breeding pairs or individuals recorded during targeted October 2019 surveys or during other surveys carried out in the study area for the proposal ▪ Scattered database records (AoLA 2021) from region including 1985 record on Macintyre River (4 km west of study area), 1986 record 2 km east of North Star and 2011 record 13 km north-east of North Star.
Polygon justification	▪ Species credit (breeding) exclusion: Remove from BAM-C ▪ The species was not recorded during targeted surveys in October 2019 or during any other survey for the proposal. Species excluded from further assessment under the BAM.
PCTs	▪ Associated PCTs in which species credit breeding habitat is predicted to occur: 27, 35, 36, 52, 53, 55, 56, 98, 147, 192, 244, 247, 418, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2017) Little Eagle – Profile (last updated 1 December 2017). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20131 [accessed 14 January 2021]

Table 40 Threatened species summary - *Lophochroa leadbeateri* | Major Mitchell's cockatoo

Aspect	Description
Species name	▪ Major Mitchell's cockatoo (Breeding)
Scientific name	▪ *Lophochroa leadbeateri*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ Small pairs, groups and large flocks are associated with food supply such as native and exotic melons, and native seeds (saltbush, wattles and cypress pines). They feed mostly on the ground and the species nests in tree hollows (OEH 2017). ▪ Species distribution largely occurs in semi-arid to arid (western) New South Wales. Study area is outside of the species normal distribution. Species is scarce in fragmented landscapes (Garnett et al 2011). More easterly occurrences of the species (including the study area) are likely to be vagrant movements of individuals from inland areas or aviary escapees.
Potential habitat in study area	▪ Study area comprises highly degraded and fragmented landscape impacted by previous land use (agriculture and grazing). Large tree hollows are uncommon but present throughout the study area.
Survey requirements	▪ September to December ▪ Daylight survey
Survey effort	▪ Daylight surveys carried out in October 2018 and 2019 including 75 surveys throughout study area (27 surveys in nominated PCTs). ▪ Non-target surveys throughout 2018,2019,2020 and 2021
Presence in the study area	▪ No breeding pairs or individuals recorded during October 2019 surveys or during any other field surveys associated with proposal. ▪ The vast majority of database records (AoLA 2021) are located west of Mungindi and Walgett (as associated with the study area). There is a single 1983 record from Goondiwindi (18 km north-west of the northern extent of the study area). The next closest record is from 1997 located over 60 km south in the Moree area.
Polygon justification	▪ Species credit (breeding) exclusion: Remove from BAM-C ▪ The species was not recorded during targeted surveys in October 2019 or during any other survey for the proposal. The study area is located outside of the normal distribution of the species. Species excluded from further assessment.
PCTs	▪ Associated PCTs in which species credit breeding habitat is predicted to occur: 36, 52, 56, 192, 244, 628 ▪ Associated PCTs located outside of known geographic range of species: 27, 35, 55, 98
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Garnett S.T., Szabo J. and Dutson G. (2011). *The action plan for Australian birds.* CSIRO Publishing, Victoria. ▪ Office of Environment and Heritage, NSW (2017). Major Mitchell's cockatoo (*Lophochroa leadbeateri*). Updated 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10116 [accessed 3 October 2019].

Table 41 Threatened species summary - *Tyto novaehollandiae* | Masked owl

Aspect	Description
Species name	■ Masked owl (Breeding)
Scientific name	■ *Tyto novaehollandiae*
BC Act	■ V
EPBC Act	■ -
Credit Type	■ Species and Ecosystem
Habitat Requirements	■ Dry eucalypt forests and woodlands from sea level to 1100 m. Often hunts along the edges of forests, adjoining open areas including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting (OEH 2019). Tree hollow used for nesting have entrances are at least 3 m above ground, in trees of at least 90 cm diameter at breast height. ■ Preferred woodland habitat includes an open understorey and a mosaic of sparse (grassy) and dense (shrubby) groundcover on gentle terrain (DEC NSW 2006).
Potential habitat in study area	■ Breeding PCT ■ Potential habitat within the proposal area is highly fragmented and impacted by clearing for grazing. Large trees with suitable hollows within substantial tracts of woodland are few in the study area.
Survey requirements	■ May to August ■ Call playback, spotlighting, stag/hollow watching.
Survey effort	■ Not surveyed as per requirements – surveys carried out in October 2018 and 2019 including call playback and spotlighting including 85 site surveys throughout study area (72 surveys in nominated PCTs). Dusk stag watching where large hollows observed in survey area.
Presence in the study area	■ Not recorded during any field surveys ■ Examination of database records (AoLA 2021) shows there are few records in the wider area surrounding the proposal. Nearest database records to study area (from 2001) are from Parkhurst state Forest located 40 km south-east of North Star and several records (2000 and 2001) from Bullala National Park (47 km south of North Star). There are no records to the west, none with 100 km to the north, and none within 150 km to the east of the study area.
Polygon justification	■ Species credit (breeding) exclusion: Breeding habitat constraints for the species note the requirement for large tree hollows (>20 cm diameter). Low-quality PCTs do not contain large trees with hollows therefore do not provide breeding habitat for the species ■ The following PCTs are not considered to include the necessary breeding habitat for the species including: – PCT 55 (Belah dominated habitat which does not form large tree hollows) – PCT 147 (low growing (6 m height) SEVT community in which large hollows do not occur), – PCT 247 (Lignum shrubland) with no trees present hence exclusion ■ All other PCTs are considered to include the necessary breeding habitat for the species as targeted surveys have not occurred during the breeding period
PCTs	■ Associated PCTs in which species credit breeding habitat is predicted to occur: 35, 36, 52, 55, 56, 98, 192, 244, 418 ■ Associated PCTs located outside of known geographic range of species: 27
PCTs (BAM-C)	■ 35, 36, 56, 98, 192, 244, 418 (medium and high)
IBRA subregions	■ Northern Basalts ■ Castlereagh-Barwon

Aspect	Description
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Department of Environment and Conservation – New South Wales (DEC NSW) (2006). *NSW Recovery plan for the large forest owls.* DEC, Sydney. ■ Office of Environment and Heritage (2019). Masked owl (*Tyto novaehollandiae*). Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10820 [accessed 3 October 2019].

Table 42 Threatened species summary - *Hoplocephalus bitorquatus* | Pale-headed snake

Aspect	Description
Species name	▪ Pale-headed snake
Scientific name	▪ *Hoplocephalus bitorquatus*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Wet and dry sclerophyll forest and open woodlands (especially *Callitris*) on floodplains and near watercourses. They rely heavily on old and dead standing trees with hollows and exfoliating bark for shelter (Australian Museum 2017). ▪ In drier environments, it appears to favour habitats close to riparian areas. Shelters during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees (OEH 2017).
Potential habitat in study area	▪ The study area has been heavily impacted by past land use (grazing and agriculture) with much of the landscape cleared of large mature trees with hollows and peeling bark. Suitable habitat in high and moderate quality PCTs: 27, 36, 52, 53, 56,192, 244, 247, 418 and adjacent 500 m.
Survey requirements	▪ November to March ▪ Spotlighting: 30-minute search on two separate nights targeting specific habitat.
Survey effort	▪ February and March 2021 surveys consisting of 11 nights of spotlighting surveys twice at each location. Total of 21 locations surveyed.
Presence in the study area	▪ A total of three Pale headed snakes were observed during the surveys, all occurring within 50m the subject land. Two snakes were observed at Mobbindry Creek 10 March 2021 (35m outside the subject area) and on 13 March 2021 (occurring 5m outside the subject area). Both snakes were observed within the flaking bark of two separate *Eucalyptus camaldulensis* trees. One PHS was observed on the 12 March 2021 at road reserve adjacent to Tucka Tucka Rd on the tessellated bark of a *Corymbia tessellaris* (occurring 10m outside the subject area). All trees in which the snakes were observed were large trees (>80cm dbh) and supported hollows ▪ In the wider region database records are sparsely scattered in the landscape surrounding the study area. The next nearest record is from Goondiwindi (no date to record – 18 km north-west of proposal crossing of Macintyre River. There are several museum records (no date on records) located 24 km south of North Star and a 2001 record located 40 km south-east of North Star. ▪ BioNet contains 5 records of the species between Boomi, Moree, Yetman and Boggabilla. The closest record to the subject land is located approximately 35km south east of North Star.
Polygon justification	▪ It is likely that the habitat surrounding the location of all sightings within the subject area can support the PHS and as such should be considered as habitat. One section of Back Creek south of Borrow pit 7 was not accessed due to wet conditions but contained highly suitable habitat and has been mapped as habitat. Other areas which were not able to be accessed but also provided suitable habitat features such as PCT 244 are mapped as species habitat in line with the BAM and the precautionary principle. ▪ The following PCTs occur in polygons developed for this species - PCT 192, 244, 36 and 56.
PCTs	▪ Associated PCTs in which species is predicted to occur: PCT 27, 36, 52, 53, 56, 192, 244, 247, 418
PCTs (BAM-C)	▪ 192, 244, 36 and 56.
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon

Aspect	Description
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Australian Museum (2017). Pale-headed Snake - *Hoplocephalus bitorquatus*. Available from: https://australianmuseum.net.au/pale-headed-snake [Accessed 24 October 2018]. ■ Office of Environment and Heritage (2017). Pale-headed snake – profile. Updated 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10057 [Accessed 21 January 2021]

Table 43 Threatened species summary - *Jalmenus eubulus* | Pale imperial hairstreak

Aspect	Description
Species name	▪ Pale imperial hairstreak
Scientific name	▪ *Jalmenus eubulus*
BC Act	CE
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Are dependent on old-growth brigalow (*Acacia harpophylla*) woodland that has not been impacted by major disturbances such as clearing, and have not been observed in regrowth. They have an obligate relationship with the Iridomyrmex group of ants that attend to the larvae. The larvae are monophagous feeding solely on the leaves of brigalow (OEH 2019). ▪ Habitat consists of brigalow species including Brigalow, Buloke (*Allocasuarina leuhmannii*) and Belah (*Casuarina cristata*) on clay soils where the landscape is gently undulating or flat. Habitat can also include emergent eucalypts including Poplar box and Wilga (OEH 2019).
Potential habitat in study area	▪ PCT 35 up to 80ha ▪ There are a number of patches of high and moderate Brigalow PCT (35) throughout the study area. Much of the community is regularly grazed and varies in condition and age. Where there is little or no regeneration of Brigalow the community has been mapped as Low condition. Where there is scattered Brigalow, of either mature trees or regeneration, the community has been mapped as Medium condition and where there are mature trees with reasonably intact understory vegetation the community has been mapped as High condition.
Survey requirements	▪ January to March ▪ Habitat searches conducted two weeks after significant rain and after confirmation of species at a reference site, if not present then return two weeks later for follow up survey ▪ A total of three survey efforts at least two weeks apart
Survey effort	▪ January 2021 survey consisting of 8 days of habitat searches with team of 4 ecologists. A total of 60 hours of targeted searches. ▪ February 2021 survey consisting of 6 days of habitat searches with a team of 3 ecologists. A total of 80 hours of targeted searches in suitable vegetation ▪ March 2021 survey consisting of habitat searches with a team of 3 ecologists for a total minimum search effort of 1 hour per hectare in suitable vegetation in areas less than 10ha and 0.5 hours per hectare in areas over 10 ha as per advice from BCD.
Presence in the study area	▪ Final surveys of a series of three phases completed in March 2021 and did not detect the species. ▪ No caterpillars, pupae or adults and evidence of breeding identified within the study area in January-March 2021. ▪ Database records (AoLA 2021) indicate two nearby sites for the species to the west of the alignment. Location data has been generalised so actual location of site is uncertain. One site located approximately 10 km west of central portion of alignment has over 30 recent records attached and is likely to be a known breeding site. Second site located 28 km west of North Star with two 2013 records. To the east there is a 2018 record from Dthinna Dthinniwan National Park (38 km east of the study area). ▪ BioNet shows 35 records from 6 locations between Boggabilla, North Star and Yetman. ▪ February 2021 survey by OEH staff located 40 old pupae and 2 young caterpillars at one of two reference sites (outside the study area)
Polygon justification	▪ Species credit exclusion: Not detected during three phase field survey completed according to the methodology nominated by BCD. The species has only ever been known to breed in old growth brigalow forest and does not appear to colonise regrowth. All areas of low and medium quality PCT 35 no longer contain old growth forest and therefore do not provide habitat for this species
PCTs	▪ Associated PCT in which species is predicted to occur: 35
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon

Aspect	Description
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Office of Environment and Heritage (2019). Pale imperial hairstreak (*Jalmenus eubulus*). Updated 20 June 2019. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10057 [Accessed 27 September 2019]

Table 44 Threatened species summary - *Calyptorhynchus banksii samueli* | Red-tailed black-cockatoo

Aspect	Description
Species name	▪ Red-tailed black-cockatoo (inland subspecies) (Breeding)
Scientific name	▪ *Calyptorhynchus banksii samueli*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Eucalypt forest and woodlands, Acacia woodlands and Casuarina woodlands, with preferred habitat River red gum and Coolibah riparian forests and woodlands along major watercourses. Other habitats include grasslands, scrublands, wetlands and floodplain vegetation (OEH 2017).
Potential habitat in study area	▪ Suitable habitat within the study area associated with patches and linear strips of remnant vegetation located near watercourses and water sources (such as dams)
Survey requirements	▪ May – December
Survey effort	▪ Bird surveys carried out in October 2018 and 2019 including 75 site surveys throughout study area (30 surveys in nominated PCTs).
Presence in the study area	▪ Red-tailed black Cockatoo was recorded at several locations during the October 2018 and 2019 spring surveys. No pairs or other evidence of 'breeding' observed. ▪ There are scattered database records (AoLA 2021) throughout region surrounding study area often associated with riverine/floodplain habitats. Nearest records include two south of Goondiwindi (1986 and 1992 – 18 km north-west of Macintyre River crossing). Nearest recent record (2007) from Yetman State Forest (35 km east of North Star).
Polygon justification	▪ Remove from BAM-C breeding ▪ Remains ecosystem credit species ▪ No evidence of breeding was recorded during targeted surveys within specified time frames. Species excluded from further assessment.
PCTs	▪ Associated PCTs in which species credit breeding habitat is predicted to occur: 36, 52 56, 192, 244, 247, 628 ▪ Associated PCTs located outside of known geographic range of species: 27, 35, 55
PCTs (BAM C) ecosystem species	▪ 36, 56, 192, 244, 247, 628
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2017) Red-tailed Black-Cockatoo (inland subspecies) – profile. Updated on 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10138 [accessed 3 October 2019].

Table 45 Threatened species summary - *Aepyprymnus rufescens* | Rufous bettong

Aspect	Description
Species name	▪ Rufous bettong
Scientific name	▪ *Aepyprymnus rufescens*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ A variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter. Day nesting is in cone-shaped nests constructed of grass in a shallow depression at the base of a tussock or fallen log (OEH 2020).
Potential habitat in study area	▪ Habitat within the study area is heavily degraded through broad scale clearing of habitat for agriculture and grazing. Drought conditions at the time of the October 2019 were not conducive to the species presence with little of the preferred tall grassy ground cover present. In addition, Red fox (a known predator of small-medium sized mammals) was observed to be common throughout the study area, likely applying further pressure on the species potential presence.
Survey requirements	▪ All year ▪ Baited camera traps with almond oil added
Survey effort	▪ Camera traps were deployed during the October 2019 fauna survey. This included a total of 28 camera trap nights targeting Rufous bettong in the nominated PCTs ▪ In addition, 85 spotlighting site surveys were carried out throughout the study area during the October 2019 survey.
Presence in the study area	▪ The species was not recorded during any surveys for the proposal ▪ Investigation of database records (AoLA 2021) shows there are no records of this species occurrence within 80 km of the proposal. The nearest record is located 86 km north of the Macintyre River crossing area in Qld). The vast majority of records are located to the east in the coastal ranges and there are some records to the south in the Pilliga area. There are no records west of the proposal.
Polygon justification	▪ Remove from BAM-C ▪ No individuals were recorded during targeted surveys within specified time frames. Species excluded from further assessment.
PCTs	▪ Associated PCTs in which species is predicted to occur: 35, 418 ▪ Associated PCTs located outside of known geographic range of species: 147
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2020). Rufous Bettong - Profile. Updated 10 December 2020. New South Wales Government. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10033 [Accessed 21 January 2021].

Table 46 Threatened species summary - *Crinia sloanei* | Sloane's froglet

Aspect	Description
Species name	■ Sloane's froglet
Scientific name	■ *Crinia sloanei*
BC Act	■ V
EPBC Act	■ -
Credit Type	■ Species credit
Habitat Requirements	■ Records are widely scattered across floodplains of the Murray-Darling Basin, however the majority of records are in the south-western bioregions in New South Wales and there are no recent records in the northern part of its range which has reduced south. The species requires periodically inundated environments such as grasslands, woodland or disturbed habitat (OEH 2019).
Potential habitat in study area	■ Suitable habitat may be present however the species is no longer believed to be present in the northern part of its former range (OEH 2019)
Survey requirements	■ Not applicable
Survey effort	■ Not applicable (however not detected in any surveys including those during wet conditions in February and March 2021 where 18 different frog species were recorded).
Presence in the study area	■ Not present
Polygon justification	■ Species credit exclusion: The threatened species information has been updated and the species is now no longer expected to occur north of Dubbo. An email from the Threatened Species Officer in charge of the species excluding the species is in Appendix D
PCTs	■ Associated PCTs in which species is predicted to occur: 56, 628
IBRA subregions	■ Castlereagh-Barwon
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Office of Environment and Heritage (2019) Sloane's Froglet – profile (last updated 16 October 2019) Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20088 [accessed on: 21 January 2021]

Table 47 Threatened species summary - *Lophoictinia isura* | Square-tailed Kite

Aspect	Description
Species name	▪ Square-tailed Kite
Scientific name	▪ *Lophoictinia isura*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ Habitat for the Square-tailed kite includes open forest, woodland, low open eucalypt woodland, Acacia shrubland, grassland and herbfields. Preferred habitats occur along watercourses with records in NSW associated with major west flowing river systems (OEH 2019).
Potential habitat in study area	▪ The only major west flowing river system within the study area is the Macintyre River, however a number of timbered watercourses also intersect the study area.
Survey requirements	▪ September to January ▪ Daylight survey, nest survey
Survey effort	▪ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (54 surveys carried out in nominated PCTs). Searches for raptor nests also carried out at all sites during bird surveys and habitat assessments.
Presence in the study area	▪ No individuals or breeding pairs recorded during surveys ▪ There are scattered database records in the wider area surrounding the study area. There are several records along the Macintyre River both up and downstream from the Macintyre River proposal crossing area. Downstream records (as far west as Goondiwindi) appear to be older records (from the 1980s). To the east there are two 2017 records close to the river in the vicinity of Dthinna Dthinniwan National Park (30 km west of the study area). There are no records close to the rest of the proposal alignment.
Polygon justification	▪ Species credit (breeding) exclusion: No individuals or breeding pairs were recorded during targeted surveys within specified time frames. Species excluded from further assessment.
PCTs	▪ Associated PCTs in which species is predicted to occur: 27, 35, 36, 55, 56, 98, 192, 244, 247, 418, 628
IBRA subregions	▪ Northern Basalts ▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage, NSW (2017) Square-tailed Kite – profile. Updated 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10495 [Accessed 3 October 2019]

Table 48 Threatened species summary - *Geophaps scripta scripta* | Squatter pigeon

Aspect	Description
Species name	▪ Squatter pigeon (southern)
Scientific name	▪ *Geophaps scripta scripta*
BC Act	▪ E
EPBC Act	▪ V
Credit Type	▪ Species
Habitat Requirements	▪ Grassy understories of open eucalypt woodlands and plains featuring sandy areas and within close proximity to permanent water (within 3 km). Ground cover in foraging and breeding habitat is typically patchy, consisting of native, perennial tussock grasses or a mix of perennial tussock grasses and low shrubs or forbs. The vegetated ground layer rarely exceeds 33 per cent of the ground area, with the remaining surface typically bare patches of gravelly or dusty soil, and areas lightly covered in leaf litter and coarse, woody debris (e.g. fallen trees, logs and smaller debris). The species is also often found alongside tracks and roadsides (DAWE 2021; OEH 2017). ▪ The species is on the southern edge of its range in the study area. In NSW the species occurs south to Glen Innes, west through the Gwydir River region to Bellata, and north-westwards through to Goondiwindi (Squatter Pigeon Workshop 2011; Cooper et al. 2014). Until 1999, there had been no confirmed records of the Squatter Pigeon in NSW since 1978 (Cooper et al. 2014). In 1999 the subspecies was sighted approximately 27 km east of Ashford and, in 2001 and 2006, the subspecies was recorded in Bebo State Forest just north of Yetman (DAWE 2021).
Potential habitat in study area	▪ The species does not tend to forage far from preferred grassy woodland habitat. Open grassy woodlands with sandy and gravelly soil which may be suitable for this species are present in small sections of the study area.
Survey requirements	▪ Daylight survey
Survey effort	▪ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (45 surveys carried out in nominated PCTs).
Presence in the study area	▪ Not recorded during any proposal surveys. The species is well known to ecologists conducting the surveys and is not likely to have been overlooked had it been present. ▪ There are sparsely scattered database records to the south and east of the proposal. Records to the south are all older records. Records to the south-east and east include more recent sightings although there are no records more recent than 2006. The nearest records are from Dthinna Dthinniwan National Park and are between 30 km and 50 km east of the study area.
Polygon justification	▪ Excluded: Species credit excluded as not identified during any surveys and species unlikely to occur based on current distribution. Species excluded from further assessment.
PCTs	▪ Associated PCTs in which species is predicted to occur: 36, 53, 56, 98, 192, 244, 247, 418, 628 ▪ Associated PCTs located outside of known geographic range of species: 27
IBRA subregions	▪ Northern Basalts ▪ Castlereagh-Barwon

Aspect	Description
References	■ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ■ Cooper, RM, McAllan, IAW and Curtis, BR (2014). *The Atlas of the Birds of NSW and the ACT*. Mini-Publishing, Gordon, New South Wales. ■ Department of Agriculture, water and the Environment (2020). *Geophaps scripta scripta* (Squatter Pigeon) in Species Profile and Threats Database. Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64440 [Accessed 22 Januray 2020]. ■ Office of Environment and Heritage (2017). Squatter Pigeon (southern) - Profile. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10350# [Accessed 22 August 2018]. ■ Squatter Pigeon Workshop (2011). Proceedings from the workshop for the Squatter Pigeon (southern). 14-15 December 2011. Toowoomba Office of the Queensland Parks and Wildlife Service.

Table 49 Threatened species summary - *Petaurus norfolcensis* | Squirrel glider

Aspect	Description
Species name	▪ Squirrel glider (Breeding)
Scientific name	▪ *Petaurus norfolcensis*
BC Act	▪ V
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ Squirrel gliders inhabit mature or old growth Box/Box-ironbark woodlands and River red gum forest west of the Great Dividing Range and Blackbutt/Bloodwood forest with a heath understorey in coastal areas. They prefer mixed species stands with a shrub or Acacia midstorey (OEH 2017)
Potential habitat in study area	▪ Larger patches and linear strips of remnant vegetation with flowering eucalypts and suitable tree hollows is present in parts of the study area.
Survey requirements	▪ January to December (year round) ▪ Spotlighting, baited camera trap
Survey effort	▪ Targeted surveys carried out in October 2018 and 2019 including spotlighting including 85 site surveys throughout study area (25 surveys in nominated PCTs). Camera traps deployed for a total of 156 trap nights (65 surveys in nominated PCTs).
Presence in the study area	▪ Recorded within PCT 36 on the Macintyre River (in 2018), a large patch of PCT 244 outside of the subject land but adjacent to PCT 56 within the subject land (in 2018) and within the rail alignment in a small area of PCT 55 (in 2019). ▪ There are no database records of Squirrel glider (AoLA 2020) close to the proposal and no records to the west. The vast majority of records are located south and east of the proposal. The nearest records are located to the east - Yetman State Forest (not dated - 35 km east of the study area) and Dthinna Dthinniwan National Park (1999 - 55 km east). There are also records (2001 and 2012) from Bullala National park (46 km south of North Star).
Polygon justification	▪ Species credit (inclusions): PCT36 Castlereagh-Barwon and 55 and 56 NB High as the species was recorded in or directly adjacent to those locations ▪ Species excluded from all other areas as not located during targeted survey efforts.
PCTs	▪ Associated PCTs in which species is predicted to occur: 36, 418 ▪ Associated PCTs located outside of known geographic range of species: 628
PCTs (BAM-C)	▪ High 36, 55, 56
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2017). Squirrel Glider - Profile. New South Wales Government. Updated 1 December 2017. Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10604 [Accessed 21 Januaray 2021]

Table 50 Threatened species summary - *Polytelis swainsonii* | Superb parrot

Aspect	Description
Species name	▪ Superb parrot (Breeding)
Scientific name	▪ *Polytelis swainsonii*
BC Act	▪ V
EPBC Act	▪ V
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ Found in Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest but will forage in grassy box woodlands. The species feeds in all canopy layers (trees, understorey shrubs and ground layer) on mainly grass seeds and herbaceous plants, but also fruits, berries, nectar, buds, flowers, insects and grain (OEH 2017). ▪ The species breeds in River Red Gum or box woodlands (DAWE 2021). Core breeding areas are all in NSW and include the south-western slopes and in the Riverina areas. The species migrates north to the Namoi and Gwydir river area in the winter outside the breeding season (OEH 2017).
Potential habitat in study area	▪ There are patchy suitable woodlands in the area (River red gum and box woodlands). Nevertheless, the species does not breed in the area and the study area is north of the species accepted distribution.
Survey requirements	▪ September to November ▪ Daylight survey
Survey effort	▪ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (45 surveys carried out in nominated PCTs).
Presence in the study area	▪ No individuals or breeding pairs were recorded during targeted surveys for the proposal ▪ Mapping of the species potential distribution by DAWE (2021) indicates the study area lies to the north of mapped habitat in which the species 'may occur' which is located to the south of Moree (ie. the study area lies outside of the mapped habitat distribution). ▪ The vast majority of database records are located south, south-west and west of the study area which aligns with the species recognised distribution. Records outside of this distribution are very likely to be vagrant individuals or aviary escapees. The nearest record to the proposal is from 2011 and located 35 km south-west of North Star.
Polygon justification	▪ Species credit (breeding) exclusion: Remove from BAM-C ▪ No breeding pairs were recorded during targeted surveys within the specified time frames. Study area is outside of the species normal distribution. Species excluded from further assessment.
PCTs	▪ Associated PCTs in which species breeding habitat is predicted to occur: 36, 52, 56, 98, 244 ▪ Associated PCTs located outside of known geographic range of species: 27, 35, 55, 418
IBRA subregions	▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Department of Agriculture, Water and the Environment (2021), Species profile and threats (SPRAT) database. Commonwealth Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/sprat. ▪ Office of Environment and Heritage (2017) Superb Parrot – profile (last updated 1 December 2017) Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10645#:~:text=The%20Superb%20Parrot%20is%20found,and%20Coolac%20in%20the%20west [accessed 21 January 2021]

Table 51 Threatened species summary - *Lathamus discolor* | Swift parrot

Aspect	Description
Species name	▪ Swift parrot (foraging)
Scientific name	▪ *Lathamus discolor*
BC Act	▪ E
EPBC Act	▪ CE
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ In northern NSW and southeastern Queensland, Narrow-leaved ironbark (*Eucalyptus crebra*), Forest red gum (*E. tereticornis*) forests and Yellow box (*E. melliodora*) forest are commonly utilised by Swift parrots (OEH 2019, Saunders and Tzaros 2011). While in woodlands on the central western slopes in NSW species favoured include Mugga ironbark (*E.sideroxylon*), Grey Box (*E. microcarpa*), White box (*E. albens*) and Yellow box (*E. melliodora*) are used (Saunders and Heinsohn 2008). The species is found to prefer large mature trees for foraging as these provide more reliable resources than smaller immature trees (Saunders and Tzaros 2011). ▪ The species is only known to breed in Tasmania
Potential habitat in study area	▪ Poplar box (*E. populnea*) is the dominant canopy tree species within the study area and is not listed as a 'key forage tree' as listed above. PCT418 occurs within proposed borrow pits of the study area. It is noted none of the preferred forage tree species listed above occur within this community within the study area. A favoured feed tree species *E. tereticornis* also occurs (in PCT 628) however only as small patches, which may limit its habitat value.
Survey requirements	▪ March to July ▪ Daylight survey
Survey effort	▪ Surveys not carried out as per survey requirements for the species. Bird surveys carried out for the proposal in October 2018 and 2019 (ie. outside of the species potential occurrence in the region). ▪ The species has not been observed during non-target field time over four years 2018 - 2021
Presence in the study area	▪ Scattered database records of the species occurrence (AoLA 2021) occur to the south and east of the study area. There are no records to the north and west. There are no confirmed records within 70 km of the proposal. The nearest record to the proposal is from 1922 located in Texas (Qld). The nearest recent record is from 2007 and located 71 km south-west of North Star.
Polygon justification	▪ Species credit (breeding) exclusion: Remove from BAM-C the species breeds in Tasmania. ▪ Ecosystem species exclusion: PCT 418 Low. The species feed on flowering eucalypts and lerps which require large old trees. Low-quality PCT 418 does not contain trees therefore is not considered suitable habitat for the species. It is noted none of the favoured tree species noted above were observed in PCT 418 within the study area.
PCTs	▪ Associated PCTs in which species is predicted to occur: 418 ▪ Associated PCTs located outside of known geographic range of species: 36, 628
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage (2019). Swift Parrot - Profile. New South Wales Government. Last updated June 2019. Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10455 [Accessed 12 September 2019]. ▪ Saunders, D. and Heinsohn, R. 2008, Winter habitat use by the endangered, migratory Swift parrot (*Lathamus discolor*) in New South Wales. *Emu.* 108:81-89. CSIRO Publishing. ▪ Saunders. D. and Tzaros, C. (2011). *National Recovery Plan for the Swift Parrot Lathamus discolor.* Birds Australia, Melbourne.

Table 52 Threatened species summary - *Haliaeetus leucogaster* | White-bellied sea-eagle

Aspect	Description
Species name	▪ White-bellied sea-eagle (Breeding)
Scientific name	▪ *Haliaeetus leucogaster*
BC Act	▪ V
EPBC Act	▪
Credit Type	▪ Species and Ecosystem
Habitat Requirements	▪ This species is exclusively a fish predator. Areas with large open water bodies including rivers, swamps, lakes and the ocean. Inland they will occupy areas within the vicinity of lakes, reservoirs, billabongs and saltmarshes. They will utilise terrestrial habitats that include coastal dunes, tidal flats, grasslands, heathlands, woodlands, and even rainforest. They will use emergent and dead trees as 'guard roosts' creating large nests from sticks lining the nest with leaves (OEH 2019).
Potential habitat in study area	▪ No large waterbodies other than the Macintyre River are present in the study area. Riparian vegetation with large trees in the vicinity of the river provides the only potential breeding or foraging habitat available.
Survey requirements	▪ Breeding months: July-December ▪ Daylight survey, nest survey
Survey effort	▪ Daylight bird surveys occurred in spring October 2018 and October 2019 including 75 20 minute surveys throughout study area (54 surveys carried out in nominated PCTs). Searches for raptor nests also carried out at all sites during bird surveys and habitat assessments.
Presence in the study area	▪ Individual recorded over the Macintyre River in October 2019. No evidence of breeding activity (raptor nests or pairs) observed. ▪ No breeding pairs were recorded during targeted surveys within specified time frames
Polygon justification	▪ Species credit (breeding) exclusion: Remove from BAM-C No breeding pairs or suitable nests were recorded during targeted surveys within the specified time frames. Species excluded from further assessment. ▪ Ecosystem species to remain for all areas as foraging habitat
PCTs	▪ Associated PCTs in which species is predicted to occur: 27, 35, 36, 56, 98, 244, 247, 418, 628 ▪ Associated PCTs located outside of known geographic range of species: 53, 55
IBRA subregions	▪ Northern Outwash ▪ Castlereagh-Barwon
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/ ▪ Office of Environment and Heritage, NSW (2019). White-bellied sea eagle (*Haliaeetus leucogaster*). Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20322 [Accessed 2 October 2019].

Table 53 Threatened species summary - *Amalosia rhombifer* | Zigzag velvet gecko

Aspect	Description
Species name	▪ Zigzag velvet gecko
Scientific name	▪ *Amalosia rhombifer*
BC Act	▪ E
EPBC Act	▪ -
Credit Type	▪ Species
Habitat Requirements	▪ The species is confined to woodland habitats that are dominated by eucalypt species including *Eucalyptus sideroxylon, E. moluccana, E. blakelyi, Callitris* species. It is an arboreal species that is found beneath the decorticating bark of live trees. The species has regional distribution in the Brigalow Belt South, Nandewar and New England Tablelands (OEH 2019).
Potential habitat in study area	▪ Potential habitat featuring *Callitris* species occurs within the study area in PCT 418
Survey requirements	▪ September to April ▪ Survey should be undertaken on warm, humid nights with good insect activity. It is unlikely to disperse across cleared ground.
Survey effort	▪ Targeted survey in February 2021 within PCT 418 over 2 hours survey time
Presence in the study area	▪ None recorded ▪ There are relatively few records of the species in NSW. Examination of database records (AoLA 2021) shows all records occur to the east or south-east of the study area. The nearest record is from 2001 in Dthinna Dthinniwan National Park (37 km east of the study area).
Polygon justification	▪ Species credit exclusion: Remove from BAM-C ▪ The species is unlikely to disperse across cleared ground and is prone to predation when dispersing between trees (OEH 2020). Areas mapped as low-quality PCTs contain either few small scattered or no trees. Therefore, these areas are not considered habitat for the species
PCTs	▪ Associated PCT in which species is predicted to occur: 418
IBRA subregions	▪ Northern Basalts
References	▪ Atlas of Living Australia (AoLA) (2021). *Spatial Portal*. Available From: https://spatial.ala.org.au/. ▪ Office of Environment and Heritage, NSW (2019). Zigzag velvet gecko (*Amalosia rhombifer)*. Available from: https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10871 [Accessed 30 September 2019].

Appendix H
Biodiversity Assessment Method Credit Reports

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00016992

Proposal Name
Inland Rail Borrow Pit FFJV Site 1

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Finalised

Date Finalised
15/10/2021

Assessment Revision
3

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion											
3	35_Low	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	21.1	21.1	0.9	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00	TRUE	9
4	35_medium	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	48	48.0	0.67	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00	TRUE	16
										Subtotal	**25**
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion											
1	147_High	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	51.8	51.8	1.2	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		31
2	147_Med	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	56.8	56.8	3.4	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		96
										Subtotal	**127**
										Total	**152**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Digitaria porrecta / Finger Panic Grass (Flora)								
147_High	51.8	51.8	0.05	Endangered	Not Listed	2	False	1
147_Med	56.8	56.8	3.4	Endangered	Not Listed	2	False	96
35_Low	21.1	21.1	0.78	Endangered	Not Listed	2	False	8
35_medium	48.0	48.0	0.67	Endangered	Not Listed	2	False	16
							Subtotal	**121**
Homopholis belsonii / Belson's Panic (Flora)								
147_High	51.8	51.8	0.59	Endangered	Vulnerable	2	False	15
147_Med	56.8	56.8	3.4	Endangered	Vulnerable	2	False	96
35_medium	48.0	48.0	0.67	Endangered	Vulnerable	2	False	16
							Subtotal	**127**
Tyto novaehollandiae / Masked Owl (Fauna)								
147_High	51.8	51.8	1.2	Vulnerable	Not Listed	2	False	31
147_Med	56.8	56.8	3.4	Vulnerable	Not Listed	2	False	96
							Subtotal	**127**

BAM Credit Summary Report

Proposal Details

Assessment Id 00013930/BAAS17097/19/00016994	Proposal Name Inland Rail Borrow Pit FFJV Site 2	BAM data last updated * 10/06/2021
Assessor Name Sarah Glauert	Report Created 15/10/2021	BAM Data version * 45
Assessor Number BAAS17097	BAM Case Status Finalised	Date Finalised 15/10/2021
Assessment Revision 4	Assessment Type Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion											
1	35_Low	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	29	29.0	0.67	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	10
										Subtotal	**10**
White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion											
2	418_High	Not a TEC	35.7	35.7	6.1			High Sensitivity to Potential Gain	1.50		81
3	418_Medium	Not a TEC	40.9	40.9	6.8			High Sensitivity to Potential Gain	1.50		104
										Subtotal	**185**
										Total	**195**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
418_High	35.7	35.7	6.1	Vulnerable	Not Listed	2	False	109
418_Medium	40.9	40.9	6.8	Vulnerable	Not Listed	2	False	138
							Subtotal	**247**
Digitaria porrecta / Finger Panic Grass (Flora)								
35_Low	29.0	29.0	0.31	Endangered	Not Listed	2	False	4
418_High	35.7	35.7	6.1	Endangered	Not Listed	2	False	109

418_Medium	40.9	40.9	3.1	Endangered	Not Listed	2	False	64
							Subtotal	**177**
Homopholis belsonii / Belson's Panic (Flora)								
418_High	35.7	35.7	6.1	Endangered	Vulnerable	2	False	109
418_Medium	40.9	40.9	3.6	Endangered	Vulnerable	2	False	73
							Subtotal	**182**

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00016964

Proposal Name
Inland Rail NS2B Borrow Pit 5

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Finalised

Date Finalised
15/10/2021

Assessment Revision
5

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW											
1	192_High	Not a TEC	45.6	45.6	9.1			High Sensitivity to Potential Gain	1.50		155
2	192_Med	Not a TEC	33.3	33.3	1.4			High Sensitivity to Potential Gain	1.50		17

3	192_Low	Not a TEC	29.8	29.8	1.9			High Sensitivity to Potential Gain	1.50	21
									Subtotal	**193**
									Total	**193**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
192_High	45.6	45.6	9.1	Vulnerable	Not Listed	2	False	207
192_Med	33.3	33.3	1.4	Vulnerable	Not Listed	2	False	22
							Subtotal	**229**
Hoplocephalus bitorquatus / Pale-headed Snake (Fauna)								
192_High	45.6	45.6	9.1	Vulnerable	Not Listed	2	False	207
192_Med	33.3	33.3	1.4	Vulnerable	Not Listed	2	False	22
192_Low	29.8	29.8	1.9	Vulnerable	Not Listed	2	False	28
							Subtotal	**257**
Polygala linariifolia / Native Milkwort (Flora)								
192_High	45.6	45.6	9.1	Endangered	Not Listed	2	False	207
192_Med	33.3	33.3	1.4	Endangered	Not Listed	2	False	22
192_Low	29.8	29.8	1.9	Endangered	Not Listed	2	False	28
							Subtotal	**257**

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00016970

Proposal Name
Inland Rail Borrow Pit 7

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Finalised

Date Finalised
15/10/2021

Assessment Revision
4

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW											
1	56_High	Not a TEC	36.6	36.6	0.13			High Sensitivity to Potential Gain	2.00		2
										Subtotal	**2**
										Total	**2**

BAM Credit Summary Report

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
56_High	36.6	36.6	0.13	Vulnerable	Not Listed	2	False	2
							Subtotal	**2**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013930/BAAS17097/21/00024373	Inland Rail NS2B Borrow Pit 7	10/06/2021
Assessor Name	Report Created	BAM Data version *
Sarah Glauert	15/10/2021	45
Assessor Number	BAM Case Status	Date Finalised
BAAS17097	Finalised	15/10/2021
Assessment Revision	Assessment Type	BOS entry trigger
0	Scattered Trees	Major Project

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Scattered Trees Credit Requirement

Class	Contains hollows	Number of trees	Ecosystem credits
56-Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW			
3	True	5.0	5
			5
			5

Species credits for threatened species

Nil

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00016969

Proposal Name
Inland Rail Borrow Pit 8

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
4

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW											
1	56_Medium	Not a TEC	74.4	74.4	21.1			High Sensitivity to Potential Gain	2.00		787
										Subtotal	**787**
										Total	**787**

BAM Credit Summary Report

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
56_Medium	74.4	74.4	21.1	Vulnerable	Not Listed	2	False	787
							Subtotal	**787**
Tyto novaehollandiae / Masked Owl (Fauna)								
56_Medium	74.4	74.4	21.1	Vulnerable	Not Listed	2	False	785
							Subtotal	**785**

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00016941

Proposal Name
Inland Rail Borrow Pit 9

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Finalised

Date Finalised
15/10/2021

Assessment Revision
4

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion											
1	418_Med	Not a TEC	39.4	39.4	3			High Sensitivity to Potential Gain	1.50		44
2	418_High	Not a TEC	63.3	63.3	3.9			High Sensitivity to Potential Gain	1.50		93

3	418_Low	Not a TEC	5.9	5.9	1			High Sensitivity to Potential Gain	1.50		0
										Subtotal	**137**
										Total	**137**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
418_Med	39.4	39.4	3	Vulnerable	Not Listed	2	False	59
418_High	63.3	63.3	3.9	Vulnerable	Not Listed	2	False	125
							Subtotal	**184**
Tyto novaehollandiae / Masked Owl (Fauna)								
418_Med	39.4	39.4	3	Vulnerable	Not Listed	2	False	59
418_High	63.3	63.3	3.9	Vulnerable	Not Listed	2	False	125
							Subtotal	**184**

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00016958

Proposal Name
Inland Rail NS2B Borrow Pit 13

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Finalised

Date Finalised
15/10/2021

Assessment Revision
2

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Poplar Box - White Cypress Pine - Wilga - Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion											
1	98_High	Not a TEC	56.1	56.1	0.57			High Sensitivity to Potential Gain	1.50		12
										Subtotal	**12**
										Total	**12**

BAM Credit Summary Report

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00016988

Proposal Name
Inland Rail Borrow Pit 25

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Finalised

Date Finalised
15/10/2021

Assessment Revision
3

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
White Cypress Pine - Silver-leaved Ironbark - Wilga shrub grass woodland of the Narrabri-Yetman region, Brigalow Belt South Bioregion											
1	418_Medium	Not a TEC	42.3	42.3	1.5			High Sensitivity to Potential Gain	1.50		24
2	418_Low01	Not a TEC	28.4	28.4	1.5			High Sensitivity to Potential Gain	1.50		16
										Subtotal	**40**
										Total	**40**

BAM Credit Summary Report

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
418_Medium	42.3	42.3	1.5	Vulnerable	Not Listed	2	False	32
							Subtotal	**32**

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00014394

Proposal Name
FFJV Inland Rail - CB

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Finalised

Date Finalised
15/10/2021

Assessment Revision
9

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion											
12	628_BR_Low	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	34	34.0	8.2	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		139
13	628_BR_Med	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	87.5	87.5	2.9	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		128
14	628_GR_Low	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	25.8	25.8	1.2	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		15
15	628_TP_Med01	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	92.2	92.2	3.1	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		144

24	628_TP_Low	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	45.9	45.9	11	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		252
										Subtotal	**678**
Lignum shrubland wetland on regularly flooded alluvial depressions in the Brigalow Belt South Bioregion and Darling Riverine Plains Bioregion											
1	247_BR_Medium	Not a TEC	35	35.0	6.2			High Sensitivity to Potential Gain	1.75		94
8	247_GR_Low	Not a TEC	40.2	40.2	2.2			High Sensitivity to Potential Gain	1.75		38
18	247_BR-Low	Not a TEC	97	97.0	2.3			High Sensitivity to Potential Gain	1.75		98
										Subtotal	**230**
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW											
4	56_BR_Low	Not a TEC	63.7	63.7	18.3			High Sensitivity to Potential Gain	2.00		583
10	56_TP_Med	Not a TEC	69.1	69.1	0.3			High Sensitivity to Potential Gain	2.00		10
21	56_TP_Low	Not a TEC	48.2	48.2	1.9			High Sensitivity to Potential Gain	2.00		46
										Subtotal	**639**
Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).											
7	244_GR_Medium	Not a TEC	75.9	75.9	3.8			High Sensitivity to Potential Gain	2.00		146

16	244_BR_Medium	Not a TEC	77.6	77.6	3.6			High Sensitivity to Potential Gain	2.00		138
17	244_BR-Low	Not a TEC	40.1	40.1	3.7			High Sensitivity to Potential Gain	2.00		75
										Subtotal	**359**
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion											
2	52_GR_Medium	Not a TEC	82.5	82.5	26.1			High Sensitivity to Potential Gain	2.00		1076
9	52_BR_Med	Not a TEC	83.8	83.8	7.4			High Sensitivity to Potential Gain	2.00		308
										Subtotal	**1384**
River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion											
3	36_TP_High	Not a TEC	81.8	81.8	0.66			High Sensitivity to Potential Gain	1.75		24
11	36_TP_Med01	Not a TEC	87.7	87.7	1.6			High Sensitivity to Potential Gain	1.75		60
19	36_BR_Med	Not a TEC	30.9	30.9	1.6			High Sensitivity to Potential Gain	1.75		22
20	36_GR_Med01	Not a TEC	63.3	63.3	0.84			High Sensitivity to Potential Gain	1.75		23
										Subtotal	**129**
Silver-leaved Ironbark - Poplar Box +/- Ironwood shrub - grass woodland on rises in the north-western plains of NSW											
5	192_GR_Low	Not a TEC	27.8	27.8	1.6			High Sensitivity to Potential Gain	1.50		17
6	192_GR_Medium	Not a TEC	45	45.0	2.3			High Sensitivity to Potential Gain	1.50		39

22	192_TP_Low	Not a TEC	17	17.0	1.5			High Sensitivity to Potential Gain	1.50		9
23	192_TP_Med	Not a TEC	40.1	40.1	2			High Sensitivity to Potential Gain	1.50		30
										Subtotal	**95**
										Total	**3514**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
192_GR_Medium	45.0	45.0	2.3	Vulnerable	Not Listed	2	False	52
244_GR_Medium	75.9	75.9	3.8	Vulnerable	Not Listed	2	False	146
628_BR_Med	87.5	87.5	2.9	Vulnerable	Not Listed	2	False	128
244_BR_Medium	77.6	77.6	3.6	Vulnerable	Not Listed	2	False	138
36_TP_High	81.8	81.8	0.66	Vulnerable	Not Listed	2	False	27
56_TP_Med	69.1	69.1	0.24	Vulnerable	Not Listed	2	False	8
36_TP_Med01	87.7	87.7	1.6	Vulnerable	Not Listed	2	False	68
628_TP_Med01	92.2	92.2	3.1	Vulnerable	Not Listed	2	False	144
36_BR_Med	30.9	30.9	1.6	Vulnerable	Not Listed	2	False	25
36_GR_Med01	63.3	63.3	0.84	Vulnerable	Not Listed	2	False	27
192_TP_Med	40.1	40.1	2	Vulnerable	Not Listed	2	False	39
							Subtotal	**802**
Desmodium campylocaulon / Creeping Tick-trefoil (Flora)								
52_GR_Medium	82.5	82.5	26.1	Endangered	Not Listed	2	False	1076

244_GR_Medium	75.9	75.9	3.8	Endangered	Not Listed	2	False	146
52_BR_Med	83.8	83.8	0.28	Endangered	Not Listed	2	False	12
							Subtotal	**1234**
Dichanthium setosum / Bluegrass (Flora)								
52_GR_Medium	82.5	82.5	26.1	Vulnerable	Vulnerable	2	False	1076
							Subtotal	**1076**
Digitaria porrecta / Finger Panic Grass (Flora)								
247_BR_Medium	35.0	35.0	6.2	Endangered	Not Listed	2	False	108
52_GR_Medium	82.5	82.5	26.1	Endangered	Not Listed	2	False	1076
56_BR_Low	63.7	63.7	18.3	Endangered	Not Listed	2	False	583
244_GR_Medium	75.9	75.9	3.8	Endangered	Not Listed	2	False	146
52_BR_Med	83.8	83.8	7.4	Endangered	Not Listed	2	False	308
628_BR_Low	34.0	34.0	1	Endangered	Not Listed	2	False	17
628_BR_Med	87.5	87.5	0.33	Endangered	Not Listed	2	False	14
244_BR_Medium	77.6	77.6	3.6	Endangered	Not Listed	2	False	138
244_BR-Low	40.1	40.1	3.7	Endangered	Not Listed	2	False	75
247_GR_Low	40.2	40.2	2.2	Endangered	Not Listed	2	False	43
247_BR-Low	97.0	97.0	2.3	Endangered	Not Listed	2	False	113
56_TP_Med	69.1	69.1	0.12	Endangered	Not Listed	2	False	4
56_TP_Low	48.2	48.2	1.9	Endangered	Not Listed	2	False	46
							Subtotal	**2671**
Homopholis belsonii / Belson's Panic (Flora)								
52_GR_Medium	82.5	82.5	26.1	Endangered	Vulnerable	2	False	1076
244_GR_Medium	75.9	75.9	3.8	Endangered	Vulnerable	2	False	146

							Subtotal	**1222**
Hoplocephalus bitorquatus / Pale-headed Snake (Fauna)								
192_GR_Medium	45.0	45.0	2.3	Vulnerable	Not Listed	2	False	52
244_GR_Medium	75.9	75.9	3.8	Vulnerable	Not Listed	2	False	146
36_TP_High	81.8	81.8	0.66	Vulnerable	Not Listed	2	False	27
36_TP_Med01	87.7	87.7	1.6	Vulnerable	Not Listed	2	False	68
36_GR_Med01	63.3	63.3	0.84	Vulnerable	Not Listed	2	False	27
192_TP_Med	40.1	40.1	2	Vulnerable	Not Listed	2	False	39
							Subtotal	**359**
Lepidium monoplocoides / Winged Peppercress (Flora)								
52_GR_Medium	82.5	82.5	25.8	Endangered	Endangered	2	False	1064
56_BR_Low	63.7	63.7	0.28	Endangered	Endangered	2	False	9
							Subtotal	**1073**
Petaurus norfolcensis / Squirrel Glider (Fauna)								
36_TP_High	81.8	81.8	0.66	Vulnerable	Not Listed	2	False	27
							Subtotal	**27**
Phascolarctos cinereus / Koala (Fauna)								
628_BR_Med	87.5	87.5	2.9	Vulnerable	Vulnerable	2	False	128
36_TP_High	81.8	81.8	0.66	Vulnerable	Vulnerable	2	False	27
628_TP_Med01	92.2	92.2	3.1	Vulnerable	Vulnerable	2	False	144
							Subtotal	**299**
Swainsona murrayana / Slender Darling Pea (Flora)								
52_GR_Medium	82.5	82.5	26.1	Vulnerable	Vulnerable	2	False	1076
244_GR_Medium	75.9	75.9	3.8	Vulnerable	Vulnerable	2	False	146

							Subtotal	**1222**
Tyto novaehollandiae / Masked Owl (Fauna)								
192_GR_Medium	45.0	45.0	2.3	Vulnerable	Not Listed	2	False	52
244_GR_Medium	75.9	75.9	3.8	Vulnerable	Not Listed	2	False	146
628_BR_Med	87.5	87.5	2.9	Vulnerable	Not Listed	2	False	128
244_BR_Medium	77.6	77.6	3.6	Vulnerable	Not Listed	2	False	138
36_TP_High	81.8	81.8	0.66	Vulnerable	Not Listed	2	False	27
56_TP_Med	69.1	69.1	0.24	Vulnerable	Not Listed	2	False	8
36_TP_Med01	87.7	87.7	1.6	Vulnerable	Not Listed	2	False	68
628_TP_Med01	92.2	92.2	3.1	Vulnerable	Not Listed	2	False	144
36_BR_Med	30.9	30.9	1.6	Vulnerable	Not Listed	2	False	25
36_GR_Med01	63.3	63.3	0.84	Vulnerable	Not Listed	2	False	27
192_TP_Med	40.1	40.1	2	Vulnerable	Not Listed	2	False	39
							Subtotal	**802**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013930/BAAS17097/19/00014150	DRP CB PCT 192 Paddock Trees	10/06/2021
Assessor Name	Report Created	BAM Data version *
Sarah Glauert	15/10/2021	45
Assessor Number	BAM Case Status	Date Finalised
BAAS17097	Finalised	15/10/2021
Assessment Revision	Assessment Type	BOS entry trigger
0	Scattered Trees	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Scattered Trees Credit Requirement

Class	Contains hollows	Number of trees	Ecosystem credits
36-River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion			
3	True	1.0	1
			1
			1

Species credits for threatened species

Nil

BAM Credit Summary Report

Proposal Details

Assessment Id 00013930/BAAS17097/19/00014244	Proposal Name Inland Rail NS2B - Northern Bassalts	BAM data last updated * 10/06/2021
Assessor Name Sarah Glauert	Report Created 15/10/2021	BAM Data version * 45
Assessor Number BAAS17097	BAM Case Status Finalised	Date Finalised 15/10/2021
Assessment Revision 8	Assessment Type Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.											
2	55_BR_High	Not a TEC	26.2	26.2	0.64			High Sensitivity to Potential Gain	2.00		8
										Subtotal	**8**

Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion											
1	35_BR_High	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	94.4	94.4	5.4	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	253
4	35_TP_High	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	77.9	77.9	0.33	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	13
5	35_BR_Low	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	31.7	31.7	2	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	32
										Subtotal	**298**
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW											
6	56_BR_High01	Not a TEC	65.2	65.2	31.6			High Sensitivity to Potential Gain	2.00		1031
7	56_TP_High	Not a TEC	68.3	68.3	2.9			High Sensitivity to Potential Gain	2.00		98
8	56_TP_Low	Not a TEC	43.8	43.8	5.1			High Sensitivity to Potential Gain	2.00		112
9	56_BR_Med	Not a TEC	57.6	57.6	3.5			High Sensitivity to Potential Gain	2.00		100

10	56_TP_Med	Not a TEC	51.1	51.1	4.4			High Sensitivity to Potential Gain	2.00	112
11	56_BR_Low	Not a TEC	42	42.0	25			High Sensitivity to Potential Gain	2.00	525
									Subtotal	**1978**
Poplar Box - White Cypress Pine - Wilga - Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion										
3	98_BR_High	Not a TEC	91.9	91.9	2.2			High Sensitivity to Potential Gain	1.50	75
									Subtotal	**75**
Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains										
12	53_BR_Med	Not a TEC	80.4	80.4	3			High Sensitivity to Potential Gain	1.75	107
13	53_TP_Med	Not a TEC	77.8	77.8	1.2			High Sensitivity to Potential Gain	1.75	40
									Subtotal	**147**
									Total	**2506**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
56_BR_High01	65.2	65.2	31.6	Vulnerable	Not Listed	2	False	1031
56_TP_High	68.3	68.3	2.9	Vulnerable	Not Listed	2	False	98
56_BR_Med	57.6	57.6	3.5	Vulnerable	Not Listed	2	False	100
56_TP_Med	51.1	51.1	4.4	Vulnerable	Not Listed	2	False	112

98_BR_High	67.7	67.7	2.2	Vulnerable	Not Listed	2	False	74
							Subtotal	**1415**
Digitaria porrecta / Finger Panic Grass (Flora)								
35_BR_High	94.4	94.4	0.84	Endangered	Not Listed	2	False	40
56_BR_High01	65.2	65.2	3.1	Endangered	Not Listed	2	False	100
56_TP_Low	43.8	43.8	5.1	Endangered	Not Listed	2	False	112
56_BR_Med	57.6	57.6	0.05	Endangered	Not Listed	2	False	1
56_BR_Low	42.0	42.0	24.9	Endangered	Not Listed	2	False	523
53_BR_Med	80.4	80.4	0.39	Endangered	Not Listed	2	False	16
							Subtotal	**792**
Homopholis belsonii / Belson's Panic (Flora)								
56_TP_High	68.3	68.3	1.7	Endangered	Vulnerable	2	False	58
56_BR_Low	42.0	42.0	0.07	Endangered	Vulnerable	2	False	1
							Subtotal	**59**
Petaurus norfolcensis / Squirrel Glider (Fauna)								
55_BR_High	26.2	26.2	0.64	Vulnerable	Not Listed	2	False	8
56_BR_High01	65.2	65.2	31.6	Vulnerable	Not Listed	2	False	1031
56_TP_High	68.3	68.3	2	Vulnerable	Not Listed	2	False	68
							Subtotal	**1107**
Phascolarctos cinereus / Koala (Fauna)								
56_BR_High01	65.2	65.2	20	Vulnerable	Vulnerable	2	False	651
56_TP_High	68.3	68.3	1.1	Vulnerable	Vulnerable	2	False	37
							Subtotal	**688**

Tyto novaehollandiae / Masked Owl (Fauna)								
35_BR_High	94.4	94.4	5.4	Vulnerable	Not Listed	2	False	253
35_TP_High	77.9	77.9	0.33	Vulnerable	Not Listed	2	False	13
56_BR_High01	65.2	65.2	31.6	Vulnerable	Not Listed	2	False	1031
56_TP_High	68.3	68.3	2.9	Vulnerable	Not Listed	2	False	98
56_BR_Med	57.6	57.6	3.5	Vulnerable	Not Listed	2	False	100
56_TP_Med	51.1	51.1	4.4	Vulnerable	Not Listed	2	False	112
98_BR_High	67.7	67.7	2.2	Vulnerable	Not Listed	2	False	74
							Subtotal	**1681**

BAM Credit Summary Report

Proposal Details

Assessment Id
00013930/BAAS17097/19/00014414

Proposal Name
FFJV Inland Rail NS2B Northern Outwash

BAM data last updated *
10/06/2021

Assessor Name
Sarah Glauert

Report Created
15/10/2021

BAM Data version *
45

Assessor Number
BAAS17097

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
6

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Brigalow - Belah open forest / woodland on alluvial often gilgaied clay from Pilliga Scrub to Goondiwindi, Brigalow Belt South Bioregion											
1	35_TP_High 01	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	83.2	83.2	5.2	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	217
6	35_BR_Low	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	20	20.0	0.4	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	4
9	35_TP_Low	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	39	39.0	1.7	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	33
14	35_BR_High	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	64.7	64.7	0.24	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00	TRUE	8
										Subtotal	**262**
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW											
4	56_BR_Medium	Not a TEC	29.2	29.2	0.96			High Sensitivity to Potential Gain	2.00		14

5	56_BR_Low	Not a TEC	28.4	28.4	31.2			High Sensitivity to Potential Gain	2.00		443
11	56_TP_Low	Not a TEC	41.5	41.5	6			High Sensitivity to Potential Gain	2.00		125
12	56_TP_High	Not a TEC	24.3	24.3	1.4			High Sensitivity to Potential Gain	2.00		17
13	56_BR_High	Not a TEC	70.7	70.7	0.47			High Sensitivity to Potential Gain	2.00		17
										Subtotal	**616**
River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion											
2	36_BR_Medium	Not a TEC	61.1	61.1	0.23			High Sensitivity to Potential Gain	1.75		6
3	36_BR_High	Not a TEC	65.5	65.5	0.51			High Sensitivity to Potential Gain	1.75		15
										Subtotal	**21**
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion											
7	27_BR_Low	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	37.1	37.1	4	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		73

8	27_NO_Med	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	65.1	65.1	0.02	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		1
10	27_TP_Low	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	24.7	24.7	4.6	Endangered Ecological Community		High Sensitivity to Potential Gain	2.00		56
										Subtotal	**130**
										Total	**1029**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits

Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)								
36_BR_Medium	61.1	61.1	0.23	Vulnerable	Not Listed	2	False	7
36_BR_High	65.5	65.5	0.51	Vulnerable	Not Listed	2	False	17
56_BR_Medium	29.2	29.2	0.96	Vulnerable	Not Listed	2	False	14
56_TP_High	24.3	24.3	1.4	Vulnerable	Not Listed	2	False	17
56_BR_High	70.7	70.7	0.47	Vulnerable	Not Listed	2	False	17
							Subtotal	**72**
Digitaria porrecta / Finger Panic Grass (Flora)								
35_TP_High01	83.2	83.2	3	Endangered	Not Listed	2	False	123
56_BR_Medium	29.2	29.2	0.26	Endangered	Not Listed	2	False	4
56_BR_Low	28.4	28.4	31.2	Endangered	Not Listed	2	False	443
27_NO_Med	65.1	65.1	0.01	Endangered	Not Listed	2	False	1
35_TP_Low	39.0	39.0	1	Endangered	Not Listed	2	False	20
56_TP_Low	41.5	41.5	6	Endangered	Not Listed	2	False	125
56_TP_High	24.3	24.3	0.06	Endangered	Not Listed	2	False	1
56_BR_High	70.7	70.7	0.29	Endangered	Not Listed	2	False	10
							Subtotal	**727**
Homopholis belsonii / Belson's Panic (Flora)								
35_TP_High01	83.2	83.2	0.33	Endangered	Vulnerable	2	False	14
							Subtotal	**14**
Hoplocephalus bitorquatus / Pale-headed Snake (Fauna)								
36_BR_Medium	61.1	61.1	0.23	Vulnerable	Not Listed	2	False	7
36_BR_High	65.5	65.5	0.51	Vulnerable	Not Listed	2	False	17
56_BR_Medium	29.2	29.2	0.8	Vulnerable	Not Listed	2	False	12

56_BR_High	70.7	70.7	0.02	Vulnerable	Not Listed	2	False	1
							Subtotal	**37**