



WESTNET RAIL UPGRADE – NARNGULU TO TILLEY (MORAWA) FAUNA ASSESSMENT



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Job Number:	<i>10.159</i>
Report Number:	<i>10/202</i>
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Date:	<i>22/12/2010</i>

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STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report (“the report”) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV.Australia Pty Ltd (ENV) (“scope of services”). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report (“the data”). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (“conclusions”) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to ENV.

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In accordance with the scope of services, ENV has relied on the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

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The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

EXECUTIVE SUMMARY

ENV.Australia Pty Ltd was commissioned by Strategen in September 2010 to undertake a Level One terrestrial fauna survey based on Environmental Protection Authority *Guidance Statement No. 56* for the proposed WestNet Rail (WNR) Upgrade from Narngulu to Tilley (Morawa). The proposed WNR upgrade survey area is 1,081 hectares (ha) and extends approximately 190 kilometres (km) from Narngulu to Mullewa and Mullewa to Tilley (approximately 2 km north of Morawa), extending 30 metres (m) either side of the existing rail infrastructure.

The purpose of the assessment is to provide supporting documentation for an application for a Native Vegetation Clearing permit under the *Environment Protection Act 1986 (WA)*.

In addition to habitat assessments and opportunistic records, targeted surveys were conducted for Threatened, Scheduled and Priority Listed Fauna and the capacity of the survey area to support them. These species are the Gilled Slender Blue-tongue (*Cyclodomorphus branchialis*), Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*), Malleefowl (*Leipoa ocellata*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Shield-backed Trapdoor Spider (*Idiosoma nigrum*) and the Tree-stem Trapdoor Spider (*Aganippe castellum*).

Four main habitat types were identified in the survey area, including Shrubland, Woodland, Samphire and Riverine. The Shrubland, Woodland and Riverine habitat types were considered to be of moderate habitat value. The Samphire habitat type was considered to be of low habitat value. The condition of the habitats in the survey area ranged from Excellent to Completely Degraded.

The existing rail reserve provides a corridor of remnant habitat which traverses a large portion of the highly fragmented northern Wheatbelt landscape. The removal of vegetation within the survey area may impact the fauna of the area by disrupting the ecological linkage provided by the vegetation within the rail reserve. Disruption to this ecological linkage may further isolate the vegetation located on either side of the rail line, thereby placing more pressure on the fauna of the region.

A total of 88 species of fauna were recorded during the survey, including three amphibian species, 13 reptile species, 63 bird species and nine mammal species. Two of these are of conservation significance, namely the Malleefowl (*Leipoa ocellata*) and Rainbow Bee-eater (*Merops ornatus*). Malleefowl were recorded in the Shrubland and Woodland habitats and four Rainbow Bee-eaters were recorded in the Shrubland and Woodland habitat types. A total of 351 vertebrate fauna have been previously recorded within the vicinity of the survey area, including 12 amphibian species, 78 reptile species, 232 bird species and 29 mammal species.

A total of 54 conservation significant fauna have been previously recorded in the vicinity of the survey area. Of these, 15 fauna of conservation significance were assessed to 'Likely', or 'Possibly' occur in the survey area. The conservation significant fauna at most risk from the proposed development are those that are ground dwelling and/or have limited dispersal capacity. These include the Gilled Slender Blue-tongue, Western Spiny-tailed Skink, Woma, Carpet Python, Malleefowl, Western Brush Wallaby, Tree-stem Trapdoor Spider and Shield-Back Trapdoor Spider.

The survey area contains 69.31 hectares of foraging habitat and four stands of trees that contain three or more mature trees (those larger than 50 cm diameter at breast height) and are classified as *Future Breeding Habitat* for Carnaby's Cockatoos. Clearing more than 1 ha of foraging habitat or any trees in the *Future Breeding Habitat* may constitute a 'controlled action' by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities and may require referral under the *Environment Protection and Biodiversity Conservation Act 1999*.

1 INTRODUCTION

1.1 OBJECTIVES

ENV.Australia Pty Ltd (ENV) was commissioned by Strategen in September 2010 to undertake a Level One terrestrial fauna survey for the proposed WestNet Rail (WNR) Upgrade from Narngulu to Tilley (Morawa) (the ‘survey area’).

The purpose of the fauna assessment is to provide supporting documentation for an application for a Native Vegetation Clearing Permit under the *Environmental Protection Act 1986* (WA).

The objectives of the fauna assessment were to undertake:

- A fauna database review, to collate historical knowledge of the survey area;
- Recording opportunistic fauna sightings;
- An assessment of the potential of habitats to support fauna of conservation significance;
- The identification of individuals and clusters of significant habitat trees, as well as the documentation of any utilisation evidence;
- A comprehensive habitat assessment and mapping of significant habitats of the survey area; and
- Targeted surveys for Threatened, Scheduled and Priority Listed Fauna.

1.2 LOCATION

The proposed WNR extends approximately 180 kilometres (km) from Narngulu (approximately 9 km SE of Geraldton) to Mullewa and then from Mullewa to Tilley (approximately 2 km north of Morawa), extending 30 metres (m) either side of the existing rail infrastructure (Figure 1). The survey area is 1080 hectares (ha) in size.

1.3 PHYSICAL ENVIRONMENT

1.3.1 Climate

The survey area is located in the Midwest region of Western Australia and due to the length of the survey area extending 190 km from the west coast at Geraldton inland to Morawa, the climate varies throughout the extent. The nearest accessible climate data for the survey area is available from Geraldton Airport, Mullewa townsite and Morawa Airport weather stations.

The Geraldton and Mullewa areas experience a Mediterranean to semi-desert climate, with a hot summer from December to March and a mild winter from May to August. The Morawa area experiences a warm Mediterranean to semi-arid climate, with a hot summer from November to March and a mild winter from May to August.

The Geraldton and Mullewa areas experience a wide temperature range, with an average annual maximum daytime temperature of 25.8°C (1941-2010) at Geraldton airport and 27.8°C (1896-2010) at the Mullewa townsite. In summer, maximum daytime temperatures may reach 47.7°C and 47.3°C at Geraldton airport and the Mullewa townsite respectively. In winter minimum night time temperatures may fall to -0.4°C and -1.4°C at Geraldton airport and the Mullewa townsite respectively (BoM 2010). The Morawa area experiences a wide temperature range, with an average annual maximum daytime temperature of 28°C (1997-2010). In summer, maximum daytime temperatures may reach 47.2°C, whilst in winter minimum night time temperatures may fall to -1.9°C (BoM 2010).

The Geraldton and Mullewa areas experience an average annual rainfall of 446.7 mm (1941-2010) at Geraldton airport and 336.7 mm (1925-2010) at the Mullewa townsite, whilst the Morawa area experiences an average annual rainfall of 332.4 mm (1925-2010) at Morawa airport (BoM 2010). The majority of rainfall occurs during the winter month's at all three weather stations (Figure 2).

For the three months (June to August 2010) preceding the survey, Geraldton airport, Mullewa townsite, and Morawa airport received 191 mm, 151.6 mm and 118.8 mm of rainfall respectively, compared with the long term average of 256.7 mm, 167.1 mm and 112.3 mm respectively for the same period (BoM 2010). Rainfall for the year to date (September 2009 to August 2010) at Geraldton Airport, Mullewa townsite and Morawa Airport was 349 mm, 286.2 mm and 263 mm respectively, compared to the long-term average for the same period was 445.8 mm, 333.9 mm and 277.9 mm respectively (BoM 2010).

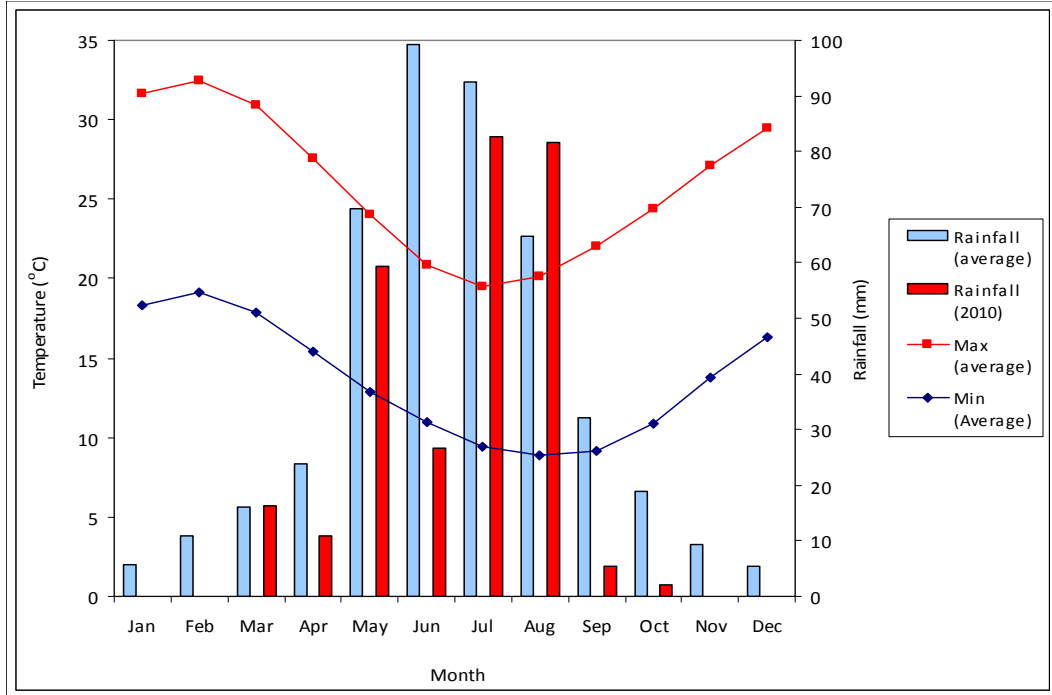


Figure 2A Geraldton Airport Average Monthly Rainfall (1942-2010) compared to Monthly Rainfall for 2010 (year to date) as well as Average (1942-2010) Maximum and Minimum Temperatures (BoM 2010)

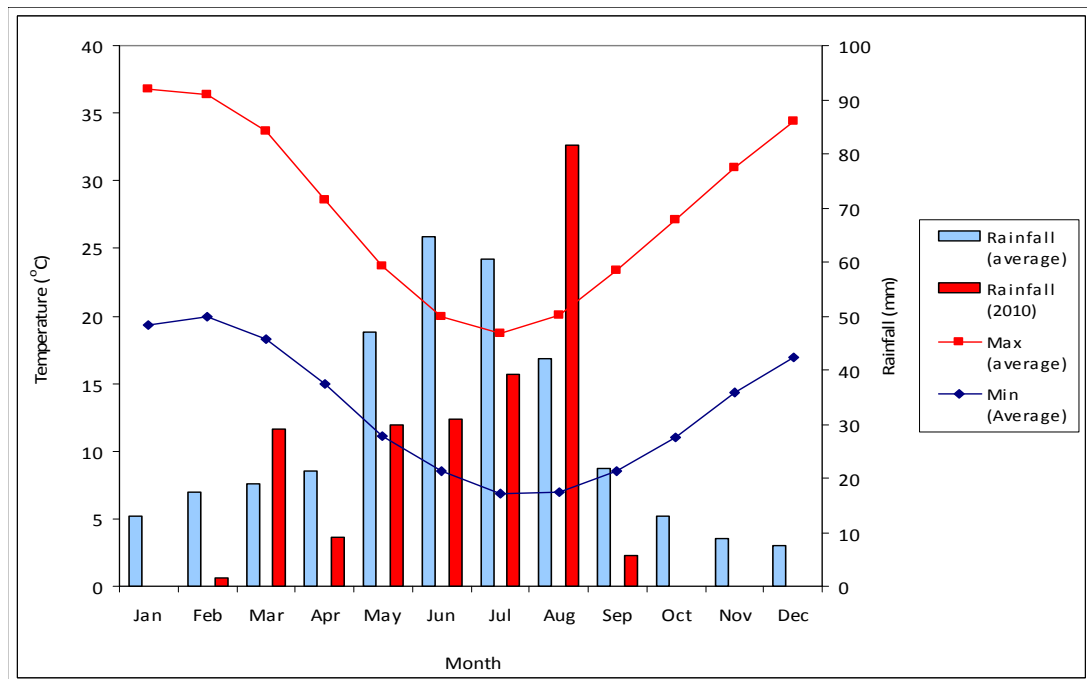


Figure 2B Mullewa Townsite Average Monthly Rainfall (1942-2010) compared to Monthly Rainfall for 2010 (year to date) as well as Average (1942-2010) Maximum and Minimum Temperatures (BoM 2010)

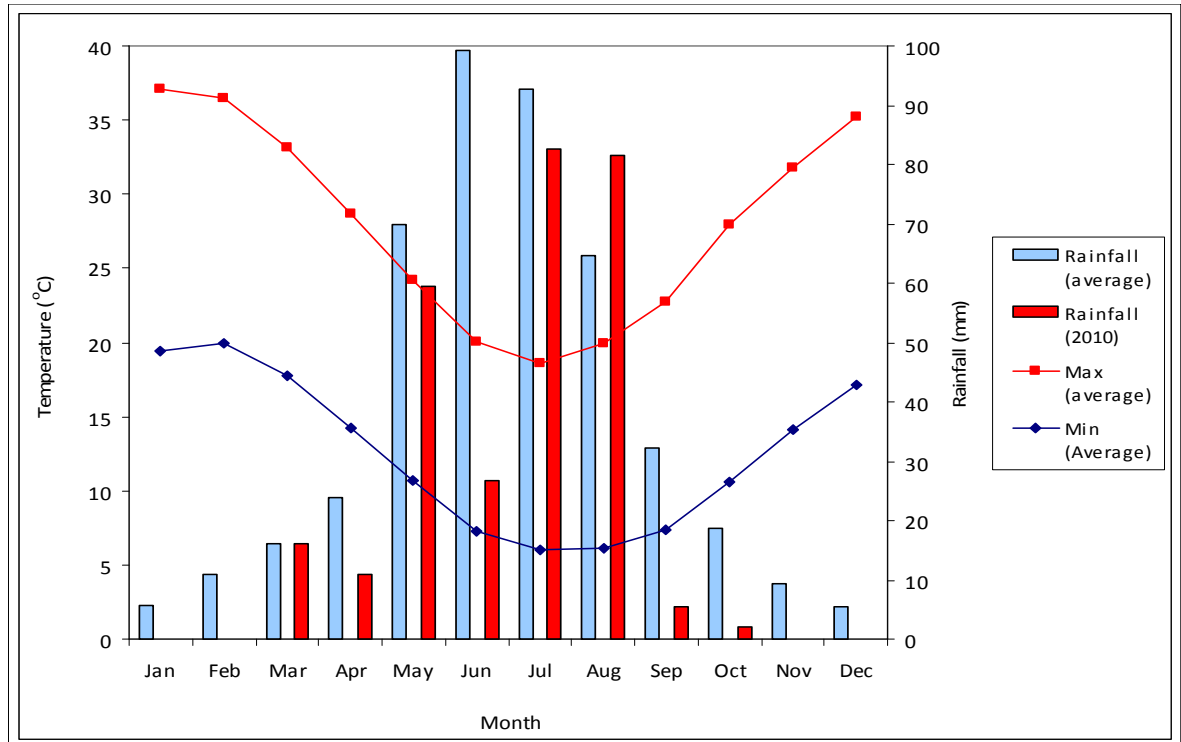


Figure 2C Morawa Airport Average Monthly Rainfall (1942-2010) compared to Monthly Rainfall for 2010 (year to date) as well as Average (1942-2010) and 2010 (year to date) Maximum and Minimum Temperatures (BoM 2010)

1.3.2 Biogeography

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into 85 bioregions based on major biological and geographical/geological attributes (Thackway and Cresswell 1995). These bioregions are subdivided into 403 subregions, as part of a refinement of the IBRA framework (Commonwealth Department of Sustainability, Environment, Water, Populations and Communities [SEWPAC] 2010a).

The survey area is located within two bioregions, the Geraldton Sandplain and Avon Wheatbelt. Approximately 480 ha of the survey area is located in the Geraldton Hills subregion (GS2) of the Geraldton Sandplain bioregion, whilst approximately 600 ha of is located within the Ancient Drainage (AW1) subregion of the Avon Wheatbelt bioregion (Thackway and Cresswell 1995).

The Geraldton Hills subregion is characterised by sand heaths with emergent *Banksia* and *Actinostrobos*, *Eucalyptus loxophleba* woodlands on alluvial plains, proteaceous heath and *Acacia* scrubs on limestone, and low closed forest of *Acacia rostellifera* on alluvial plains (Desmond and Chant 2001).

The Ancient Drainage subregion of the Avon Wheatbelt is characterised as an ancient undulating peneplain with proteaceous scrub heath mixed *Eucalyptus* spp. and *Allocasuarina huegeliana* woodlands on alluvial and eluvial soils.

1.4 PREVIOUS FAUNA SURVEYS

The most relevant fauna surveys that have been conducted in the vicinity (within 50 km) of the survey area are:

- Vertebrate Fauna Koolanooka Mine Site Morawa (Alan Tingay and Associates 1996);
- Fauna Assessment Koolanooka (ATA Environmental 2004);
- Blue Hills Fauna Assessment (Bamford Consulting Ecologists 2004); and
- Oakajee Terrestrial Port Development: Terrestrial Vertebrate Fauna Assessment (*ecologia* Environment 2010).

The results of these surveys were reviewed and incorporated into the findings of the Desktop review.

2 METHODOLOGY

2.1 BACKGROUND TO SURVEY METHODOLOGY

2.1.1 Protection of Fauna and Habitat

Fauna, their habitat, and faunal ecological communities are protected formally and informally by various legislative and non-legislative measures, which are outlined below. Species listed under these Acts and non-legislative measures are considered 'conservation significant' in this assessment.

Legislative Protection

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);*
- *Wildlife Conservation Act 1950 (WC Act);* and
- *Environmental Protection Act 1986 (EP Act).*

Non-Legislative Protection

- Department of Environment and Conservation (DEC) Priority lists; and
- Informal recognition of fauna of interest.

A short description of these legislative and non-legislative measures is given below, and definitions of the species conservation codes and ecological community categories they use, and those used by the DEC, are provided in Appendix A.

Environment Protection and Biodiversity Conservation Act 1999

The *EPBC Act* is a Federal Act which aims to protect matters of national environmental significance, which are detailed in Appendix A. Under the *EPBC Act*, SEWPAC lists protected species and Threatened Ecological Communities (TECs) by criteria set out in the Act. Species are considered to be conservation significant if they are listed as Threatened i.e. Endangered, Vulnerable and/or Migratory.

Migratory bird species, protected as Migratory under the *EPBC Act*, include those listed under international migratory bird agreements to which Australia is a signatory, and relate to the protection of birds which migrate between Australia and other countries. This includes the: Japan-Australia Migratory Bird Agreement (JAMBA); China-Australia Migratory Bird Agreement (CAMBA); Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA); and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Some marine or terrestrial fauna that use marine habitats are listed as Marine under the *EPBC Act*. These species are only considered conservation significant when a proposed development occurs in a Commonwealth marine area (i.e. any Commonwealth Waters or Commonwealth Marine Protected Area). Outside of such areas the *EPBC Act* does not consider these species to be matters of national environmental significance, so are not protected under the Act. As such species only listed as Marine under the *EPBC Act* have not been considered to be conservation significant in this assessment.

Wildlife Conservation Act 1950

The DEC lists taxa under the provisions of the Western Australian *WC Act* as protected and these are classified as Schedule 1 to Schedule 4 according to their need for protection (see Appendix A). The Act makes it an offence to 'take' threatened species without an appropriate licence. There are financial penalties for contravening the *WC Act*.

Environmental Protection Act 1986

Significant habitat necessary for the maintenance of fauna indigenous to Western Australia and TECs are given special consideration in environmental impact assessment, and areas covered by TECs have special status as Environmentally Sensitive Areas (ESAs) under the Western Australian *EP Act*, and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

The protection of 'significant habitats' in terms of fauna indigenous to Western Australia and TECs is a 'clearing principle' for assessing applications for permits to clear native vegetation, where exemptions for a clearing permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply. There are substantial penalties for unlawfully damaging ESAs.

DEC Priority Lists

The DEC produces a list of Priority species that have not been assigned statutory protection under the *WC Act*. Priority fauna are under consideration as 'Scheduled' fauna, but are in urgent need for further survey or require regular monitoring, and although not currently threatened may become so in the future. Appendix A provides definitions of Priority codes.

In addition, the DEC maintains a list of Priority Ecological Communities (PECs) which identifies those communities that need further investigation before possible nomination for TEC status.

Although DEC Priority species and communities have no formal legal protection, they are under consideration as 'Scheduled' taxa under the *WC Act* or as ESAs under the *EP Act*. Therefore, it can be expected that sensitivities to harm occurring to Priority species or communities is heightened.

Informal Recognition of Threatened Fauna

Certain populations or communities may be of local significance or interest because of their patterns of distribution and abundance. For example, fauna may be locally significant because they are range extensions to the previously known distribution or are newly discovered taxa (and therefore have the potential to be listed as threatened in the future). In addition, many species are in decline as a result of threatening processes, and relict populations of such species may assume local importance.

2.1.2 EPA Requirements for Fauna Surveys

The surveys were carried out in a manner consistent with the EPA requirements for the environmental surveying and reporting of fauna surveys in Western Australia:

- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002).
- *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56* (EPA 2004).

2.1.3 EPA Guidance Statement No. 56

A baseline field fauna survey for environmental impact assessment should at the very least provide a comprehensive list of species within a given area. There are two levels of fauna survey as delineated by the EPA:

- **Level One:** desktop study to collate historical knowledge, in conjunction with a reconnaissance survey (site inspection); and
- **Level Two:** trapping and opportunistic field survey to characterise the fauna present, combined with a Level One survey.

The methodology of the current survey, a Level One survey, has been developed in consideration of the EPA Guidance Statement No. 56 (EPA 2004).

2.2 DESKTOP REVIEW

The purpose of the desktop review was to gather background information on the survey area and the fauna that it may support. This involved a search of the following sources:

- Western Australian Museum (WAM) and DEC combined biological database NatureMap (DEC 2010a) (area search based on approximately 10 km buffer either side of the survey area);
- DEC Threatened and Priority Fauna Database (DEC 2010b) (area search based on approximately 10 km buffer either side of the survey area);

- SEWPAC Protected Matters Search Tool (SEWPAC 2010b), also known as an EPBC search (area search based on approximately 10 km buffer either side of the survey area);
- Birds Australia's Birdata (Birdata 2010) (area search based on a one degree square at three points along the survey area); and
- previous fauna surveys (e.g. previous ENV reports, other consultant's reports, DEC reports).

Collectively, these sources were used to compile a list of species that have been previously recorded in the region. This list will invariably include some species that do not occur in the survey area, as some fauna have a limited or patchy distribution, high level of habitat specificity, are locally extinct or were erroneously identified in previous surveys.

2.3 FIELD SURVEY

The purpose of the field survey was to verify the accuracy of the desktop survey and further delineate and characterise the fauna and faunal assemblages present in the survey area. The fauna field survey was undertaken from 5 October to 12 October 2010 (16 person days), and consisted of:

- A habitat assessment;
- Acoustic micro bat recordings (AnaBat);
- Opportunistic observations; and
- Targeted conservation significant fauna searches.

2.3.1 Habitat Assessment

During the field survey, broad habitats were identified based on vegetation associations and landforms. The vegetation associations used in habitat assessments are sourced from the flora and vegetation assessment (ENV 2010) conducted over the same survey area. These habitats were then assessed for their potential to support species of conservation significance and the quality of habitat they provide to a wider suite of fauna. Habitats were assessed on the basis of:

- Vegetation association type, condition and structure;
- The presence of microhabitats; and
- Other features likely to provide habitat for fauna.

2.3.2 Acoustic Bat Recordings

Bat recordings were undertaken at night, using AnaBat SD1 recording units to document bat species in the area. The recording units convert ultrasonic echolocation signals produced by bats into audible electronic signals, which are later analysed for species-specific calls. Tree hollows identified as potential roosting or maternal breeding places were subjected to AnaBat recordings. AnaBat SD1 units were also set in areas likely to be used by bat species for foraging and were set on a timer to turn on at dusk and off at dawn (recording all night), and were left in place for up to five nights per location.

2.3.3 Opportunistic Observations

At all times, while walking or driving around the survey area, fauna were opportunistically observed and recorded. Field staff also investigated scats, tracks, burrows and other traces of fauna throughout the entire survey period.

2.3.4 Conservation Significant Fauna Targeted Searches

Gilled Slender Blue-tongued Lizard and Western Spiny-tailed Skinks Targeted Searches

There are two forms of Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*) that occur in the region; a brown and a black form. Each of these is found in different habitat types, the brown form prefers Woodland areas, whereas the black form prefers rocky habitats that contain crevices and boulders (SEWPAC 2010c). Areas that contained a sufficient level of leaf litter and fallen timber were examined for the presence of Gilled Slender Blue-tongued Lizards (*Cyclodomorphus branchialis*) and the brown form of the Western Spiny-tailed Skink. Large piles of timber, logs and rocky areas were examined for the presence of latrines (communal faecal deposits) that are evidence of Western Spiny-tailed Skinks.

Malleefowl Targeted Searches

The survey area was searched for the presence of Malleefowl (*Leipoa ocellata*). Sections of the survey area that contained a sufficient level of leaf litter were examined for the presence of Malleefowl nest sites, which require large amounts of leaves and twigs in the nest's construction. Details of the nest site recorded included GPS coordinates, size, current or historical breeding evidence and photographs taken. When Malleefowl were located, these positions were recorded using GPS co-ordinates.

Tree-stem Trapdoor Spiders and Shield-backed Trapdoor Spiders Targeted Searches

Targeted searches were conducted for sections of the survey area that contained habitat suitable for the Trapdoor Spiders, that is shrubland or woodland in areas containing sandy, gravel, granite or loam soils and 100 m either side of each habitat assessment location. Both species produce distinctive burrows that allow identification without excavating the individual.

Carnaby's Cockatoo Assessment

There is an increasing focus by the regulatory authorities on proposals that have the potential to impact on black cockatoo habitat, particularly that of Carnaby's Cockatoo. As part of the assessment the survey area was rated on its level of potential habitat for black cockatoos in terms of foraging and breeding potential.

The focus of the Carnaby's Cockatoo habitat assessment was to:

- Record the distribution of foraging resources or foraging habitat;
- Record the number of mature trees (those larger than 50 cm diameter at breast height [DBH]) in the survey area, as these may be considered as future breeding trees under SEWPAC criteria; and
- Record all trees with suitable breeding hollows in the survey area.

During the field survey, details of flora that are known foraging resources were recorded, including their distribution throughout the survey area. To determine if black Cockatoos forage within the survey area, potential foraging plants were identified and the ground under these plants searched for any evidence of black cockatoo foraging. Carnaby's Cockatoo feeding evidence is often characterised by severed new growth, developing flower heads and/or chewed seed pods of *Banksia* species (Cale 2003) and chewed sides of Marri (*Eucalyptus calophylla*) fruit.

Foraging habitat for Carnaby's Black Cockatoo was determined where known foraging plant species, as listed by Birds Australia (2008), were dominant in the vegetation associations described by ENV (2010).

Breeding habitat is a particularly important aspect for any assessment of impacts upon Carnaby's Cockatoos. Under the criteria used by SEWPAC, any 0.5 ha parcel of habitat that contains three or more mature trees should be considered future breeding habitat.

Based on these criteria, the survey area was classified into four categories with regard to breeding habitat for black cockatoos, particularly the Carnaby's Cockatoo (Table 1). Any tree that was classified as a mature tree had its GPS location recorded and other important details such as species of tree, height, DBH and the number and size of hollows recorded.

Table 1. Criteria for Determining Breeding Habitat Classification for Black Cockatoos

Breeding Classification	Habitat	Classification Criteria
<i>Non-Breeding Habitat</i>		No <i>mature trees</i> ¹ of the type potentially used for breeding by black cockatoos, and no trees with <i>suitable breeding hollows</i> ² .
<i>Future Breeding Habitat</i>		Any site which has 0.5 ha or more of habitat that contains 3 or more <i>mature trees</i> , but lacks trees with <i>suitable breeding hollows</i> .
<i>Potential Breeding Habitat</i>		Any site with trees that have <i>suitable breeding hollows</i> , but actual breeding has not been confirmed.
<i>Actual Breeding Habitat</i>		A site with <i>suitable breeding hollows</i> in which breeding by black cockatoos has been recorded.

Key. 1 (*Mature trees*)= Any living tree (of a species known to form tree hollows) with a diameter at body height (DBH) of 50 cm or more. 2 (*Suitable breeding hollows*)= Large hollows in mature trees with that could be used by black cockatoos for breeding, based on known breeding hollow characteristics for black cockatoo species.

If potential breeding habitat existed, passive dusk or dawn surveys were used to determine if actual breeding was taking place. Passive dusk and dawn surveys were conducted to record any behaviour that could indicate that black cockatoos were roosting within the survey area. These surveys were conducted in parts of the survey area with trees that had potential breeding hollows.

These surveys involved sitting passively at dusk and/or dawn listening for bird calls or observing bird behaviour. Passive dusk surveys commenced one hour before dark until it was completely dark. Passive dawn surveys commenced one hour before first light and continued for one hour after first light.

2.4 TAXONOMY

For species identified in the desktop assessment where there is doubt to their true taxonomy (through subsequent name changes or taxonomic reviews) an effort was made to determine the current scientific name for each taxa. In cases where correct taxonomy of an old record cannot be determined, old scientific names may be presented. Some taxa names may be followed by 'sp.', meaning that the species name was not given in the data source or the taxonomy is in doubt. Where there are previously recorded taxa such as this that have the potential to be a conservation significant species, they will be discussed specifically in the results section.

Species were identified in the field using relevant field guides. Tyler, Smith and Johnstone (2000) and Cogger (2000) were used to identify frogs. Wilson and Swan (2008), Storr, Smith and Johnstone (1999, 2002) and Cogger (2000) were used to identify reptiles. Pizzey and Knight (2007), Simpson and Day (2004) and Geering, Agnew and Harding (2007) were used to identify birds. Menkhorst and Knight (2004), van Dyck and Strahan (2008) and Churchill (2008) were used to identify mammals, while Triggs (1996) was used to identify mammal scats, tracks and traces.

3 RESULTS

3.1 VARIABLES AND CONSTRAINTS

As per EPA *Guidance Statement No. 56* (EPA 2004), the variables associated with a survey need to be documented. These variables are detailed in Table 2.

Table 2: Variables Associated with the Fauna Assessment

Variable	Impact on Survey Outcomes
Access Problems	Access was sufficient throughout the survey area so that all aspects of the site were inspected.
Experience levels/ Resources	<p>The biologists that executed these surveys included practitioners that are regarded as suitably qualified in their respective fields.</p> <p>Field Survey</p> <ul style="list-style-type: none"> • Mr John Trainer – Zoologist; and • Mr James Sansom – Biologist. <p>Reporting</p> <ul style="list-style-type: none"> • Mr John Trainer – Zoologist.
Scope: sampling methods/ Intensity	<p>A Level One survey was undertaken. As such, many species that occur in the survey area would not have been observed during the survey, particularly small ground-dwelling fauna that are normally recorded by trapping methods employed in a Level Two Survey.</p> <p>The survey consisted of a desktop review and site reconnaissance. The site reconnaissance involved opportunistic observations, targeted conservation significant fauna searches, two nights of nocturnal searches and five nights of AnaBat recordings.</p>
Sources of Information	<p>The desktop analysis utilised a number of different resources to obtain a list of fauna previously recorded within the vicinity of the survey area. For example records from the DEC threatened fauna database search, NatureMap (DEC 2010a), Birds Australia’s Birdata (Birdata 2010) and SEWPAC Protected Matters Search Tool (SEWPAC 2010b). Furthermore, all the previous fauna surveys identified in Section 1.3 assisted in the compilation of a base faunal assemblage.</p>

Variable	Impact on Survey Outcomes
Timing, weather, season.	<p>The survey was undertaken between 5 – 12 October 2010. The area had received 126.4 mm of rainfall in the three months preceding the survey (BoM 2010). The daily maximum temperatures during the survey period varied from 22.8-34.8°C (mean 29.5°C), with overnight temperatures ranging from 9.2-15.3°C (mean 12.3°C) (BoM 2010).</p> <p>The temperatures recorded during the survey period were sufficiently warm for activity for ectothermic animals such as reptiles and frogs. Warmer temperatures also create greater insect activity, thus insectivorous vertebrates such as microbats would be more active during these conditions.</p> <p>The level of rainfall received in the three months prior to the survey was on par with the average. This would not impede the regeneration of vegetation particularly for those that provide food source for ground-dwelling species, especially herbivorous mammals. However, there was a lack of surface water in the survey area that would restrict species such as frogs and waterbirds.</p>
Completeness	<p>As the fauna survey was a Level One many species that occur in the survey area would not have been observed, however all conservation significant species deemed to potentially occur in the survey areas have been addressed.</p>

3.2 HABITAT ASSESSMENT

3.2.1 Habitat Types Present in the Survey Area

Four broad habitat types were identified in the survey area, aside from areas which were classified as cleared (Table 3). These are mapped in Figures 3.01-3.48. Twenty-five habitat assessments were conducted along the rail easement. These involved assessing and documenting the availability of features and characteristics important to faunal assemblages. The locations and details of the habitat assessments can be seen in Appendix B and Figure 4.

Table 3: Major Habitat Types of the Survey Area

Habitat Type	Habitat Value	Vegetation Communities	Habitat Assessments	Approximate Area of Habitat Type (ha)
Shrubland	Moderate	AT- AbArApEl (D), DT-Rd, BNLW-XpEc, DAdAT-El, DT-Ab, DAAIS, AT-AxAb, MyPrH, XW-AcAb, AH-Css, AAIT-GcEmAe, AT-ArAsAe, AIT-Em, XW-Cp, COW-Xa, ACS-Ba, AMyS-Ghh, AIMS-Ae, CELF-Rd, AT-MtEl, AS-EICd (D), AT-MpPc, AS-TsMb, AGT-PcPmm, AHT-Hrr, AT-PmmSi, AGS-KhCd, AS-HggAe, AGS-ElAcc, AS-PcAc (D), AT-Ac, AT-ALMa, MeT-GpCaa, AGS-ElWaa, AT-Gof, AT-Cd, AGT-MtAa, AT-AbAb, AT-Gb, AMeT-Cd, AAIT-Mt, AAIT-MnPt, AMeS-AcAa, AMeH-EIPs, MaT-Cp, AAIT-MvvMI, AMeS-DdBs, AT-ALMIAe, AT-CoBG, AT-MvvAc, AAIT-MaMc, AS-RdEt, AT-AaAan, AGT-HraRd, AGT-AuLpr, MeS-Ac, AMeT-Gg, AAIT-Mvv, AMeT-Gof, AT-PoCd, AGS-Ae, MeT-A, AT-VeWaa, AT-ArlAs	17	539.21
Woodland	Moderate	ET-EcAt, EW-AsBm (D), ET-EILc (D), ELW-Aa, ET-MaRd, ELW-RdSs, ET-Ac, ELW-ArElBd, EW-AsArCd (D), ET-AcGof, ET-MvvAa, ET-MuAsAa, ET-AaAs, ET-MuPo, ET-AaAa, ET-EggAsRd, ET-MvvArl, ELF-AsHt, ET-EjAc	6	154.89
Riverine	Moderate	EW-Co (D)	1	0.18
Samphire	Low	TH	1	15.16
Cleared	nil	I-CD, I-S and I	0	371

Shrubland

The shrubland broadly consists of *Acacia* spp. (*Acacia acuminata*, *Acacia rostellifera* and *Acacia stereophylla* var. *stereophylla*), *Allocasuarina campestris*, *Grevillia* spp. (*Grevillea levis* and *Grevillea paradoxa*) and *Melaleuca* spp. (*Melaleuca cordata* and *Melaleuca viminea* subsp. *viminea*), over mixed grasses and herbs.

This vegetation provides a variety of microhabitats such as fallen timber, leaf litter and loose bark which are foraging and sheltering sites for a wide variety of geckos and skinks. Termite mounds were also present and these are utilised by terrestrial ground-dwelling fauna e.g. blind snakes and geckos.

The soils of this habitat type are suitable for digging and burrowing animals such as lizards (e.g. dragons) and trapdoor spiders. Areas of shrubland that contained granite outcropping provide microhabitats such as small cracks and crevices that are utilised by geckos and skinks.

The vegetation condition ranged from Excellent to Completely Degraded with the major disturbance being introduced species and the clearing of vegetation for vehicle tracks. This habitat type is considered to be of moderate habitat value.

Two conservation significant fauna were recorded in this habitat type: Malleefowl (*Leipoa ocellata*) and the Rainbow Bee-eater (*Merops ornatus*). Other conservation significant fauna that may occur in this habitat type are: the Gilled Slender Blue-tongue (*Cyclodomorphus branchialis*), Woma (*Aspidites ramsayi*), Carpet Python (*Morelia spilota* subsp. *imbricata*), Peregrine Falcon (*Falco peregrinus*), Australian Bustard (*Ardeotis australis*), southern sub-species of the Crested Bellbird (*Oreoica gutturalis* ssp. *gutturalis*), Western Wheatbelt sub-species of the White-browed Babbler (*Pomatostomus superciliosus* ssp. *ashbyi*), Shield-backed Trapdoor Spider (*Idiosoma nigrum*) and the Tree-stem Trapdoor Spider (*Aganippe castellum*).

This habitat type comprises 11 Beard vegetation associations summarised in Appendix C. The table shows the current extent of these vegetation communities compared to the pre-european extent, as well as the current extent in nature reserves. Nine of the 11 vegetation associations are less than 50% of their previous extent and six of these are less than 25% of their previous extent.

Woodland

The Woodland habitat type broadly consists of *Eucalyptus ewartiana*, *Eucalyptus jucunda* and *Eucalyptus loxophleba* subsp. *supralaevis* over *Acacia acuminata* and *Melaleuca viminea* subsp. *viminea* over mixed grasses and herbs.

The vegetation of this habitat type provides microhabitats such as fallen timber, leaf litter, loose bark and tree hollows. These microhabitats are foraging and sheltering sites for a range of fauna. Geckos and goannas use the fallen timber, leaf litter and loose bark and the tree hollows are breeding sites for a variety of birds and roosting sites for arboreal mammals and micro bats. The Woodland habitat type also contains termite mounds that are utilised by terrestrial ground-dwelling fauna such as blind snakes and geckos. The soils of this habitat type are suitable for digging and burrowing animals such as dragons and trapdoor spiders.

The vegetation condition ranged from Excellent to Completely Degraded with the major disturbance being introduced plant species and the clearing of vegetation for vehicle tracks. Taking these factors into consideration, this habitat type is considered to be of moderate habitat value.

Two conservation significant fauna were recorded in this habitat type: Malleefowl (*Leipoa ocellata*) and the Rainbow Bee-eater (*Merops ornatus*). Other conservation

significant fauna that may occur in this habitat type are the Gilled Slender Blue-tongue (*Cyclodomorphus branchialis*), Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*), Woma (*Aspidites ramsayi*), Carpet Python (*Morelia spilota* subsp. *imbricata*), Peregrine Falcon (*Falco peregrinus*), Australian Bustard (*Ardeotis australis*), Bush Stone-curlew (*Burhinus grallarius*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), southern sub-species of the Crested Bellbird (*Oreoica gutturalis* ssp. *gutturalis*), Western Wheatbelt sub-species of the White-browed Babbler (*Pomatostomus superciliosus* ssp. *ashbyi*), Western Brush Wallaby (*Macropus irma*), Shield-backed Trapdoor Spider (*Idiosoma nigrum*) and the Tree-stem Trapdoor Spider (*Aganippe castellum*).

This habitat type comprises five Beard vegetation associations presented in Appendix C. The table shows the current extent of these vegetation associations compared to pre-european extent and the current extent in nature reserves. All five of the vegetation communities exist at less than 25% of their previous extent.

Riverine

The survey area contained only one Riverine habitat type which crossed the rail line and as such, only a small portion of this habitat occurs in the survey area (0.18 ha). The Riverine habitat type broadly consists of *Eucalyptus camaldulensis* over *Casuarina obesa* over **Avena barbata* and **Bromus diandrus*. The vegetation condition of the habitat type was considered to be Degraded.

At the time of the survey the Riverine habitat type was completely dry (in the survey area). Hence it would be expected that some animals that were not recorded during the survey may occur during wetter times of the year (i.e. amphibians and water birds). The creek is lined with *Eucalyptus* species that are larger than any plants in the surrounding habitat, so it is likely that it is a corridor for some wildlife. In particular, birds, bats, large mammals (such as the Euro) and wide-ranging reptiles (such as snakes and goannas) are likely to use the drainage line as a corridor. The eucalypts of the Riverine habitat type were immature and did not contain any hollows. As a result this habitat type has been given a moderate habitat value.

Conservation significant fauna that may occur in this habitat type are the Eastern Great Egret (*Ardea modesta*), Peregrine Falcon (*Falco peregrinus*), Bush Stone-curlew (*Burhinus grallarius*) and Rainbow Bee-eater (*Merops ornatus*).

Samphire

This habitat consists of low shrubland of *Tecticornia pruinosa* and *Hakea bucculenta* with no over-storey or mid-storey. There was a distinct lack of over-storey and mid-storey flora species in this habitat type that can be attributed to saline soils. Due to the lack of over-storey and mid-storey there were limited microhabitats available to support fauna. As such, arboreal mammals and reptiles are expected to be absent from these areas. Vegetation conditions varied from Good to Degraded. This habitat type has been given a low habitat value.

Only one species of conservation significant fauna may occur in this habitat type, the Eastern Great Egret (*Ardea modesta*).

This habitat type comprises two Beard vegetation associations (Appendix C). The appendix shows the current extent of these vegetation communities compared to pre-european extent and the current extent in nature reserves. Both of the vegetation associations are still well represented as they both retain 85% of their previous extent.

3.3 FAUNA ASSEMBLAGES

A total of 88 fauna were recorded during the field survey. This included three amphibian species, 13 reptile species, 63 bird species, and nine mammal species.

The fauna assemblage of the survey area has been compiled from data acquired from previous fauna surveys and database searches as detailed in the methods. All fauna recorded previously in the region (including specific search results from NatureMap, Birddata, EPBC Protected Matters and DEC) are listed in Appendix D, with conservation significant fauna potentially occurring and/or previously recorded for the survey area listed in Appendix E.

A total of 351 vertebrate fauna have been previously recorded within the vicinity (within 10 km) of the survey area. This includes 12 amphibian species, 78 reptile species, 232 bird species and 29 mammal species. Many of these species may not occur in the survey area on a regular basis as these database records encompass a wide range of habitats of which not all may be present in the survey area. Furthermore, many bird species that potentially occur are usually found in an area only on a transitory basis.

3.3.1 Amphibians

Three species of amphibians were recorded during the fauna survey. These were the Western Banjo Frog (*Limnodynastes dorsalis*), Crawling Toadlet (*Pseudophryne guentheri*) and Motorbike Frog (*Littoria Moorei*) (Appendix D1). No conservation significant amphibians were recorded during the survey.

Twelve species of amphibians have been previously recorded in the general vicinity of the survey area (Appendix D1).

3.3.2 Reptiles

Thirteen reptile species were recorded during the survey (Appendix D2). Geckos that were commonly recorded during the survey were the Variegated Tree Dtella (*Gehyra variegata*), Bynoe's Gecko (*Heteronotia binoei*) and *Diplodactylus pulcher*. Some examples of commonly recorded dragons include the Long-nosed Dragon (*Amphibolurus longirostris*), Central Netted Dragon (*Ctenophorus nuchalis*) and Bearded Dragon (*Pogona minor*). The only snake recorded during the survey was the Gwardar (*Pseudonaja nuchalis*). No conservation significant reptiles were recorded.

Seventy-eight species of reptile have been previously recorded in the general vicinity of the survey area (Appendix D2).

3.3.3 Birds

Sixty-three bird species were recorded during the survey (Appendix D3). Common raptors recorded include the Whistling Kite (*Haliastur sphenurus*), Nankeen Kestrel (*Falco cenchroides*) and Black-shouldered Kite (*Elanus axillari*). Common parrots recorded in the survey area include the Galah (*Cacatua roseicapilla*), Little Corella (*Cacatua sanguinea*), Australian Ringneck (*Barnardius zonarius*) and Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *samueli*). Common nocturnal birds recorded in the survey area include the Tawny Frogmouth (*Podargus strigoides*) and the Australian Owlet-nightjar (*Aegotheles cristatus*).

Common small passerine birds recorded in the survey area include the Variegated Fairy-wren (*Malurus lamberti*), White-winged Fairy-wren (*Malurus leucopterus*), Weebill (*Smicrornis brevirostris*), Red-capped Robin (*Petroica goodenovii*), Magpie-lark (*Grallina cyanoleuca*), Black-faced Woodswallow (*Artamus cinereus*) and Zebra Finch (*Taeniopygia guttata*). Common honeyeaters recorded in the survey area include the Yellow-throated Miner (*Manorina flavigula*), Singing Honeyeater (*Lichenostomus virescens*) and White-plumed Honeyeater (*Lichenostomus penicillatus*).

Other common birds recorded in the survey area include the Sacred Kingfisher (*Todiramphus sanctus*), Rufous Whistler (*Pachycephala rufiventris*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*), Pied Butcherbird (*Cracticus nigrogularis*), Australian Raven (*Corvus coronoides*) and Australasian Pipit (*Anthus novaeseelandiae*). Two introduced birds recorded in the survey area were the Rock Dove (**Columba livia*) and the Laughing Dove (**Streptopelia senegalensis*). Conservation significant birds which were recorded are the Malleefowl and Rainbow Bee-eater (discussed in Section 3.5).

Two hundred and thirty-two species of birds have been previously recorded in the general vicinity of the survey area (Appendix D3).

3.3.4 Mammals

Nine mammal species were recorded during the survey (Appendix D4). Commonly recorded mammals were macropods e.g. Western Grey Kangaroo (*Macropus fuliginosus*) and Red Kangaroo (*Macropus rufus*). One dasyurid, the Little Long-tailed Dunnart (*Sminthopsis dolichura*) was recorded in the survey area. No native rodents were recorded in the survey area.

At least two species of microbats were identified as being present within the survey area during the course of the fauna assessment (Appendix F) (Specialised Zoological 2010). Some calls could not be identified reliably to a single species, for example the calls of long-eared bats (*Nyctophilus* spp.) are typically difficult to identify to species, and may be attributed to the Lesser Long-eared Bat (*Nyctophilus geoffroyi*) or the

Central Greater Long-eared Bat (*Nyctophilus major*) (Specialised Zoological 2010). Bats that could not be accurately verified were not included in the report (Appendix D4).

Four species of introduced mammals were recorded; the House Mouse (*Mus musculus*), Rabbit (*Oryctolagus cuniculus*), Red Fox (*Vulpes vulpes*) and the Feral Cat (*Felis catus*).

No conservation significant mammals were recorded.

Twenty-nine species of mammals have previously been recorded in the general vicinity of the survey area (Appendix D4).

3.4 CONSERVATION SIGNIFICANT FAUNA

3.4.1 Desktop Review

From the desktop review of previous surveys conducted in the area and database searches, a list of previously recorded conservation significant species has been compiled. The desktop review revealed that 54 species of conservation significance have been previously recorded within the vicinity of the survey area. Of these, two were recorded during the survey and 15 species were assessed as 'Likely' or 'Possibly' occurring within the survey area (Appendix E).

The two species of conservation significance recorded within the survey area were the Malleefowl and the Rainbow Bee-eater. The Malleefowl is listed as Vulnerable under the *EPBC Act* and Schedule 1 on the *WC Act*. The Rainbow Bee-eater is classified as Migratory under the *EPBC Act*. Locations of conservation significant fauna recorded during the survey are presented in Appendix G and Figure 5 a-c.

3.4.2 Targeted Searches

Gilled Slender Blue-tongued Lizard and Western Spiny-tailed Skink

No Gilled Slender Blue-tongued Lizards or Western Spiny-tailed Skink were recorded during the survey. No Western Spiny-tailed Skink latrines were located during the survey.

Malleefowl

Malleefowl were recorded at two locations along the Mullewa to Morawa section of the survey area (Appendix G and Figure 5 a-c). One Malleefowl was recorded in the Shrubland habitat in vegetation described as a Tall Shrubland of *Acacia acuminata*, *Acacia stereophylla* var. *stereophylla* and *Casuarina obesa* over Shrubland of *Baeckea* sp. Gutha (B.L. Rye 239041 and M.E. Trudgen), *Grevillea obliquistigma* subsp. *funicularis*, *Melaleuca cordata*, *Allocasuarina campestris* and *Grevillea paradoxa* (ENV 2010). Two Malleefowl were sighted at one location in the Woodland habitat, in vegetation described as a Very Open Tree Mallee of *Eucalyptus loxophleba* subsp.

supralaevis over Tall Shrubland of *Melaleuca uncinata*, *Acacia sibina* and *Melaleuca eleuterostachya* over Low Open Shrubland of *Acacia andrewsii* (ENV 2010). Extensive searches in the areas surrounding these sightings and throughout all habitats with sufficient leaf litter were conducted, but no nest sites (current or historic) were recorded.

Tree-stem Trapdoor Spiders and Shield-backed Trapdoor Spiders

Searches were conducted throughout the survey area where suitable habitat occurred and 100 m either side of each habitat assessment location. However, no Tree-stem Trapdoor Spiders or Shield-backed Trapdoor Spiders or their burrows were recorded.

Carnaby's Cockatoo

Thirty-three mature trees (DBH over 50 cm) were recorded at seven locations in the survey area. These consisted of two species of eucalypt (*Eucalyptus wandoo* and *Eucalyptus loxophleba*) which are both known breeding resources for Carnaby's Cockatoo (Appendix G). The majority of the trees contained small to medium sized hollows. However, none were of suitable size at the time of the survey to be considered breeding sites for Carnaby's Cockatoo.

The survey area contained four dominant flora species that are known foraging resources for Carnaby's Cockatoo (*Banksia attenuata*, *Dryandra sessilis*, *Grevillea paradoxa* and *Hakea trifurcata*). These species were dominant within 69.4 ha of the survey area, which has been mapped as foraging habitat for Carnaby's Black Cockatoo (Figure 6). However, no foraging evidence was recorded during the survey. Furthermore, no roosting locations were identified during dusk and nocturnal surveys.

4 DISCUSSION

4.1 A REGIONAL PERSPECTIVE OF THE SURVEY

The survey area occurs within the Mid-West region of Western Australia, specifically within two bioregions of the Geraldton Sandplains and Avon Wheatbelt. Both of these bioregions have been extensively cleared for dryland agriculture and livestock grazing (SEWPAC 2007). As a result of this extensive clearing, the Geraldton Sandplains and Avon Wheatbelt bioregions are included within the south-west biodiversity ‘hotspot’, which is an area that is characterised by high endemism among its flora and fauna yet is undergoing exceptional loss of habitat (Myers *et al.* 2000).

European settlement of the Mid-West region of Western Australia saw the beginning of vegetation clearance for agriculture (Saunders and Hobbs 1991). So extensive was the removal of native vegetation that it appeared that much of the State’s unique flora, and the fauna which depends on it, would be lost (Saunders and Hobbs 1991). As a result of increasing public concern the State government was motivated to designate land as conservation nature reserves in newly-created agricultural areas (Saunders and Hobbs 1991).

Vegetation clearing associated with agriculture from the three Local Government Areas (LGAs) that the survey area intersects have been extensive. The Greenough (Geraldton), Mullewa and Morawa LGAs contain only 15%, 7.1% and 19.4% of remnant vegetation respectively (Shepherd 2001). The Mullewa LGA has been cleared to the extent that it is categorised as Endangered by the Department of Natural Resources (2002).

Much of the remaining vegetation within the Mid-West region has been conserved within nature reserves (Shepherd 2001). However, according to Shepherd (2001), only 42.7% of the native vegetation existing prior to pre-European settlement remains within the Geraldton Sandplains, and only 15.2% remains within the Avon Wheatbelt. Therefore, the Geraldton Sandplains and Avon Wheatbelt are categorised as ‘Depleted’ and ‘Vulnerable’ by the Department of Natural Resources (2002), respectively.

In addition to allocating land as conservation areas, it was highlighted that these conservation reserves would need to be connected to allow for the movement of biota between reserves to maintain genetic diversity (Saunders *et al.* 1995). This issue was remedied by the conservation of roadside vegetation, forming vegetative corridors, or ‘wildlife corridors’ (Saunders *et al.* 1995).

A wildlife corridor is defined as a linear two-dimensional landscape element that connects two or more patches of wildlife habitat which would have been connected prior to European settlement (Saunders *et al.* 1995). These corridors are considered to be significant for a wide range of reasons, such as to: allow for the movement of biota between habitats and facilitate genetic diversity amongst populations; provide a

regional representation of vegetation associations that were present prior to European settlement; and represent significant areas of conserved land.

The survey area is part of a corridor that intersects the Leda, Forty Mile and Wilroy Nature Reserves. The Mullewa to Tilley (Morawa) section of the rail line has been described as the most important corridor within the northern Wheatbelt by Hussey and Loney (1990). This narrow path of vegetation acts as a corridor that allows for these nature reserves to be connected to each other and assists gene flow between wildlife populations located within the Leda, Forty Mile and Wilroy Nature Reserves (Saunders *et al.* 1995).

Four main habitat types were identified in the survey area, including, Shrubland, Woodland, Samphire and Riverine habitats. The majority of the survey area has been impacted by the existing rail infrastructure and the access tracks either side of it. The vegetation condition of the habitats present within the survey area ranged from Excellent to Completely Degraded, with most habitat assessments revealing the habitats to be in Good condition due to the high level of clearing and introduced species.

The vegetation within the survey area is often the only remnant habitat in the vicinity due to extensive agricultural clearing that has occurred in the region. The remnant habitat within the survey area provides important ecological connectivity in the region as it acts as an important wildlife corridor that links sections of remnant habitat (e.g. nature reserves) in which fauna can move from one section to another (Saunders *et al.* 1995). Ecological connectivity is important for life-history functions (such as breeding) of many fauna. A loss of habitat through clearing reduces the ability for habitats to be connected and places further pressure on species' survival. For example, isolated populations are prone to increased levels of decline due to inbreeding, population fluctuations due to overexploitation of their habitat and stochastic events such as fire.

The removal of vegetation for the proposed development has the potential to impact the fauna of the region by disrupting the ecological linkage provided by the remnant habitat of the existing rail reserve that traverses the fragmented wheatbelt landscape. Disruption to this ecological linkage may further isolate remnant bush reserves located sporadically on either side of the rail line, thereby placing greater pressure on the fauna of the region.

4.2 SPECIES OF CONSERVATION SIGNIFICANCE RECORDED IN THE SURVEY

Two species of conservation significance were recorded within the survey area, namely the Malleefowl and the Rainbow Bee-eater.

Malleefowl were recorded in two locations within the survey area during the field survey (Appendix G, Figure 5 a-c). This species is potentially found throughout both the Woodland and Shrubland habitat types which comprise 64.2% of the survey area. There were no Malleefowl nests recorded within the survey area. The locations at which both

Malleefowl were observed, were within nature reserves where there is substantial remnant vegetation surrounding the rail reserve. Malleefowl are a large, sedentary, ground dwelling bird (Parsons and Short 2008) that disperses on foot rather than by flight. In areas of cleared or open land, Malleefowl travel through corridors of dense, native vegetation (Benshemesh 1992, 2005). Therefore, the removal of habitat within the rail reserve, which currently provides linkage, may isolate individuals of this species. This could potentially restrict gene flow and makes populations more susceptible to further decline as a result of other disturbances, such as fire or disease.

Four Rainbow Bee-eaters were recorded in the survey area during the field survey (Appendix G, Figure 5 a-c). Two of the recorded locations were in the Shrubland habitat type, and two were in the Woodland habitat type. The Rainbow Bee-eater is a commonly recorded species during fauna surveys and is likely to be found in the Shrubland, Woodland and Riverine habitats which cover 64.2% of the survey area. This species can easily move to other similar habitat types within the vicinity of the survey area. Therefore, no localised mortalities are expected. Any proposed clearing within the survey area is not expected to impact this species as it is common and widespread.

4.3 POTENTIALLY OCCURRING SPECIES OF CONSERVATION SIGNIFICANCE

A further fifteen fauna of conservation significance potentially occur within the survey area and were assessed as to 'Likely' or 'Possibly' occur. However, some of these species such as the Fork-tailed Swift, Peregrine Falcon, Australian Bustard and Bush Stone-curlew are highly mobile and transitory. Each of these fifteen species have differing habitat requirements and will utilise any potential habitat within the survey area to different extents.

The brown form of the Western Spiny-tailed Skink is likely to reside in the hollow logs found in the Woodland habitat type, which comprises 14.3% of the survey area. The Shrubland habitat type contained some granite outcropping, which is a potential habitat for the black form of the Western Spiny-tailed skink. However, the outcrops observed in the survey area were flat domes that did not contain sufficient microhabitats such as large cracks, crevices or boulders. Therefore, no habitat suitable for the black form of the Western Spiny-tailed Skink was observed in the survey area.

Ground dwelling species with poor dispersal abilities are most likely to be affected by proposed disturbances to the survey area. Potentially occurring ground dwelling species include; the Western Spiny-tailed Skink, the Gilled Slender Blue-tongue, Woma and Carpet Python. Although these species may not specifically reside in the vegetation of the survey area, their poor dispersal capabilities make them more reliant on the ecological connectivity provided by the rail reserve habitats than other more mobile species. The removal of the linkage provided by remnant vegetation within the existing rail reserve may isolate populations of these species. This has the potential to reduce their capacity for population growth, restrict gene flow and make populations more susceptible to other disturbances.

The Fork-tailed Swift is an aerial species and may only be found foraging high in the air space, independent of habitat types of the survey area and often at infrequent times. No impacts are expected upon this species from any proposed development of the survey area.

The Eastern Great Egret is likely to occur within the Samphire and Riverine habitat types of the survey area if surface water is present after significant rain events. These habitat types cover 1.4% of the survey area. The Eastern Great Egret is mobile and transitory, meaning it can easily disperse to other similar habitat types in the vicinity of the survey area. As such, their representation at a local and regional scale will not be compromised by any proposed development within the survey area.

Although no Peregrine Falcons were recorded, a number of mature trees in the Woodland and Riverine habitats have the potential to be suitable nesting sites for this species. The Peregrine Falcon will also use the Shrubland and Woodland habitat types while foraging. These habitat types cover 64.2% of the survey area. The removal of mature trees is unlikely to have a net impact on this species due to the limited number of potential nesting sites involved. The clearing of the foraging habitat is also unlikely to impact this species as these areas would only be a small portion of a wider home range.

One Australian Bustard was recorded approximately 5 km outside of the survey area in habitat similar to that of the Woodlands habitat type (Appendix G). However, this record was not included within the total recorded fauna for the survey area, due to its distance outside the survey. This species is likely to utilise the Shrubland and Woodland habitat types which cover 64.2% of the survey area. This species is highly mobile and can easily move to other similar habitat types in the local vicinity and so is unlikely to be impacted by the proposed development.

The Bush Stone-curlew is likely to utilise the Woodland and Riverine habitat types which cover 14.4% of the survey area. This species, like the Australian Bustard, can easily move to other similar habitat types within the local vicinity and so is unlikely to be impacted by the proposed development.

Major Mitchell's Cockatoo is likely to utilise the Shrubland and Woodland habitat types of the survey area as a foraging resource. The Major Mitchell's Cockatoo breeds in hollows of eucalypts; there are limited suitable breeding trees within the survey area. This species is unlikely to be impacted by clearing in the survey area due to the lack of suitable breeding habitat and this species' dispersal ability.

The Priority sub-species of the Crested Bellbird and White-browed Babbler are likely to utilise the Shrubland and Woodland habitat types which cover 64.2% of the survey area. These species can easily move to other similar habitat types within the local vicinity, so are unlikely to be impacted by the proposed development.

The Western Brush Wallaby is likely to utilise the Woodland habitat type which covers 14.3% of the survey area. This species is only found in large areas of remnant bushland in the Wheatbelt (van Dyck and Stahan 2008) and may be impacted by the development of the survey area. The removal of the ecological linkage provided by the remnant habitat in the rail reserve may isolate the resident populations. This may reduce their capacity for population growth, restrict gene flow and make populations more susceptible to other disturbances.

While neither burrows nor individuals of the Shield-back Trapdoor Spider (*Idiosoma nigrum*) or the Tree-stem Trapdoor Spider (*Aganippe castellum*) were found to occur within the search parameters of the NatureMap search, it can be seen from NatureMap records that their distributions overlap the survey area. This is shown in Figure 8.

Only basic information on the habitat preference of these species is known. The Shield-back Trapdoor Spider is thought to prefer granitic and loam soils in eucalypt woodlands and are generally found in small bare patches in the leaf litter and avoid areas with dense leaf litter (DEC 2010c). The Tree-stem Trapdoor Spider is thought to prefer sandy loam or loamy gravel soils against trees and shrubs and they are thought to be more common where there is nodulated soil near gravel pits and granite outcrops (DEC 2010c).

The Shield-back Trapdoor Spider is most likely to reside in just the Woodland habitat type within the survey area as it contains eucalypts and loam soils (DEC 2010c). This habitat type comprises 14.3% of the survey area. However, the Tree-stem Trapdoor Spider is likely to inhabit both the Shrubland and Woodland habitats as they both contain loam soils suitable for the burrows of this species. These habitat types comprise 64.2% of the survey area.

These species of trapdoor spider are vulnerable to disturbance as they are sedentary in nature and have poor dispersal abilities (DEC 2010c). Although the number of individuals residing in the vegetation of the survey area may be limited, the poor dispersal capabilities of these species make them more reliant on the ecological connectivity provided by the remnant vegetation within the rail reserve than other more mobile species. The removal of this linkage may isolate populations of these

species and thus reduce their capacity for population growth, restrict gene flow and make populations more susceptible to other disturbances.

The conservation significant fauna at most risk from the proposed development are those that are ground-dwelling and/or have limited dispersal capacity. These are the Gilled Slender Blue-tongue, Western Spiny-tailed Skink, Woma, Carpet Python, Malleefowl, Western Brush Wallaby, Tree-stem Trapdoor Spider and Shield-Back Trapdoor Spider.

4.3.1 Carnaby's Cockatoo

Carnaby's Cockatoos have been previously recorded within close proximity to the survey area (within 10 km). One record is from the Wicherina Nature Reserve in 1984 and another record is from Mullewa in 2008 (DEC 2010a). As this species is transitory and wide ranging it is likely to utilise the foraging resources located in the survey area. There are no records of Carnaby's Cockatoos breeding in the vicinity of the survey area.

The clearing of black cockatoo habitat is a threatening process and there is an increasing focus by the regulatory authorities on proposals that impact black cockatoo habitat. SEWPAC is currently establishing a draft policy with respect to 'significance' for black cockatoo habitat designed to establish the criteria for the referral of a proposal to the Commonwealth for consideration under the *EPBC Act* for impacts on black cockatoos. Currently, clearing an area of foraging habitat in excess of 1 ha is the threshold for consideration of a referral to SEWPAC. As such, any development that will result in the loss of at least 1 ha of foraging habitat for Carnaby's Cockatoo should be referred to SEWPAC for approval under the *EPBC Act*.

No Carnaby's Cockatoo roosting sites or evidence of roosting sites were recorded during the survey. Carnaby's Cockatoos roost in trees that contain a dense canopy that provides perch sites and shelter. The mature trees of the survey area were missing the quality of canopy required to be used as a significant roosting location.

Breeding habitat is a particularly important aspect for any assessment of impacts on black cockatoos. Currently SEWPAC advises that a 0.5 ha parcel of habitat that contains three or more mature trees should be considered future breeding habitat. A mature tree is any living tree or stag (of a species known to form tree hollows) with a DBH of 50 cm or more. The Carnaby's Cockatoo assessment revealed the survey area contained 33 mature trees (Appendix H). However, none of the habitat trees identified contained any hollows of suitable size for breeding at the current time.

The survey area can be classified into four categories with regard to breeding habitat for black cockatoos. Based on the results of the assessment, the survey area is classified as containing *Future Breeding Habitat*, as four sections of the survey area contain three or more mature trees per 0.5 ha (Appendix H, Figure 7 a-e).

The survey area contains both foraging and future breeding habitat for black cockatoos and the clearing of these habitats constitute a threatening process for this species. Should the proposed development clear more than 1 ha of black cockatoo habitat and/or clear more than three mature trees in any 0.5 ha parcel, may constitute a 'controlled action' by SEWPAC and may require referral under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Carnaby's Cockatoo is likely to utilise elements of the Shrubland and Woodland habitat types that contain plant species within the survey area while foraging. Vegetation within these habitats contained four dominant flora species (*Banksia attenuata*, *Dryandra sessilis*, *Grevillea paradoxa* and *Hakea trifurcata*) that are known foraging resources for Carnaby's Cockatoo (Birds Australia 2008) (Appendix I). Sections of the survey area that contained known foraging resources as a dominant species were classified as being foraging habitat (Figures 6.01- 6.09). Foraging habitat for Carnaby's Cockatoo totals 69.3 ha or 6.4 % of the survey area.

5 REFERENCES

- Alan Tingay and Associates (1996) *Vertebrate Fauna Koolanooka Mine Site Morawa*. Report No 96/53. Prepared for Kingstream Resources N.L.
- ATA Environmental (2004) *Fauna Assessment Koolanooka*. Report 2004/40. Prepared for Midwest Corporation.
- Bamford Consulting Ecologists (2004) *Blue Hills Fauna Assessment*, prepared for ATA Environmental
- Benshemesh, J (1992). *The conservation ecology of Malleefowl, with particular regard to fire*. Ph.D. Thesis. Ph. D. thesis, Monash University.
- Benshemesh, J (2005). *National Recovery Plan for Malleefowl 2006-2010*. Department of Environment and Heritage, Adelaide.
- Birddata (2010). *Birddata: Distribution Maps*. Online: www.birddata.com.au/maps.vm [Accessed October 2010]
- Birds Australia (2008). *Native Plant Species Used by Carnaby's Black Cockatoos*. Online: www.birdswa.iinet.net.au/projects/carnaby/assets/ [Accessed November 2008]
- Bureau of Meteorology [BoM] (2010). *Daily Weather Observations*. Commonwealth of Australia. Online: www.bom.gov.au/climate.
- Cale, B (2003). *Carnaby's Black Cockatoo (Calyptorhynchus latirostris) Recovery Plan*. Department of Conservation and Land Management, Perth.
- Churchill, S (2008). *Australian Bats 2nd Edition*, Reed New Holland, Sydney.
- Cogger, HG (2000). *The Reptiles and Amphibians of Australia*. Reed New Holland Publishers, Sydney.
- Department of Environment and Conservation [DEC] (2010a). *NatureMap: Mapping Western Australia's Biodiversity*. Department of Environment and Conservation and Western Australian Museum. Online: <http://naturemap.dec.wa.gov.au/>
- Department of Environment and Conservation [DEC] (2010b). *Threatened and Priority Fauna Database (custom search)*. Department of Environment and Conservation, Perth Western Australia.
- Department of Environment and Conservation [DEC] (2010c). *Threatened Trapdoor Spiders of the Avon*. Department of Environment and Conservation. Online: <http://www.wheatbeltnrm.org.au/resources/trap-door-spider-kit-090130MW.pdf>

Department of Natural Resources and Environment [DNRE] (2002). *Biodiversity Action Planning. Action planning for native biodiversity at multiple scales; catchment bioregional; landscape, local*. Department of Natural Resources and Environment, Victoria.

Department of the Sustainability, Environment, Water, Population and Communities [SEWPAC] (2007). *Biodiversity Assessment – Avon Wheatbelt* Available from: <<http://www.anra.gov.au/topics/vegetation/assessment/wa/ibra-avon-wheatbelt.html>> [October 2010].

Department of the Sustainability, Environment, Water, Population and Communities [SEWPAC] (2010a). *Maps: Australia's Bioregions (IBRA)* Available from: <www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html> [October 2010].

Department of Sustainability, Environment, Water, Populations and Communities [SEWPAC] (2010b). *EPBC Act Protected Matters Search Tool*. Online: <www.environment.gov.au/erin/ert/epbc/index.html> [October 2010].

Department of Sustainability, Environment, Water, Populations and Communities [SEWPAC] (2010c). *Species Profile and Threats Database*. Available from: <<http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>> [October 2010].

Desmond A and Chant A (2001). Geraldton Sandplains 1 (GS1 – Edel Subregion) In: *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*. Department of Conservation and Land Management, Perth, Western Australia.

Ecologia (2010). *Oakajee Terrestrial Port Development: Terrestrial Vertebrate Fauna Assessment*, prepared for Oakajee Port and Rail.

Environmental Protection Authority [EPA] (2002). *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3*. EPA, Perth, Western Australia.

Environmental Protection Authority [EPA] (2004). *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, Guidance Statement No. 56. EPA, Perth, Western Australia.

ENV. Australia (2010). *Westnet Rail Upgrade – Narngulu to Tilley (Morawa) Flora and Vegetation Assessment*, prepared for Strategen.

Geering, A, Agnew L and Harding, S (2007). *Shorebirds of Australia*, CSIRO Publishing, Collingwood, Vic.

Hussey, P and Loney, B. (1990). Wubin-Mullewa road-rail corridor, Western Australia. In: *Living Corridors*, Breckwoldt, R (1990). Greening Australia, Canberra.

Menkhorst, P and Knight, F (2004). *A Field Guide to the Mammals of Australia*. (2nd ed.) Oxford University Press, South Melbourne.

Morcombe, M (2004). *Field Guide to Australian Birds*. Steve Parish Publishing, Archerfield, Queensland.

Myers, N, Russell, A. M, Cristina G. M, Gustavo, A. B, Kent, J (2000). *Biodiversity Hotspots for Conservation Priorities*. Nature. 403 (24), p853-856.

Parsons, B, Short, J and Roberts, J (2008). *Contraction in the range of Malleefowl (*Leipoa ocellata*) in Western Australia: a comparative assessment using presence-only and presence/absence datasets*. Emu. 108:221-231.

Pizzey, G and Knight, F (2007). *The Field Guide to Australian Birds*. Harper Collins Australia.

Saunders, D, Hobbs, R (1991). *Nature Conservation Two: The Role of Corridors*. Western Australian Laboratory of the Commonwealth Scientific and Industrial Research Organisation Western Australia, Perth.

Saunders, D, Craig, J, Mattiske, E (1995). *Nature Conservation 4: The Role of Networks*. Western Australian Laboratory of the Commonwealth Scientific and Industrial Research Organisation Western Australia, Perth.

Shepherd, DP, Beeston, GR and Hopkins, AJM (2001). *Native Vegetation in Western Australia: Extent, Type and Status*. Resource Management Technical Report 249, Department of Agriculture, Government of Western Australia.

Simpson, K and Day, N (2004). *A Field Guide to the Birds of Australia*. Penguin Books Australia Ltd, Melbourne.

Specialised Zoological (2010). *Bat Call Identification from Mullewa, Western Australia*. Report prepared for ENV.Australia Pty Ltd [October 2010].

Storr, GM, Smith, LA and Johnstone, RE (1999). *Lizards of Western Australia. I. Skinks*. Western Australian Museum.

Storr, GM, Smith, LA and Johnstone, RE (2002). *Snakes of Western Australia*. Western Australian Museum.

Thackway, R and 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.

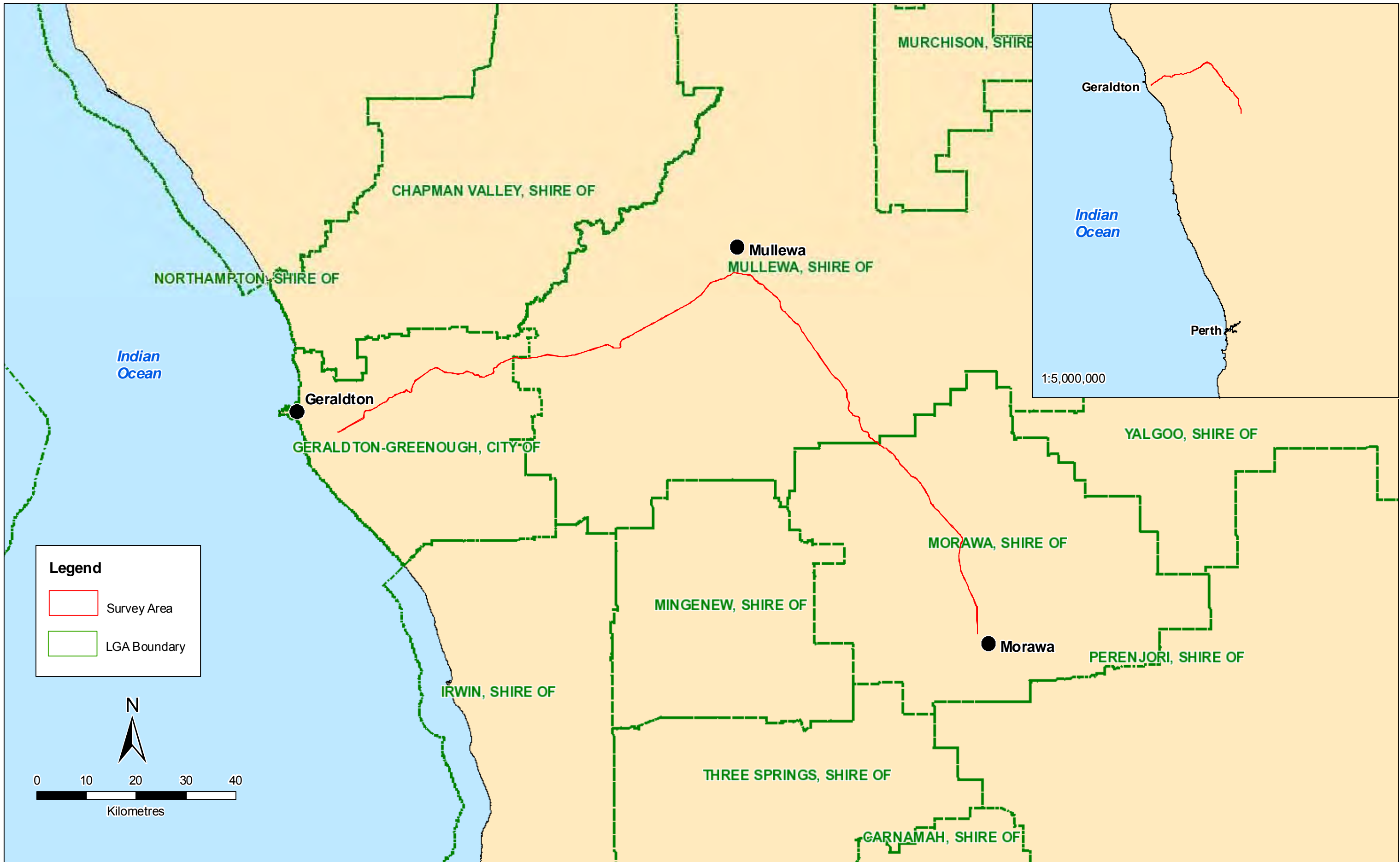
Triggs, B (1996). *Tracks, Scats and Other Traces: A field guide to Australian mammals*. Oxford University Press, Melbourne.

Tyler, MJ, Smith, LA and Johnstone, RE (2000). *Frogs of Western Australia*. Western Australian Museum, Perth.

van Dyck, S and Strahan R. (2008). *The Mammals of Australia – Third Edition*. Reed New Holland, Sydney.

Wilson, S and Swan, G (2008) *Reptiles of Australia*. New Holland Publishers, Australia.

FIGURES



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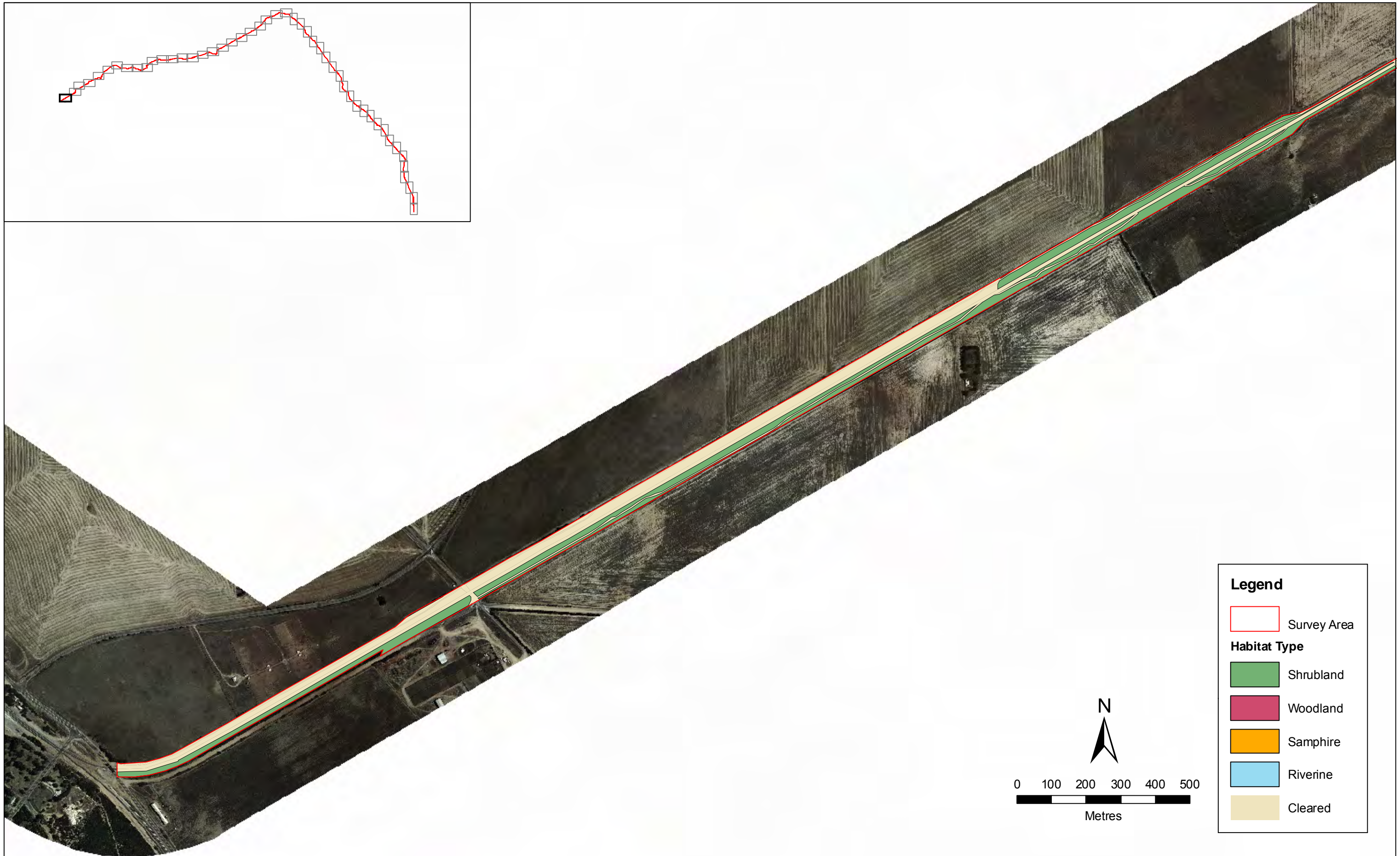
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Regional Location

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

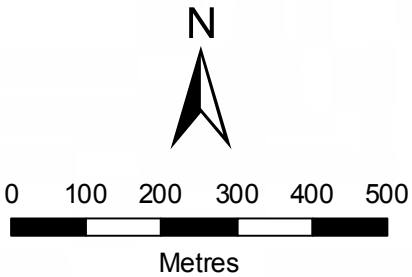


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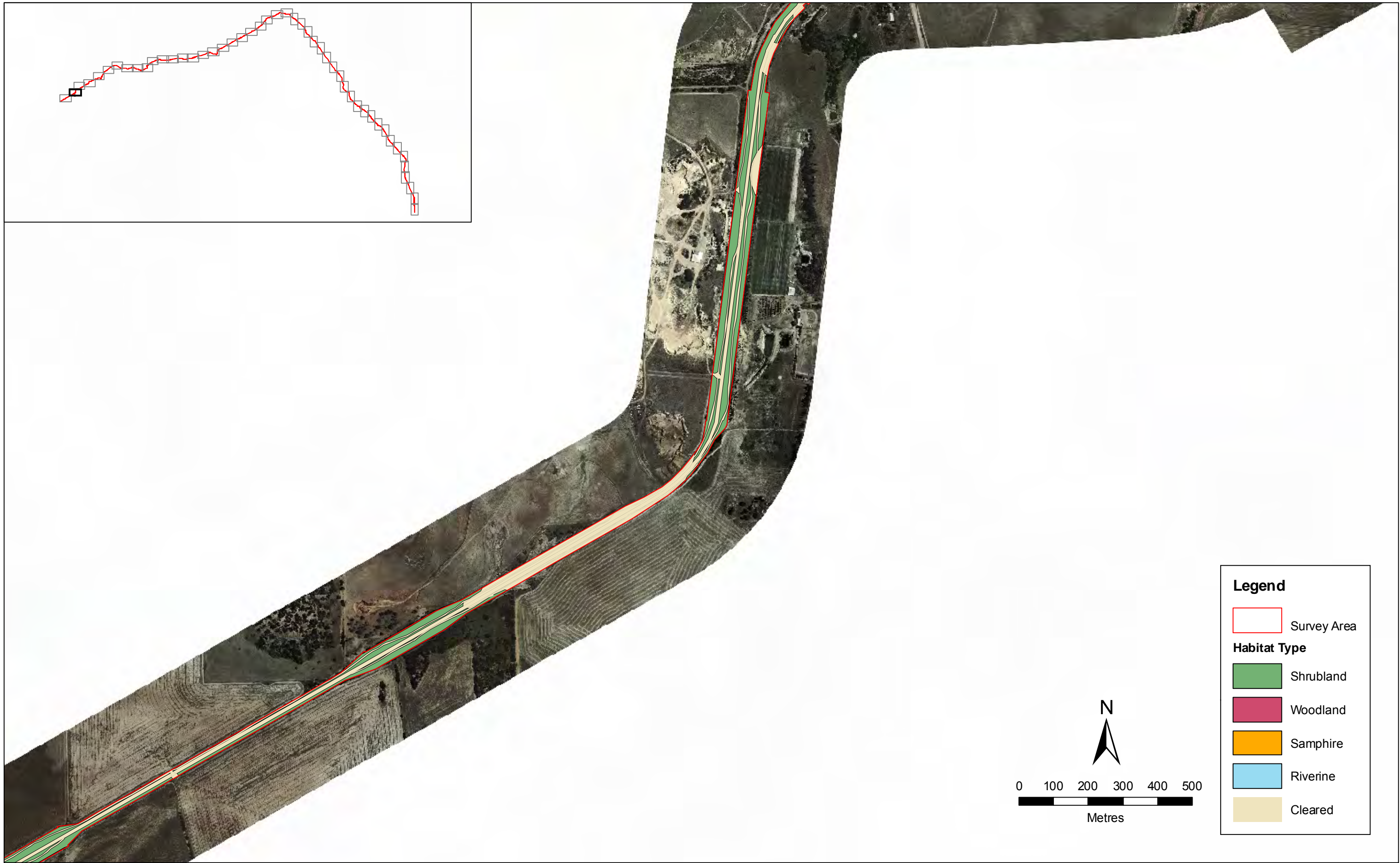
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- Woodland
- Samphire
- Riverine
- Cleared



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Strategen	10.159
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J. Trainer	S. Rho
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Habitat Map

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Narngulu to Tilley (Morawa) Fauna Assessment

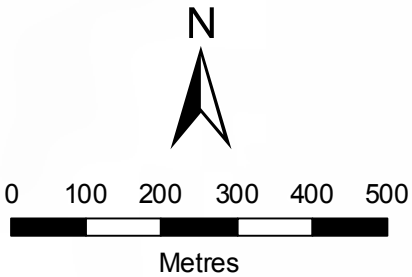


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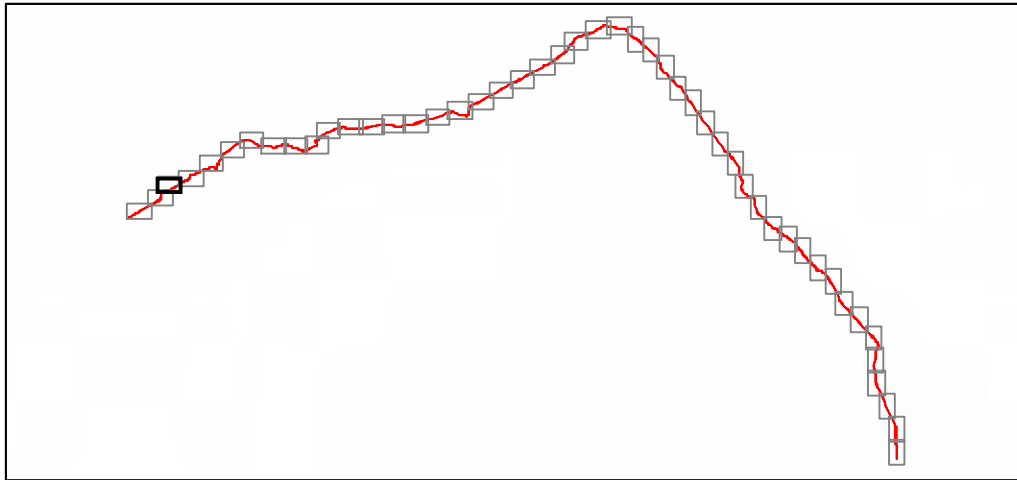
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AUTHOR: J. Trainer	DATE 14-12-2010
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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

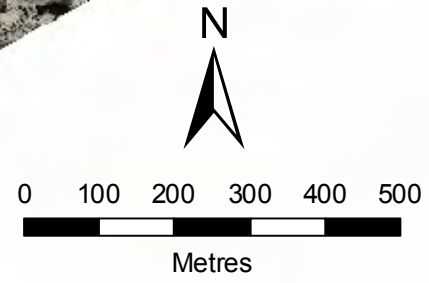


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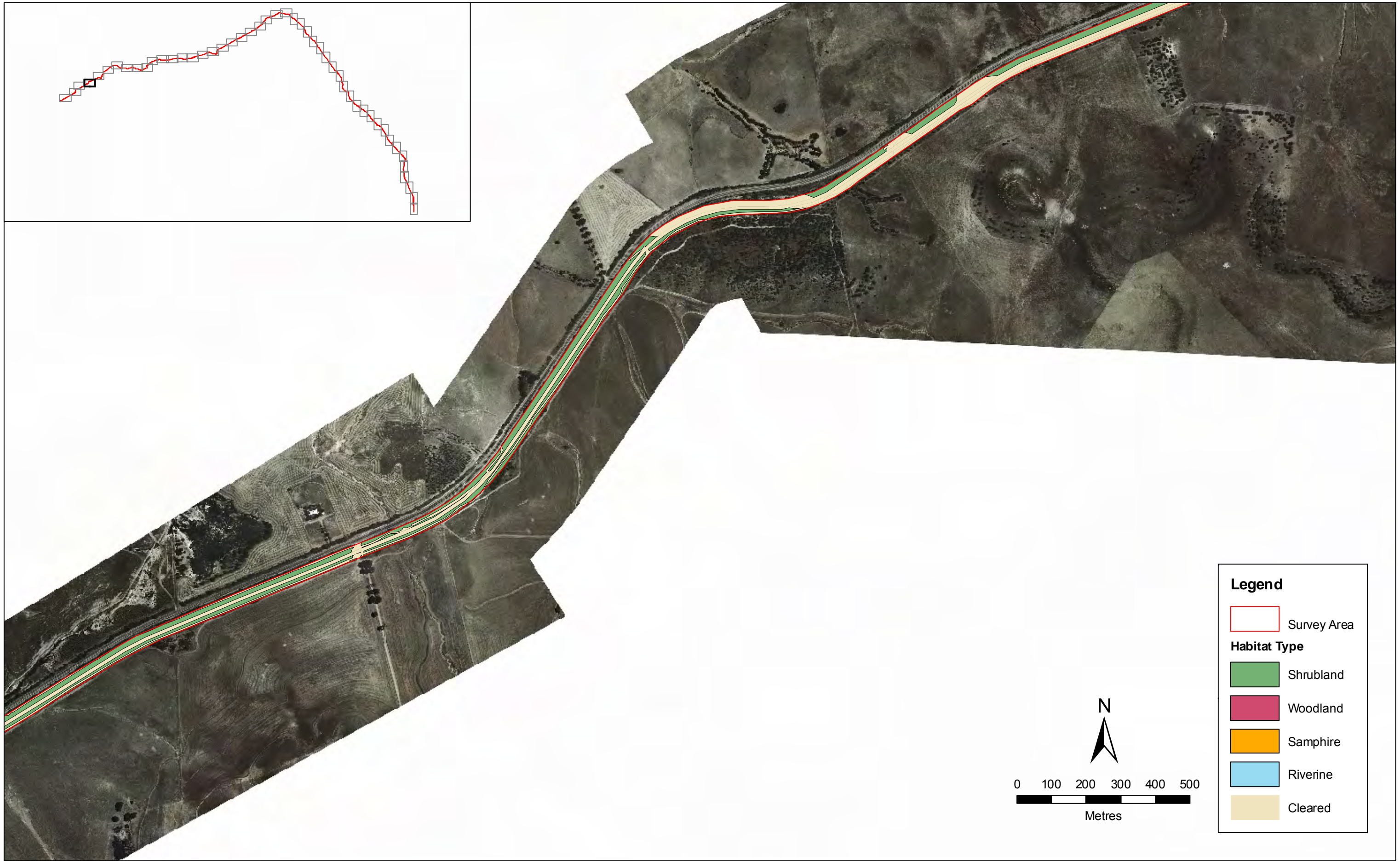
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- Samphire
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J. Trainer	S. Rho
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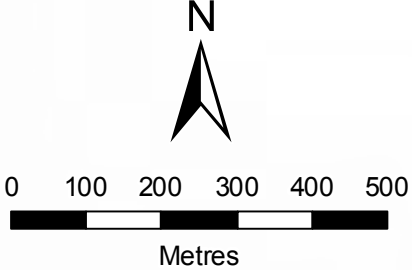
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WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



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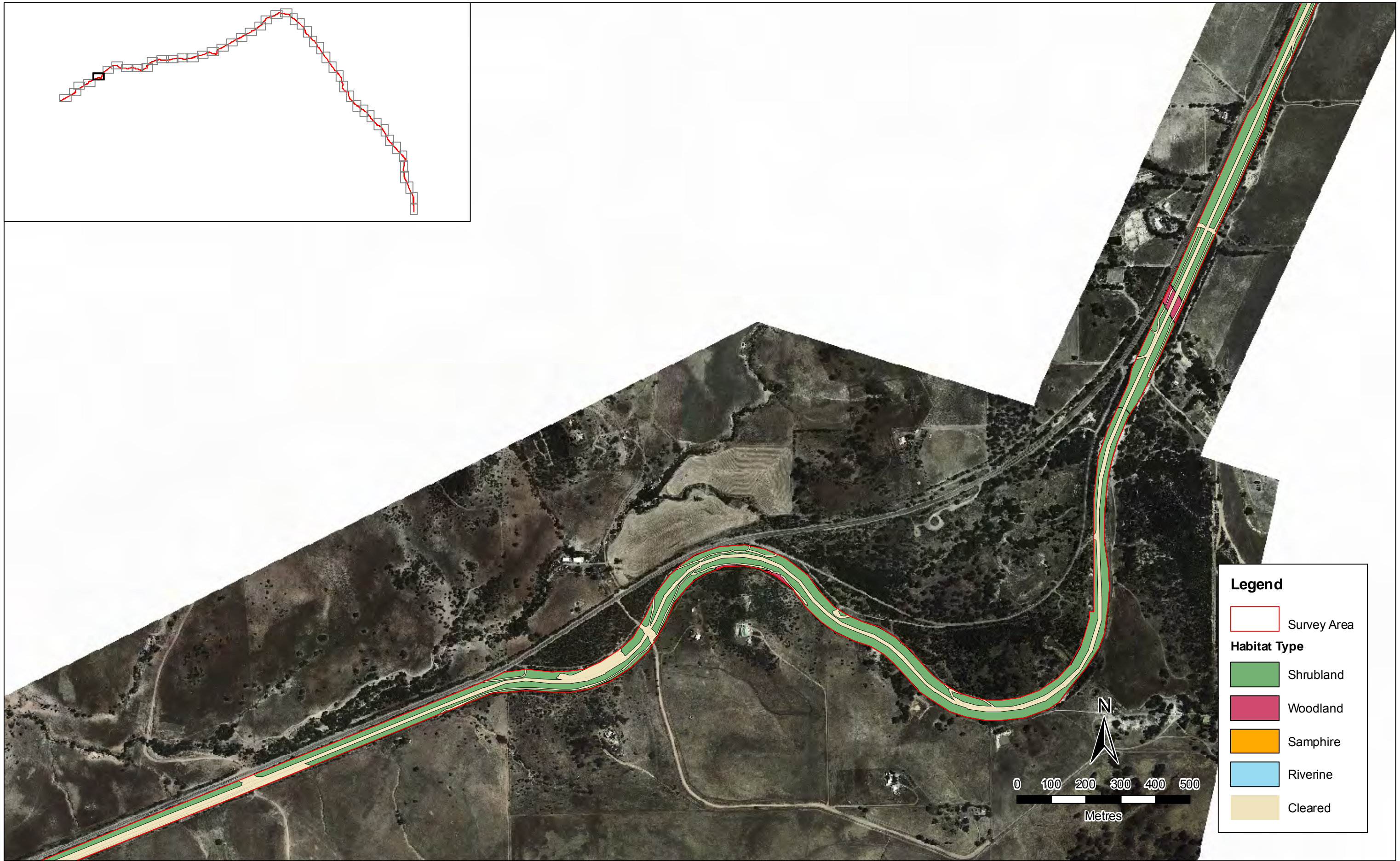
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- Woodland
- Samphire
- Riverine
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Habitat Map

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Narngulu to Tilley (Morawa) Fauna Assessment

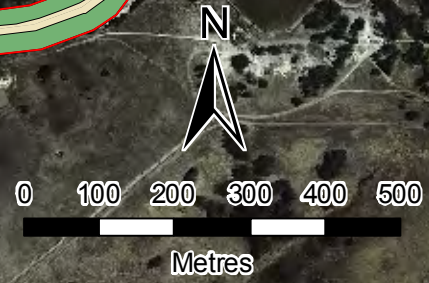


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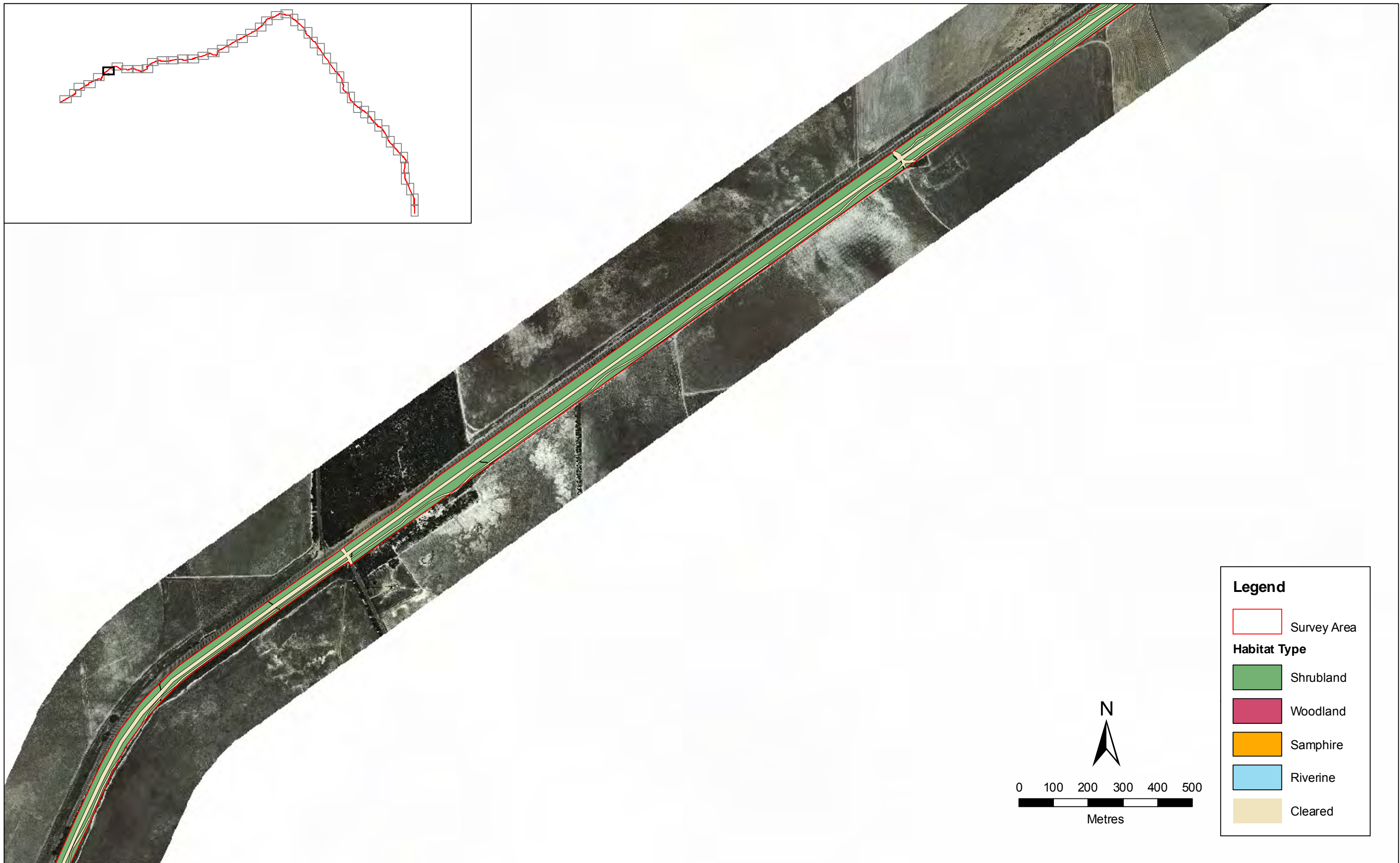
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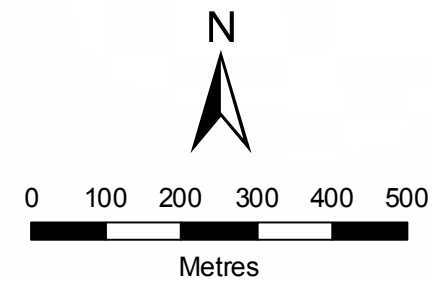
Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



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- Habitat Type**
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- Woodland
- Samphire
- Riverine
- Cleared

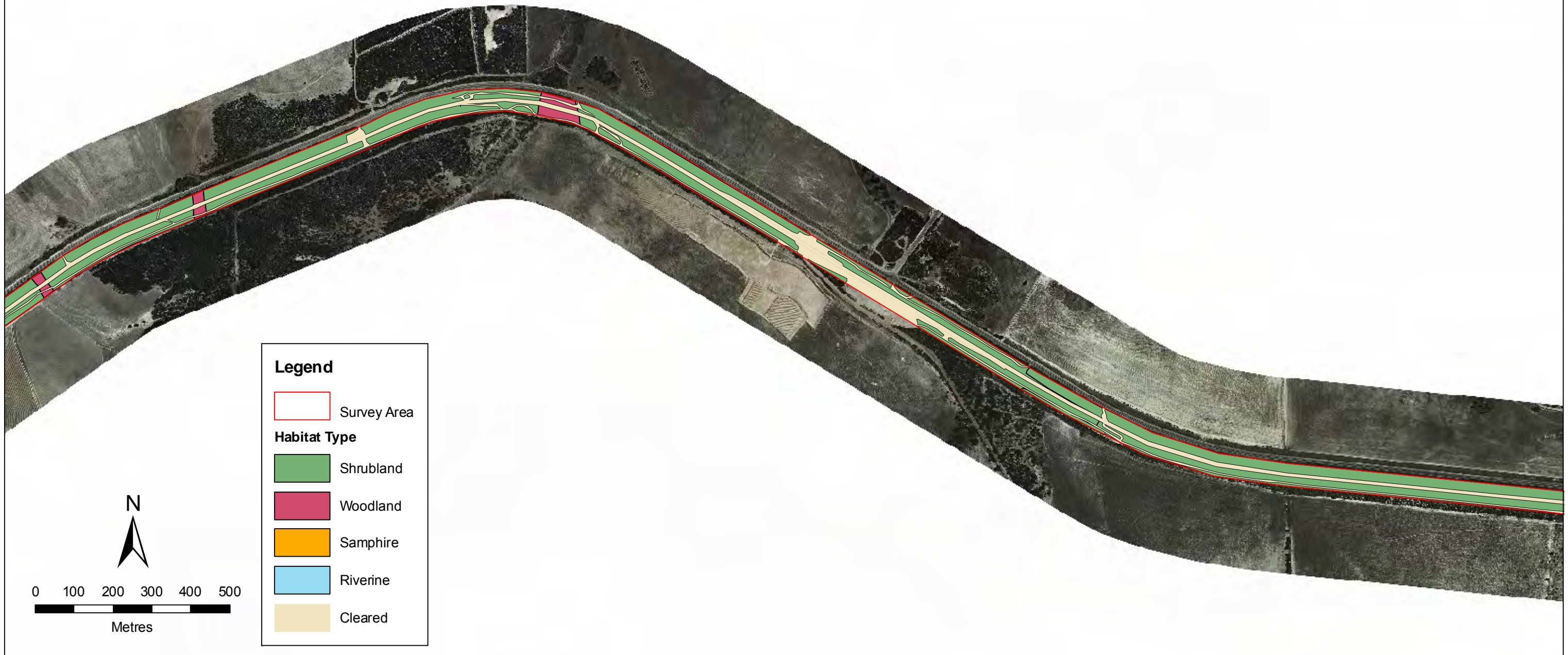
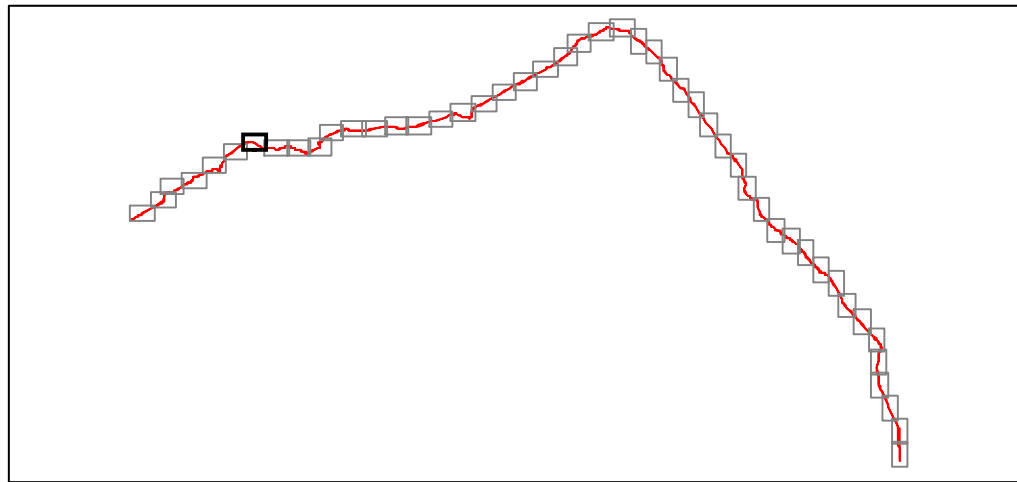


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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

FIGURE **3.06**

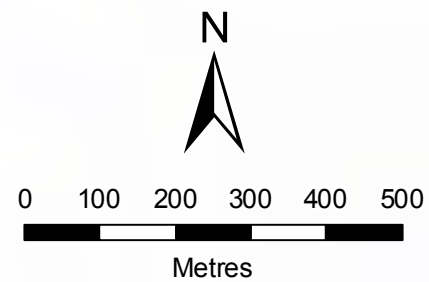


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- Survey Area

Habitat Type

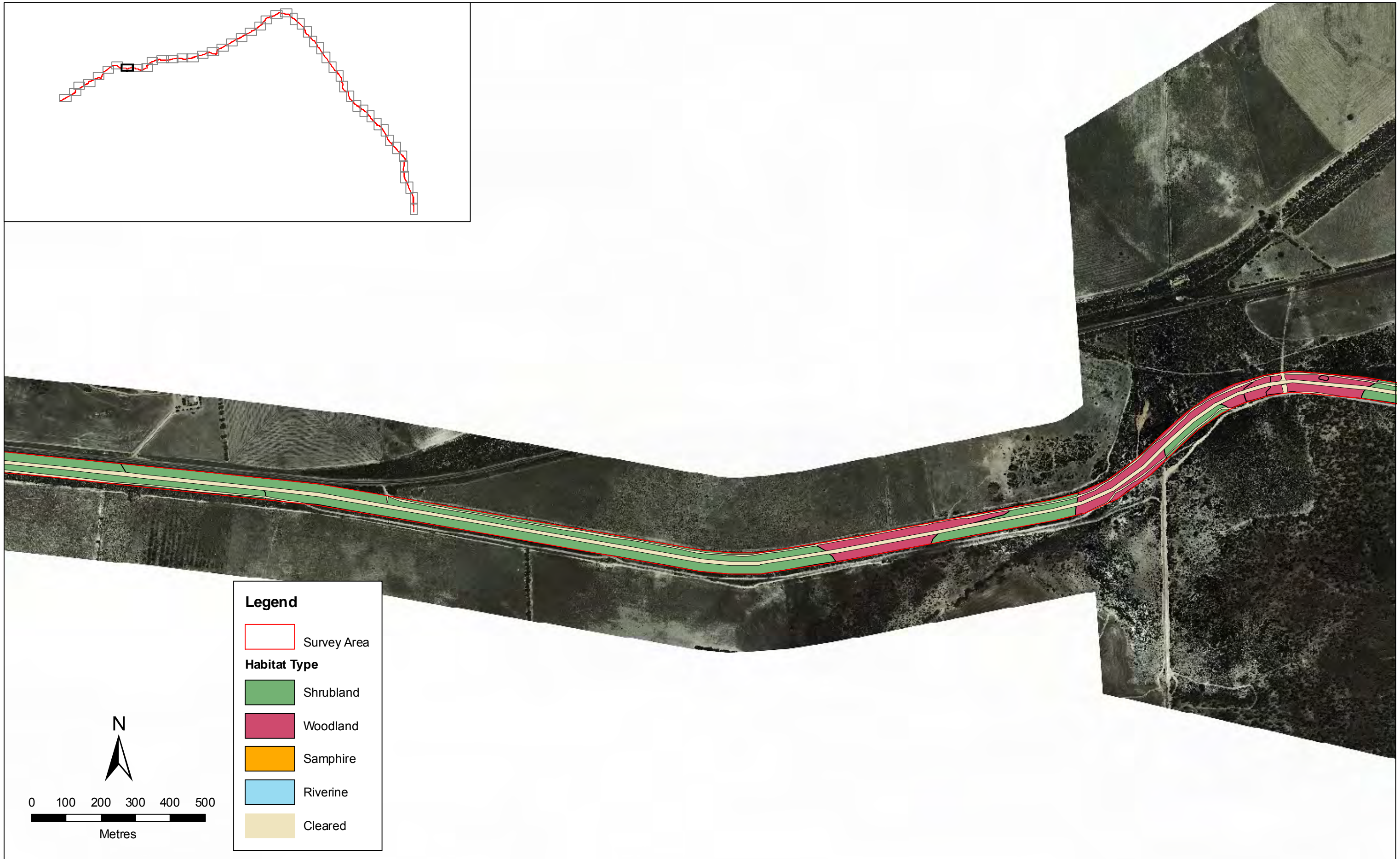
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- Woodland
- Samphire
- Riverine
- Cleared



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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE 3.07**



Legend

Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared

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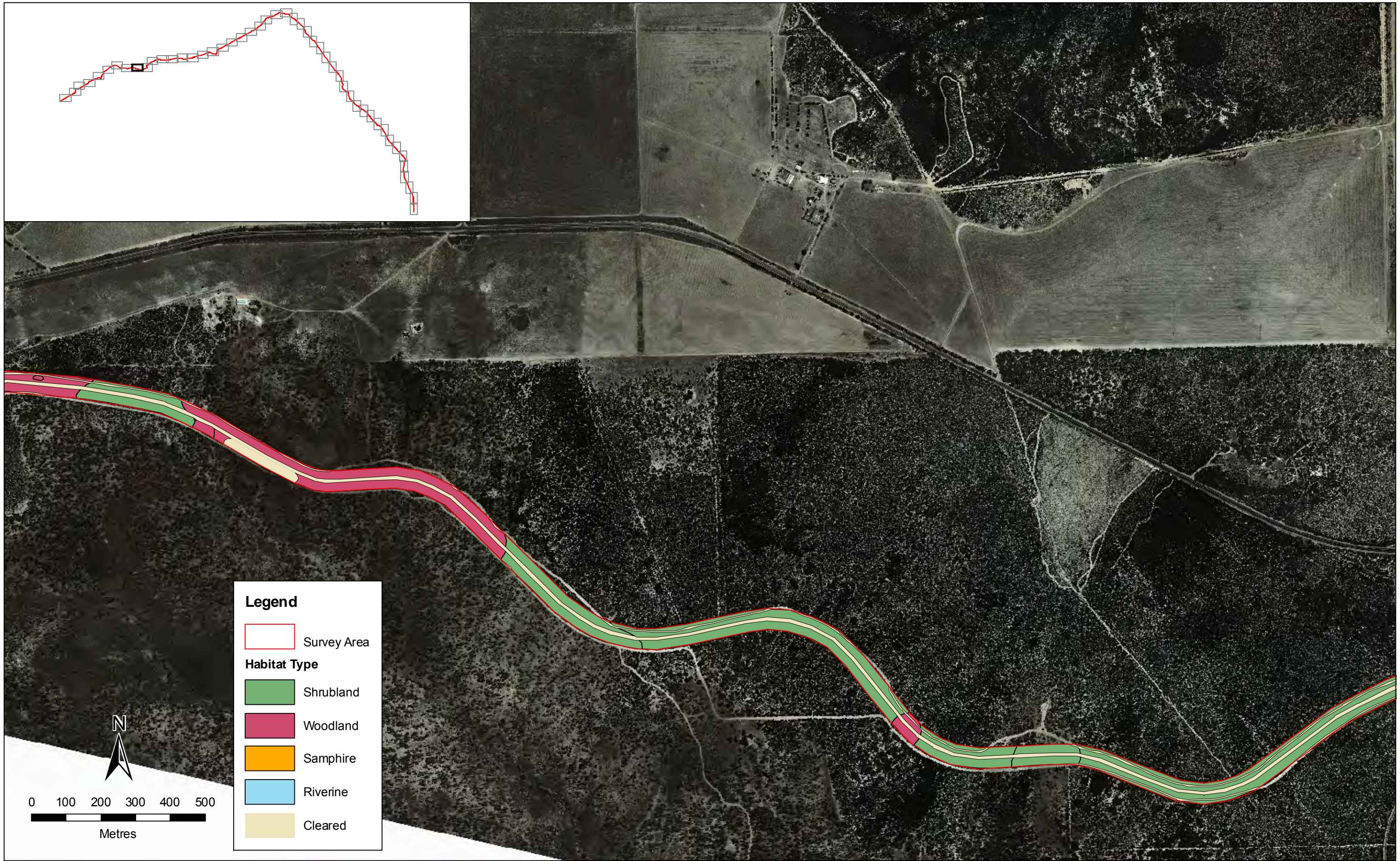
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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

- Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared

N

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PROJECTION GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

- Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared

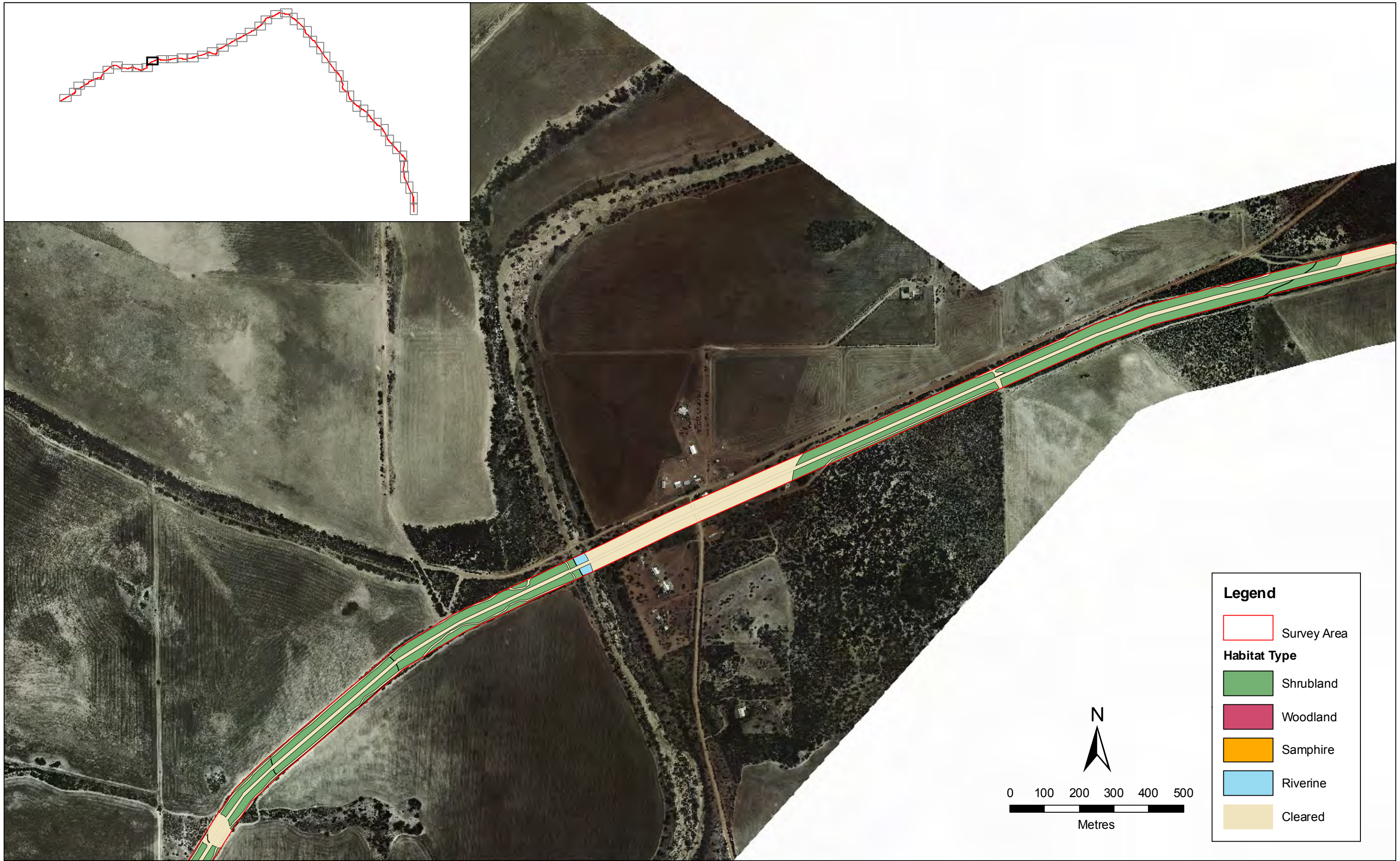
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Habitat Map
 WestNet Rail Upgrade –
 Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE 3.10**



Legend

Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared

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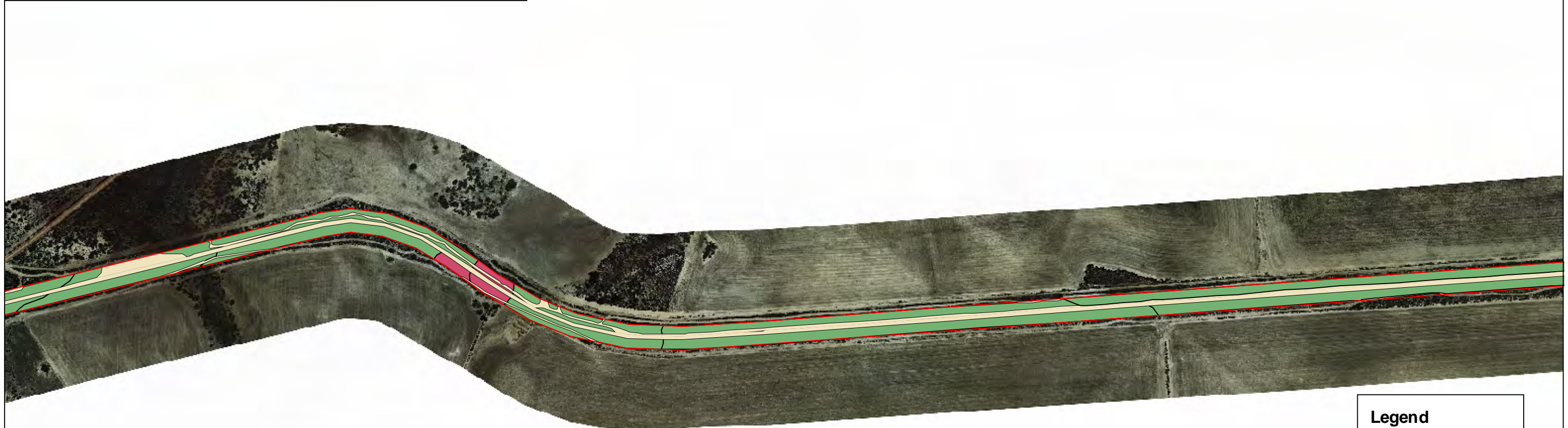
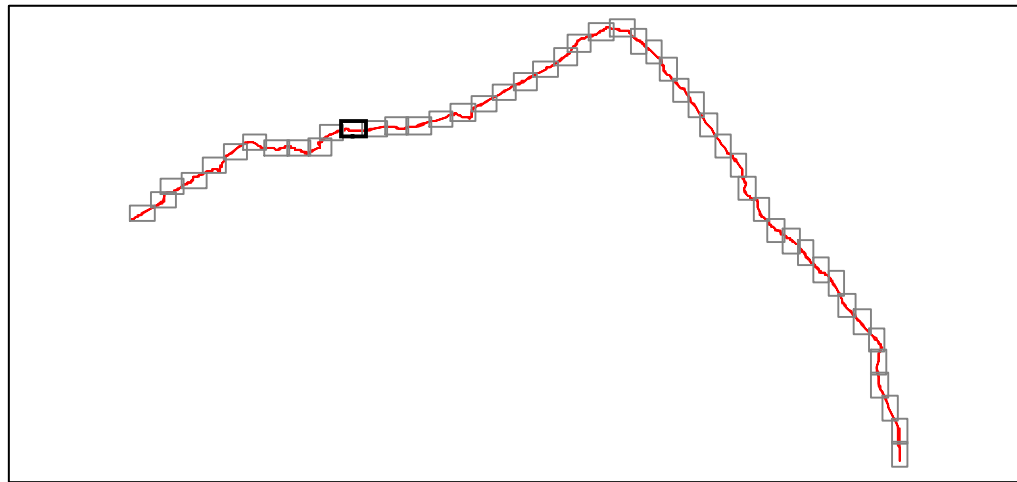
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Strategen	10.159
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J. Trainer	S. Rho
SCALE	PROJECTION
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Habitat Map
 WestNet Rail Upgrade –
 Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE 3.11**

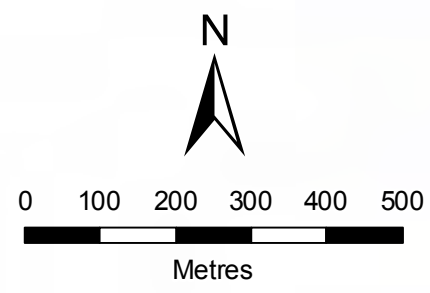


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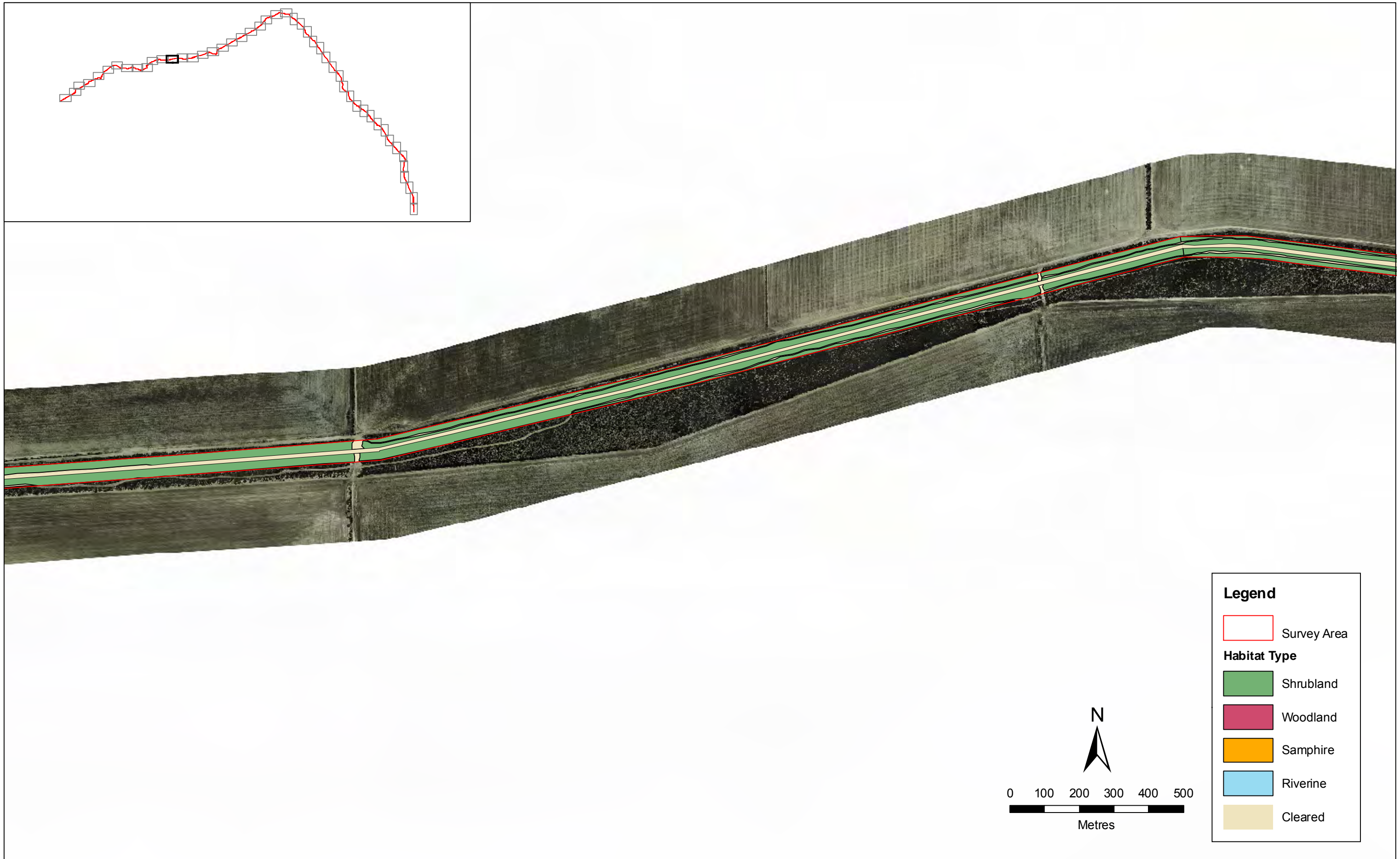
Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



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Habitat Map
 WestNet Rail Upgrade –
 Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE 3.12**

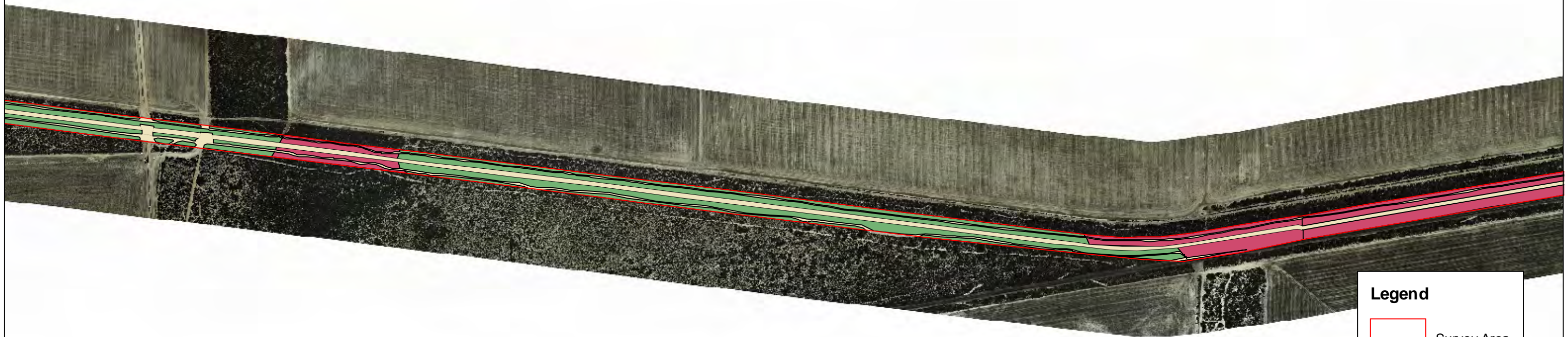
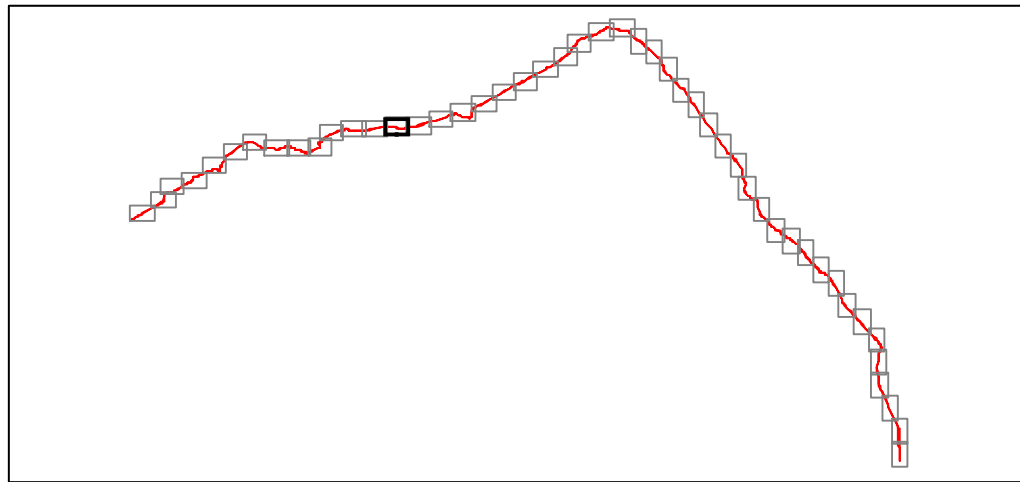


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Habitat Map

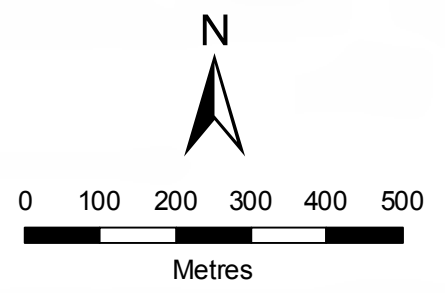
WestNet Rail Upgrade –
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FIGURE **3.13**



Legend

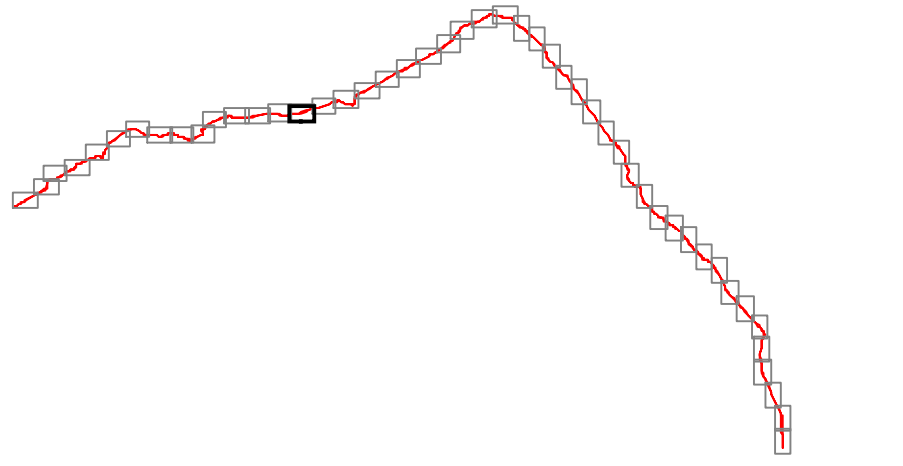
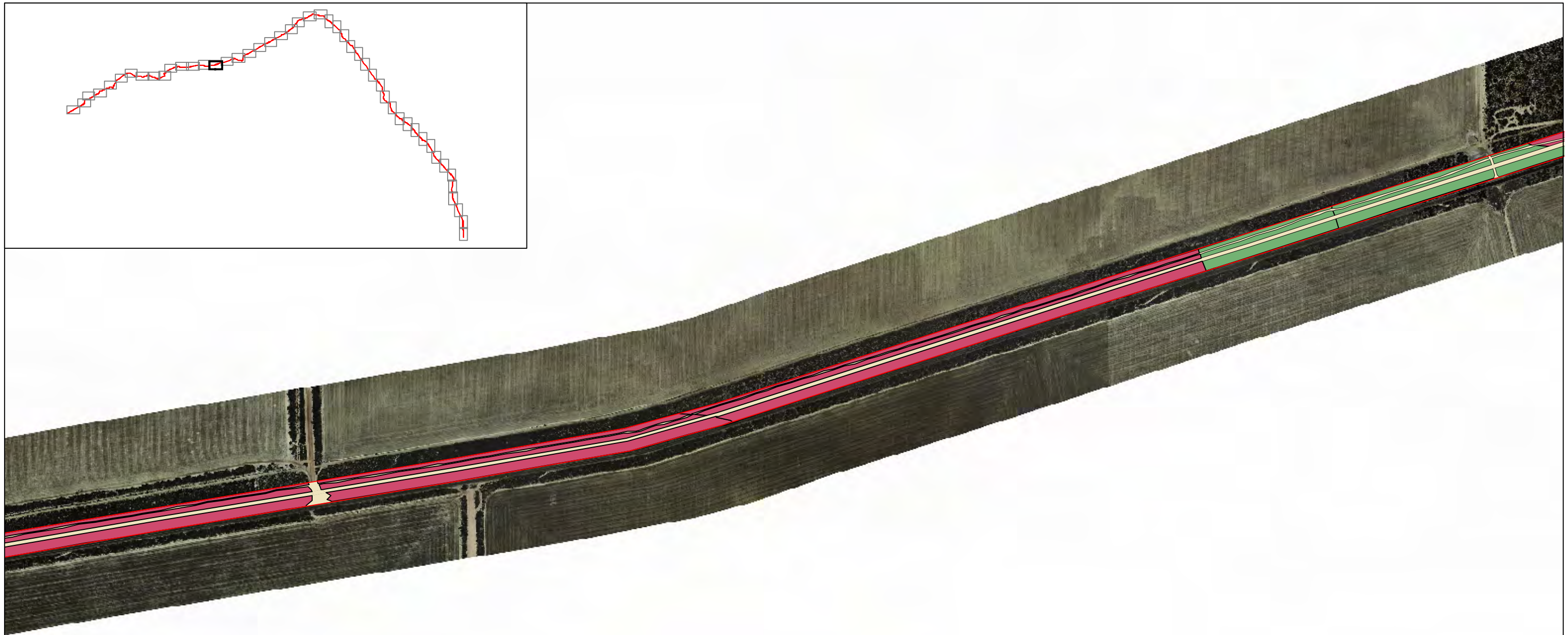
- Survey Area
- Habitat Type**
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	PROJECTION
1:10,000 @ A3	GDA 94 MGA 50
	DATE
	14-12-2010

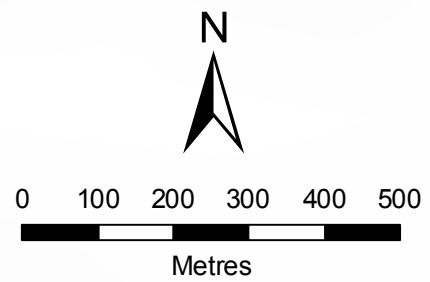
Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

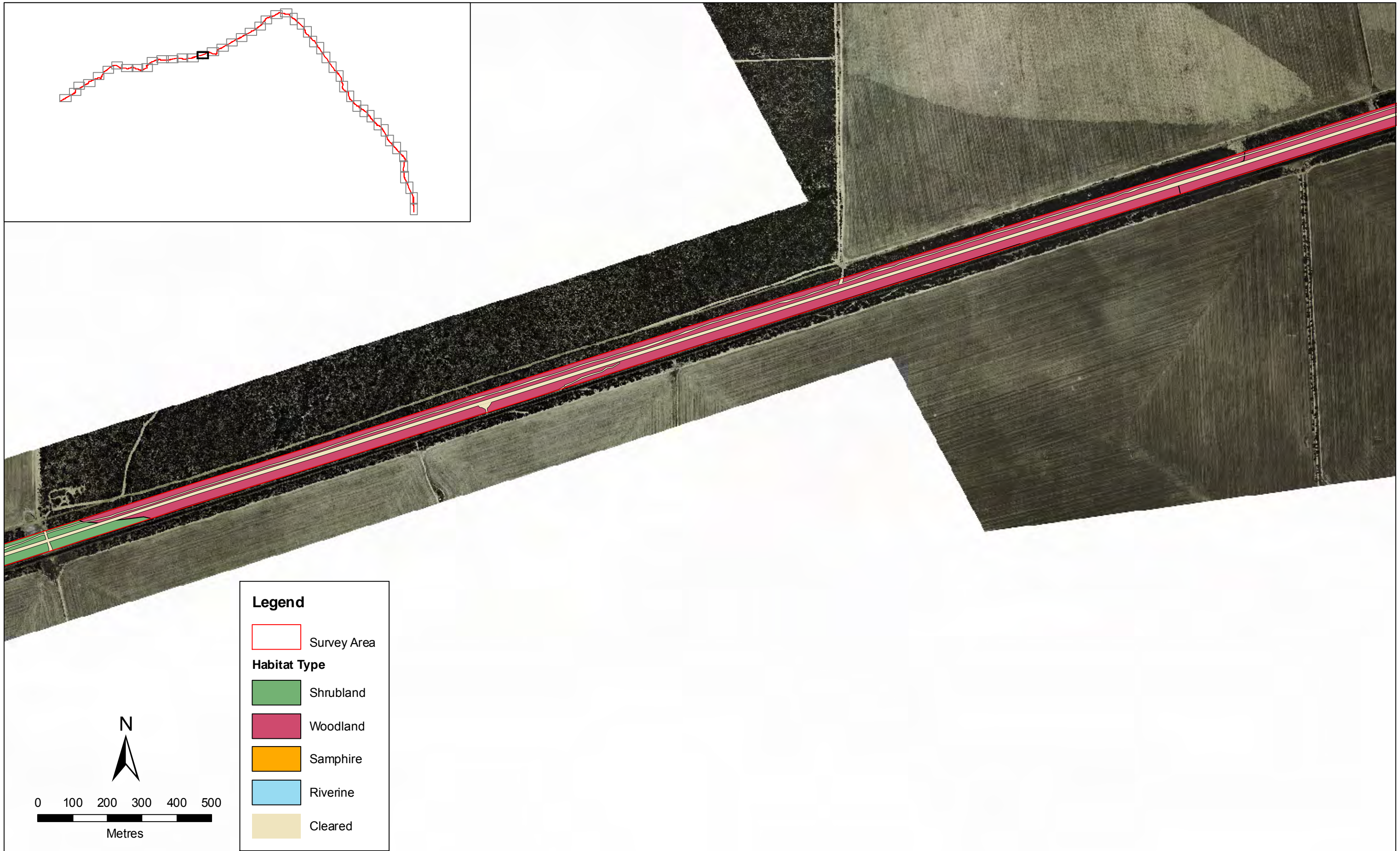
- Survey Area
- Habitat Type**
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

Habitat Map

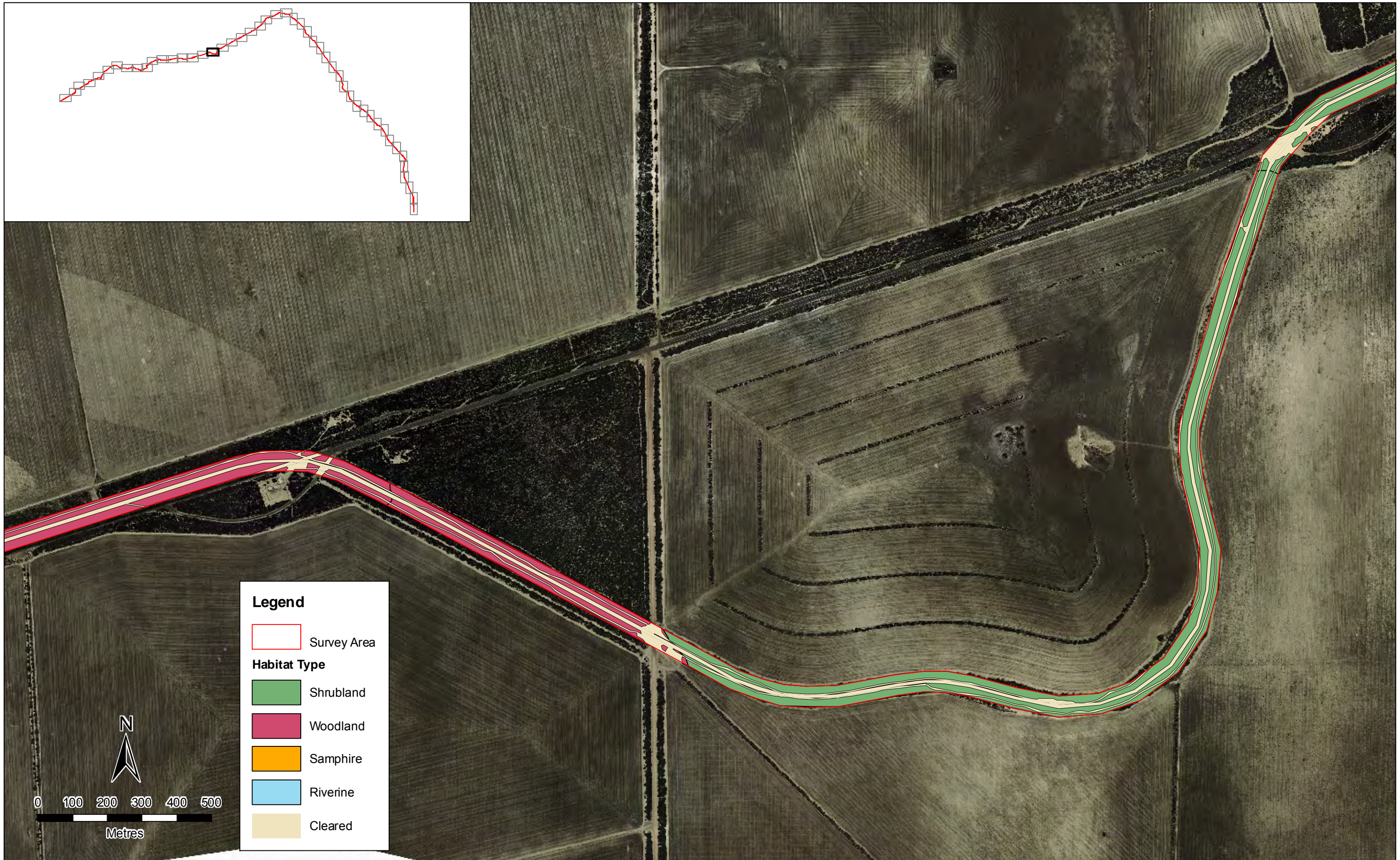
WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



CLIENT	Strategen	JOB NO.	10.159
AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:10,000 @ A3	DATE	14-12-2010
	PROJECTION		GDA 94 MGA 50

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

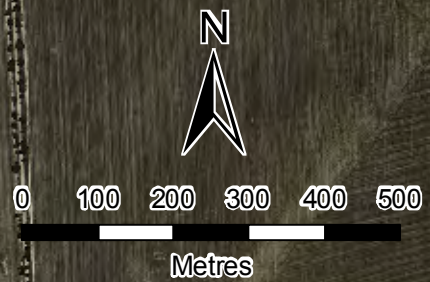


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- Survey Area

Habitat Type

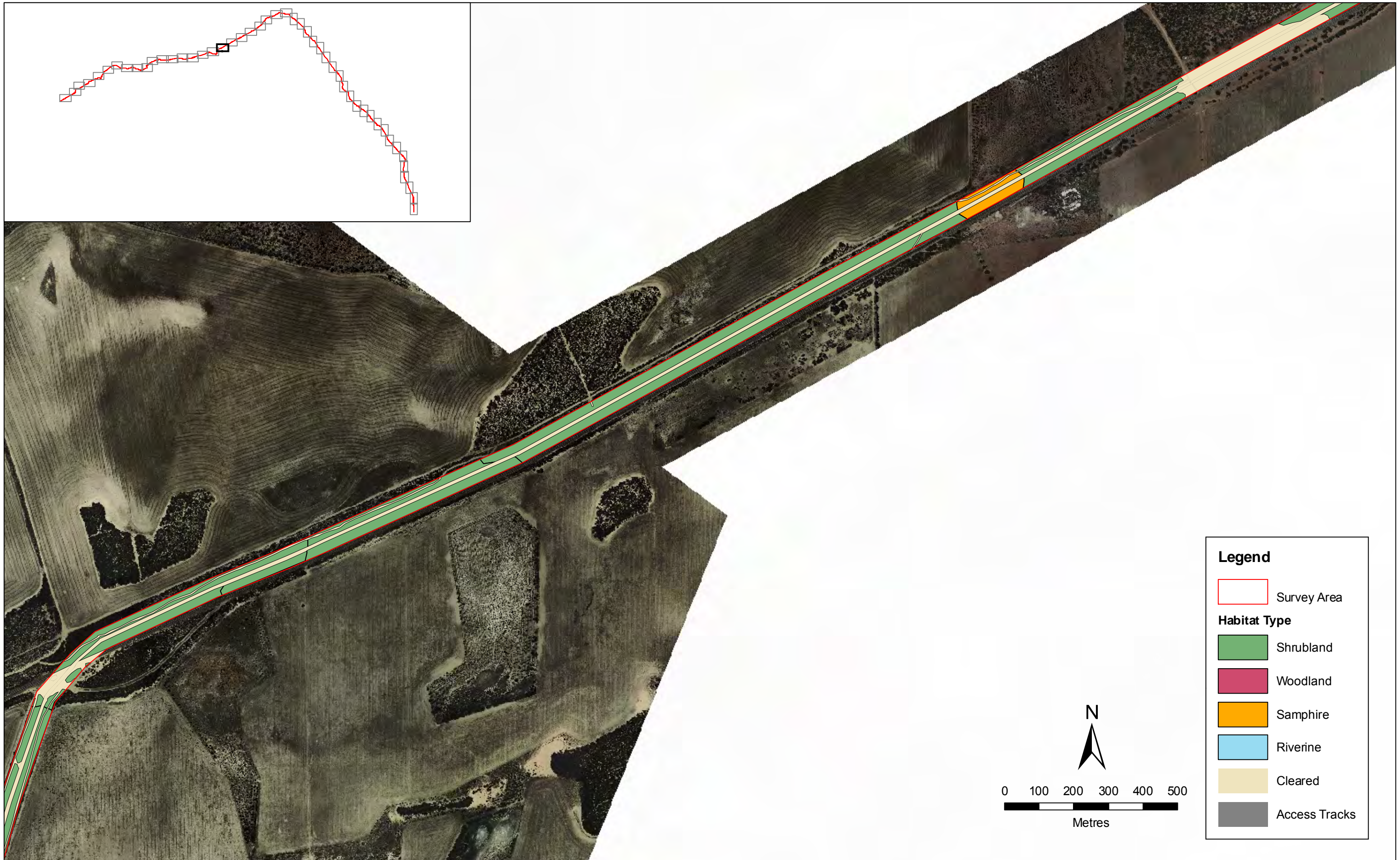
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

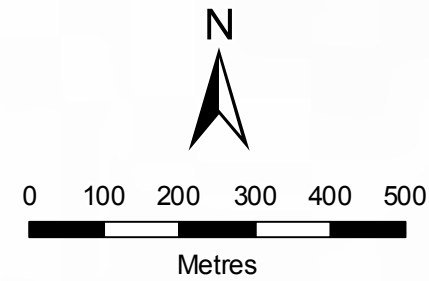
Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

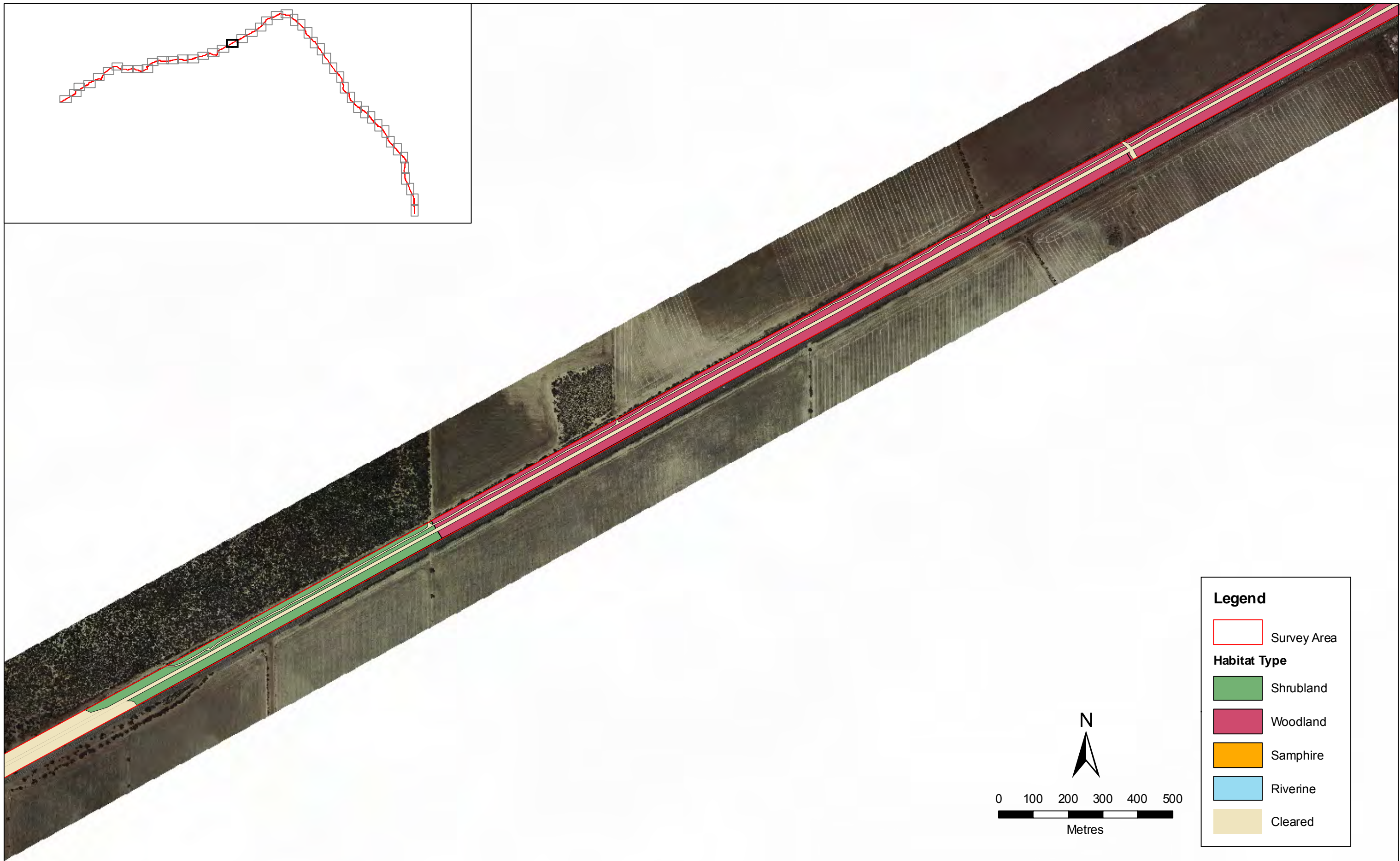
- Survey Area
- Habitat Type**
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared
- Access Tracks



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
DRAWN S. Rho	
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

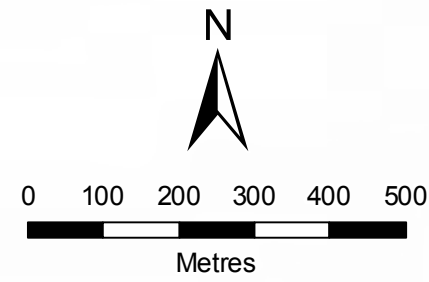


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- Survey Area

Habitat Type

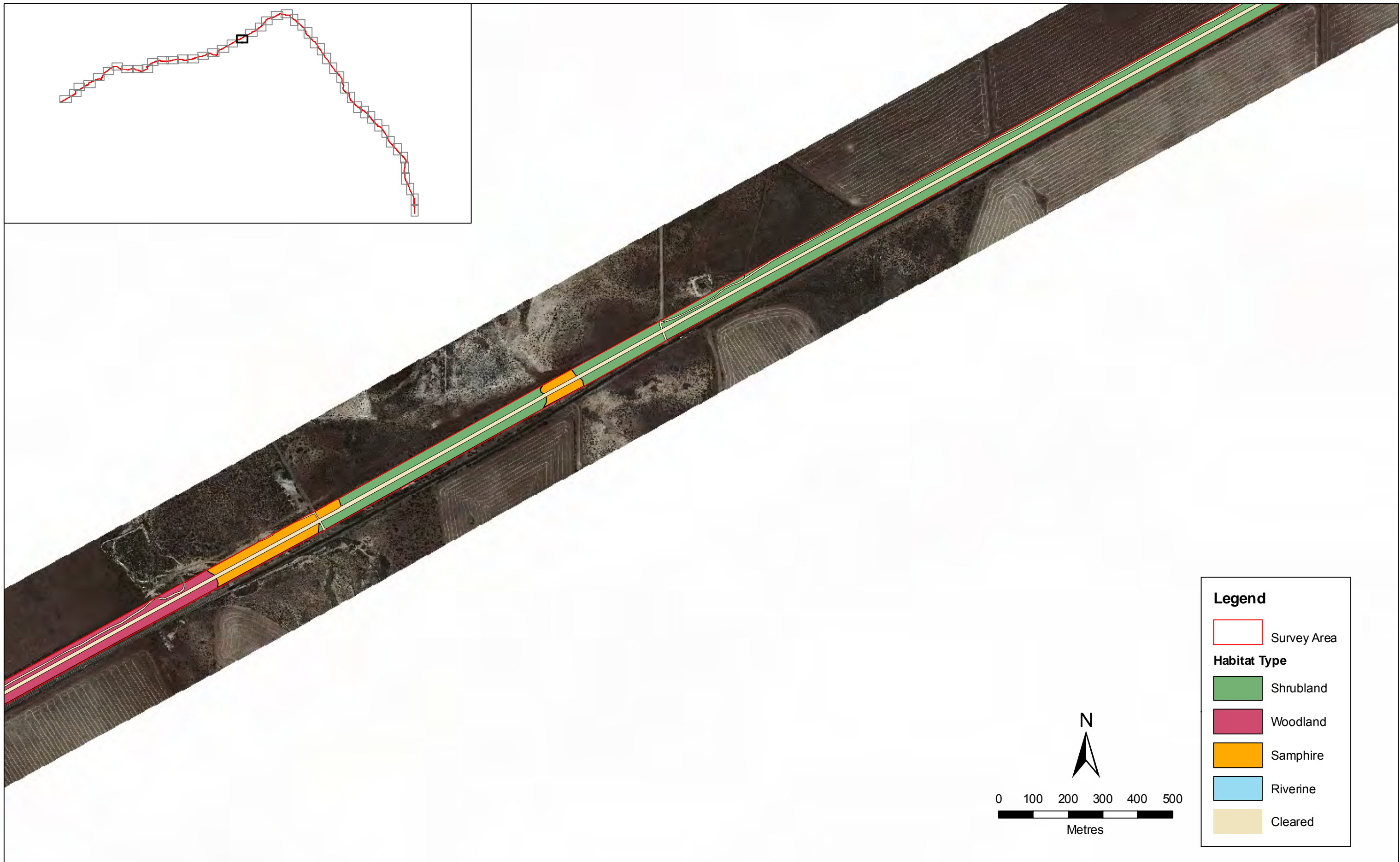
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	DATE
1:10,000 @ A3	14-12-2010
PROJECTION	
GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

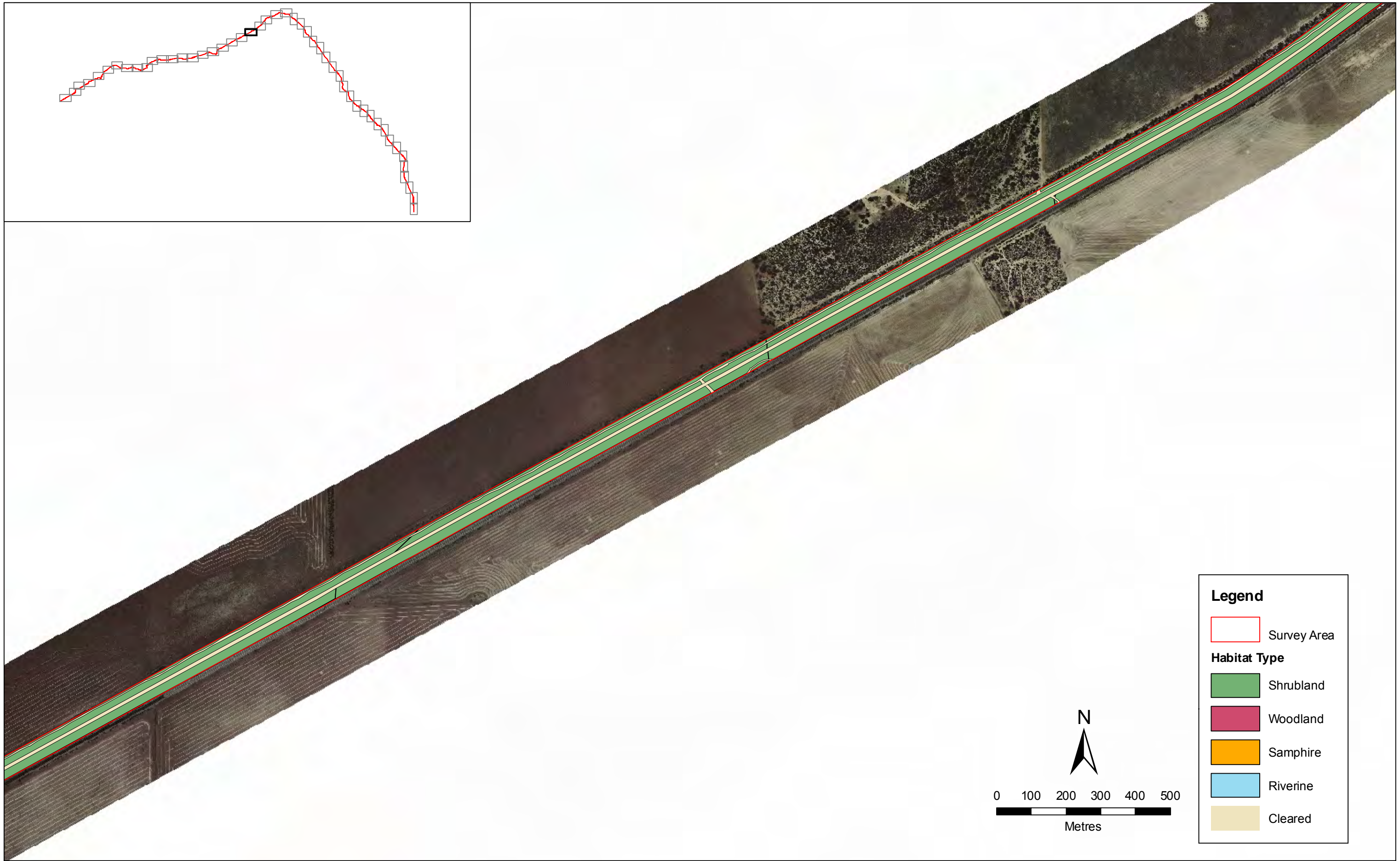


CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	DATE
1:10,000 @ A3	14-12-2010
PROJECTION	
GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

FIGURE **3.20**



Legend

- Survey Area

Habitat Type

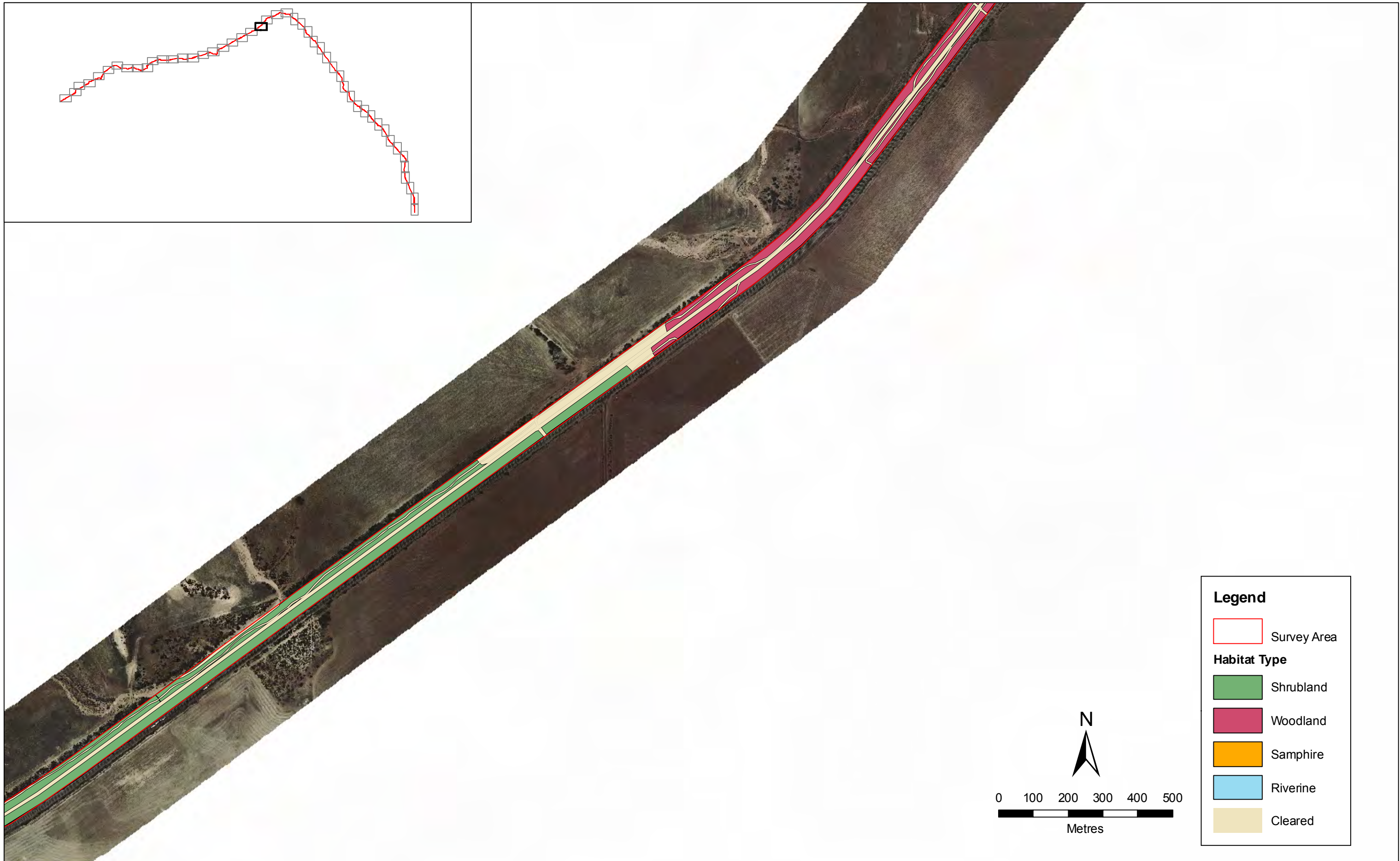
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
DRAWN S. Rho	
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

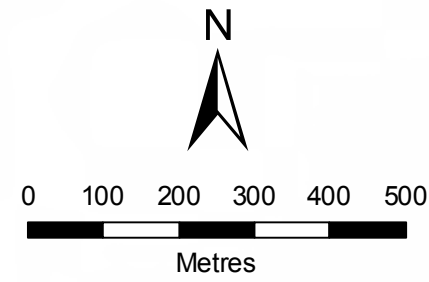


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- Survey Area

Habitat Type

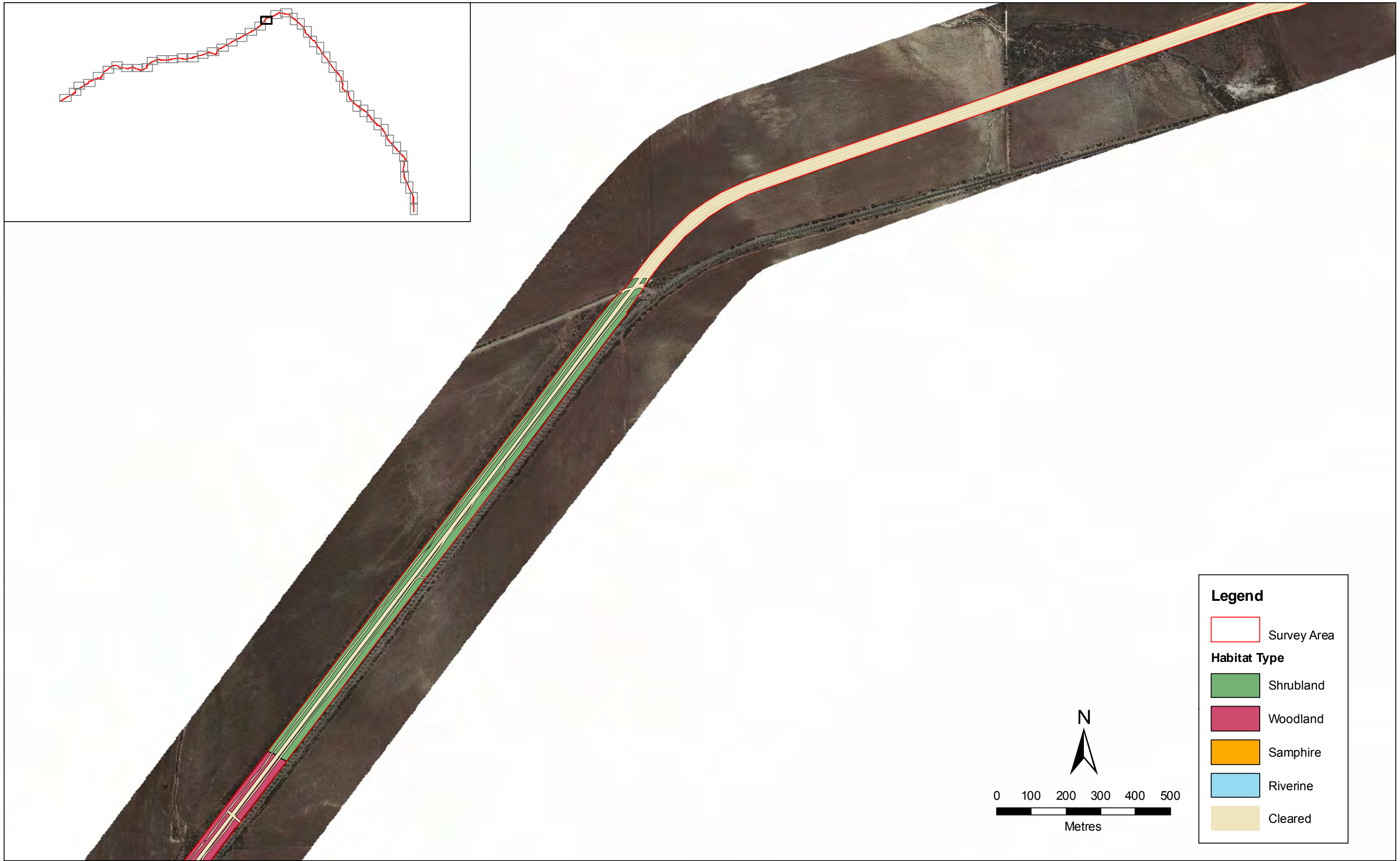
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	PROJECTION
1:10,000 @ A3	GDA 94 MGA 50
	DATE
	14-12-2010

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

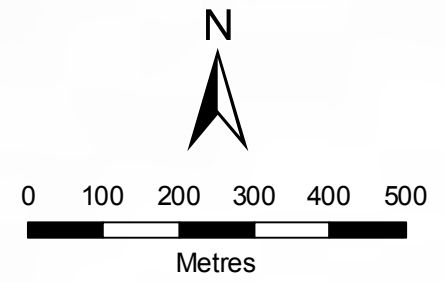


Legend

- Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
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SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50

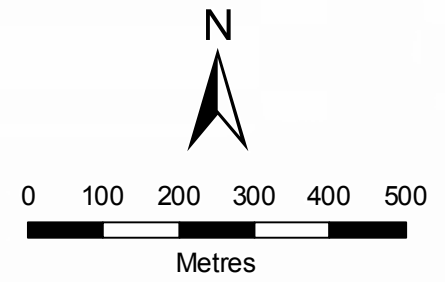
Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

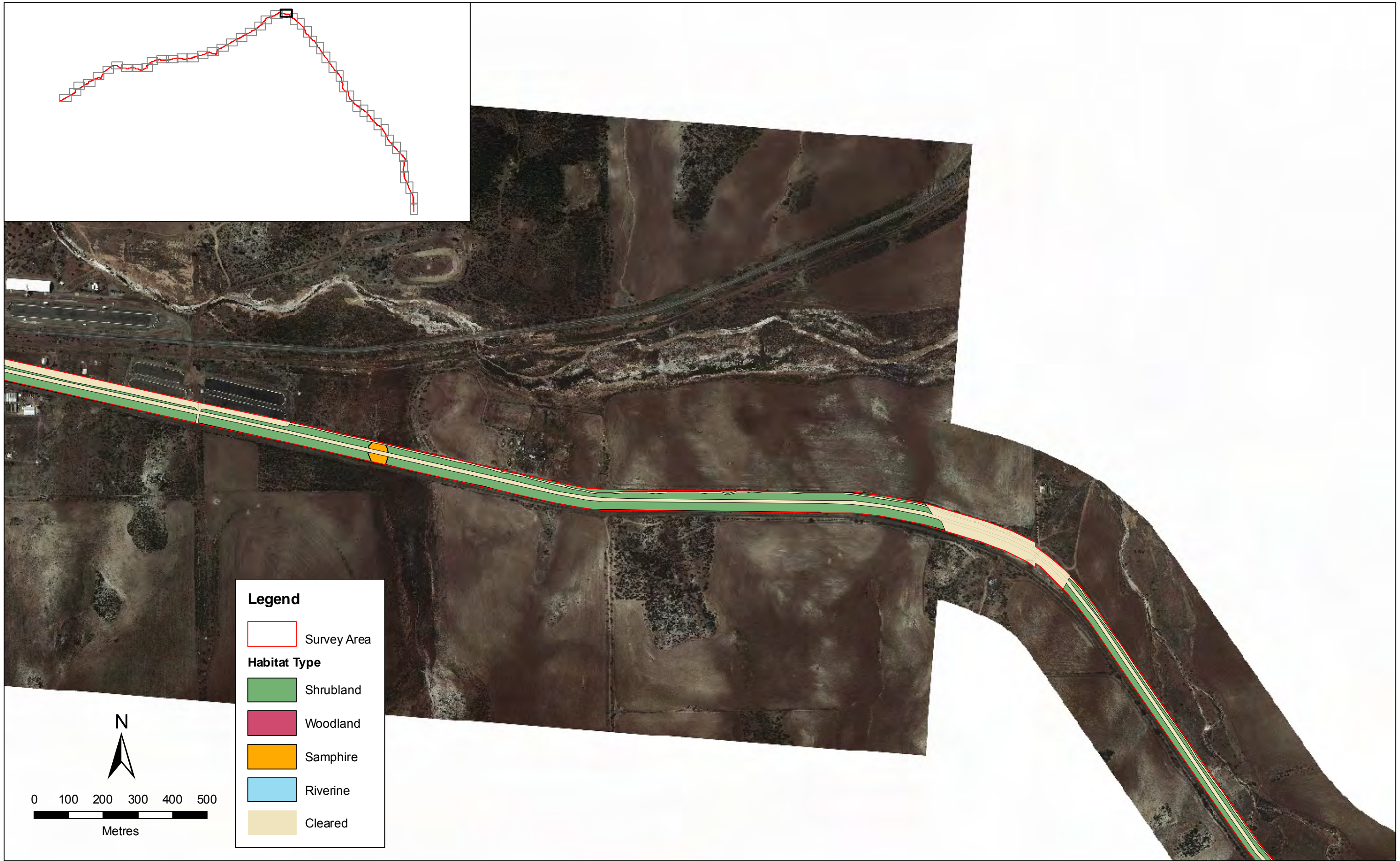
- Survey Area
- Habitat Type**
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	DATE
1:10,000 @ A3	14-12-2010
PROJECTION	
GDA 94 MGA 50	

Habitat Map

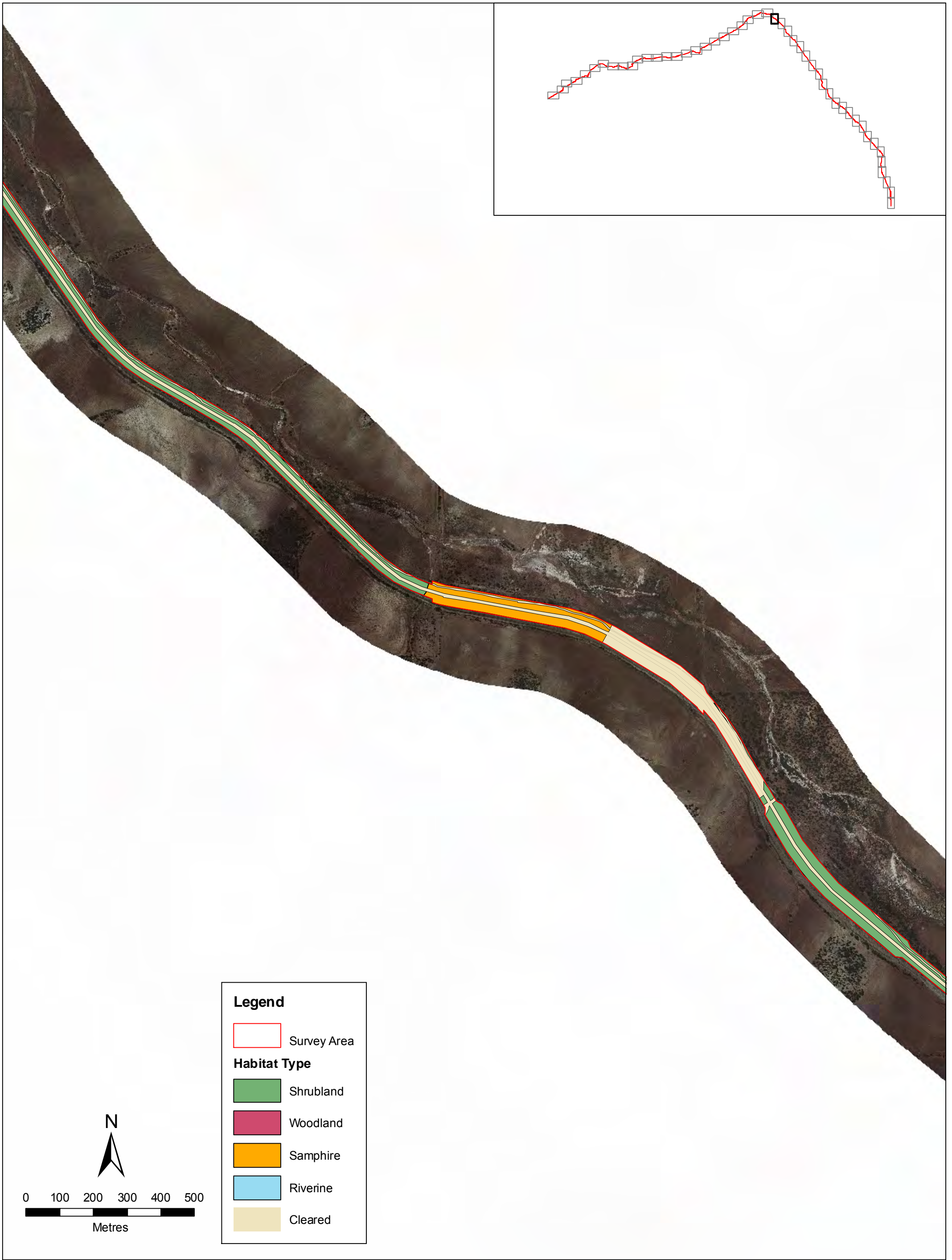
WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

Shrubland

Woodland

Samphire

Riverine

Cleared

N

0 100 200 300 400 500

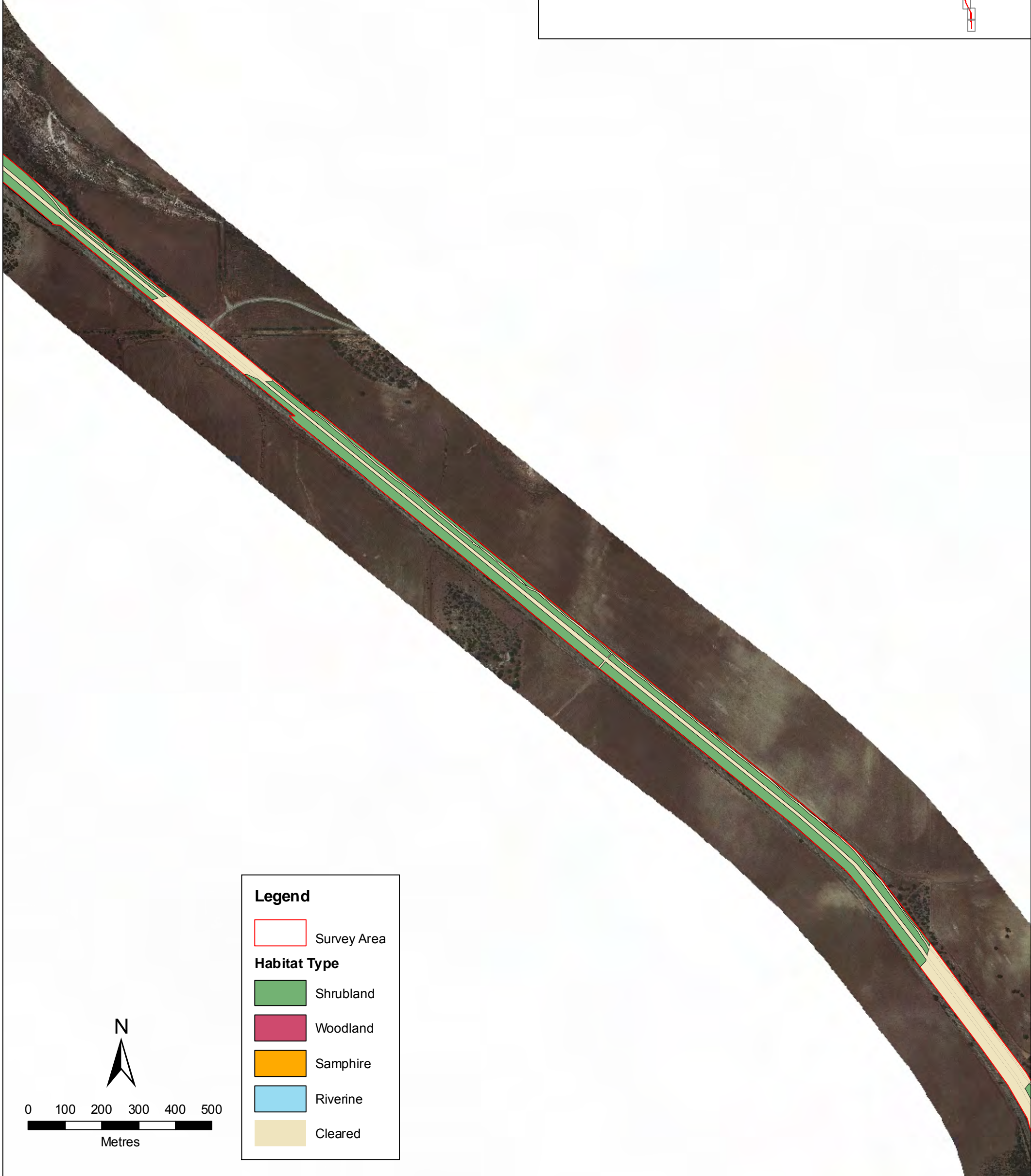
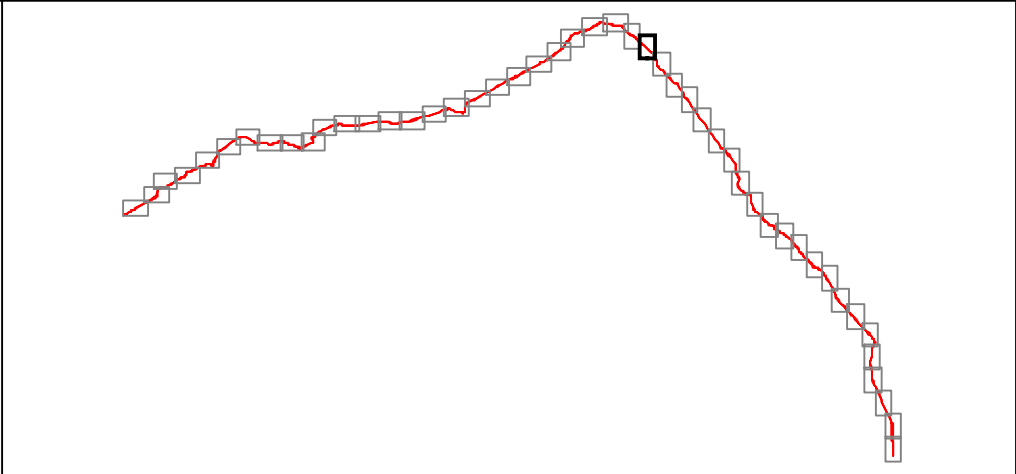
Metres



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SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

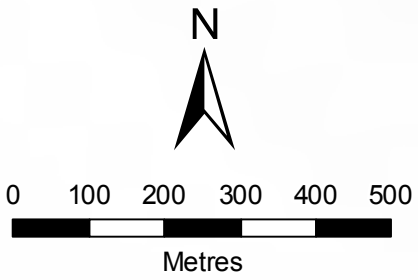
Shrubland

Woodland

Samphire

Riverine

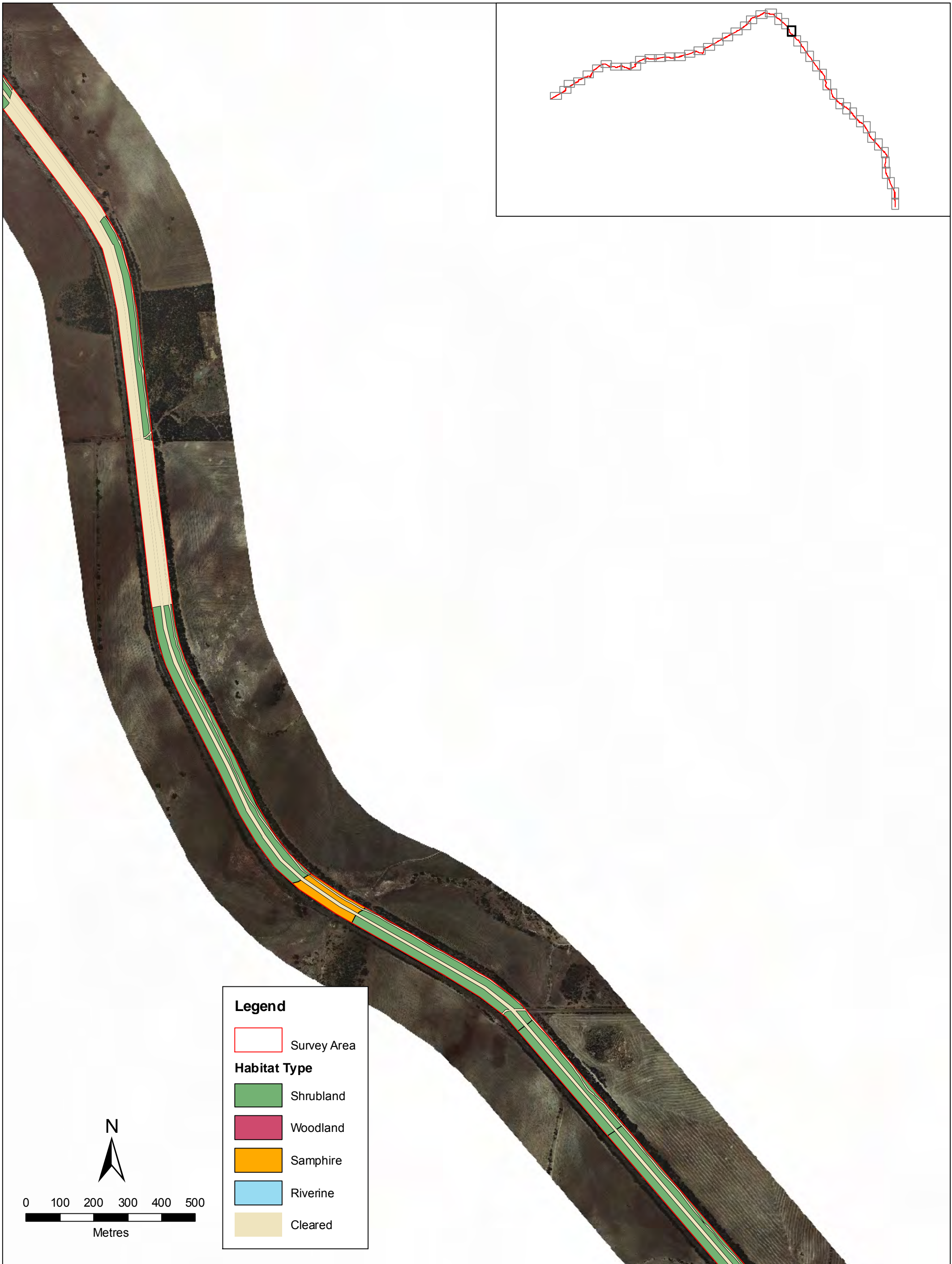
Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

Shrubland

Woodland

Samphire

Riverine

Cleared

N

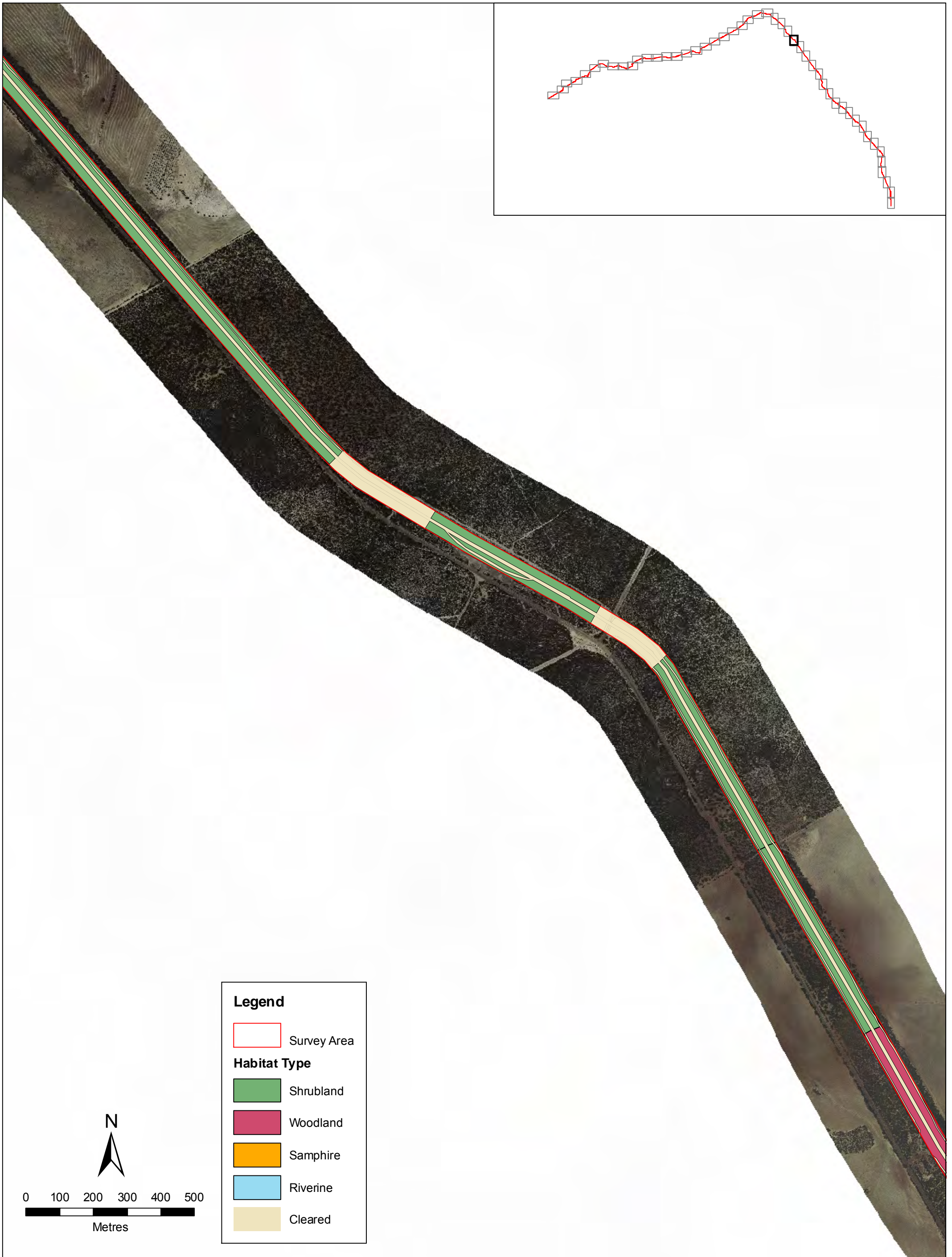
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Metres



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AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
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Habitat Map
 WestNet Rail Upgrade –
 Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE 3.28**



Legend

Survey Area

Habitat Type

Shrubland

Woodland

Samphire

Riverine

Cleared

N

0 100 200 300 400 500

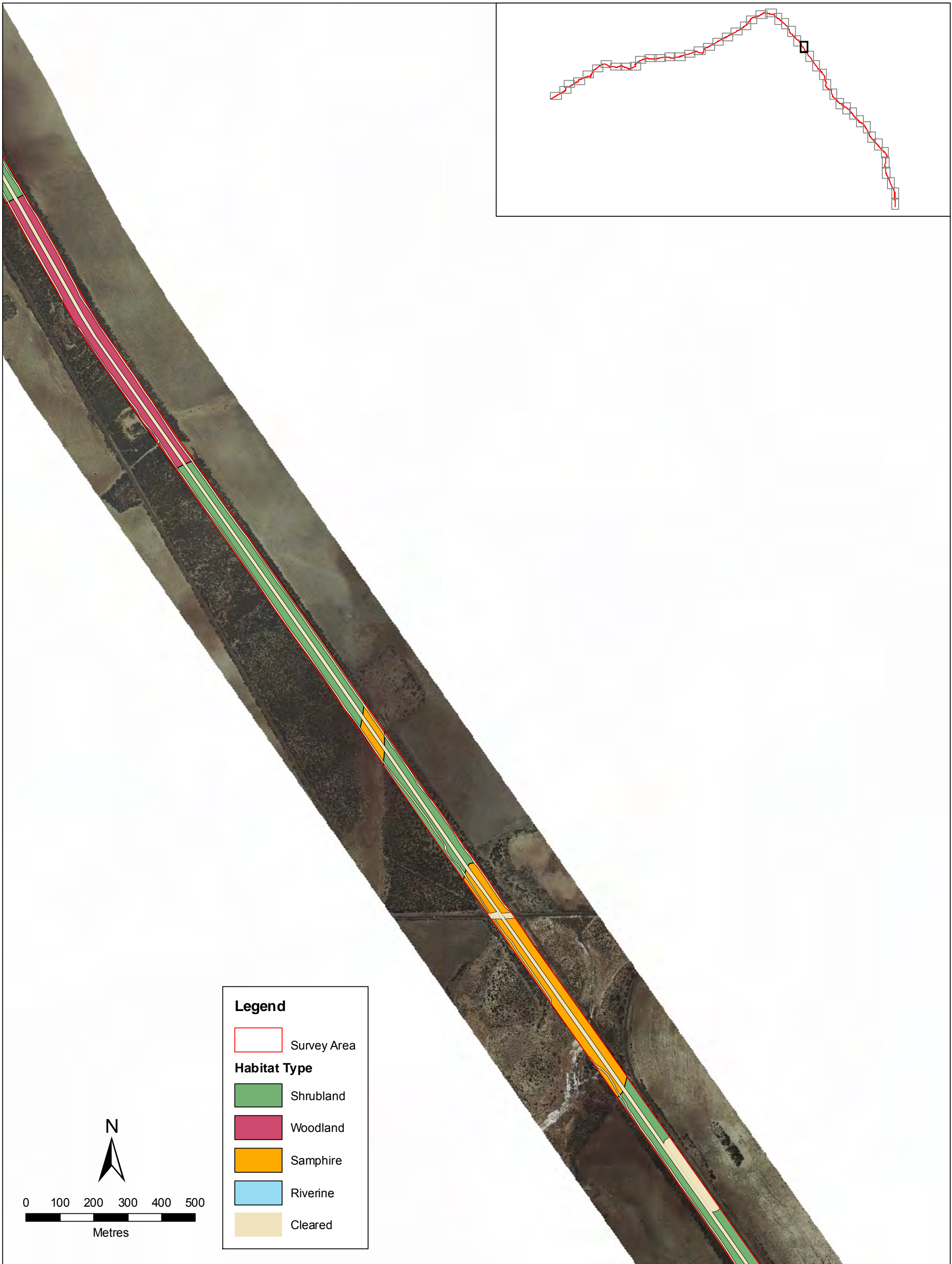
Metres



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

Shrubland

Woodland

Samphire

Riverine

Cleared

N

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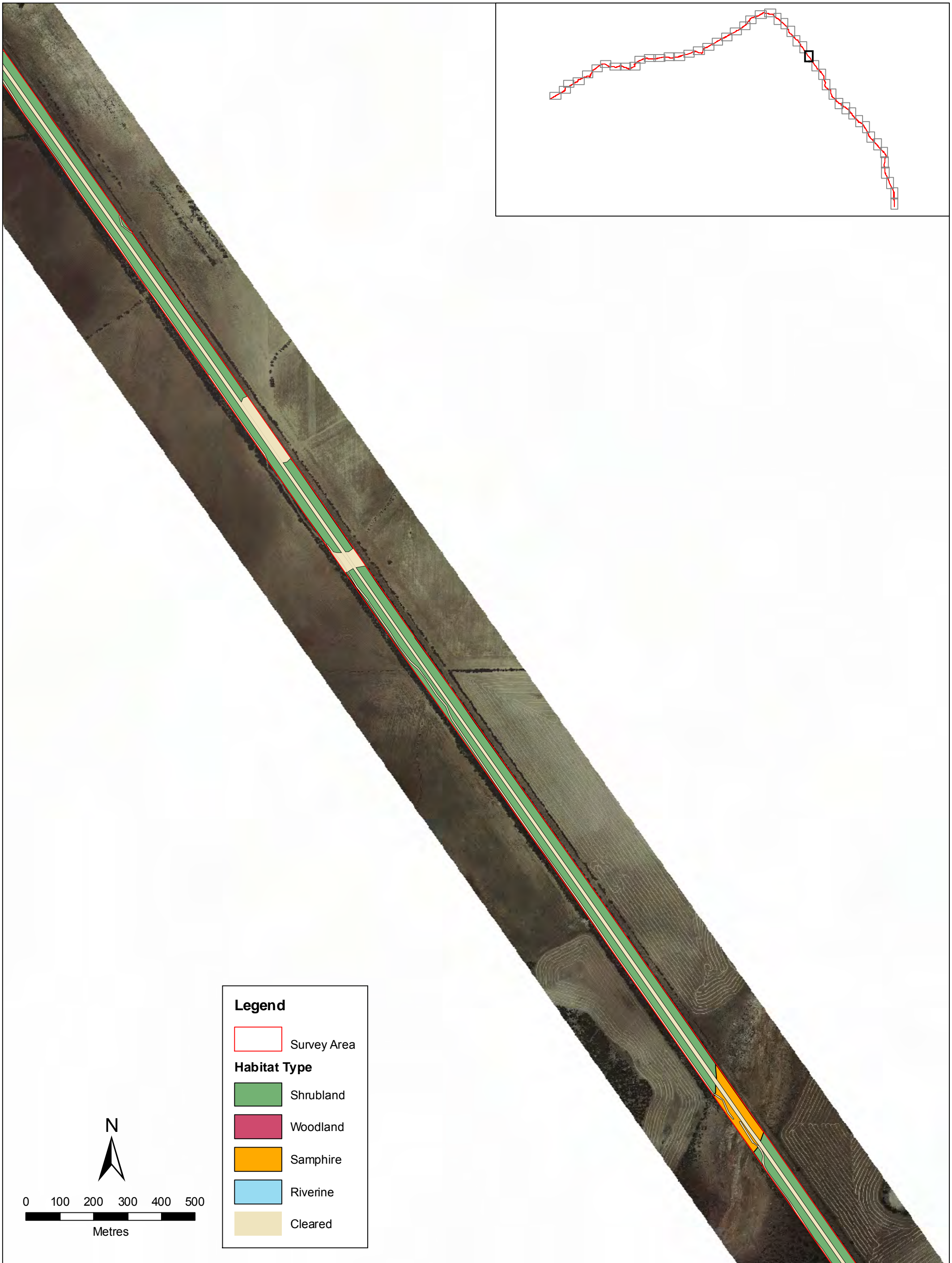
Metres



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

Shrubland

Woodland

Samphire

Riverine

Cleared

N

0 100 200 300 400 500

Metres



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

Shrubland

Woodland

Samphire

Riverine

Cleared

N

0 100 200 300 400 500

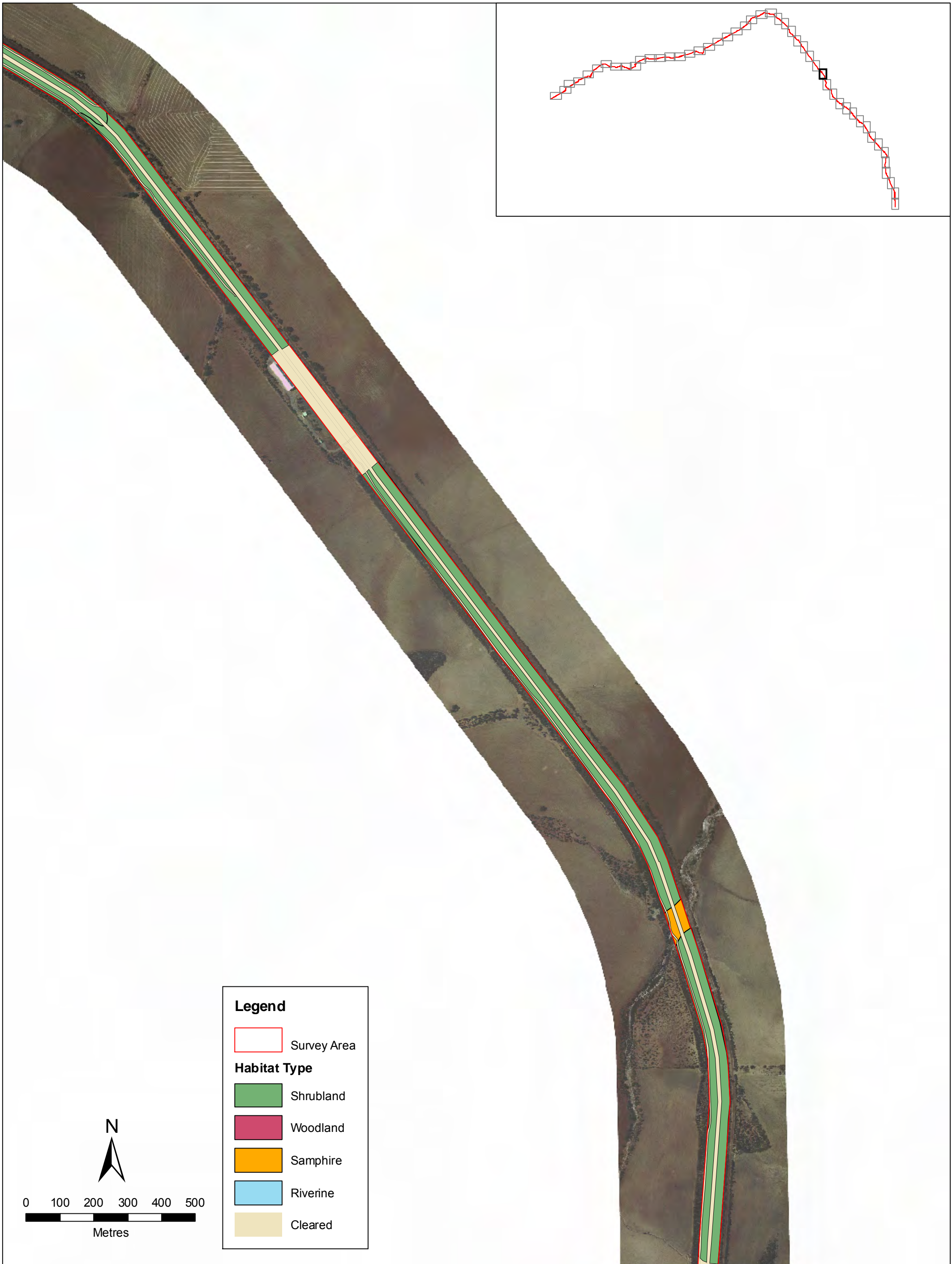
Metres



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AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

Shrubland

Woodland

Samphire

Riverine

Cleared

N

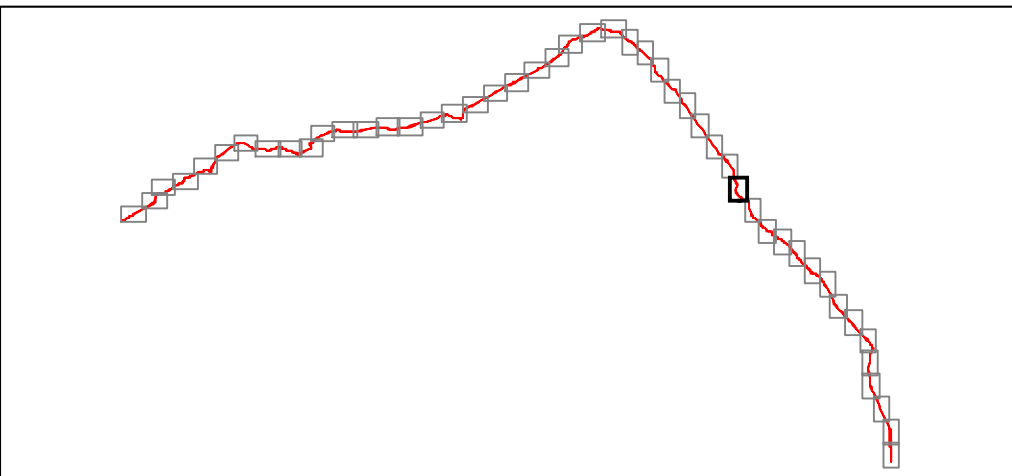
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Metres



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
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Habitat Map
 WestNet Rail Upgrade –
 Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE 3.33**

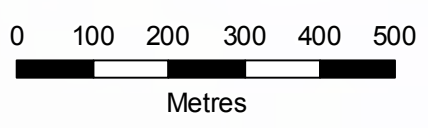


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- Survey Area

Habitat Type

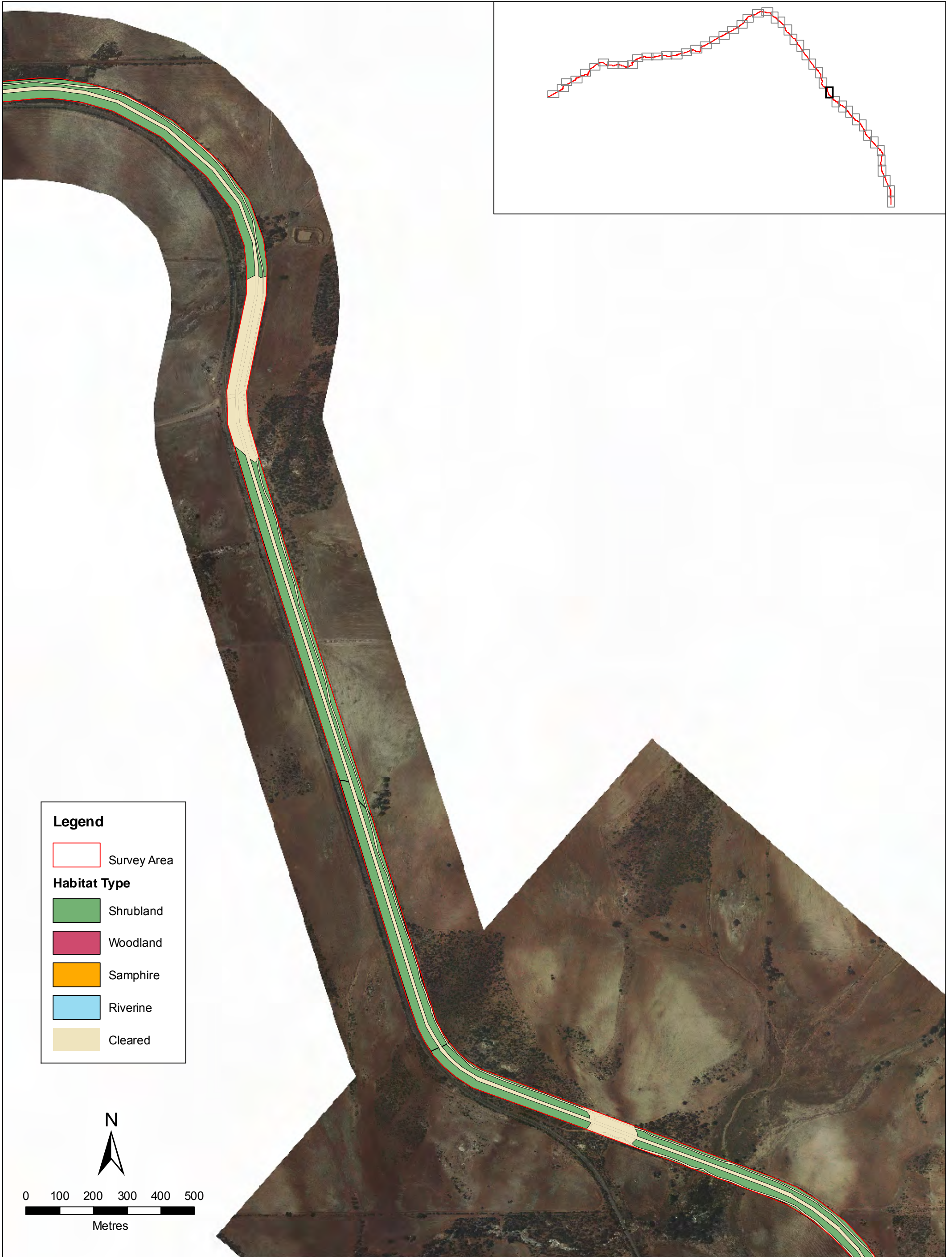
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

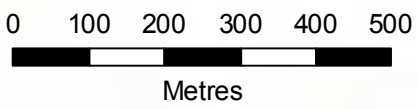


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Survey Area

Habitat Type

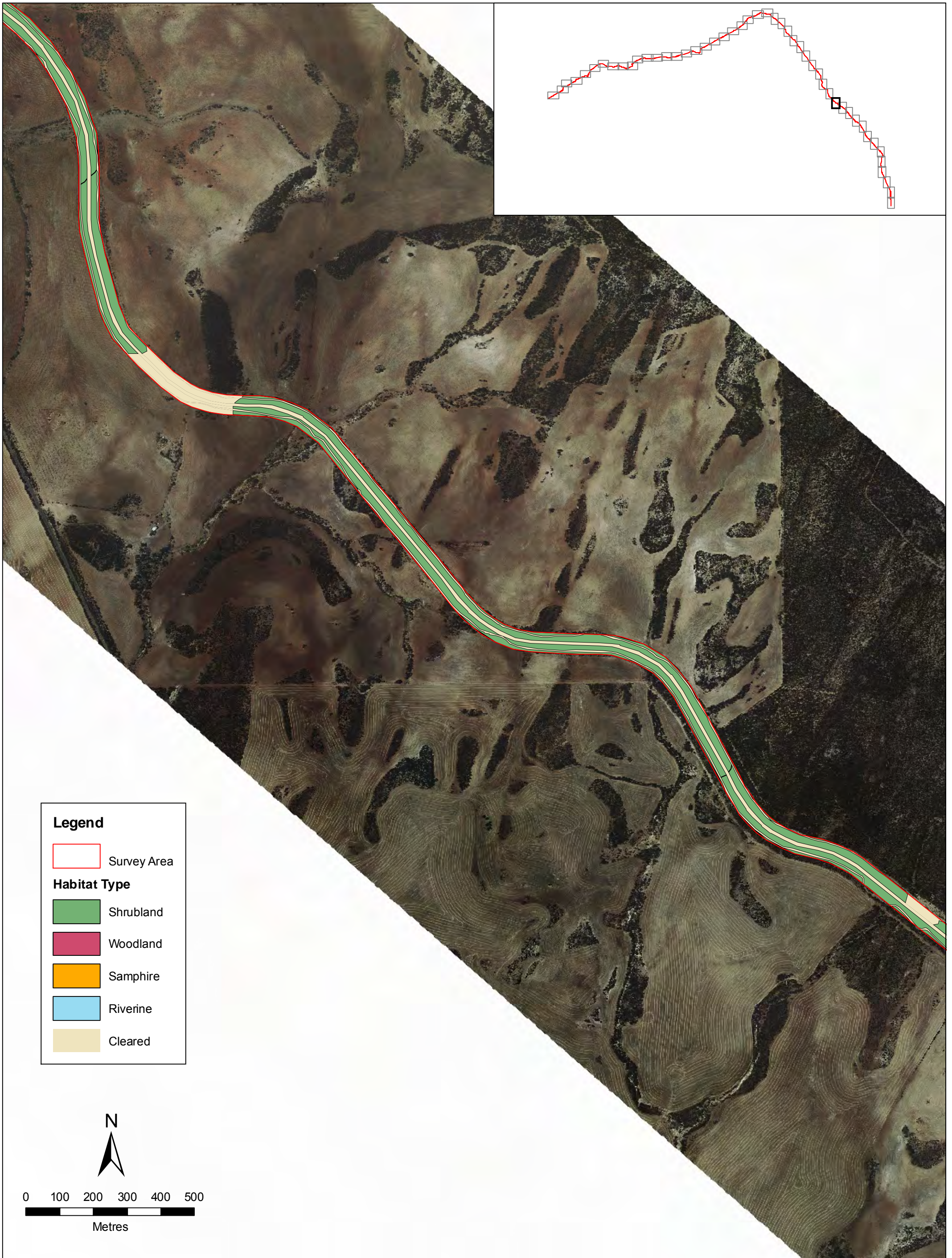
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

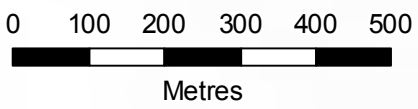


Legend

- Survey Area

Habitat Type

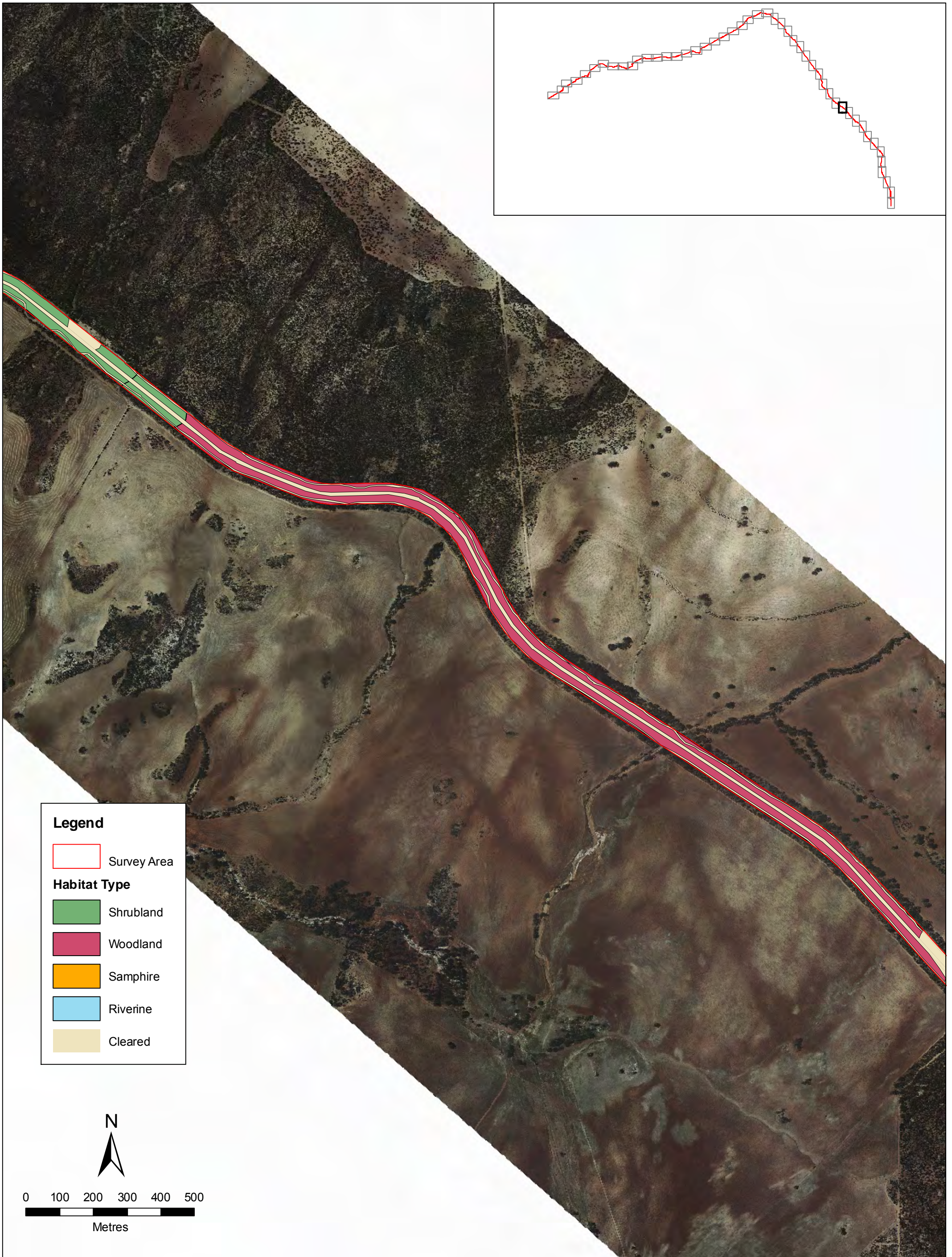
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

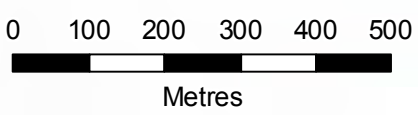


Legend

- Survey Area

Habitat Type

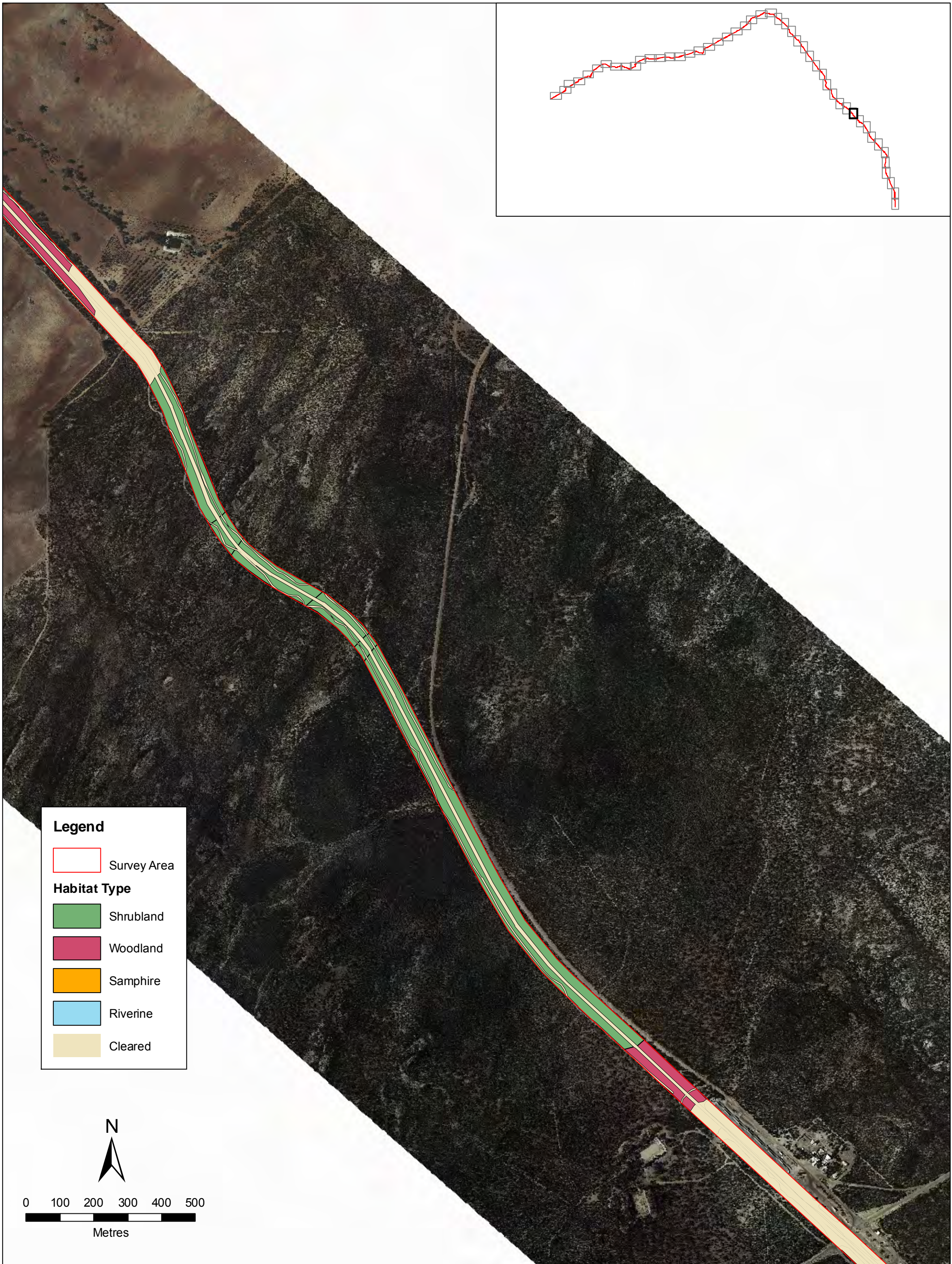
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT	Strategen	JOB NO.	10.159
AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:10,000 @ A3	DATE	14-12-2010
	PROJECTION		GDA 94 MGA 50

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

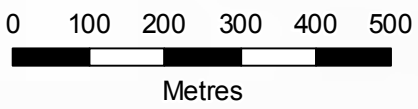


Legend

- Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
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Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

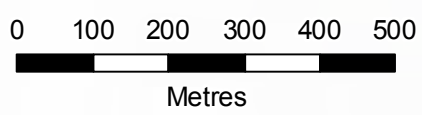


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- Survey Area

Habitat Type

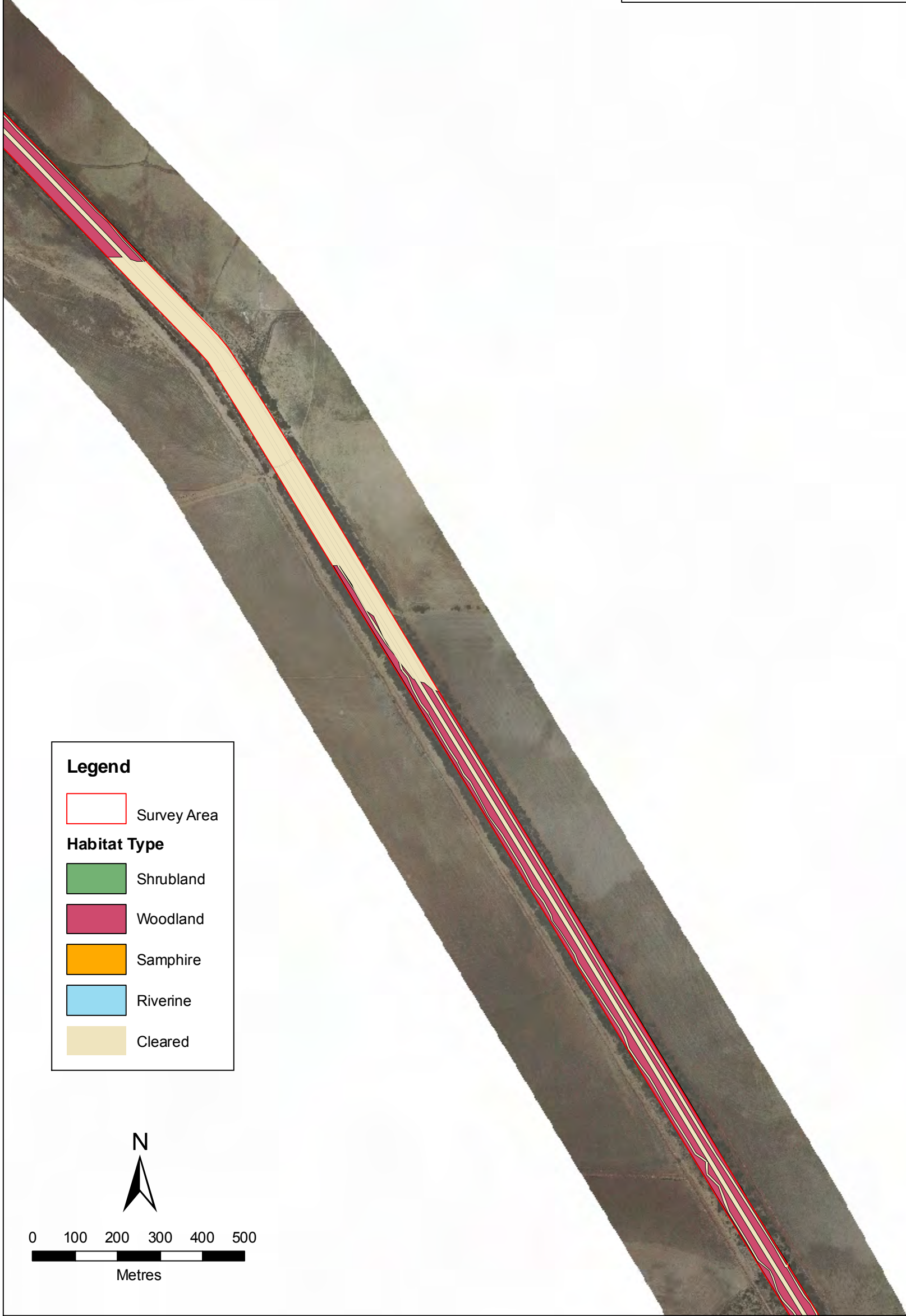
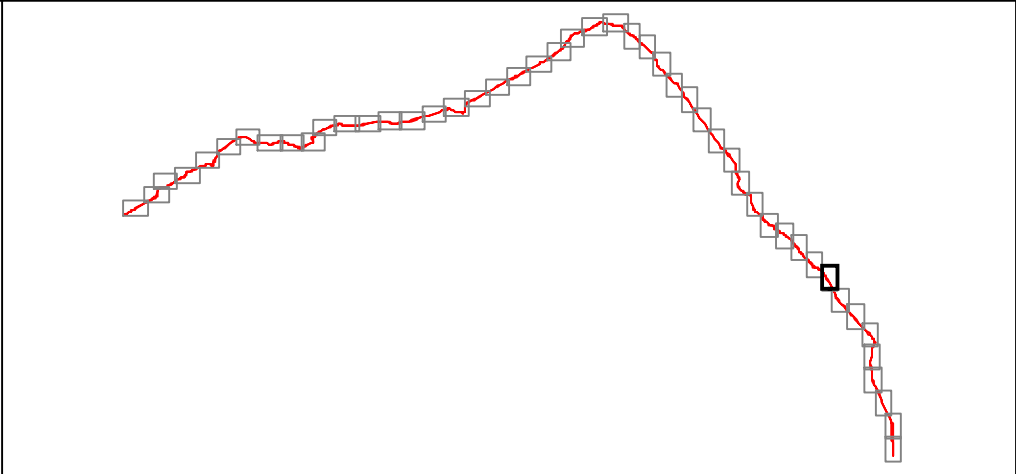
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

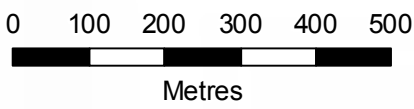


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Survey Area

Habitat Type

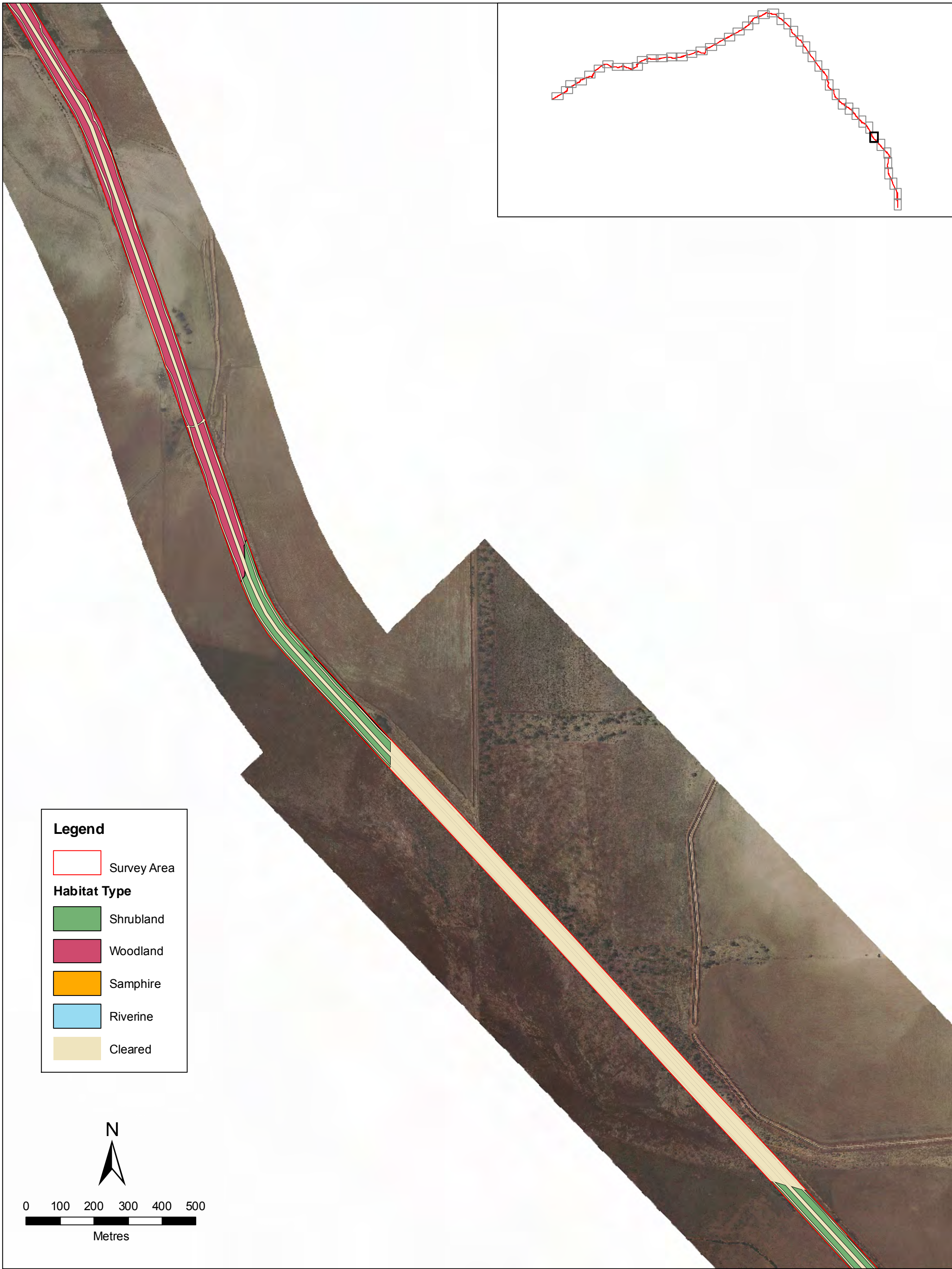
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

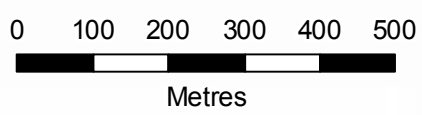


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Survey Area

Habitat Type

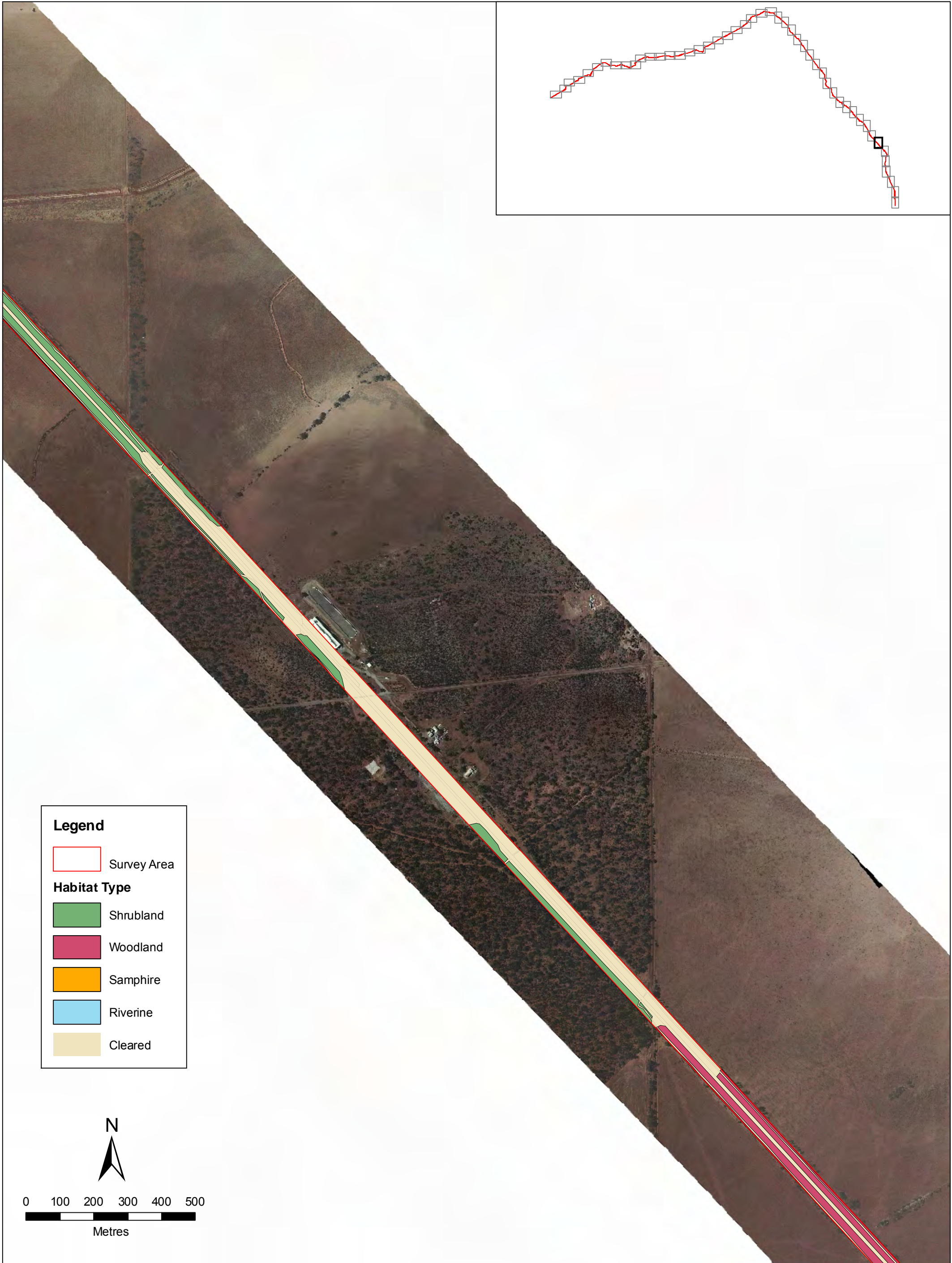
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

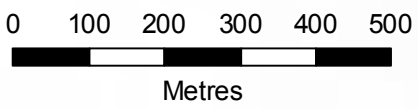


Legend

Survey Area

Habitat Type

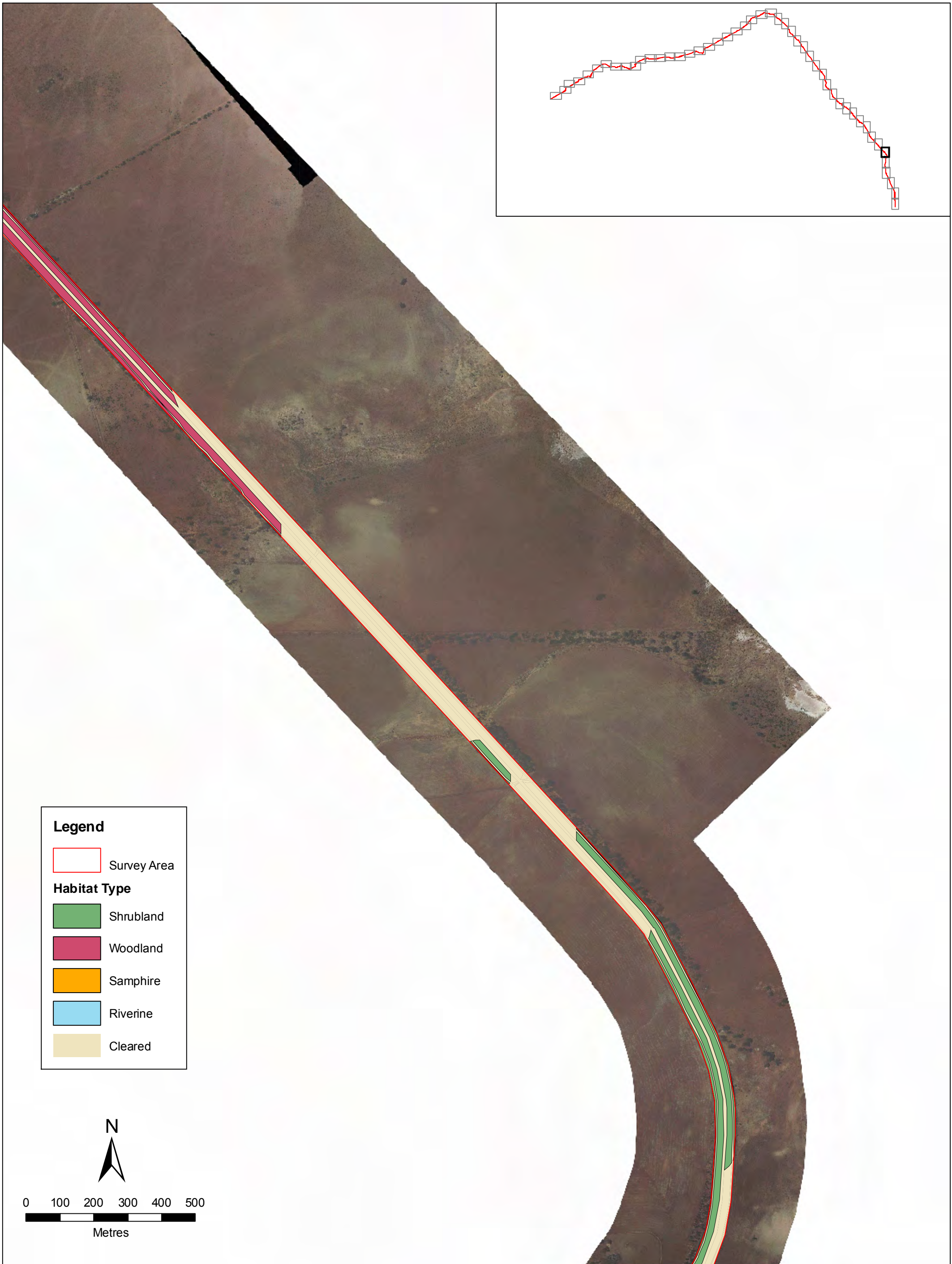
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

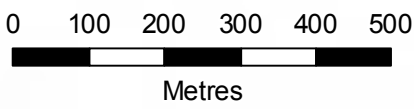
Shrubland

Woodland

Samphire

Riverine

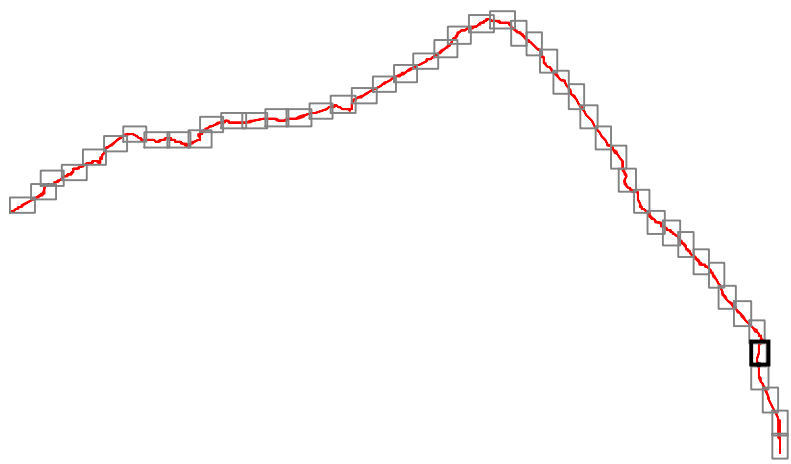
Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

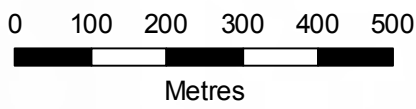


Legend

Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



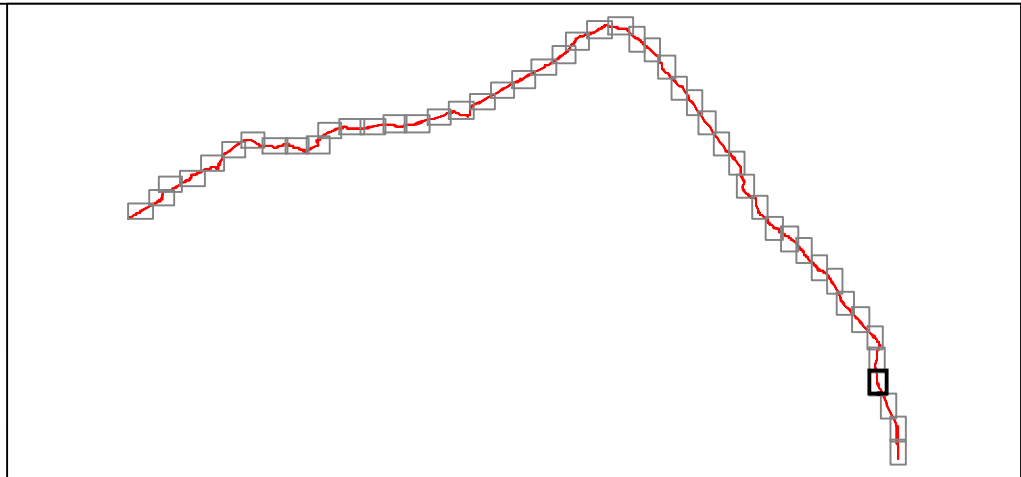
CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

FIGURE

3.44

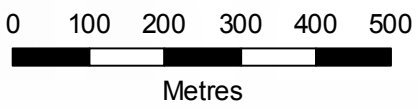


Legend

Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

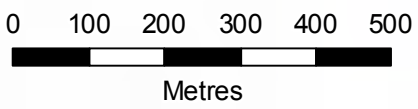
Shrubland

Woodland

Samphire

Riverine

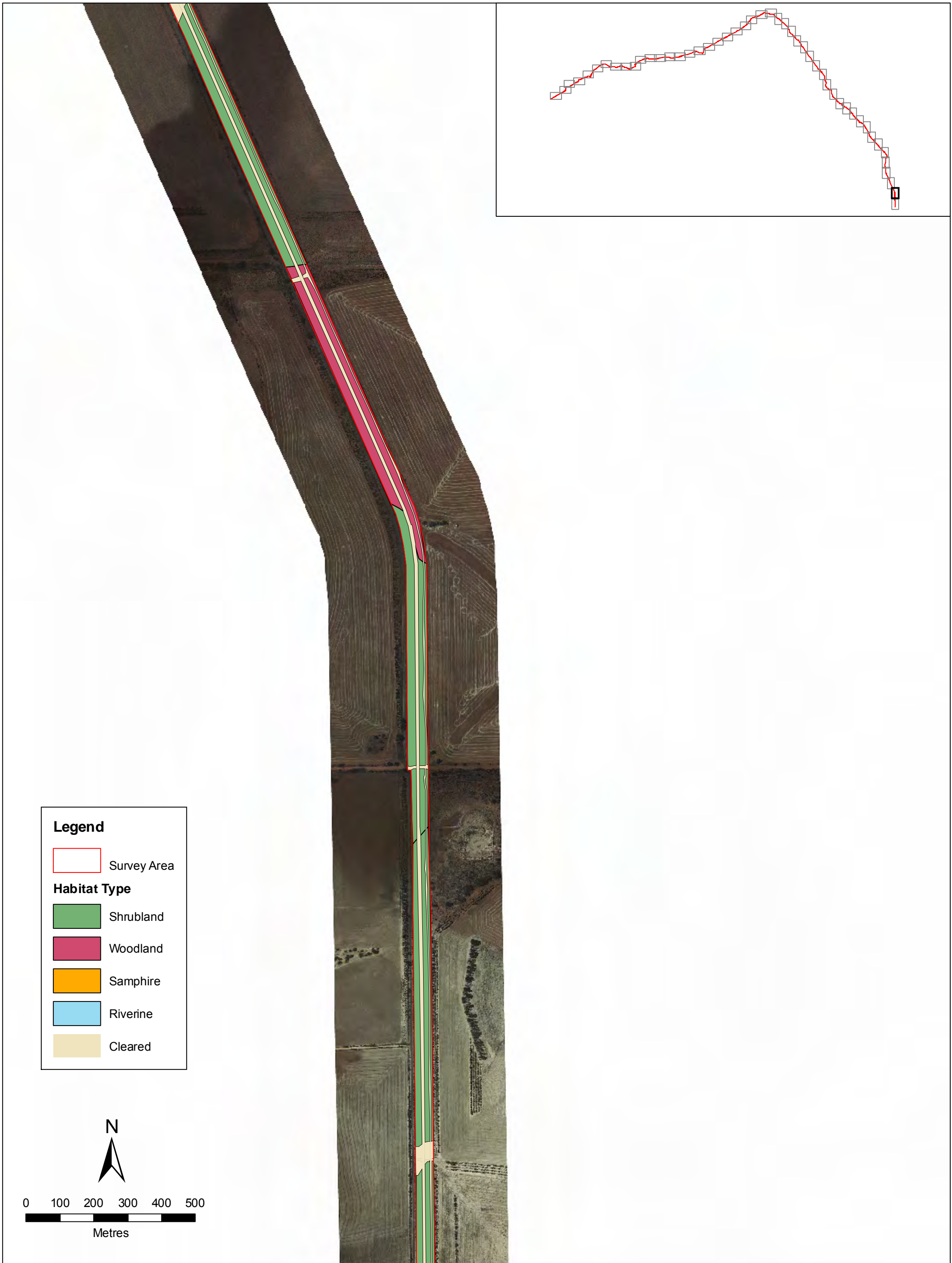
Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Habitat Type

- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared

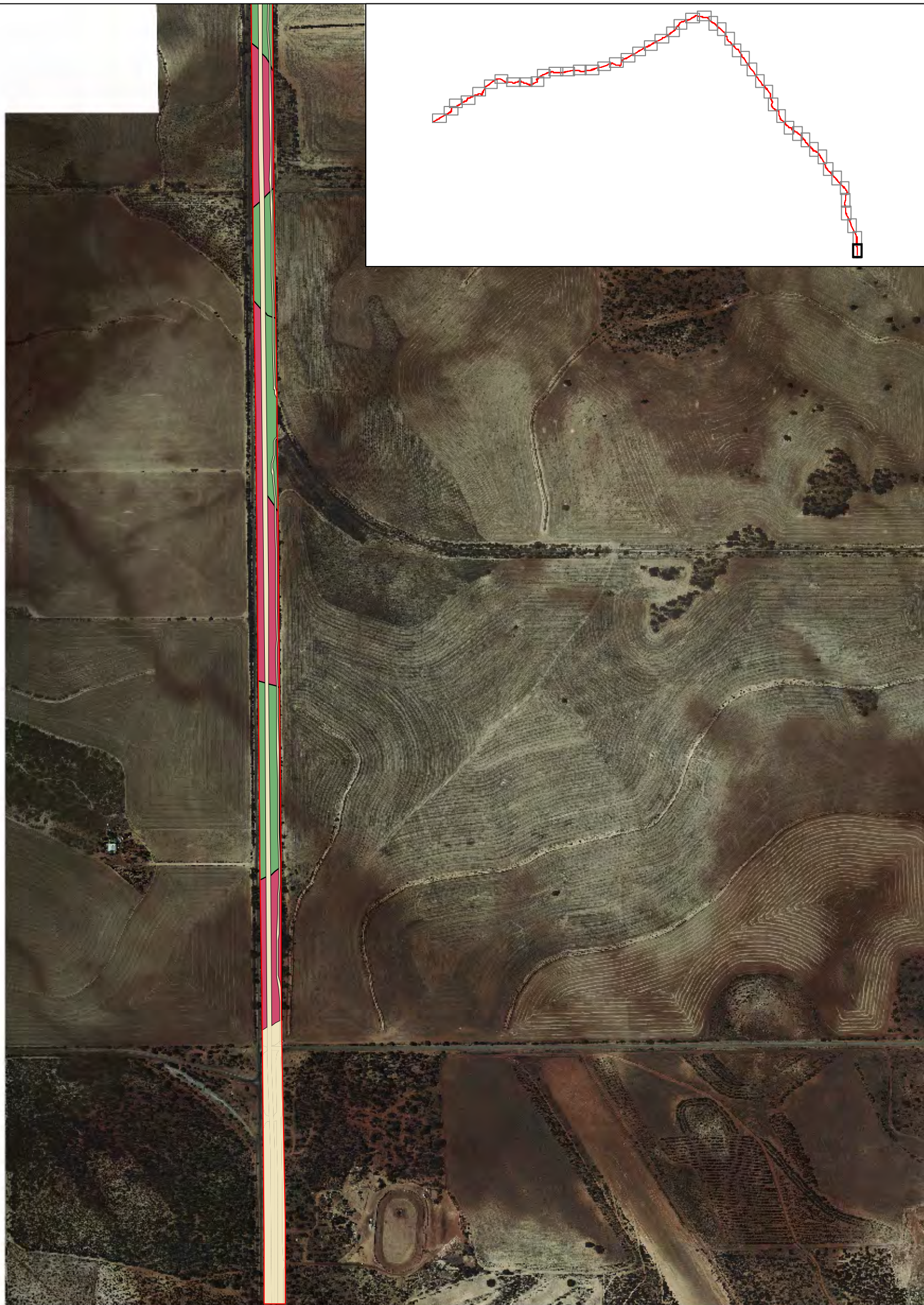


0 100 200 300 400 500
Metres



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AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:10,000 @ A3	DATE	14-12-2010
	PROJECTION		GDA 94 MGA 50

Habitat Map
WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE 3.47**

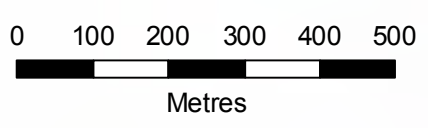


Legend

Survey Area

Habitat Type

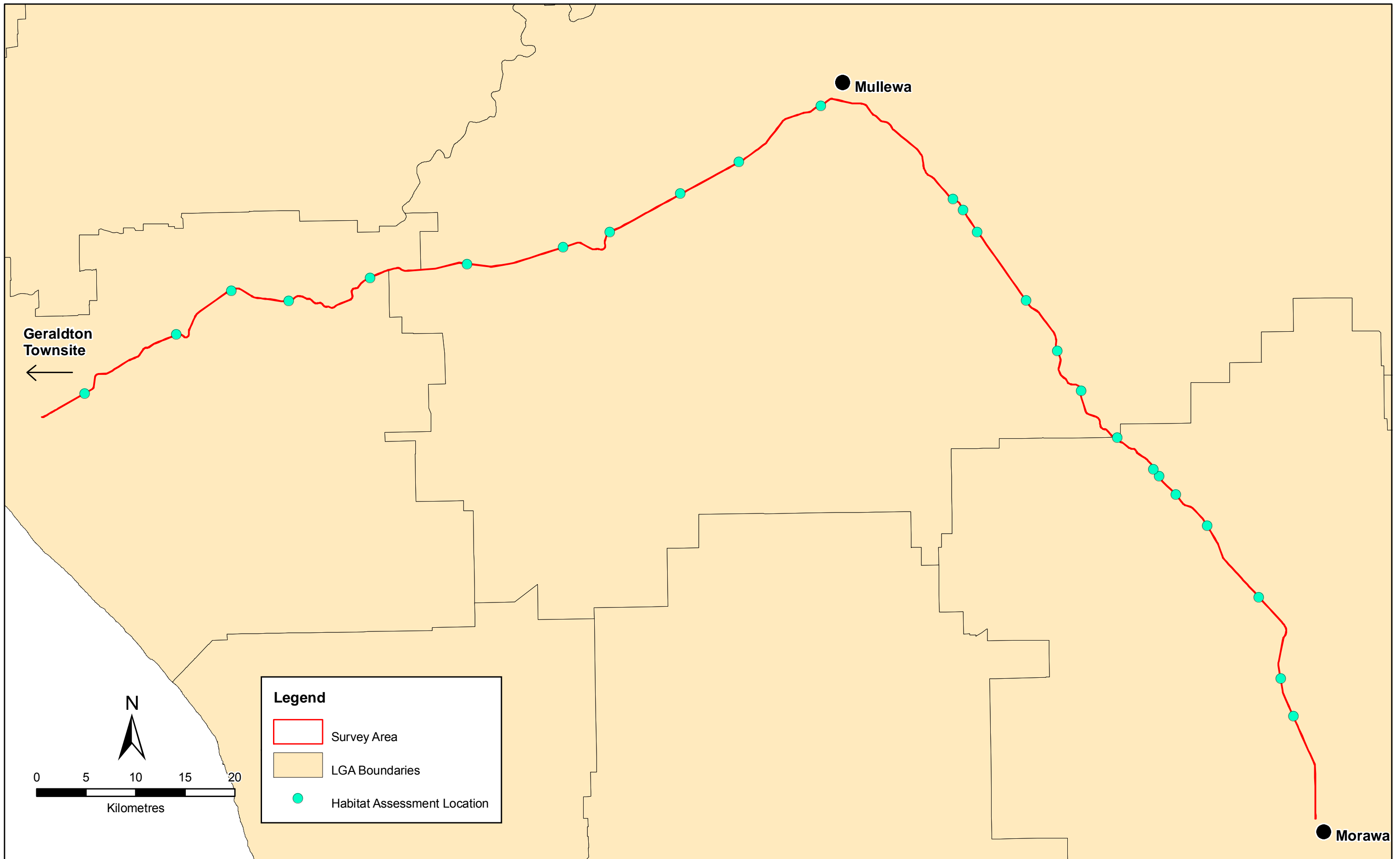
- Shrubland
- Woodland
- Samphire
- Riverine
- Cleared



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

Habitat Map

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



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AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:350,000 @ A3	DATE	26-10-2010
	PROJECTION		GDA 94 MGA 50

Habitat Assessment Location

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



CLIENT	Strategen	JOB NO.	10.159
AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:21,000 @ A3	DATE	26-10-2010
	PROJECTION		GDA 94 MGA 50

Location of Conservation Significant Fauna

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

FIGURE **5a**



Legend

- Survey Area
- Significant Fauna
 - Malleefowl
 - Rainbow Bee-eater



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AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:5,000 @ A3	DATE 26-10-2010
PROJECTION GDA 94 MGA 50	

Location of Conservation Significant Fauna

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

Survey Area

Significant Fauna

- Malleefowl
- Rainbow Bee-eater

N

0 100 200 300 400 500

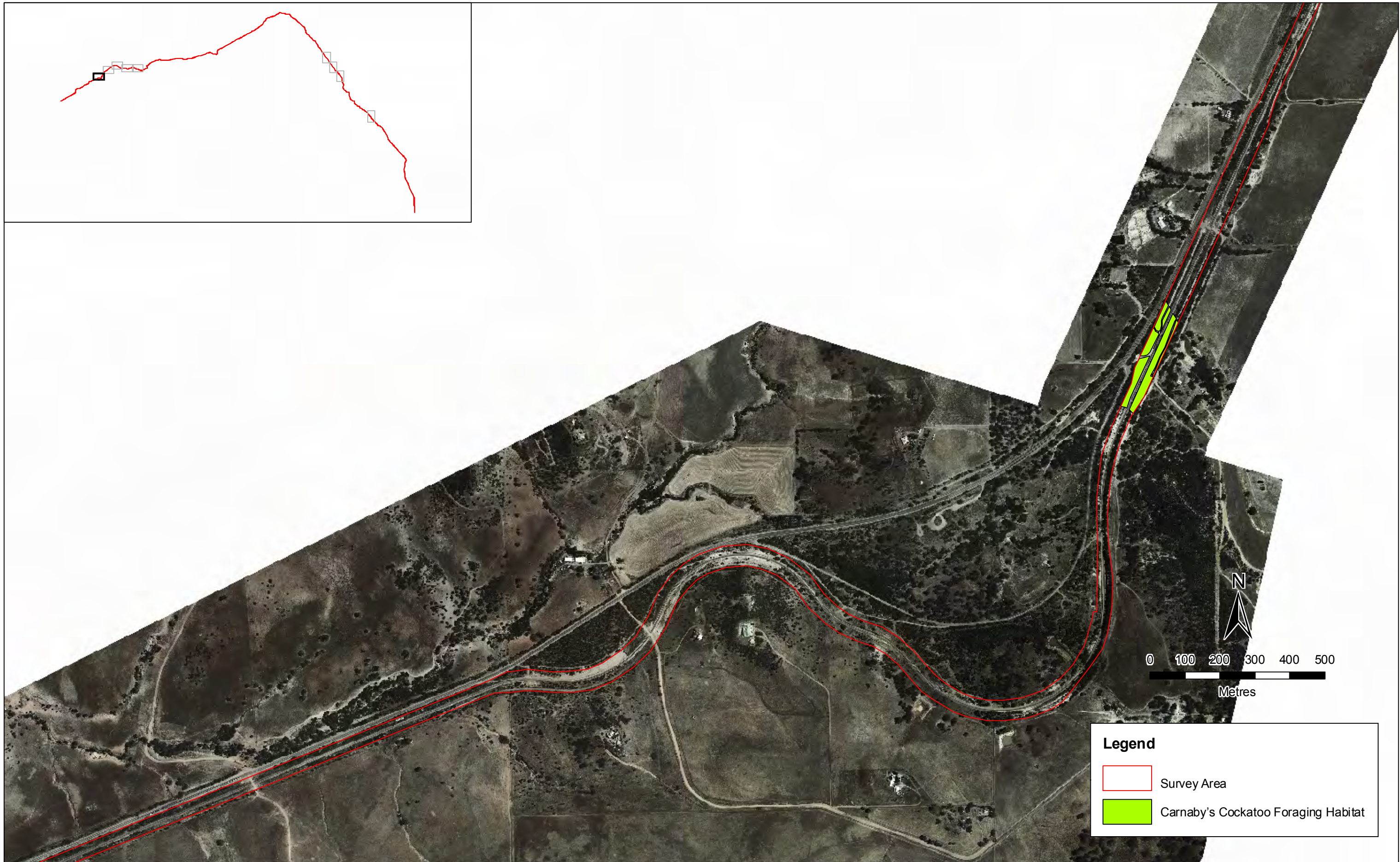
Metres



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AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:12,500 @ A3	DATE	26-10-2010
	PROJECTION		GDA 94 MGA 50

Location of Conservation Significant Fauna

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

- Survey Area
- Carnaby's Cockatoo Foraging Habitat

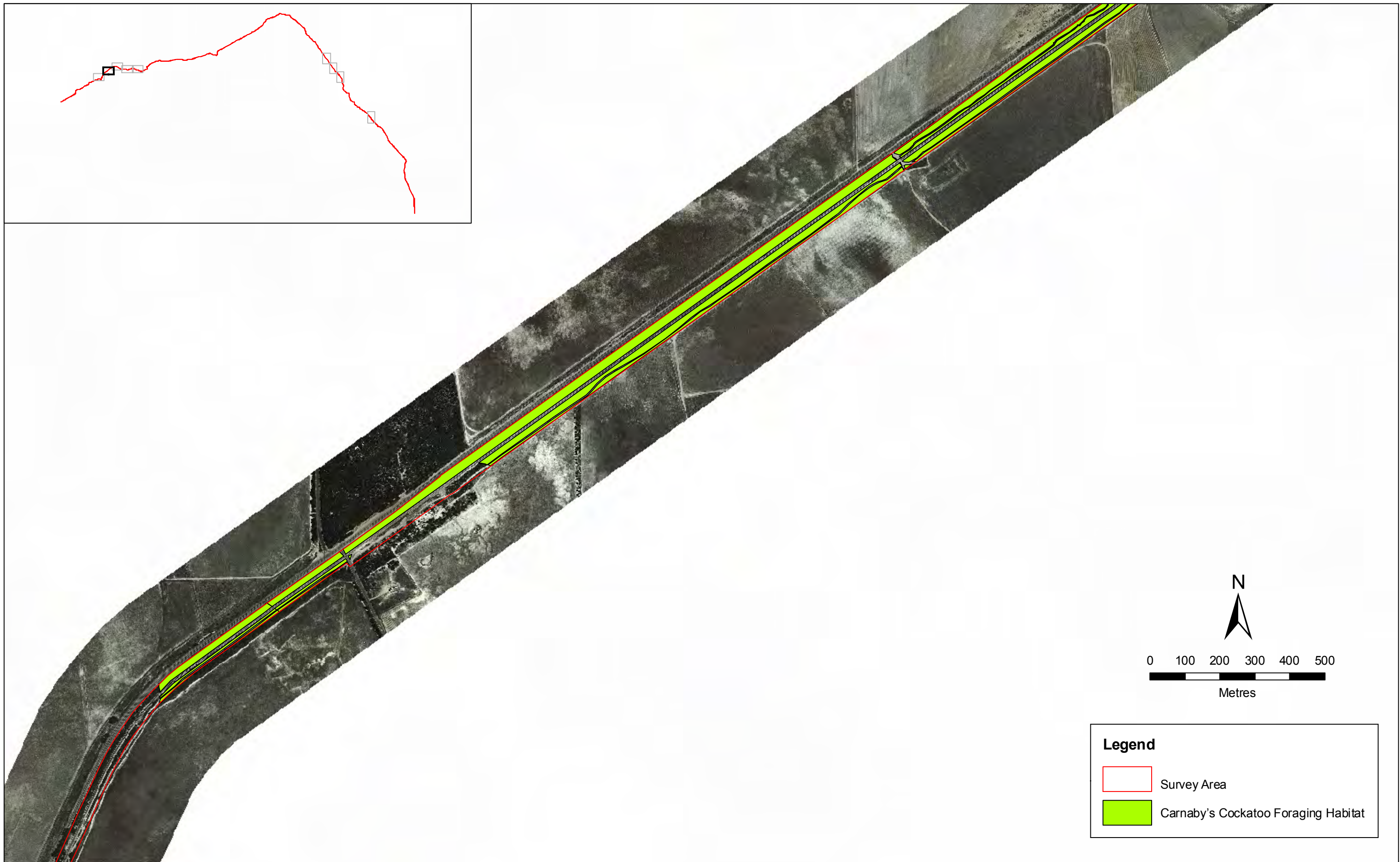


CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	PROJECTION
1:10,000 @ A3	GDA 94 MGA 50
	DATE
	14-12-2010

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE**

6.01



Legend

- Survey Area
- Carnaby's Cockatoo Foraging Habitat

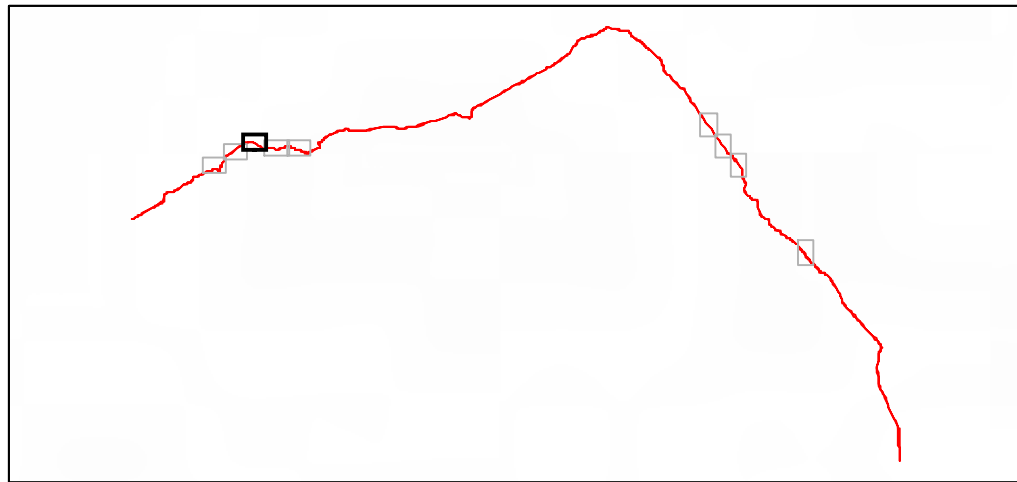


CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	PROJECTION
1:10,000 @ A3	GDA 94 MGA 50
	DATE
	14-12-2010

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE**

6.02



Legend

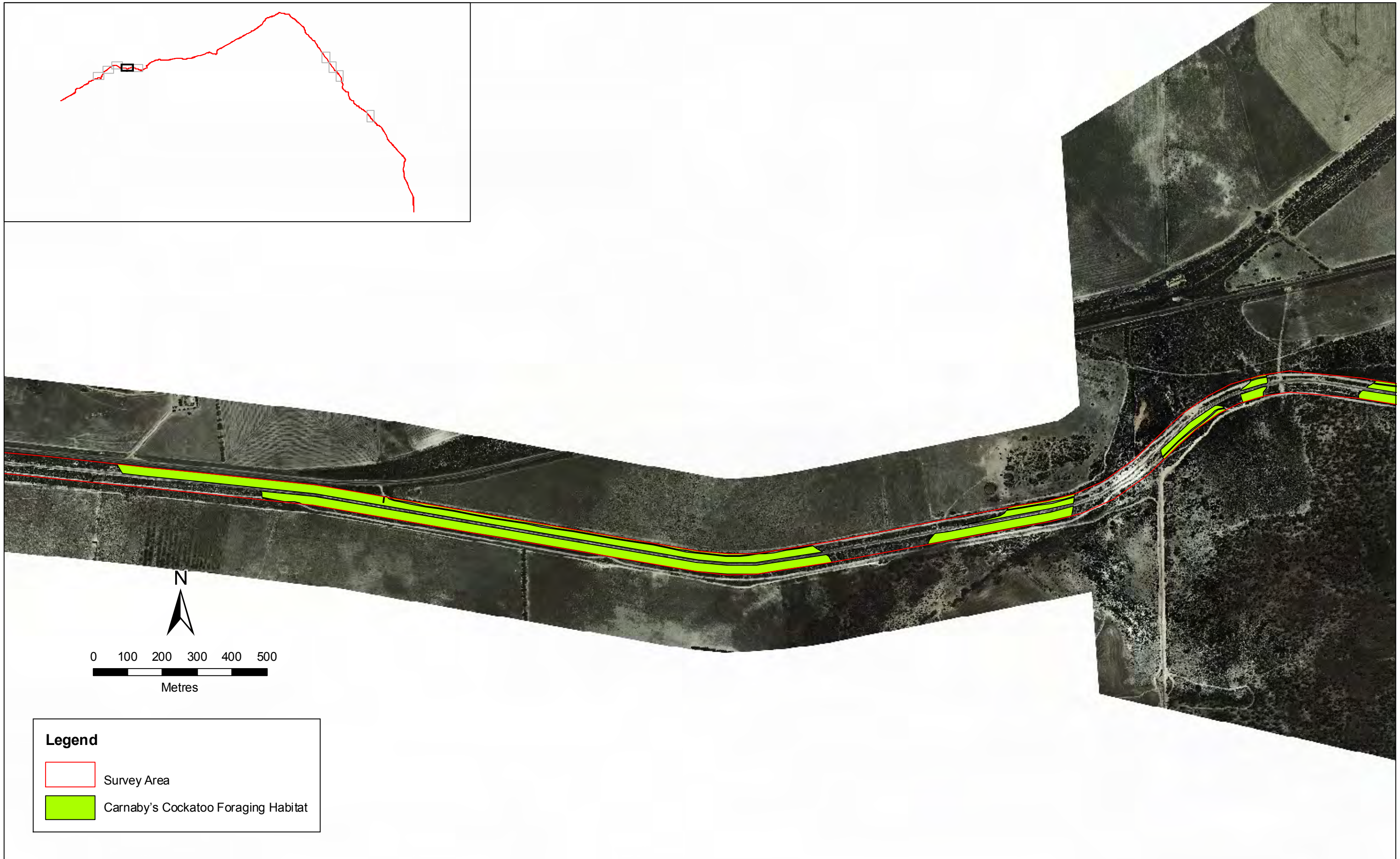
- Survey Area
- Carnaby's Cockatoo Foraging Habitat



CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	DATE
1:10,000 @ A3	14-12-2010
PROJECTION	
GDA 94 MGA 50	

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment FIGURE



Legend

- Survey Area
- Carnaby's Cockatoo Foraging Habitat



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:10,000 @ A3	DATE 14-12-2010
PROJECTION GDA 94 MGA 50	

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment FIGURE



Legend

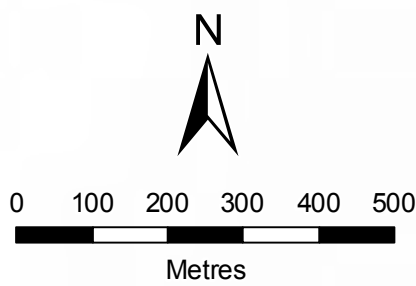
- Survey Area
- Carnaby's Cockatoo Foraging Habitat



CLIENT	JOB NO.
Strategen	10.159
AUTHOR:	DRAWN
J. Trainer	S. Rho
SCALE	DATE
1:10,000 @ A3	14-12-2010
PROJECTION	
GDA 94 MGA 50	

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment **FIGURE**



Legend

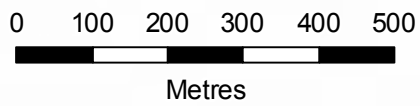
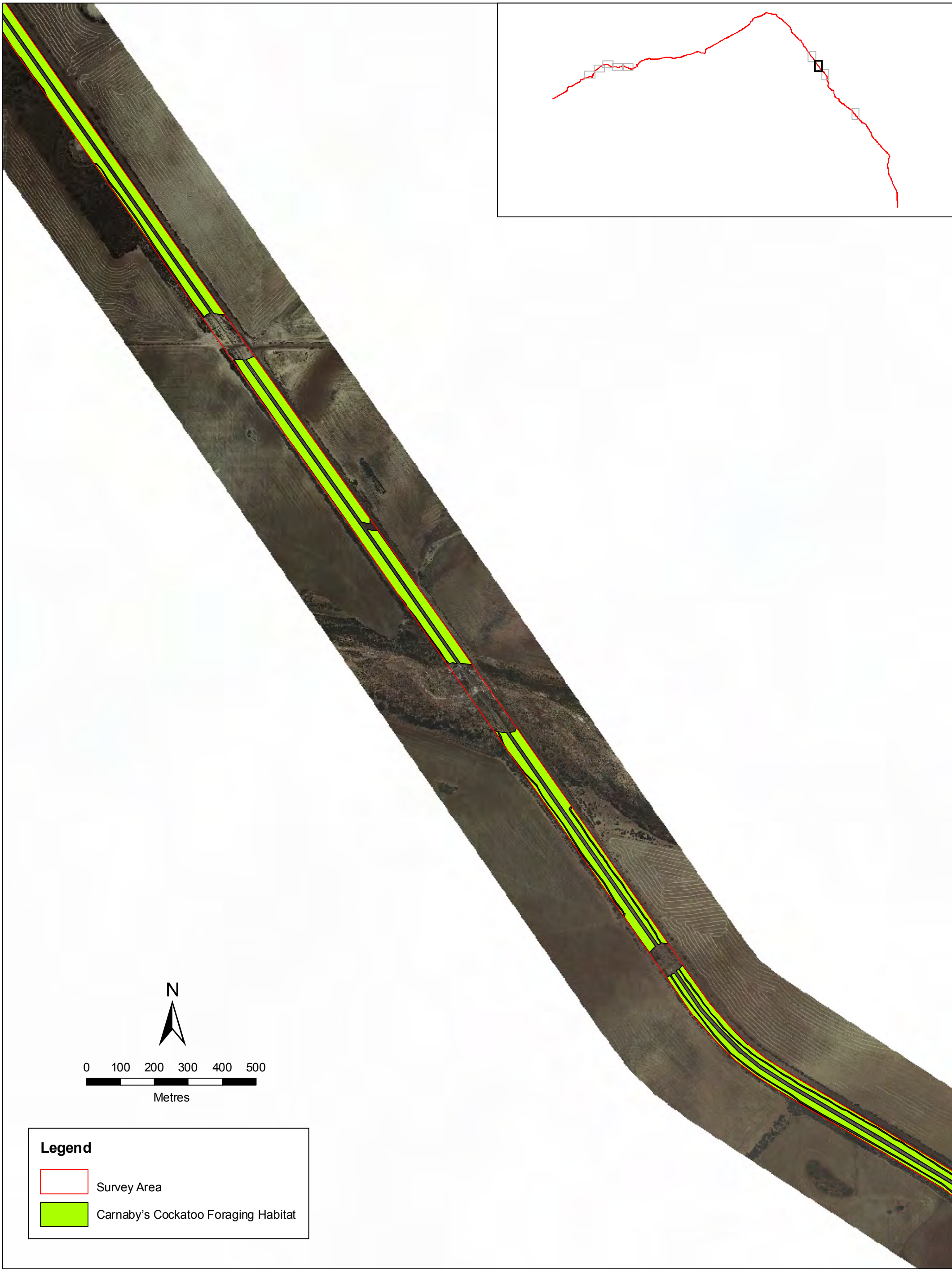
- Survey Area
- Carnaby's Cockatoo Foraging Habitat



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

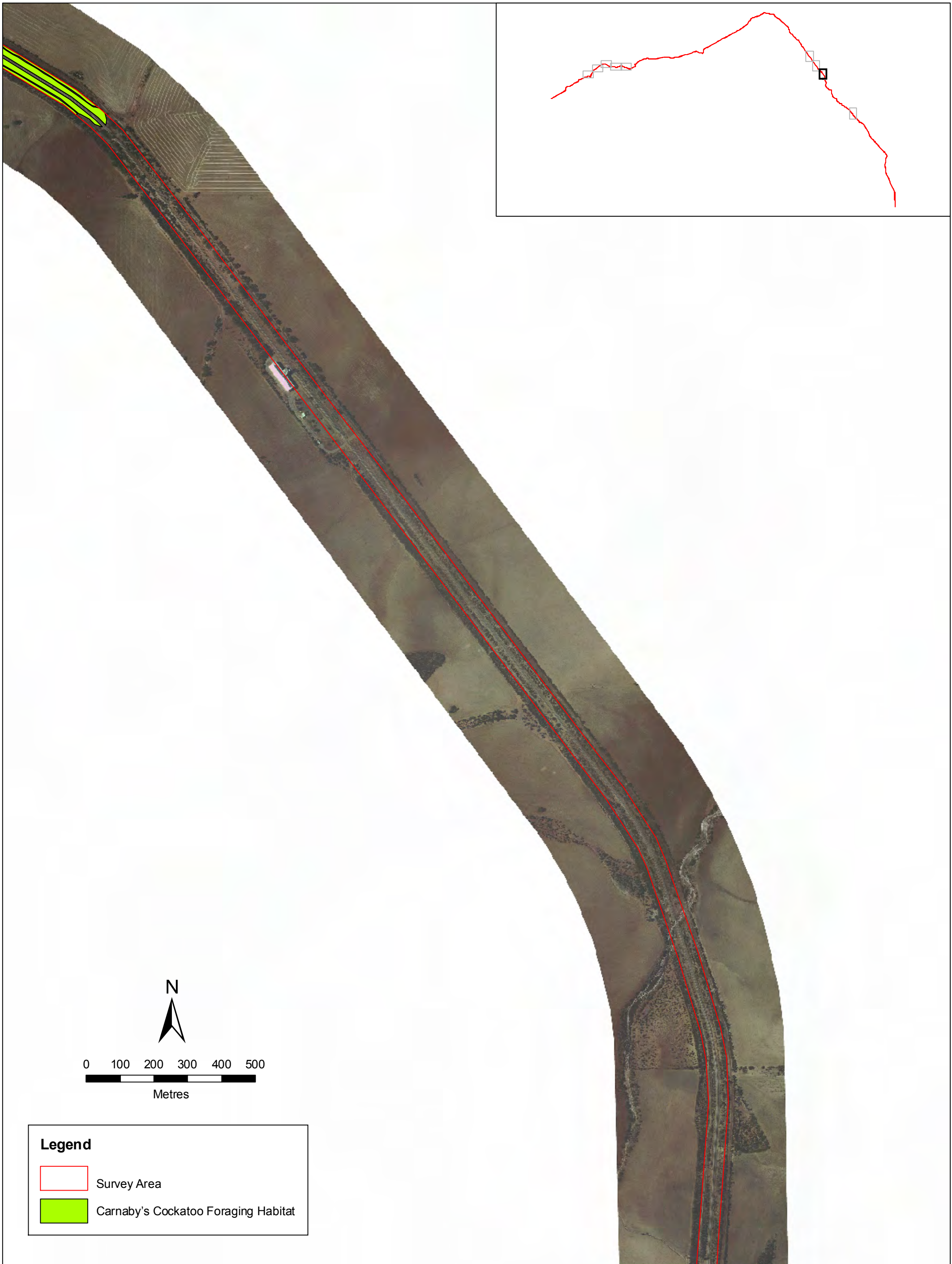
- Survey Area
- Carnaby's Cockatoo Foraging Habitat



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

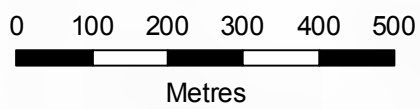
- Survey Area
- Carnaby's Cockatoo Foraging Habitat



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

- Survey Area
- Carnaby's Cockatoo Foraging Habitat



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DATE 14-12-2010
SCALE 1:10,000 @ A3	PROJECTION GDA 94 MGA 50
DRAWN S. Rho	

Carnaby's Cockatoo Foraging Habitat

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment

FIGURE

6.09



Legend

- Survey Area
- Single Mature Tree
- Future Breeding Habitat – Three or More Trees Per Half Hectare



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AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:5,000 @ A3	DATE 26-10-2010
PROJECTION GDA 94 MGA 50	

Location of Mature Trees for Carnaby's Cockatoos

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



Legend

- Survey Area
- Single Mature Tree
- Future Breeding Habitat – Three or More Trees Per Half Hectare



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:5,000 @ A3	DATE 26-10-2010
PROJECTION GDA 94 MGA 50	

Location of Mature Trees for Carnaby's Cockatoos

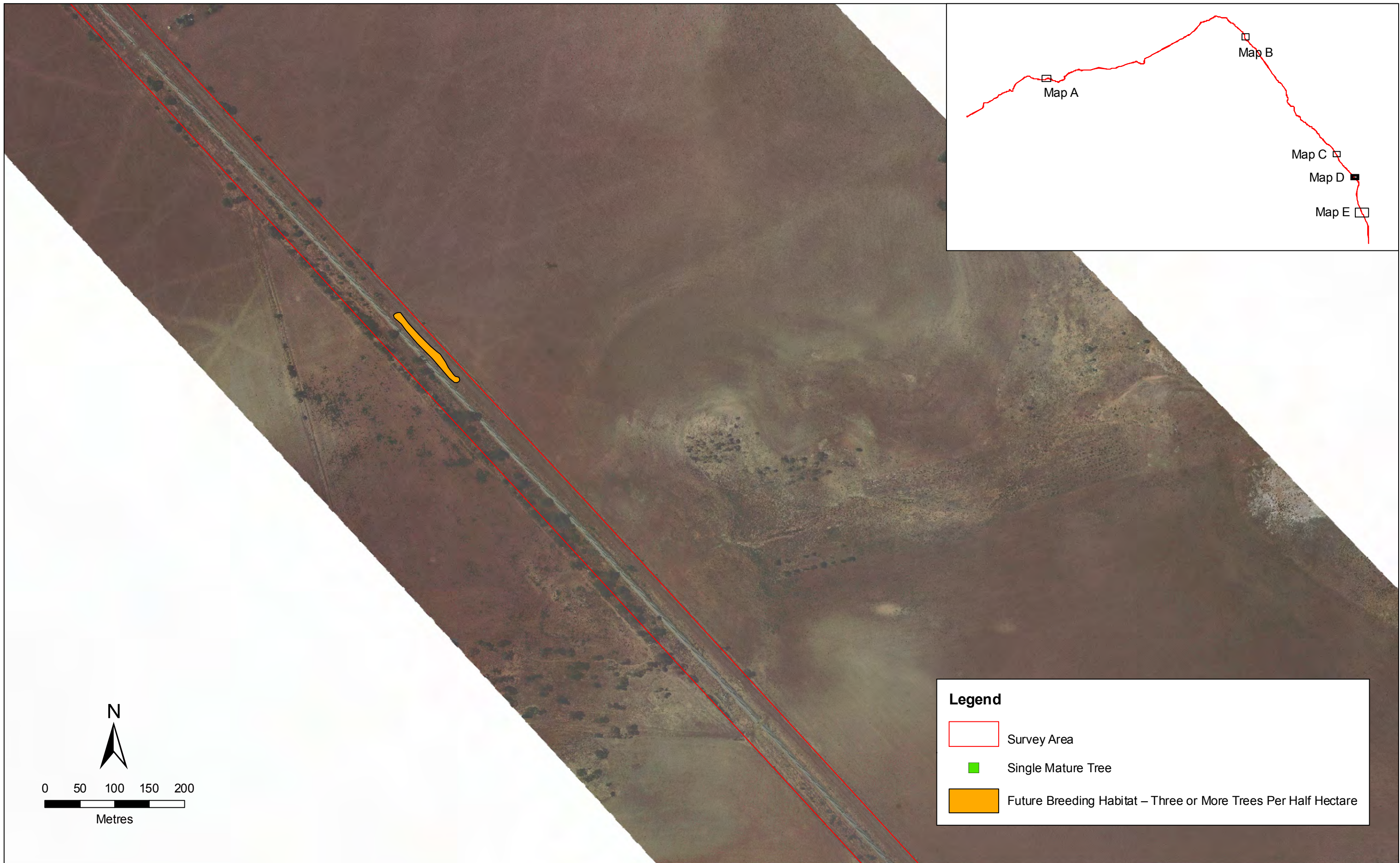
WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



CLIENT Strategen	JOB NO. 10.159
AUTHOR: J. Trainer	DRAWN S. Rho
SCALE 1:5,000 @ A3	DATE 26-10-2010
PROJECTION GDA 94 MGA 50	

Location of Mature Trees for Carnaby's Cockatoos

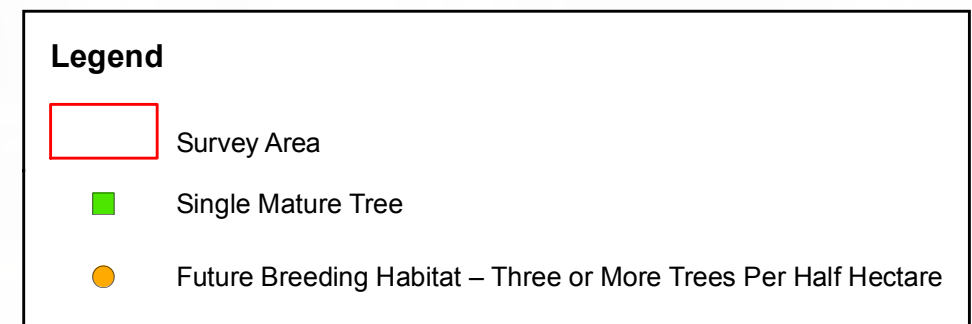
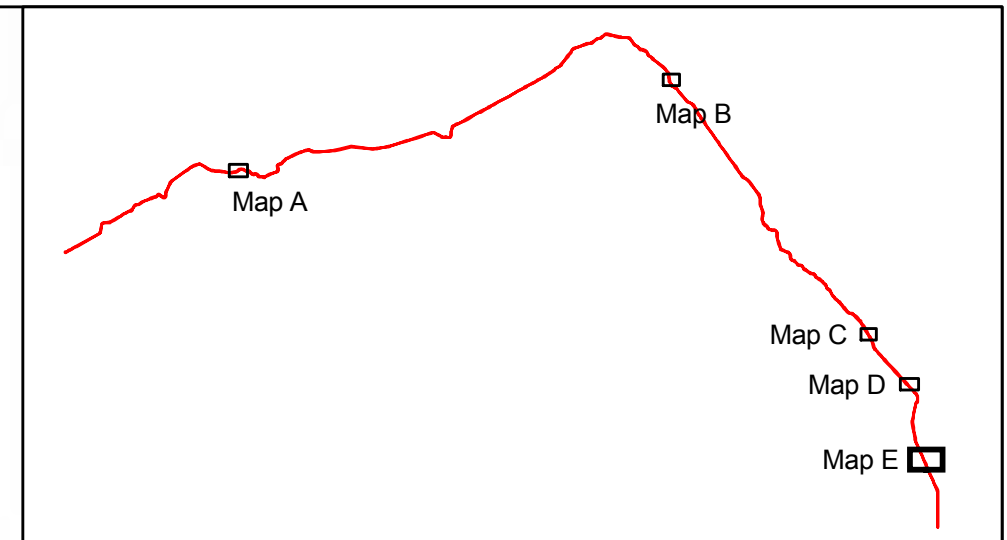
WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



CLIENT	Strategen	JOB NO.	10.159
AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:5,000 @ A3	DATE	26-10-2010
		PROJECTION	GDA 94 MGA 50

Location of Mature Trees for Carnaby's Cockatoos

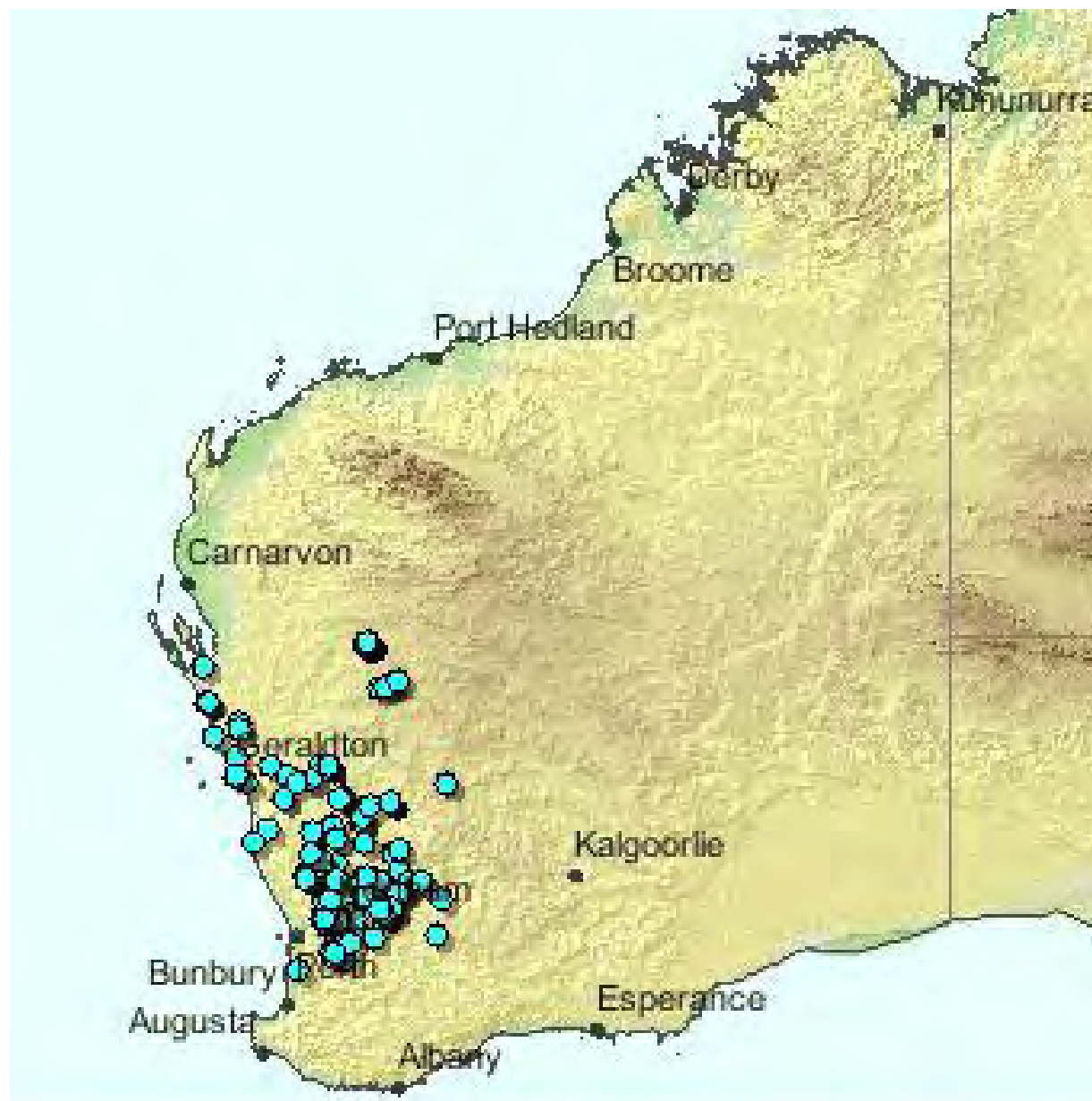
WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



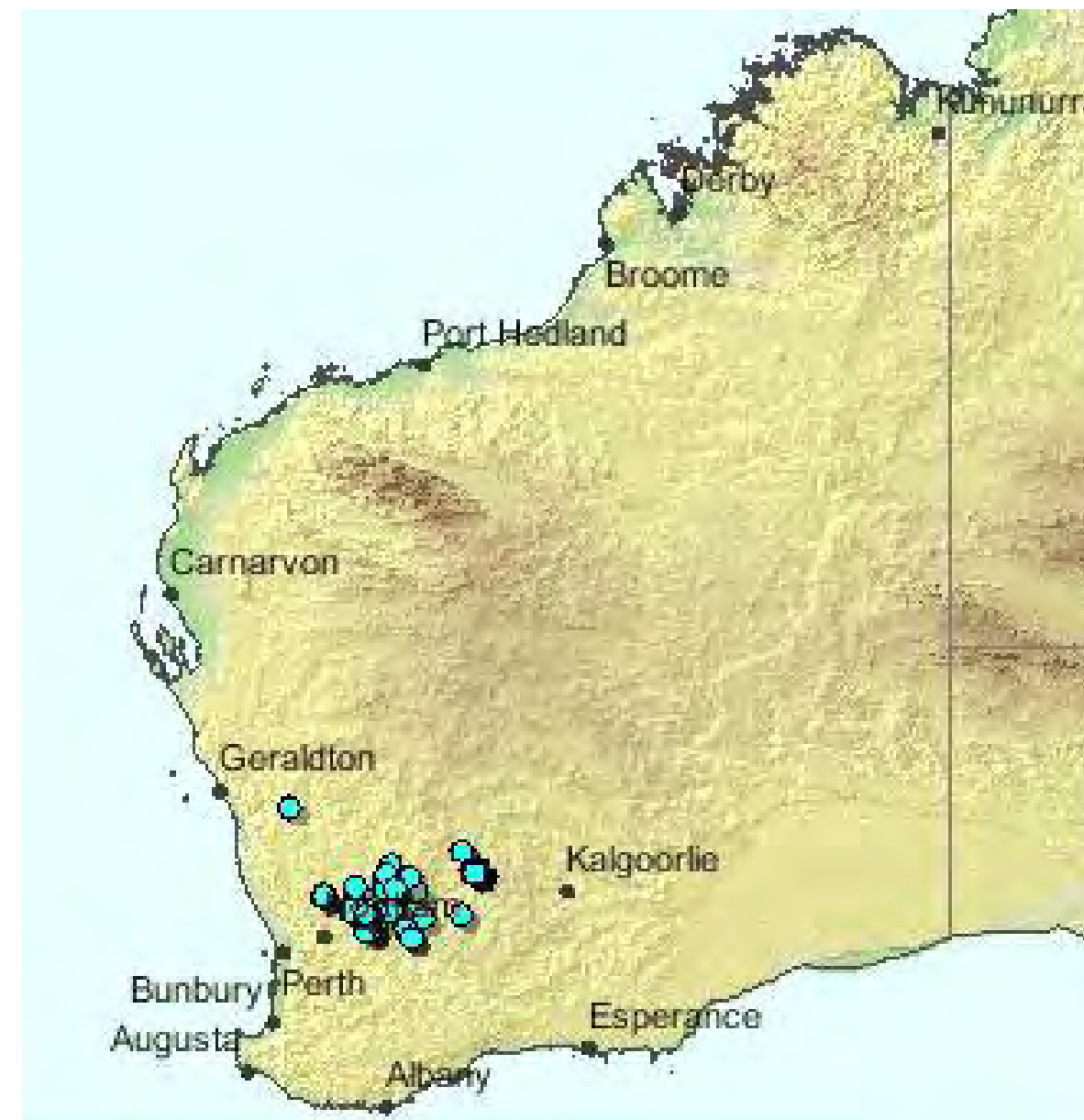
CLIENT	Strategen	JOB NO.	10.159
AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	1:12,000 @ A3	DATE	26-10-2010
	PROJECTION		GDA 94 MGA 50

Location of Mature Trees for Carnaby's Cockatoos

WestNet Rail Upgrade –
Narngulu to Tilley (Morawa) Fauna Assessment



A.



B.

Source: NatureMap (DEC 2010)



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AUTHOR:	J. Trainer	DRAWN	S. Rho
SCALE	NTS	DATE	26-10-2010
		PROJECTION	N/A

Distribution of A: the Shield-back Trapdoor spider (*Idiosoma nigrum*) and B: The Tree-stem Trapdoor spider (*Aganippe castellum*)

WestNet Rail Upgrade – Narngulu to Tilley (Morawa) Fauna Assessment

APPENDIX A

**DEFINITIONS OF CONSERVATION
CODES FOR FAUNA OF CONSERVATION
SIGNIFICANCE**

APPENDIX A

DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

A1: Environment Protection and Biodiversity Conservation Act 1999 (Cth): Threatened Species and Threatened Ecological Communities Codes

The *EPBC Act* prescribes seven matters of national environmental significance:-

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance;
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

Species in the categories ExW, CE, E, V and M (see below), and Threatened Ecological Communities in the CE and E categories are protected as matters of national environmental significance under the *EPBC Act*.

Category	Code	Category
Extinct	Ex	Taxa for which there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	ExW	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or not 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 life cycle and form.
Critically Endangered	CE	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	E	Taxa not critically endangered and facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Vulnerable	V	Taxa not critically endangered or endangered and facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Category	Code	Category
Conservation Dependent	CD	Taxa which are the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within five years.
Migratory	Mi	<p>Taxa that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations, that are included in an international agreement approved by the Minister for the Environment, Heritage and the Arts and that have been placed on the national List of Migratory Species under the provisions of the EPBC Act. At present there are four such agreements:</p> <ul style="list-style-type: none"> • the Bonn Convention • the China-Australia Migratory Bird Agreement (CAMBA) • the Japan-Australia Migratory Bird Agreement (JAMBA) • the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
Marine	Ma	<p>Taxa protected in a Commonwealth Marine Protected Area by virtue of section 248 of the <i>EPBC Act</i>. These taxa include certain seals, crocodiles, turtles and birds, as well as various marine fish.</p> <p>Commonwealth marine areas are matters of national environmental significance under the <i>EPBC Act</i>.</p> <p>An action will require approval if the:</p> <ul style="list-style-type: none"> • action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment, or • action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment in a Commonwealth marine area¹ <p>The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters.</p> <p>The Commonwealth marine area stretches from 3 to 200 nautical miles (approximately 5-370 km) from the coast. Marine protected areas are marine areas which are recognised to have high conservation value.</p>

A2: Western Australian Threatened Fauna Categories

Wildlife Conservation Act 1950 (WA)

Category	Code	Description
Schedule 1	S1	Rare or likely to become extinct.
Schedule 2	S2	Presumed extinct.
Schedule 3	S3	Birds subject to an agreement between the governments of Australia and Japan, the People's Republic of China & the Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Other specially protected fauna.

A3: Department of Environment and Conservation Fauna Priority Codes

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring: not currently threatened or in need of special protection, but could become so. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring: not considered threatened, but the subject of a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

APPENDIX B

HABITAT ASSESSMENT DATA SHEETS

APPENDIX B

HABITAT ASSESSMENT DATA SHEETS

Habitat Assessment - HA 1

Broad Fauna Habitat: Shrubland

UTM Co-ordinates: 50K 279550 Easting, 6812306 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a

Soil: Grey sand.

Ground Cover: Vegetation: 85%, Leaf Litter: +%, Woody Debris: +%, Bare Ground: 15 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia blakelyi</i> , <i>Acacia rostellifera</i> , <i>Acacia prainii</i> and/or <i>Acacia alata</i> var. <i>biglandulosa</i> .	10-30%	2-3m
Ground Cover	* <i>Ehrharta longiflora</i> , * <i>Ehrharta calycina</i> , <i>Pennisetium setaceum</i> , * <i>Bromus diandrus</i> and * <i>Lupinus cosentinii</i> .	30-70%	0.5m
Condition Rating:	Degraded.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

No suitable Black Cockatoo habitat.

Habitat Assessment - HA 2

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 288768 Easting, 6818322 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a

Soil: Red Clay

Ground Cover: Vegetation: 70%, Leaf Litter: +%, Woody Debris: 2%, Bare Ground: 28 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia blakelyi</i> , <i>Acacia rostellifera</i> , <i>Acacia prainii</i> and/or <i>Acacia alata</i> var. <i>biglandulosa</i> .	30-70%	4-6m
Ground Cover	* <i>Ehrharta longiflora</i> , * <i>Ehrharta calycina</i> , <i>Pennisetium setaceum</i> , * <i>Bromus diandrus</i> and * <i>Lupinus cosentinii</i> .	30-70%	0.5m
Condition Rating:	Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

No suitable Black Cockatoo habitat.

Habitat Assessment - HA 3

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 294345 Easting, 6822697 Northing

Habitat Value: Moderate



Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %

Habitat Structure and Microhabitats

Aspect: n/a
Soil: Red Gravel
Ground Cover: Vegetation: 70%, Leaf Litter: 10%, Woody Debris: +%, Bare Ground: 20 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Dryandra sessilis</i> var. <i>flabellifolia</i> , <i>Acacia blakelyi</i> and/or <i>Acacia brumalis</i> .	10-30%	2m
Ground Cover	Mixed grasses and herbs.	70-100%	0.7m
Condition Rating:	very good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Black Cockatoo Foraging Habitat: *Dryandra* +% Cover

Habitat Assessment - HA 4

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 300126 Easting, 6821692 Northing

Habitat Value: Moderate



Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %

Habitat Structure and Microhabitats

Aspect: n/a

Soil: White/ Grey Sand

Ground Cover: Vegetation: 70%, Leaf Litter: 5%, Woody Debris: +%, Bare Ground: 25 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Dryandra sessilis</i> var. <i>flabellifolia</i> and <i>Rhagodia drummondii</i> .	30-70%	3m
Ground Cover	* <i>Ehrharta calycina</i> , * <i>Pennisetum setaceum</i> and * <i>Ehrharta longiflora</i> .	70-100%	0.5m
Condition Rating:	good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Black Cockatoo Foraging Habitat: *Dryandra* 40% Cover

Habitat Assessment - HA 5

Broad Fauna Habitat: Riverine

UTM Co-ordinates 50K 308333 Easting, 6823994 Northing

Habitat Value: Moderate

Total Area of Habitat: 0.18 ha

Proportion of Project Area: 0.02%



Habitat Structure and Microhabitats

Aspect: n/a

Soil: White/ Grey Sand

Ground Cover: Vegetation: 70%, Leaf Litter: 5%, Woody Debris: +%, Bare Ground: 25 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory	<i>Eucalyptus camaldulensis</i> .	10-30%	15m
Midstory	<i>Casuarina obesa</i> .	2-10%	2m
Ground Cover	* <i>Avena barbata</i> and * <i>Bromus diandrus</i> .	30-70%	0.5m
Condition Rating:	degraded.		
Disturbance:	Introduced species, rubbish.		
Fire Age	Old.		

Other Relevant Information:

No Black Cockatoo Foraging Habitat, Dry River bed.

Habitat Assessment - HA 6

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 318141 Easting, 6825319 Northing

Habitat Value: Moderate



Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %

Habitat Structure and Microhabitats

Aspect: n/a
Soil: White/ Grey Sand
Ground Cover: Vegetation: 70%, Leaf Litter: 2%, Woody Debris: 3%, Bare Ground: 15 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Allocasuarina campestris</i> .	30-70%	1.5m
Ground Cover	<i>Ecdeiocolea monostachya</i> .	10-30%	0.5m
Condition Rating:	Excellent.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 7

Broad Fauna Habitat: Woodland

UTM Co-ordinates 50K 327838 Easting, 6827087 Northing

Habitat Value: Moderate



Total Area of Habitat: 154.9 ha

Proportion of Project Area: 14.3%

Habitat Structure and Microhabitats

Aspect: n/a
Soil: White/ Grey Sand
Ground Cover: Vegetation: 5%, Leaf Litter: 70%, Woody Debris: 25%, Bare Ground: 0 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory	<i>Eucalyptus jucunda</i> .	10-30%	5m
Midstory	<i>Allocasuarina campestris</i> and <i>Baeckea sp. Dudawa</i> .	30-70%	2m
Ground Cover	Mixed grasses and herbs.	2-10%	0.5m
Condition Rating:	excellent.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 8

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 332525 Easting, 6828625 Northing

Habitat Value: Moderate



Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %

Habitat Structure and Microhabitats

Aspect: n/a

Soil: Yellow Sand

Ground Cover: Vegetation: 90%, Leaf Litter: 5%, Woody Debris: 5%, Bare Ground: 0 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Banksia sceptrum</i> , <i>Allocasuarina campestris</i> and <i>Callitris arenaria</i> .	70-100%	3m
Ground Cover	Mixed grasses and herbs.		
Condition Rating:	Very Good		
Disturbance:	Introduced species.		
Fire Age	Old		

Other Relevant Information:

Habitat Assessment - HA 9

Broad Fauna Habitat: Samphire

UTM Co-ordinates 50K 339652 Easting, 6832487 Northing

Habitat Value: Low

Total Area of Habitat: 15.16 ha

Proportion of Project Area: 1.4%



Habitat Structure and Microhabitats

Aspect: n/a
Soil: Red Clay
Ground Cover: Vegetation: 25%, Bare Ground: 75 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory			
Ground Cover	<i>Tecticornia pruinosa</i> and <i>Hakea bucculenta</i> .	10-30%	0.4m
Condition Rating:	Degraded		
Disturbance:	Introduced species, salinity.		
Fire Age	Old		

Other Relevant Information:

Habitat Assessment - HA 10

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 345551 Easting, 6835675 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a
Soil: Yellow Sand
Ground Cover: Vegetation: 60%, Leaf Litter: 2%, Woody Debris: 2%, Bare Ground: 36 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia rostellifera</i> , <i>Rhagodia drummondii</i> , <i>Grevillea hakeoides</i> subsp. <i>Hakeoides</i> .	10-30%	1.5m
Ground Cover	<i>*Ehrharta longiflora</i> , <i>*Monachather paradoxus</i> , <i>Austrostipa elegantissima</i> and <i>Waitzia acuminata</i> var. <i>acuminata</i> .	10-30%	0.5m
Condition Rating:	Very Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 11

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 353839 Easting, 6841362 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: East
Soil: Red Gravel/ Sand
Ground Cover: Vegetation: 75%, Leaf Litter: 2%, Woody Debris: +%, Bare Ground: 20 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia acuminata</i> , <i>Acacia rostellifera</i> , <i>Maireana tomentosa</i> and <i>Chenopodium gaudichaudianum</i> .	30-70%	2 m
Ground Cover	<i>*Ehrarta longiflora</i> , <i>*Bromus rubens</i> , <i>*Lolium perenne</i> , <i>Cephalipterum drummondii</i> and <i>*Arctotheca calendula</i> .	30-70%	0.5m
Condition Rating:	Very Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 12

Broad Fauna Habitat: Woodland

UTM Co-ordinates 50K 401514 Easting, 6779775 Northing

Habitat Value: Moderate



Total Area of Habitat: 154.9 ha

Proportion of Project Area: 14.3%

Habitat Structure and Microhabitats

Aspect: n/a
Soil: Red/ Yellow Sand
Ground Cover: Vegetation: 70%, Leaf Litter: 5%, Woody Debris: +%, Bare Ground: 25 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory	<i>Eucalyptus ewartiana</i> .	2-10%	6m
Midstory	<i>Acacia acuminata</i> and <i>Melaleuca viminea</i> subsp. <i>viminea</i> .	30-70%	4m
Ground Cover	Mixed grasses and herbs.	10-30%	0.2m
Condition Rating:	Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 13

Broad Fauna Habitat: Woodland

UTM Co-ordinates 50K 400245 Easting, 6783542 Northing

Habitat Value: Moderate



Total Area of Habitat: 154.9 ha

Proportion of Project Area: 14.3%

Habitat Structure and Microhabitats

Aspect: n/a
Soil: Red/ Orange Sand
Ground Cover: Vegetation: 60%, Leaf Litter: 20%, Woody Debris: +%, Bare Ground: 20 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory	<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>	10-30%	20m
Midstory	<i>Acacia acuminata</i> and <i>Acacia aneura</i> .	30-70%	2m
Ground Cover	<i>Austrostipa elegantissima</i> and <i>Austrostipa variabilis</i> .	10-30%	0.2m
Condition Rating:	Good.		
Disturbance:	Introduced species, Rubbish.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 14

Broad Fauna Habitat: Woodland

UTM Co-ordinates 50K 397998 Easting, 6791761 Northing

Habitat Value: Moderate



Total Area of Habitat: 154.9 ha

Proportion of Project Area: 14.3%

Habitat Structure and Microhabitats

Aspect: n/a

Soil: Red Sand

Ground Cover: Vegetation: 40%, Leaf Litter: 5 %, Woody Debris: 15%, Bare Ground: 40 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory	<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>	30-70%	15m
Midstory	<i>Acacia anthochaera</i> , <i>Senna charlesiana</i> and <i>Rhagodia drummondii</i>	2-10%	2m
Ground Cover	<i>Hordeum leporinum</i> *	30-70%	0.2m
Condition Rating:	Very Good		
Disturbance:	Introduced species		
Fire Age	Old		

Other Relevant Information:

4-9 Moderate sized Eucalypts per ¼ Ha, 50% small hollows, 10% medium Hollows.

Habitat Assessment - HA 15

Broad Fauna Habitat: Woodland

UTM Co-ordinates 50K 392829 Easting, 6798957 Northing

Habitat Value: Moderate



Total Area of Habitat: 154.9 ha

Proportion of Project Area: 14.3%

Habitat Structure and Microhabitats

Aspect: n/a
Soil: Red Clay/ Sand
Ground Cover: Vegetation: 65%, Leaf Litter: 2 %, Woody Debris: 3%, Bare Ground: 30 %

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory	<i>Eucalyptus loxophleba</i> subsp. <i>supralaevis</i>	2-10%	4m
Midstory	<i>Acacia anthochaera</i> and <i>Acacia acuaria</i>	30-70%	2.5m
Ground Cover	* <i>Ehrharta longiflora</i> and * <i>Avena barbata</i> .	30-70%	0.4m
Condition Rating:	Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 16

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 389669 Easting, 6802130 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: West

Soil: Granite Outcrop

Ground Cover: Vegetation: 70%, Leaf Litter: 0 %, Woody Debris: +%, Bare Ground: 0%, Exposed Granite: 30%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstorey			
Midstorey	<i>Acacia acuminata</i> , <i>Melaleuca uncinata</i> and <i>Astroloma serratifolium</i> .	30-70%	2m
Ground Cover	Mixed grasses and herbs.	30-70%	0.2 m
Condition Rating:	Excellent.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Scattered granite outcrops.

Habitat Assessment - HA 17

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 387976 Easting, 6804012 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a
Soil: Red Sand/ Clay
Ground Cover: Vegetation: 40%, Leaf Litter: +%, Woody Debris: 10%, Bare Ground: 50%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia acuminata</i> , <i>Acacia stereophylla</i> var. <i>stereophylla</i> , <i>Casuarina obesa</i> , <i>Melaleuca cordata</i> , <i>Allocasuarina campestris</i> , <i>Grevillea obliquistigma</i> subsp. <i>funicularis</i> , <i>Grevillea paradoxa</i> .	30-70%	3m
Ground Cover	Mixed grasses and herbs.	30-70%	0.4m
Condition Rating:	Excellent.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Scattered granite outcrops.

Habitat Assessment - HA 18

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 387376 Easting, 6804674 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a
Soil: Orange/ Red Sand
Ground Cover: Vegetation: 60%, Leaf Litter: +%, Woody Debris: +%, Bare Ground: 40%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia acuminata</i> and <i>Melaleuca longistaminea</i>	30-70%	1m
Ground Cover	<i>*Ehrharta longiflora</i> , <i>Austrostipa scabra</i> subsp. <i>scabra</i> , <i>Podolepis lessonii</i> and <i>Pogonolepis stricta</i> .	30-70%	0.2m
Condition Rating:	Excellent		
Disturbance:	Introduced species		
Fire Age	Old		

Other Relevant Information:

Habitat Assessment - HA 19

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 383728 Easting, 6807867 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a

Soil: Orange/ Red Sand

Ground Cover: Vegetation: 60%, Leaf Litter: +%, Woody Debris: 5%, Bare Ground: 35%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia brumalis</i> and <i>Acacia acuminata</i> over <i>*Avena barbata</i> and <i>*Pentachistis airiodes</i> .	30-70%	3m
Ground Cover	<i>Podolepis capillaries</i> .	30-70%	0.2m
Condition Rating:	Very Good		
Disturbance:	Introduced species		
Fire Age	Old		

Other Relevant Information:

Habitat Assessment - HA 20

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 377713 Easting, 6816632 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a
Soil: Orange/ Red Gravel and Sand
Ground Cover: Vegetation: 70%, Leaf Litter: 0%, Woody Debris: +%, Bare Ground: 30%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia stereophylla</i> var. <i>stereophylla</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> and <i>Grevillea levis</i>	10-30%	3m
Ground Cover	* <i>Ehrharta longiflora</i> , <i>Austrostipa elegantissima</i> , <i>Waitzia acuminata</i> var. <i>acuminata</i> and * <i>Arctotheca calendula</i> .	30-70%	0.4m
Condition Rating:	Good		
Disturbance:	Introduced species		
Fire Age	Old		

Other Relevant Information:

Habitat Assessment - HA 21

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 374562 Easting, 6821699 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a

Soil: Orange/ Red Clayey Sand

Ground Cover: Vegetation: 40%, Leaf Litter: +%, Woody Debris: +%, Bare Ground: 60%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia stereophylla</i> var. <i>stereophylla</i> , <i>Melaleuca cordata</i> and <i>Grevillea paradoxa</i>	30-70%	2m
Ground Cover	<i>Austrostipa elegantissima</i> and <i>Amphipogon caricinus</i> var. <i>caricinus</i> .	30-70%	0.2m
Condition Rating:	Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 22

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 369618 Easting, 6828644 Northing

Habitat Value: Moderate



Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %

Habitat Structure and Microhabitats

Aspect: n/a
Soil: Orange/ Red Sand
Ground Cover: Vegetation: 75%, Leaf Litter: +%, Woody Debris: 5%, Bare Ground: 20%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia anthochaera</i> .	30-70%	2.5m
Ground Cover	<i>Podolepis capillaris</i> and <i>Arctotheca calendula</i> *.	30-70%	0.2m
Condition Rating:	Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 23

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 368169 Easting, 6830836 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a

Soil: Yellow/ Orange Sand

Ground Cover: Vegetation: 65%, Leaf Litter: +%, Woody Debris: 5%, Bare Ground: 30%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia sclerosperma</i> subsp. <i>Sclerosperma</i> , <i>Acacia acuaria</i> and <i>Pimelea microcephala</i> subsp. <i>Microcephala</i> .	30-70%	2.5m
Ground Cover	<i>Chenopodium gaudichaudianum</i> , <i>Sisymbrium irio</i> and <i>Maireana tomentosa</i> .	10-30%	0.5m
Condition Rating:	Very Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Habitat Assessment - HA 24

Broad Fauna Habitat: Woodland

UTM Co-ordinates 50K 367178 Easting, 6831980 Northing

Habitat Value: Moderate



Total Area of Habitat: 154.9 ha

Proportion of Project Area: 14.3%

Habitat Structure and Microhabitats

Aspect: n/a

Soil: Red Clayey Sand

Ground Cover: Vegetation: 65%, Leaf Litter: 10%, Woody Debris: 5%, Bare Ground: 20%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory	<i>Eucalyptus loxophleba</i> ssp. <i>supralaevis</i>	2-10%	5-8m
Midstory	<i>Acacia sclerosperma</i> subsp. <i>Sclerosperma</i> , <i>Acacia acuaria</i> and <i>Pimelea microcephala</i> subsp. <i>Microcephala</i> .	30-70%	2.5m
Ground Cover	<i>Chenopodium gaudichaudianum</i> , <i>Sisymbrium irio</i> and <i>Maireana tomentose</i> .	10-30%	0.5m
Condition Rating:	Very Good.		
Disturbance:	Introduced species.		
Fire Age	Old.		

Other Relevant Information:

Eucalypts too immature for breeding hollows.

Habitat Assessment - HA 25

Broad Fauna Habitat: Shrubland

UTM Co-ordinates 50K 380093 Easting, 6812591 Northing

Habitat Value: Moderate

Total Area of Habitat: 539.21 ha

Proportion of Project Area: 49.9 %



Habitat Structure and Microhabitats

Aspect: n/a
Soil: Red Sand
Ground Cover: Vegetation: 90%, Bare Ground: 10%

Vegetation

Stratum	Vegetation Species	Cover	Height
Overstory			
Midstory	<i>Acacia acuminata</i> , <i>Acacia sibina</i> , <i>Mirbelia depressa</i> , <i>Acacia ulicina</i> , <i>Grevillea levis</i> .	2-10%	2m
Ground Cover	* <i>Bromus diandrus</i> and * <i>Avena barbata</i> .	30-70%	0.3m
Condition Rating:	Degraded		
Disturbance:	Introduced species		
Fire Age	Old		

Other Relevant Information:

APPENDIX C

BEARD VEGETATION COMMUNITY SUMMARY

WESTNET RAIL UPGRADE – NARNGULU TO TILLEY (MORAWA) FAUNA ASSESSMENT

APPENDIX C

BEARD VEGETATION ASSOCIATIONS, EXTENT AND HABITAT TYPE

Beard Code	Vegetation Description	% Remaining From Pre-European Extent	% of Remaining in IUCN Class I-IV Reserves	Habitat Type
a23Lc	Low forest; <i>Acacia rostellifera</i>	9.8	3.7	Shrubland
abSi	Shrublands; <i>Acacia</i> & <i>Banksia</i> scrub	21.1	0	Shrubland
acmSc	Shrublands; <i>Acacia</i> , <i>Casuarina</i> & <i>Melaleuca</i> thicket	60.6	14.7	Shrubland
acSc	Shrublands; thicket, <i>Acacia</i> - <i>Casuarina</i> alliance	41.3	10.8	Shrubland

Beard Code	Vegetation Description	% Remaining From Pre-European Extent	% of Remaining in IUCN Class I-IV Reserves	
c3Sc	Shrublands; <i>Allocasuarina</i> campestris thicket	24.2	18.7	Shrubland
mhSc	Shrublands; mixed thicket (<i>Melaluca</i> & <i>Hakea</i>)	21.7	2.8	Shrubland
x2SZc	Shrublands; scrub-heath on coastal association, yellow sandplain	40.4	62.6	Shrubland
x3SZc	Shrublands; scrub-heath on sandplain	52.3	31.5	Shrubland
x3SZc/acSc	Mosaic: Shrublands; scrub-heath on deep sandy flats / Shrublands; thicket, <i>Acacia</i> - <i>Casuarina</i> alliance	30.1	84.8	Shrubland
x4SZc	Shrublands; scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region	20.2	20.3	Shrubland
e6Mr a19Si/c3Sc	Mosaic: Shrublands; Shrublands; Jam scrub with scattered York gum in the valleys / <i>Allocasuarina</i> <i>campestris</i> thicket	20.9	1.2	Shrubland/Woodland
e6,8Mi	Medium woodland; York gum & Salmon gum	24.8	14.5	Woodland

Beard Code	Vegetation Description	% Remaining From Pre-European Extent	% of Remaining in IUCN Class I-IV Reserves	
e6c5Mr a9,19Si	Shrublands; Bowgada & Jam scrub with scattered <i>Allocasuarina heugelliana</i> & York gum	17.5	27.3	Woodland
e6Mr a19Si	Shrublands; Jam scrub with scattered York gum	10.3	2.3	Woodland
e6Mr eaSi	Shrublands; mallee & Acacia scrub with scattered York gum	4.5	17.1	Woodland
k1,3Ci	Succulent steppe; Saltbush & Samphire	85.7	0	Samphire
k3Ci	Succulent steppe; Samphire	98.9	6.5	Samphire

* Shepherd, DP, Beeston, GR and Hopkins, AJM (2002). *Native Vegetation in Western Australia: Extent, Type and Status. Resource Management Technical Report 249*, Department of Agriculture, Government of Western Australia.

APPENDIX D

FAUNA PREVIOUSLY RECORDED IN THE REGION

APPENDIX D

D1: AMPHIBIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPAC Protected Matters Search Tool, E = Recorded in Previous Fauna Surveys, F = Recorded in the Current Survey.

Note: For Definitions of Conservation Codes see Appendix A.

AMPHIBIANS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
HYLIDAE											
<i>Cyclorana platycephala</i>	Water-holding Frog				x						
<i>Litoria moorei</i>	Motorbike Frog				x					x	
LIMNODYNASTIDAE											
<i>Heleioporus albopunctatus</i>	Western Spotted Frog				x				x		
<i>Heleioporus eyrei</i>	Moaning Frog				x						
<i>Limnodynastes dorsalis</i>	Western Banjo Frog				x				x	x	
<i>Neobatrachus kunapalari</i>	Kunapalari Frog				x						
<i>Neobatrachus pelobatoides</i>	Humming Frog				x						
<i>Neobatrachus sutor</i>	Shoemaker Frog				x						
<i>Neobatrachus wilsmorei</i>	Plonking Frog				x						
MYOBATRACHIDAE											
<i>Crinia georgiana</i>	Quacking Frog				x						
<i>Myobatrachus gouldii</i>	Turtle Frog				x						
<i>Pseudophryne guentheri</i>	Crawling Toadlet				x					x	

[X] fauna species recorded.

[*] denotes introduced species.

APPENDIX D

D2: REPTILIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPAC Protected Matters Search Tool, E = Recorded in Previous Fauna Surveys, F = Recorded in the Current Survey.

Note: For Definitions of Conservation Codes see Appendix A.

REPTILES	Scientific Name	Common Name	Conservation Codes								
			EPBC	WC	DEC	A	B	C	D	E	F
CHELUIDAE											
	<i>Chelodina steindachneri</i>	Flat-shelled Turtle				x					
AGAMIDAE											
	<i>Amphibolurus longirostris</i>	Long-nosed Dragon				x					x
	<i>Caimanops amphiboluroides</i>	Mulga Dragon								x	
	<i>Ctenophorus maculatus</i> subsp. <i>maculatus</i>	Spotted Military Dragon				x				x	
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon				x				x	x
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon				x				x	
	<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon				x				x	
	<i>Moloch horridus</i>	Thorny Devil				x					
	<i>Pogona minor</i>	Bearded Dragon				x				x	x
DIPLODACTYLIDAE											
	<i>Crenadactylus ocellatus</i> subsp. <i>ocellatus</i>	Clawless Gecko				x					
	<i>Diplodactylus granariensis</i> subsp. <i>granariensis</i>	Western Stone Gecko				x					x
	<i>Diplodactylus ornatus</i>					x				x	
	<i>Diplodactylus pulcher</i>					x				x	x
	<i>Lucasium alboguttatum</i>									x	
	<i>Lucasium squarrosum</i>					x				x	
	<i>Strophurus spinigerus</i> subsp. <i>spinigerus</i>	Soft Spiny-tailed Gecko				x				x	
	<i>Strophurus strophurus</i>									x	
	<i>Underwoodisaurus milli</i>	Barking Gecko								x	
CARPHODACTYLIDAE											
	<i>Nephurus levis</i> subsp. <i>occidentalis</i>	Smooth Knob-tailed Gecko				x					
GEKKONIDAE											
	<i>Gehyra variegata</i>	Variegated Tree Dtella				x				x	x
	<i>Heteronotia binoei</i>	Bynoe's Gecko				x				x	x

REPTILES		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
PYGOPODIDAE											
<i>Aprasia repens</i>	Sand-plain Worm-lizard				x						
<i>Delma australis</i>	Burton's Legless Lizard				x				x		
<i>Delma fraseri</i>					x				x		
<i>Delma grayii</i>					x				x		
<i>Delma tincta</i>					x						
<i>Lialis burtonis</i>	Burton's Legless Lizard				x				x		
<i>Pletholax gracilis</i> subsp. <i>gracilis</i>	Keeled Legless Lizard				x						
<i>Pygopus lepidopodus</i>	Common Scaly Foot				x						
<i>Pygopus nigriceps</i>	Western Hooded Scaly Foot				x						
SCINCIDAE											
<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Skink				x						
<i>Cryptoblepharus carnabyi</i> #									x		
<i>Cryptoblepharus plagiocephalus</i>					x				x		
<i>Ctenotus alleni</i>					x						
<i>Ctenotus fallens</i>					x				x		
<i>Ctenotus mimetes</i>					x				x		
<i>Ctenotus pantherinus</i>	Leopard Ctenotus				x				x	x	
<i>Ctenotus schomburgkii</i>					x				x		
<i>Ctenotus uber</i>					x				x		
<i>Cyclodomorphus branchialis</i>	Gilled Slender Blue-tongue		S1		x		x		x		
<i>Cyclodomorphus celatus</i>	Western Slender Blue-tongue				x						
<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink				x				x		
<i>Egernia stokesii</i> subsp. <i>badia</i>	Western Spiny-tailed Skink	EN	S1		x		x	x	x		
<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer				x				x		
<i>Lerista connivens</i>					x						
<i>Lerista distinguenda</i>					x						
<i>Lerista gerrardii</i>					x				x		
<i>Lerista kingi</i>					x						
<i>Lerista lineata</i>	Lined Skink			P3			x				
<i>Lerista lineopunctulata</i>					x				x		
<i>Lerista muelleri</i>					x				x		
<i>Lerista praepedita</i>					x				x		
<i>Lerista yuna</i>				P3	x		x				
<i>Menetia greyii</i>	Common Dwarf Skink				x				x		
<i>Morethia butleri</i>									x		
<i>Morethia lineoocellata</i>									x		
<i>Morethia obscura</i>					x						
<i>Tiliqua occipitalis</i>	Western Bluetongue				x				x	x	
<i>Tiliqua rugosa</i> subsp. <i>rugosa</i>	Bobtail				x				x	x	

REPTILES		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
VARANIDAE											
<i>Varanus caudolineatus</i>	Stripe-tailed Monitor				x				x	x	
<i>Varanus tristis</i> subsp. <i>tristis</i>	Racehorse Monitor				x				x	x	
<i>Varanus gouldii</i>	Gould's Monitor								x	x	
<i>Varanus panoptes</i>	Yellow-spotted Monitor								x		
TYPHLOPIDAE											
<i>Ramphotyphlops australis</i>	Southern Blind Snake								x		
<i>Ramphotyphlops hamatus</i>									x		
BOIDAE											
<i>Antaresia stimsoni</i> subsp. <i>stimsoni</i>	Stimson's Python				x				x		
<i>Aspidites ramsayi</i>	Woma (southwest population)		S4	P1	x		x				
<i>Morelia spilota</i> subsp. <i>imbricata</i>	Carpet Python		S4				x				
ELAPIDAE											
<i>Acanthophis pyrrhus</i>	Desert Death Adder				x						
<i>Brachyuropsis semifasciata</i>	Southern Shovel-nosed Snake				x				x		
<i>Demansia psammophis</i> subsp. <i>reticulata</i>	Yellow-faced Whipsnake				x				x		
<i>Parasuta monachus</i>	Monk Snake				x				x		
<i>Pseudechis australis</i>	Mulga Snake				x				x		
<i>Pseudonaja modesta</i>	Ringed Brown Snake				x						
<i>Pseudonaja nuchalis</i>	Gwardar				x				x	x	
<i>Simoselaps bertholdi</i>	Jan's Banded Snake				x						
<i>Simoselaps littoralis</i>	West Coast Banded Snake								x		
<i>Suta fasciata</i>	Rosen's Snake				x						

[X] fauna species recorded.

[*] denotes introduced species.

[#] denotes name is not current.

APPENDIX D

D3: AVIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPAC Protected Matters Search Tool, E = Recorded in Previous Fauna Surveys, F = Recorded in the Current Survey.

Note: For Definitions of Conservation Codes see Appendix A.

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
CASUARIIDAE											
<i>Dromaius novaehollandiae</i>	Emu				x	x			x	x	
MEGOPODIIDAE											
<i>Leipoa ocellata</i>	Malleefowl	VU, Mi	S1		x	x	x	x	x	x	
PHASIANIDAE											
<i>Coturnix pectoralis</i>	Stubble Quail	Ma			x	x			x		
ANATIDAE											
<i>Anas castanea</i>	Chestnut Teal				x	x					
<i>Anas gracilis</i>	Grey Teal				x	x			x	x	
<i>Anas rhynchotis</i>	Australasian Shoveler				x	x					
<i>Anas superciliosa</i>	Pacific Black Duck				x	x			x	x	
<i>Aythya australis</i>	Hardhead				x	x					
<i>Biziura lobata</i>	Musk Duck	Ma			x	x					
<i>Chenonetta jubata</i>	Australian Wood Duck				x	x					
<i>Cygnus atratus</i>	Black Swan				x	x			x		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck				x	x					
<i>Oxyura australis</i>	Blue-billed Duck				x	x					
<i>Tadorna tadornoides</i>	Australian Shelduck				x	x			x		
PODICIPEDIDAE											
<i>Podiceps cristatus</i>	Great Crested Grebe					x					
<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe				x	x			x		
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe				x	x			x		
COLUMBIDAE											
* <i>Columba livia</i>	Rock Dove					x			x	x	
<i>Geopelia cuneata</i>	Diamond Dove					x					
<i>Geopelia striata</i>	Peaceful Dove				x	x					
<i>Ocyphaps lophotes</i>	Crested Pigeon				x	x			x	x	
<i>Phaps chalcoptera</i>	Common Bronzewing				x	x			x	x	
* <i>Streptopelia senegalensis</i>	Laughing Dove				x	x			x	x	

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
PODARGIDAE											
<i>Podargus strigoides</i>	Tawny Frogmouth				x	x			x	x	
CAPRIMULGIDAE											
<i>Eurostopodus argus</i>	Spotted Nightjar				x	x			x		
AEGOTHELIDAE											
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				x	x			x	x	
APODIDAE											
<i>Apus pacificus</i>	Fork-tailed Swift	Mi, Ma			x	x		x	x		
OCEANITIDAE											
<i>Pelagodroma marina</i>	White-faced Storm-Petrel	Ma				x					
PROCELLARIIDAE											
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	Ma				x					
<i>Ardenna pacifica</i>	Wedge-tailed Shearwater	Mi, Ma				x					
SULIDAE											
<i>Morus serrator</i>	Australasian Gannet	Ma				x					
ANHINGIDAE											
<i>Anhinga novaehollandiae</i>	Australasian Darter				x	x					
PHALACROCORACIDAE											
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant				x	x			x		
<i>Phalacrocorax carbo</i>	Great Cormorant				x	x					
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant				x	x			x		
<i>Phalacrocorax varius</i>	Pied Cormorant					x					
PELECANIDAE											
<i>Pelecanus conspicillatus</i>	Australian Pelican	Ma			x	x					
ARDEIDAE											
<i>Ardea ibis</i>	Cattle Egret	Mi, Ma				x		x			
<i>Ardea modesta</i>	Eastern Great Egret	Mi, Ma						x			
<i>Ardea pacifica</i>	White-necked Heron				x	x					
<i>Egretta garzetta</i>	Little Egret	Ma				x					
<i>Egretta novaehollandiae</i>	White-faced Heron				x	x			x		
<i>Egretta sacra</i>	Eastern Reef Egret	Mi, Ma				x					
<i>Nycticorax caledonicus</i>	Nankeen Night-Heron	Ma			x	x					
THRESKIORNITHIDAE											
<i>Platalea flavipes</i>	Yellow-billed Spoonbill				x	x					
<i>Plegadis falcinellus</i>	Glossy Ibis	Mi			x	x					
<i>Threskiornis molucca</i>	Australian White Ibis	Ma			x	x					
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	Ma			x	x			x	x	
ACCIPITRIDAE											
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				x	x					
<i>Accipiter fasciatus</i>	Brown Goshawk	Ma			x	x			x	x	
<i>Aquila audax</i>	Wedge-tailed Eagle				x	x			x	x	
<i>Circus approximans</i>	Swamp Harrier	Ma				x					
<i>Circus assimilis</i>	Spotted Harrier				x	x			x		

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
<i>Elanus axillaris</i>	Black-shouldered Kite				x	x			x	x	
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Mi, Ma			x	x		x	x		
<i>Haliastur sphenurus</i>	Whistling Kite	Ma			x	x			x	x	
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard					x					
<i>Hieraaetus morphnoides</i>	Little Eagle				x	x			x		
<i>Lophoictinia isura</i>	Square-tailed Kite				x	x					
<i>Milvus migrans</i>	Black Kite					x					
<i>Pandion cristatus</i>	Eastern Osprey	Mi, Ma				x			x		
FALCONIDAE											
<i>Falco berigora</i>	Brown Falcon				x	x			x	x	
<i>Falco cenchroides</i>	Australian Kestrel	Ma			x	x			x	x	
<i>Falco longipennis</i>	Australian Hobby				x	x			x		
<i>Falco peregrinus</i>	Peregrine Falcon		S4		x	x	x				
RALLIDAE											
<i>Fulica atra</i>	Eurasian Coot				x	x			x		
<i>Gallinula tenebrosa</i> subsp. <i>tenebrosa</i>	Dusky Moorhen				x						
<i>Gallirallus philippensis</i>	Buff-banded Rail	Ma				x					
<i>Porphyrio porphyrio</i>	Purple Swamphen					x					
<i>Porzana fluminea</i>	Australian Spotted Crane					x					
<i>Porzana tabuensis</i>	Spotless Crane					x					
<i>Tribonyx ventralis</i>	Black-tailed Native-hen				x	x					
OTIDIDAE											
<i>Ardeotis australis</i>	Australian Bustard			P4	x	x	x				
BURHINIDAE											
<i>Burhinus grallarius</i>	Bush Stone-curlew			P4		x					
HAEMATOPODIDAE											
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher					x					
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher					x					
RECURVIROSTRIDAE											
<i>Cladorhynchus leucocephalus</i>	Banded Stilt					x					
<i>Himantopus himantopus</i>	Black-winged Stilt	Ma			x	x			x		
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	Ma			x	x					
CHARADRIIDAE											
<i>Charadrius australis</i>	Inland Dotterel				x	x					
<i>Charadrius dubius</i>	Little Ringed Plover	Mi, Ma				x					
<i>Charadrius leschenaultii</i>	Greater Sand Plover	Mi, Ma				x					
<i>Charadrius ruficapillus</i>	Red-capped Plover	Ma			x	x			x		
<i>Elsyornis melanops</i>	Black-fronted Dotterel				x	x				x	
<i>Erythrogonys cinctus</i>	Red-kneed Dotterel				x	x					
<i>Pluvialis squatarola</i>	Grey Plover	Mi				x					
<i>Thinornis rubricollis</i>	Hooded Plover	Ma		P4		x					
<i>Vanellus tricolor</i>	Banded Lapwing				x	x			x		

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
SCOLOPACIDAE											
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, Ma				x					
<i>Arenaria interpres</i>	Ruddy Turnstone	Mi, Ma				x					
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, Ma				x					
<i>Calidris alba</i>	Sanderling	Mi, Ma				x					
<i>Calidris ferruginea</i>	Curlew Sandpiper	Mi, Ma				x					
<i>Calidris ruficollis</i>	Red-necked Stint	Mi, Ma				x					
<i>Limosa lapponica</i>	Bar-tailed Godwit	Mi, Ma				x					
<i>Limosa limosa</i>	Black-tailed Godwit	Mi, Ma				x					
<i>Numenius minutus</i>	Little Curlew	Mi, Ma				x					
<i>Numenius phaeopus</i>	Whimbrel	Mi, Ma				x					
<i>Phalaropus lobatus</i>	Red-necked Phalarope	Mi, Ma				x					
<i>Tringa brevipes</i>	Grey-tailed Tattler	Mi, Ma				x					
<i>Tringa glareola</i>	Wood Sandpiper	Mi, Ma				x					
<i>Tringa nebularia</i>	Common Greenshank	Mi, Ma				x					
TURNICIDAE											
<i>Turnix varius</i>	Painted Button-quail					x			x		
<i>Turnix velox</i>	Little Button-quail				x	x					
STERCORARIIDAE											
<i>Stercorarius antarcticus</i>	Brown Skua					x					
<i>Stercorarius parasiticus</i>	Arctic Jaeger	Mi, Ma				x					
<i>Stercorarius pomarinus</i>	Pomarine Jaeger	Mi, Ma				x					
LARIDAE											
<i>Chlidonias hybrida</i>	Whiskered Tern	Ma				x					
<i>Chroicocephalus novaehollandiae</i>	Silver Gull	Ma				x			x		
<i>Gelochelidon nilotica</i>	Gull-billed Tern	Ma				x					
<i>Hydroprogne caspia</i>	Caspian Tern	Mi, Ma				x					
<i>Larus pacificus</i>	Pacific Gull	Ma				x					
<i>Onychoprion anaethetus</i>	Bridled Tern	Mi, Ma				x					
<i>Sterna dougallii</i>	Roseate Tern	Mi, Ma				x					
<i>Sternula albifrons</i>	Little Tern	Mi, Ma				x					
<i>Sternula nereis</i>	Fairy Tern					x					
<i>Thalasseus bergii</i>	Crested Tern	Ma				x					
CACATUIDAE											
<i>Cacatua pastinator</i>	Western Corella				x	x			x		
<i>Cacatua sanguinea</i>	Little Corella				x	x			x	x	
<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo				x	x			x	x	
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo	VU	S1		x		x				
<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo	EN	S1		x	x	x	x			
<i>Eolophus roseicapillus</i>	Galah				x	x			x	x	
<i>Nymphicus hollandicus</i>	Cockatiel				x	x				x	

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
PSITTACIDAE											
<i>Barnardius zonarius</i>	Australian Ringneck				x	x			x	x	
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet					x					
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo		S4		x	x					
<i>Melopsittacus undulatus</i>	Budgerigar				x	x					
<i>Neophema elegans</i>	Elegant Parrot					x					
<i>Neopsephatus bourkii</i>	Bourke's Parrot				x	x					
<i>Pezoporus wallicus</i> subsp. <i>flaviventrus</i>	Western Ground Parrot	EN	S1		x		x				
<i>Polytelis anthopeplus</i>	Regent Parrot				x	x					
<i>Psephotus varius</i>	Mulga Parrot				x	x			x	x	
CUCULIDAE											
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	Ma			x	x			x		
<i>Cacomantis pallidus</i>	Pallid Cuckoo	Ma			x	x					
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo	Ma			x	x					
<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	Ma			x	x				x	
<i>Chalcites osculans</i>	Black-eared Cuckoo	Ma			x	x					
STRIGIDAE											
<i>Ninox novaeseelandiae</i>	Southern Boobook	Ma			x	x			x		
TYTONIDAE											
<i>Tyto javanica</i>	Eastern Barn Owl				x	x			x	x	
ALCEDINIDAE											
<i>Dacelo novaeguineae</i>	Laughing Kookaburra					x					
<i>Todiramphus pyrrophygius</i>	Red-backed Kingfisher				x	x				x	
<i>Todiramphus sanctus</i>	Sacred Kingfisher	Ma			x	x			x	x	
MEROPIIDAE											
<i>Merops ornatus</i>	Rainbow Bee-eater	Mi, Ma			x	x		x	x	x	
CLIMACTERIDAE											
<i>Climacteris rufa</i>	Rufous Treecreeper				x	x			x		
PTILONORHYNCHIDAE											
<i>Ptilonorhynchus guttatus</i>	Western Bowerbird					x					
MALURIDAE											
<i>Malurus lamberti</i>	Variegated Fairy-wren				x	x			x	x	
<i>Malurus leucopterus</i>	White-winged Fairy-wren				x	x			x	x	
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren				x	x			x		
<i>Malurus splendens</i>	Splendid Fairy-wren				x	x			x	x	
PARDALOTIDAE											
<i>Acanthiza apicalis</i>	Inland Thornbill				x	x			x		
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				x	x			x	x	
<i>Acanthiza inornata</i>	Western Thornbill					x					
<i>Acanthiza iredalei</i> subsp. <i>iredalei</i>	Slender-billed Thornbill (western)	VU						x			
<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill				x	x					
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill				x	x			x	x	
<i>Aphelocephala leucopsis</i>	Southern Whiteface				x	x			x		

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
<i>Calamanthus campestris</i>	Rufous Fieldwren					x					
<i>Gerygone fusca</i>	Western Gerygone				x	x			x	x	
<i>Pardalotus punctatus</i>	Spotted Pardalote								x		
<i>Pardalotus striatus</i>	Striated Pardalote				x	x			x	x	
<i>Pyrrholaemus brunneus</i>	Redthroat				x	x			x		
<i>Sericornis frontalis</i>	White-browed Scrubwren				x	x			x		
<i>Smicronis brevirostris</i>	Weebill				x	x			x	x	
MELIPHAGIDAE											
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				x	x			x	x	
<i>Anthochaera carunculata</i>	Red Wattlebird				x	x					
<i>Anthochaera lunulata</i>	Western Wattlebird					x					
<i>Certhionyx variegatus</i>	Pied Honeyeater				x	x			x		
<i>Epthianura albifrons</i>	White-fronted Chat				x	x			x		
<i>Epthianura aurifrons</i>	Orange Chat				x	x			x		
<i>Epthianura tricolor</i>	Crimson Chat				x	x			x		
<i>Glyciphila melanops</i>	Tawny-crowned Honeyeater				x	x					
<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater					x					
<i>Lichenostomus leucotis</i>	White-eared Honeyeater					x			x	x	
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater				x	x					
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater				x	x			x		
<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater				x						
<i>Lichenostomus virescens</i>	Singing Honeyeater				x	x			x	x	
<i>Lichmera indistincta</i>	Brown Honeyeater				x	x			x	x	
<i>Manorina flavigula</i>	Yellow-throated Miner				x	x			x	x	
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				x	x					
<i>Phylidonyris niger</i>	White-cheeked Honeyeater				x	x			x		
<i>Purnella albifrons</i>	White-fronted Honeyeater				x	x			x	x	
<i>Sugomel niger</i>	Black Honeyeater				x	x					
POMATOSTOMIDAE											
<i>Pomatostomus superciliosus</i>	White-browed Babbler				x	x			x		
<i>Pomatostomus superciliosus</i> subsp. <i>ashbyi</i>	White-browed Babbler (Western Wheatbelt)			P4	x		x				
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler					x				x	
EUPETIDAE											
<i>Cinlosoma castaneothorax</i>	Chestnut-breasted Quail-thrush					x					
<i>Cinlosoma castanotum</i>	Chestnut Quail-thrush				x	x			x		
<i>Psophodes occidentalis</i>	Chiming Wedgebill					x					
NEOSITTIDAE											
<i>Daphoenositta chrysoptera</i>	Varied Sittella				x						
CAMPEPHAGIDAE											
<i>Coracina maxima</i>	Ground Cuckoo-shrike					x					
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	Ma			x	x			x	x	
<i>Lalage sueurii</i>	White-winged Triller				x	x					

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
PACHYCEPHALIDAE											
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				x	x			x	x	
<i>Daphoenositta chrysoptera</i>	Varied Sittella					x					
<i>Oreica gutturalis</i>	Crested Bellbird				x	x			x		
<i>Oreica gutturalis</i> subsp. <i>gutturalis</i>	Crested Bellbird (Southern)			P4	x		x				
<i>Pachycephala pectoralis</i>	Golden Whistler				x	x			x		
<i>Pachycephala rufiventris</i>	Rufous Whistler				x	x			x	x	
ARTAMIDAE											
<i>Artamus cinereus</i>	Black-faced Woodswallow				x	x			x	x	
<i>Artamus cyanopterus</i>	Dusky Woodswallow				x	x					
<i>Artamus minor</i>	Little Woodswallow					x			x		
<i>Artamus personatus</i>	Masked Woodswallow					x					
<i>Cracticus nigrogularis</i>	Pied Butcherbird				x	x			x	x	
<i>Cracticus tibicen</i>	Australian Magpie				x	x			x	x	
<i>Cracticus torquatus</i>	Grey Butcherbird				x	x			x	x	
<i>Strepera versicolor</i>	Grey Currawong				x	x				x	
RHIPIDURIDAE											
<i>Rhipidura albiscapa</i>	Grey Fantail				x	x			x		
<i>Rhipidura leucophrys</i>	Willie Wagtail				x	x			x	x	
CORVIDAE											
<i>Corvus bennetti</i>	Little Crow				x	x			x		
<i>Corvus coronoides</i>	Australian Raven				x	x			x	x	
<i>Corvus orru</i>	Torresian Crow				x	x					
MONARCHIDAE											
<i>Grallina cyanoleuca</i>	Magpie-lark	Ma			x	x			x	x	
PETROICIDAE											
<i>Drymodes brunneopygia</i>	Southern Scrub-robin				x	x			x		
<i>Eopsaltria georgiana</i>	White-breasted Robin					x			x		
<i>Eopsaltria griseogularis</i>	Western Yellow Robin				x	x			x	x	
<i>Melanodryas cucullata</i>	Hooded Robin				x	x					
<i>Microeca fascinans</i>	Jacky Winter				x	x				x	
<i>Petroica goodenovii</i>	Red-capped Robin				x	x			x	x	
ACROCEPHALIDAE											
<i>Acrocephalus australis</i>	Australian Reed-Warbler				x	x					
MEGALURIDAE											
<i>Cincloramphus cruralis</i>	Brown Songlark				x	x			x		
<i>Cincloramphus mathewsi</i>	Rufous Songlark				x	x			x		
<i>Megalurus gramineus</i>	Little Grassbird					x					
TIMALIIDAE											
<i>Zosterops lateralis</i>	Silvereye	Ma			x	x			x	x	

BIRDS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
HIRUNDINIDAE											
<i>Cheramoeca leucosterna</i>	White-backed Swallow				x	x			x	x	
<i>Hirundo neoxena</i>	Welcome Swallow	Ma			x	x			x	x	
<i>Petrochelidon ariel</i>	Fairy Martin				x	x				x	
<i>Petrochelidon nigricans</i>	Tree Martin	Ma			x	x			x		
NECTARINIIDAE											
<i>Dicaeum hirundinaceum</i>	Mistletoebird				x	x			x	x	
ESTRILDIDAE											
<i>Taeniopygia guttata</i>	Zebra Finch				x	x			x	x	
MOTACILLIDAE											
<i>Anthus novaeseelandiae</i>	Australasian Pipit	Ma			x	x			x	x	

[X] fauna species recorded.

[*] denotes introduced species.

APPENDIX D

D4: MAMMALIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPAC Protected Matters Search Tool, E = Recorded in Previous Fauna Surveys, F = Recorded in the Current Survey.

Note: For Definitions of Conservation Codes see Appendix A.

MAMMALS		Conservation Codes									
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F	
TACHYGLOSSIDAE											
<i>Tachyglossus aculeatus</i>	Echidna				x				x		
DASYURIDAE											
<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart				x				x		
<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart				x				x	x	
MYRMECOBIIDAE											
<i>Myrmecobius fasciatus</i>	Numbat	VU	S1		x		x				
MACROPODIDAE											
<i>Macropus fuliginosus</i>	Western Grey Kangaroo				x				x	x	
<i>Macropus robustus</i> subsp. <i>erubescens</i>	Euro				x				x		
<i>Macropus rufus</i>	Red Kangaroo				x				x	x	
<i>Macropus irma</i>	Western Brush Wallaby			P4			x				
<i>Petrogale lateralis</i> subsp. <i>lateralis</i>	Black-footed Rock-wallaby	VU	S1				x				
TARSIPEDIDAE											
<i>Tarsipes rostratus</i>	Honey Possum				x						
VESPERTILIONIDAE											
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				x				x	x	
<i>Chalinolobus morio</i>	Chocolate Wattled Bat				x						
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat				x				x		
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat								x		
<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat								x		
<i>Vespadelus regulus</i>	Southern Forest Bat								x		
MOLOSSIDAE											
<i>Mormopterus planiceps</i>	Southern Freetail-bat				x						
<i>Tadarida australis</i>	White-striped Freetail-bat				x				x	x	

MAMMALS		Conservation Codes								
		EPBC	WC	DEC	A	B	C	D	E	F
Scientific Name	Common Name									
MURIDAE										
* <i>Mus musculus</i>	House Mouse				x				x	x
<i>Notomys alexis</i>	Spinifex Hopping-mouse				x					
<i>Notomys mitchellii</i>	Mitchell's Hopping-mouse				x					
<i>Pseudomys albocinereus</i>	Ash-grey Mouse				x					
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse				x				x	
* <i>Rattus rattus</i>	Black Rat								x	
LEPORIDAE										
* <i>Oryctolagus cuniculus</i>	Rabbit				x				x	x
CANIDAE										
* <i>Vulpes vulpes</i>	Red Fox				x				x	x
BOVIDAE										
* <i>Bos taurus</i>	European Cattle				x				x	
* <i>Capra hircus</i>	Goat								x	
FELIDAE										
* <i>Felis catus</i>	Cat								x	x

[X] fauna species recorded.

[*] denotes introduced species.

APPENDIX D

D5: ARACHNID SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPAC Protected Matters Search Tool, E = Recorded in Previous Fauna Surveys, F = Recorded in the Current Survey.

Note: For Definitions of Conservation Codes see Appendix A.

MAMMALS		Conservation Codes								
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E	F
<i>Aganippe castellum</i>	Tree-stem Trapdoor Spider			P4	x		x			
<i>Idiosoma nigrum</i>	Shield-backed Trapdoor Spider		S1		x		x			

[X] fauna species recorded.

[*] denotes introduced species.

APPENDIX E

**CONSERVATION SIGNIFICANT FAUNA
PREVIOUSLY RECORDED WITHIN THE
VICINITY OF THE
SURVEY AREA**

WESTNET RAIL UPGRADE – NARNGULU TO TILLEY (MORAWA) FAUNA ASSESSMENT

APPENDIX E

CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED WITHIN THE VICINITY OF THE SURVEY AREA

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Reptiles				
Gilled Slender Blue-tongue	S1	The Gilled Slender Blue-tongue has a fragmented distribution from inland Murchison to the interior of the Yalgoo bioregion (Wilson and Swan 2008). The Gilled Slender Blue-tongue inhabits semi-arid shrublands on red sand often sheltering in spinifex, leaf litter and fallen timber (Wilson and Swan 2008).	The Shrubland and Woodland habitat types of the survey area are suitable habitat for this species. However no recent sightings of this species near the survey area have been recorded (DEC 2010a).	Possible
Western Spiny-tailed Skink	EN, S1	The Western Spiny-tailed Skink is a subspecies of spiny-tailed skink, <i>Egernia stokesii badia</i> . One population of the Western Spiny-tailed Skink is known to occur from Mullewa south to Kellerberrin (Storr, Smith and Johnstone 1999). This species is known to occur in hollow logs in woodland habitat and rocky crevices in rocky outcrops, and in particular in Banded Iron Formations (Wilson and Swan 2008). There are two forms of Western Spiny-tailed Skink that occur in the region; the brown and the black forms. Each of these is found in different habitat types, the brown form prefers Woodland areas whereas the black form prefers rocky habitats that contain crevices and boulders (SEWPAC 2010c).	The Woodland habitat type in the survey area is suitable habitat for this species and numerous records near the survey area have been documented (DEC 2010a).	Likely



Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Lined Skink	P3	The Lined Skink occurs in sandy coastal heath and shrubland areas in isolated populations in the south-west and mid-west coast of Western Australia, in disjunct and isolated populations (Wilson and Swan 2008). This burrowing species is found in loose soil or sand beneath logs and termite mounds, where it feeds on termites and other small insects (Cogger 2000).	The survey area does not contain the coastal heath which is the preferred habitat for this species and is also outside of the known distribution for this species.	Unlikely
<i>Lerista yuna</i>	P3	The skink <i>Lerista yuna</i> occurs in the semi-arid western interior in the vicinity of Yuna (Wilson and Swan 2008). This species is found in the pale sand plains sheltering in the soft soil under leaf litter around the base of shrubs (Wilson and Swan 2008).	The limited distribution and lack of suitable substrate (pale sand) suggests this species is unlikely to occur within the survey area.	Unlikely
Woma (South-west population)	S4, P1	The Woma occurs in myrtaceous heaths on sandplains and dune fields, hummock grasslands, shrublands or woodlands and shelters in animal burrows, hollow logs or under grass hummocks. (Wilson and Swan 2008, Storr, Smith and Johnstone 2002, Cogger 2000).	The Shrubland and Woodland habitat types of the survey area are suitable habitat for this species. However recent records from around the survey area are scarce (DEC 2010a).	Possible
Carpet Python	S4	The south-western population of the Carpet Python has a wide distribution in the south-west, but is generally uncommon, having been recorded from semi-arid coastal and inland habitats, <i>Banksia</i> woodland, eucalypt woodlands, and grasslands. It commonly utilises hollow logs for shelter (Wilson and Swan 2008).	The Shrubland and Woodland habitat types of the survey area are suitable habitat for this species. However this species distribution has retracted significantly over past few decades and is now only relatively distributed south of Perth in the south-west of Western Australia.	Unlikely
Birds				
Malleefowl	VU, S1, Mi	The habitat of the Malleefowl can broadly be described as semi-arid areas and remnant vegetation in the agricultural zones of south-west WA. It prefers woodland or shrubland with an abundant litter layer	Two Malleefowl were recorded within the survey area during the survey. Both were recorded in reserves along the Mullewa to Morawa section of the railway (Appendix F,	Recorded



Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
		that provides essential material for the construction of its nest mound. The Malleefowl creates a nesting mound that is made from sand or soil, leaf litter, twigs and bark and are usually 4 or 5 m in diameter (SEWPAC 2010c). The main danger to the species lies in land clearing, predation by introduced predators and altered fire regimes (SEWPAC 2010c).	Figure 5 a-c). The Shrubland and Woodland habitat types of the survey area are suitable habitat for this species.	
Fork-tailed Swift	Mi	The Fork-tailed Swift is a summer migrant (October-April) to Australia, that has not been recorded breeding in Australia (Barrett <i>et al.</i> 2003). The Fork-tailed Swift is an aerial species, which forages high above the tree canopy and rarely lower so is independent of terrestrial habitats in Australia (Johnstone and Storr 1998). It usually occurs in flocks of up to 2000 and is often seen accompanying Tree Martins and Masked Woodswallows (Johnstone and Storr 1998).	As this species forages high in the airspace it is reasonably independent of the ground habitat. This species may fly over the survey area from time to time but only as a temporary resident.	Possible
Wedge-tailed Shearwater	Mi	The Wedge-tailed Shearwater is a medium-large shearwater in the seabird family Procellariidae. The Wedge-tailed Shearwater breeds in colonies on small tropical islands. Breeding seasons vary depending on location, with synchronised breeding seasons more common at higher latitudes. Northern hemisphere birds begin breeding around February; southern hemisphere birds begin around September. Wedge-tailed Shearwaters feed pelagically on fish, squid and crustaceans largely out at sea.	This species is mainly found out at sea and breeds in the north-west of Western Australia on offshore islands. The project area has no suitable foraging or breeding habitat for this species.	Highly Unlikely
Eastern Great Egret	Mi	The Eastern Great Egret occurs in the Kimberley, Pilbara, and on the west coast from the Murchison River south, throughout the south-west, and east to Cape Arid. This species is considered common to very	This species is likely to inhabit the Samphire and Riverine habitat types within the survey area.	Likely



Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
		common in the Kimberley, and scarce to moderately common elsewhere (Johnstone and Storr 1998). It inhabits mostly shallow fresh lakes, pools in rivers, lagoons, lignum swamps, clay pans and samphire flats, large dams and sewage ponds. It also inhabits shallow saltwater habitat such as mangrove creeks, tidal pools, samphire swamps and salt work ponds. It breeds colonially at wooded swamps and river pools, nesting in riparian trees.		
Cattle Egret	Mi	The Cattle Egret occurs in the wetter parts of Western Australia, in particular the Kimberly and the south-west. The species inhabits short grass, in particular damp pastures and wetlands, usually in the company of cattle and occasionally other livestock. In Western Australia it is an irregular visitor, occurring mostly in autumn, and is not thought to breed regularly in Western Australia (Johnstone and Storr 1998).	The survey area lacks the damp pastures and wetlands which are the preferred habitat for this species.	Unlikely
Eastern Reef Egret	Mi	The Eastern Reef Egret occurs in coastal areas along the entire Western Australian coast, although it is more common in the warmer regions to the north. The species inhabits beaches, rocky shores, tidal rivers and inlets, mangroves, and exposed coral reefs. Although it is listed as migratory, the Eastern Reef Egret is largely sedentary in nature (Johnstone and Storr 1998). This species lay clutches of eggs year round in colonies in the jungle, between palms and mangroves or in cavities of old buildings.	No suitable marine habitats exist within the project area suggesting this species is largely unlikely to occur.	Unlikely
Glossy Ibis	Mi	The Glossy Ibis inhabit areas of freshwater wetlands, estuaries and creeks; with occasional foraging in dry grassland. This bird species is generally uncommon,	No suitable marsh/wetland habitats exist in the project area suggesting this species is unlikely to occur.	Unlikely



Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
		but has a widespread and erratic distribution. The Glossy Ibis nests colonially in trees, often with herons. It is also gregarious when feeding in marshy wetlands; it preys on fish, frogs and other water creatures, as well as occasionally on insects.		
White-bellied Sea-Eagle	Mi	The White-bellied Sea Eagle is distributed along the coast, islands and estuaries of Western Australia but not the lower west and south-west or far east (Johnstone and Storr 1998). They feed on fish, sea snakes and nesting seabirds. Nests are usually placed on high ground such as rock pinnacles, rigid shrubs or in tall trees (Johnstone and Storr 1998).	The White-bellied Sea-Eagle is predominantly marine in nature and the survey area lacks the habitat preferred by this species.	Unlikely
Eastern Osprey	Mi	The Eastern Osprey is distributed along the coast, islands and lower river courses of West Australia. They feed on fish and other marine animals (Johnstone and Storr 1998). They nest in trees, cliffs and sometimes man-made structures such as radio towers, often close to the water.	The Eastern Osprey is predominantly marine in nature and the survey area lacks the habitat preferred by this species.	Unlikely
Peregrine Falcon	S4	The Peregrine Falcon is uncommon but wide-ranging across Australia. They occur mainly along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes. The Peregrine Falcon nests primarily on cliffs, granite outcrops, quarries and in the wheatbelt in old Raven and Whistling Kite nests (Johnstone and Storr 1998).	The Woodland habitat type of the survey area contained mature trees that are potential nesting sites for this species. The Peregrine Falcon may forage both in the Shrubland and Woodland habitat types as part of a wider home range.	Likely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Australian Bustard	P4	The Australian Bustard is typically widespread and nomadic, but locally scarce. This species is distributed across most of Western Australia, although is most prevalent in grasslands, especially tussock grasses, arid scrub and dry open woodlands (Morcombe 2000). The abundance of this species varies according to habitat and season, in particular the abundance of grasshoppers. Habitat loss has led to a decline in this species in the south-west (Johnstone and Storr 1998).	One Bustard was recorded approximately 5km from the rail line in habitat similar to that present in the survey area (Appendix F). The Shrubland and Woodland habitat type provides suitable habitat for this species.	Likely
Bush Stone-curlew	P4	The Bush Stone-curlew inhabits dry open woodlands with groundcover of small sparse shrubs, grass or litter of twigs. It tends to avoid dense forest, closed-canopy habitats (Morcombe 2000). The species generally occurs near a watercourse or swamp (Geering, Agnew and Harding (2007). Bush Stone-curlews are locally rare because of predation by foxes - the main concern for their regional decline (Johnstone and Storr 1998).	The Woodland habitat type provides suitable habitat for this species. However there have been limited records of Bush Stone-curlews in the vicinity of the survey area.	Possible
Little Ringed Plover	Mi	The Little Ringed Plover is a small compact shorebird that is usually found on muddy edges of freshwater wetlands (Geering, Agnew and Harding 2007). This species is considered a vagrant in Western Australia and is rarely found south of the Kimberley region.	No suitable habitat exists in the survey area and the low records for this species in the south-west of Western Australia suggest this species is unlikely to occur.	Highly Unlikely
Greater Sand Plover	Mi	This migratory bird breeds from Turkey to Siberia and migrates to Australian waters in August to May (Pizzey and Knight 2007). It is uncommon to moderately common around Perth and Mandurah. This species requires coastal marine waters for habitat, rarely inland (Simpson and Day 2004).	The site lacks suitable habitat for this species also the Greater Sand Plover is rarely found inland.	Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Grey Plover	Mi	The Grey Plover inhabits coastal areas, preferring marine shores of estuaries or lagoons on broad open mudflats, sandy bars or beaches and rocky coasts as well as coastal salt lakes and swamps (Morcombe 2000). They occasionally are found in drying freshwater lakes (Johnstone and Storr 1998).	This species will not be found in the survey area as there is a lack of suitable habitat present.	Unlikely
Hooded Plover	P4	The Hooded Plover is an Australian endemic shorebird that inhabits sandy beaches, coastal and inland lakes in south-west Western Australia (Simpson and Day 2004, Geering, Agnew and Harding 2007). It occurs in Western Australia from around Geraldton, to Lake Moore, Lake Cowan and Esperance, and along the coast to Eyre (Johnstone and Storr 1998). The Hooded Plover is a uncommon to rare resident on southern sea beaches and inlets, a scarce to moderately common breeding visitor (mostly in winter and spring) to inland salt lakes, and a scarce to common non-breeding visitor (mostly in summer and autumn) to beaches, estuaries and coastal salt lakes (Johnstone and Storr 1998). This species is thought to be locally extinct within the Perth metropolitan area.	The Hooded Plover prefers margins and shallows of salt lakes, sandy and seaweed beaches and estuaries that which are not present within the site. The Samphire habitat type does not provided foraging or sheltering potential for this priority listed species.	Unlikely
Common Sandpiper	Mi	This Migratory bird breeds from the British isles to Siberia and Japan. It migrates to Australian waters in August to May (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species requires marine waters for habitat such as banks, rocks, and sandy beaches (Simpson and Day 2004).	The survey area lacks suitable habitat for this species as they are typically found in more marine environments.	Unlikely



Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Ruddy Turnstone	Mi	This migratory bird breeds in the Arctic and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is moderately common around Perth and Mandurah. This species requires marine waters for habitat preferably rocky shores with seaweed (Simpson and Day 2004).	The site lacks suitable habitat for this species such as rocky shores and sand shorelines found in marine environments.	Unlikely
Sharp-tailed Sandpiper	Mi	This Migratory bird breeds in Siberia and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is common around Perth and Mandurah. This species is found widespread in coastal and interior wetlands (Simpson and Day 2004).	The project area does not contain the preferred habitat for this species.	Unlikely
Sanderling	Mi	The Sanderling is a small compact shorebird and is often found in small to large flocks, mostly on open beaches exposed to surf. This species has also been recorded within inter-tidal mudflats. This species distinctly dashes between waves when feeding and is known at high tide to roost among beach debris (Geering, Agnew and Harding 2007).	The Sanderling is unlikely to be found in the survey area as no suitable marine habitats exist, such as open beaches and intertidal mudflats.	Unlikely
Curlew Sandpiper	Mi	This migratory bird breeds in Siberia and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is abundant to common around Perth and Mandurah. This species is found in coastal and inland mudflats, sometimes saltworks (Simpson and Day 2004).	The survey area lacks suitable habitat for this species such as coastal inland mudflats and estuarine environments.	Unlikely
Red-necked Stint	Mi	This migratory bird breeds in Siberia and Alaska and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is abundant to common around Perth and Mandurah during this time. This species requires marine waters for habitat such as coastal and inland shores (Simpson and Day 2004).	This species prefers drying inland freshwater and salt lakes where exposed mud and sand provide foraging and roosting potential. These types of fauna habitats do not exist in the project area.	Unlikely



Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Bar-tailed Godwit	Mi	The Bar-tailed Godwit a relatively common summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia and typically inhabits inter-tidal mudflats (Geering, Agnew and Harding 2007).	This species usually prefers intertidal mudflats for foraging which is not present in the survey area.	Unlikely
Black-tailed Godwit	Mi	The Black-tailed Godwit is an uncommon summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia (Geering, Agnew and Harding 2007). It inhabits fresh and brackish wetlands as well as inter-tidal mudflats (Geering, Agnew and Harding 2007). This Migratory bird breeds off the coast of Mongolia and Siberia. It migrates to Australian waters in September to May (Pizzey and Knight 2007).	No inter-tidal mudflats are present in the survey area therefore it is unlikely this species will occur.	Unlikely
Little Curlew	Mi	The Little Curlew is strongly migratory, travelling from mid-August to October along the coast of eastern Asia on a narrow front with few stop-overs (del Hoyo <i>et al.</i> 1996). The wintering grounds in Australia for this species is typically short, dry grasslands and sometimes on artificially grassed areas such as lawns, racecourses, sides of roads and airfields (Geering, Agnew and Harding 2007). This species has also been recorded on dry mudflats and coastal plains of black soil (Johnsgard 1981) with scattered shallow pools of freshwater (Higgins and Davies 1996), swamps, lakes or flooded ground.	This species will not be found in the survey area as there is a lack of suitable habitat present.	Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Whimbrel	Mi	This migratory bird breeds off the coast of Siberia and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is moderately common in the coastal areas around Perth and Mandurah. This species prefers coastal estuaries, mudflats and mangroves (Simpson and Day 2004).	The Whimbrel prefers marine environments which are mainly influence by tidal patterns allowing foraging opportunities on exposed mud and sand flats. This type of fauna habitat is absent from the site making this species unlikely to occur.	Unlikely
Red-necked Phalarope	Mi	In Australia the Red-necked Phalarope is found mainly on shallow, near coastal wetlands, in water ranging from fresh to saline. It is a rare but regular migrant to north-west Australia but is irregularly recorded in other parts of the country (Geering, Agnew and Harding 2007).	This species will not be found in the survey area as there is a lack of suitable habitat present. This species is rarely recorded out of the north-west of Western Australia.	Highly Unlikely
Grey-tailed Tattler	Mi	This migratory bird breeds in Siberia and migrates to Australian waters in September to April (Pizzey and Knight 2007). It is a common species around Perth and Mandurah. This species requires marine waters for habitat such as estuaries, mangroves, rocky coasts and reefs (Simpson and Day 2004).	The site lacks suitable habitat for this species such as tidal mud and reef flats, estuaries and mangroves.	Unlikely
Wood Sandpiper	Mi	The Wood Sandpiper is a summer non-breeding migratory shorebird that occurs along the coast and inland regions of Western Australia. It primarily inhabits freshwater wetlands and rarely inter-tidal mudflats (Geering, Agnew and Harding 2007).	No freshwater wetlands such as shallows swamps and drying lakes exist in the project area, suggesting this species is unlikely to occur.	Unlikely
Common Greenshank	Mi	This migratory bird breeds from Scotland to Siberia and migrates to Australian waters in September to April (Pizzey and Knight 2007). It is commonly found around Perth and Mandurah. This species prefers estuaries, inland lakes and open swamps (Simpson and Day 2004).	Shallow fresh waters (claypans, lagoons, open swamps, river pools and dams) do not exist within the survey area making this species unlikely to occur.	Unlikely



Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Arctic Jaeger	Mi	This Migratory bird breeds throughout the Arctic and migrates to Australian waters in October to April (Pizzey and Knight 2007). The Arctic Jaeger is a summer migrant to the region. This species is oceanic as well as coastal bays, rarely in large sub-coastal wetlands (Simpson and Day 2004).	This species preferred habitat type does not exist in the project area suggesting this species largely unlikely to occur.	Unlikely
Caspian Tern	Mi	The Caspian Tern is distributed along the coast of Western Australia. It is scarce or uncommon north of Broome and uncommon to moderately common further south (Johnstone and Storr 1998). This species inhabits coastal areas as well as inland watercourses, saline and brackish lakes (Simpson and Day 2004).	The Caspian Tern is usually found foraging and sheltering in marine habitats such as beaches and estuaries and inlets. This species may fly over the survey area on an infrequent basis but will not use habitats of the survey area for any purpose.	Unlikely
Bridled tern	Mi	This Migratory bird breeds of the coast of West, North and East Australia (Pizzey and Knight 2007). It is common around Perth and Mandurah. This is oceanic as well as found in coastal regions usually on coastal islands (Simpson and Day 2004).	No suitable habitat such as marine / coastal bays and lagoons exist in the project area suggesting this species is unlikely to occur.	Unlikely
Roseate Tern	Mi	This species breeds in colonies on coasts and islands. It nests in a ground scrape, often in a hollow or under dense vegetation, and lays one or two (rarely three) eggs. It is less defensive of its nest and young than other white terns, often relying on Arctic and Common Terns in the surrounding colony to defend them. Roseate Tern feeds by plunge-diving for fish, almost invariably from the sea; it is much more marine than allied terns, only rarely visiting freshwater lagoons on the coast to bathe and not fishing in fresh water. It usually dives directly, and	This species preferred habitat type does not exist in the project area suggesting this species largely unlikely to occur.	Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
		not from the "stepped-hover" favoured by Arctic Tern.		
Little Tern	Mi	The Little Tern is distributed along the northern coast of Western Australia south to Broome. There are three sub populations that occur, two that breed in Australia and the third that migrates north to breed in Asia but spends the spring/summer in Australia (SEWPAC 2010c). This species inhabits coastal and estuarine areas, breeding on sandy beaches and sand spits (Simpson and Day 2004).	No suitable habitat such as marine / coastal bays and lagoons exist in the project area suggesting this species is unlikely to occur.	Unlikely
Baudin's Cockatoo	VU,S1	Baudin's Cockatoo is distributed through the south-western humid and subhumid zones, from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and across to Albany (Johnstone and Storr 1998). This species forages primarily in Eucalypt forest, where it feeds on Marri seeds (<i>Corymbia calophylla</i>), flowers, nectar and buds (Johnstone and Kirkby 2008). They also feed on a wide range of seeds of <i>Eucalyptus</i> , <i>Banksia</i> and <i>Hakea</i> , as well as fruiting apples and pears and persimmons, as well as Pines, and beetle larvae from under the bark of trees (Johnstone and Kirkby 2008, Johnstone and Storr 1998). Baudin's Cockatoo nests in tree hollows in the deep south-west of Western Australia. Primary nesting trees are Karri (<i>Eucalyptus diversicolor</i>), Marri, and Wandoo (Johnstone and Kirkby 2008).	Baudin's Cockatoos have not been recorded in the vicinity of the survey area for more than thirty years (DEC 2010a) and is now outside the current distribution of this species.	Highly Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Carnaby's Black-Cockatoo	EN, S1	Carnaby's Cockatoo is endemic to south-west Western Australia, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). The species was once common, but the population has declined significantly in the last half century (Johnstone and Storr 1998). Breeding has been recorded from early July to mid-December and usually occurs in the Wheatbelt (Johnstone and Storr 1998). Carnaby's Cockatoos feed on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include <i>Banksia</i> , Pine trees (<i>Pinus</i> spp.), Marri, Jarrah, as well as <i>Grevillea</i> , <i>Allocasuarina</i> , and <i>Hakea</i> (Shah 2006). Trees used as nest sites by Carnaby's Cockatoo are mature, hollow-bearing trees, usually with a crown containing dead limbs and a sparse canopy (Cale 2003, Chapman 2007, Johnstone and Storr 1998). They generally nest in hollows of smooth-barked Eucalypts, especially Salmon Gum (<i>Eucalyptus salmonophloia</i>) and Wandoo (<i>Eucalyptus wandoo</i>), and on the Swan Coastal Plain most nests are in Tuart (Johnstone and Storr 1998).	The Woodlands habitat type provides suitable habitat for this species. However the mature trees within the survey area contain limited hollows and are unsuitable as breeding sites.	Likely
Major Mitchell's Cockatoo	S4	Major Mitchell's Cockatoo has a widespread but disjunct distribution in arid and semi-arid zones of Western Australia (Johnstone and Storr 1998). It prefers open woodland with access to water, and requires Eucalypts with hollows for nesting. It occurs in Mallee, Mulga, Murray Pine and Sheoak-based vegetation (Simpson and Day 2004). The species is in decline because of man-made changes to the landscape, and it cannot tolerate fragmented	The Woodlands habitat type is suitable habitat for this species. However the mature trees within the survey area contain limited hollows and are unsuitable as breeding sites.	Likely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
		landscapes because breeding pairs will not nest close together (Johnstone and Storr 1998).		
Western Ground Parrot	EN, S1	The Western Ground Parrot is patchily distributed along the south coastal area from Denmark to Cape Arid, where it inhabits low dense shrubland (Johnstone and Storr 1998).	The current distribution of this species is far outside of the survey area. All previous records of this species are historical and no longer relevant.	Highly Unlikely
Rainbow Bee-eater	Mi	The Rainbow Bee-eater is a common breeding migrant that occurs in Western Australia in the Kimberley, and Pilbara through to the South-west (Johnstone and Storr 1998). It generally breeds in summer in the greater south-west and occurs as a passage migrant or visitor in the northern part of its range throughout the rest of the year (Johnstone and Storr 1998, Barrett <i>et al.</i> 2003). It occurs in lightly wooded, often sandy country, preferring areas near water. The Rainbow Bee-eater feeds on airborne insects, and nests in burrows excavated in sandy ground or banks, often at the margins of roads and tracks (Johnstone and Storr 1998).	Four individuals were recorded during the survey in both the Shrubland and Woodland habitat types (Appendix F, Figure 5 a-c). This species is also known to occur in the Riverine habitat type.	Recorded
Slender-billed Thornbill (western)	VU	The Slender-billed Thornbill inhabits chenopod shrub steppe, in bluebush, saltbush and samphire as well as dwarf mangroves and low melaleuca. There are several disjunct populations in the southern arid zone as well as an isolated population in coastal areas of Shark Bay (Johnstone and Storr 2004).	The current distribution of this species is far outside of the survey area (Johnstone and Storr 2004).	Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
White-browed Babbler (Western Wheatbelt)	P4	This subspecies of White-browed Babbler inhabits drier, more open forest with shrubby understorey, mallee and Mulga scrub, bushy understorey of Bloodwood and River Gum flats, thickets of <i>Acacia rostellifera</i> and <i>Melaleuca</i> species and partially cleared tracts of dense bush near farmlands (Johnstone and Storr 1998).	Numerous White-browed Babblers were recorded within the survey area during the survey. The region around the survey area contains both the priority subspecies and more common subspecies, it is unclear as to which one was recorded as morphological differences are limited (pers. com. Ron Johnstone).	Likely
Crested Bellbird (Southern)	P4	This subspecies of the Crested Bellbird lives in the shrub layer of eucalypt woodlands, mallee and <i>Acacia</i> shrublands. This species has declined due to land clearing, and is particularly susceptible to habitat fragmentation. It feeds mainly on insects as well as some grass seeds (Johnstone and Storr 2004).	Numerous Crested Bellbirds were recorded within the survey area during the survey. The region around the survey area contains both the priority subspecies and more common subspecies, it is unclear as to which one was recorded as morphological differences are limited (pers. com. Ron Johnstone).	Likely
Mammals				
Numbat	VU,S1	The Numbat is a small, diurnal marsupial that is endemic to Western Australia. This species once ranged widely but due to predation by foxes and cats, loss of habitat due to clearing for agriculture and changes in fire regimes (van Dyck and Strahan 2008). Its current distribution is limited to east of Manjimup in upland Jarrah forests, open eucalypt woodlands, <i>Banksia</i> woodlands and tall closed shrublands, where it shelters in hollow logs and branches and feeds almost exclusively on termites (van Dyck and Strahan 2008).	The current distribution of this species is far outside of the survey area. All previous records of this species are historical and no longer relevant.	Highly Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Western Brush Wallaby	P4	The Western Brush Wallaby occurs in open forest or woodland, particularly where are grassy understorey and scrubby thickets are present (Menkhorst and Knight 2004). It is found only in south-western Western Australia, where it appears to be in decline, probably as a result of an increase in the numbers of foxes.	The Woodland habitat type provides suitable habitat for this species.	Likely
Black-footed Rock-wallaby	VU,S1	The Black-footed Rock-wallaby has a scattered distribution throughout Western Australia. The Black-footed Rock-wallaby uses cliffs, rock-piles, gorges or escarpments for shelter (van Dyck and Strahan 2008, SEWPAC 2010c). The Black-footed Rock-wallaby appears to be highly vulnerable to fox predation (van Dyck and Strahan 2008, SEWPAC 2010c). Remaining populations are generally small and insecure, and are in decline except where foxes are absent (such as islands) or intensively controlled (SEWPAC 2010c).	The current distribution of this species is far outside of the survey area with scattered with populations occurring in the Kimberly, Pilbara and on many coastal islands (van Dyck and Strahan 2008).	Highly Unlikely
Arachnids				
Shield-backed Trapdoor Spider	S1	The Shield-backed Trapdoor Spider is distributed throughout south-west Western Australia from Shark Bay to Narenbeen (DEC 2008a). This species inhabits areas with granite or loam soils in Eucalypt woodlands where it produces a distinct burrow with twigs that are arranged in a moustache-like fashion, with leaves and twigs radiating from the centre of the burrow rim (DEC 2010c).	The Shrubland and Woodland habitat type provides suitable habitat for this species.	Likely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Tree-stem Trapdoor Spider	P4	The Tree-stem Trapdoor Spider is distributed throughout south-west Western Australia from Morowa, south to Merredin and east to Southern Cross (DEC 2008b). This species is found in sandy or gravel loam soils where it produces a distinct burrow that is usually built up against the base or trunk of a tree, usually sheoak or Allocasuarina sp (DEC 2010c). The burrows extend approximately 1cm to 10cm above ground, and commonly make their burrow lid and surrounding triplines from the leaves and bark of the host plant.	The Shrubland and Woodland habitat type provides suitable habitat for this species.	Likely

KEY:

- En** Listed as Endangered under the EBPC Act 1999.
- Vu** Listed as Vulnerable under the EBPC Act 1999.
- Mi** Listed as Migratory under the EBPC Act 1999.
- S** Scheduled under the WC Act 1950. Schedule 1 and 2 fauna are also protected by the EBPC Act 1999.
- P** Listed as Priority by the DEC.
- Recorded** Recorded during the field survey or site reconnaissance.
- Likely** Suitable habitat is present in the site and the site is in the species' known distribution.
- Possible** Limited or no suitable habitat is present in site but is nearby, the species has good dispersal abilities and is known from the general area.
- Unlikely** No suitable habitat is present in site but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however the site is outside of the species' known distribution.
- Highly Unlikely** The species has poor dispersal abilities, no suitable habitat is present, and the species is uncommon; or the species is thought to be locally extinct.



APPENDIX F

ANABAT SUMMARY

APPENDIX F
ANABAT LOCATIONS

Date	Code	Easting	Northing	Habitat	Species of Bat Recorded
5/10/2010	AnaBat 1	289912	6818182	Man-made Dam	White-striped Freetail-bat and Gould's Wattled Bat
6/10/2010	AnaBat 2	339652	6832487	Samphire	White-striped Freetail-bat and Gould's Wattled Bat
7/10/2010	AnaBat 3	340313	6832883	Samphire	White-striped Freetail-bat and Gould's Wattled Bat
10/10/2010	AnaBat 4	368162	6830819	Woodland	White-striped Freetail-bat and Gould's Wattled Bat

#Australian Geocentric 1994 (GDA94) Zone 50K

APPENDIX G

LOCATION OF CONSERVATION SIGNIFICANT FAUNA

APPENDIX G

LOCATION OF CONSERVATION SIGNIFICANT FAUNA

Species Name	Common Name	Listing	#Eastings	#Northings	Vegetation Community Recorded in	Vegetation Description
<i>Ardeotis australis</i>	Australian Bustard	Priority – P4	353928	6849806		Recorded approximately 5 km outside of the survey area in habitat similar to the Woodland habitat type.
<i>Merops ornatus</i>	Rainbow Bee-eater	EPBC – Mi	289956	6818307	EW-AsBm (D)	Woodland of Eucalyptus camaldulensis over Tall Shrubland of Acacia saligna, Exocarpos sparteus, Melaleuca viminea subsp. viminea and Grevillea biternata over Open Shrubland of Grevillea pinaster and Acacia tetragonophylla over Grassland of Briza maxima, Pennisetum setaceum and *Ehrharta longiflora
			295113	6822872	EW-AsBm (D)	Woodland of Eucalyptus camaldulensis over Tall Shrubland of Acacia saligna, Exocarpos sparteus, Melaleuca viminea subsp. viminea and Grevillea biternata over Open Shrubland of Grevillea pinaster and Acacia tetragonophylla over Grassland of Briza maxima, Pennisetum setaceum and *Ehrharta longiflora
			345103	6835560	AS-TsMb	Open Shrubland of Acacia rostellifera over Low Open Shrubland of Thryptomene strongylophylla, Calytrix sp. Paynes Find, Rhagodia drummondii, Grevillea hakeoides subsp. hakeoides, Mirbelia trichocalyx over Very Open Grassland of Ehrharta longiflora, Monachather paradoxus and Austrostipa elegantissima

Species Name	Common Name	Listing	#Eastings	#Northings	Vegetation Community Recorded in	Vegetation Description
			346227	6836084	AS-TsMb	Open Shrubland of <i>Acacia rostellifera</i> over Low Open Shrubland of <i>Thryptomene strongylophylla</i> , <i>Calytrix</i> sp. Paynes Find, <i>Rhagodia drummondii</i> , <i>Grevillea hakeoides</i> subsp. <i>hakeoides</i> , <i>Mirbelia trichocalyx</i> over Very Open Grassland of <i>Ehrharta longiflora</i> , <i>Monachather paradoxus</i> and <i>Austrostipa elegantissima</i>
<i>Leipoa ocellata</i>	Malleefowl	EPBC – VU,S1,Mi	387987	6804070	AT-CoBG	Tall Shrubland of <i>Acacia acuminata</i> , <i>Acacia stereophylla</i> var. <i>stereophylla</i> and <i>Casuarina obesa</i> over Shrubland of <i>Baeckea</i> sp. Gutha (B.L. Rye 239041 & M.E. Trudgen), <i>Grevillea obliquistigma</i> subsp. <i>Funicularis</i> , <i>Melaleuca cordata</i> , <i>Allocasuarina campestris</i> and <i>Grevillea paradoxa</i>
			385435	6806755	ET-MuAsAa	Very Open Tree Mallee of <i>Eucalyptus loxophleba</i> subsp. <i>Supralaevis</i> over Tall Shrubland of <i>Melaleuca uncinata</i> , <i>Acacia sibina</i> and <i>Melaleuca eleuterostachya</i> over Low Open Shrubland of <i>Acacia andrewsii</i>

#Australian Geocentric 1994 (GDA94) Zone 50K

APPENDIX H

LOCATION OF MATURE TREES FOR CARNABY'S COCKATOOS

APPENDIX H

APPENDIX H1: LOCATION OF MATURE TREES FOR CARNABY'S COCKATOOS

Habitat Tree Location	Species Name	Eastings	Northings	DBH	Height	Number of Mature Trees	Number and Size of Hollows
HT1	<i>Eucalyptus Wandoo</i>	300586	6829847	0.8m	25m	4	3-4 Small hollows
HT2	<i>Eucalyptus loxophleba</i>	364163	6835586	0.75-0.9m	15-20m	3	1 Tree has 1 large hollow, The other two have 2-3 small hollows
HT3	<i>Eucalyptus loxophleba</i>	364352	6834810	1m	20m	1	2 Small hollows
HT4	<i>Eucalyptus loxophleba</i>	393474	6797905	0.6-0.8m	15m	20	50% of trees with small hollows and 10% with medium hollows.
HT5	<i>Eucalyptus loxophleba</i>	399184	6790553	0.8m	15m	4	No hollows
HT6	<i>Eucalyptus loxophleba</i>	401219	6780443	0.9m	15m	1	1 Small hollow
HT7	<i>Eucalyptus loxophleba</i>	402241	6778124	0.8m	17m	1	1 Small hollow

#Australian Geocentric 1994 (GDA94) Zone 50K

APPENDIX H2: PHOTOGRAPHS OF MATURE TREES FOR CARNABY'S COCKATOOS

Habitat Tree Location	Photograph
HT1	


Habitat Tree Location	Photograph
HT2	

Habitat Tree Location	Photograph
HT3	

Habitat Tree Location	Photograph
HT4	

Habitat Tree Location	Photograph
HT5	 A photograph showing a large, spreading tree with green and brown foliage in a dry, open landscape under a clear blue sky. The ground is reddish-brown soil with sparse, dry vegetation. The tree is the central focus, with several smaller trees visible in the background.

Habitat Tree Location	Photograph
HT6	

Habitat Tree Location	Photograph
HT7	

APPENDIX I

**LIST OF CARNABY'S COCKATOO
FORAGING RESOURCES RECORDED IN
THE SURVEY AREA**

APPENDIX I

LIST OF CARNABY'S COCKATOO FORAGING RESOURCES RECORDED AS DOMINANT SPECIES IN THE SURVEY AREA

Foraging Species	Common Name	Habitat Type
<i>Banksia attenuata</i>	Slender <i>Banksia</i>	Shrubland
<i>Dryandra sessilis</i>	Parrot bush	Shrubland
<i>Grevillea paradoxa</i>	Bottlebrush <i>Grevillea</i>	Shrubland
<i>Hakea trifurcata</i>	Two-leaved <i>Hakea</i>	Shrubland and Woodland

Reference: Birds Australia 2008