



Kwinana Freeway Widening Project

Biological Survey

Main Roads WA

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➔ The Power of Commitment



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Executive Summary

As part of the Smart Freeway initiative based on Maximum Sustainable Flow Rate requirements contained in the Smart Freeways guidelines Main Roads Western Australia (Main Roads) is planning to widen the Kwinana Freeway from Roe Highway south to Mortimer Road and upgrade the Mundijong and Safety Bay Road on ramps.

GHD Pty Ltd (GHD) was commissioned by Main Roads to undertake a Detailed and Targeted flora and vegetation survey, Floristic Community Type (FCT) assessment, Basic fauna survey, including a Targeted Short-Range Endemic (SRE) survey for signs of burrows of the trapdoor spider (*Idiosoma sigillatum*) and Targeted Black Cockatoo habitat assessment, and wetland assessment of the survey area. The survey area is located along the alignment of the Kwinana Freeway, beginning at the Roe Highway intersection and consists of three sections:

- Kwinana Freeway from the intersection of Roe Highway south to Mortimer Road
- Kwinana Freeway, Mundijong intersection west
- Kwinana Freeway, Safety Bay Road intersection west

Combined, the survey area covers 285.44 hectares (ha) and is approximately 27 kilometres (km) in extent north to south.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.5 and the assumptions and qualifications contained throughout the Report.

Vegetation

Most of the survey area consisted of Cleared areas (173.87 ha, 60.9%) and roadside revegetation (92.65 ha, 32.5%) from circa 2002 or before. Native vegetation covered 18.92 ha (6.6%) of the survey area. In some sections, particularly where the revegetation lies adjacent to remnant vegetation the revegetation has been mapped using a consistent vegetation type to the native vegetation extents. This is because endemic flora species were selected when these areas were revegetated and as a result the revegetation has integrated with adjacent remnant bushland. Five native vegetation types were mapped for the survey area three *Banksia* woodland types, one *Corymbia calophylla* woodland and a wetland vegetation type. Another five vegetation types were mapped for the roadside revegetation. These vegetation types have been grouped under roadside revegetation and were split to assist with Black Cockatoo foraging habitat mapping. Infrastructure such as roads and houses were mapped as Cleared.

A FCT analysis was performed using native vegetation quadrats. However, the native vegetation of the survey area were generally fragmented linear extents where the quality of the vegetation was variable. As a result, not all quadrats were able to be placed in vegetation of good or better condition. For the analysis ten Kwinana quadrats and 17 Roe Highway quadrats (GHD, 2025) were used. Roe Highway quadrats were used to supplement the Kwinana data due to the vegetation quality in the survey area. From the analysis four FCTs were determined, wetland community 11 and *Banksia/Eucalyptus* communities 21a, 23a and 28. None of the FCTs identified in the survey area are listed as Threatened Ecological Communities (TECs) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or *Biodiversity Conservation Act 2016* (BC Act), nor are they listed as Priority Ecological Communities (PECs) by Department of Biodiversity, Conservation and Attractions (DBCA).

Vegetation condition was variable throughout the survey area and ranged from Very Good to Completely Degraded. Apart from Cleared areas (which were not rated) most of the survey area was in Completely Degraded condition (89.30 ha, 31.3%). The poor condition of the survey area was reflected in the patch assessments for significant vegetation. Patch and condition thresholds were applied to patches of remnant vegetation considered representative of *Banksia* Woodlands of the Swan Coastal Plain Ecological Community and/or Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain, EPBC Act listed TECs and DBCA listed PECs. The results of the patch assessments concluded 13.34 ha of the *Banksia* Woodlands of the SCP TEC and PEC and 2.56 ha of the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP TEC and PEC occur within the survey area.

Two hundred and twenty vascular flora species were recorded in the survey area, none of these species were EPBC Act listed taxa. Three significant flora species were recorded, however two of these species are considered

naturalised and therefore they are not bound by the regulatory requirements for significant species as listed by the EPBC Act and/ or BC Act or DBCA.:

- *Jacksonia gracillima* (P3)
- *Grevillea curviloba* listed as Endangered under the BC Act (naturalised)
- *Grevillea olivacea* (P4) (naturalised)

The likelihood of occurrence assessment post-field survey concluded one taxon was known and recorded in the survey area during the survey (*Jacksonia gracillima*) and two taxa were considered possibly to occur.

Of the 240 flora species recorded 64 were introduced. Five of the introduced species are listed as Declared Pest (DP) plants in Western Australia under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), two are also listed as Weeds of National Significance (WoNS) (Australian Weeds Committee, 2012).

Wetlands

Thirty-four geomorphic wetlands had been mapped across the survey area by DBCA (2024c). A Preliminary wetland evaluation was carried out on eight Conservation category and one Resource Enhancement wetland. Upon completion it was determined that a secondary evaluation (DBCA, 2017a) was not required as all nine wetlands met the preliminary criteria as detailed in DBCA (2017a) to meet the Conservation category. Resource Enhancement wetland UFI 6664 was deemed fit to be upgraded to a Conservation category. This wetland was dissected by an existing freeway noise/screening wall, with the extent considered Conservation category occurring outside the survey area.

The remaining 25 wetlands intersecting the survey area were not evaluated, as they had been subject to high levels of clearing or fragmentation, had lost functionality, or were classified as a Dryland by DBCA.

Fauna Habitats

Eight broad fauna habitat types were identified across the survey, including cleared areas that accounts for 60.9% of the total survey area. Habitats are generally highly degraded in most areas due to survey area location in an extensively urbanised landscape. Habitat remnants are highly fragmented and subject the long-term degradation from the effects of weed invasion, landscape modification, and vegetation loss. Habitat present does provide suitable foraging and shelter for several locally occurring significant fauna.

The regional scale setting of the survey area is within the Swan Coastal Plain which is known for its high fauna biodiversity. This is reflected in the desktop assessment database list showing a diverse assemblage totalling 54 species including migratory shorebirds, and a range of mammals, reptiles and invertebrates occurring within the region. Even though this list is comprehensive, the characteristics, quality and extent within the survey area limit the types of species likely to occur and potentially use the habitat. For example, there are approximately 20 Migratory shore birds occurring locally due to proximity of the survey area to Ramsar, coastal and estuarine wetlands, therefore locally occurrence is well documented and frequent, however habitat within the survey area is marginal to unsuitable.

Significant fauna

Carnaby's Cockatoo was recorded during the field survey at several locations from sightings and foraging evidence in Banksia woodland habitats. Suitable diameter breast height (DBH) potential breeding trees and potential roosting habitat includes Naturalised and native trees, and Modified wetland drainage areas.

Forest Red-tailed Black Cockatoo was observed and heard calling at several locations and foraging evidence recorded at several locations across the survey area. Suitable DBH potential breeding trees and potential roosting habitat includes Naturalised and Native trees, and Modified wetland drainage areas.

Baudin's Cockatoo was not recorded during the survey but is known to occasionally forage and roost regionally. The survey area is located on the western edge of current known foraging distribution and lies outside the known breeding range of this species, which has a bearing on the habitat suitability and value for this cockatoo. Baudin's Cockatoo should be considered an occasional visitor however this is only likely to be in the context of temporary fly-over activity or rare and temporary foraging activity.

In terms of Black Cockatoo foraging habitat the following foraging values and extents were mapped:

- Carnaby's Black Cockatoo – 26.67 ha (mod-high)
- Forest Red-tailed Black Cockatoo – 1.97 ha (high), 14.40 ha (mod) and 10.30 ha (low)

In terms of Black Cockatoo breeding habitat, 44 suitable DBH trees without breeding hollows were recorded within the survey area comprising Marri, Flooded Gum, Tuart, and Jarrah trees. It is noteworthy that many of these are replanted trees and while they ultimately carry the potential as future breeding trees, this is unlikely to be the case for at least another 50 to 100 years in some cases.

Although no confirmed roosts occur within the survey area, 40 individual tree groupings of suitable height, species type and location were assessed as potential roost habitat based on suitable roosting habitat criteria.

Quenda were recorded from signs of foraging during the field survey and scat confirming species' presence within the survey area. Numerous local records indicate populations persisting in small, fragmented bushland areas within and around the survey area. Dense remnant and modified vegetation provides habitat for this species.

Several species of vertebrate and invertebrate occurring locally were not recorded during the survey but are likely to occur based on habitat suitability and proximity of records including Peregrine Falcon (OS), Perth Slider (P3), Black-striped Snake (P3), Swan Coastal Plain Shield-backed Spider (P3), Blue-billed Duck (P4), and Graceful Sun Moth (P4).

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1. Introduction

1.1 Background

As part of the Smart Freeway initiative based on Maximum Sustainable Flow Rate requirements contained in the Smart Freeways guidelines Main Roads Western Australia (Main Roads) is planning to widen a section of the Kwinana Freeway between Roe Highway south to Mortimer Road, with upgrades to on ramps at Mundijong Road and Safety Bay Road.

GHD Pty Ltd (GHD) was commissioned by Main Roads to undertake a Detailed and Targeted, flora and vegetation survey, including a Floristic Community Type (FCT) assessment, a Basic fauna survey including a Targeted Short-Range Endemic (SRE) survey for trapdoor spider (*Idiosoma sigillatum*) burrows and Targeted Black Cockatoo habitat assessment, and wetland assessment of the survey area.

1.2 Purpose of this report

GHD was commissioned by Main Roads to assess the biological values within the survey area. The purpose of this report is to document the biological values identified during the survey. The outcome of the survey and information supplied in this biological survey report will be used to inform the environmental assessment and approvals process and refinement of the proposals design. The results of the biological survey may also assist in the preparation of Environmental Impact Assessment documentation.

1.3 Project location

1.3.1 Survey area

The survey area is located along the alignment of the Kwinana Freeway, beginning at the Roe Highway intersection 14 kilometres (km) south of Perth. The survey area consists of three sections:

- Kwinana Freeway from the intersection of Roe Highway south to Mortimer Road
- Kwinana Freeway, Mundijong intersection west
- Kwinana Freeway, Safety Bay Road intersection west.

With the three sections combined, the survey area covers 285.44 hectares (ha) and is approximately 27 km in extent north to south (Figure 1, Appendix A).

1.3.2 Context vegetation area

Context area mapping was undertaken to broadly identify vegetation patterns and vegetation units immediately adjacent to the survey area. The area represents a 500 m buffer of the three sections of the survey area.

1.3.3 Study area

A study area was defined using a 5 km buffer around each of the three sections of the survey area for the desktop search assessment.

1.4 Scope of works

GHD and Main Roads agreed the scope of work for the current project and biological survey includes the following for the survey area:

- A desktop assessment of the study area, prior to the field survey component work to identify biological features and constraints
- A two phase Detailed and Targeted, flora and vegetation survey, including FCT analysis, a Basic fauna survey, a Targeted SRE survey and Targeted Black Cockatoo habitat assessment, and wetland assessment

- One stand-alone technical report covering the flora, vegetation, fauna and Black Cockatoo assessment
- Survey data in electronic format consistent with Index of Biodiversity Surveys for Assessments and Main Roads data standards.

1.5 Report limitations and assumptions

This report has been prepared by GHD for Main Roads WA and may only be used and relied on by Main Roads WA for the purpose agreed between GHD and Main Roads WA as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Main Roads WA arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

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

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

Site conditions may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed desktop environmental aspects and biological factors in the field for the survey area. Should these areas change or be refined, further assessment may be required.

1.6 Relevant legislation, conservation codes and background information

In Western Australia (WA), some ecological communities and flora are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this flora and vegetation survey and fauna survey are provided in Appendix B.

2. Methods

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to the study area and to assist in survey design. The information sources utilised in the desktop assessment are presented in Table 1 below.

Table 1 *Desktop information sources*

Aspect	Information source
Climate	Bureau of Meteorology (BoM) Climate Data Online (BoM, 2024)
Geology, landforms and soil	Department of Primary Industries and Regional Development (DPIRD) soil landscape mapping (DPIRD, 2022)
Environmentally Sensitive Areas (ESAs)	Department of Water and Environmental Regulation (DWER) mapping of Environmentally Sensitive Areas (DWER-046) (DBCA, 2024b, 2024a; DWER, 2018a)
Conservation reserves and areas	Department of Biodiversity, Conservation and Attractions (DBCA) – Legislated Lands and Waters (DBCA – 011) (DBCA, 2024a) DBCA – Lands of Interest (DBCA-012) (DBCA, 2024b)
Hydrology and wetlands	Public Drinking Water Source Areas (DWER-033) (DWER, 2018b) Rights in Water and Irrigation Act 1914 (RIWI Act), Surface Water Areas and Irrigation Districts (DWER-037) (DWER, 2022a) RIWI Act, Groundwater Areas (DWER-034) (DWER, 2022b) RIWI Act, Rivers (DWER-036) (DWER, 2022c) Waterways Conservation Act Management Areas (DWER-072) (DWER, 2018c) Ramsar Sites (DBCA-010) (DBCA, 2017a) Directory of Important Wetlands in Australia - Western Australia (DBCA-045) (DBCA, 2018a) Mapping of internationally significant (RAMSAR) wetlands, Nationally Important Wetlands and Geomorphic wetlands of the Swan Coastal Plain (DBCA, 2017c, 2018, 2024c) (DBCA, 2024c)
Vegetation	Pre-European Vegetation (DPIRD-006) (DPIRD, 2019) Native Vegetation Extent (DPIRD-005) (DPIRD, 2023) State-wide Vegetation Statistics (GoWA, 2019) Broad vegetation mapping of the survey area (Beard, 1979; Heddle et al., 1980) Regional biogeography, including of Interim Biogeographic Regionalisation of Australia (IBRA) mapping (DCCEEW, 2023b) and detailed subregional information from the Department of Conservation and Land Management (CALM) biodiversity audit (CALM, 2002)
Threatened and Priority Ecological Communities (TECs and PECs)	The DBCA Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) database to determine the potential for TECs or PECs to be present within the study area as provided by Main Roads (DBCA, 2024d)
Significant flora and fauna	DBCA Threatened and Priority Flora database (TPFL) and WA Herbarium database (WAHERB) (DBCA, 2024g) DBCA Threatened and Priority Fauna database (DBCA, 2024f). This database contains data from various sources, including Atlas of Australian Birds, BirdLife Australia, DBCA Fauna Survey Returns database and WA Museum (WAM) databases. Black cockatoo breeding and roosting data was also provided as part of the search results DBCA NatureMap database (DBCA, 2024e) (Appendix C)
Matters of National Environmental Significance	EPBC Act Protected Matters Search Tool (PMST) - The Department of Climate Change, Energy, the Environment and Water (DCCEEW, 2024a) (Appendix C)

2.2 Field survey

2.2.1 Survey timing and personnel

GHD Senior Botanists Angela Benkovic (flora licence no. FB62000080-3) and Alex Sleep (flora licence no. FB62000557) completed a two phase, Detailed flora and vegetation survey, Targeted flora search and wetland assessment. The Basic Fauna Survey, Targeted SRE survey and Targeted Black Cockatoo Habitat Assessment was completed by Senior Zoologist/Ecologist Sarah Flemington and Zoologist Melissa Wood. In total 18 person days were used to complete the field survey component (Table 2).

Table 2 Survey timing

Date	Survey type	Survey effort
29 July – 30 July 2024	Wetland assessment, Targeted Flora survey <i>Drakaea elastica</i>	4 person days
16 – 17 September 2024	Targeted Flora and Detailed flora and vegetation survey Basic Fauna Survey, Targeted SRE survey and Targeted Black Cockatoo Habitat Assessment	8 person days
26 and 27 November 2024	Detailed flora and vegetation survey Basic Fauna Survey, Targeted SRE survey and Targeted Black Cockatoo Habitat Assessment	6 person days

2.2.2 Vegetation and flora

The survey methodology and data collection by GHD was consistent with relevant aspects of:

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016)
- A methodology for the evaluation of wetlands on the Swan Coastal Plain (DBCA, 2017a)
- Methods for survey and identification of Western Australian threatened ecological communities (DBCA, 2023a)
- Technical guidance on the Threatened Ecological Community Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain (Main Roads Western Australia, 2021a)
- Technical guidance on the Threatened Ecological Community - *Banksia* Woodlands of the Swan Coastal Plain (Main Roads Western Australia, 2021b)
- Approved Conservation Advice for the *Banksia* Woodlands of the Swan Coastal Plain Ecological Community (Threatened Species Scientific Committee (TSSC), 2016)
- Approved Conservation Advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community (DotEE, 2019).

Data collection and storage

The survey methods involved a combination of quadrats, relevés and field notes. Sampling was undertaken from 10 quadrats, 21 relevés and opportunistic collections. Quadrats measuring 10 x 10 m or 100m² as per regulatory expectations for the Swan Coastal Plain (SCP) bioregion were established. Four of the 10 quadrats that showed affinities to TEC communities were rescored. A minimum of three quadrats were located within each identified vegetation type, where possible. In some instances, less than three quadrats were described per vegetation type, this was due to the limited area and geographic range of the vegetation type and/or the degraded condition of the vegetation. One vegetation type, EmB spp, has one quadrat representing it. This is because most of this vegetation was Degraded and only a restricted patch was found to be in Good condition.

In areas of poor-quality vegetation, relevés using a search area of approximately 100 m² were conducted to assist with mapping. The survey effort (track log and sample sites) are presented in Figure 2, Appendix A.

Field data at each quadrat and relevé was recorded on a pro-forma data sheet and included the parameters detailed in Table 3.

Table 3 Data collected at each quadrat and relevé

Aspect	Measurement
Collection attributes	Site code, personnel/recorder, date, photograph
Physical features	Aspect, slope, landform, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA2020 datum using Stonex S580+ tablets with S580 DGPS to an accuracy of approximately ± 1 cm
Vegetation condition	Vegetation condition was assessed using the condition rating scale adapted by the Environmental Protection Authority (EPA) (2016a) for South West and Interzone Botanical Province
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, clearing)
Flora	List of dominant flora from each structural layer, list of all species within the quadrat including average height and cover (using National Vegetation Information System (NVIS))

A flora inventory was compiled from taxa listed in quadrats, relevés and from opportunistic floristic records throughout the survey area. The data is provided in Appendix D.

Flora field data collection for the survey was undertaken using Stonex S580+ tablets with S580 DGPS units to achieve centimetre-level accuracy. Fauna field data was captured using Global Positioning System (GPS) enabled Samsung tablets using electronic forms in Collector. Data was synced to the cloud at the conclusion of each field day. GPS devices were used to capture survey effort (track logs) displayed in Figure 2, Appendix A. Field photographs were stored and where applicable have been provided as part of the deliverables.

Vegetation types

Vegetation types were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations. Vegetation types were described based on structure, dominant taxa and cover characteristics as defined by quadrat data, relevé data, Black Cockatoo tree point data and field observations. Where vegetation types aligned, quadrat and relevé data from the Roe Highway survey (GHD 2025) were used to supplement the Kwinana survey data. In some instances, revegetation types for Kwinana freeway were restrictive and degraded, therefore only mapping notes were taken. Relevés from Roe highway were used to provide a description of these areas. Vegetation type descriptions follow NVIS and are consistent with NVIS Level V (Association). At Level V up to three taxa per stratum are used to describe the association (NVIS Technical Working Group, 2017).

Much of the survey area has been previously disturbed and subject to landscaping or revegetation with infill planting of a range of different species, including locally native species, native species occurring outside their native range (for example *Melaleuca nesophila*), non-native species and commercially available cultivars. Vegetation types were divided up into native vegetation types and roadside revegetation. In the determination of native vegetation compared to roadside revegetation, a number of aspects were considered:

- Species composition
- Structural formation
- Age of individual plants/trees
- Landform – is the landform/ground level naturally occurring or is it part of freeway infrastructure for example battered slopes
- Mapping of native vegetation extent (DPIRD, 2023).

Context vegetation mapping

Context vegetation area mapping was undertaken by extrapolation of survey data, aerial imagery and a review of nearby Gibson et al. (1994) and Keighery et al. (2012) quadrats to broadly identify vegetation patterns and vegetation units. No ground-truthing of the context area was undertaken. The context area is mapped in Figure 6, Appendix A.

Vegetation condition

The vegetation condition was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (devised by Keighery (1994) and adapted by EPA (2016)). The scale recognises the intactness of vegetation and consists of six rating levels. The vegetation condition rating scale is outlined in Appendix B.

Significant vegetation and Floristic Community Types (FCT)

Floristic analyses were undertaken to determine relationships between the vegetation units described from the survey area and the SCP FCT defined by Gibson et al. (1994) and Government of Western Australia (2000a, 2000b). Two datasets are available and include the Gibson et al. (1994) dataset (referred to as the Gibson Dataset) and the Keighery et al. (2012) dataset (previously accessed through NatureMap (DBCA, 2024e) referred to as the Keighery Dataset). The Gibson dataset includes floristic data for 509 sites across the SCP and the Keighery Dataset includes floristic data from the Gibson Dataset as well as data from more than 500 additional sites.

The Gibson and Keighery datasets were updated by GHD to reflect current flora nomenclature and analysed against quadrat data from the field survey. Due to the fragmented and modified remnant vegetation along Kwinana Freeway and Roe Highway it was difficult to locate vegetation in good or better condition to enable a three sample site representation for each vegetation type. Therefore, quadrat data from the Roe Highway survey (GHD, 2025) has been used in conjunction with the Kwinana Freeway quadrats to provide more context when vegetation mapping and a more robust statistical analysis.

To confirm identified GHD vegetation types an analysis was completed on only GHD quadrats. Introduced and annual species were not removed for statistical analysis. Weed dominance in the wetland quadrats resulted in limited species to undertake an analysis with. The GHD quadrat analysis is provided in Appendix D.

Analysis methods using GHD quadrats against SCP datasets followed those outlined in DBCA (2024g). These included:

- Analysis of GHD quadrats from the Kwinana and Roe survey area with the Gibson Dataset
- Analysis of GHD quadrats from the Kwinana and Roe survey area with the Keighery Dataset
- Single site insertion (SSI) analysis of GHD quadrats from the Kwinana and Roe survey area with the Gibson Dataset
- SSI analysis of GHD quadrats from the Kwinana and Roe survey area with the Keighery Dataset.

For all the above analyses introduced and annual species were not removed from the Gibson or Keighery datasets as they were unable to be removed from the GHD quadrats.

SSI analysis involves running analyses for each quadrat, one at a time, with the respective datasets. SSI is considered an alternate and more reliable means of deriving a classification for each quadrat as it causes less 'disruption' of the clustering of the datasets (DBCA, 2024d).

Primer software was used to conduct the analyses, and analysis methods undertaken with reference to the methods utilised by Gibson et al. (1994). A Cluster analysis using the Bray-Curtis similarity measure (no overall transform or weighting) was undertaken to produce a similarity matrix. Using Group average cluster mode a dendrogram was created. Similarity matrices and dendrograms were used to infer vegetation type and FCT relationships. It is important to note that statistical analyses such as classifications are not absolute. To provide further support for the inferences made, taxon lists from quadrats were also compared to the typical species lists for SCP FCTs presented in Gibson et al. (1994), as well as consideration of landforms, soils, topography and geographical distribution data.

Banksia woodlands of the SCP TEC

Data captured in quadrats was used to determine the presence of the *Banksia* woodlands of the SCP TEC within the survey area based on the key diagnostic characteristics and condition thresholds listed within the Approved Conservation Advice (TSSC, 2016) and Main Roads technical guidance (Main Roads Western Australia, 2021b). At least one quadrat was captured within each mapped *Banksia* patch.

Small scale variations, gaps and disturbances (tracks, paths, breaks in vegetation including exposed soil, leaf litter, watercourses and drainage lines) that did not significantly alter the overall functionality of the TEC were

included in the mapping of *Banksia* patches. Conversely, breaks in native vegetation cover of 30 m or more from the tree canopy, including housing, extensive cleared areas and bitumen roads, were excluded from patches as per the Approved Conservation Advice (Threatened Species Scientific Committee, 2016).

Tuart Woodlands and Forests TEC

Quadrat data and key diagnostic characteristics and condition thresholds listed within the Approved Conservation Advice (DotEE, 2019) and Main Roads technical guidance (Main Roads Western Australia, 2021b) were used to determine the presence of the Tuart Woodlands and Forests TEC within the survey area. At least one quadrat was captured within each Tuart patch and tree canopy was mapped.

Small scale variations, gaps and disturbances (tracks, paths, breaks in vegetation including exposed soil, leaf litter, watercourses and drainage lines) that did not significantly alter the overall functionality of the TEC were included in the mapping of tuart patches. Conversely, breaks in tree canopy cover of >60m constituted multiple patches present as per Approved Conservation Advice (Threatened Species Scientific Committee, 2016).

Targeted Flora searches

Habitats and vegetation types in the survey area considered to have the potential to support significant flora (based on previously recorded significant flora records and associated habitat preference information) were targeted in the field to record the presence or absence of significant flora. Planted and highly modified vegetation were generally not targeted as these areas did not provide habitat for significant flora given the historic previous disturbances and clearing. For potential significant orchid species, habitats were searched then grid searched at a suitable distance apart as per Draft Survey Guidelines for Australia's Threatened Orchids (DCCEEW, 2013). Where significant flora taxa were identified the locations, number of plants present were recorded using Stonex S580+ tablets with S580 DGPS.

Flora inventory, identification and nomenclature

A flora inventory was compiled from species listed in described quadrats, relevés and from opportunistic floristic records throughout the survey area. Species well known to the survey botanists were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Species were identified by the use of taxonomic literature, electronic keys and online electronic databases.

2.2.3 Fauna

The Basic Fauna Survey, including a Targeted SRE survey for trapdoor spider (*Idiosoma sigillatum*) burrows and Targeted Black Cockatoo habitat assessment was consistent with relevant aspects of:

- EPA Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA, 2020)
- EPA Technical Guidance – Sampling of short-range endemic invertebrate fauna (EPA, 2016b)
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Survey Guidelines for Australia's Threatened Mammals (DSEWPC, 2011)
- Environmental Factsheet Technical Guidance Protecting Black Cockatoos – Baudin's Cockatoo, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo (Main Roads Western Australia, 2022)
- Referral guideline for 3 WA threatened black cockatoo species Carnaby's Cockatoo (*Zanda latirostris*), Baudin's Cockatoo (*Zanda baudinii*) and the Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*) (DAWE, 2022)
- Environmental Factsheet: Technical Guidance Protecting Black Cockatoos – Baudin's Cockatoo, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo (Main Roads Western Australia, 2021b).

In the context of a Basic fauna survey, the guidance statement advises field observers to describe the fauna habitats of the survey area, which gives a comprehensive list of fauna that can reasonably be expected to occur. Therefore, the aim of the fauna component of the survey included descriptions of fauna habitats in the survey area and a compilation of fauna species recorded opportunistically as the survey area was traversed. Significant fauna considered likely to occur were targeted during the traverses undertaken, through targeting and recording any

secondary signs of fauna (mounds, tracks, feeding evidence) or visible/audible encounters of the target species in suitable habitat. Fauna survey effort and methods are presented in Figure 9A, Appendix A.

Habitat assessments

Fauna habitat assessment was undertaken at point locations to document the type, value and extent of habitats within the survey area and to inform habitat mapping. Specifically, the assessment included:

- Habitat structure (e.g. vegetation types, structural layers / strata such as ground cover and mid storey)
- Presence/absence of refuge including density of ground covers, fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways
- Location of the habitat within the survey area in comparison to the habitat within the surrounding landscape
- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey area
- Current land use and disturbance history
- Evaluation of key habitat features, and types identified during the desktop assessment relevant to fauna of conservation significance
- Evaluation of the likelihood of occurrence of significant fauna (based on presence of suitable habitat)
- A representative photograph of each habitat type
- Floristic species present and foliage density estimates for the purposes of assessing Black Cockatoo foraging habitat.

Fauna habitats were delineated and mapped on field tablet at broad scale based on characteristics recorded in the habitat assessments, and in consideration of the vegetation community types identified during the field survey. Habitat types where practicable align with VTCs mapped polygon boundaries.

Opportunistic fauna observations and active searches

Targeted searches and opportunistic observations were undertaken in the survey area, specifically including:

- Searching the survey area for tracks, scats, remains, diggings and feeding areas for both native and feral species
- Searching through microhabitats including turning over logs or rocks, turning over leaf litter and examining tree hollows and logs
- Visual and aural surveys, which accounted for many bird species potentially utilising the survey area
- Recording GPS locations of any significant fauna species observed.

Targeted transects for *Idiosoma sigillatum* burrows

The Targeted searches for *Idiosoma sigillatum* included following:

- Transect searches a suitable distance apart through suitable habitat for burrows of *Idiosoma sigillatum*
- Opportunistic hand foraging under leaf litter and around tree bases for evidence of *Idiosoma sigillatum*.

2.2.4 Black Cockatoo assessment

A Black Cockatoo habitat assessment for Baudin's Cockatoo (*Zanda baudini*), Carnaby's Cockatoo (*Zanda latirostris*), Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) was undertaken across the survey area to assess the presence, quality, and extent of habitat for foraging, breeding and roosting. The assessment involved visual and aural assessment of the survey area, identifying breeding habitat (presence/absence of actual and potential breeding trees), foraging habitat, roosting areas, current species' activity, and any other signs of use by Black Cockatoos.

Foraging habitat

Foraging habitat is defined by DAWE (2022) as 'Plant species known to support foraging within the range of cockatoo species'. Foraging habitat was assessed to quantify the value of each habitat type within the survey area.

The flora species were identified within the survey area from on-site habitat assessment and floristic community sampling. Plants were classified as foraging species based on established cockatoo food plant species in literature (Valentine and Stock 2008). As part of the foraging assessment, the ground below known food plants and trees was searched for evidence of Black Cockatoo foraging residue such as Marri and Jarrah chewed seed pods, chewed Banksia cones and foliage clippings. Opportunistic sightings of foraging cockatoos were also recorded as part of the assessment. Vegetation and foraging data were used to calculate foraging quality score.

The foraging score method preferred by Main Roads and used in this assessment is that developed by Bamford Consulting Ecologists (Bamford, 2020). The foraging scoring system established by Bamford are shown in Table 4 through to Table 8. Scores are included in the fauna habitats descriptions (Table 33) and foraging scores (Table 35). Detailed forage value assessment is presented in Appendix E.

Table 4 Summary of the BCE system (Bamford, 2020)

Component	BCE system
Site condition	Out of 6
Site context	Out of 3
Species density (stocking rate)	Out of 1
Total score	Out of 10
Moderation of score	-/+
Final score	Out of 10

Table 5 Site Condition (Bamford, 2020)

Site condition	Score	Description (Carnaby's Cockatoo)	Description (Forest Red-tailed Black Cockatoo)	Description (Baudin's Cockatoo)
High	6	Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).
Moderate to high	5	– Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover – Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths – Pine plantations with trees more than 10 years old (but see pine note below in moderation section).	– Marri-Jarrah Forest with 40-60% projected foliage cover – Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree death – Sheoak Forest with > 60% projected foliage cover.	– Marri-Jarrah Forest with 40-60% projected foliage cover – Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths.

Site condition	Score	Description (Carnaby's Cockatoo)	Description (Forest Red-tailed Black Cockatoo)	Description (Baudin's Cockatoo)
Moderate	4	- Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) 20-40% projected foliage cover - Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover - Eucalypt Woodland/Forest with Marri 20-60% projected foliage cover.	- Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover - Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths - Sheoak Forest with 40-60% projected foliage cover.	- Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover - Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths - Eucalypt Woodland/Forest with diverse, healthy understorey and known food trees (especially Marri) 10-20% projected foliage cover - Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).
Low to moderate	3	- Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover - Woodland with tree banksias 5-20% projected foliage cover - Eucalypt woodland/mallee of small-fruited species - Eucalypt Woodland with Marri <10% projected foliage cover.	- Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5- 20% projected foliage cover - Parkland-cleared Eucalypt Woodland/Forest with known food plants such as Marri 10-40% projected foliage cover but badly-degraded understorey (poor long-term viability without management) - Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).	- Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover - Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); - Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).
Low	2	- Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover - Woodland with tree banksias 2-5% projected foliage cover - Eucalypt woodland/mallee of small-fruited species - Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source	- Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah or Sheoak) 1-5% projected foliage cover - Urban areas with scattered food plants such as Cape Lilac, <i>Eucalyptus caesia</i> and <i>E. erythrocorys</i> - Paddocks with <i>Erodium</i> spp. and other weeds.	- Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover - Urban areas with scattered foraging trees.
Negligible to low	1	Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could	Scattered specimens of known food plants but projected foliage cover of these < 1%. Could include urban areas with scattered foraging trees.	Scattered specimens of known food plants but projected foliage cover of these < 1%. This could include urban areas with scattered foraging trees.

Site condition	Score	Description (Carnaby's Cockatoo)	Description (Forest Red-tailed Black Cockatoo)	Description (Baudin's Cockatoo)
		include urban areas with scattered foraging trees; – Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source; – Blue Gum plantations (foraging by Carnaby's Cockatoos has been reported but appears to be unusual).		
No foraging value	0	No Proteaceae, eucalypts or other potential sources of food. Examples: – Water bodies (e.g. salt lakes, dams, rivers) – Bare ground – Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes – Mown grass.	No eucalypts or other potential sources of food. Examples: – Water bodies (e.g. dams, rivers) – Bare ground – Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits)	No eucalypts or other potential sources of food. Examples: – Water bodies (e.g. dams, rivers) – Bare ground – Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).

Table 6 Site Context (Bamford, 2020)

Percentage of existing native vegetation within the 'local' area ¹ that the study site represents		
Score	Description	
	"Local" breeding known/likely	"Local" breeding unlikely
3	> 5 %	> 10 %
2	1-5 %	5-10 %
1	0.1-1 %	1-5 %
0	<0.1 %	< 1%

Table 7 Species density (stocking rate) (Bamford, 2020)

Presence/absence of species	
Score	Description
1	Species is reported regularly and/or there is abundant foraging evidence (seen at intervals of every few days or weeks for at least several months of the year).
0	Species is recorded or reported very infrequently and there is little or no foraging evidence.

¹ "Local" area is defined as within a 15 km radius of the centre point of the study site.

Table 8 Moderation of scores (Bamford, 2020)

Moderation of site context and species density scores for site condition ²		
Score	Context score	Species density score
3-6 (low/moderate to high value)	Assessed as per Table 6	Assessed as per Table 7
0-2 (no to low value)	0	0

Breeding habitat

For most tree species such as Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Blackbutt (*E. patens*), Tuart (*E. gomphocephala*) and Flooded Gum (*E. rudis*), suitable DBH is ≥ 500 mm. For Wandoo (*E. wandoo*) and Salmon Gum (*E. salmonophloia*) suitable DBH is ≥ 300 mm. On average, Carnaby's Cockatoo is known to nest in hollows with an entrance greater than 20 cm (Johnstone & Storr, 1998; Groom, 2011). While the Forest Red-tailed Black Cockatoo is known to nest in hollows with an entrance greater than 12 cm (Johnstone & Storr, 1998). Hollows also tend to be selected in preference for being vertical or near vertical, with diagonal and horizontal hollows generally regarded as marginal to unsuitable. Therefore, hollow suitability was assessed in consideration of these hollow characteristics.

The survey site was targeted on foot where accessible, to record potential trees with suitable DBH for Black Cockatoos. For each habitat tree (DBH ≥ 500 mm) located, binoculars were used to detect presence of suitable nesting hollows (adequate hollow orientation and hollow entrance diameter). All suitable DBH trees had their location recorded on GPS tablet together with tree species, DBH, size and numbers of hollows observed, any evidence of cockatoo use and any other significant observations were recorded.

The assessment methodology based on Main Roads environmental factsheet (Main Roads, 2023) distinguishes actual and potential breeding habitat as per the following:

- Actual nest trees: Evidenced as currently being used or have been used in the past (visible chews of hollow entrances)
- Potential breeding habitat: Trees with available hollows that do not show evidence of use now or in the past, trees with hollows that do not show evidence of use now or in the past where the hollow is not available (e.g. hollows are occupied by bees or galahs); and those trees without hollows but which have the potential to develop hollows in the future, and which have DBH >500 mm or 300 mm for different species.

In addition to identifying suitable breeding trees, Main Roads (2023) have developed a tree category system where trees are assigned a category number which refers to the degree of suitability of the tree/hollow. Table 9 presents the Main Roads seven categories for assessing suitable DBH trees, that was referred to during the survey.

For each potential or actual nesting tree, details of the tree location, tree species, DBH, hollow size (diameter) suitable for Black Cockatoo entry, number of hollows available in the tree, evidence of use (chews around entry, signs of foraging/roosting) and any other significant observations were recorded.

Table 9 Suitable DBH Tree Categories for Black Cockatoos (Main Roads, 2023)

Category number	Tree category	Description
1	Suitable DBH Tree with Known Nesting Hollows – hollows where breeding has been recorded or there is evidence of previous use.	Hollow where breeding has been recorded (i.e. bird/s observed in hollow) or there is evidence of previous use (i.e. hollow contains Black Cockatoo feathers or eggs).
2	Suitable DBH Tree with a potential suitably hollow with signs of use (not confirmed).	Hollows that appear to have a suitably sized entry and display signs of use, however internal dimensions have not been assessed. Although signs of use may be present, the signs, such as chew marks, could be from prospecting Black Cockatoos or other birds such as Galahs, which leave very distinctive marks on hollow and trees (impacted potentially suitably sized hollows should be confirmed by competent observer). Where hollows

² Note that this moderation approach may require interpretation depending on the context. For example, vegetation with a condition score of 2 could be given a context score of 1 under special circumstances. Such as when very close to a major breeding area or if strategically located along a movement corridor.

Category number	Tree category	Description
		cannot be avoided, the status of Category 2 hollows must be reassessed during the assessment process to determine whether it is a Category 1, 3, 4 or 6 hollow.
3	Suitable DBH Tree with a suitable hollow with no signs of use (confirmed).	Hollows that appear to have a suitably sized entry, with internal dimensions assessed. Category usually based on follow up hollow assessment with pole camera or drone. Although hollow appears to be suitable, there is no evidence of Black Cockatoo use. Where hollows cannot be avoided, status of Category 3 hollows should be reassessed immediately prior to clearing.
4	Suitable DBH Tree with a marginally unsuitable hollow with no signs of use (confirmed)	Hollows that are not currently suitable but have the potential to become suitable within five years. Where hollows cannot be avoided and have not been checked within 5 years, the hollow status must be reassessed to determine whether it has become suitable (Category 3 hollows) or a Known Nesting Hollow (Category 1 hollows).
5	Suitable DBH Tree with a potential suitable hollow with no signs of use (not confirmed).	Hollows that appear to have a suitably sized entry, however internal dimensions have not been assessed. Category usually based on ground observation only. Where hollows cannot be avoided, status of Category 5 hollows must be reassessed during the assessment process to determine whether it is a Category 1, 3, 4 or 6 hollow.
6	Suitable DBH Tree with unsuitable hollows.	Hollows that have a hollow entry greater than 50 mm that is not suitable due to the size of its entry, internal dimensions, angle and/or height off ground.
7	Suitable DBH Tree without hollows.	Trees with a 500 mm DBH (or 300 mm for Wandoo or Salmon Gum) that do not have visible hollows (hollows with an entry opening below 50 mm not considered a hollow). Note – multiple stemmed trees that branch above DBH may not be suitable.

Roosting habitat

Based on the referral guidelines, night roosts for Black Cockatoo species tend to be the tallest trees of an area, and usually close to a source of drinking water and in proximity to quality foraging habitat (DAWE, 2022). The survey area was visually surveyed for trees or stands of trees that matched these descriptions, and for any evidence of recent use as a roost site (feathers and droppings).

2.3 Wetland assessment

The wetland assessment was carried out in accordance with DBCA guidelines 'A methodology for the evaluation of wetlands on the Swan Coastal Plain' (DBCA, 2017a). This document provides an evaluation process for the identification of a wetland management category. The wetland assessment was conducted using a combination of field survey data and publicly available datasets referred to in the DBCA evaluation methodology, including Ramsar Sites (DBCA, 2017c), the Directory of Important Wetlands in Australia (DBCA, 2018), DBCA Legislated Lands and Waters (2024b) Lands of Interest (2024a), Geomorphic Wetlands (DBCA, 2024c) and EPA Redbook Recommended Conservation Reserves (DBCA, 2017b).

2.4 Limitations

2.4.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the study area. The records from the DBCA searches of Threatened and Priority flora provide more accurate information for the study area and local occurrence. However, some collections cannot be dated and often misrepresent the current range of Threatened and Priority species.

2.4.2 Field survey limitations

The EPA (2016, 2020) Technical Guidance states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 10. Based on this assessment, the survey effort has not been subject to any constraints that affect the thoroughness of the assessment, and the conclusions formed.

Table 10 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area, this includes: - Broadscale (1:250,000) mapping by Beard (1979) and digitised by Shepherd et al. (2002) - Vegetation complex mapping (Heddle et al., 1980; Webb et al., 2016) - DBCA Threatened and Priority ecological community, flora and fauna database searches (DBCA, 2024g, 2024f, DBCA 2024h) and NatureMap (DBCA, 2024e).
Scope (what life forms were sampled etc.).	Nil	Vascular flora were sampled during the survey. Terrestrial vertebrate fauna and SRE <i>Idiosoma sigillatum</i> were surveyed. Non-vascular flora, aquatic fauna and other invertebrates were not surveyed.
Proportion of flora collected and identified (based on sampling, timing and intensity). Proportion of fauna identified, recorded and/or collected.	Nil	The Two-Phase Detailed flora and vegetation survey, wetland assessment and Targeted flora survey was undertaken from July to November 2024, which is within the recommended timing for flora surveys in the South West and Interzone Botanical Province region (September-November) (EPA 2016a). A full flora species list is provided in Appendix D. All significant fauna relevant to the study area and region were assessed according to the requested level during the field surveyed via on-ground searches and habitat assessment.
Flora determination	Moderate	Flora determination was undertaken by the survey botanists in the field. Species that could not be identified in the field were collected and identified using appropriate taxonomic keys. One taxon was only identified to family level, 8 taxa were only able to be identified to genus level and six were tentatively identified to species due to lack of flowering/fruitlet material or the specimen was in a juvenile form. One taxon, <i>Dodonaea</i> sp. may possibly be <i>Dodonaea hackettiana</i> (P4). One plant was observed by the survey botanist on an onramp between Kwinana Freeway and Roe Highway. The area was unsafe to stop and so the plant was unable to be collected or properly identified. All other collections not identified to species level are not similar to known significant flora (as identified in the desktop searches). The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Nil	The survey area was considered adequately surveyed to compile a representative list of species, as well as to describe and map vegetation at a level appropriate for management decisions. Mapping of the context area was conducted at a desktop level using extrapolation, Gibson <i>et al.</i> (1994) plots, Keighery <i>et al.</i> (2012) plots, and Google Maps Street View. Therefore, assigned vegetation types can only be considered indicative, as their presence has not been confirmed by on-ground survey.
Mapping reliability	Nil	The survey was conducted using high-resolution aerial imagery obtained from Landgate, topographical features, previous vegetation mapping (Heddle <i>et al.</i> 1980 and Webb <i>et al.</i> 2016) and field data.

Aspect	Constraint	Comment
		Data was recorded in the field using hand-held GPS tools (e.g. Samsung tablet, Garmin GPS and Stonex S580+ tablets with S580 DGPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers, including tree canopies. The Garmin GPS units used for fauna component are accurate to within ± 5 metres on average. Therefore, data points consisting of coordinates recorded from the GPS may contain minor inaccuracies. The flora and vegetation component used Stonex S580+ tablets with S580 DGPS, these devices are accurate to within ± 1 cm.
Timing/weather/season/cycle	Nil	The field survey was conducted during late winter to early spring (July to November 2024). This is within the recommended survey timing for flora and vegetation surveys within the South-West botanical province (EPA, 2016). In the three months prior to the survey (May-July) 447.6 mm of rainfall was recorded. This total is comparable to the long-term average for the same period (May- July 429 mm) (BoM, 2024), therefore the season is not considered to be a limitation.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	The majority of the survey area has been subjected to urban development; however, these disturbances did not affect the results of the survey.
Intensity (in retrospect, was the intensity adequate)	Nil	The vascular flora of the survey area was sampled in accordance with EPA (2016a). The fauna survey was sampled in accordance with EPA (2020). The survey area was sufficiently covered by the field team using 18 people days.
Resources	Nil	Adequate resources were employed during the field survey. Two Senior Botanists, one Senior Zoologist and one Zoologist undertook the survey over 18 person days.
Access restrictions	Moderate	The survey area was in some parts, unable to be accessed on foot, due to the freeway restrictions (safety in parking), high security fencing, sound-blocking walls and suburb boundaries. In some areas, the site was driven by in the vehicle as slow as safely possible to map vegetation and make assessments for significant vegetation, potential significant flora habitat, habitat suitability for Black Cockatoos and other significant fauna. In this instance vegetation mapping was done through aerial imagery and extrapolation. Potential significant flora habitat was judged on the density of weeds in the understorey and vegetation. For fauna this involved assessing the plants present, and the height and canopy cover range for the patches of Banksia woodland adjacent the freeway. When the zoologists were unable to reach sections of the survey area due to the constraints listed above, they would park as close as was possible and utilise binoculars to make an assessment of the habitat that was present. The limitation here is that a full detailed search for signs of fauna and significant flora was not possible in some areas.
Experience level	Nil	The botanists and zoologists who executed the survey are practitioners suitably qualified and experienced in their respective fields: – Senior Botanist Angela Benkovic has over 18 years experience in undertaking flora and vegetation surveys – Senior Botanist Alex Sleep has over 16 years experience in undertaking flora and vegetation surveys – Senior Zoologist Sarah Flemington has over 7 years' experience conducting fauna surveys – Zoologist Melissa Wood has over 4 years experience in undertaking fauna surveys.

3. Desktop assessment

3.1 Physical environment

3.1.1 Climate

The Perth Metropolitan area where the project is located has a temperate climate of hot dry summers and cold winters. The climate is characteristic of a mediterranean climate with low summer rainfall followed by wet winters (BoM, 2024).

At the Jandakot Airport weather station (site number: 009172) the mean maximum temperature is 24.7 C° and the mean minimum temperature is 11.7 C°. July receives the highest mean rainfall of 174.0mm, and December the lowest of 9.9mm. The mean annual rainfall is 810mm. In the three months prior to the survey (May-July) 447.6 mm of rainfall was recorded. This total is comparable to the long-term average for the same period (May-July; 429mm). Climate statistics for the region are illustrated in Plate 1 (BoM, 2024).

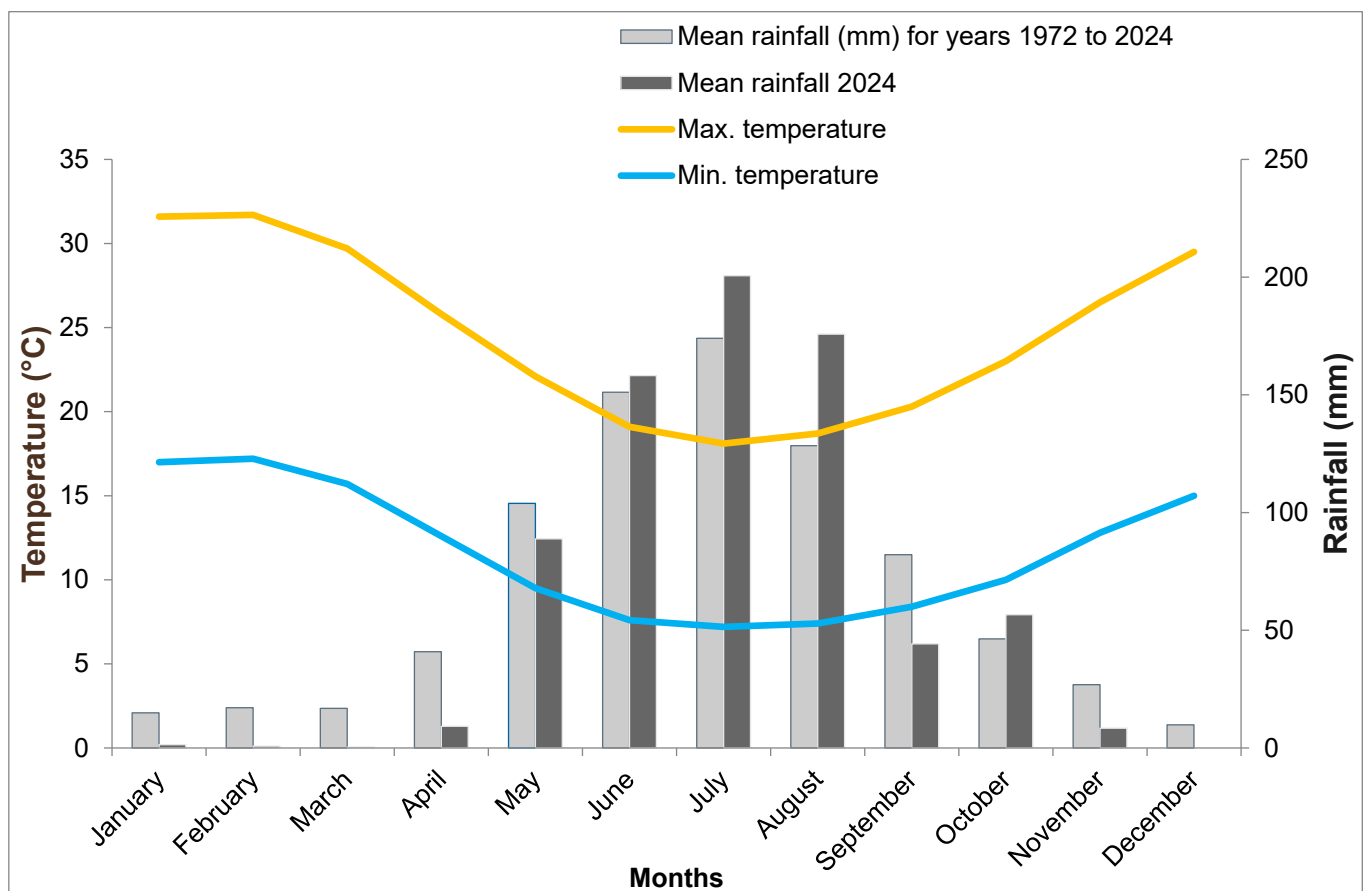


Plate 1 Jandakot Airport monthly climate statistics (BoM weather station: 009172)

3.1.2 Land systems and soil

Geology

The survey area intersects two geological units at the broad 1:500,000 scale (DMIRS, 2018):

- Coolyena Group: Composition of chalk, greensand, glauconitic sandstone, siltstone, marl; and glauconite
- Warnbro Group: Interbedded sandstone, siltstone, and shale; minor conglomerate.

Soil types

The survey area intersects the following unique soil landscape zones (DPIRD, 2025).

- Bassendean Zone (212): Mid Pleistocene Bassendean sand. Fixed dunes inland from coastal dune zone. Non-calcareous sands, podsolised soils with low-lying wet areas
- Perth Coastal Zone (211): Coastal sand dunes and calcarenite. Late Pleistocene to Recent age. Calcareous and siliceous sands and calcarenite
- Pinjarra Zone (213): Alluvial deposits (early Pleistocene to recent) between the Bassendean Dunes Zone and the Darling Scarp, colluvial and shelf deposits adjacent to the Darling Scarp. Clayey to sandy alluvial soils with wet areas.

Land zones have been further classified into soil-landscape systems (DPIRD, 2022). The survey area intersects four soil landscape systems:

- Bassendean system (212Bs): Swan Coastal Plain from Busselton to Jurien. Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths
- Pinjarra System (213Pj): Swan Coastal Plain from Perth to Capel. Poorly drained coastal plain with variable alluvial and aeolian soils. Variable vegetation includes Jarrah, Marri, Wandoo, paperbark sheoaks and Rudis
- Spearwood System (211Sp): Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/brown shallow sands
- Vasse System (211Va): Poorly drained estuarine flats, of the Swan Coastal Plain. Tidal flat soil, saline wet soil and pale deep sand. Samphire, sedges and paperbark woodland.

The survey area is predominantly located within a moderate to low acid sulfate soil risk area (DWER, 2017). There are intersects with high-risk acid sulfate soil areas across the Survey Area.

3.2 Land use

Land use constraints relevant to the survey area are shown in Figure 3, Appendix A.

3.2.1 Conservation reserves and estates

A total of 66 DBCA managed lands occur within the study area, comprising 55 Crown freehold DBCA-managed lands, 3 conservation parks, seven nature reserves and one Section 5(1)(h) reserve (DBCA, 2024b).

While no conservation reserves intersect the survey area, a group of reserves east of the Spectacles do lie on the survey area boundary (identifiers R 53313, 1758/697, 2781/538) (DBCA, 2024b).

3.2.2 Environmentally sensitive areas

There were 71 ESAs identified in the study area, the survey area intersects six of these (identifiers 3287, 3290, 3296, 3299, 3349 and 3393) (DWER, 2018a). The ESAs are represented by wetland areas and the Banksia Woodlands of the Swan Coastal Plain ecological communities. ESAs are declared under section 51B of the *Environmental Protection Act 1986* and impacts to ESAs are considered by the EPA during the assessment process. A clearing permit may be required for vegetation clearing within an ESA unless Schedule 6 exemptions apply.

3.2.3 Bush forever

Forty-nine Bush Forever sites occur within the study area. Bush Forever Site 270 – Sandy Lake and Adjacent Bushland Anketell occurs within the survey area boundary (DPLH, 2019).

3.3 Hydrology

The DWER geographic data layers identified the following hydrology and hydrogeology aspects proclaimed under the RIWI Act within the survey area are provided in Table 11. Hydrology aspects are illustrated in Figure 4, Appendix A.

Table 11 Hydrology aspects within the study area

Aspect	Details	Results
Groundwater Areas	Groundwater areas proclaimed under the RIWI Act	The survey area is within the Jandakot, Serpentine and Stakehill groundwater areas (DWER, 2018c)
Surface Water Areas	Surface water areas proclaimed under the RIWI Act	The survey area does not intersect any RIWI listed Surface water areas (DWER, 2018e)
Irrigation District	Irrigation Districts proclaimed under the RIWI Act	The survey area does not intersect any RIWI listed Irrigation District areas (DWER, 2018e)
Rivers	Rivers proclaimed under the Rights in RIWI Act	The survey area does not intersect any RIWI listed Rivers (DWER, 2018d)
Public Drinking Water Source Areas (PDWSA)	PDWSA is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the <i>Country Area Water Supply Act 1947</i>	The northern and central sections of the survey area intersect the Jandakot Underground Water Pollution Control Area. The intersected areas are listed as PDWSA Priority 3 areas (DWER, 2018b)
Waterways Management Areas	Areas proclaimed under the <i>Waterway Conservation Act 1976</i>	The Safety Bay Road section of the survey area intersects the Peel Inlet Management Area (DWER, 2018f)

3.3.1 Wetlands

Globally and nationally significant wetlands

The desktop study of various databases reported one wetland system of global RAMSAR listing significance occurring within the study area, the Thomsons and Forestdale Lakes wetland system (DBCA, 2017c). Thomson Lake is 1.3 km west of the survey area, between Beeliar Drive and Gibbs Road, while Forestdale Lake is to the east of the survey area, outside the study area.

A further two wetlands listed in the Directory of Important Wetlands in Australia were identified within the study area (DBCA, 2018), Spectacles Swamp and Gibbs Road Swamp System. The nearest of these is Spectacles Swamp, which is 0.2 km west of the survey area, between Anketell Road and Thomas Road.

No globally or nationally significant wetlands occur within the survey area.

Geomorphic wetlands of the Swan Coastal Plain

Wetlands cover more than 25% of the Swan Coastal Plain, with approximately 75% of these occurring as seasonally waterlogged flats or basins. The geomorphic classification system developed by Semeniuk and Semeniuk (1987; 1995) has been used to classify wetlands on the Swan Coastal Plain into types based on the shape of the host landform and hydrological regime. This table was reproduced in “*A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia*” (DBCA, 2017a), and adapted for this report (Table 12).

Table 12 Wetland landform types adapted from DBCA (2017a) methodology for evaluation of wetlands

Hydrology	Wetland Landform			
	Basin	Flat	Channel	Slope
Permanent inundation	Lake		River	
Seasonal inundation	Sumpland	Floodplain	Creek	
Seasonal waterlogging	Dampland	Palusplain	Trough	Paluslope

Consanguineous suites

Wetlands on the Swan Coastal Plain have been grouped into 62 recognised consanguineous suites based on similar regional features such as “*wetland’s classification, geometry, stratigraphy, inferred origin and hydrology*” (DBCA, 2017a; Semeniuk, 1988). The survey area is primarily contained within the Jandakot suite, however a

small sliver of the survey area between Anketell Road and Thomas Road intersects the Bibra suite, and the Safety Bay Road and Mundijong Road sections fall within the Keysbrook suite.

Wetland management categories

Wetlands in the Geomorphic Wetlands Dataset (DBCA, 2024c) are assigned management categories to guide management and protection. Wetlands on the Swan Coastal Plain have been assigned either a Conservation, Resource Enhancement or Multiple Use management category (Table 13).

Table 13 Wetland management categories (DBCA, 2017a)

Category	General Description	Objectives
Conservation	Wetlands which support a high level of attributes and functions.	To preserve and protect their existing conservation values through various mechanisms including: – reservation in national parks, Crown reserves and state-owned land – wetland covenanting by landowners. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.
Resource Enhancement	Wetlands which may have been modified or degraded, but still support substantial attributes and functions.	To manage, restore and protect towards improving their conservation value and hydrological/hydrogeological regime. These wetlands have the potential to be restored or rehabilitated to Conservation category focusing on wetland functions, structure and biodiversity value.
Multiple Use	Wetlands with few remaining important attributes and functions.	The use, development and management of these wetlands should be considered in the context of ecologically sustainable development and best management practice catchment planning. Their role in managing the natural hydrological and hydrogeological regime of the general area should be maintained.

Approximately 25% of the survey area has been mapped as geomorphic wetlands by DBCA (2024c), totalling 73.2 ha across 34 wetlands. These are currently assigned the following conservation categories:

- Conservation – nine wetlands, intersecting 2.2 ha (0.7%) of the survey area
- Resource Enhancement – six wetlands, intersecting 17.1 ha (6.0%) of the survey area
- Multiple Use – 14 wetlands, intersecting 44.0 ha (15.4%) of the survey area
- Not Applicable – five wetlands, intersecting 9.9 ha (3.4%) of the survey area.

Of these, eight Conservation category and one Resource Enhancement wetland were evaluated using the criteria detailed by DBCA (2017a) to provide supporting information for environmental approvals for the Project. Details of these are shown in Table 14 and the results of the wetland evaluation are shown in section 4.4.

Note that in two cases, one distinct wetland, observable as a single wetland via aerial imagery, was mapped by DBCA as two neighbouring polygons with different UFIs (Unique Feature Identifiers). In these cases, the smaller UFI intersection was merged and assessed as part of the larger neighbouring UFI (see Table 14).

The remaining 25 Geomorphic Wetlands were not evaluated, as they aligned with one or more of the following considerations, and it was therefore concluded that a formal assessment was not necessary:

- comprised predominantly cleared land or highly disturbed road verges. These wetlands no longer retain any natural attributes, functions or values of a wetland and are considered 'no longer a wetland'
- categorised as a Dryland by DBCA assigned a management category of 'not applicable'
- did not represent functioning wetlands where they intersected the survey area, due to fragmentation, degradation or clearing. The remaining remnant portion of the wetland is not reliant on the disturbed and highly modified portion of the wetland that occurs within the survey area. This portion of the wetland within the survey area is considered no longer a wetland.

Wetlands of the survey area are shown in Figure 4, Appendix A. Appendix F contains a list of wetlands intersecting the survey area, including a justification for wetlands which were not formally evaluated.

Table 14 Geomorphic Wetlands within the survey area which were evaluated using DBCA methodology (2017a).

UFI	Wetland name	Type	Category	Total wetland area (ha)	Area intersected by survey area (ha)	Proportion of wetland intersected by survey area
6664	Mandogalup Swamp Mid Nth	Sumpland	Resource Enhancement	6.3	2.8	45.1%
12981	Mandogalup Swamp South	Dampland	Conservation	3.4	0.5	15.2%
14663 ³	Mandogalup Swamp Mid Sth	Sumpland	Conservation	4.9	<0.1	<0.1%
15397	Unknown	Sumpland	Conservation	5.9	0.5	8.0%
15399 ⁴	Unknown	Sumpland	Conservation	0.6	<0.1	5.5%
15584	Mandogalup Swamp Mid Sth	Sumpland	Conservation	0.9	0.3	35.8%
15968	Unknown	Sumpland	Conservation	0.7	<0.1	13.3%
15970	Unknown	Sumpland	Conservation	0.8	0.2	20.1%
15973	Unknown	Sumpland	Conservation	5.8	0.4	7.7%

3.4 Vegetation and flora

3.4.1 Regional biogeography

The survey area lies within the SCP bioregion of the Perth (SWA2) subregion in WA (CALM, 2002).

- The SCP is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia and Jarrah Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials (CALM, 2002).

3.4.2 Broad vegetation mapping and extent

Broad scale (1:250,000) pre-European vegetation mapping identified three vegetation associations as present within the survey area (DPIRD, 2019). These are shown in Table 15 along with their extents in the survey area.

Table 15 Pre-European Vegetation Associations and extents in the survey area

Pre-European Vegetation Association	Extent (ha) in survey area
6: Medium woodland of Tuart and Jarrah.	3.8
968: Medium woodland of Jarrah, Marri and Wandoo	16.3
1001: Medium very sparse Jarrah woodland with low woodland of Banksia and Casuarina.	265.6

The vegetation associations of the survey area have been subject to a high proportion of clearing with less than 38.32% of pre-European Vegetation extents remaining. Two of the three vegetation associations within the survey area have > 21% of their extents remaining within the State, Interim Biogeographic Regionalisation for Australia (IBRA) Region, IBRA Subregion, and Local Government Area (LGA) extents. Vegetation association 968 has 6.62% of its extent remaining within the SCP bioregion and Perth subregion and only 3.69% remaining within the City of Rockingham LGA (Table 16).

³ Assessed as part of neighboring wetland 15584

⁴ Assessed as part of neighboring wetland 15397

Table 16 Extents of vegetation associations for the survey area within the state, IBRA regions, subregions and LGA

Vegetation association	Scale		Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% current extent in all DBCA managed land (proportion of current extent)
Veg Assoc No. 6	Statewide: WA		56,343.01	13,362.25	23.72	39.83
	IBRA Bioregion	Swan Coastal Plain	56,343.01	13,362.25	23.72	39.83
	IBRA Sub-region	Perth	56,343.01	13,362.25	23.72	39.83
	Local Government Authority	City of Cockburn	2,286.74	480.29	21.00	47.25
		City of Kwinana	1,477.48	547.36	37.05	-
Veg Assoc No. 968	Statewide: WA		296,877.84	95,048.82	32.02	57.64
	IBRA Bioregion	Swan Coastal Plain	136,188.20	9,017.32	6.62	21.61
	IBRA Sub-region	Perth	136,188.20	9,017.32	6.62	21.61
	Local Government Authority	City of Kwinana	52.80	13.08	24.77	-
		City of Rockingham	4,013.82	148.11	3.69	-
Veg Assoc No. 1001	Statewide: WA		57,410.23	12,660.76	22.05	14.19
	IBRA Bioregion	Swan Coastal Plain	57,410.23	12,660.76	22.05	14.19
	IBRA Sub-region	Perth	57,410.23	12,660.76	22.05	14.19
	Local Government Authority	City of Cockburn	7,328.39	2,002.93	27.33	14.92
		City of Kwinana	4,694.17	1,745.29	37.18	1.96
		City of Rockingham	3,010.32	1,153.53	38.32	6.38

Regional vegetation has been mapped by Heddle et al (1980) with updates from Webb et al. (2016) based on major geomorphic units of the Swan Coastal Plain. The mapping indicates five complexes are present within the survey area (Table 17).

Table 17 Vegetation complexes of the survey area

Vegetation Complex	Structure	Landform	Description	Extent (ha) within survey area
Cottesloe Complex – Central and South	Woodland and open forest and closed heath	Aeolian deposits	Mosaic of woodland of <i>Eucalyptus gomphocephala</i> (Tuart) and open forest of <i>Eucalyptus gomphocephala</i> (Tuart) - <i>Eucalyptus marginata</i> (Jarrah) - <i>Corymbia calophylla</i> (Marri); closed heath on the Limestone outcrops.	17.29
Serpentine River Complex	Closed scrub and fringing woodland	Fluviatile deposits	Closed scrub of <i>Melaleuca</i> species and fringing woodland of <i>Eucalyptus rudis</i> (Flooded Gum) - <i>Melaleuca raphiophylla</i> (Swamp Paperbark) along streams.	13.98
Herdsmen Complex	Sedgeland and fringing woodland	Aeolian deposits	Sedgeland and fringing woodland of <i>Eucalyptus rudis</i> (Flooded Gum) - <i>Melaleuca</i> species.	10.80
Karrakatta Complex – Central and South	Open forest and woodland	Aeolian deposits	Predominantly open forest of <i>Eucalyptus gomphocephala</i> (Tuart) - <i>Eucalyptus marginata</i> (Jarrah) - <i>Corymbia calophylla</i> (Marri) and woodland of <i>Eucalyptus marginata</i> (Jarrah) - <i>Banksia</i> species. <i>Agonis flexuosa</i> (Peppermint) is co-dominant south of the Capel River.	2.28

Vegetation Complex	Structure	Landform	Description	Extent (ha) within survey area
Bassendean Complex – Central and South	Woodland to low woodland and sedgeland	Aeolian deposits	Vegetation ranges from woodland of <i>Eucalyptus marginata</i> (Jarrah) - <i>Allocasuarina fraseriana</i> (Sheoak) - Banksia species to low woodland of Melaleuca species, and sedgeland on the moister sites. This area includes the transition of <i>Eucalyptus marginata</i> (Jarrah) to <i>Eucalyptus tottiana</i> (Pricklybark) in the vicinity of Perth.	241.09

GoWA (2018) assessed the vegetation complexes against presumed pre-European extents within the SCP IBRA bioregion, Perth sub-region and the Cities of Cockburn, Kwinana and Rockingham respectively. Annual updates were provided from 2016 to 2018, however note that this data has not been updated since then. Serpentine River Complex had the lowest extent remaining at 9.58%, Karrakatta Complex – Central and South and Bassendean Complex Central and South had less than 30% extent remaining. Cottesloe Complex – Central and South and Herdsman Complex had marginally over 30% remaining at 32.17% and 31.88% respectively (Table 18). Extents by LGA are included in Table 19.

Table 18 Extents of vegetation complexes on the Swan Coastal Plain mapped within the survey area (GoWA 2018)

Vegetation complex	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DBCA managed lands
Cottesloe Complex – Central and South	45,299.61	14,571.43	32.17	14.55
Serpentine River Complex	19,855.41	1,902.48	9.58	2.61
Herdsman Complex	9,665.15	3,081.05	31.88	10.97
Karrakatta Complex – Central and South	53,080.99	12,465.24	23.48	8.06
Bassendean Complex – Central and South	87,476.25	23,533.09	26.90	4.99

Table 19 Extents of Vegetation Complexes in LGAs (GoWA 2018)

Vegetation Complex	LGA	Pre-European extent (ha)	Current extent (ha)	% of pre-European extent	Proportion of the vegetation complex within the LGA (%)
Cottesloe Complex – Central and South	City of Cockburn	4,990.60	965.91	19.35	11.02
	City of Kwinana	3,789.77	1,281.71	33.82	8.37
	City of Rockingham	2,017.46	743.90	36.87	4.45
Serpentine River Complex	City of Kwinana	3.56	2.97	83.44	0.02
	City of Rockingham	3,658.19	366.54	10.02	18.42
Herdsman Complex	City of Cockburn	1,230.82	507.62	41.24	12.73
	City of Kwinana	579.45	282.06	48.68	6.00
	City of Rockingham	531.85	294.80	55.43	5.50
	City of Cockburn	1,390.24	145.48	10.46	2.62
	City of Kwinana	1,633.94	485.73	29.73	3.08

Vegetation Complex	LGA	Pre-European extent (ha)	Current extent (ha)	% of pre-European extent	Proportion of the vegetation complex within the LGA (%)
Karrakatta Complex – Central and South	City of Rockingham	4,275.59	1,140.32	26.67	8.05
Bassendean Complex – Central and South	City of Cockburn	6,809.99	1,766.14	25.93	7.78
	City of Kwinana	4,678.84	1,743.46	37.26	5.35
	City of Rockingham	1,977.56	912.09	46.12	2.26

3.4.3 Significant ecological communities

A review of the DBCA TEC and PEC database and EPBC Act PMST identified the presence of 18 listed communities previously recorded within (or potentially occurring within as identified by the PMST) the study area (Table 20).

The survey area intersects three significant ecological communities or their mapped buffer

- Banksia Woodlands of the Swan Coastal Plain ecological community (EPBC TEC and DBCA P3)
- Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain (EPBC TEC and DBCA P3)
- Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) / Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain (EPBC and State TEC).

The locations of TECs and PECs in the vicinity of the survey area are mapped in Figure 5, Appendix A.

Table 20 Significant Ecological Communities

Community Name	Status		Description (derived from (DBCA, 2021) unless specified)	Distance from survey area
	EPBC Act	BC Act/DBCA		
<i>Banksia ilicifolia</i> woodlands (SCP22) A component of the Banksia Woodlands of the Swan Coastal Plain ecological community EPBC listed TEC	EN	P3	Low lying sites generally consisting of <i>Banksia ilicifolia</i> – <i>B. attenuata</i> woodlands, but <i>Melaleuca preissiana</i> woodlands and scrubs are also recorded. Occurs on Bassendean and Spearwood systems in the central Swan Coastal Plain north of Rockingham. Typically has very open understorey, and sites are likely to be seasonally waterlogged.	All previously recorded occurrences of this community occur to the east of the survey area, the nearest being 700 m east of the survey area south of Anketell Road in line with the extensive remnant vegetation that occurs between Anketell Road and Thomas Road.
<i>Banksia</i> Woodlands of the Swan Coastal Plain ecological community	EN	P3	Canopy is most commonly dominated or co-dominated by <i>Banksia attenuata</i> and/or <i>B. menziesii</i> . Other <i>Banksia</i> species that can dominate in the community are <i>B. prionotes</i> or <i>B. ilicifolia</i> . It typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands; it is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau and, in other less common scenarios. The description, area and condition thresholds that apply to the EPBC-listed TEC of the same name, also apply to this Priority ecological community.	A total of 104 occurrences (or their buffers) of this community intersect the survey area.
Clay Pans of the Swan Coastal Plain	CR	EN	The ecological community generally occurs as a shrubland (less commonly as a low, open woodland) over a ground layer of geophytes, herbs and sedges which are characteristic of the wetter parts of the sites (Threatened Species Scientific Committee, 2012). There are no dominant species which characterise the entire ecological community (Threatened Species Scientific Committee, 2012). The ecological community, however, shows similar landform and vegetation structural features across its range. A distinctive feature of these clay pan wetlands is the suite of geophytes and annual flora that germinates, grows and flowers sequentially as these areas dry over summer, producing a floral display for over three months (Threatened Species Scientific Committee, 2012). The clay pans have very high species richness, a number of local endemics and are the most floristically diverse of the Swan Coastal Plain wetlands (Threatened Species Scientific Committee, 2012). Includes the following WA listed TECs: – Herb rich saline shrublands in clay pans (SCP07) – Herb rich shrublands in clay pans (SCP08) – Dense shrublands on clay flats (SCP09) – Shrublands on dry clay flats (SCP10a)	'Dense shrublands on clay flats SCP09' occurs 4.3 km east of the survey area.

Community Name	Status		Description (derived from (DBCA, 2021) unless specified)	Distance from survey area
	EPBC Act	BC Act/DBCA		
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) / Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	EN	CR	The habitat of this community is characterised by continuous discharge of groundwater in raised areas of peat (Department of Environment and Conservation, 2005). The peat and surrounds provide a stable, permanently moist series of microhabitats (Department of Environment and Conservation, 2005). Typical species associated with the tumulus springs include <i>Banksia littoralis</i> , <i>Melaleuca preissiana</i> , <i>Eucalyptus rudis</i> , <i>Agonis linearifolia</i> , <i>Pteridium esculentum</i> , <i>Astartea fascicularis</i> and <i>Cyclosorus interruptus</i> (Department of Environment and Conservation, 2005). Common weed species include <i>Isolepis prolifera</i> and <i>Cenchrus clandestinus</i> (Department of Environment and Conservation, 2005).	One occurrence (or buffer) of this community intersects the survey area.
<i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain			A series of <i>Corymbia calophylla</i> dominated plant communities on heavy soils on the eastern side of the Swan Coastal Plain (Department of Environment and Conservation, 2011b). Typical understorey species include <i>Banksia nivea</i> , <i>Philotheca spicata</i> , <i>Kingia australis</i> and <i>Xanthorrhoea preissii</i> with herbs, rushes and sedges <i>Cyathochaeta avenacea</i> , <i>Dampiera linearis</i> , <i>Haemodorum laxum</i> , <i>Desmodcladus fasciculatus</i> , <i>Mesomelaena tetragona</i> and <i>Morelotia octandra</i> (Department of Environment and Conservation, 2011b).	Identified by PMST only, no known occurrence within study area.
<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands of the Swan Coastal Plain	EN	CR	Plant community located on heavy soils of the eastern side of the Swan Coastal Plain between Bullsbrook, and Waterloo near Bunbury. Dominant species in the community are the trees <i>Corymbia calophylla</i> and occasionally <i>Eucalyptus wandoo</i> ; the shrubs <i>Xanthorrhoea preissii</i> , <i>Acacia pulchella</i> , <i>Banksia nivea</i> , <i>Gompholobium marginatum</i> , and <i>Hypocalymma angustifolia</i> and the herbs <i>Burchardia congesta</i> , <i>Cyathochaeta avenacea</i> and <i>Neurachne alopecuroidea</i> . The introduced species <i>Briza maxima</i> and <i>Romulea rosea</i> are also common (English & Blyth, 2000).	All occurrences of this community are to the east of the survey area. The nearest is approximately 4 km east of the Mundijong Road section.
Dense shrublands on clay flats (floristic community type 9 as originally described in Gibson et al. (1994)) A component of the Clay Pans of the Swan Coastal Plain EPBC listed TEC.	CR	VU	The community occurs as shrublands or open woodlands on clay flats that are inundated for long periods. It has been recorded between Moore River National Park and Dunsborough. Sedges are more apparent in the community than in other claypans, generally with moderate frequencies of <i>Chorizandra enodis</i> (black bristlerush), <i>Cyathochaeta avenacea</i> , <i>Lepidosperma longitudinale</i> (pithy sword-sedge) and <i>Leptocarpus coangustatus</i> . The community has a lower species richness and weed frequency than other claypan threatened ecological communities.	Nearest record of this community is approximately 4.3 km east of the survey area (Mundijong Road section).

Community Name	Status		Description (derived from (DBCA, 2021) unless specified)	Distance from survey area
	EPBC Act	BC Act/DBCA		
Empodisma peatlands of southwestern Australia	EN		An assemblage of plants, animals and other organisms associated with a type of freshwater, peat-based wetland that is found in the High Rainfall Province of the south-west of Western Australia (DCCEEW, 2023a). It is typically a sedgeland to shrubland vegetation complex on peaty substrates that almost always includes the perennial grass-like twig rush <i>Empodisma gracillimum</i> (DCCEEW, 2023a). <i>Empodisma</i> peatlands predominantly occur in the Warren IBRA bioregion and the Southern Jarrah Forest IBRA subregion of the Jarrah Forest bioregion (DCCEEW, 2023a).	Identified by PMST only, no known occurrence within study area.
Low lying <i>Banksia attenuata</i> woodlands or shrublands (SCP21c)	EN	P3	This type occurs sporadically between Gingin and Bunbury and is largely restricted to the Bassendean system. The type tends to occupy lower lying wetter sites and is variously dominated by <i>Melaleuca preissiana</i> , <i>Banksia attenuata</i> , <i>B. menziesii</i> , <i>Regelia ciliata</i> , <i>Eucalyptus marginata</i> or <i>Corymbia calophylla</i> . Structurally, this community type may be either a woodland or occasionally shrubland.	The nearest record of this community is approximately 780 m east of the survey area, south of Anketell Road in line with the extensive remnant vegetation that occurs between Anketell Road and Thomas Road.
<i>Melaleuca huegelii</i> - <i>Melaleuca systema</i> shrublands on limestone ridges (floristic community type 26a as originally described in Gibson et al. (1994)) / Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion	CR	EN	Species rich thickets, heaths or scrubs dominated by <i>Melaleuca huegelii</i> , <i>M. systema</i> (previously <i>M. acerosa</i>), <i>Banksia sessilis</i> over <i>Grevillea preissii</i> , <i>Acacia lasiocarpa</i> and <i>Spyridium globulosum</i> , occurring on skeletal soil on ridge slopes and ridge tops (community 26a as described by Gibson et al. 1994) (Luu & English, 2005). The broader community type 26 occurs on Spearwood Sands (Tamala Limestone) on large limestone ridges (Luu & English, 2005). Two distinct subgroups are related to the degree of soil development on the limestone ridges. 26a occurs on skeletal soils on ridge slopes and ridge tops. The other subgroup (26b) is found on the lower slopes or in pockets with deeper soil and is not listed as threatened (Luu & English, 2005).	The survey area is generally considered outside the known range of this vegetation type, which occurs closer to the coast (in association with limestone ridges). Nearest record is approximately 2.9 km west of the survey area (Anketell Rd).
Microbial community of a coastal saline lake (Lake Walyungup) / Brackish microbial community number 1 (Lake Walyungup)	Not listed	P1	Microbial community formed in Lake Walyungup, Rockingham.	This PEC is a discrete community associated with Lake Walyungup. The DBCA data includes a substantial buffer, the edge of which is approximately 1.5 km west of the survey area (Safety Bay Road). Lake Walyungup itself is approximately 3.3 km west of the survey area.
Northern Spearwood shrublands and woodlands (SCP24)	Not listed	P3	Heaths with scattered <i>Eucalyptus gomphocephala</i> occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system. The heathlands in this group typically include <i>Banksia sessilis</i> , <i>Calothamnus quadrifidus</i> , and <i>Schoenus grandiflorus</i> .	The nearest record of this community is approximately 1.3 km west of the survey area

Community Name	Status		Description (derived from (DBCA, 2021) unless specified)	Distance from survey area
	EPBC Act	BC Act/DBCA		
Sedgeland in Holocene dune swales of the southern Swan Coastal Plain (floristic community type 19a as originally described in Gibson et al. (1994))	EN	CR	The community occurs in linear damplands and occasionally sumplands, between Holocene dunes. Typical and common native species are the shrubs <i>Acacia rostellifera</i> , <i>Acacia saligna</i> , <i>Xanthorrhoea preissii</i> , the sedges <i>Baumea juncea</i> , <i>Ficinia nodosa</i> , <i>Lepidosperma gladiatum</i> , and the grass <i>Poa porphyroclados</i> . Several exotic weeds are found in this community but generally at low cover values (Department of Environment and Conservation, 2011a)	Nearest occurrences of this community are approximately 1.3 km west of the survey area (Safety Bay Road).
Southern <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> woodlands (SCP25)	EN/CR	P3	Can be a component of the Endangered <i>Banksia</i> Woodlands of the Swan Coastal Plain EPBC listed TEC, or the Tuart woodlands and forests of the Swan Coastal Plain EPBC listed TEC) Priority 3(iii) Endangered /Critically Endangered TEC (part) Woodlands of <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> south of Woodman Point. Recorded from the Karrakatta, Cottesloe and Vasse units. Dominants other than Tuart were occasionally recorded, including <i>Corymbia calophylla</i> at Paganoni block and <i>Eucalyptus decipiens</i> at Kemerton. Banksias found in this community include <i>Banksia attenuata</i> , <i>B. grandis</i> and <i>B. littoralis</i> .	Nearest record of this community is approximately 1 km west of the survey area (Mundijong Road).
Subtropical and Temperate Coastal Saltmarsh	VU	P3	Consists of the assemblage of plants, animals and micro-organisms associated with saltmarsh in coastal regions of sub-tropical and temperate Australia (south of 23oS latitude). It occurs on the coastal margin, along estuaries and coastal embayments and on low wave energy coast in places with at least some tidal connection, including rarely-inundated supratidal areas, intermittently opened or closed lagoons, and groundwater tidal influences. The community occurs on sandy or muddy substrate and may include coastal clay pans and similar habitats. It consists of dense to patchy areas of characteristic coastal saltmarsh plant species that include salt- tolerant herbs, succulent shrubs or grasses, and may also include bare sediment as part of the mosaic. It can occur where the proportional cover by tree canopy such as mangroves, Melaleucas or Casuarinas or seagrass is not greater than 50%.	Identified by PMST only, no known occurrence within study area.

Community Name	Status		Description (derived from (DBCA, 2021) unless specified)	Distance from survey area
	EPBC Act	BC Act/DBCA		
Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain	CR	P3	Mostly confined to Quindalup Dunes and Spearwood Dunes but can also occur on the Bassendean dunes and Pinjarra Plain. It can occur on the banks of rivers and wetlands. Tuart is the key upper canopy species although it may co-occur with trees of other species. Trees commonly co-occurring with Tuart include <i>Agonis flexuosa</i> (peppermint), <i>Banksia grandis</i> , <i>Banksia attenuata</i> , <i>Eucalyptus marginata</i> ; and less commonly, <i>Corymbia calophylla</i> , <i>Banksia menziesii</i> and <i>Banksia prionotes</i> . An understorey of native plants is typically present, which may include grasses, herbs and shrubs. The description, area and condition thresholds that apply to the EPBC-listed TEC of the same name, also apply to this Priority ecological community. Threats: land clearing, weed invasion, grazing, disease, altered fire regimes, hydrological change	Two occurrences (or their buffers) of this community intersect the survey area.
Wooded wetlands which support colonial waterbird nesting areas	Not listed	P2	Includes Chandala, Booragoon Lake, unnamed wetland near Pinjarra and McCarleys Swamp. Melaleuca dominated, fresh-brackish.	The nearest record of this community is at Booragoon Lake. The locations has been given a substantial buffer in the DBCA data, the edge of which is approximately 3.1 km north of the northern most end of the survey area. Booragoon Lake is approximately 5.2 km north of the survey area.
Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).(SCP19b)	EN	CR	This TEC is a sub-community of Sedgelands in Holocene dune swales of the southern Swan Coastal Plain. It represents older occurrences, between 4500 and 7000 years of age that generally have a tree overstorey and so the community is subdivided into 'sedgelands in Holocene dune swales' (Sub-type 19a) and 'woodlands over sedgelands in Holocene dune swales' (Sub-type 19b) based on floristic differences between these groups, but both sub-community types represent the TEC 'sedgelands in Holocene dune swales' (Department of Environment and Conservation, 2011a) Typical and common native shrub species are summer-scented wattle (<i>Acacia rostellifera</i>), orange wattle (<i>Acacia saligna</i>) and grass tree (<i>Xanthorrhoea preissii</i>). Typical sedges include the bare twigrush (<i>Baumea juncea</i>), knotted club rush (<i>Ficinia nodosa</i>) and coast sword-sedge (<i>Lepidosperma gladiatum</i>). The native grass <i>Poa porphyroclados</i> is also common in the community. Some older occurrences have an overstorey characterised by Tuart (<i>Eucalyptus gomphocephala</i>), swamp paperbark (<i>Melaleuca raphiophylla</i>) and swamp banksia (<i>Banksia littoralis</i>) (Department of Environment and Conservation, 2011a).	Nearest record of this community occurs approximately 1.9 km west of the survey area.

3.4.4 Flora diversity

The *NatureMap* database search of the study area identified 2,130 flora species belonging to 698 genera and 161 families (DBCA, 2024e). The most dominant families and genera of the study area are summarised in Table 21.

Table 21 Dominant families and genera of the study area

Family	Number of Species	Genus	Number of Species
Fabaceae	180	<i>Stylidium</i>	60
Poaceae	147	<i>Schoenus</i>	50
Cyperaceae	139	<i>Lepidosperma</i>	45
Orchidaceae	129	<i>Acacia</i>	41
Myrtaceae	126	<i>Drosera</i>	36

3.4.5 Significant flora

The EPBC Act PMST (DCCEEW, 2024a) and DBCA TPFL and WA Herbarium databases (DBCA, 2024g) identified the presence/potential presence of 41 significant flora taxa within the desktop study area, comprising of :

- Fifteen Threatened taxa listed under the EPBC Act and/or BC Act.
- Five Priority 1 taxa, listed by the DBCA
- Three Priority 2 taxa, listed by the DBCA
- Eight Priority 3 taxa listed by the DBCA
- Ten Priority 4 taxa listed by the DBCA.

The locations of significant flora registered on the DBCA database are mapped in Figure 5, Appendix A. A pre-survey likelihood determined that twelve taxa were considered likely to occur and ten were considered to possibly occur. The remainder were considered unlikely or highly unlikely to occur in the survey area. The full likelihood of occurrence assessment is shown in Appendix D.

3.5 Fauna

3.5.1 Fauna diversity

The *NatureMap* database (DBCA, 2024e) identified 605 terrestrial vertebrate fauna taxa, representing 397 bird species, 60 mammal species, 19 species of amphibians and 129 species of reptiles. In addition, the search identified 247 species of terrestrial invertebrate fauna officially recorded within the survey area. The *NatureMap* database search is provided in Appendix C.

3.5.2 Significant fauna

Desktop searches of the EPBC Act PMST (DCCEEW 2024a), *NatureMap* (DBCA 2007-), DBCA Threatened Fauna databases (DBCA, 2024f) identified the presence/potential presence of 54 significant fauna taxa within the study area, of which 49 were terrestrial vertebrate species and 5 were invertebrate species of conservation significance. Exclusively Marine species identified in the PMST were excluded from the likelihood of occurrence assessment as marine habitats are not present in the survey area. From an analysis of vertebrate and invertebrate fauna, the desktop searches recorded:

- Four species taxa listed as Critically Endangered (CR) under the EPBC Act and/or BC Act
- Six species listed as Endangered (EN) under the EPBC Act and/or BC Act
- Six species listed as Vulnerable (VU) under the EPBC Act and/or BC Act
- One species listed as Conservation Dependant (CD) under the EPBC Act and/or BC Act
- One species listed as a species of Special Protection (OS) under the BC Act

- Twenty-three species listed as Migratory (MI) under the EPBC Act and/or BC Act
- One species of Priority 1 taxa listed by the DBCA
- Four species listed as Priority 3 taxa listed by the DBCA
- Eight species listed as Priority 4 taxa listed by the DBCA.

The location of significant fauna as recorded by the DBCA database is presented in Figure 5, Appendix A. The likelihood of occurrence assessment is included in Appendix E.

3.5.3 Black Cockatoos

Based on the desktop assessment, all three Black Cockatoo species occur regionally and two locally, based on previous database records and distribution patterns. Carnaby's Cockatoo (*Zanda latirostris*) - Endangered, Baudin's Cockatoo (*Zanda baudinii*) - Endangered and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) - Vulnerable are endemic to the south-west of Western Australia with a wide-spread distribution. The survey area is within the modelled distribution for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, including within the modelled breeding range for Carnaby's Cockatoo (DAWE, 2022). Baudin's Cockatoo are anecdotally known to occur within the vicinity of the survey area, with additional confirmed DBCA records extending as far as 4km further North and North-West of the survey area (DBCA, 2025), the most recent of which have been recorded in 2012. However, the scarcity of such recordings and the position of the species on the very edge of its foraging known range and lack of breeding records indicates that the species is considered unlikely to occur, being a rare occasional visitor, with their modelled distribution occurring to the east and south.

A review of the Black Cockatoo breeding sites buffered (DBCA-063) dataset (GoWA, 2024a) identified the nearest breeding sites are of Carnaby's Cockatoo located at the Murdoch University campus, approximately 3 km northwest of the survey area. Majority of the breeding accounts are from artificial hollows but there is one confirmed natural hollow. The last recorded breeding event is in 2019. There were no breeding sites for the Forest Red-tailed Black Cockatoo recorded within 15 km of the survey area from data. A potentially suitable breeding hollow assessed as Category 2 was recorded nearby during the survey at Roe Hwy (see section 4.3.3). The survey area is located outside the known and predicted breeding range for Baudin's Cockatoo, and while this species is known to occur regionally i.e. eastern parts of Perth Swan Coastal Plain and Scarp approximately 15 km east of the survey area, these occurrences are associated with opportunistic foraging and feeding activity and not for specific breeding purposes.

There are numerous confirmed and un-confirmed roosts of Carnaby's and Forest Red-tailed Black Cockatoo within the western portion of the Swan Coastal Plain including a 10 km radius of the survey area (GoWA, 2024b). A review of the Black Cockatoo Roosting Sites – Buffered (DBCA-064) (GoWA, 2024b) identified five roost site buffers intersecting the survey area, and numerous other roost sites recorded nearby. A summary of the five roost sites intersecting the survey area (buffer only) is provided in Table 22. Of note, is the data from COCCOCR001, that recorded 15 and 102 Forest Red-tailed Black Cockatoos in 2018 and 2019 respectively.

Table 22 Roost Site data (DBCA-064) for roost site buffers intersecting the survey area

Site Code	Coordinates	Survey years	Bird count
COCBIBR003	-32.09055600 115.84666700	White-tailed Black Cockatoo – 2010, 2011, 2013 – 2017 Forest Red-tailed Black Cockatoo – 2014-2017	0 for all years
COCJANR002	-32.08833300 115.85361100	White-tailed Black Cockatoo –2010 and 2016 Forest Red-tailed Black Cockatoo – 2016.	0 for all years
COCJANR001	-32.10361100 115.85916700	White-tailed Black Cockatoo – 2012 – 2014, 2016 Forest Red-tailed Black Cockatoo – 2014 and 2016	0 for all years
COCCOCR001	-32.11371200 115.84973600	White-tailed Black Cockatoo – 2018 and 2019 Forest Red-tailed Black Cockatoo – 2018 and 2019	White-tailed Black Cockatoo – 0 for all years Forest Red-tailed Black Cockatoo – 2018: 15 birds

Site Code	Coordinates	Survey years	Bird count
			2019: 102 birds
COCATWR001	-32.15416700 115.86277800	White-tailed Black Cockatoo – 2010 – 2013, 2015 – 2017 Forest Red-tailed Black Cockatoo – 2015 - 2017	0 for all years

4. Field survey results

4.1 Vegetation

4.1.1 Vegetation Types

The vegetation of the survey area occurs either side of the Kwinana Freeway and consisted patches of native vegetation (18.92 ha, 6.6%) intermittently divided by roadside revegetation (92.65 ha, 32.5%), and infrastructure/cleared areas (173.87 ha, 60.9%). Vegetation type mapping is provided in Figure 6, Appendix A and site data is presented in Appendix D.

Five remnant native vegetation types were mapped within the survey area. Three were *Banksia* woodlands, differentiated by the presence or absence of *Eucalyptus* spp. one was a *Corymbia calophylla* woodland (Cc) and the fifth represented wetlands. The dominant remnant native vegetation type for the survey area was *Eucalyptus gomphocephala* and *Banksia* spp. Woodland (EgBsp) with 7.45 ha. This vegetation type was mapped predominately between Anketell and Mortimer Roads where the Spearwood system intersects the survey area. Cc occurred in a restricted area adjacent to *Eucalyptus rudis* and *Melaleuca raphiophylla* woodland (ErMr) vegetation types. Cc made up 0.42 ha consisting of two isolated patches in Very Good to Good condition. There was 3.94 ha of ErMr mapped in the survey area but only 1.14 ha was in Good or better condition for quadrat establishment. Due to the restrictive extent of Cc and the restrictive extent of vegetation in good or better condition for ErMr both of these vegetation types were represented by two quadrats each. Descriptions and representative photographs for remnant vegetation types are presented in Table 23.

Roadside revegetation was split into seven vegetation types, these areas were split to assist with Black Cockatoo foraging habitat mapping. Most of the revegetation within the survey area is from circa 2002 (Main Roads coms) and before. Endemic flora species were selected when areas were being revegetated and as a result the revegetation has in some places integrated with remnant bushland adjacent to the survey area. Although not to the same condition and diversity as remnant bushland some of the revegetation has established enough to be able to be mapped as vegetation types BmBa (1.84 ha) and EgBsp (1.86 ha). Mixed shrubland was the most dominant roadside revegetation and was mapped in patches along the entire length of the survey area with 61.27 ha. Roadside revegetation types are listed in Table 24.

Infrastructure such as roads, cycle paths and rail were mapped as Cleared, which represented the majority of the survey area.

GHD native vegetation type analysis

There were clear groupings for GHD quadrats assigned to vegetation type BmBa at more than 35% similarity. The wetland quadrats Kwin06 and Kwin07 from ErMr showed little to no similarity (11.11%) to each other and were also separated out from the other vegetation types. These two quadrats were grouped together based on landscape position and dominant upper storey vegetation. Both had *Melaleuca raphiophylla* and *Eucalyptus rudis* as dominants, this was distinctive from other vegetation types mapped in the survey area. For the understorey species Kwin06 was dominated by weeds, whilst Kwin07 was dominated by several native sedges.

The vegetation types with *Eucalyptus gomphocephala* (EgBsp.) and *Eucalyptus marginata* (EmBsp.) were separated based on the emergent Eucalypts and land system position. Quadrats from these two vegetation types also showed similarity to quadrats from vegetation type BmBa as all are *Banksia* woodlands. However emergent Eucalypt species were either absent or rare in vegetation type BmBa. The last vegetation type to be mapped was *Corymbia calophylla* woodland (Cc). The two quadrats that represented this vegetation type showed strong similarity to each other (53.33%) and then grouped with the *Banksia* woodland quadrats on a larger clade (Appendix D).

4.1.2 Context area

The extrapolation of vegetation type mapping for the context area determined the following extents (and percentage of the context area):

- BmBa (32.34ha, 1.3%)
- EgBspp. (22.82 ha, 0.9%)
- EmBspp. (204.34 ha, 8.4%)
- ErMr (274.11 ha (11.2%)
- Isolated Banksia spp.(4.38 ha, 0.2%)
- Isolated Corymbia calophylla (4.41 ha, 0.2%)
- Isolated Euca spp. (170.01 ha, 7.0%)
- Mixed Shrubland (62.60 ha, 2.6%)
- Modified wetland drainage area (96.63 ha, 4.0%)
- Pinus sp. (2.04 ha, 0.1%)
- Cleared (1567.08, 64.2%).

Vegetation type mapping in the context area is provided in Figure 6, Appendix A.

Table 23 *Remnant native vegetation types and Floristic Community Types*

Vegetation type	Vegetation Type Description	Landform and soils	Condition Range	Extent (ha)	Sample location and FCT alignment	Photograph
BmBa - <i>Banksia menziesii</i> <i>B. attenuata</i> woodland	<i>Banksia menziesii</i> and <i>Banksia attenuata</i> woodland over <i>Hibbertia hypericoides</i> <i>Scholtzia involucreta</i> <i>Styphelia conostephioides</i> low shrubland over <i>Patersonia occidentalis</i> , <i>Desmocladius flexuosus</i> and <i>Lyginia barbata</i> open herb/sedgeland	Bassendean system	Very Good to Completely Degraded	2.02	Kwin05, Roe01, Roe06, Roe07, Roe08, Roe12, Roe13, Roe14, Roe15, Roe16 Roe02R, Roe04R, Roe17R FCT 23a - Central <i>Banksia attenuata</i> - <i>B. menziesii</i> woodland	
Cc – <i>Corymbia calophylla</i> woodland	<i>Corymbia calophylla</i> tall woodland over <i>Kunzea glabrescens</i> tall sparse shrubland over <i>Xanthorrhoea preissii</i> and <i>X. gracilis</i> mid shrubland over <i>Phlebocarya ciliata</i> , <i>Dasypogon bromeliifolius</i> and <i>Desmocladius flexuosus</i> herbland/sedgeland	Bassendean system	Very Good to Good-Degraded	0.42	Kwin08, Kwin09 21a – Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodlands	

Vegetation type	Vegetation Type Description	Landform and soils	Condition Range	Extent (ha)	Sample location and FCT alignment	Photograph
EgBspp. - <i>Eucalyptus gomphocephala</i> and <i>Banksia</i> spp. woodland	+/- <i>Eucalyptus gomphocephala</i> tall open woodland over <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland over <i>Acacia pulchella</i> var <i>pulchella</i> , <i>Xanthorrhoea preissii</i> and <i>Hibbertia hypericoides</i> low open shrubland over <i>Mesomelaena pseudostygia</i> and * <i>Ehrharta calycina</i> sedgeland/ grassland	Spearwood system and Bassendean system	Very Good to Degraded	7.45	Kwin01, Kwin02, Kwin03, Kwin10, Roe02, Roe10 Kwin02R, Kwin03R, Kwin05R, FCT 28 - Spearwood <i>Banksia attenuata</i> - or <i>Banksia attenuata</i> <i>Eucalyptus</i> woodland	
EmBspp. <i>Eucalyptus marginata</i> and <i>Banksia</i> spp. woodland	+/- <i>Eucalyptus marginata</i> tall open woodland over <i>Banksia attenuata</i> , <i>B. menziesii</i> and <i>Allocasuarina fraseriana</i> woodland over <i>Acacia pulchella</i> var <i>pulchella</i> <i>Hibbertia hypericoides</i> , <i>Bossiaea eriocarpa</i> low open shrubland over weedy grasses	Bassendean system	Good to Completely Degraded	5.09	Kwin04, Kwin09R, Kwin10R, Kwin21R 21a – Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodlands	

Vegetation type	Vegetation Type Description	Landform and soils	Condition Range	Extent (ha)	Sample location and FCT alignment	Photograph
ErMr - <i>Eucalyptus rudis</i> over <i>Melaleuca raphiophylla</i> +/- <i>M. preissiana</i> woodland	<i>Eucalyptus rudis</i> over <i>Melaleuca raphiophylla</i> +/- <i>M. preissiana</i> over <i>Kunzea glabrescens</i> tall sparse shrubland over <i>Xanthorrhoea preissii</i> low shrubland over <i>Lepidosperma longitudinale</i> sedgeland	Bassendean system	Very Good to Completely Degraded	3.94	Kwin06, Kwin07, Roe06R Kwin19R, Kwin14R, Kwin07R, Kwin16R, Kwin18R, Kwin11R FCT 11 Wet forests and woodlands	

Table 24 Roadside revegetation types and cleared areas

Roadside Vegetation Type	Description	Condition Range	Extent (ha)	Sample locations	Photograph
Isolated <i>Corymbia calophylla</i>	Isolated stands of <i>Corymbia calophylla</i> over scattered natives and weeds	Completely Degraded	1.55	no site	
Isolated <i>Eucalyptus</i> spp.	Native and planted naturalised <i>Eucalyptus</i> spp. over scattered natives and weeds	Degraded -Completely Degraded to Completely Degraded	13.28	Kwin04R, Kwin20R, Kwin15R, , Roe01R, Roe03R, Roe09R	
Isolated <i>Banksia</i> spp.	Isolated <i>Banksia menziesii</i> and <i>B. attenuata</i> over scattered natives and weeds	Degraded to Completely Degraded	6.44	Kwin01R Kwin17R, Kwin08R, Roe05R	

Roadside Vegetation Type	Description	Condition Range	Extent (ha)	Sample locations	Photograph
Mixed shrubs	Native and Introduced shrubs	Completely Degraded	61.27	Kwin12R	
Modified wetland	Modified wetland/ drainage area	Degraded – Completely Degraded to Completely Degraded	6.40	Roe03R, KwinR06, Kwin13R	
BmBa	<i>Banksia menziesii</i> B. <i>attenuata</i> woodland	Very Good to Completely Degraded	1.84	See Table 23 for sample locations for this vegetation type	
EgBspp.	<i>Eucalyptus gomphocephala</i> and <i>Banksia</i> spp. woodland	Very Good to Degraded	1.86	See Table 23 for sample locations for this vegetation type	

Roadside Vegetation Type	Description	Condition Range	Extent (ha)	Sample locations	Photograph
Cleared	Cleared- infrastructure, roads	Cleared	173.87		

Note: The above revegetated vegetation types may include a limited number of isolated remnant native trees and/or shrubs, however the majority of the area has been historically completely cleared and revegetated and no longer represents an intact native vegetation type.

4.1.3 Floristic Community Types

The Floristic Community Types (FCTs) identified in the survey area are not listed as TECs under the EPBC Act or BC Act, nor are they listed as PECs by DBCA. However, remnant patches of FCTs/ vegetation types that meet key criteria as listed in TSSC (2016) and DotEE (2019) are considered TECs under the EPBC Act and listed as PECs by DBCA (discussed further in section 4.1.5).

Floristic analyses were undertaken to determine relationships between vegetation types and quadrats in the survey area and SCP FCTs defined by Gibson et al. (1994) (analyses methods described in section 2.2.2). Analysis was run using two scenarios on the complete datasets for both:

Gibson:

- All species (base quadrat data) (Stress: 0.15)
- Removal of single species (species only recorded once in both datasets) (Stress: 0.15).

Keighery:

- All species (base quadrat data) (Stress: 0.19)
- Removal of single species (species only recorded once in both datasets) (Stress: 0.19).

A third scenario for statistical analysis was also performed by removing introduced species, however the results proved even more inconclusive due to the dominance of weeds and lack of native species in some GHD quadrats.

As the removal of single species did not affect the stress value of the results, the first scenario presence and absence of all species, has been used to lessen the degree of data manipulation.

The cluster analysis and the resulting dendrogram using the Gibson and GHD datasets showed GHD vegetation types mostly grouping together with a couple of outliers. The GHD vegetation types BmBa and Espp.Bspp. clustered together on clades associated with FCTs S15, 17, 19b 20a, 21a, 23a, 25 and 28. Two quadrats from ErMr grouped together then clustered with 21a and 23a. One ErEm quadrat clustered with multiple S17 quadrats, and another grouped with 6, S07 and S17. This preliminary analysis indicates that, statistically, the vegetation recorded in the GHD quadrats do not have strong affinities to any particular Gibson FCT. The dendrogram of the cluster analysis is presented in Appendix D. Nodes that showed no association with GHD vegetation types at <30% have been collapsed, to simplify viewing of the dendrogram.

The cluster analysis and the resulting dendrogram using the Keighery and GHD datasets showed an even closer grouping of GHD vegetation types with each other. The GHD vegetation types BmBa and Espp.Bspp. initially clustered together and then at 25-30% similarity grouped with FCTs 1a, 20a, 20b, 20c, 21a, 21c 23a, 23b 25, and 28. Most of these FCTs are associated with Banksia woodland communities. Two quadrats from ErMr clustered together and then formed a clade with one quadrat from 21a. The other two ErMr quadrat had a weak relationship with each other and FCTs 11 and 13. As with the Gibson data, preliminary analysis indicates that, statistically, the vegetation recorded in the GHD quadrats do not have strong affinities to any Keighery FCT. The dendrogram of the cluster analysis is presented in Appendix D. Nodes that had no association with GHD vegetation types have been collapsed to simplify viewing of the dendrogram.

DBCA (2024g) recommends using the Single Site Insertion (SSI) method as its common for localised quadrat data (eg GHD quadrats from the survey area) to group together when analysed against regional datasets such as Gibson and Keighery. Table 25 shows the results of the similarity matrix for each GHD quadrat using SSI and final determination of the FCT assigned to each GHD quadrat. It should be noted that the data analysis only performs a presence/absence comparison, it includes no consideration of dominant taxa within each vegetation type. Therefore, in addition to the statistical analysis the experience of the survey botanists, landform characteristics and key dominant species within each vegetation type was also used to assign the appropriate FCT to GHD vegetation types.

Table 25 *Floristic Community Type determination*

Quadrat (Vege unit)	Single Site Insertion (Gibson Dataset)				Single Site Insertion (Keighery Dataset)				Final determination
	Similarity	FCT	SCP Q	Dendrogram	Similarity	FCT	SCP Q	Dendrogram	
Kwin01 (EgBspp.)	41.37	23a	kalis02	Clustered with a quadrat from 21c. Part of a larger clade from predominately 23a	40.62	21c	hymus03	Clustered with a quadrat from 6 then formed a larger clade with FCTs 21c, 28, 20c, 20a, 20b, 23b, 23a, 21a, 1a	28- due to the quadrat's position on the Cottesloe unit of the Spearwood and system review of GHD quadrats of the same vegetation type and supported by statistical analysis with 37.89% and 39.67%, similarity to FCT 28 quadrats from Gibson and Keighery respectively. It should be noted that this vege type could also represent FCT 21a. GoWA (2000) has both FCTs inferred for Bush Forever site 270, that occurs adjacent to this quadrat and others of this vege type. When comparing the typical and common species list by Gibson et al (1994) for both FCTs EgBspp. had slightly more in common with FCT 28
	41.30	23a	Cresw01		40.00	21a	low04		
	38.46	23a	kalis01		43.47	23a	WAND-1		
Kwin02 (EgBspp.)	29.16	19b	cool14	Clustered with a large clade with quadrats from 25, 17, and 19b at around 26% similarity	14.43	25	KEME-1	Clustered with a very large clade at 3.94% with most FCTs	Inconclusive, the area adjacent to the quadrat has been revegetated, therefore weed encroachment from edge effects was high. Kwin02 aligns closest with Kwin03 and Kwin04. Therefore, based on placement in the landscape, surrounding vegetation, species composition and landform this quadrat has been mapped as FCT 28
	29.26	17	leda03		15.15	24	KERO-2		
	27.27	S11	m4601		18.46	25	MEAL-1		
Kwin03 (EgBspp.)	32.55	25	bold16	Clustered with quadrats from 25 and S15. Part of a larger clade with 25, 28, 26b, 18, 24, 30b,	34.92	24	NEER-11	Clustered with a quadrat from 6 then formed a larger clade with FCTs 21c, 28, 20c, 20a, 20b, 23b, 23a, 21a, 1a	Inconclusive as the area is Degraded. Therefore, based on placement in the landscape, surrounding vegetation, species composition and landform this quadrat has been mapped as FCT 28
	32.55	S09	ELE21		31.25/ 31.25	24/28	THOM-2/ NEER-3		
	32.83	24	star01		32.25	28	WOODV-1		
Kwin04 (EmBspp.)	44.15	21a	Cavs10	Clustered with a quadrat from 25 and S15. Then formed part of a larger clade with 25, 28, 26b, 18, 24, 30b,	46.75	28	NEER-3	Clustered with quadrats from FCT 21a	21a- due to land system, dominant species and supported by statistical analysis
	42.22	23a	Cresw01		47.22	21a	NINE-1		
	41.66	28	yela01		44.70	21a	PAGA-4		

Quadrat (Vege unit)	Single Site Insertion (Gibson Dataset)				Single Site Insertion (Keighery Dataset)				Final determination
	Similarity	FCT	SCP Q	Dendrogram	Similarity	FCT	SCP Q	Dendrogram	
Kwin05 (BmBa)	50.57	21a	Cavs10	Clustered with a clade of quadrats from 20b, 21a and 28 at around 41%. Then grouped with a larger clade of 23a	49.54	23a	hurst03	Clustered with a quadrat from 21b, then formed a larger clade with more quadrats from FCT 21b	23a- due to land system, dominant species and supported by statistical analysis
	48	23a	Cresw01		48.00	23a	WAND-1		
	47.78	23a	Light01		46.93	23a	YULE-2		
Kwin06 (ErMr)	23.52	S07	benn01	Clustered with a large clade at around 16% similarity, which included quadrats from FCTs S07, 6, S17 and 11	24.39	11	low10b	Clustered with a quadrat from 13, then formed a larger clade with FCTs 11, and 14	11- Statistical analysis showed a weak association with the SCP FCTs. FCT 11 was most closely aligned due to land system, position in the landscape, surrounding SCP quadrat locations and dominant species
	20	S11	m4601		27.27	13	MILT-2		
	21.42	S17	raven02		18.18	16	Possum2		
Kwin07 (ErMr)	30.76	18	ELE13	Clustered with quadrats from FCT S17.	33.33	13	MILT-2	Clustered with a quadrat from 13 then formed part of a larger clade with 10, 11, 14, 25, 12	11-S Communities do not occur near the survey area. FCT 11 was most closely aligned due to land system, position in the landscape, surrounding SCP quadrat locations and dominant species
	40	S17	pinj13		26.08	11	MOD0-3		
	33.33	S17	raven02		23.52	12	RIVD-1		
Kwin08 (Cc)	29.50	23b	5D01	Part of a large clade that contains quadrats from FCT 20a, 21a, 21c, 22, 23a, 23b, 23c, 28 and S09	33.84	21a	card7	Clustered with quadrats from FCT 6 at 21.21%	21a- due to land system, Gibson et al. (1994) typical and common species and supported by statistical analysis
	28.20	23a	beel02		34.37	21c	low07		
	35.71	21a	ELE04		35.29	24	THOM-2		
Kwin09 (Cc)	37.20	21a	Cavs11	Clustered with 21c then formed part of a larger clade with quadrats from FCT 23a and 21a	35.955	1a	AUSTRA-1	Clustered with a quadrat from 21a at 36.36% then formed a larger clade with quadrats from FCT 21c at 29.3%	21a- due to land system, Gibson et al. (1994) typical and common species and supported by statistical analysis
	36.58	23a	gosn04		36.36	21a	DEPOT-1		
	39.53	21a	Hamp03		36.11	21c	MOD0-2		
Kwin10 (EgBspp.)	42.30	23a	Cresw01	Clustered with a large clade represented by quadrats from FCTs 28, 21a and 20b	46.29	28	HARRY-2	Clustered with several quadrats from FCT 28 at 37.17% and 34.67%	28- due to land system, common shrub layer and supported by statistical analysis
	42.73	23a	Light02		43.29	28	KING-2		
	46.72	28	wire01		46.15	28	NEER-3		

Floristic Community Type assignment

Most of the vegetation within the survey area has been impacted to some degree by edge effects or has been revegetated. Bushland remnants in most cases lie adjacent to the revegetated areas and so have been influenced by edge effects. In some cases, the SSI analysis would group GHD quadrats with SCP quadrats of a certain FCT however final determination would place the GHD quadrat in a different FCT. This is because the final determination for FCT assignment took into account landform and dominant species as well as statistical analysis. For example, Kwin01 showed similarities to SCP quadrats from FCT 23a, 21a and 21c. However, 23a and 21c are restricted to the Bassendean system, and the Gibson *et al.* (1994) typical and common species from Kwin01 was more similar to FCT 28 than 21a (Table 26).

The final determination of GHD quadrats Kwin02, Kwin03, Kwin08 and Kwin09 were deemed inconclusive. Kwin 02 and Kwin03 were established in areas of Tuart so that a TEC Patch Assessment (MRWA 2021a) could be completed. Kwin02 lies adjacent to roadside vegetation and Kwin03 is south of more revegetation. Both these quadrats were highly modified and in Degraded condition and showed only weak associations with SCP FCTs.

Kwin08 and Kwin09 were two very restricted areas between the Kwinana Freeway and *Melaleuca* wetlands. It's thought that these areas are ecotones from the *Melaleuca* wetlands into *Banksia* woodlands that once existed where the Kwinana freeway now dissects. These two quadrats showed strong similarities to each other and then clustered with a suite of FCTs (1a, 21a, 21c 23a, 23b and 24). FCTs 21a, 21c 23a and 23b are *Banksia* spp. communities. Even though *Banksia* spp. were not common or dominant within the upper storey stratum for Kwin08 and Kwin09 it should be noted that the names applied to FCTs in Gibson *et al.* (1994) are intended to be descriptive, not diagnostic. DBCA (2024) report occurrences of '*Banksia attenuata* woodlands over species rich dense shrublands' (FCT 20a) that do not contain *Banksia attenuata* but occur in the appropriate habitat, with statistical analyses of the quadrat data to indicate alignment. The dominant species for Kwin08 and Kwin09 was *Corymbia calophylla*, which are rare in FCTs 23b (<5%) and 23a (<6%). Occurrences of *C. calophylla* are higher in FCT 21c (23%) and again in FCT 21a (36%) Gibson *et al.* (1994). The final determination for FCT assignment to these two quadrats was FCT 21a - Central *Banksia attenuata-Eucalyptus marginata* woodlands. Statistical analysis supports this alignment, and the typical and common species recorded in these quadrats was also supportive of FCT 21a (Table 26).

Table 26 Typical and common species occurrence in Gibson *et al.* (1994) quadrats compared with GHD quadrats

Quadrat	Typical and common species occurrence in FCT quadrats (Gibson <i>et al.</i> 1994)	
	Typical species >50%	Common species 50>30%
Kwin01	21a - 13	21a - 2
	28 - 14	28 - 5
Kwin08	21a - 9	21a - 1
	21c - 7	21c - 4
Kwin09	21a - 11	21a - 6
	21c - 8	21c - 5

Typical species of 21c and 21a that were in common with vegetation type Cc (Kwin08 and Kwin09) are shown in Table 27. The percentage occurrence of these species in Gibson *et al.* (1994) quadrats that represented FCTs 21a and 21c are also shown.

Table 27 Typical and common species of FCTs 21c and 21a that were recorded in vegetation type *Corymbia calophylla* woodland

Species	21c		21a	
	Typical species	Common species	Typical species	Common species
* <i>Aira caryophyllea</i>				44%
<i>Banksia menziesii</i>	61%			
<i>Bossiaea eriocarpa</i>		30%	76%	

Species	21c		21a	
	Typical species	Common species	Typical species	Common species
<i>*Briza maxima</i>	57%		75%	
<i>Burchardia congesta</i>	50%		78%	
<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>		30%	53%	
<i>Conostylis juncea</i>		42%	63%	
<i>Corymbia calophylla</i>				36%
<i>Dampiera linearis</i>				44%
<i>Dasypogon bromeliifolius</i>	61%		78%	
<i>Desmocladius flexuosus</i>		34%	59%	
<i>Gompholobium tomentosum</i>		57%	73%	
<i>Jacksonia furcellata</i>				30%
<i>Lobelia tenuior</i>				32%
<i>Patersonia occidentalis</i>	73%		65%	
<i>Phlebocarya ciliata</i>	50%		71%	
<i>Trachymene pilosa</i>	76%		84%	
<i>Xanthorrhoea preissii</i>	53%			48%
Total	8	5	11	6

Typical species of FCTs 28 and 21a that were in common with Kwin01 are shown in Table 28. The percentage occurrence of these species in Gibson et al (1994) quadrats that represented FCTs 21a and 28 are also shown.

Table 28 Typical and common species of FCTs 28 and 21a that were recorded in Kwin01

Species	28		21a	
	Typical species	Common species	Typical species	Common species
<i>Banksia attenuata</i>	72%		82%	
<i>Banksia menziesii</i>		45%		
<i>Briza maxima</i>	75%		75%	
<i>Burchardia congesta</i>	77%		78%	
<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>			53%	
<i>Conostylis aculeata</i> subsp. <i>aculeata</i>	54%		51%	
<i>Desmocladius flexuosus</i>	72%		59%	
<i>Drosera erythrorhiza</i>	62%		57%	
<i>Gladiolus caryophyllaceus</i>	68%			
<i>Gompholobium tomentosum</i>	59%		73%	
<i>Hibbertia hypericoides</i>	93%		84%	
<i>Jacksonia furcellata</i>				30%
<i>Lomandra caespitosa</i>		42%	59%	
<i>Lomandra hermaphrodita</i>		44%	53%	
<i>Mesomelaena pseudostygia</i>	93%			
<i>Scaevola canescens</i>		37%		
<i>Sowerbaea laxiflora</i>	62%			

Species	28		21a	
	Typical species	Common species	Typical species	Common species
<i>Trachymene pilosa</i>	80%		84%	
<i>Ursinia anthemoides</i>	75%		61%	
Total	13	4	13	1

4.1.4 Vegetation condition

The remnant native vegetation and revegetation of the survey was variable and ranged from Very Good to Completely Degraded. Approximately 60% of the remnant native vegetation was in Degraded or poorer condition. The majority of the revegetated areas was in Completely Degraded condition.

Vegetation condition extent and percentage of the survey area and per vegetation type are quantified in Table 29, and mapped in Figure 7, Appendix A.

Several factors were attributed to degradation in the survey area:

- Weedy grasses, particularly **Ehrharta calycina*, **E. longiflora* and **Eragrostis curvula* were recorded in the remnant *Banksia/ Eucalyptus* patches recorded throughout the survey area. Where these grasses dominated there was little to no native understorey, and the condition rating was Degraded or Completely Degraded
- Areas infested with Declared Pests and Weeds of National Significance, such as **Asparagus asparagoides* (bridal creeper) and **Zantedeschia aethiopica* were also rated as Degraded or Completely Degraded
- Areas in Good or Very Good condition were generally buffered by vegetation in poorer quality and were part of a larger patch that extended outside the survey area. These areas still recorded a number of weeds however the presence of these weeds either were not dominant or invasive. Also, basic strata structure of these areas was retained.

Table 29 *Vegetation condition extent and percentage per vegetation type within the survey area*

Vegetation Condition	Native vegetation type (ha)						Roadside revegetation / Cleared (ha)	% within the survey area
	BmBa	EgBspp.	EmBspp	ErMr	Cc	Total		
Very Good	0.17	0.67	-	0.65	0.17	1.66	0.27	0.7%
Good	0.91	1.40	0.18	0.49	0.25	3.23	0.46	1.3%
Good-Degraded	-	0.46	-	0.49	-	0.95	-	0.3%
Degraded	0.27	4.92	4.62	0.61	-	10.42	2.67	4.6%
Degraded to Completely Degraded	-	-	-	-	-	-	2.61	0.9%
Completely Degraded	0.67	-	0.29	1.70	-	2.66	86.64	31.3%
Cleared	-	-	-	-	-		173.87	60.9%
Total	2.02	7.45	5.09	3.94	0.42	18.92	92.65 / 173.87	100%

4.1.5 Significant ecological communities

Vegetation types EgBspp., EmBspp. and BmBa showed affinities to significant ecological communities *Banksia* Woodlands of the SCP TEC and PEC and Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC and PEC. However, not all extents of the above vegetation types mapped within the survey area met the key criteria set out by Threatened Species Scientific Committee (TSSC, 2016) and Department of Environment and Energy (DotEE, 2019). Table 30 breaks down the extent and representative vegetation type for the two significant ecological communities mapped within the survey area. Patches of vegetation type EgBspp. are considered to represent both communities (Table 30).

Table 30 Significant ecological communities and their extent mapped within the survey area

Vegetation type	Banksia Woodlands of the SCP TEC and PEC (ha)	Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain TEC and PEC (ha)
EgBspp.	7.77	2.56
EmBspp.	1.71	-
BmBa	3.86	-
Total	13.34	2.56

Significant vegetation patch assessment is discussed below for each community.

Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain TEC and PEC

Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC was recorded within the survey area. As the description, area and condition thresholds that apply to the EPBC Act listed TEC, also apply to the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' State listed PEC (DBCA 2023b), any areas considered to be the TEC are also inferred as the PEC.

Four patch assessments were completed for the survey area. Three of these assessments represented by vegetation type EgBspp were found to be representative of the ecological community and mapped within the survey area with a combined total of 2.56 ha. Patches 1 and 3 lie adjacent to Conservation Park R 53313, ESA site 3287 and Bush Forever site 270. Patch 2 lies adjacent to Conservation Park R 53313, ESA site 3290 and Bush Forever site 269. Tuart canopies can be seen from aerial imagery extending eastward and westward from the survey area and are mapped as >5ha for patches 1 and 2. It is noted that sections of the survey area patches contain revegetated areas. These revegetated areas had established (>15cm DBH) Tuart trees and between 10 – 32 native understorey species diversity. As they lay adjacent to Tuart communities >5ha they are therefore considered part of the Tuart woodlands and forests of the Swan Coastal Plain TEC and PEC as they play an important ecological function.

Patch 4 did not meet the key criteria listed by DotEE (2019) and was not representative of the Tuart ecological community.

A summary of the patch assessments are included in Table 31. Patch assessment site data is provided in Appendix D. Tuart patches are mapped in Figure 8, Appendix A.

Table 31 Patch assessment of Tuart woodland and forests of the SCP TEC within the survey area

Patch ID	Quadrat	Patch size within the survey area	TEC Condition Category	Criteria compliance	Total patch size (ha)	Comments
1	Kwin03	1.48	Poor.	Yes	Estimated to be 11.08 ha	Patches that are 0.5<2ha in Poor condition are not part of the nationally protected ecological community; however, this patch is part of a larger patch (11.08 ha) represented by Conservation Park R 53313, ESA 3287 and Bush Forever site 270, aerial imagery shows a canopy of <i>Eucalyptus gomphocephala</i> extending eastward

Patch ID	Quadrat	Patch size within the survey area	TEC Condition Category	Criteria compliance	Total patch size (ha)	Comments
						from the survey area. The Conservation Park R 53313, ESA 3287 and Bush Forever site 270, adjacent to Patch 1 is the same remnant that lies adjacent to Patch 3.
2	Kwin02	0.68	Poor	Yes	Estimated to be 8.12 ha	Patches that are 0.5 ha in Poor condition are not part of the nationally protected ecological community; however, this patch is part of a larger patch (8.12 ha) represented by Conservation Park R 53313, ESA 3290 and Bush Forever site 269, aerial imagery shows a canopy of <i>Eucalyptus gomphocephala</i> extending westward from the survey area.
3	Kwin01	0.40	Moderate	Yes	Estimated to be 3.61 ha	Patches < 0.5 ha in Moderate condition are not part of the nationally protected ecological community; however, this patch is part of a larger patch (3.61 ha) represented by Conservation Park R 53313, ESA 3287 and Bush Forever site 270, aerial imagery shows a canopy of <i>Eucalyptus gomphocephala</i> extending eastward from the survey area. The Conservation Park R 53313, ESA 3287 and Bush Forever site 270, adjacent to Patch 1 is the same remnant that lies adjacent to Patch 3.
4	Field notes	0.11	Poor	No	0.22	The patch contained two Tuart trees; one tree (800 mm DBH) and one mallee (200 mm DBH). It was <0.5 ha and had <4 native understorey species per 0.1ha. This patch did not meet key criteria and is therefore not part of the nationally protected ecological community.

***Banksia* Woodlands of the SCP TEC and PEC**

The *Banksia* Woodlands of the SCP TEC and PEC are restricted to the SCP IBRA bioregion and immediately adjacent areas, including the Dandaragan Plateau, from Jurien Bay in the north, to Dunsborough in the south, and northwest on the Whicher and Darling escarpments (TSSC, 2016). The ecological community typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands (TSSC, 2016).

Three vegetation types, BmBa, EmBspp. and EgBspp. mapped within the survey area showed affinities to the *Banksia* Woodlands of the SCP TEC and PEC, as outlined in TSSC (2016). Specifically:

- The survey area occurs in the SCP IBRA bioregion
- The survey area occurs on sandplain landform, notably Spearwood and Bassendean sands
- The vegetation types have a low woodland structure and the upper sclerophyllous layer is dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. The understorey consists of a mid-ground sclerophyllous shrub layer and/or a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs that sometimes includes grasses.

However, due to minimum condition and patch size criteria outlined by TSSC (2016) not all areas mapped as BmBa, EgBspp. and EmBspp. are considered part of the TEC and PEC. Seven *Banksia* woodland patches were mapped within the survey area and are considered representative of the *Banksia* Woodland of the SCP TEC and PEC. The portions of these patches contained within the survey area would not normally meet the criteria for the

ecological community due to their size and or condition. However, all these patches lie adjacent to larger remnants (5< ha) that are likely to be in good or better condition due to their size and access restrictions. GHD mapped 13.34 ha of vegetation considered representative of the *Banksia* Woodland of the SCP TEC and PEC within the survey area.

Table 32 breaks down the condition and size of each patch from the *Banksia* Woodland of the SCP TEC and PEC patch assessment.

Table 32 Patch field assessment of Banksia Woodlands of the SCP TEC within the survey area

Patch number	Quadrat/ Relevé	Vegetation type	Condition within the survey area	Patch size within the survey area	Total patch size (ha)	Comments	Final determination
1	Kwin10	EgBspp.	Very Good	0.24	>5ha	Due to its condition the extent of vegetation within the survey area does not meet the criteria to be considered a TEC. However, it does lie adjacent to remnant bushland ~6.78ha that may be in Good or better condition.	Yes- It is assumed a remnant of this size would be in good or better condition, making the total patch size ~7.48 ha.
			Good to Degraded	0.46			
			Total	0.70			
2	Kwin02R Roe02, Roe10, Roe12 ⁵	EgBspp.	Good	0.43	>5ha	Due to its condition the extent of vegetation within the survey area does not meet the criteria to be considered a TEC. However, it does lie adjacent to remnant bushland ~11.62ha that is known to be in Good or better condition as it has been surveyed and mapped as part of the Roe Highway Widening (GHD 2025).	Yes- as part of the Roe highway widening scope (GHD 2025) this remnant was assessed, and the vegetation condition was Very Good. The total patch size is 12.34 ha.
			Degraded	0.30			
			Total	0.72			
3	Kwin05	BmBa	Very Good	0.35	>5ha	Due to its condition the extent of vegetation within the survey area does not meet the criteria to be considered a TEC. However, it does lie adjacent to remnant bushland ~15.08ha that may be in Good or better condition. A section rated as Completely Degraded (1.18 ha) at the time of the survey was burnt in 2024, its unknown what condition this area will regenerate to post fire.	Yes- It is assumed a remnant of this size would be in good or better condition. It is unknown if the burnt vegetation north will regenerate to good or better condition. However, even if this section does not recover the remnant patch would still be ~17.76 ha.
			Good	1.26			
			Degraded	1.06			
			Completely Degraded	1.18			
			Total	3.86			
4	Kwin01, Kwin03, Kwin05R, Kwin03R	EgBspp.	Very Good	0.52	>5ha	Due to its condition the extent of vegetation within the survey area does not meet the criteria to be considered a TEC. However, it does lie adjacent to Conservation Park R 53313, ESA 3287 and Bush Forever site 270. This bushland remnant is approximately ~58.41ha and is likely to be in Good or better condition.	Yes- It is assumed a remnant of this size that is fenced and therefore reduces access would be in good or better condition, making the total patch size ~62.59 ha.
			Good	0.61			
			Degraded	3.05			
			Total	4.18			
5	Kwin04, Kwin10R	EmBspp.	Good	0.18	>5ha	Due to its condition the extent of vegetation within the survey area does not meet the criteria to be considered a TEC. However, it does lie adjacent to remnant bushland that is	Yes- It is assumed a remnant of this size that is fenced and therefore reduces access would be in good or better condition, making the total patch size ~7.15 ha.
			Degraded	1.53			
			Total	1.71			

⁵ Roe quadrats are from the Roe Highway Flora and Vegetation survey (GHD 2025). Banksia patch 2 is continuous and contains all sample sites
GHD | Main Roads WA | 12634226 | Kwinana Freeway Widening Project

Patch number	Quadrat/ Relevé	Vegetation type	Condition within the survey area	Patch size within the survey area	Total patch size (ha)	Comments	Final determination
						~5.44ha, which may be in Good or better condition. The northern section of this remnant is Conservation Park R 53313.	
6		EgBspp.	Degraded	1.11	>5ha	Due to its condition the extent of vegetation within the survey area does not meet the criteria to be considered a TEC. However, it does lie adjacent to Conservation Park R 53313, ESA 3290 and Bush Forever site 269, which is ~49.96haha and may be in Good or better condition.	Yes- It is assumed a remnant of this size that is fenced and therefore reduces access would be in good or better condition, making the total patch size ~51.07 ha.
7	Kwin02	EgBspp.	Degraded	1.05	>5ha	Due to its condition the extent of vegetation within the survey area does not meet the criteria to be considered a TEC. However, it does lie adjacent to Conservation Park R 53313, ESA 3290 and Bush Forever site 269, which is ~49.96ha and may be in Good or better condition.	Yes- It is assumed a remnant of this size that is fenced and therefore reduces access would be in good or better condition, making the total patch size ~51.01 ha.

4.2 Flora

4.2.1 Flora diversity

Two hundred and twenty vascular flora taxa (including species, subspecies, varieties, forms and specimens not identified to species level) from 54 families and 153 genera, were recorded in the survey area. One-hundred and forty-eight of the flora recorded were native taxa, seven were naturalised⁶ and 65 were introduced. The dominant families for the survey area included:

- Myrtaceae -18 species
- Fabaceae- 16 species
- Poaceae – 14 species.

The inventory of flora recorded within the survey area is provided in Appendix D.

A species accumulation curve was generated using PRIMER to assess adequacy of sampling effort within the survey area (Plate 2). The species accumulation curve for the survey area, based on flora recorded within quadrats and relevés is approaching an asymptote for UGE but still rising for bootstrap. The bootstrap estimate of species richness generated from this data indicates that 225 species could be expected from the survey area based on the diversity recorded within quadrats and relevés, UGE estimate is 189. The total taxa recorded within the quadrats and relevés was 189 however the total for the survey area including opportunistic species was 220 flora taxa. Therefore, the sampling effort for survey area is considered representative of the floristic diversity in the area.

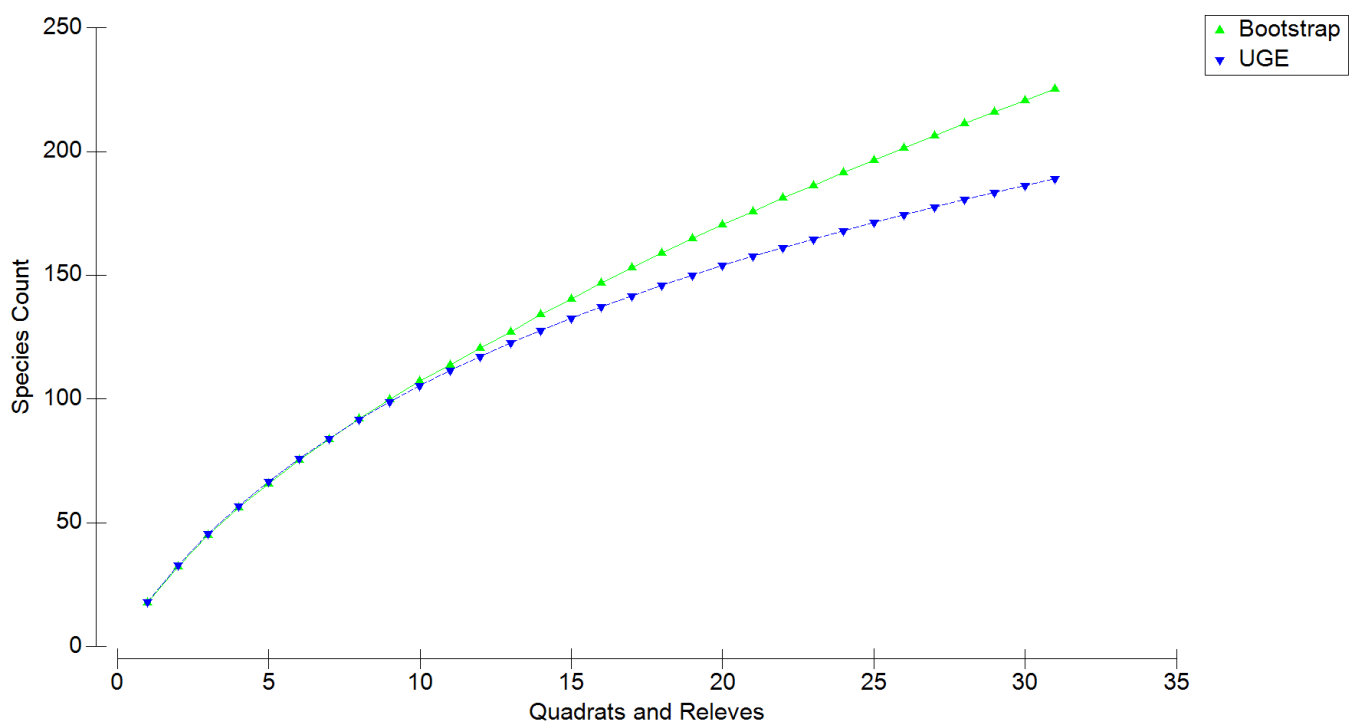


Plate 2 Flora species accumulation curve for the Kwinana survey area

Vegetation type EgBsp. was the most floristically diverse with 92 taxa, EmBsp. was the least diverse with 48 taxa. The most floristically diverse quadrat was Kwin04 from vegetation type BmBa with 42 taxa and the least was from the wetland quadrat Kwin06 with 11 taxa.

⁶ Taxa that are native to WA however are not endemic to the survey area.

4.2.2 Significant flora

No EPBC Act listed flora were recorded within the survey area. Three significant flora species were recorded within the survey area, however two of these species are considered naturalised:

- *Jacksonia gracillima* (P3)
- *Grevillea curviloba* listed as Endangered under the BC Act (naturalised)
- *Grevillea olivacea* (P4) (naturalised).

The locations of these significant flora are shown in Figure 8, Appendix A and listed in Appendix D.

Jacksonia gracillima (P3) is a spreading shrub that produces pink to orange flowers in October and November (Plate 3). Generally found in low lying areas associated with sandy to loamy soils (Western Australian Herbarium (WAH) 1998–). The collected specimen was formerly identified at the WA Herbarium (accession number 11329). Three plants were recorded growing south of Kwin08 within an isolated pocket of Cc vegetation, which was restricted to 0.42 ha. Vegetation extending beyond the boundary of the survey area was vegetation type ErMr. This area was searched and no further records of *J. gracillima* were located.



Plate 3 Stock photo of *Jacksonia gracillima* (P3) (WA Herbarium 1998–)

Although *Grevillea curviloba* and *Grevillea olivacea* are significant flora they are both considered to be planted within the survey area and outside their natural range and habitat. The natural range of *Grevillea curviloba* is north of the survey area around Bullsbrook and Muchea and is found growing in winter wet heaths (Western Australian Herbarium (WAH) 1998–). Several plants were recorded at Kwin17R (5% coverage) in an area of roadside vegetation mapped as Isolated *Banksia* spp. (roadside revegetation).

The natural range of *G. olivacea* (P4) is north of the survey area in the Geraldton Sandplains and northern part of the Swan Coastal Plain (Dandaragan Plateau) IBRA regions, however it is commonly used around the Perth metropolitan area as a horticultural species (Western Australian Herbarium (WAH) 1998–). *Grevillea olivacea* was recorded in multiple locations along the roadside (within roadside revegetation).

Likelihood of occurrence

A likelihood of occurrence assessment was conducted post-field survey for significant flora taxa identified in the desktop assessment (Appendix D). The assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species.

The likelihood of occurrence assessment post-field survey concluded one taxon was known and recorded in the survey area during the survey, *Jacksonia gracillima* (P4) and two taxa were considered possibly to occur. *Poranthera moorokatta* (P2) was considered possible as it's a very small cryptic annual species that may also have been missed. *Dodonaea hackettiana* (P4) was possibly observed on the edge of a slip lane. However, the area was too dangerous to pull over and so the plant was unable to be collected for identification.

Threatened orchid species were identified by the pre-survey likelihood of occurrence as likely or possibly occurring within the survey area including *Caladenia huegelii*, *Diuris drummondii*, *Diuris micrantha*, *Diuris purdiei* and *Drakaea elastica*. Post-survey all were considered unlikely to occur due to the fragmentation and degradation of potential habitats that occur within the survey area and/or sufficient survey effort during the optimal season for identification.

There is a record of *Caladenia huegelii* from 2006 within 20 m of the survey area near Beeliar Drive, therefore pre-survey this species was considered likely to occur. Searches were undertaken within suitable habitat (such as *Banksia* woodland vegetation types) within the survey area during September. The species was recorded in the nearby Roe Highway and offset survey areas during the survey (GHD, 2025), so it was known that the seasonal timing was suitable to identify the species if present within the survey area. *Caladenia huegelii* occurs in areas of mixed *Banksia* – *Jarrah* woodland over dense shrubs such as *Stirlingia latifolia*, *Hypocalymma robustum*, *Hibbertia hypericoides*, *Xanthorrhoea preissii* and *Conostylis* spp. (DEC, 2009a). As areas of suitable habitat become more degraded (weed invasion, changes to structure caused by *Phytophthora* dieback, increased fires) they may not be able to support the orchids associated mycorrhizal fungus or pollinating wasp (DEC, 2009a). Some areas of *Banksia* woodland, although disturbed were considered to provide suitable habitat, such as areas south of the Roe Highway interchange where the *Banksia* woodland was still somewhat structurally intact (Plate 5), however many of the areas which may have provided suitable habitat in the past, were considered to have become too degraded to support *Caladenia huegelii* due to loss of understorey and structural changes to canopy (Plate 4).



Plate 4 *Banksia* woodland of the east side of Kwinana Freeway, just south of Thomas Road. High disturbance, lack of native understorey, dominated by weedy grasses. Unlikely to provide suitable habitat for *Caladenia huegelii*



Plate 5 *Banksia* woodland on the east side of Kwinana Freeway, south of Roe Highway interchange. Vegetation is disturbed, however still considered to be suitable habitat for *Caladenia huegelii*

Drakaea elastica was considered likely to occur pre-survey due to presence of records in study area and potential areas of habitat between specifically south of Anketell Road to Thomas Road. Targeted survey was conducted during July, specifically to target the habitat of this species when the leaf (identifying feature) is visible. It was found that the vegetation through this area consisted of narrow bands of remnant vegetation/potential habitat lying between the northbound Principal Shared Pathway (PSP) and firebreak along the boundary of land parcels east of Spectacles Road, and on the eastern side of Kwinana Freeway, there was a narrow band of vegetation occurring between the south bound lanes and firebreak and fenceline of adjacent blocks. Due to the edge effects on these narrow remnants and interface with planted vegetation, the areas potentially supporting this species were found to be significantly disturbed (Plate 6 and Plate 7). *D. elastica* is known to be sensitive to disturbance as it requires sufficient canopy structure to prevent the desiccation of the orchid and associated mycorrhizal fungus, as well as the negative effect of weed invasion on the species which has a preference for bare sand lens habitats (DEC,

2009b). Based on the high levels of disturbance in areas of suitable habitat and survey effort, this species was considered unlikely to occur within the survey area post survey.



Plate 6 Vegetation on the east side of Kwinana Freeway, north of Sandy Lake and 800 m south west of previous *Drakaea elastica* records. Previously cleared with mixture of native and revegetation species. Understorey dominated by weedy grasses.



Plate 7 Vegetation on the west side of Kwinana Freeway east of Spectacles Drive. Remnant vegetation with disturbed understorey dominated by weedy grasses.

There are historic records of *Diuris drummondii* within the study area, the closest records are approximately 1.5 km east of the survey area (Jandakot, 1959) and 4 km west (Banganup Swamp, 1959) (WAH, 1998-). Habitat includes low-lying depressions in peaty and sandy clay swamps, often in several centimetres of water (DEWHA, 2008). Wetland areas that occur within the survey area represent highly modified areas which are tied in with road drainage resulting in areas which would not provide suitable habitat for this species (Plate 8 and Plate 9) due to changes to hydrology and landform (such as deep standing water) and/or dominance by invasive species and *Typha* spp. and/or *Pteridium esculentum*.



Plate 8 Wetland on the east side of Kwinana Freeway, north of Mortimer Road showing deep water and modified landform.



Plate 9 Wetland on the east side of Kwinana Freeway, north of Mortimer Road, less modified but still impacted by road drainage.

Diuris micrantha has been previously recorded within a winter wet swamp, approximately 300 m west of the survey area along Johnson Road, in an area of dense herbs such as *Wurmbea dioica* and *Tribonanthes* sp. and sedges bordered by *Melaleuca raphiophylla* (WAH 1998-). There is a continuation of these wetlands east of Johnson Road and intersecting the survey area. There is mixed planted shrubland immediately adjacent to the northbound freeway lanes, the footprint of the northbound PSP and then west of the PSP there is remnant vegetation (Plate 10) of which a section of approximately 19 m wide intersects the survey area. This area was not considered to

provide suitable habitat for *D. micrantha* due to presence of dense *Pteridium esculentum* (approximately 90% cover) (Plate 11).



Plate 10 Looking west across PSP to remnant vegetation on west side of Kwinana Freeway, area bounded by Karakin Place in the north and Sanctuary Drive in the south



Plate 11 Dense *Pteridium esculentum* on west side of Kwinana Freeway, area bounded by Karakin Place in the north and Sanctuary Drive in the south.

Previous records of *Diuris purdiei* occur to the east of the survey area, with the nearest approximately 5.6 km east of the survey area. Previous records occur in a north to south corridor to the east of the survey indicating that the survey area falls outside the currently known distribution of the species. *Diuris purdiei* grows on sand to sandy clay soils in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana*, *Corymbia calophylla*, *Eucalyptus marginata* and *Nuytsia floribunda* (DEWHA, 2008). Flowering is only known occurs after a summer or early autumn fire (DEWHA, 2008). No suitable habitat for this species was identified within the survey area. All remaining significant flora identified by the desktop assessment are unlikely or highly unlikely to occur. This is due to a combination of distance from the survey area, visibility of the taxa during the field survey, intensity of the field survey and most significantly the high level of disturbance and clearing throughout the survey area.

4.2.3 Introduced flora

Sixty-four introduced flora species were recorded within the survey area representing 29.4% of the total flora species recorded. Of the 64 introduced species five species are listed as Declared Pest (DP) plants in WA under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), two are also listed as Weeds of National Significance (WoNS) (Australian Weeds Committee, 2012):

- **Asparagus asparagoides* (DP and WoNS)
- **Opuntia stricta* (DP and WoNS)
- **Gomphocarpus fruticosus* (DP)
- **Moraeea flaccida* (DP)
- **Solanum linnaeanum* (DP)
- **Zantedeschia aethiopica* (DP)

The locations of significant weeds within the survey area are presented in Figure 7, Appendix A.

4.3 Fauna

4.3.1 Fauna habitat types

Eight broad fauna habitat types including Cleared areas have been delineated and described (Table 33) and mapped in Figure 9A, Appendix A. Each fauna habitat type aligns with at least one vegetation community types (VCT) described during the flora and vegetation survey and listed in section 4.2.1.

Table 33 Habitat types identified in the survey area

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph						
Banksia woodland	This habitat type corresponds with vegetation types BmBa, and Isolated <i>Banksia</i> spp. It is present as several small areas and includes isolated scattered patches. Floristically characterised by <i>Banksia attenuata</i>, <i>B. menziesii</i> and scattered areas of <i>B. ilicifolia</i> woodland over <i>Hibbertia</i> species, <i>Scholtzia involucrata</i> <i>Styphelia conostephioides</i> over, <i>Patersonia occidentalis</i> <i>Desmocladius flexuosus</i> <i>Lyginia barbata</i>. Patches of understory include <i>Xanthorrhoea preissii</i> and <i>Hibbertia subvaginata</i> over <i>Dasypogon bromeliifolius</i>, <i>Phlebocarya ciliata</i>, <i>Schoenus caespititius</i> shrub layer. Substrate is pale grey deep sand. Habitat condition varies widely from degraded to very good. But retention of upper stratum <i>Banksia</i> maintains high foraging value for Black Cockatoos. Where this habitat is in good or better condition, it supports a wide range of woodland birds and reptiles that continue to persist in sandplain Banksia woodland remnant patches including New Holland and White-cheeked Honeyeater and Grey Shrike-thrush, Splendid Fairy-wren and Rufous Whistler. Reptile examples include Burton's Legless Lizard and Sandplain Worm Lizard. Significant fauna species: Moderate to high quality foraging habitat for Carnaby's Cockatoo (<i>Zanda latirostris</i>), Quenda (<i>Isoodon fusciventer</i>), Perth Slider (<i>Lerista lineata</i>), Black-striped Snake (<i>Neelaps calolotus</i>), Swan Coastal Plain Shield-back Spider (<i>Idiosoma sigilatum</i>), Short-tongued Bee (<i>Leioproctus contrarius</i>), and Bush Stylet Cricket (<i>Throscodectes xiphos</i>). <table><tr><td></td><td>Carnaby's Cockatoo</td><td>FRTB Cockatoo</td></tr><tr><td>Foraging score</td><td>6 mod-high</td><td>2 low</td></tr></table>		Carnaby's Cockatoo	FRTB Cockatoo	Foraging score	6 mod-high	2 low	10.30 ha (3.6%)	
	Carnaby's Cockatoo	FRTB Cockatoo							
Foraging score	6 mod-high	2 low							

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph						
Eucalyptus woodland over Banksia	This habitat type corresponds with vegetation types EgBspp and EmBspp. It is characterised as emergent sparse to open Tuart or Jarrah and occasional patches of <i>Allocasuarina</i> over <i>Banksia attenuata</i> and <i>B.menziesii</i> woodland over <i>Acacia</i>, <i>Xanthorrhoea</i> and <i>Hibbertia</i> low shrubland over weedy sedgeland/ grassland. Substrate is deep pale grey sandy soil. Habitat condition varies widely from degraded to very good. But retention of upper emergent eucalypts and mid-story <i>Banksia</i> maintains high foraging value for Black Cockatoo. It comprises a relatively small and scattered proportion of the survey area. Where this habitat is in good or better condition, it supports a wide range of woodland birds and reptiles that continue to persist in remnant patches including Crested Pigeon, Striated Pardalote, and Weebil. Reptile examples include Bobtail, Western Bearded Dragon, and Marbled Gecko. Significant fauna species: Moderate to high quality foraging habitat for Carnaby's Cockatoo (<i>Zanda latirostris</i>), moderate value for Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>) and represents breeding habitat for both species. Habitat for Quenda (<i>Isoodon fusciventer</i>), Perth Slider (<i>Lerista lineata</i>), Black-striped Snake (<i>Neelaps calolotus</i>), Swan Coastal Plain Shield-back Spider (<i>Idiosoma sigilatum</i>), Short-tongued Bee (<i>Leioproctus contrarius</i>), and Bush Stylet Cricket (<i>Throscodectes xiphos</i>). <table><tr><td></td><td>Carnaby's Cockatoo</td><td>FRTB Cockatoo</td></tr><tr><td>Foraging score</td><td>6 mod-high</td><td>4 mod</td></tr></table>		Carnaby's Cockatoo	FRTB Cockatoo	Foraging score	6 mod-high	4 mod	14.40 ha (5.0%)	
	Carnaby's Cockatoo	FRTB Cockatoo							
Foraging score	6 mod-high	4 mod							

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph						
Melaleuca dampland and sparse flooded gum	This habitat type corresponds with vegetation type ErMr and is comprised of occasional to sparse Flooded Gum over <i>Melaleuca raphiophylla</i> and / or <i>M. preissiana</i> over <i>Kunzea glabrescens</i>, <i>Xanthorrhoea preissii</i> and <i>Lepidosperma longitudinale</i>. Soil is sandy grey Bassendean formation but tends to be poor draining and relatively low elevation. Habitat condition varies from degraded to very good however the lower stratum vegetation tends to retain high density although tends to be weedy. Total extent area is low and limited to few patches. Due to the degraded condition and small area of this habitat, fauna species present are limited to those with a degree of resilience and habitat generality such as Brown Honeyeater, Silvereye, and frogs such as Glauert's Froglet, and Gunther's False Toadlet Significant fauna species: Preferred foraging and shelter / refuge habitat for Quenda (<i>Isoodon fusciventer</i>). Low quality habitat for remaining significant fauna. <table><tr><td></td><td>Carnaby's Cockatoo</td><td>FRTB Cockatoo</td></tr><tr><td>Foraging score</td><td>1 Negligible to low</td><td>1 Negligible to low</td></tr></table>		Carnaby's Cockatoo	FRTB Cockatoo	Foraging score	1 Negligible to low	1 Negligible to low	3.94 ha (1.4%)	
	Carnaby's Cockatoo	FRTB Cockatoo							
Foraging score	1 Negligible to low	1 Negligible to low							

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph						
Marri woodland	This habitat type corresponds with the Isolated <i>Corymbia calophylla</i> and <i>C. calophylla</i> woodland vegetation types and comprises relatively small remnant patches and isolated stands of tall <i>Corymbia calophylla</i> over scattered natives such as occasional Grass trees and weeds. The lower strata understory and shrub layers are highly degraded to absent. The retained canopy provides habitat for a range of locally occurring woodland birds including Black Cockatoos. Due to the degraded condition and small area of this habitat, fauna species present are limited to those with a degree of resilience and habitat generality that persist in fragmented Marri woodland patches such as Pied Butcherbird, Australian Magpie, Red-wattlebird, and Singing Honeyeater. Significant fauna species: High quality foraging habitat and breeding habitat Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>), and moderate to high for Carnaby's Cockatoo (<i>Zanda latirostris</i>). <table><tr><td></td><td>Carnaby's Cockatoo</td><td>FRTB Cockatoo</td></tr><tr><td>Foraging score</td><td>5 mod-high</td><td>7 high</td></tr></table>		Carnaby's Cockatoo	FRTB Cockatoo	Foraging score	5 mod-high	7 high	1.97 ha (0.7%)	
	Carnaby's Cockatoo	FRTB Cockatoo							
Foraging score	5 mod-high	7 high							

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph						
Naturalised and native trees	This habitat type corresponds with the Isolated Eucalyptus spp vegetation type and comprises a range of <i>Eucalyptus</i> species. over scattered natives and weeds and is considered highly degraded. Trees include River Red-Gum, Spotted Gum, Lemon-scented Gum, occasional Tuart, Marri and Jarrah. Usually associated with disturbed areas along road verges and cycle path embankments. The lower strata are absent, replaced by weed grasses and annual herb species. The habitat provides foraging and nesting habitat for a wide range of common native nectivore insectivore bird species such as honeyeaters and Weebill. Significant fauna species: The canopy provides seasonal nectar for all three species of Threatened Black Cockatoo and potentially suitable night roosts. There is relatively low density of Marri and Jarrah as foraging. <table><tr><td></td><td>Carnaby's Cockatoo</td><td>FRTB Cockatoo</td></tr><tr><td>Foraging score</td><td>1 Negligible to low</td><td>1 Negligible to low</td></tr></table>		Carnaby's Cockatoo	FRTB Cockatoo	Foraging score	1 Negligible to low	1 Negligible to low	13.29 ha (4.7%)	
	Carnaby's Cockatoo	FRTB Cockatoo							
Foraging score	1 Negligible to low	1 Negligible to low							

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph		
Native and introduced shrubs	This habitat type corresponds with Mixed shrubland vegetation type and comprises a range of naturalised, introduced and native planted shrubs, with weed grasses and herbaceous weeds, and usually associated with disturbed areas along road verges and cycle path embankments, often planted or regenerated vegetation in disturbed areas post-road construction. It is comprised of Acacia and myrtaceous shrubs and relatively low density to patchy proteaceous shrubs including banksia, hakea and grevillea. Vegetation condition is highly degraded. Due to the degraded condition of this habitat, fauna species present are limited to those with resilience and habitat generality that persist in highly disturbed and modified vegetation structure such as Singing Honeyeater, Rainbow Bee-eater, and Willie Wagtail. Significant fauna species: Suitable to marginal foraging habitat for Quenda (<i>Isoodon fusciventer</i>), and low quality foraging habitat for all three species of Threatened Black Cockatoo.	61.27 ha (21.5%)			
				Carnaby's Cockatoo	FRTB Cockatoo
	Foraging score			1 Negligible to low	1 Negligible to low

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph						
Modified wetland drainage area	This habitat corresponds with Modified wetland drainage area vegetation type. It includes small artificial lakes and sumps and associated fringing trees, shrubs, and Typha rushes. Vegetation of these areas is generally highly degraded. The water bodies are seasonal and fluctuate providing temporary habitat for water birds. Patches of dense low vegetation provide some refuge habitat, and fringing scattered trees provide habitat for woodland birds. Marri and Jarrah are absent to very low density. Due to the degraded condition of this habitat, fauna species present are limited to those with resilience and habitat generality that persist in highly disturbed or artificial wetlands. Species such waterbirds such as Ducks and Egrets. Significant fauna species: Water body provides seasonal feeding habitat for Blue-billed Duck (<i>Oxyura australis</i>). Fringing vegetation is suitable shelter and forage habitat for Quenda (<i>Isoodon fusciventer</i>). Fringing trees provide some seasonal nectar for all three species of Threatened Black Cockatoo and potentially suitable night roosts. <table><tr><td></td><td>Carnaby's Cockatoo</td><td>FRTB Cockatoo</td></tr><tr><td>Foraging score</td><td>1 Negligible to low</td><td>1 Negligible to low</td></tr></table>		Carnaby's Cockatoo	FRTB Cockatoo	Foraging score	1 Negligible to low	1 Negligible to low	6.40 ha (2.2%)	
	Carnaby's Cockatoo	FRTB Cockatoo							
Foraging score	1 Negligible to low	1 Negligible to low							

Habitat Type	Description	Extent (ha) and proportion (%) of survey area	Representative photograph		
Cleared area	These areas include areas of road and other infrastructure with no vegetation and also completely degraded cleared land along road verges often with dense ground cover of colonising broad-leaf annual weed and naturalised grasses, and occasional planted or native tree or shrub. The density of native species is negligible. Cleared areas cover most of the survey area and there is minimal habitat value for native species. Bird species that utilise disturbed areas are limited and include feral doves and pigeons, Australia Magpie, and Magpie Lark. Significant fauna species: No notable habitat value for any significant species.	173.87 ha (60.91%)			
				Carnaby's Cockatoo	FRTB Cockatoo
	Foraging score			0 nil	0 nil

4.3.2 Significant fauna

During the field survey three significant species were recorded, including:

- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) – Vulnerable under EPBC and BC Acts
- Carnaby's Cockatoo (*Zanda latirostris*) – Endangered under EPBC and BC Acts
- Quenda (*Isoodon fusciventer*) – listed Priority 4 under DBCA.

A likelihood of occurrence assessment of significant fauna presented in the desktop assessment was revised following the field survey. This assessment was refined with consideration to the ecological field observations. Most of the 54 species are assessed post-survey as unlikely to occur based on unsuitable or marginal habitat or species' distribution. Apart from the above-mentioned three recorded species, eight additional species are considered likely to occur within the survey area as shown in Table 34.

Table 34 Significant fauna present or likely to occur within the survey area

Common name	Status		Likelihood of occurrence
	BC Act/ DBCA	EPBC Act	
Birds			
Carnaby's Cockatoo (<i>Zanda latirostris</i>)	EN	EN	Present. Recorded during the survey from bird sightings and extensive foraging evidence (chewed banksia pods) multiple locations.
Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>)	VU	VU	Present. Recorded during the survey from bird sightings and extensive foraging evidence (chewed marri pods) in multiple locations.
Blue-billed Duck (<i>Oxyura australis</i>)	P4	-	Likely. Suitable wetland habitat and occurs locally even though not recorded during the survey.
Peregrine Falcon (<i>Falco peregrinus</i>)	OS	-	Likely. Trees within the survey area represent marginal nesting habitat. Likely to hunt on at least an occasional to regular basis.
Mammals			
Quenda (<i>Isoodon fusciventer</i>)	P4	-	Present. Recorded during the survey from foraging signs (diggings) at one location.
Reptiles			
Perth Slider (<i>Lerista lineata</i>)	P3	-	Likely. Several database records in close proximity to survey area (within 1-3 km) and suitable remnant bushland habitat present.\
Black Striped Snake (<i>Neelaps calonotos</i>)	P3	-	Likely. Locally recorded and suitable habitat occurs within the survey area such as The Spectacles bushland reserve.
Invertebrates			
Swan Coastal Plain Shield-backed Spider (<i>Idiosoma sigillatum</i>)	P3	-	Likely. The survey area intersects with suitable banksia woodland habitat in Anketell in the vicinity of the Spectacles Wetland area. Even though it was not detected during the field survey, it is likely to occur in remnant patches of Banksia woodland of good or better condition.
Short-tongued bee species (<i>Leioproctus contrarius</i>)	P3	-	Likely. Based on field assessment host plants <i>Scaevola repens</i> is present, and <i>Leschenaultia spp</i> also present within the survey area.
Graceful Sun Moth (<i>Synemon gratiosa</i>)	P4	-	Likely. Host plants species namely Lomandra hermaphrodita recorded within the survey area, therefore species is likely to occur.
Stylet Bush Cricket (<i>Throscodectes xiphos</i>)	P1	-	Likely. Potentially suitable Banksia woodland habitat within the survey area.

Further information on each recorded and likely to occur significant species is described below.

Carnaby's Cockatoo (*Zanda latirostris*)

The Carnaby's Cockatoo is listed as Endangered under the EPBC Act and BC Act. This species is endemic to the south-west of WA from near Cape Arid on the south coast through the eastern Wheat Belt and north to about Kalbarri (Saunders 1979). Carnaby's Cockatoo nest in hollows of live or dead eucalyptus, primarily smooth-barked salmon gum (*Eucalyptus salmonophloia*) and Wandoo (*E. wandoo*) (Saunders 1979, 1982) though breeding has been reported in other Wheatbelt tree species and some tree species on the Swan Coastal Plain and Jarrah forest (Saunders 1979, 1982, Storr 1991, Johnstone & Storr 1998). Success in breeding is dependent on sufficient high quality foraging habitat located in proximity of nesting and is nominally a radius of up to 12km of nesting sites (Saunders 1979, 1982, Saunders and Ingram 1987). High quality foraging habitat include Kwongan heathlands and Banksia woodlands having abundant Banksia species and other proteaceous plants.

This species was recorded during the field survey at several locations including birds sighted and extensive foraging evidence in *Banksia* woodland and *Eucalyptus* woodland over *Banksia* habitats. Suitable breeding trees (Figure 10) and potential roosting habitat includes Naturalised and Native trees, and Modified wetland drainage areas.

The full assessment for Black Cockatoo habitat is provided in section 4.3.3.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)

The Forest Red-tailed Black Cockatoo is listed as Vulnerable under the EPBC Act and BC Act. It inhabits the dense jarrah, karri, and marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E.patens*), Wandoo (*E.wandoo*), Tuart (*E.gomphocephala*), Albany Blackbutt (*E.staeri*), Yate (*E.cornuta*), and Flooded Gum (*E. rudis*) (DEE 2017). Habitats tend to have an understorey or snottygobble (*Persoonia* spp.), holly-leaved mirbelia (*Mirbelia dilatata*), bullich (*Taxandria* spp.) and sheoak (*Allocasuraina fraseriana*). They are most common in the jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the Swan Coastal Plain, mainly in search of food the exotic white cedar (*Melia azedarach*). There are also several small, isolated populations in the eastern parts of its range (DAWE 2022).

Birds were observed and heard calling at several locations and foraging evidence (chewed Marri pods) was recorded at several locations across the survey area. Suitable breeding trees (Figure 10) and potential roosting habitat includes Naturalised and Native trees, and Modified wetland drainage areas.

A Tuart tree was assessed as Category 2 within the Roe Hwy survey area approximately 350 metres northeast of the survey area within Road offset area D. A pair of Forest Red-tailed Black Cockatoos were observed perching on a trunk spout hollow, and subsequent assessment using pole camera identified extensive fresh chew marks, and this hollow was assessed as a potentially suitable hollow (breeding not confirmed).

The full assessment for Black Cockatoo habitat is provided in section 4.3.3.

Quenda (*Isoodon fusciventer*)

The Quenda is listed by DBCA as a Priority 4 species. Its preferred habitat is low dense scrubby, often swampy, vegetation with dense cover up to one metre high. It also occurs in woodlands, and also known to utilise weedy low condition habitat adjacent higher quality bushland. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland close to dense cover (Van Dyck & Strahan 2008). Persists in semi-rural areas such as Swan Valley and occurs in some Perth urban areas. Signs of diggings were recorded during the field survey in one location, confirming species' presence within the survey area. Populations of Quenda are likely to be persisting in small, fragmented bushland areas within and around the survey area, especially where there is suitable vegetation outside and adjacent to the survey area.

Blue-billed Duck (*Oxyura australis*)

The Blue-billed Duck is listed by DBCA as Priority 4. It is endemic to Australia's temperate regions, ranging from the South-West of WA, extending to southern Queensland, through New South Wales and Victoria, to Tasmania. The species is readily seen on freshwater lakes and billabongs where deep fresh water is present (Morcombe 2004). Not recorded during the field survey, however based on the site field assessment, the survey area has suitable habitat, namely modified wetland drainage areas that have either permanent or seasonal ponds of at least moderate depth that provide foraging habitat. Not recorded, but occurs locally including Thomsons, Yangebup and Bibra lakes, and is likely to visit this habitat on at least an occasional or seasonal basis.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed under the BC Act as 'Other specially protected fauna'. It is uncommon but wide ranging across Australia. Found everywhere from woodlands to open grasslands and coastal cliffs, though less frequently in desert regions. It feeds almost exclusively on other birds. It also eats rabbits and other moderate sized mammals, bats and reptiles. The Peregrine Falcon is very territorial during breeding season (DEE 2019b, Morcombe 2004). Not recorded during the field survey, however trees within the survey area potentially suitable to marginal nesting habitat, and it is likely to hunt within survey area on occasional to regular basis.

Perth Slider (*Lerista lineata*)

This small cryptic lizard is listed by DBCA as Priority 3. It is endemic to the Swan Coastal Plain preferring sandy, coastal heath and shrubland, particularly between Perth and Mandurah (Wilson & Swan, 2013). It also occurs in remnant bushland areas and recorded in disturbed areas such as residential land. Not recorded within the survey area but occurs locally based on database records within 3 km of the survey area and suitable remnant bushland habitat such as *Banksia* woodland.

Black-striped Snake (*Neelaps calolotus*)

This small cryptic reptile is listed by DBCA as Priority 3. Not recorded but occurs locally and suitable habitat such as *Banksia* woodland occurs within the survey area such as The Spectacles bushland reserve where area native vegetation is of adequate size to support this species.

Swan Coastal Plain Shield-back Trapdoor Spider (*Idiosoma sigilatum*)

This spider is listed by DBCA as Priority 3. It was recently described as part of a revision of Shield-back Trapdoor spider group (Rix et.al 2018). It has a relatively widespread distribution along the Swan Coastal Plain of south-western Western Australia, from Dalyellup north to at least Ledge Point (including Rottnest Island and Garden Island). The eastern limit of its range along the sandy foothills of the Darling Escarpment, from Boyanup north to at least Gingin. Preferred habitat appears to be *Banksia* woodland and heathland on sandy soils. The vertical burrows are enhanced with a typical 'moustache-like' arrangement of twig-lines (Figs 16, 17). There are several historical records from the Swan Coastal Plain attributed to the WA Museum but the expansion of Perth has significantly reduced and fragmented its former habitat area. Even though it was not detected during the field survey, it is likely to occur in remnant patches of *Banksia* woodland such as in the vicinity of the Spectacles Wetland area in Anketell.

Short-tongued Bee (*Leioproctus contrarius*)

This bee is listed by DBCA as Priority 3. The ecology is not well documented. It is known to be associated with *Scaevola repens* and *Lechenaultia* spp. (Houston 2000). Not recorded during the survey however this species is likely to occur based on host plants *Scaevola repens* and *Lechenaultia* species present within the survey area in *Banksia* woodland habitat.

Graceful Sun Moth (*Synemon gratiosa*)

This moth is listed by DBCA as Priority 4 and is endemic to the Swan Coastal Plain. Its range extends from Bunbury to Kalbarri. Host plants include *Lomandra species* found in *Banksia* woodlands of Bassendean Dunes, and *Lomandra matitima* which is common on coastal Quindalup Dunes. The moth completes its metamorphosis and emerges as adult moth in early Autumn (early March) and is active for several weeks to mate and complete life cycle before mortality. Eggs are laid on host plants, and the larvae (grubs) remain in the plant for several years before reaching maturity. Several local records from Perth-Peel region in areas of remnant *Banksia* woodland. Host plants species namely *Lomandra hermaphrodita* was recorded within the survey area, therefore the species is likely to occur.

Bush Stylet Cricket (*Throscodectes xiphos*)

The ecology of this species is poorly known but is thought to be endemic to the Swan Coastal Plain. Known from very few specimens: the holotype was collected from *Banksia* woodland located at Cutler Road, Jandakot on the Bassendean complex where it was collected from a grass tree. It is a Confirmed SRE species and is currently classified by DBCA as a Priority 1 species (Rentz.1993). Potentially suitable *Banksia* woodland habitat occurs within the survey area.

4.3.3 Black Cockatoo Assessment

Field results are mapped in Figure 9A-C and Figure 10, Appendix A, with the detailed field assessment data presented in Appendix E.

Foraging habitat

Baudin's Cockatoo was not recorded during the survey. Although foraging plant species occur within two fauna habitats, namely Marri woodland, and Eucalypt woodland over *Banksia*, however foraging value is considered low to moderate at best due the local context of this species' distribution.

Carnaby's Cockatoo was recorded via sightings of birds present, and foraging evidence (chewed *Banksia* pods) found at several locations. Three habitat types: *Banksia* woodland, Eucalypt woodland over *Banksia*, and Marri woodland are considered as moderate to high value foraging habitat for this species. There is a total of 26.67 ha of moderate to high foraging value habitat present in the survey area.

Forest Red-tailed Black Cockatoo was recorded via several observations, calls heard, and foraging residue (chewed Marri pods) from numerous point locations across the survey area. All foraging evidence associated with this species was found in areas of Marri woodland, or in isolated Marri indicating that birds were foraging on single trees across the broader landscape. Marri woodland was assessed as high value foraging habitat for this species. For Forest Red-tailed Black Cockatoo there is 1.97 ha of high value, 14.40 ha of moderate value and 10.30 ha of low value foraging habitat present in the survey area.

Foraging values for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo by survey area habitat type are summarised in Table 35, with the detailed assessment based on the Bamford (2020) method presented in Appendix E.

Table 35 Summary of Black Cockatoo habitat assessment

Fauna habitat	Area (ha)	Carnaby's Cockatoo	FRTB Cockatoo	No. DBH Trees for all three BC Species	DBH Tree Species	Potential Roosting Trees
<i>Banksia</i> woodland	10.30	6 (mod-high)	2 (low)	0	-	0
Eucalypt woodland over <i>Banksia</i>	14.40	6 (mod-high)	4 (mod)	8	<i>Eucalyptus gomphocephala</i> (5) <i>Corymbia calophylla</i> (3)	6
<i>Melaleuca</i> Dampland	3.94	1 (neg-low)	1 (neg-low)	2	<i>Corymbia calophylla</i> (2)	0
Marri woodland	1.97	5 (mod-high)	7 (high)	15	<i>Corymbia calophylla</i> (14) <i>Eucalyptus gomphocephala</i> (1)	15
Naturalised and native trees	13.29	1 (neg-low)	1 (neg-low)	6	<i>Eucalyptus camaldulensis</i> (4) <i>Corymbia calophylla</i> (1) <i>Eucalyptus camaldulensis</i> (1)	6
Native and introduced shrubs	61.27	1 (neg-low)	1 (neg-low)	1	<i>Corymbia calophylla</i> (1)	1
Modified wetland drainage area	6.40	1(neg-low)	1 (neg-low)	12	<i>Eucalyptus rudis</i> (10) <i>Corymbia calophylla</i> (1) <i>Eucalyptus gomphocephala</i> (1)	12
Cleared land	173.87	0 (nil)	0 (nil)	0	-	0

It is to be noted that all scores 1 or below are not considered to be habitats that provide foraging habitat, with Bamford describing a score of 1 as a "Negligible to Low", with "Low" being 2 and above, and scores of 0 representing "Nil" foraging habitat value,

Breeding habitat

The survey area is located within the modelled breeding distribution of the Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo which is supported by regular and frequent confirmed local records of both these cockatoos. The location of the survey area is beyond the Baudin's Cockatoo modelled breeding distribution (DAWE, 2022), with this species occurring more frequently towards the eastern edge of the Swan Coastal Plain.

A total of 44 suitable DBH trees nesting trees were recorded and mapped (Figure 10) across the survey area. These are trees with DBH greater than the specific threshold of 500mm. The majority of trees were Marri (50%), Flooded Gum (23%) and Tuart (14%). All suitable nesting trees were assessed according to MRWA (2023) breeding tree assessment method (Appendix E). All suitable DBH trees were categorised as Tree Category 7. These trees meet the 500mm DBH criteria but lack hollows based on ground-based assessment.

Of relevance is the recording of a Tuart tree assessed as Category 2 - suitable DBH tree with a potentially suitable hollow with signs of use (not confirmed) within the MRWA Roe Hwy survey area (GHD, 2025) approximately 350 m northeast of the survey area within Road offset area D. A pair of Forest Red-tailed Black Cockatoos were observed perching on a trunk spout hollow, and subsequent assessment using pole camera identified extensive fresh chew marks, and this hollow was assessed as a suitable hollow and likely breeding tree. This represents the nearest potentially suitable hollow to the survey area.

Roosting habitat

No confirmed Black Cockatoo roosts were recorded within the survey area during the field survey. Potential roost habitat was identified as 40 individual tree groupings of suitable height, species type and location. These trees are presented in Figure 9C, Appendix A. As these potential roosting trees are adjacent to major road infrastructure, the roost suitability is expected to be reduced.

4.4 Wetlands

Preliminary evaluation

The preliminary evaluation criteria (outlined in DBCA 2017 section 5.4 and Table 3) provide the first step in determining the management category for a wetland. This initial assessment is used to determine whether a wetland or a portion of a wetland should be considered high conservation value. If a 'Yes' can be answered to any of the seven preliminary evaluation criteria then the wetland is considered to support the highest level of attributes, values and functions and automatically assigned to a Conservation category. Nine wetlands have been evaluated, based on both desktop information and the site assessment: UFI 6664, 12981, 14663³, 15397, 15399⁴, 15584, 15968, 15970 and 15973 (Figure 11, Appendix A).

All nine wetlands assessed were assigned to a Conservation category, on the basis that equal to or greater than 90% of each wetland supported vegetation in a Good or better condition, and therefore Criterion 6 was met. None of the remaining criteria were met for any of the wetlands assessed. Full results of the evaluation are provided in Appendix F.

Secondary evaluation

A secondary evaluation provides additional information on the wetlands attributes, functions and values. In a secondary evaluation, the information collected through the desktop and site assessment is used to assess against the 42 criteria outlined in Table 4 of the DBCA wetland evaluation guidelines (2017) wetland evaluation guidelines.

Further secondary evaluation has not been undertaken for the Geomorphic Wetlands intersected by the survey area as the onsite assessment information has been used to inform the preliminary evaluation, as the Geomorphic wetlands UFI 6664, 12981, 14663, 15397, 15399, 15584, 15968, 15970 and 15973 satisfactorily fit into the Conservation category.

Therefore, it is considered that a further secondary evaluation of the Geomorphic Wetlands within the survey area is not warranted.

Resulting categories

Based on the current evaluation, all wetlands fall into the Conservation category due to the condition of their associated vegetation.

For UFI 6664, this would mean an upgrade from a Resource Enhancement wetland. However, due to access restrictions, a full inspection was not possible, resulting in insufficient data to request a category modification. The portion of the wetland intersecting the survey area was fully inspected, however the majority of the wetland was fenced off. Despite the access restriction, it was confidently determined that the wetland was in Excellent condition within the fence, and that criterion 6 of the evaluation guidelines, which states that 'equal to or greater than 90% of the wetland supports vegetation in Good or better condition', was met.

While the wetland as a whole meets the criteria to be upgraded to Conservation category, only the perimeter intersects the survey area. This part of the wetland was subject to considerable disturbance and is of lower value than the centre of the wetland.

5. Discussion

The survey area consisted of a linear corridor separated into three sections with a combined length of 285.44 ha, approximately 27 km extending north to south and intersecting four land systems. The survey area runs along the boundaries of three DBCA managed lands, six ESA's and one Bush Forever site.

5.1 Vegetation

The vegetation of the survey area occurs either side of the Kwinana Freeway and consists of remnant patches of native vegetation intermittently divided by roadside revegetation and infrastructure. Five native vegetation types were mapped within the survey area including a *Banksia* woodland, *Eucalyptus gomphocephala* and *Banksia* woodland, *E. marginata* and *Banksia* woodland, *Corymbia calophylla* woodland and *E. rudis* and *Melaleuca raphiophylla* in wetland areas. Some areas of revegetation integrated with adjacent remnant bushland, these sections were mapped using the relevant native vegetation type description. The remaining revegetation was typically more Degraded and modified, so was grouped together as roadside revegetation. Roadside revegetation was mapped as seven different types to assist with Black Cockatoo foraging habitat mapping. This included modified wetland and drainage areas, mixed shrubland of native and introduced shrubs, isolated planted *Banksia* spp., isolated stands of planted *Corymbia calophylla* and naturalised *Eucalyptus* spp, in addition to *Banksia menziesii* B. *attenuata* woodland and *Eucalyptus gomphocephala* and *Banksia* spp. woodland. Infrastructure such as roads and houses were mapped as Cleared.

Cleared areas made up the largest portion of the survey area, covering 173.87 ha (60.9%). Roadside revegetation accounted for 92.65 ha (32.5%) and native vegetation was mapped for 18.92 ha (6.6%). Native vegetation typically occurred as a fragmented narrow band within the survey area. Across much of the survey area there was planted vegetation along the immediate roadside and then a narrow band of remnant vegetation. The native vegetation was either restricted to the road reserve due to adjacent clearing, or if the vegetation extended beyond the survey area it was broken up by the PSP or other linear disturbance such as firebreaks and fencelines.

Floristic Community Type analysis was carried out on 10 Kwinana quadrats and 17 Roe Highway quadrats (GHD, 2025). Roe Highway quadrats were used to supplement the Kwinana data as it was difficult to locate vegetation in good or better condition to enable a three-sample site representation for each vegetation type. From the analysis four FCTs were determined, wetland community 11 and *Banksia/ Eucalyptus* communities 21a, 23a and 28. By using the Roe quadrats in conjunction with the Kwinana Highway quadrats it is anticipated a more robust statistical analysis would be achieved. However, in several instances the statistical results were inconclusive and so the final FCT determination was based on not only the statistical result but also landform, dominant species, botanist field notes and local experience.

None of the FCTs identified in the survey area are listed as TECs under the EPBC Act or BC Act, nor are they listed as PECs by DBCA. However, remnant patches of FCTs/ vegetation types that met the key criteria for *Banksia* Woodlands of the SCP TEC and PEC (TSSC, 2016) and Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC and PEC (DotEE, 2019) are considered TECs under the EPBC Act and listed as PECs by DBCA.

The survey area occurred in the relevant IBRA region and intersected the land systems associated with these two significant ecological communities. Patch and condition thresholds were applied to patches of remnant vegetation considered representative of one or both of these communities. The results of the patch assessment concluded 13.34 ha of the *Banksia* woodlands of the SCP TEC and PEC and 2.56 ha of the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC and PEC occur within the survey area. It should be noted the portions of the *Banksia* woodlands TEC and PEC mapped within the survey area would not normally meet the key criteria for the ecological community due to their size and or condition. However, all these patches lie adjacent to larger remnants (>5ha) that are likely to be in good or better condition due to their size and access restrictions.

Remnant vegetation in good or better condition which does not meet the criteria to be considered a TEC or PEC may still be considered significant in the context of the SCP subregion due to extensive clearing that has occurred. Three vegetation associations were mapped across the survey area, 6, 968 and 1001. The extents of each association within the survey area were 3.8 ha, 16.3 ha and 265.6 ha respectively. All associations have been

subject to a high proportion of historic clearing. Two of the three vegetation associations within the survey area have > 21% of their extents remaining within the State, IBRA region, subregion, LGA extents. Vegetation association 968 has 6.62% of its extent remaining within the SCP bioregion and Perth subregion and only 3.69% remaining within the City of Rockingham LGA according to data last updated in 2019 (DPIRD 2019). Remnant vegetation within Bush Forever Site 270 (Sandy Lake and Adjacent Bushland) is considered to be regionally significant and the vegetation adjacent to reserves east of Spectacles Swamp and Bush Forever Site 270 (this encompasses most of the survey area south of Anketell Road to Thomas Road) have significance as a buffer to the reserves and Bush Forever site.

Vegetation type Cc (*Corymbia calophylla* woodland) is considered to be locally significant due to a restricted extent across the survey area and wider context area, also as supporting Priority flora species (*Jacksonia gracillima* (P3)). This vegetation type occurred in a low-lying area, adjacent to *Eucalyptus rudis* and *Melaleuca raphiophylla* woodland and was mapped across 0.42 ha of the survey area. It was not mapped within the context area.

Some vegetation types mapped within the survey area are significant due to representing moderate to high-value foraging habitat for Threatened fauna species. Vegetation types Cc, Isolated *Corymbia calophylla*, BmBa, EgBsp and EmBsp are moderate to high-value foraging habitat for Carnaby's Cockatoo and vegetation types Cc, and Isolated *Corymbia calophylla* represent moderate to high-value foraging habitat for Forest Red-tailed Black Cockatoo.

5.2 Flora

Two hundred and twenty vascular flora species were recorded in the survey area. A species accumulation curve was generated based on flora recorded within quadrats and relevés. The results concluded the sampling effort was considered representative of the floristic diversity in the area. The most diverse quadrat, Kwin04 from vegetation type BmBa (FCT 23a) had 42 species recorded. Gibson et al. (1994) reports that species richness for FCT 23a is usually very high with an average of 62.8. Considering the proximity to the freeway and other anthropogenic disturbances this species count is reasonable.

No EPBC Act listed flora were recorded within the survey area. Three significant flora species were recorded within the survey area, however in the context of this project only one is considered to be significant as the other two species have been planted:

- *Jacksonia gracillima* (P3)
- *Grevillea curviloba* listed as Endangered under the BC Act (planted)
- *Grevillea olivacea* (P4) (planted).

Although *Grevillea curviloba* and *Grevillea olivacea* are significant flora they are both considered to be planted within the survey area and outside their natural range and habitat. Therefore, they are not bound by the regulatory requirements for significant species as listed by the EPBC Act and/ or BC Act or by the DBCA as they are not an approved translocation site. No other species of local or regional significance were recorded within the survey area.

The likelihood of occurrence assessment conducted post-field concluded one taxon was known and recorded in the survey area (*Jacksonia gracillima*) during the survey and two taxa were considered possibly to occur. The possible significant flora consisted of *Poranthera moorokatta* (P2) and *Dodonaea hackettiana* (P4) species. The possibility of their occurrence in the survey area was due to *P. moorokatta* being a very small cryptic annual that may have been missed and *Dodonaea hackettiana* (P4) was possibly observed on the edge of a slip lane. However, the area was too dangerous to pull over and so the plant was unable to be collected for identification.

Sixty-four introduced flora species were recorded within the survey area representing 29.4% of the total flora species recorded. Of the 64 introduced species five species are listed as Declared Pest (DP) plants in Western Australia under the BAM Act, two are also listed as Weeds of National Significance (WoNS) (Australian Weeds Committee, 2012). **Asparagus asparagoides* (DP and WoNS) and **Zantedeschia aethiopica* (DP) were recorded throughout the survey area and in some areas were blanketing the vegetation. The other four significant weeds were recorded in spot locations but were not dominant in the landscape.

5.3 Fauna Habitat and Species Assessment

Eight broad fauna habitat types were identified across the survey, including cleared areas that accounts for approximately 60% of the total area. Habitats are generally highly degraded in most areas due to survey area location in an extensively urbanised landscape. Habitat remnants are highly fragmented and subject the long-term degradation due to the effects of weed invasion, landscape modification, and vegetation loss. Habitat present does provide suitable foraging and shelter for several locally occurring significant fauna.

The regional scale setting of the survey area is within the SCP, which is known for its high fauna biodiversity. This is reflected in the desktop assessment database list showing a diverse assemblage totalling 54 species including migratory shorebirds, and a range of mammals, reptiles and invertebrates occurring within the region. Even though this list is comprehensive, the characteristics, quality and extent within the survey area limit the types of species likely to occur and potentially use the habitat. For example, there are approximately 20 Migratory shore birds occurring locally due to proximity of the survey area to Ramsar, coastal and estuarine wetlands, therefore locally occurrence is well documented and frequent, however habitat within the survey area is marginal to unsuitable.

Carnaby's Cockatoo was recorded during the field survey at several locations from sightings and extensive foraging evidence in Banksia woodland habitats. Forest Red-tailed Black Cockatoo was also observed and heard calling at several locations and foraging evidence recorded at several locations across the survey area. Potential breeding trees (suitable DBH, all without hollows) and potential roosting habitat includes Naturalised and native trees, and Modified wetland drainage areas.

Baudin's Cockatoo was not recorded during the survey but is known to occasionally forage and roost in the region. However the survey area is located on the western edge of current known foraging distribution and lies outside the known breeding range of this species, which has a bearing on the habitat suitability and value for this cockatoo.

The Black Cockatoo foraging assessment indicates the northern and central sections of the survey area contain the highest density and proportion of higher scoring foraging habitat based on the Bamford scoring system, particularly in reference to Banksia Woodland, Eucalyptus over Banksia Woodland and Marri Woodland habitats. It is important to note the survey area extends approximately 27 km north to south, as a relatively thin corridor when considering potential impacts to Black Cockatoos. As a highly mobile species the clearing of the native vegetation and roadside revegetation may not be as significant as a larger contiguous area of habitat. Furthermore, while 44 suitable DBH trees were recorded across the survey area, it is noteworthy that many of these are replanted trees and while ultimately carry the potential as future breeding trees, this is unlikely to be the case for at least another 50 to 100 years in some cases.

The Quenda was recorded from signs of diggings during the field survey at one location. Numerous local records (DBCA, 2024f) indicate populations persisting in small, fragmented bushland areas within and around the survey area. Dense remnant and modified vegetation provides habitat for this species.

Several species of vertebrate and invertebrate occurring locally were not recorded during the survey but are likely to occur based on habitat and proximity of records. They include Blue-billed Duck (*Oxyura australis*), Peregrine Falcon (*Falco peregrinus*), Perth Slider (*Lerista lineata*), Black Striped Snake (*Neelaps calonotos*) Swan Coastal Plain Shield-backed Spider (*Idiosoma sigillatum*) Short-tongued bee species (*Leioproctus contrarius*) Graceful Sun Moth (*Synemon gratiosa*) and Stylet Bush Cricket (*Throscodectes xiphos*).

5.4 Wetlands

Approximately 25% of the survey area has been mapped as geomorphic wetlands by DBCA (2024c), totalling 73.2 ha across 34 wetlands. These wetlands occur primarily within the Jandakot Consanguineous suite, however a small sliver of the survey area between Anketell Road and Thomas Road intersects the Bibra suite, and the Safety Bay Road and Mundijong Road sections fall within the Keysbrook suite. A wetland evaluation was carried out on eight Conservation category and one Resource Enhancement wetland, in accordance with DBCA methodology (2017a). The remaining 27 wetlands were not evaluated, as they comprised predominantly cleared land or highly disturbed road verges, were categorised as a Dryland by DBCA and assigned a management category of 'not applicable', or did not represent functioning wetlands where they intersected the survey area, due to fragmentation, degradation or clearing.

A preliminary evaluation using the of the eight Conservation category and one Resource Enhancement wetland was conducted in accordance with DBCA methodology. Upon completion it was determined that a secondary evaluation was not required as all nine wetlands fell into the Conservation category.

UFI 6664, which is currently assigned a Resource Enhancement management category, met the criteria to be upgraded to Conservation category, however a full inspection was not possible due to access restrictions, resulting in insufficient data to request a category modification with DBCA. It should be noted that the survey only intersects the western perimeter of the wetland, which is subject to considerable disturbance, and the proportion of the wetland that is of the highest value lies outside the survey area.

Remnant wetland vegetation within the survey area ranged from Very Good (0.65 ha) to Completely Degraded (1.70 ha) and made up 3.94 ha (1.4%) of the survey area. Wetland vegetation was assigned to FCT 11 and described as *Eucalyptus rudis* over *Melaleuca raphiophylla* +/- *M. preissiana* over *Kunzea glabrescens* tall sparse shrubland over *Xanthorrhoea preissii* low shrubland over *Lepidosperma longitudinale* sedgeland. Areas of Very Good and Good condition had floristic diversity of the mid and understorey, poorer condition wetlands were either dominated by *Pteridium esculentum* (bracken), which although native can be invasive in disturbed wetter areas (Hussey et al. 1997), or smothered by significant weeds.

6. Conclusion

The conclusions drawn from the results of the field survey and report are detailed below

Vegetation and flora

- The vegetation of the survey area consisted of patches of native vegetation (18.92 ha, 6.6%) intermittently divided by roadside revegetation (92.65 ha, 32.5%) and infrastructure/cleared areas (173.87 ha, 60.9%). Five vegetation types were mapped for remnant native vegetation and seven vegetation types were mapped for roadside revegetation to assist with Black Cockatoo foraging habitat mapping
- The FCTs identified in the survey area are not listed as TECs under the EPBC Act or BC Act, nor are they listed as PECs by DBCA. The FCTs identified within the survey area included 11, 21a, 23a and 28
- The remnant native vegetation and revegetation of the survey was variable and ranged from Very Good to Completely Degraded. Approximately 60% of the remnant native vegetation was in Degraded or poorer condition. The majority of the revegetated areas were in Completely Degraded condition
- Two significant ecological communities were mapped within the survey area Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC and PEC and Banksia Woodlands of the SCP TEC and PEC. Three Tuart patches represented by vegetation type EgBspp. were mapped within the survey area with a combined total of 2.56 ha. Seven patches of Banksia Woodlands of the SCP TEC and PEC were mapped with a combined total extent of 13.34 ha in the survey area
- Two hundred and twenty vascular flora taxa were recorded during the field survey. A species accumulation curve to assess sampling effort showed adequate sampling and diversity for the survey area
- No EPBC Act listed flora were recorded within the survey area. Three significant flora species were recorded within the survey area, however two of these species are considered naturalised
- The likelihood of occurrence assessment post-field survey concluded one taxon was known and recorded in the survey area during the survey and two taxa were considered possibly to occur
- Sixty-four introduced flora species were recorded within the survey area, five of these species are listed as DP plants in Western Australia under the BAM Act, two are also listed as WoNS
- Nine wetlands that intersected the survey area were evaluated, based on both desktop information and the site assessment. All were assessed and assigned to a Conservation category, on the basis that equal to or greater than 90% of each wetland supported vegetation in a Good or better condition.

Fauna and Habitat

- Fauna habitats are generally highly degraded and fragmented in most areas due to survey area location in an extensively urbanised landscape
- Some areas of good quality habitat present provide suitable foraging and shelter for several locally occurring significant fauna, particularly in the vicinity of The Spectacles bushland that intersects with the survey area
- There is 26.67 ha of moderate to high value Carnaby's Cockatoo foraging habitat, which includes Banksia woodland, Eucalyptus over Banksia Woodland and Marri Woodland
- There is 1.97 ha of high, 14.40 ha of moderate and 10.30 ha of low value Forest Red-tailed Black Cockatoo foraging habitat, which includes remnant Marri trees and Eucalyptus over Banksia Woodland
- A total of 44 suitable Black Cockatoo DBH trees were recorded across the survey area. The majority of trees were Marri (50%), Flooded Gum (23%) and Tuart (14%). None of the trees contained suitable hollows for Black Cockatoos
- A total of 40 individual Black Cockatoo potential roosting sites were identified across the survey area based on DAWE (2022) tree height, species type and proximity to nearby water sources and significant feeding habitat in surrounding areas
- Quenda habitat includes dense remnant and modified vegetation.

7. Glossary and Abbreviations

Term	Definition
Threatened Ecological Community (TEC)	An ecological community that is listed as critically endangered, endangered, or vulnerable under Part 2, Division 2 of the <i>Biodiversity Conservation Act 2016</i>
Priority Ecological Community (PEC)	Ecological communities with insufficient information to be considered a TEC, or which are rare but not currently threatened.
Environmentally Sensitive Area (ESA)	ESAs are declared by the Minister under section 51B of the Environmental Protection Act 1986. Impacts on ESAs are considered by the EPA during the EIA process. A clearing permit is required for clearing within an ESA unless Schedule 6 exemptions apply.
Conservation Codes (DBCA 2023)	
Threatened	Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection. Threatened taxa are further ranked according to their level of threat into Critically Endangered, Endangered, or Vulnerable based on IUCN (2013) definitions.
Threatened fauna	Species of fauna that are listed as Critically Endangered, Endangered or Vulnerable Threatened species.
Threatened flora	Species of flora that are listed as Critically Endangered, Endangered or Vulnerable Threatened species.
Critically Endangered (CR)	Taxon is facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxon is facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxon is facing a high risk of extinction in the wild.
Priority 1 (P1)	Taxon is known from one or a few collections or sight records, all on lands not managed for conservation.
Priority 2 (P2)	Taxon is known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation.
Priority 3 (P3)	Taxon is known from collections or sight records from several locations not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat.
Priority 4 (P4)	Taxon is Rare, Near Threatened, or otherwise in need of monitoring. • Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. • Near Threatened: Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. • Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Migratory	Fauna that periodically or occasionally visit Australia and are subject to an international agreement relating to the protection of migratory species.
Other Specially Protected (OS)	Species in need of special protection to ensure their conservation.

Abbreviation	Definition
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions

Abbreviation	Definition
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DotEE	Department of the Environment and Energy
DP	Declared Pest plants in Western Australia under the <i>Biosecurity and Agriculture Management Act 2007</i>
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environmental Protection, Biodiversity and Conservations Act 1999</i>
ESA	Environmentally Sensitive Area
FCT	Floristic Community Type
GHD	GHD Pty Ltd
ha	hectare
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometer
LGA	Local government authority
MNES	Matters of National Environmental Significance
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
PSP	Principal Shared Pathway
RiWI Act	<i>Rights in Water and Irrigation Act 1914</i>
SCP	Swan Coastal Plain
SSI	Single Site Insertion
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
WA	Western Australia
WoNS	Weeds of National Significance

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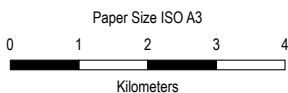
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Appendices

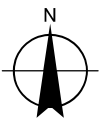
Appendix A

Figures

Figure 1	Survey area location
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Figure 4	Hydrology constraints
Figure 5	Biological constraints
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Figure 7	Vegetation condition and significant weeds
Figure 8	Significant vegetation and flora
Figure 9A	Fauna habitats and Significant fauna
Figure 9B	Black cockatoo foraging habitat
Figure 9C	Black cockatoo potential night roost habitat
Figure 10	Black Cockatoo breeding habitat
Figure 11	Wetland assessment



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

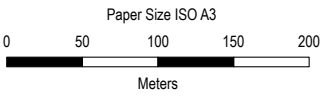
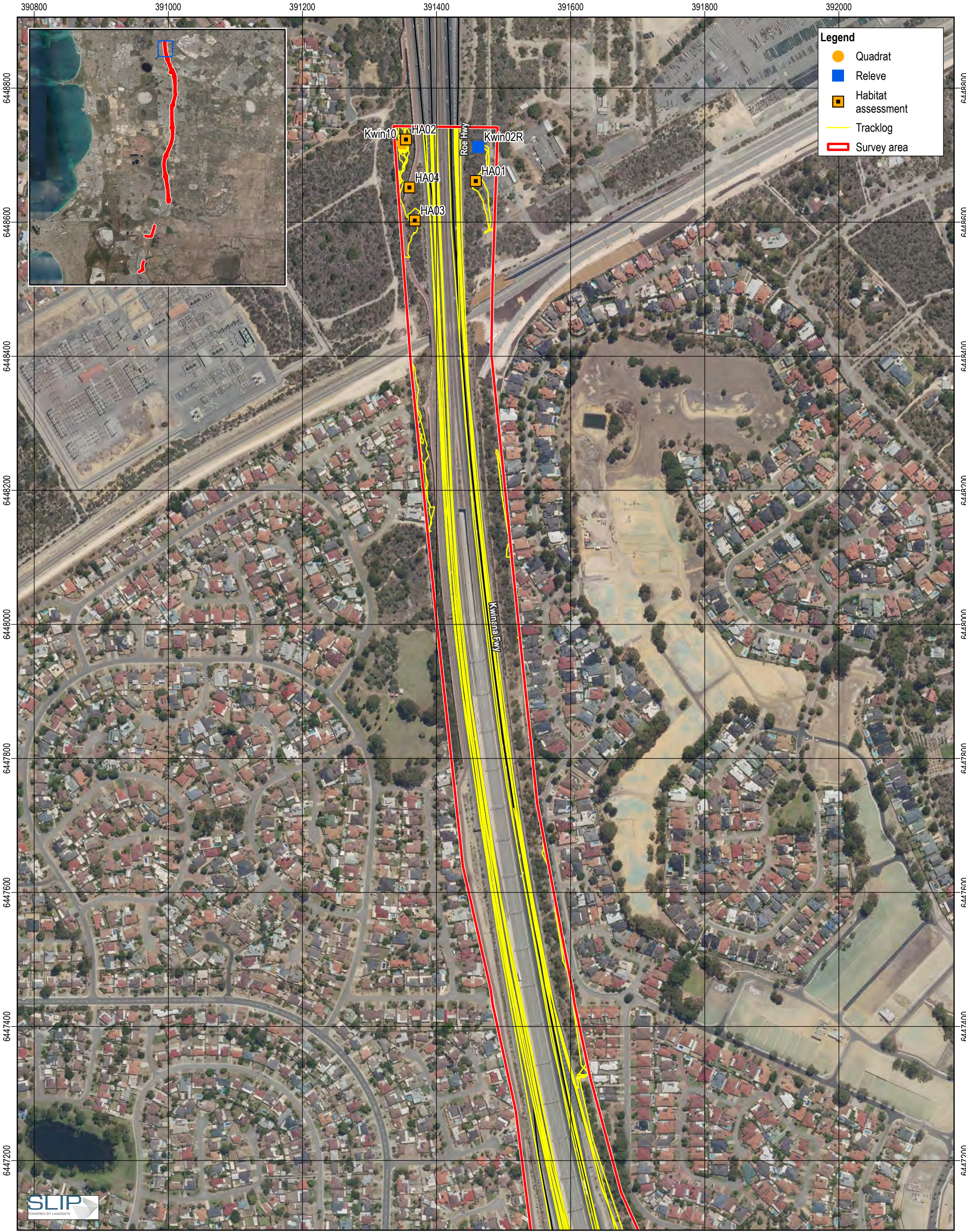


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

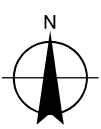
Project No. 12634226
Revision No. 0
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Project Location

FIGURE 1



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

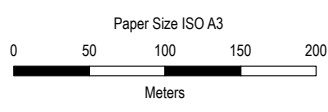
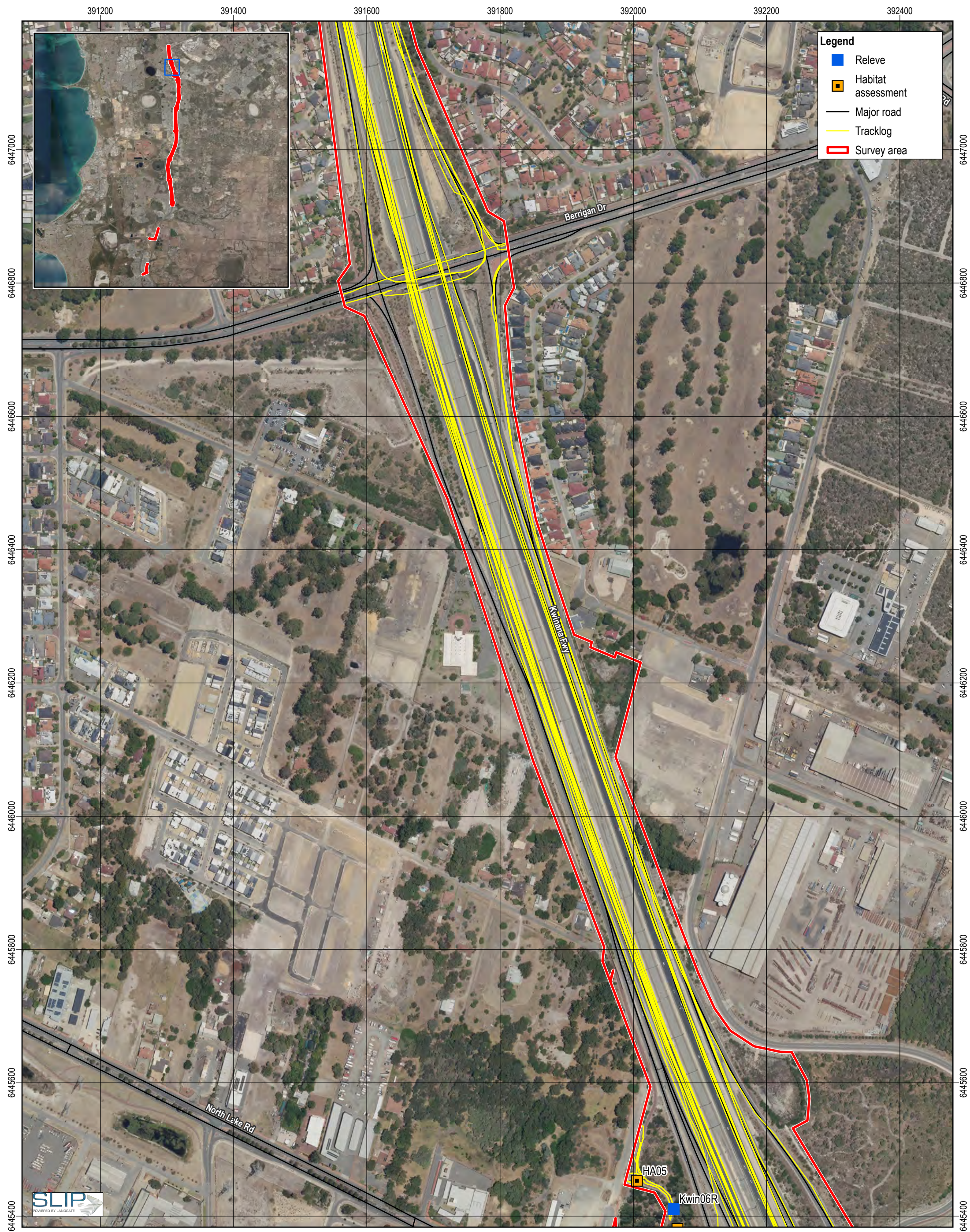


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

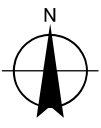
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FIGURE 2



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

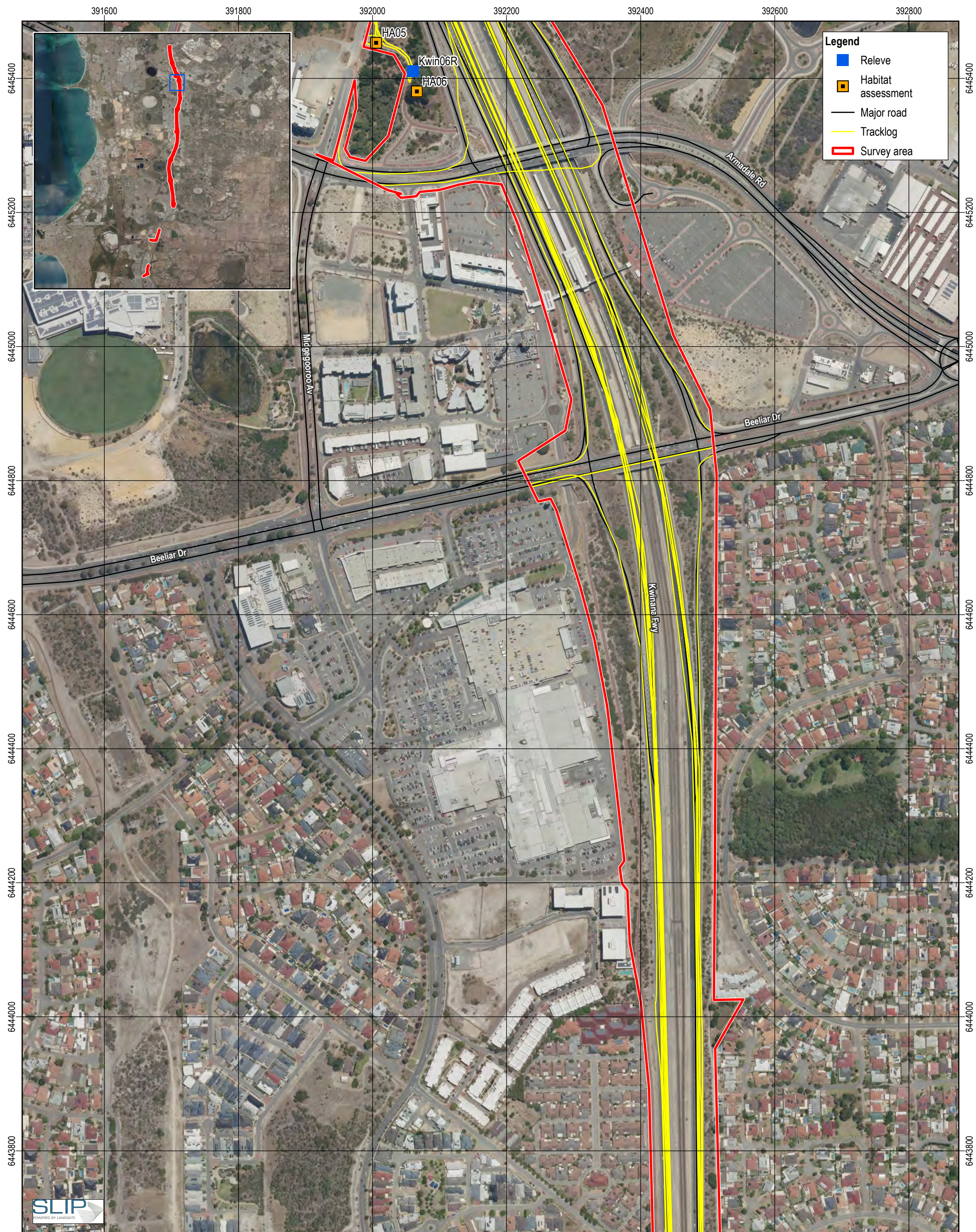


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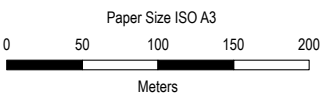
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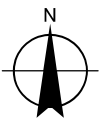


Legend

- Releve
- Habitat assessment
- Major road
- Tracklog
- Survey area



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

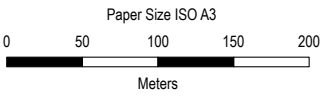
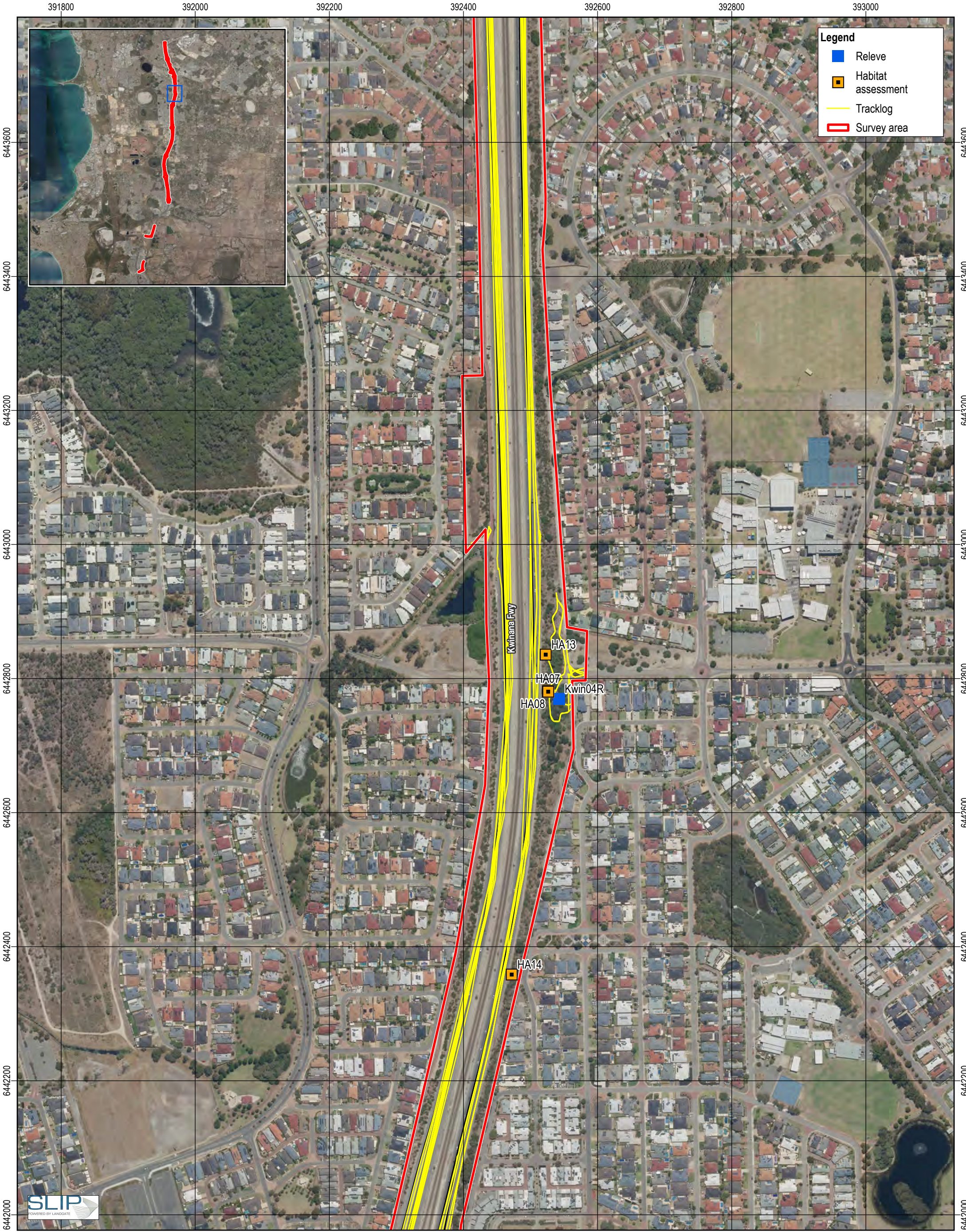


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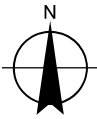
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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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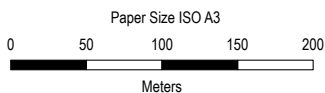
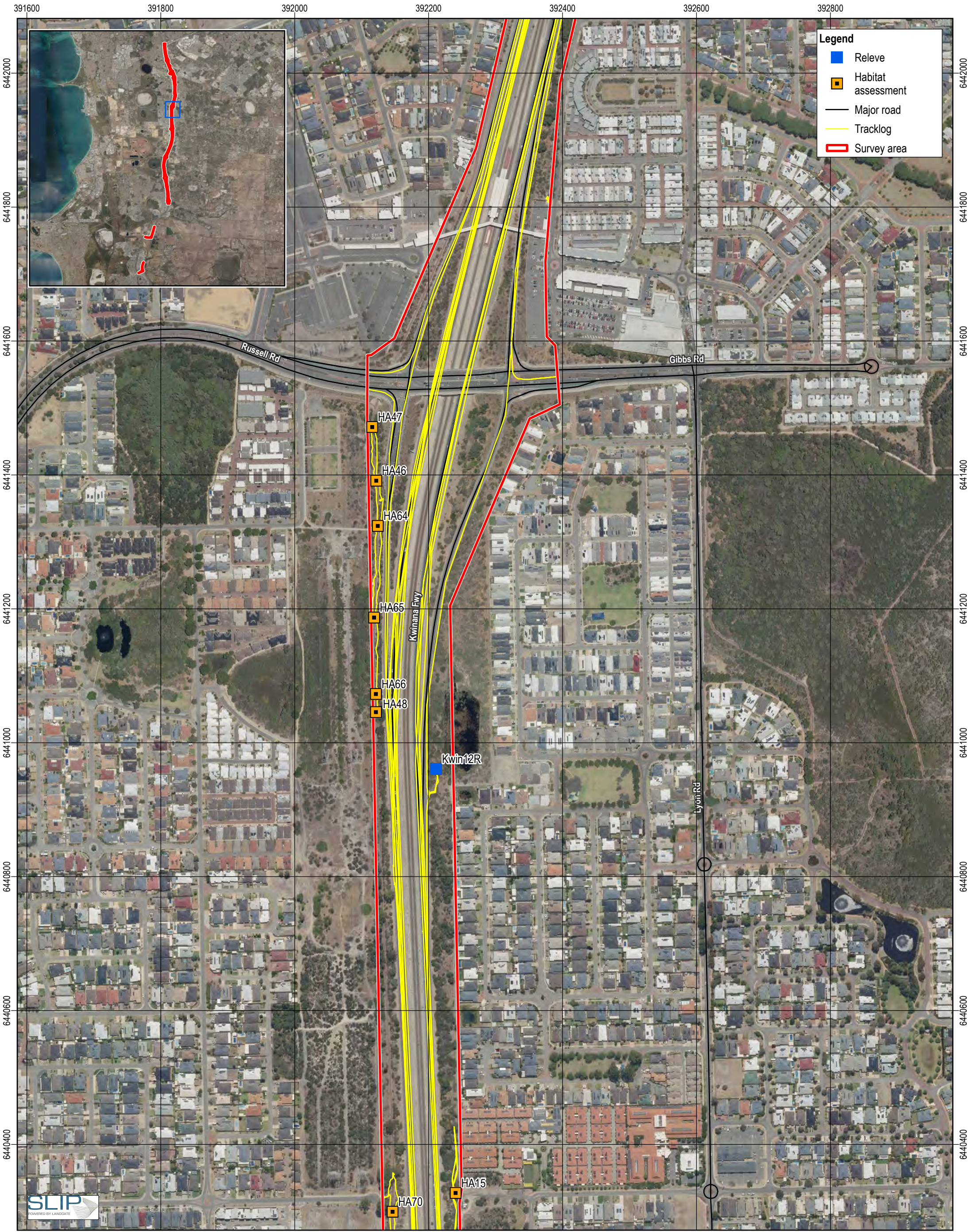


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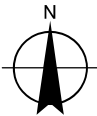
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Map Projection: Transverse Mercator
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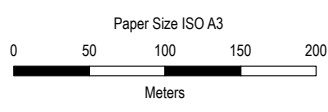
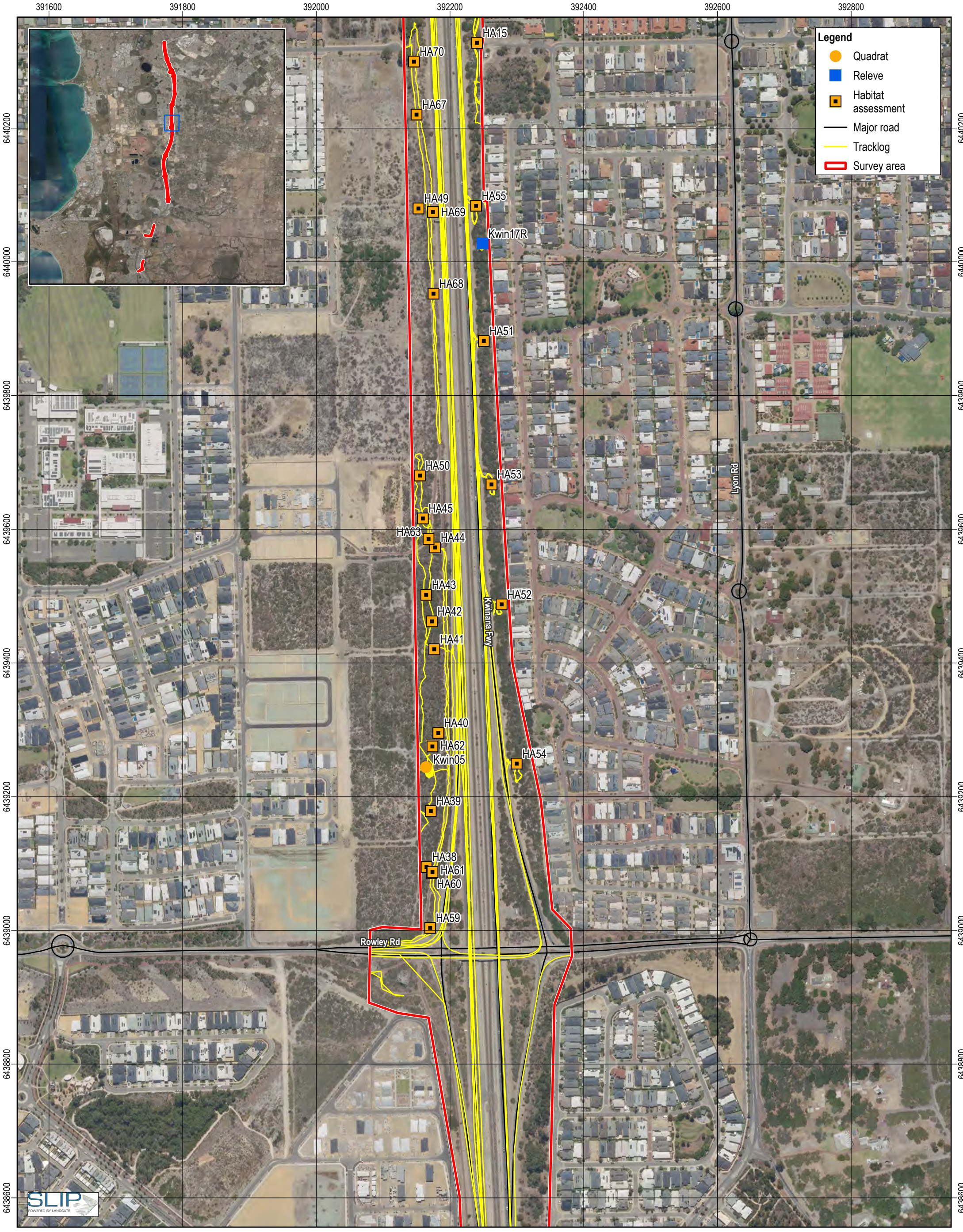


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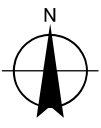
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FIGURE 2



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Horizontal Datum: GDA2020
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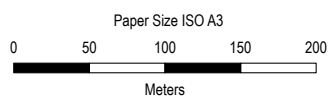
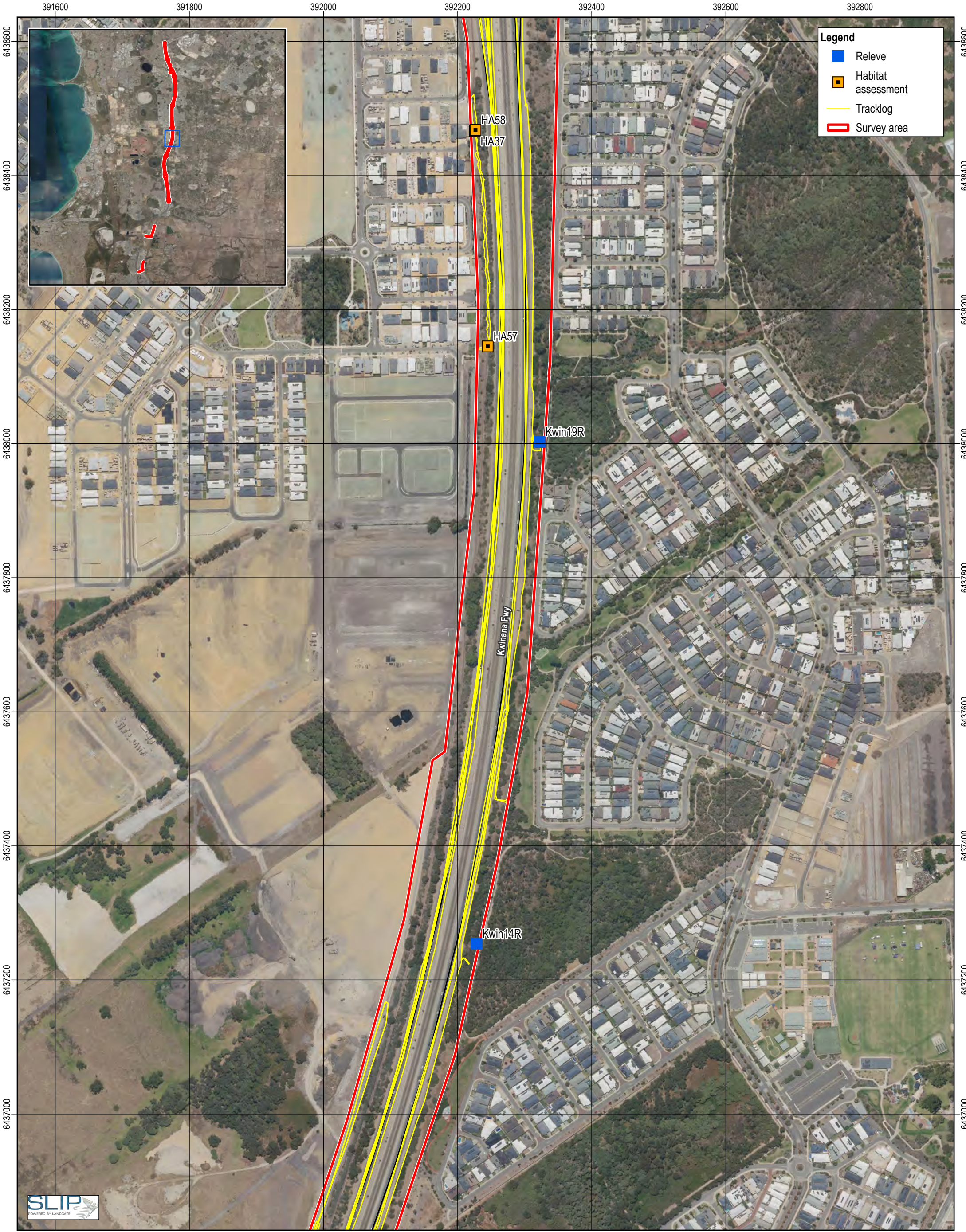


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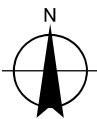
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Map Projection: Transverse Mercator
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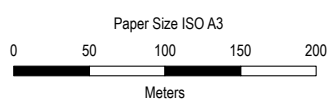
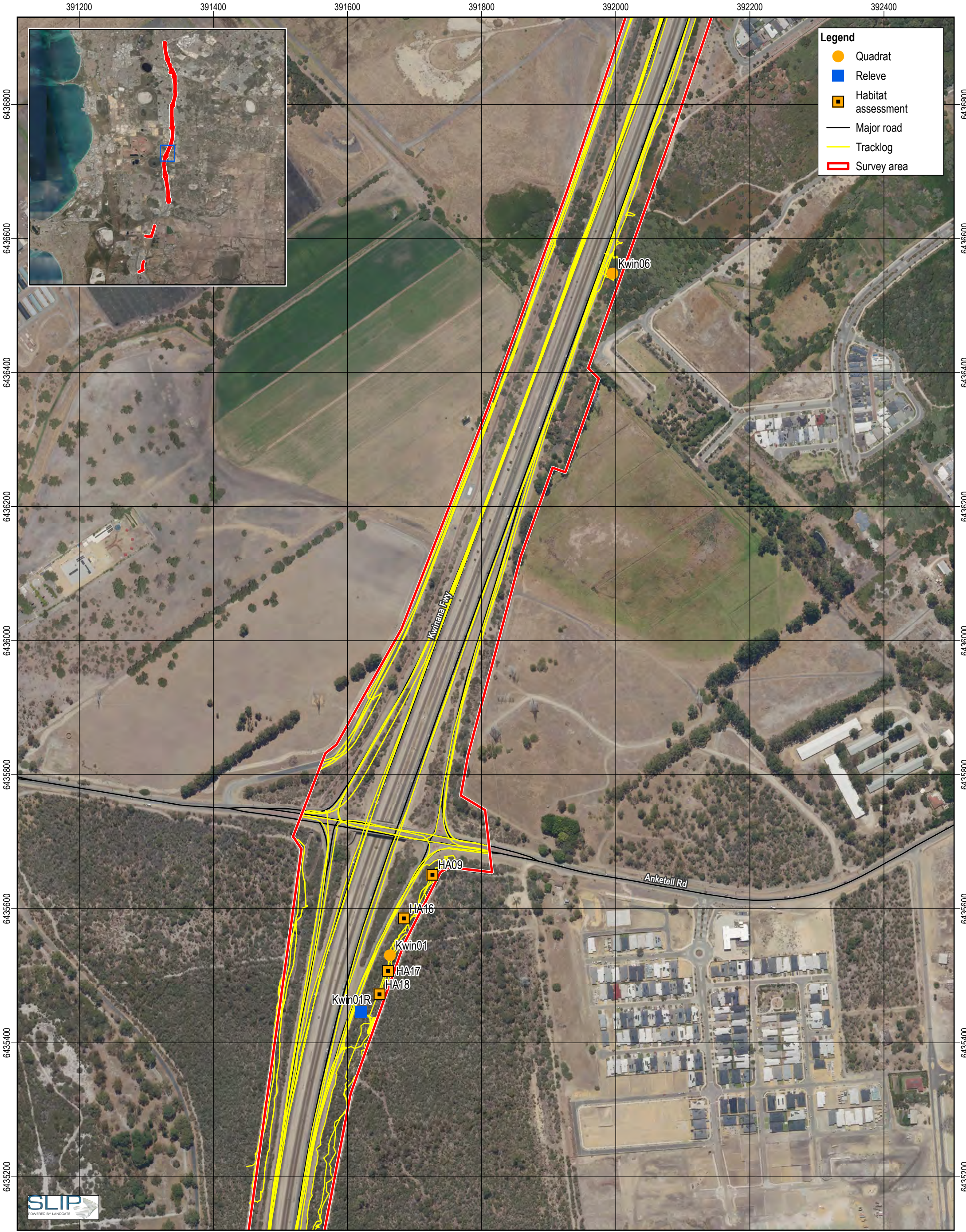


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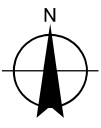
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Map Projection: Transverse Mercator
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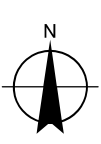
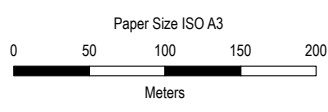
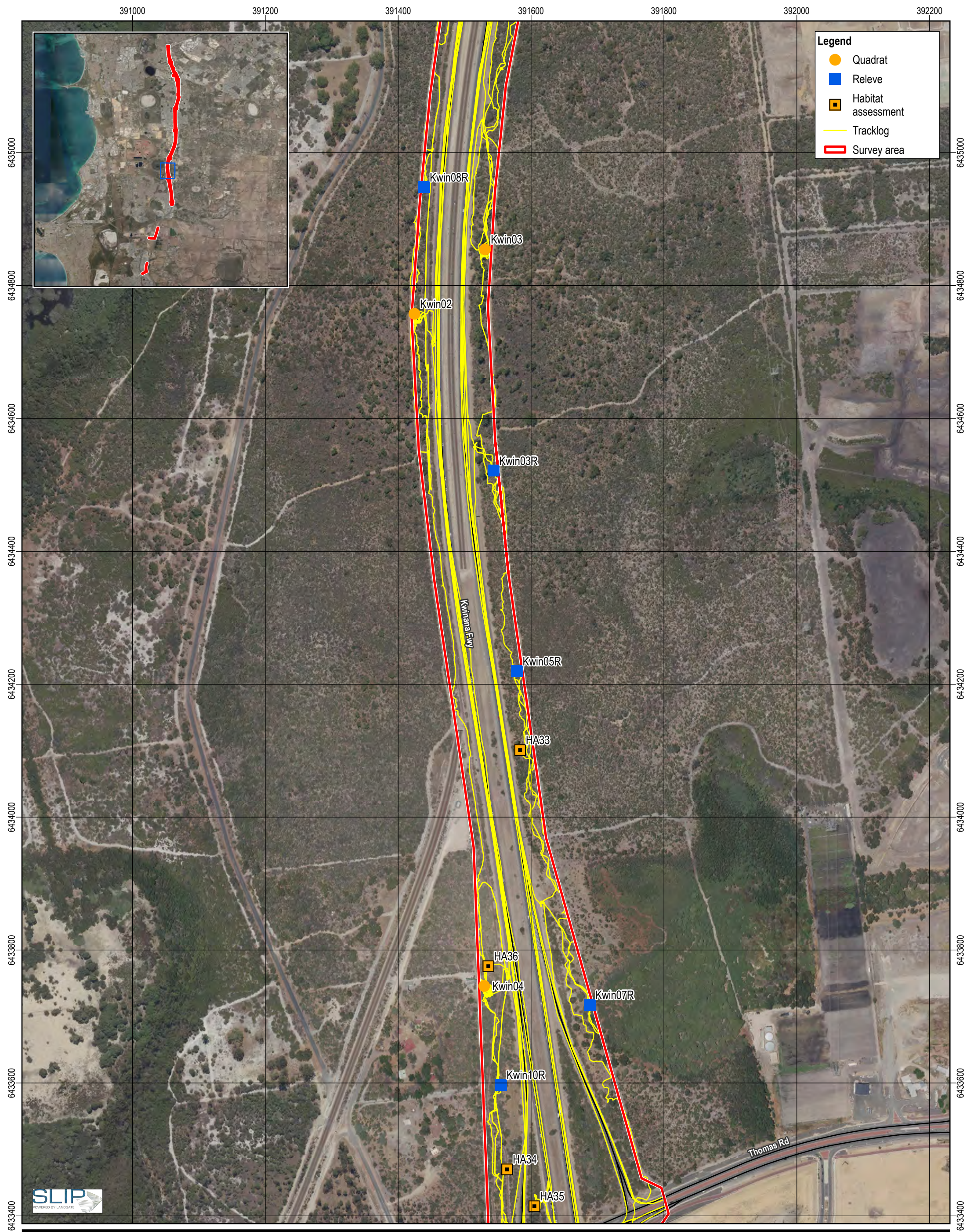


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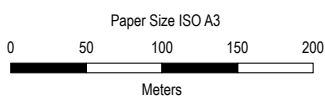
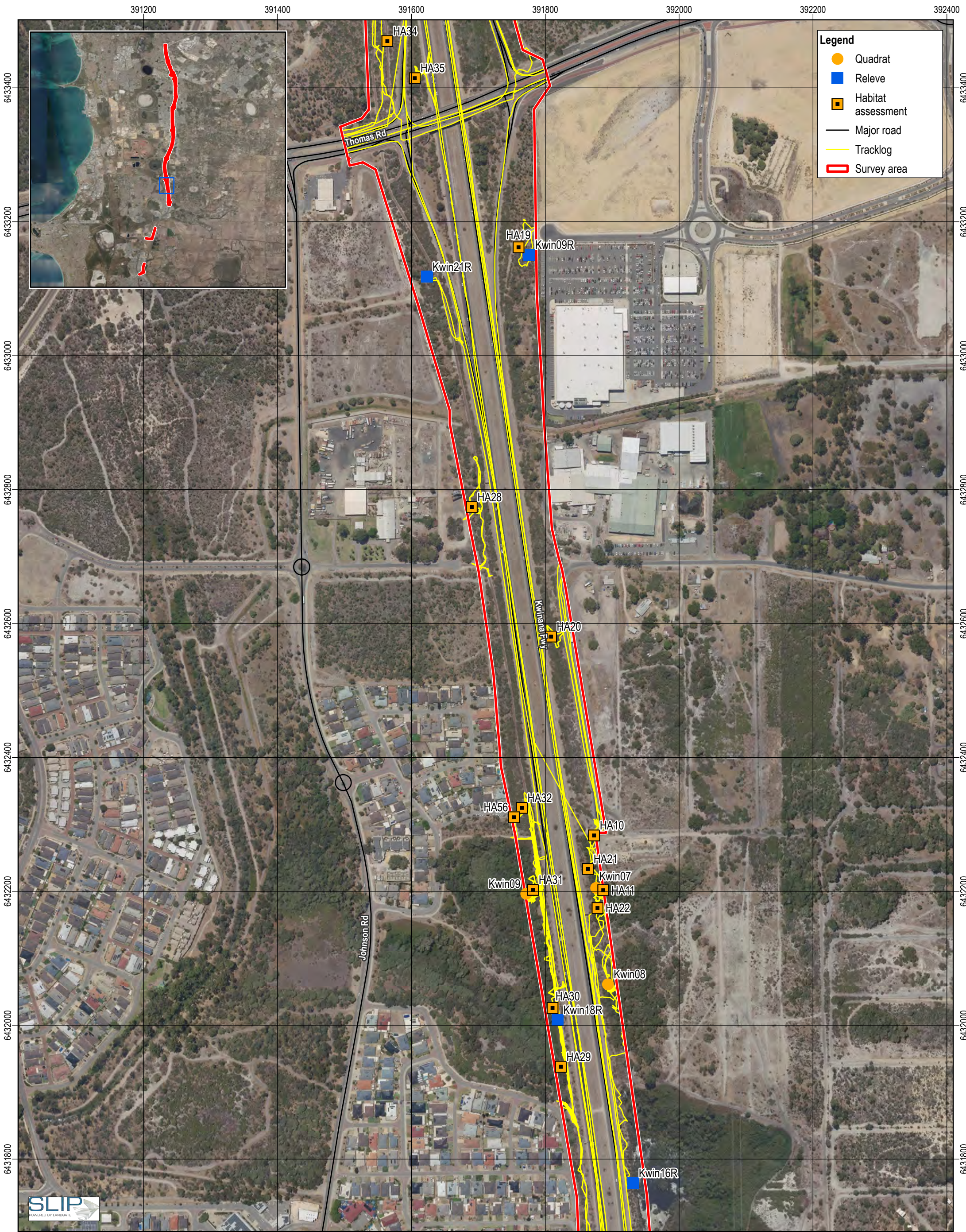


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Roe Hwy Widening Flora and Fauna Assessment

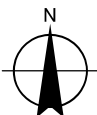
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Map Projection: Transverse Mercator
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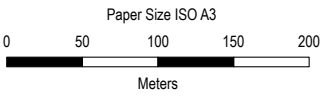
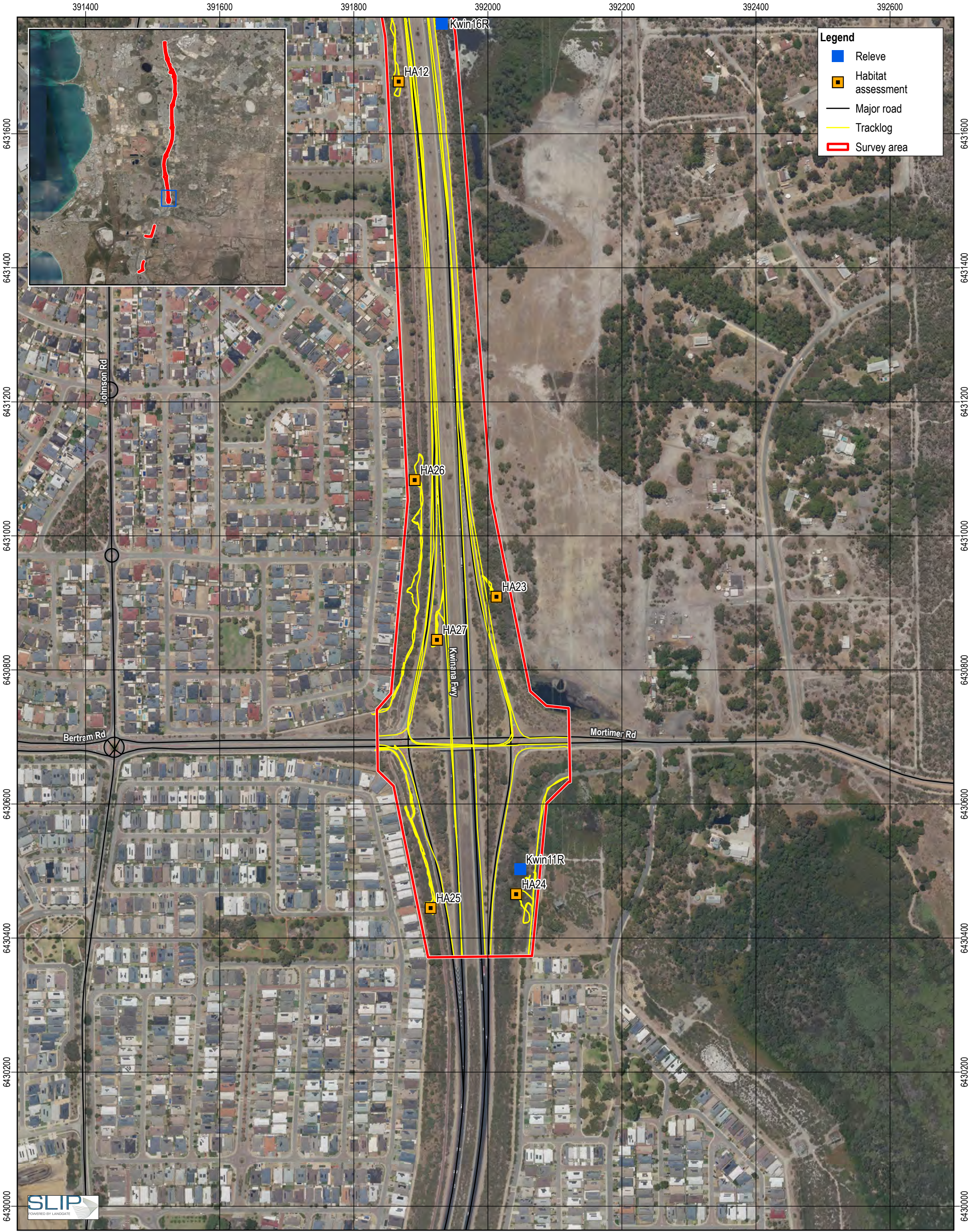


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Roe Hwy Widening Flora and Fauna Assessment

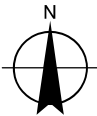
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Map Projection: Transverse Mercator
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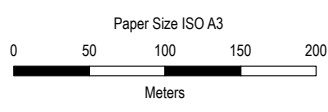


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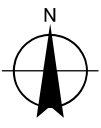
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Map Projection: Transverse Mercator
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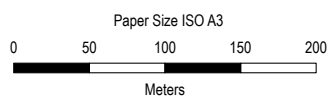
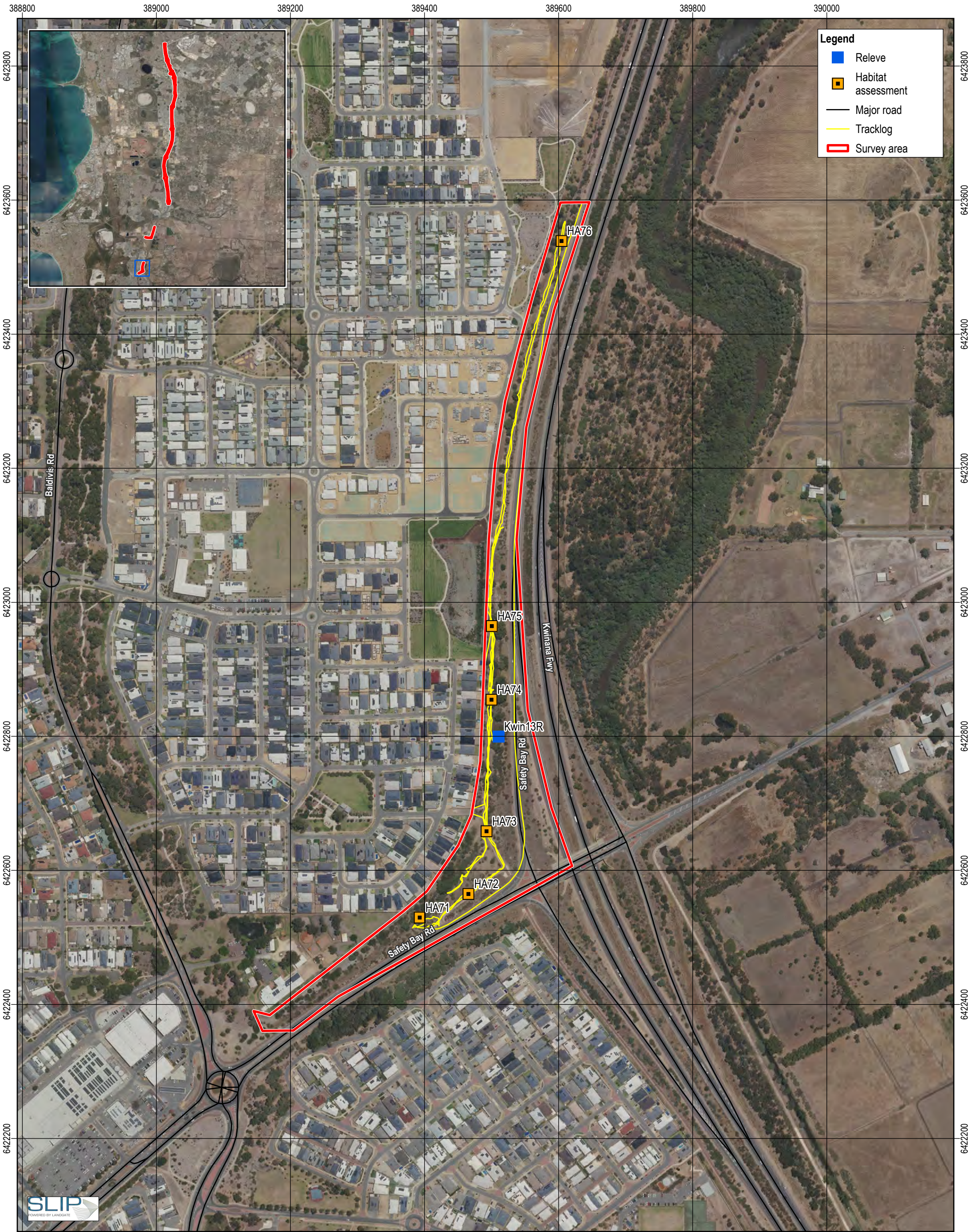


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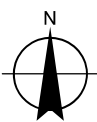
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Map Projection: Transverse Mercator
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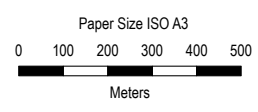
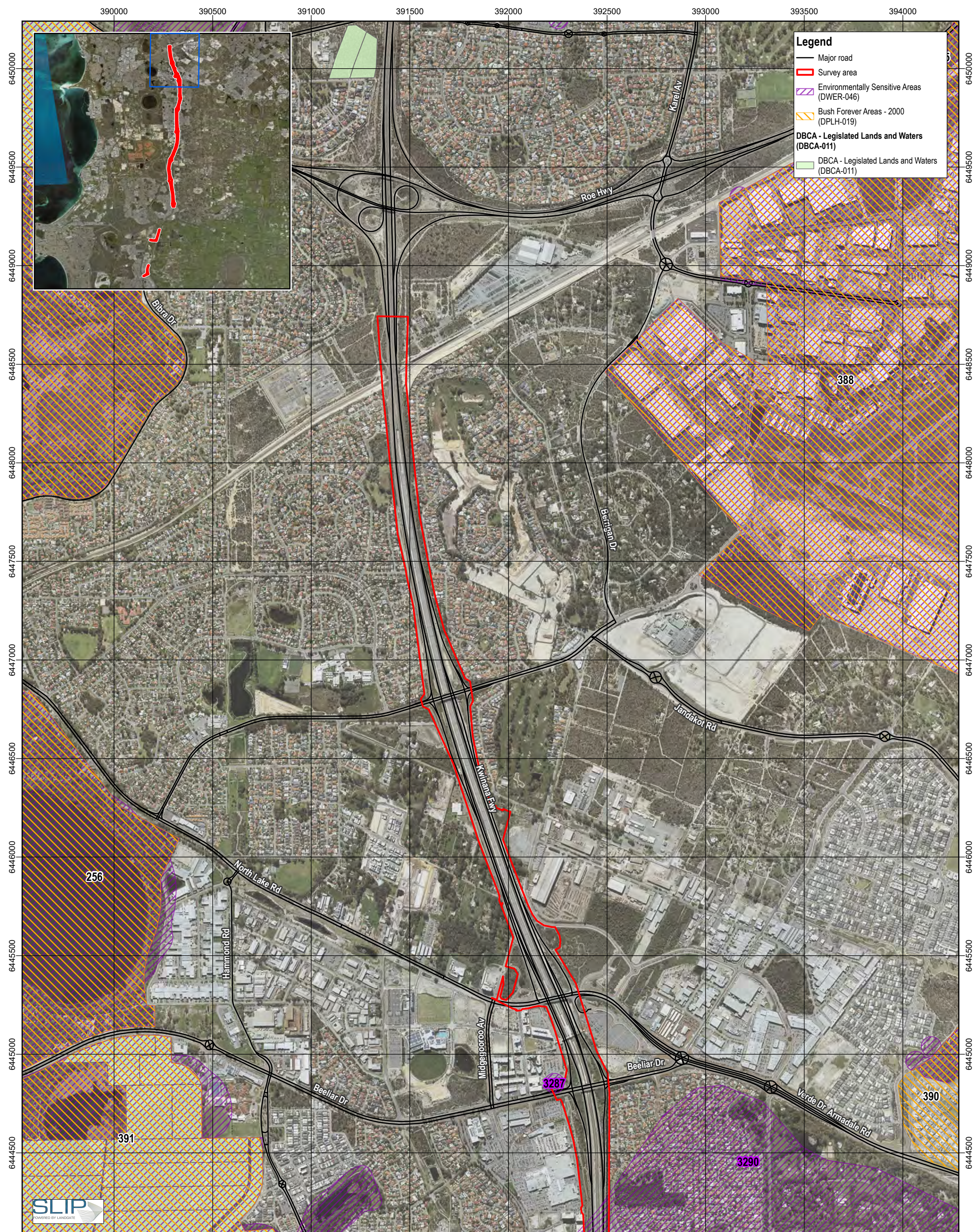


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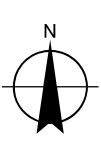
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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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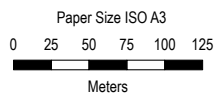
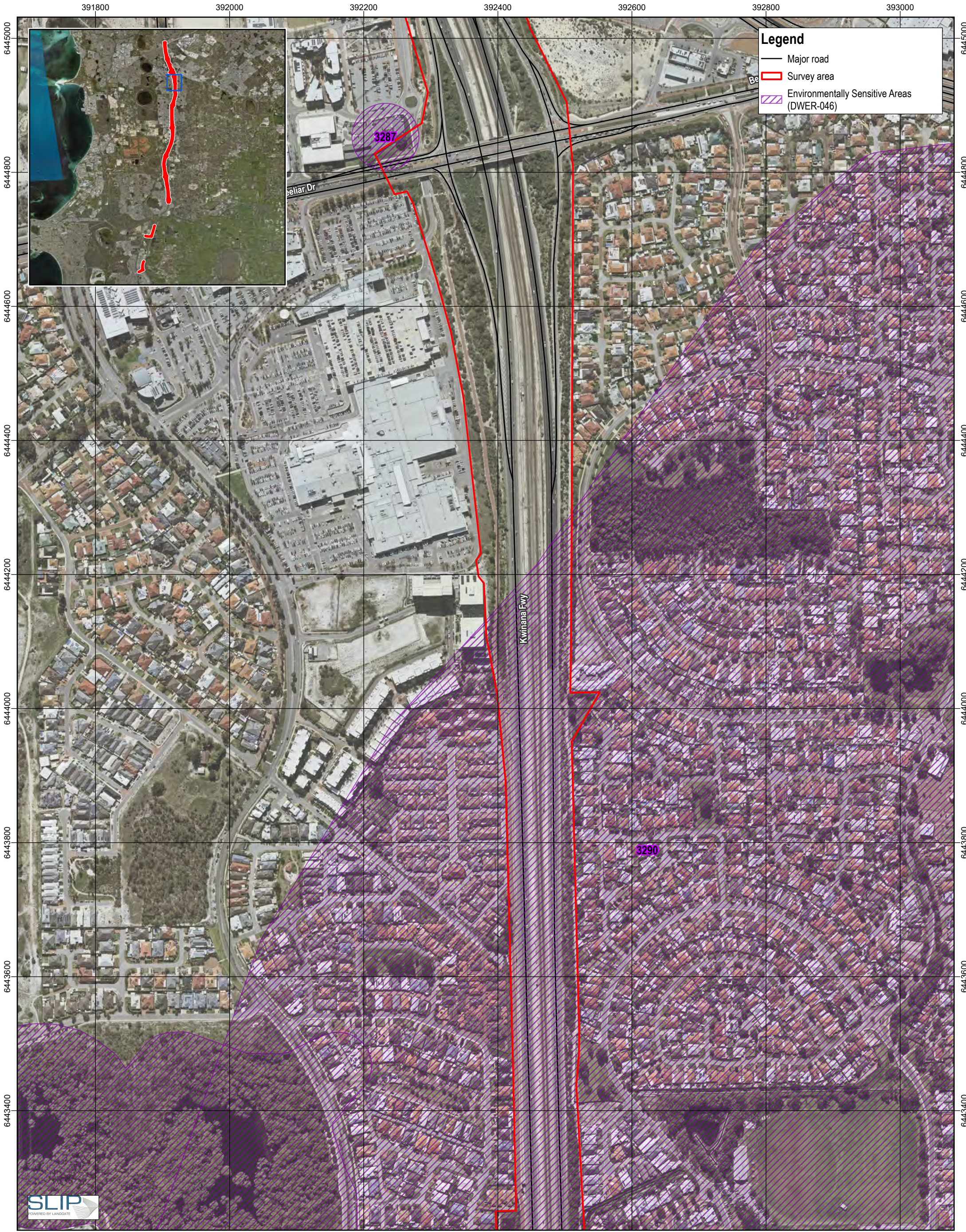
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Land Use Constraints

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FIGURE 3



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



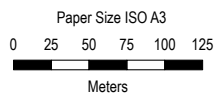
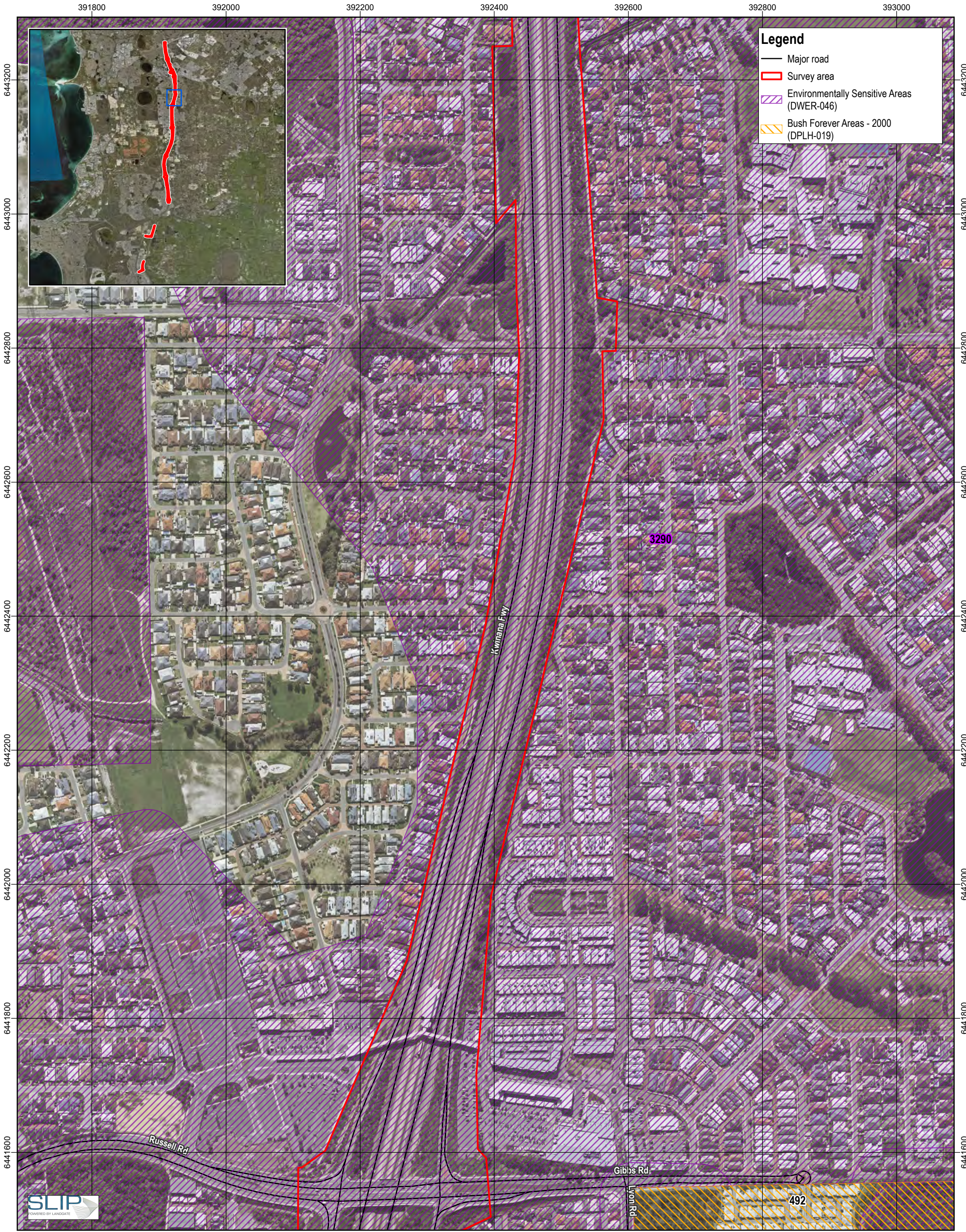
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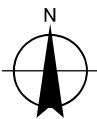
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Land Use Constraints



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



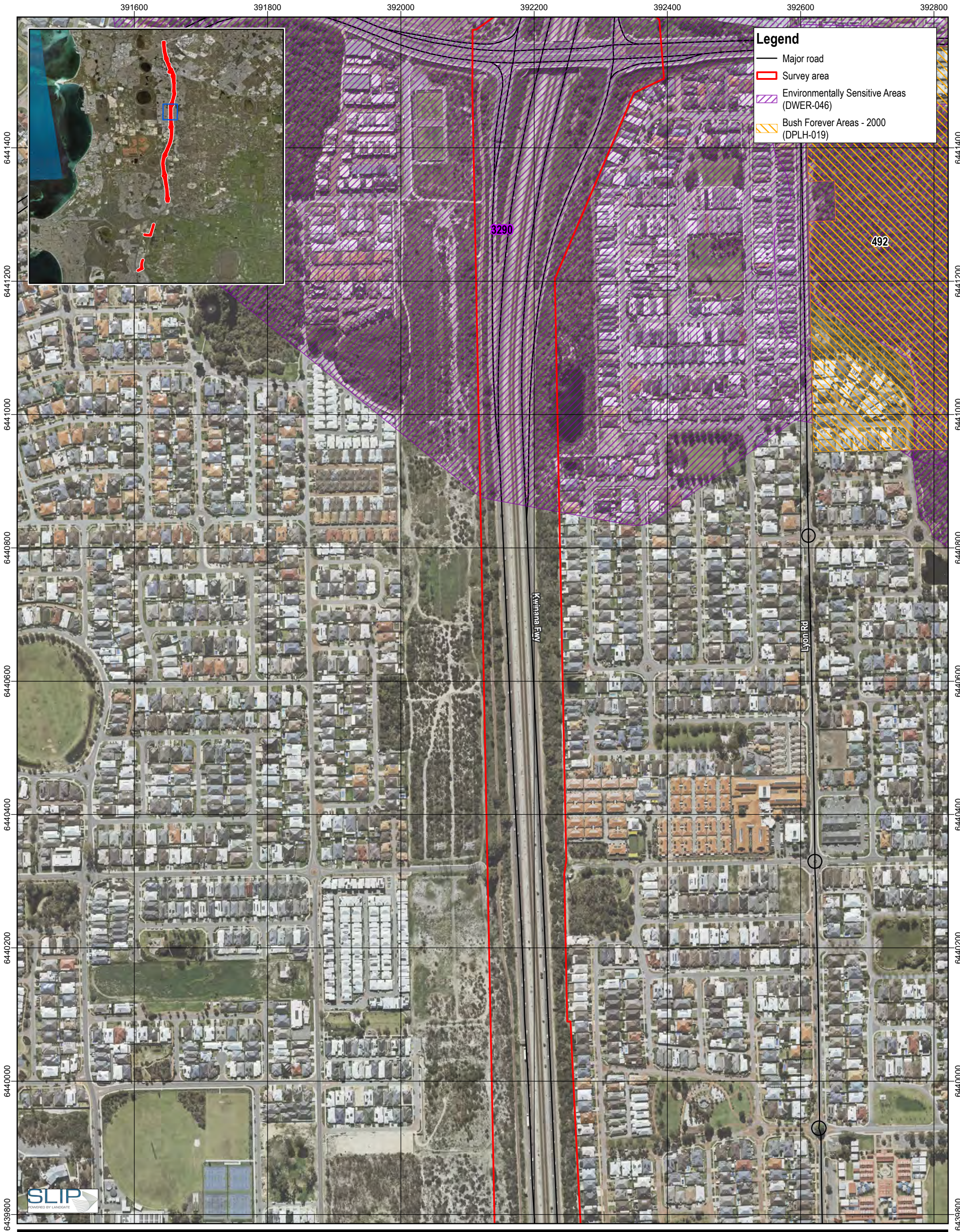
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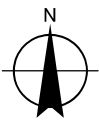
Land Use Constraints

FIGURE 3



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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



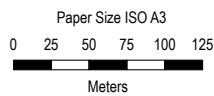
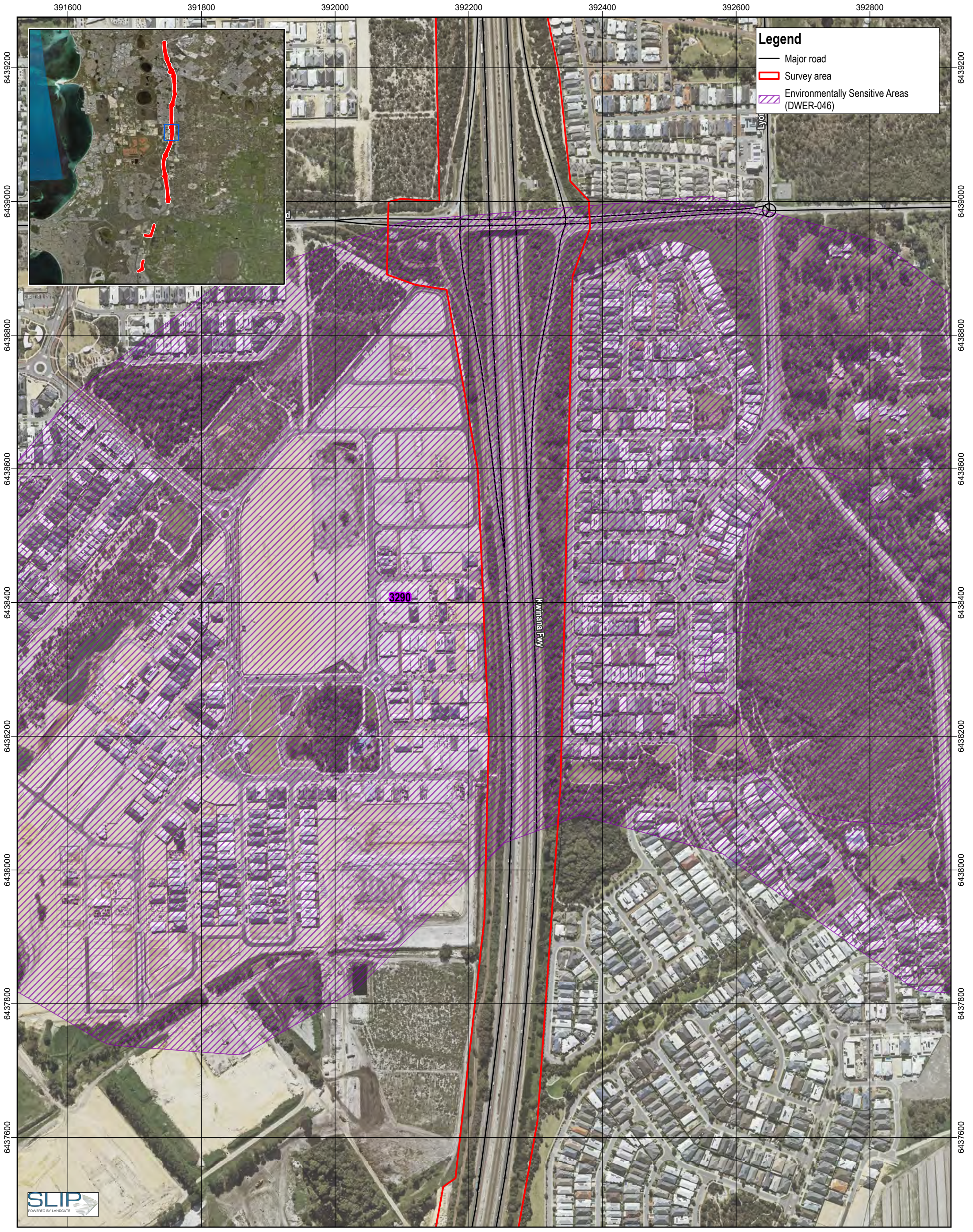
Main Roads
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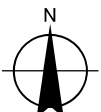
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Map Projection: Transverse Mercator
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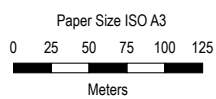
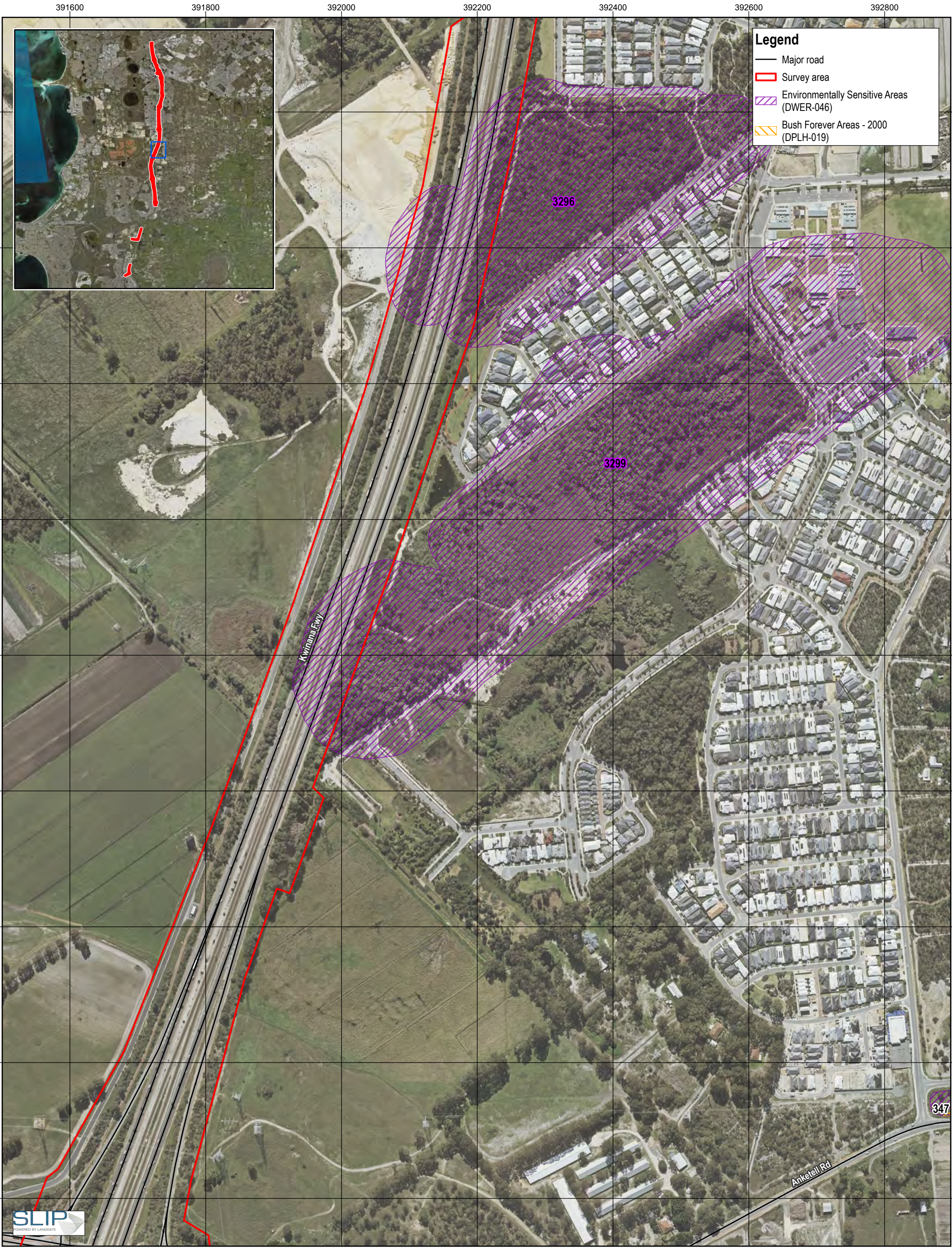
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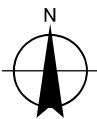
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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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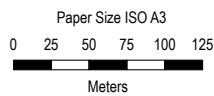
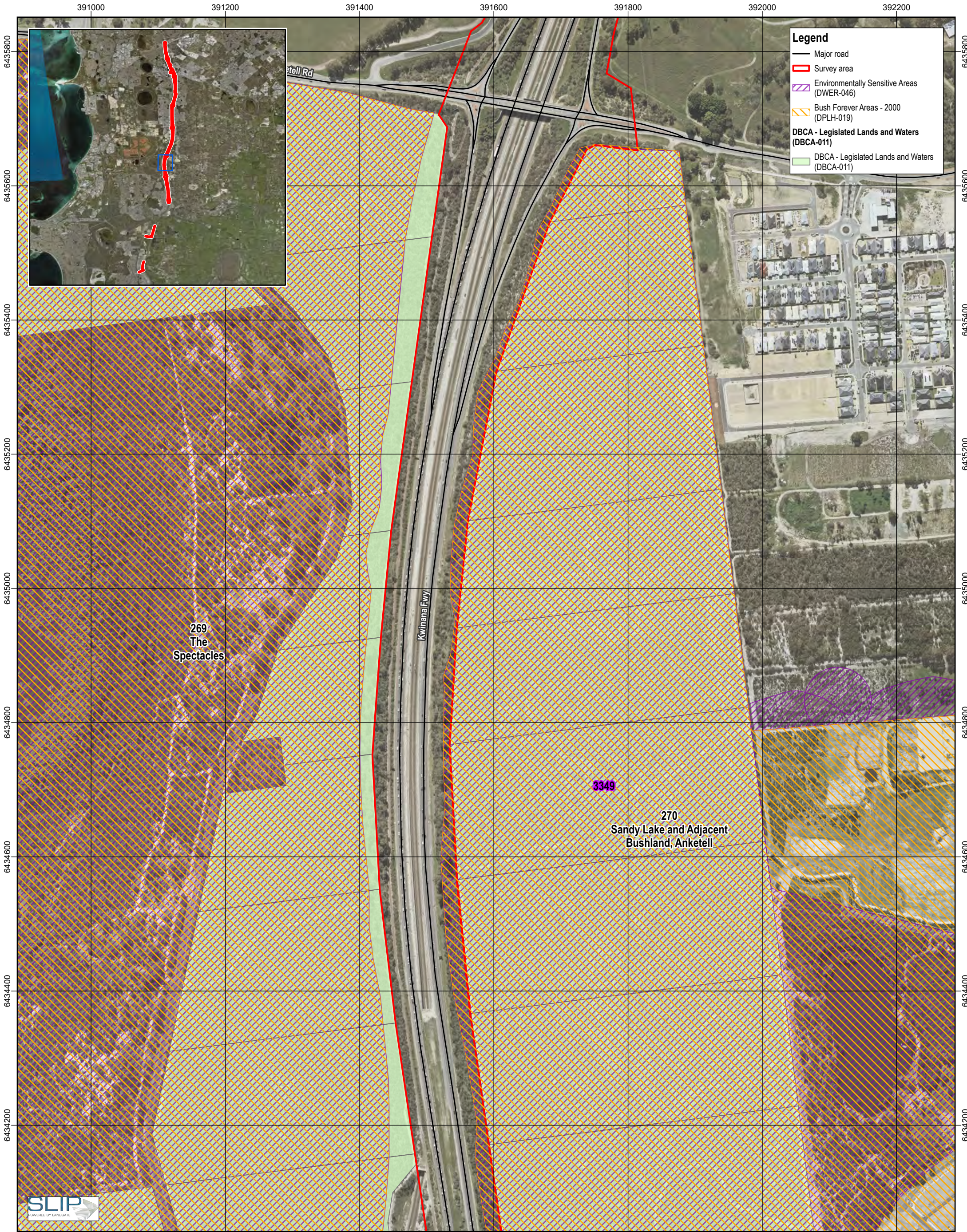
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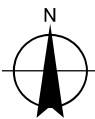
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Map Projection: Transverse Mercator
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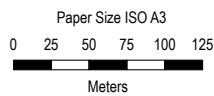
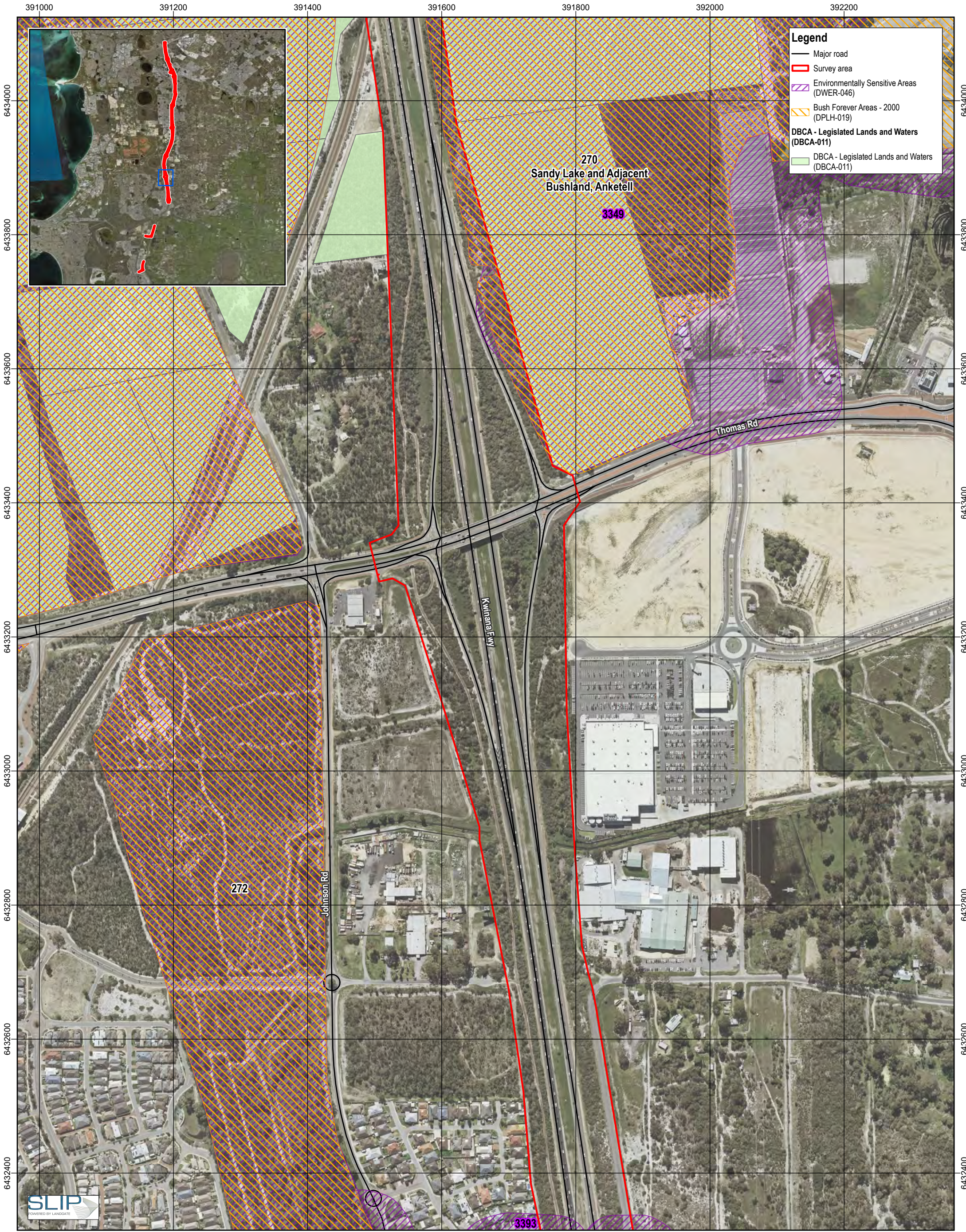
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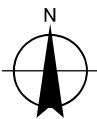
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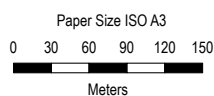
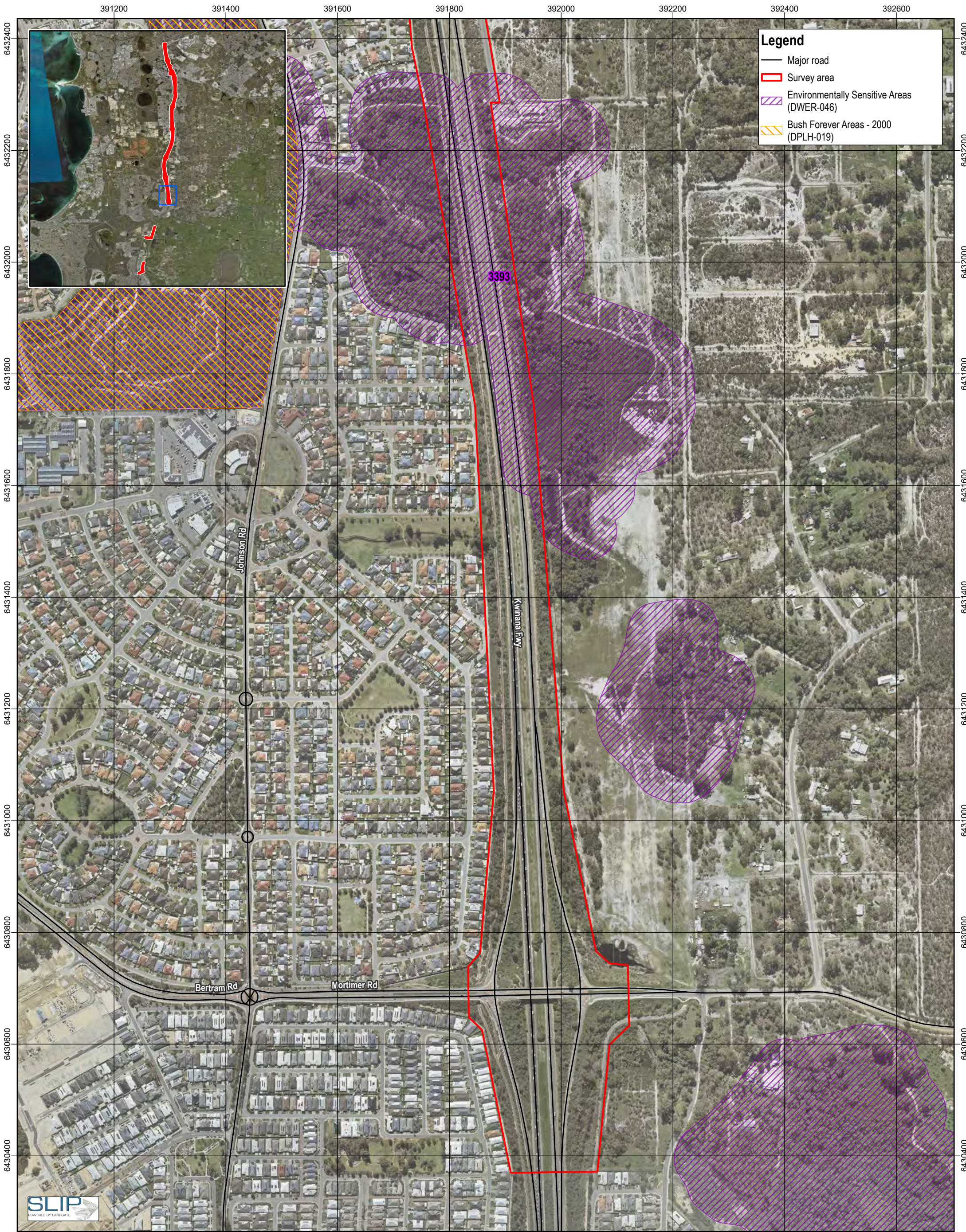
Main Roads
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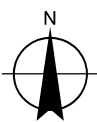
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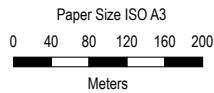
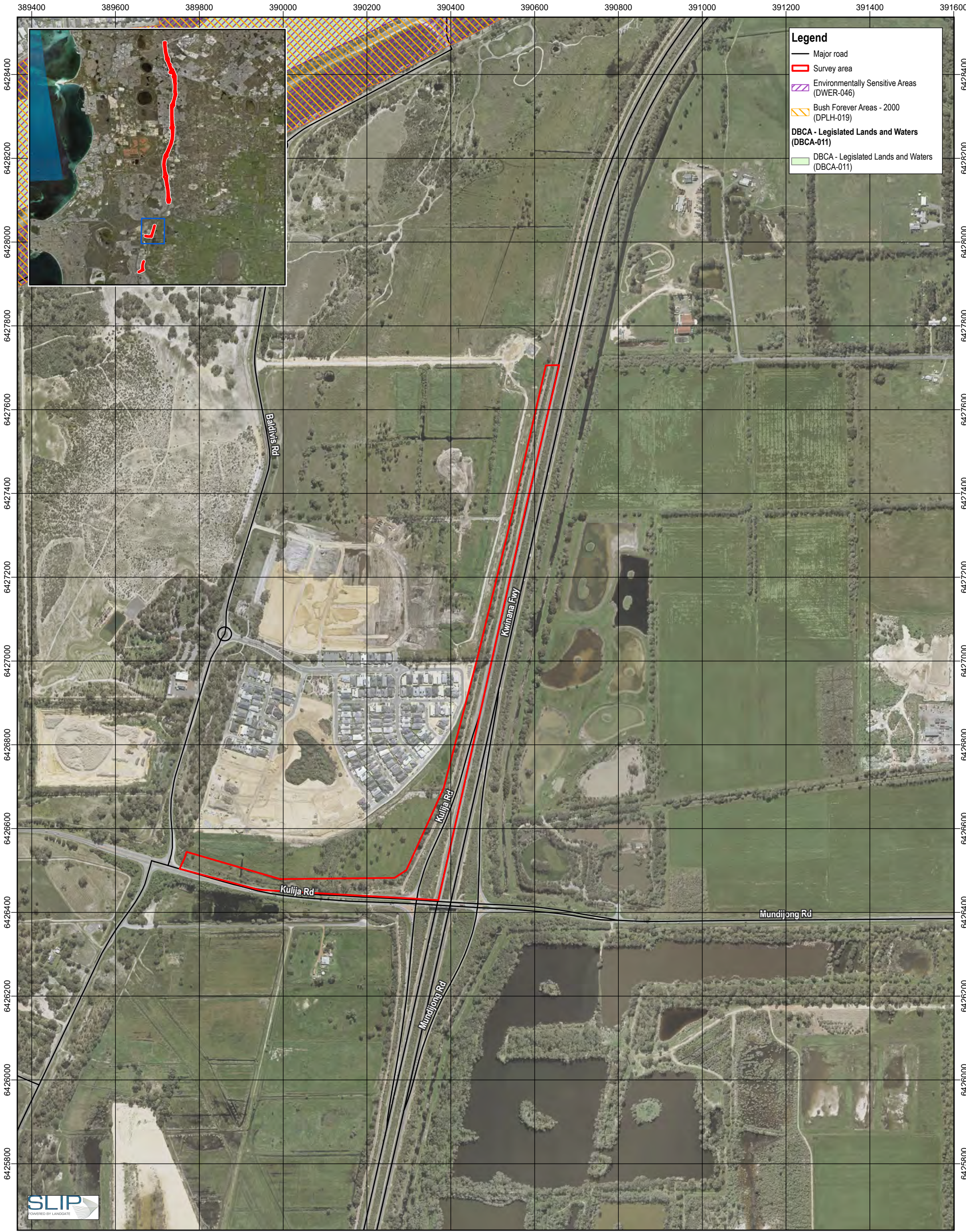
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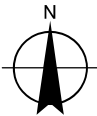
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Horizontal Datum: GDA2020
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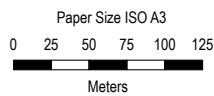
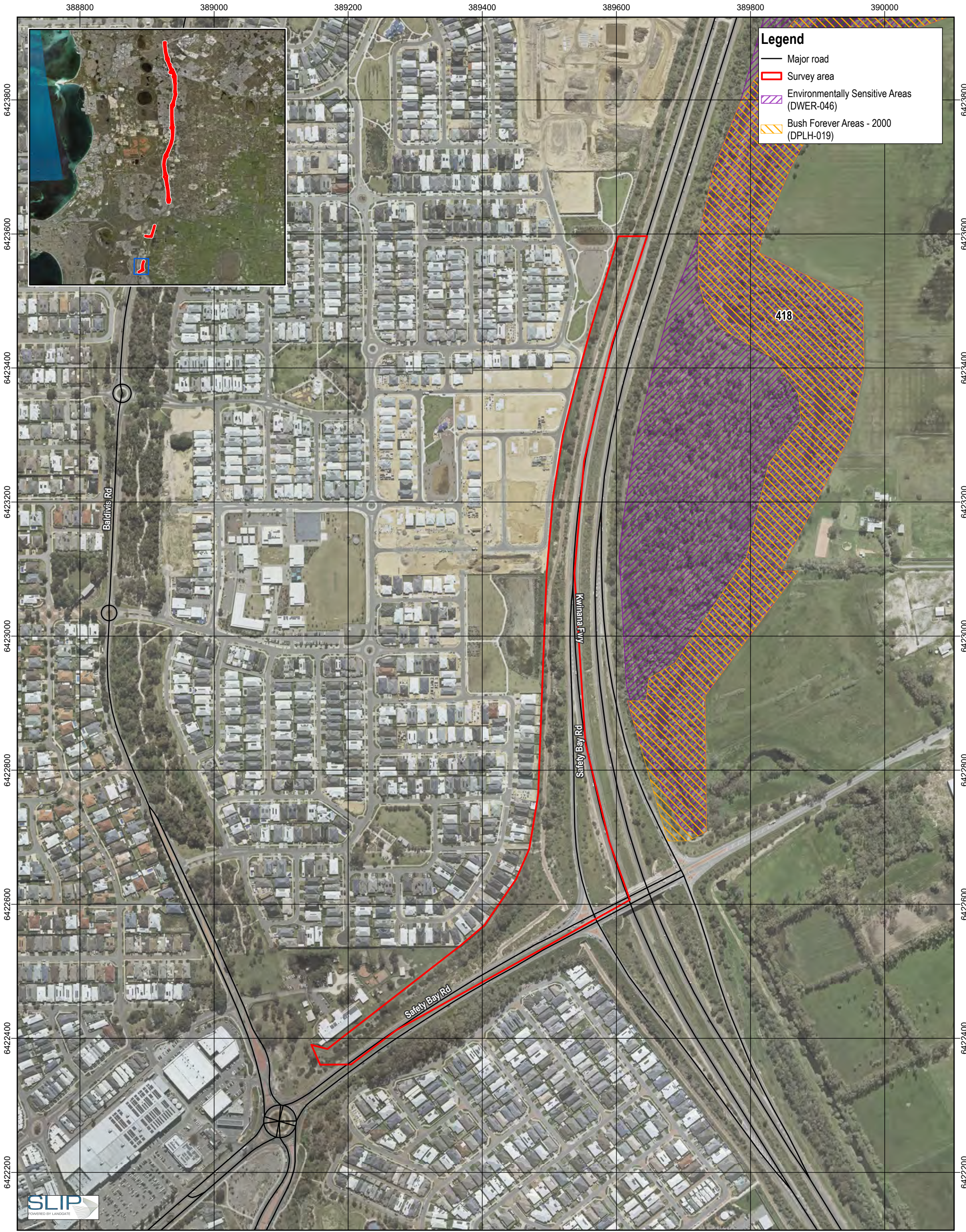
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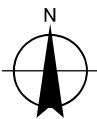
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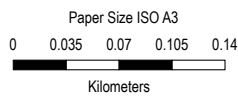
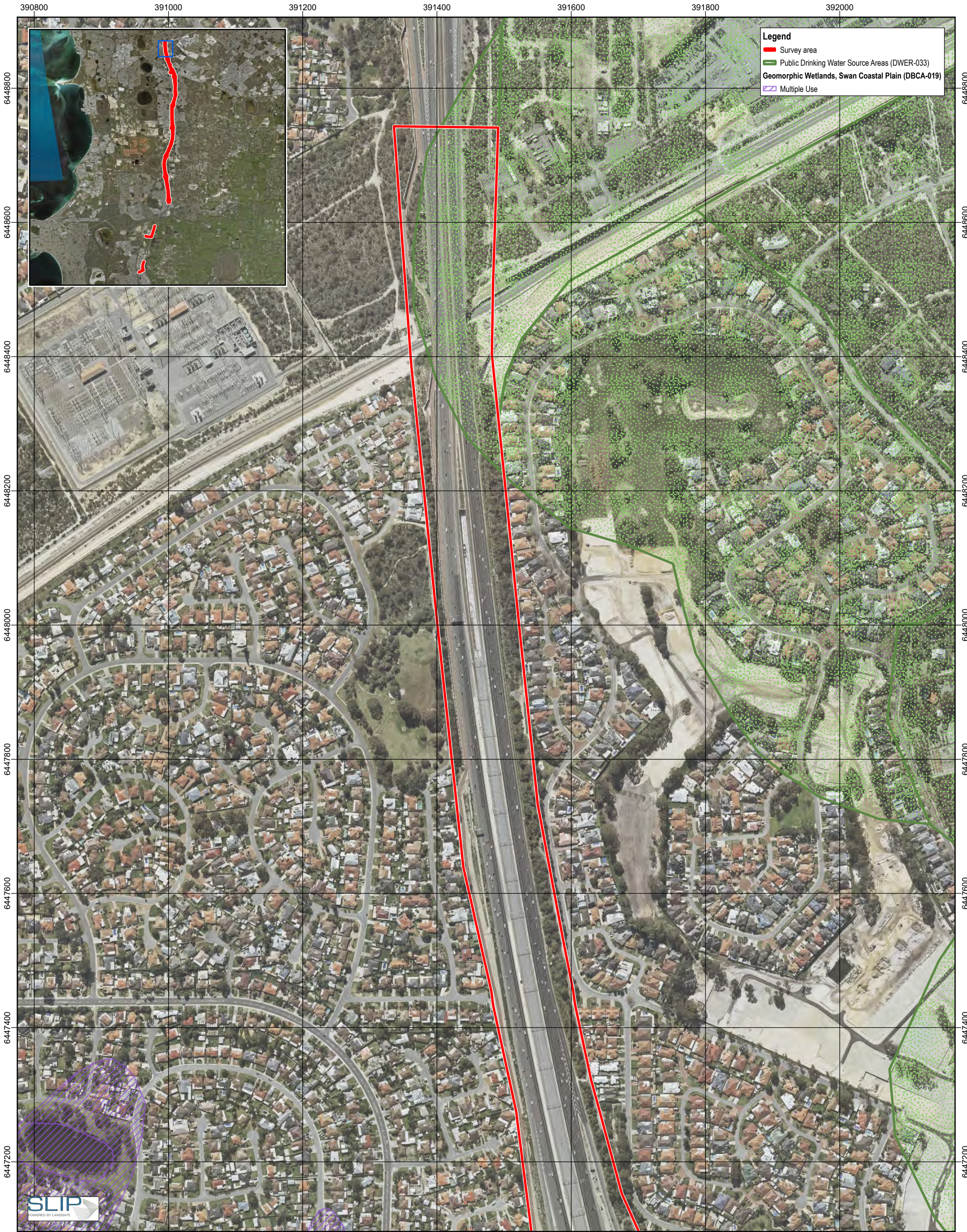
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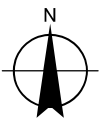
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Map Projection: Transverse Mercator
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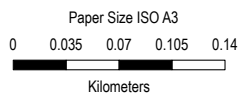
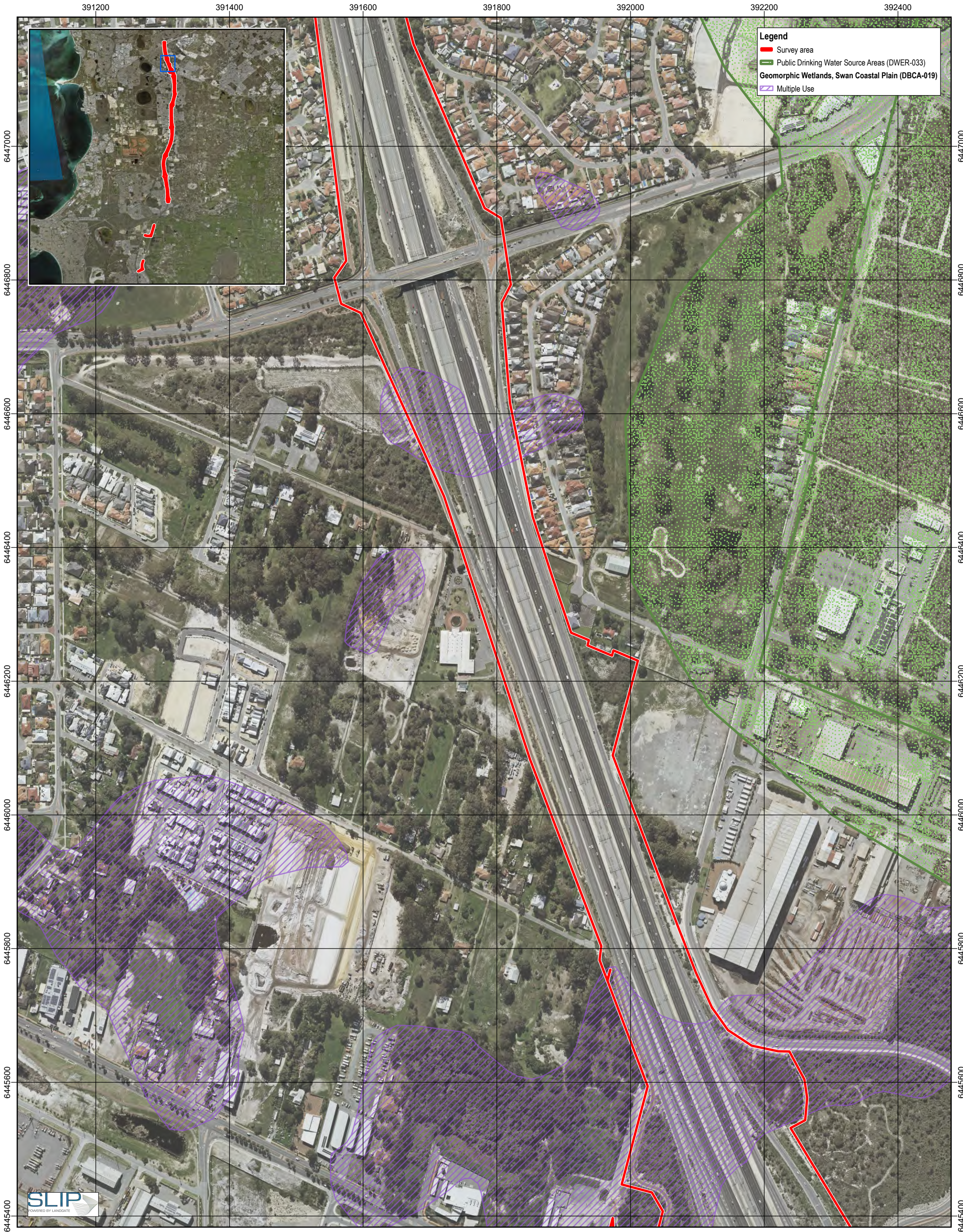
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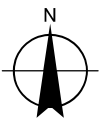
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Hydrology Constraints

FIGURE 4



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



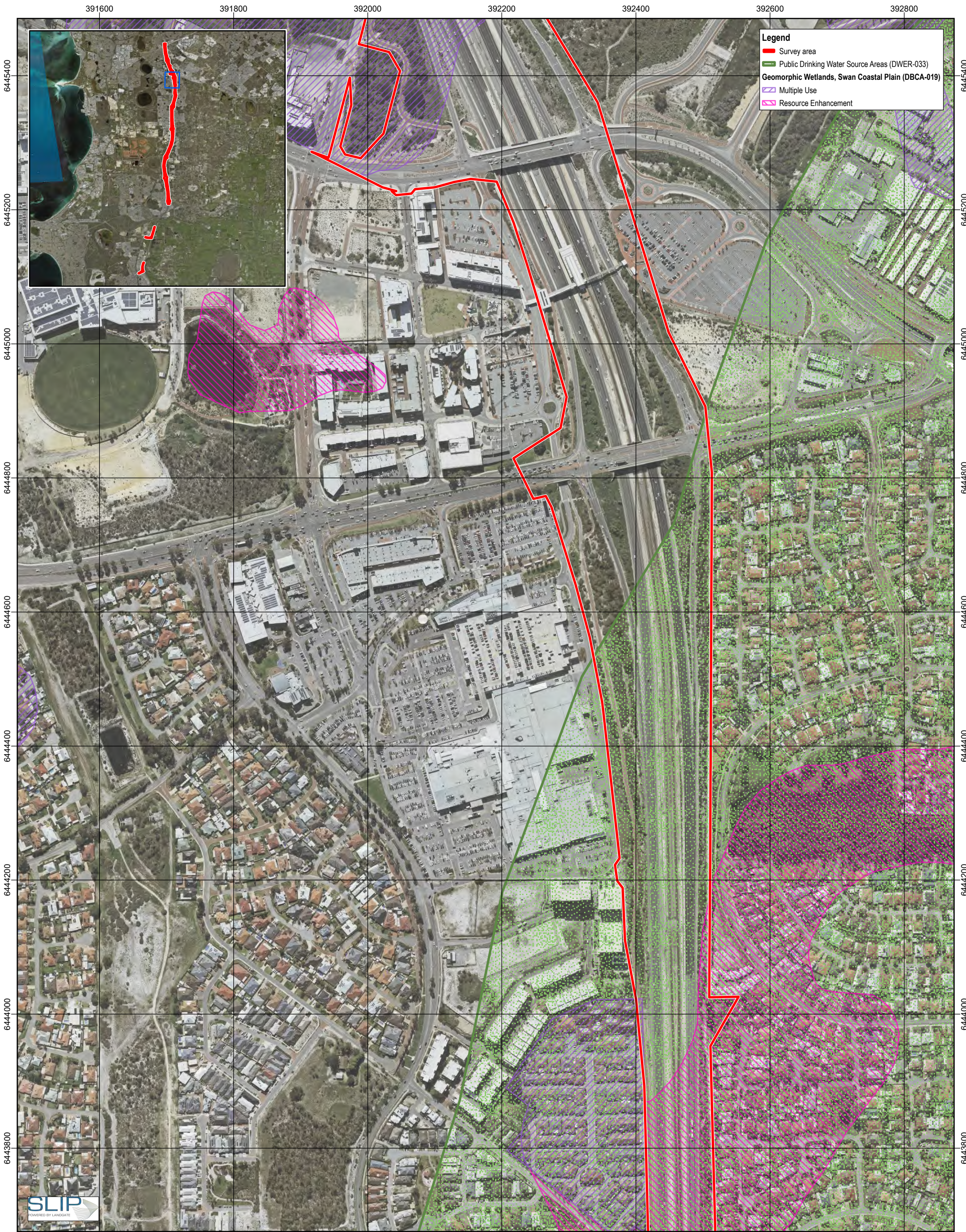
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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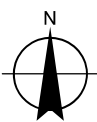
Hydrology Constraints

FIGURE 4



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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



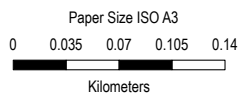
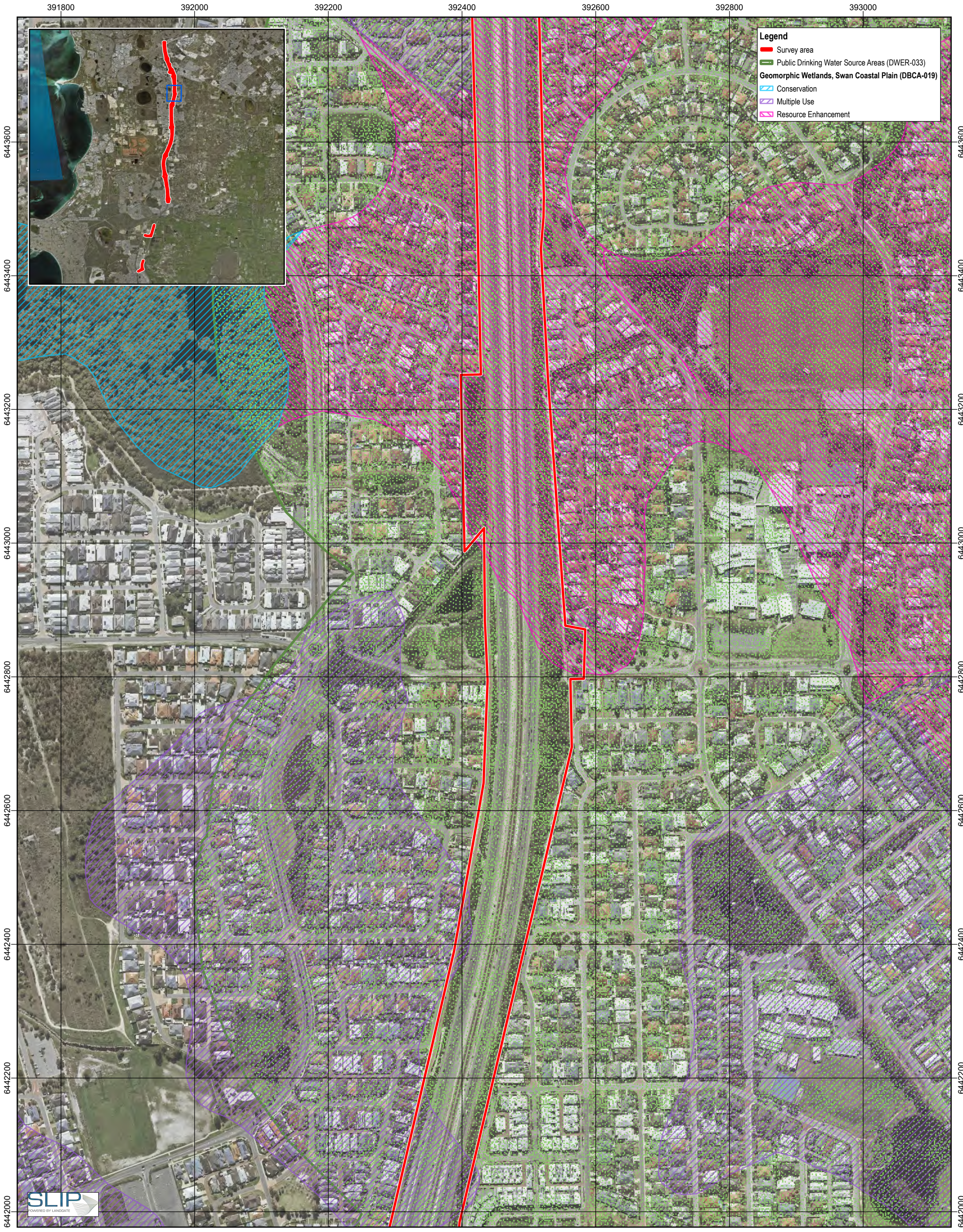
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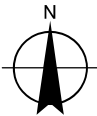
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Hydrology Constraints

FIGURE 4



Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50



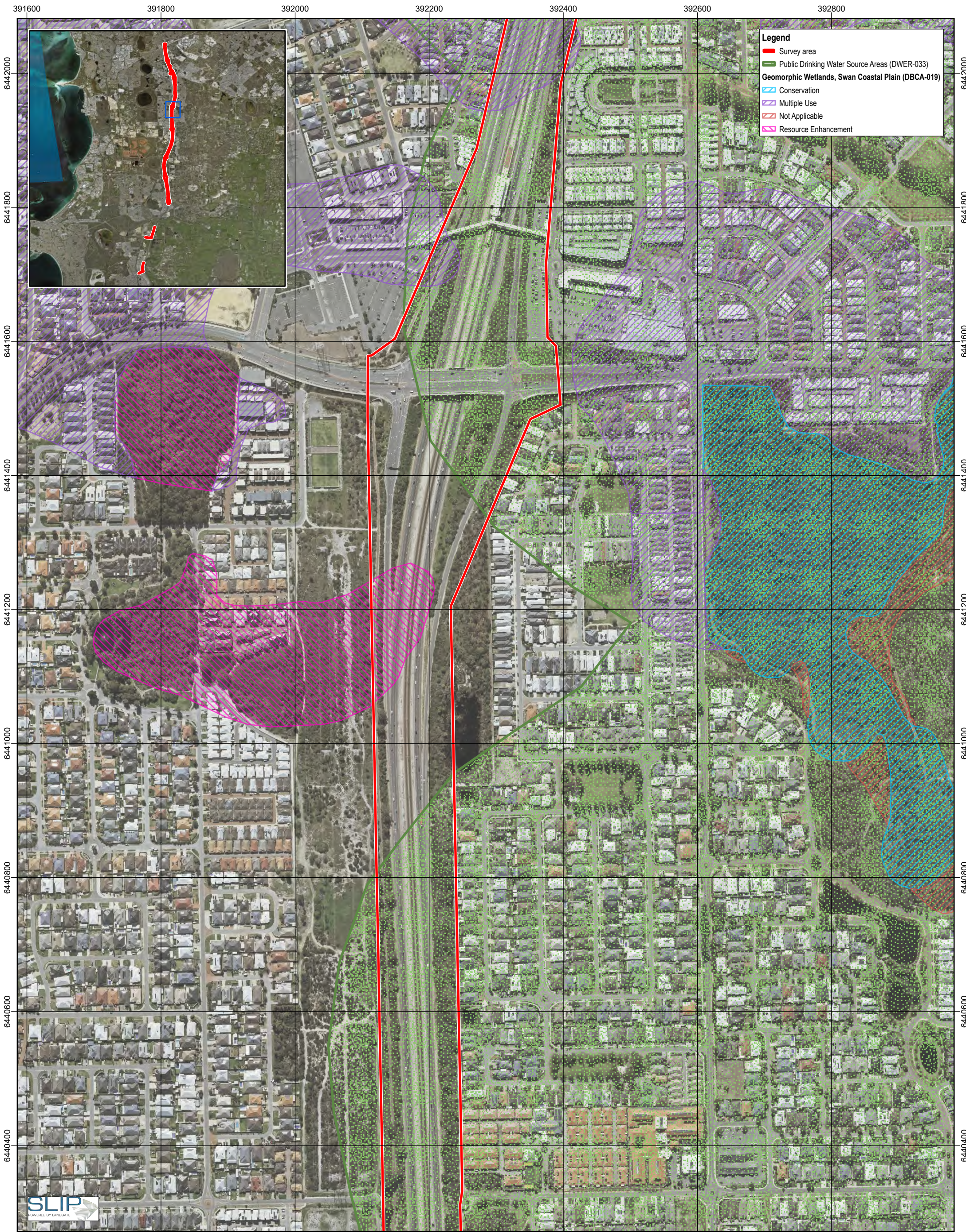
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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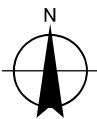
Hydrology Constraints

FIGURE 4



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Map Projection: Transverse Mercator
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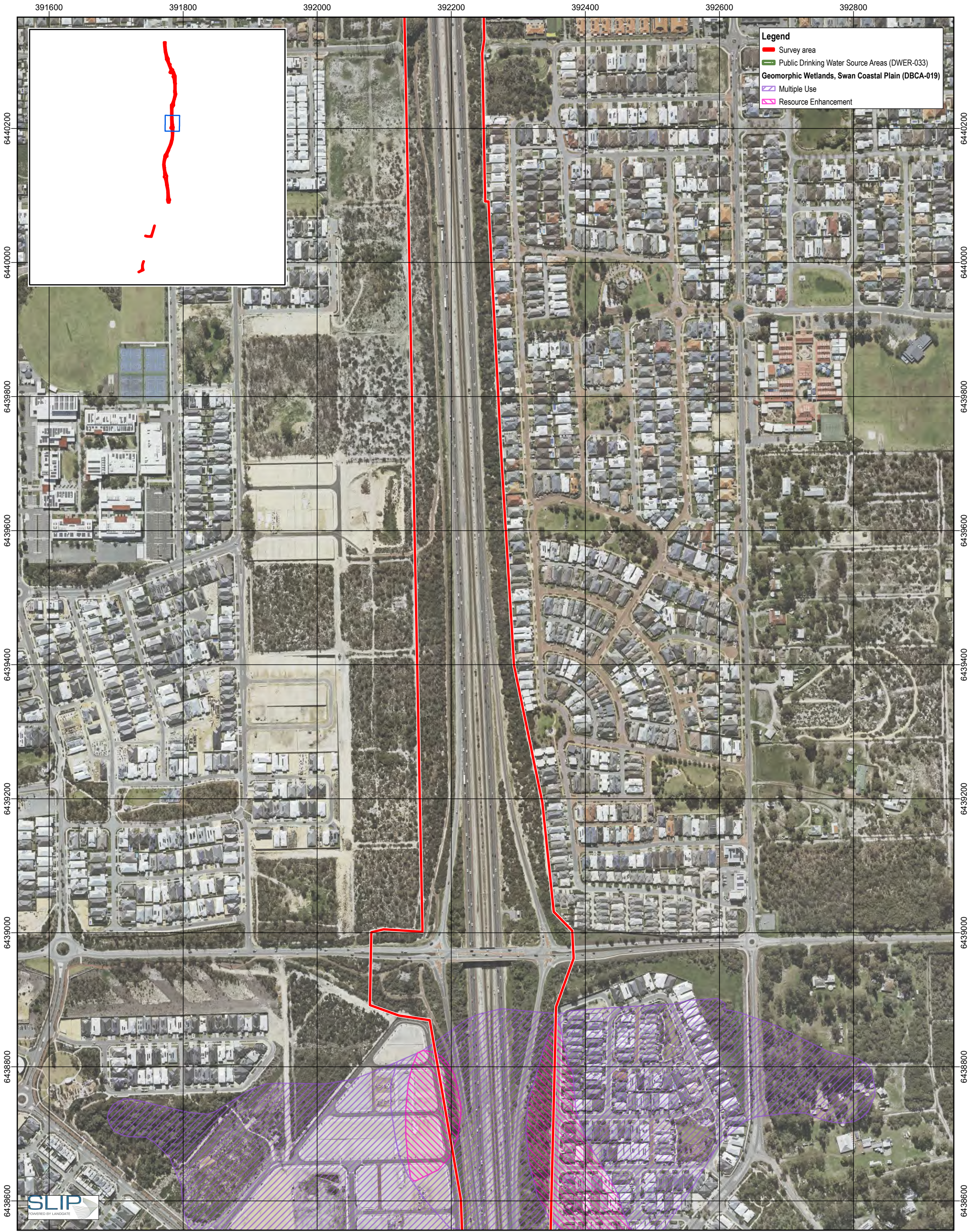
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Roe Hwy Widening Flora and Fauna Assessment

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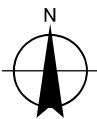
Hydrology Constraints

FIGURE 4



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Map Projection: Transverse Mercator
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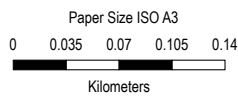
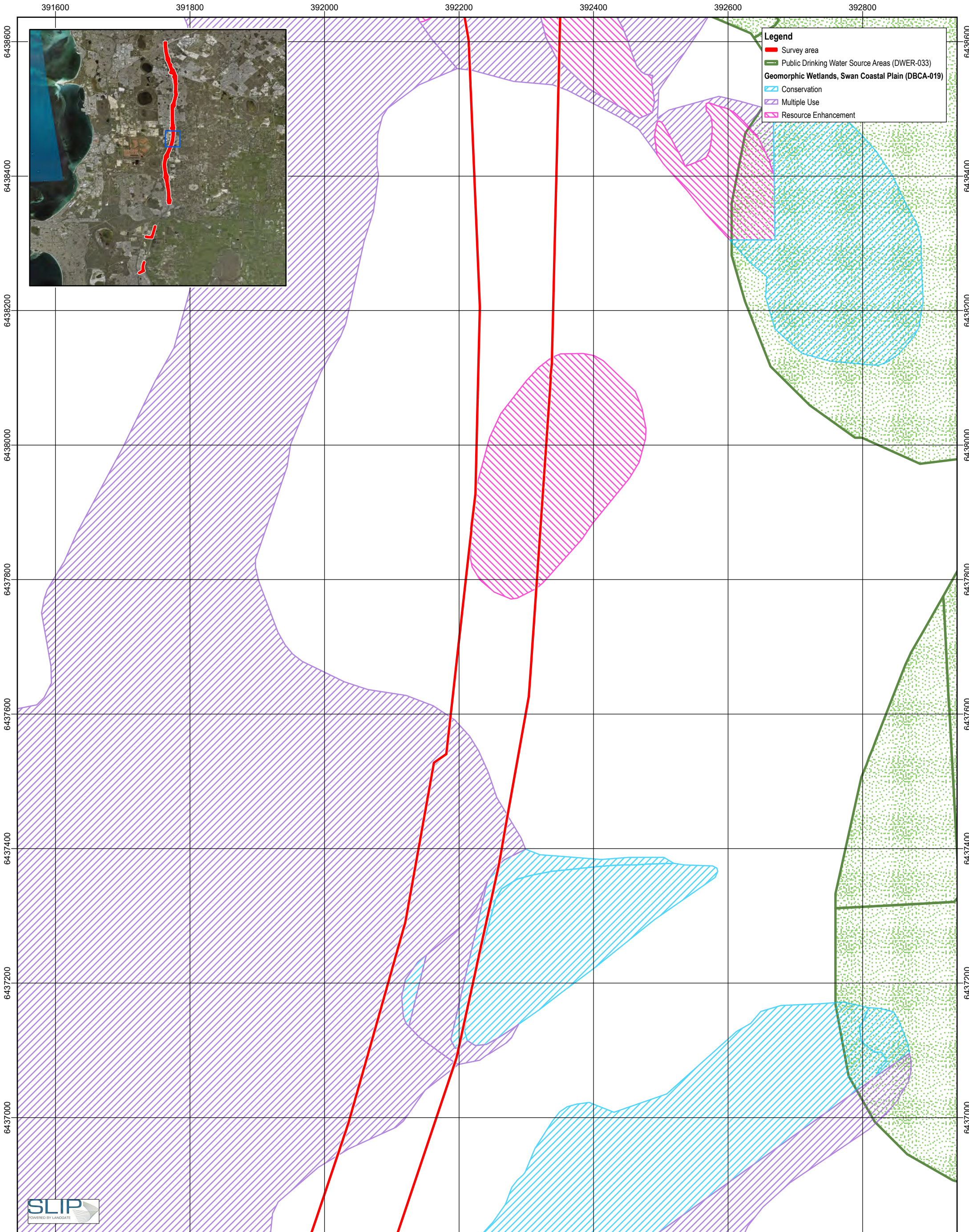
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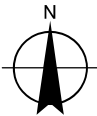
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Hydrology Constraints

FIGURE 4



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



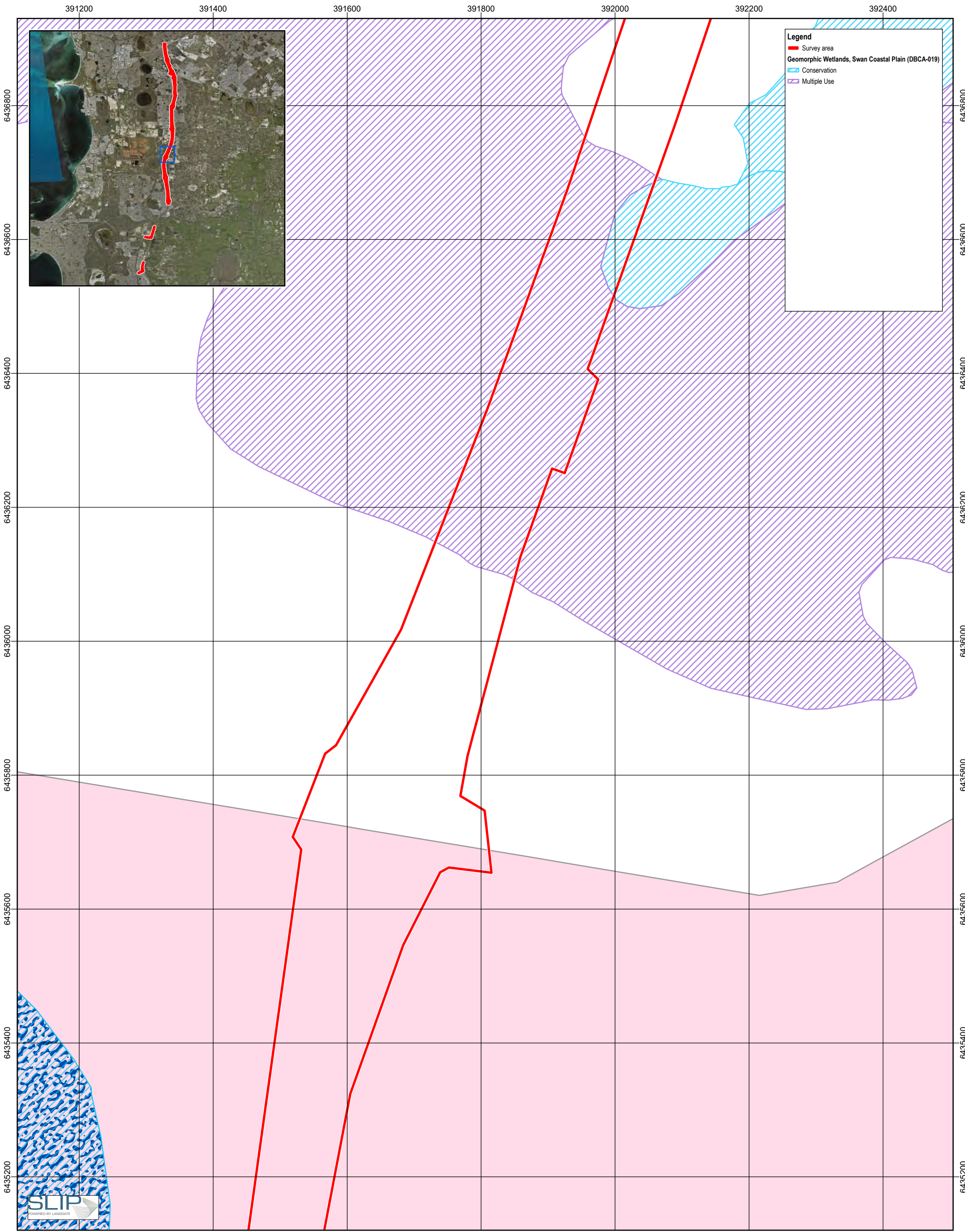
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

Hydrology Constraints

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Revision No. A
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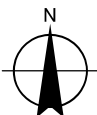
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FIGURE 4



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Kilometers

Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50



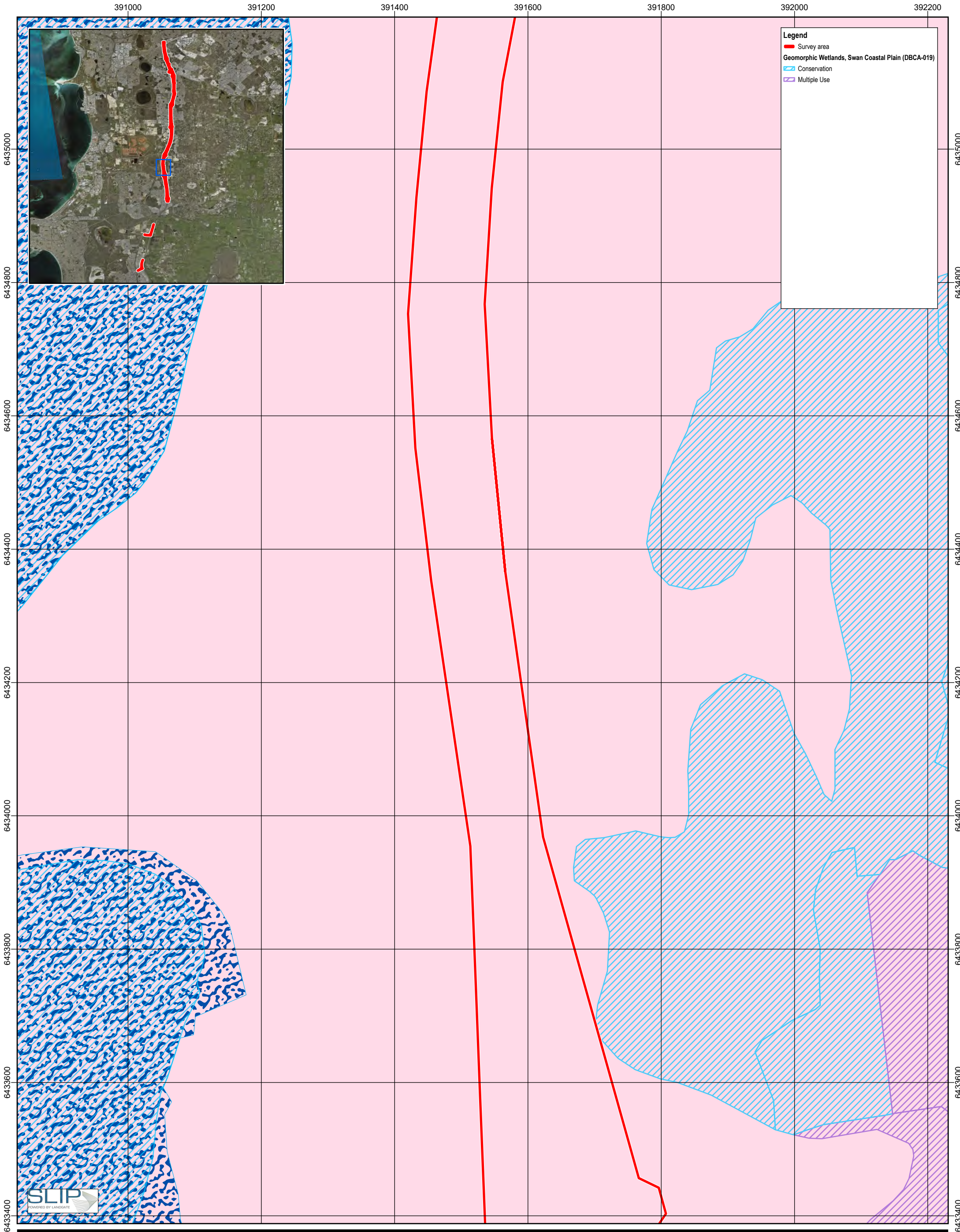
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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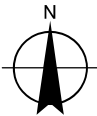
Hydrology Constraints

FIGURE 4



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Map Projection: Transverse Mercator
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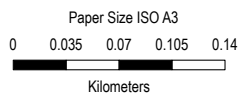
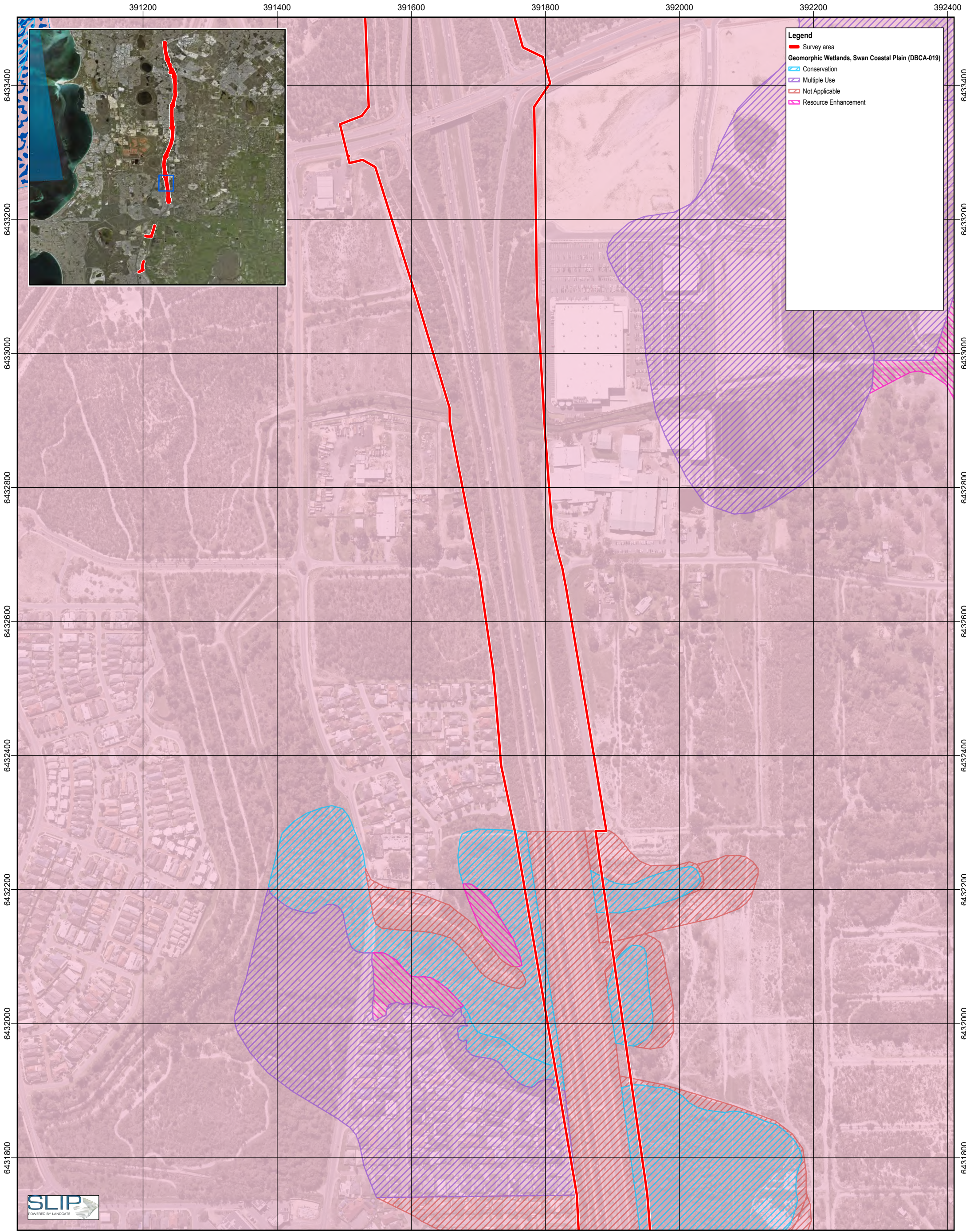
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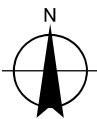
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Hydrology Constraints

FIGURE 4



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



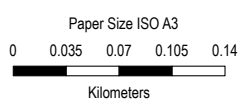
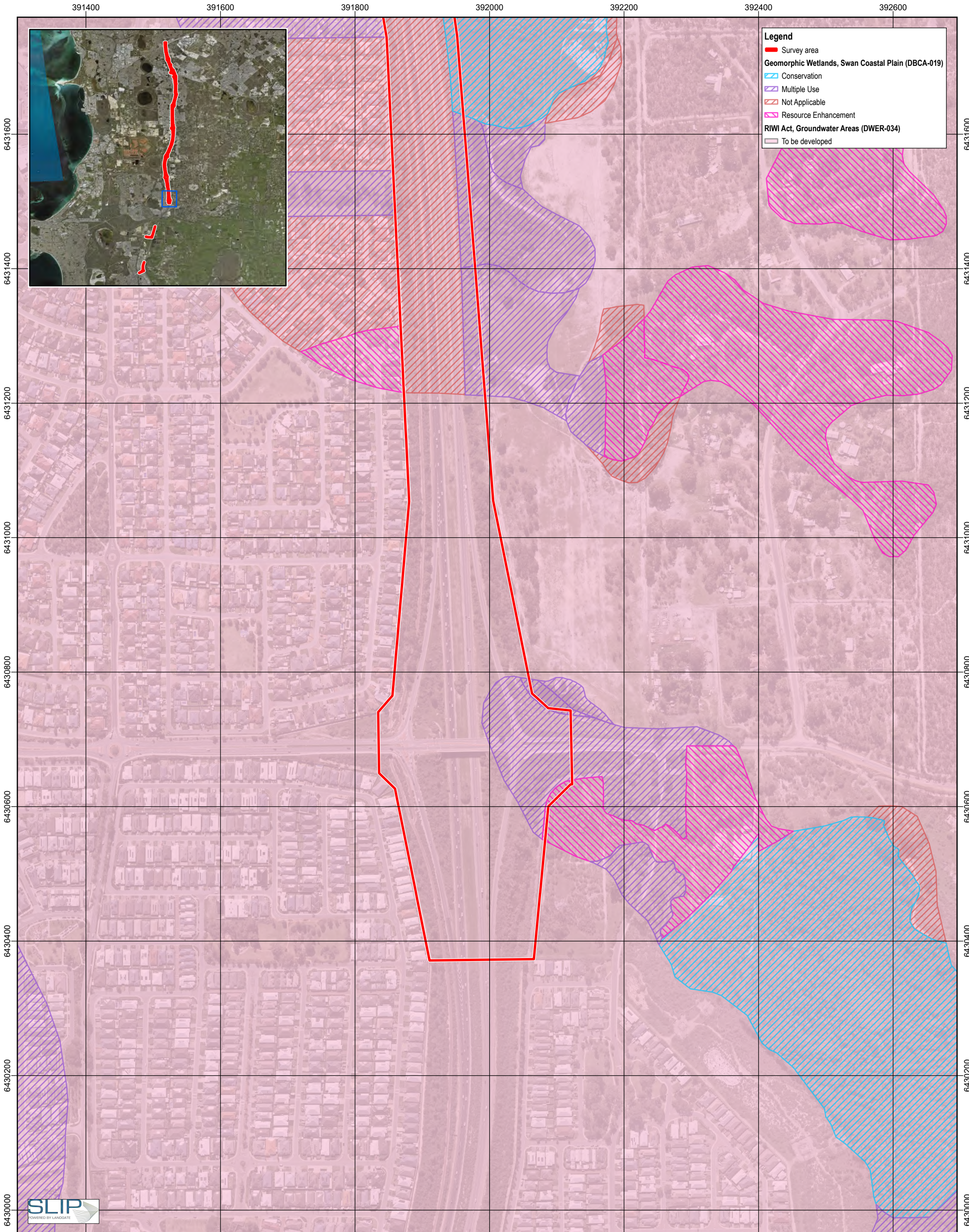
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Roe Hwy Widening Flora and Fauna Assessment

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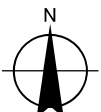
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Hydrology Constraints

FIGURE 4



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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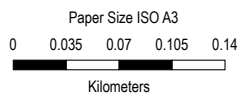
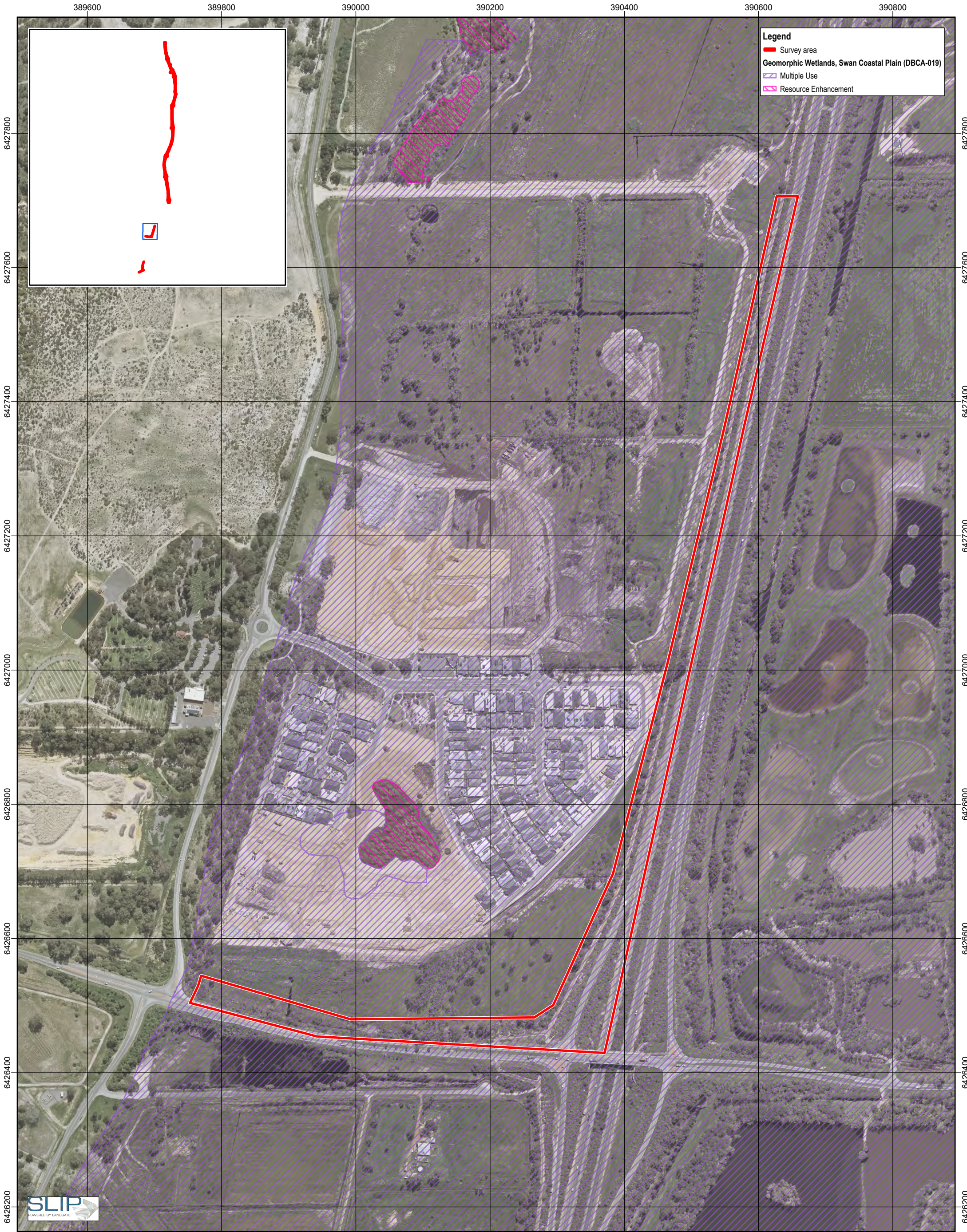
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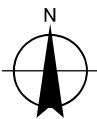
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Hydrology Constraints

FIGURE 4



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



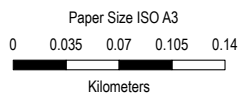
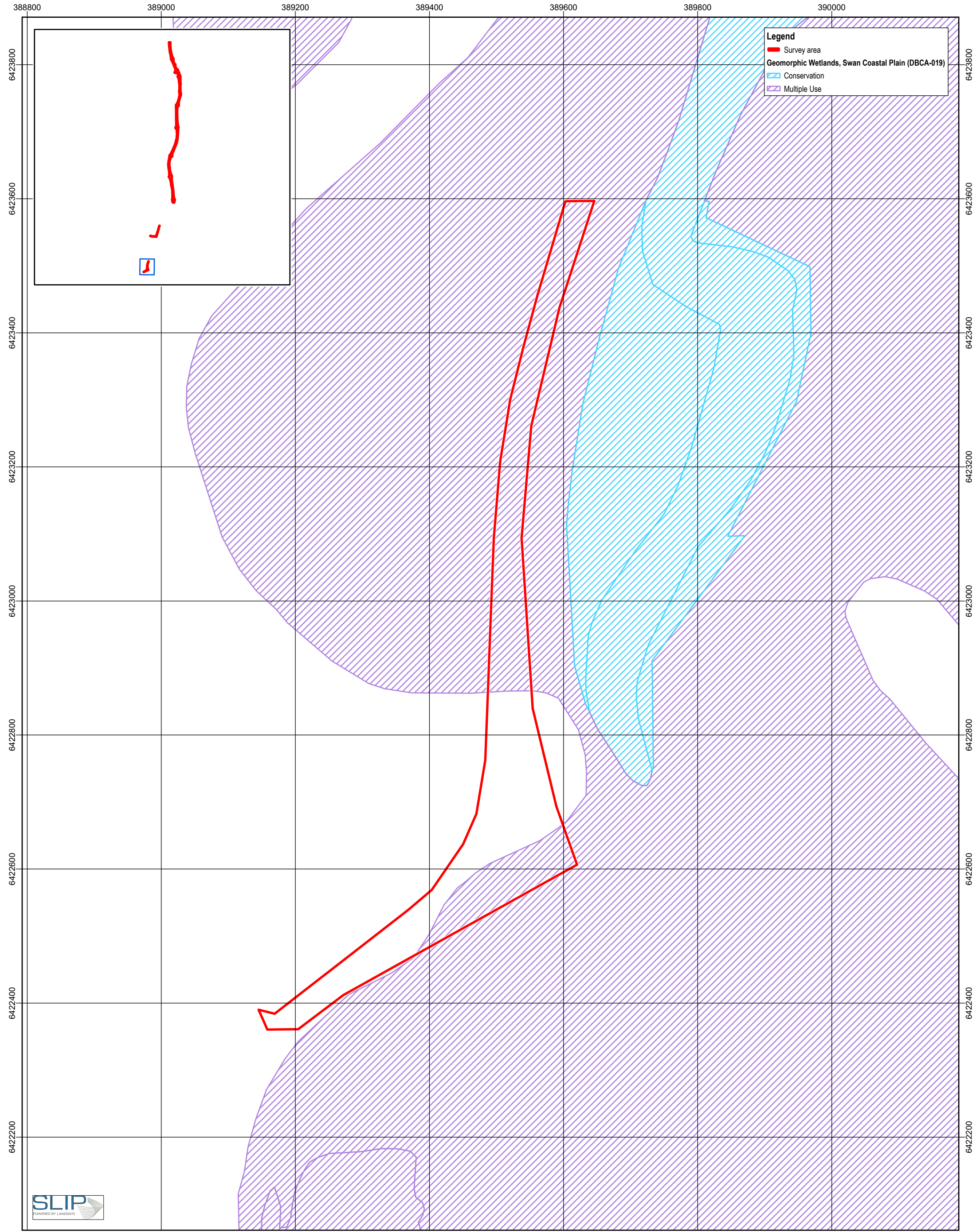
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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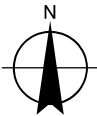
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Hydrology Constraints

FIGURE 4



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



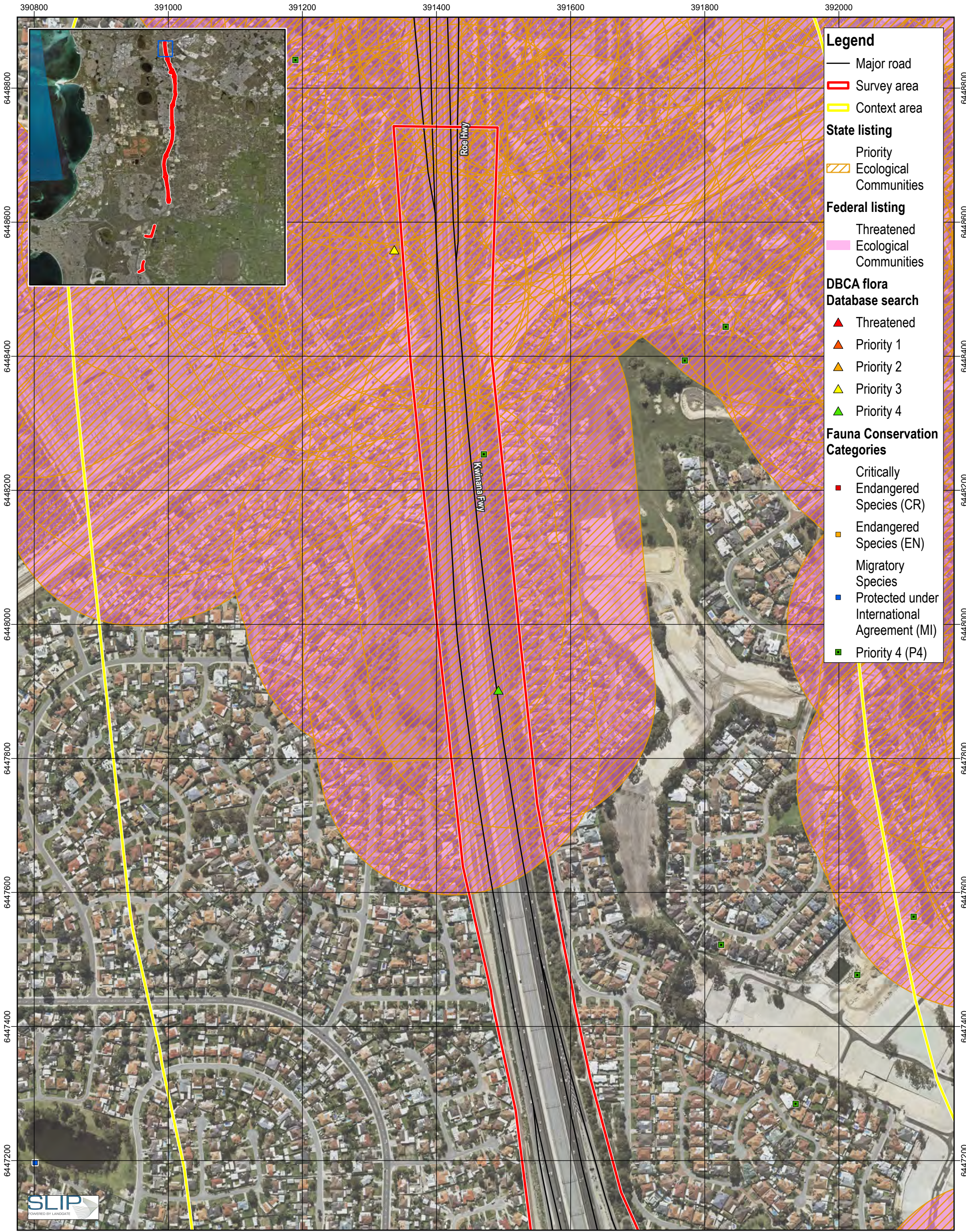
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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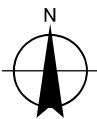
FIGURE 4

Hydrology Constraints



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Grid: GDA2020 MGA Zone 50



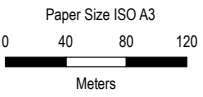
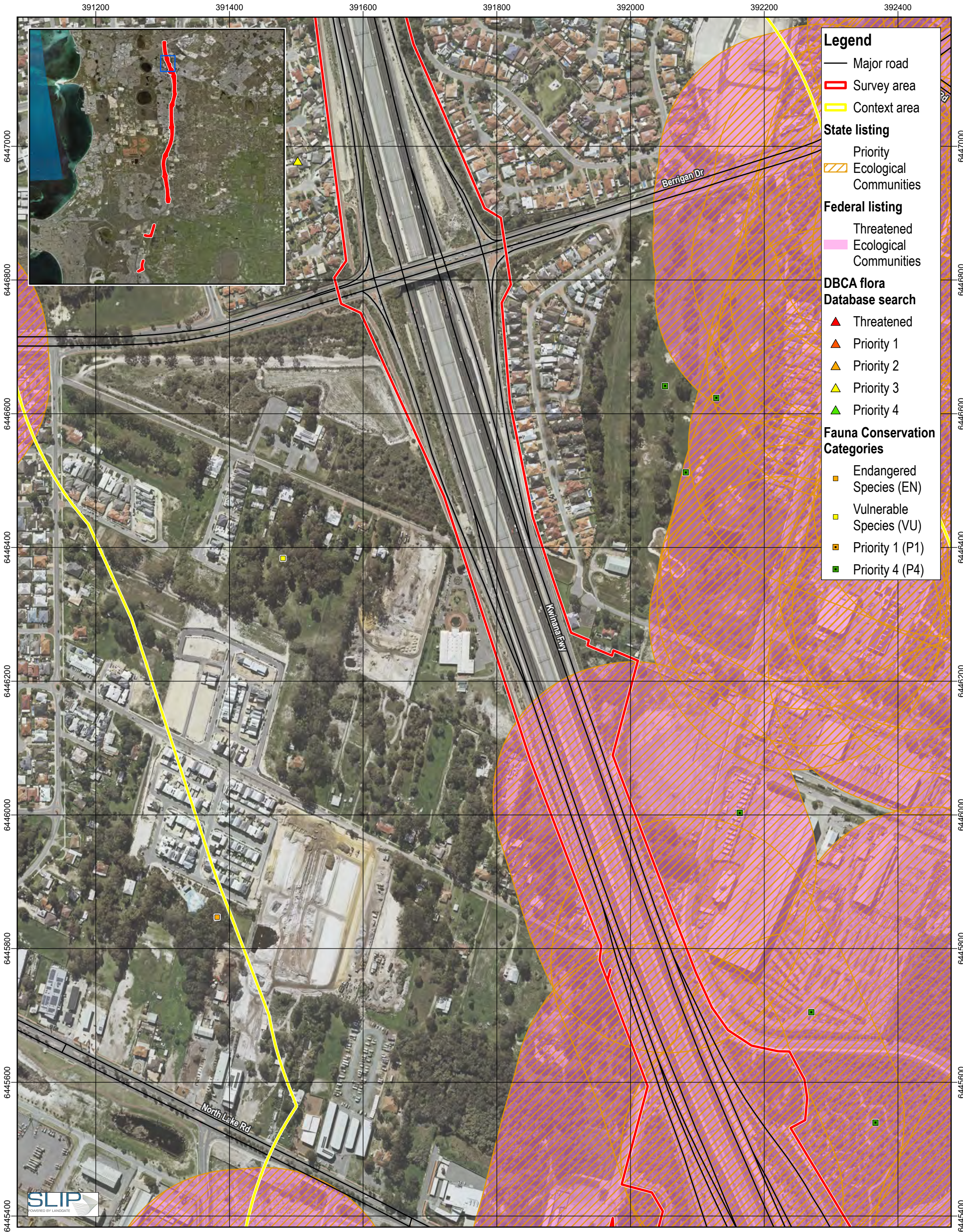
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Date 10/03/2025

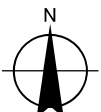
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Biological Constraints

FIGURE 5



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



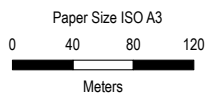
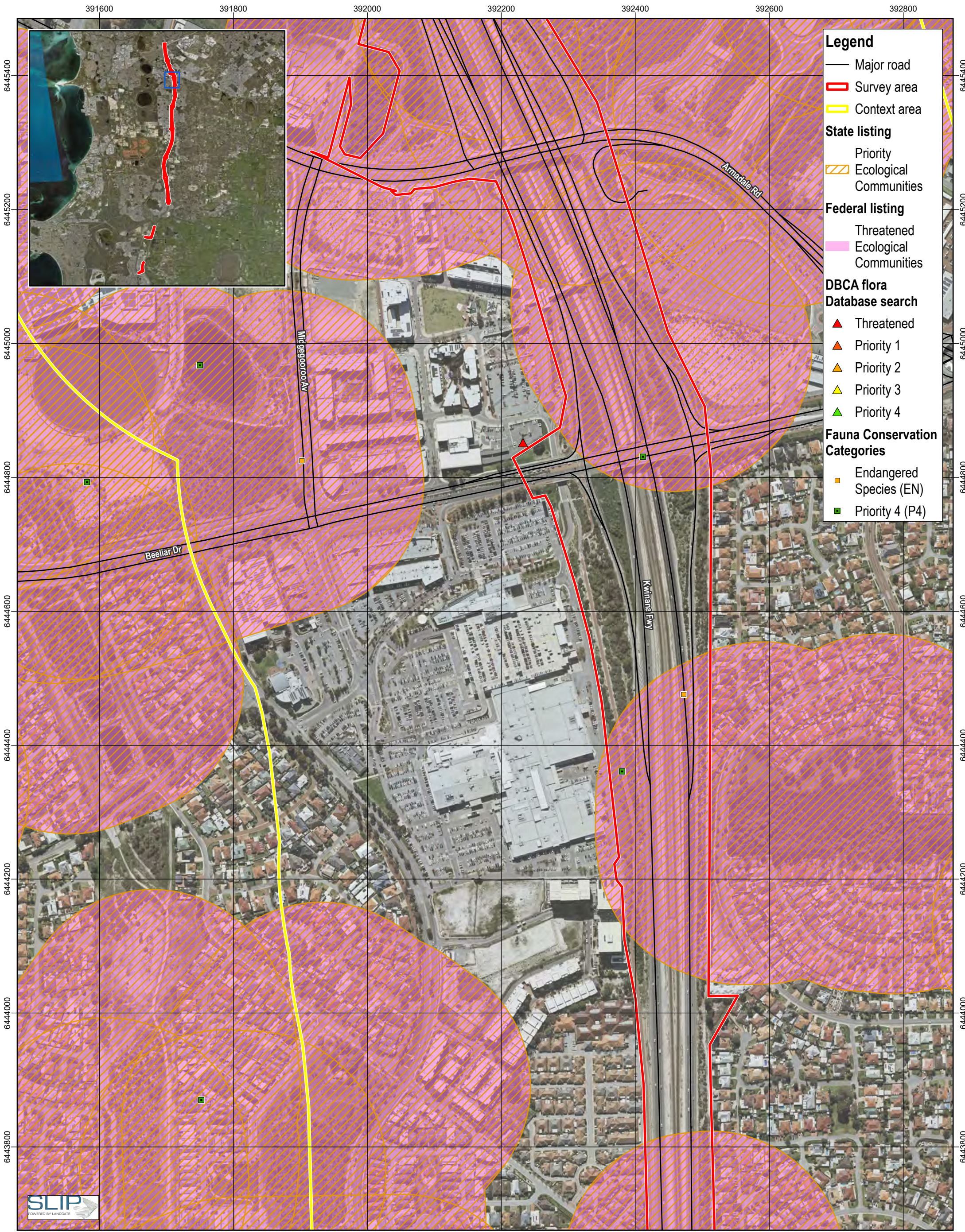
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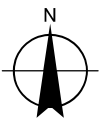
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Biological Constraints

FIGURE 5



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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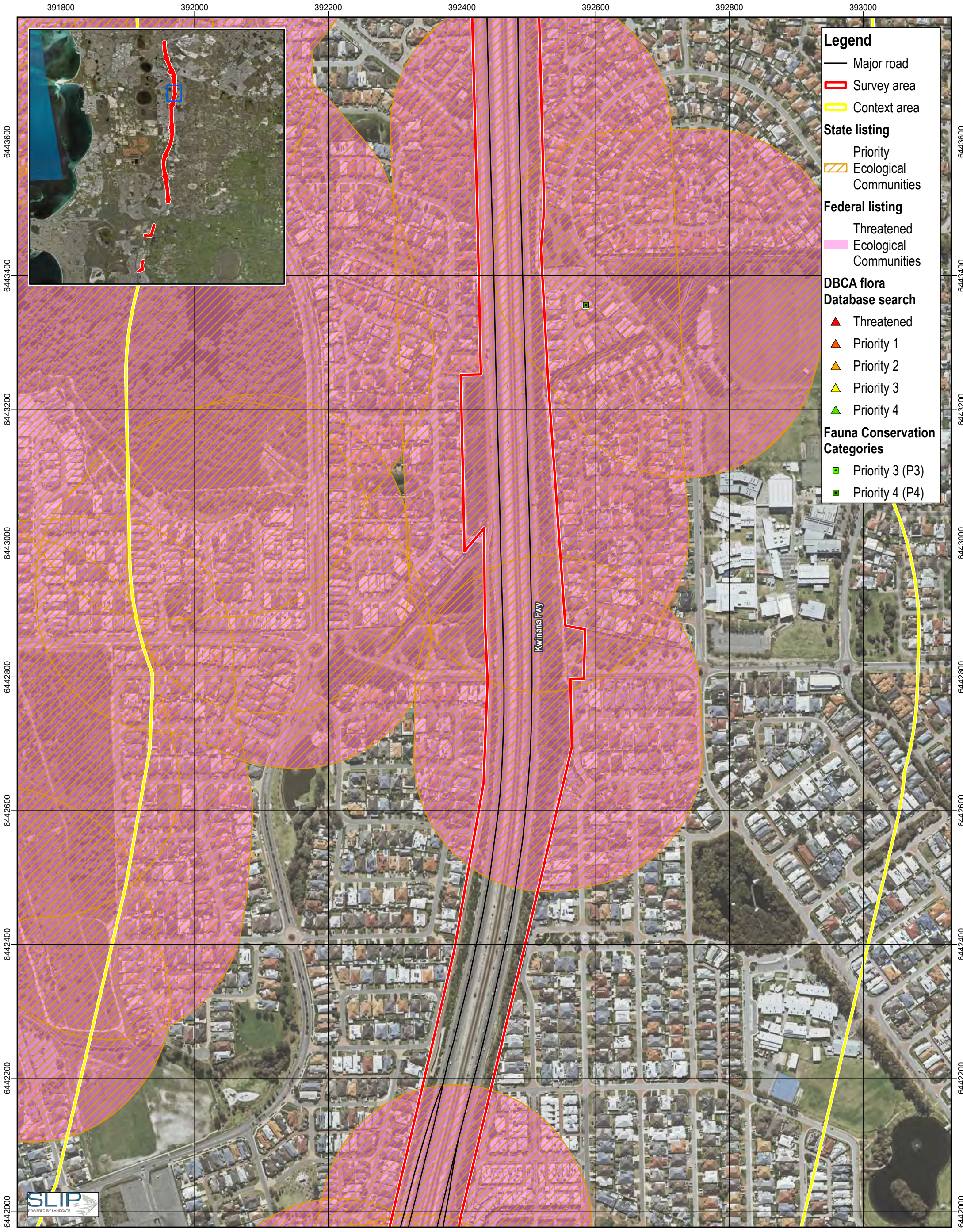
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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Biological Constraints

FIGURE 5



Legend

- Major road
- Survey area
- Context area

State listing

- Priority Ecological Communities

Federal listing

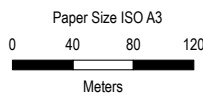
- Threatened Ecological Communities

DBCA flora Database search

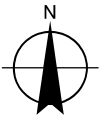
- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

Fauna Conservation Categories

- Priority 3 (P3)
- Priority 4 (P4)



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



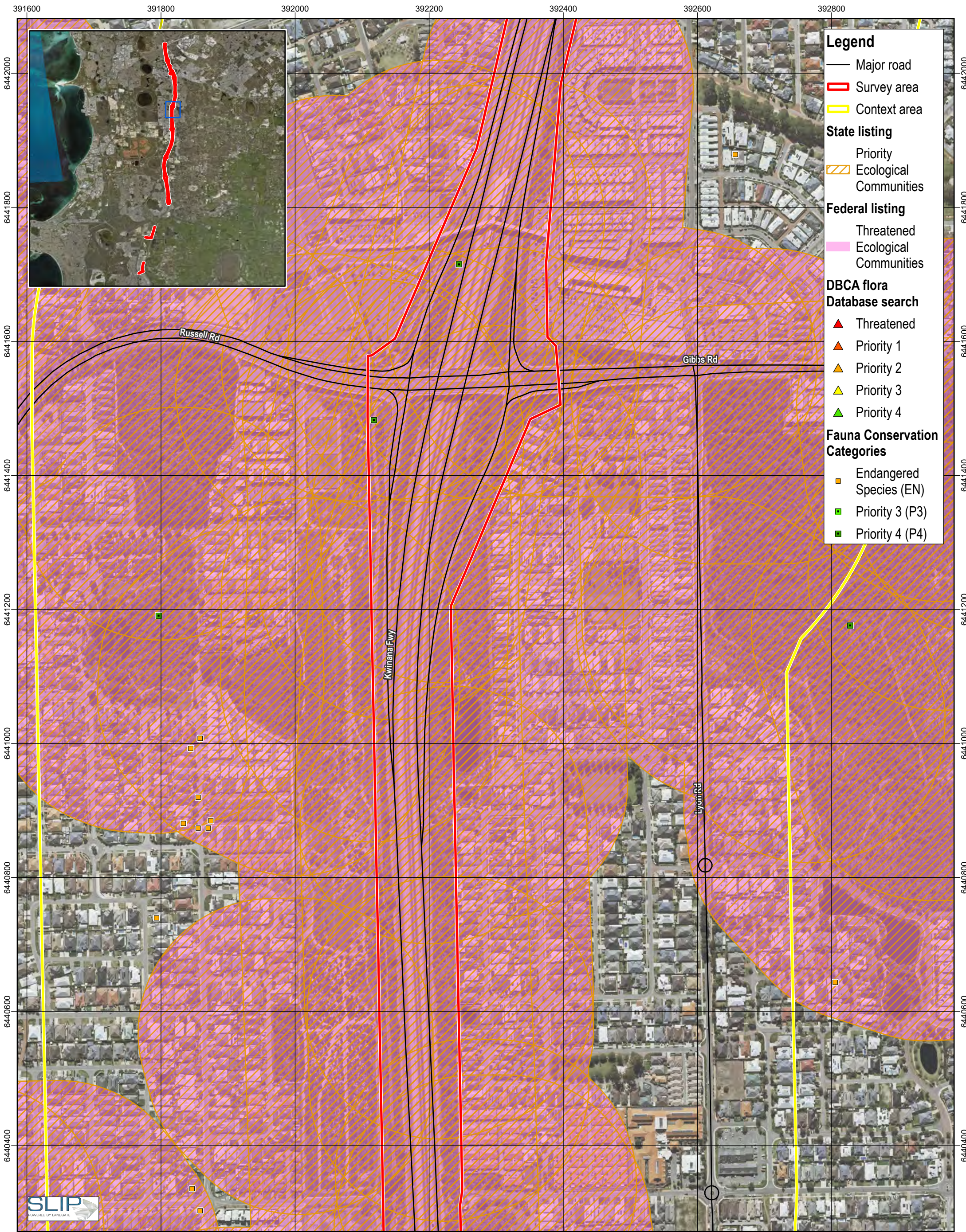
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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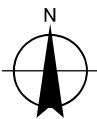
Biological Constraints

FIGURE 5



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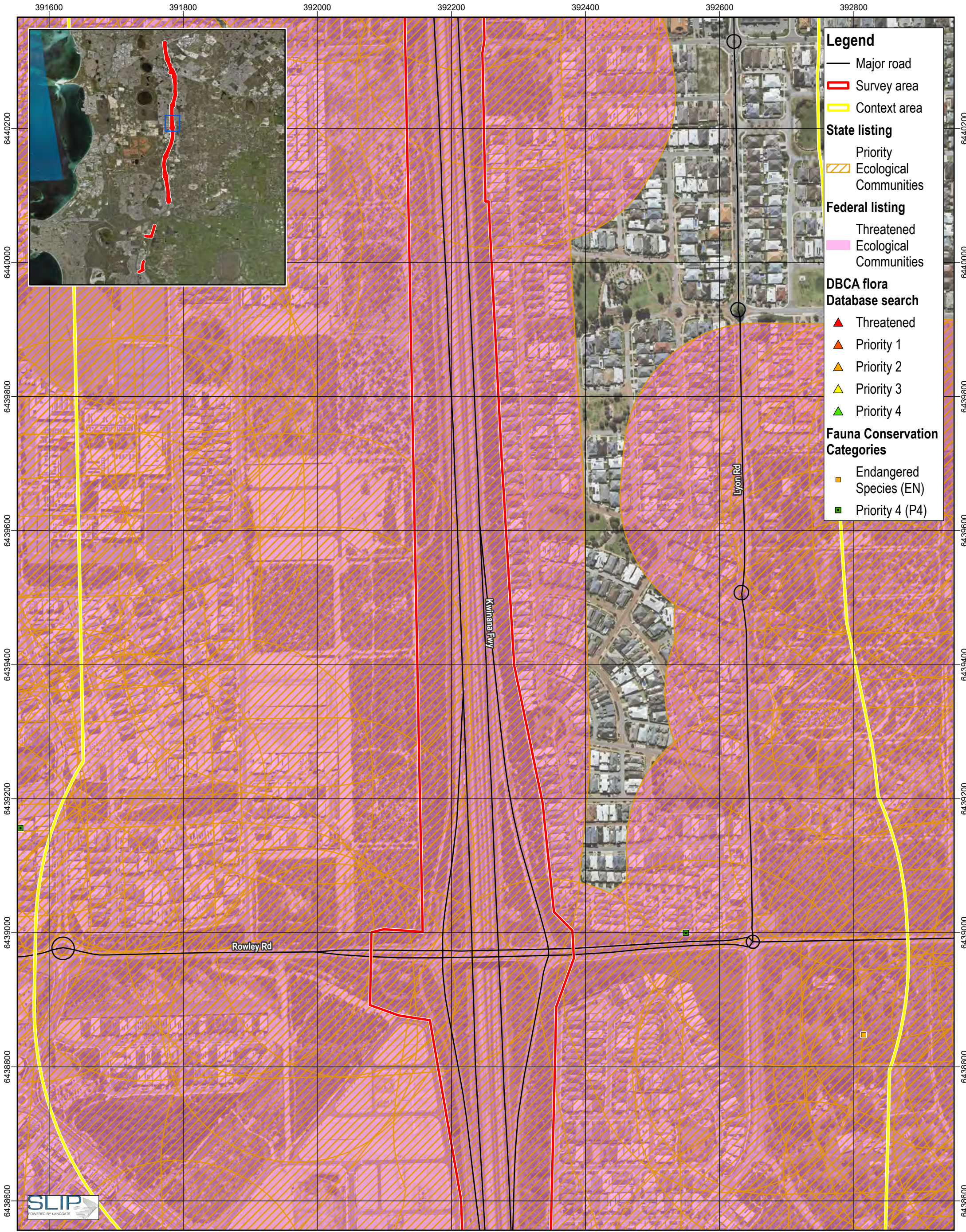
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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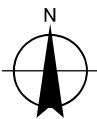
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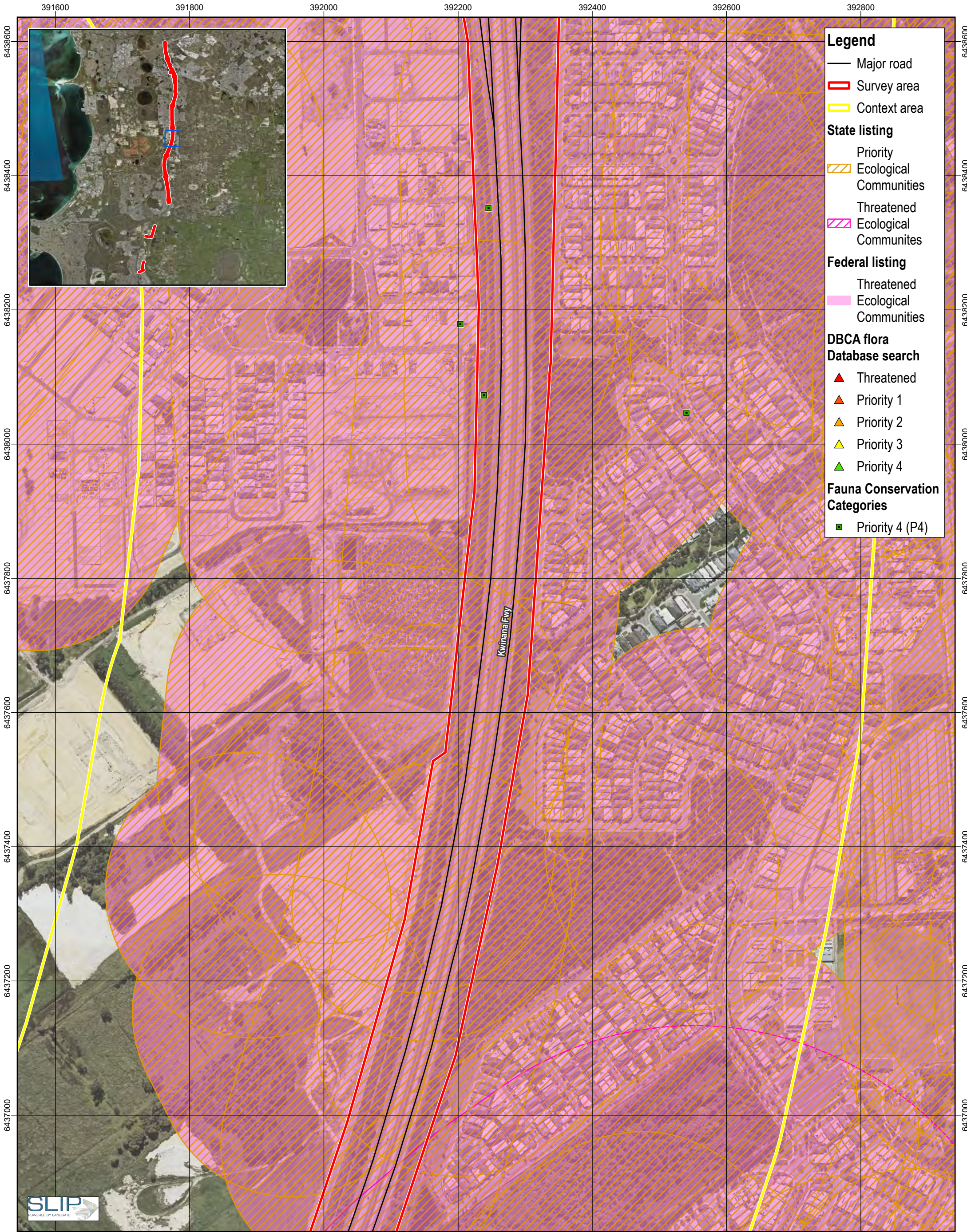
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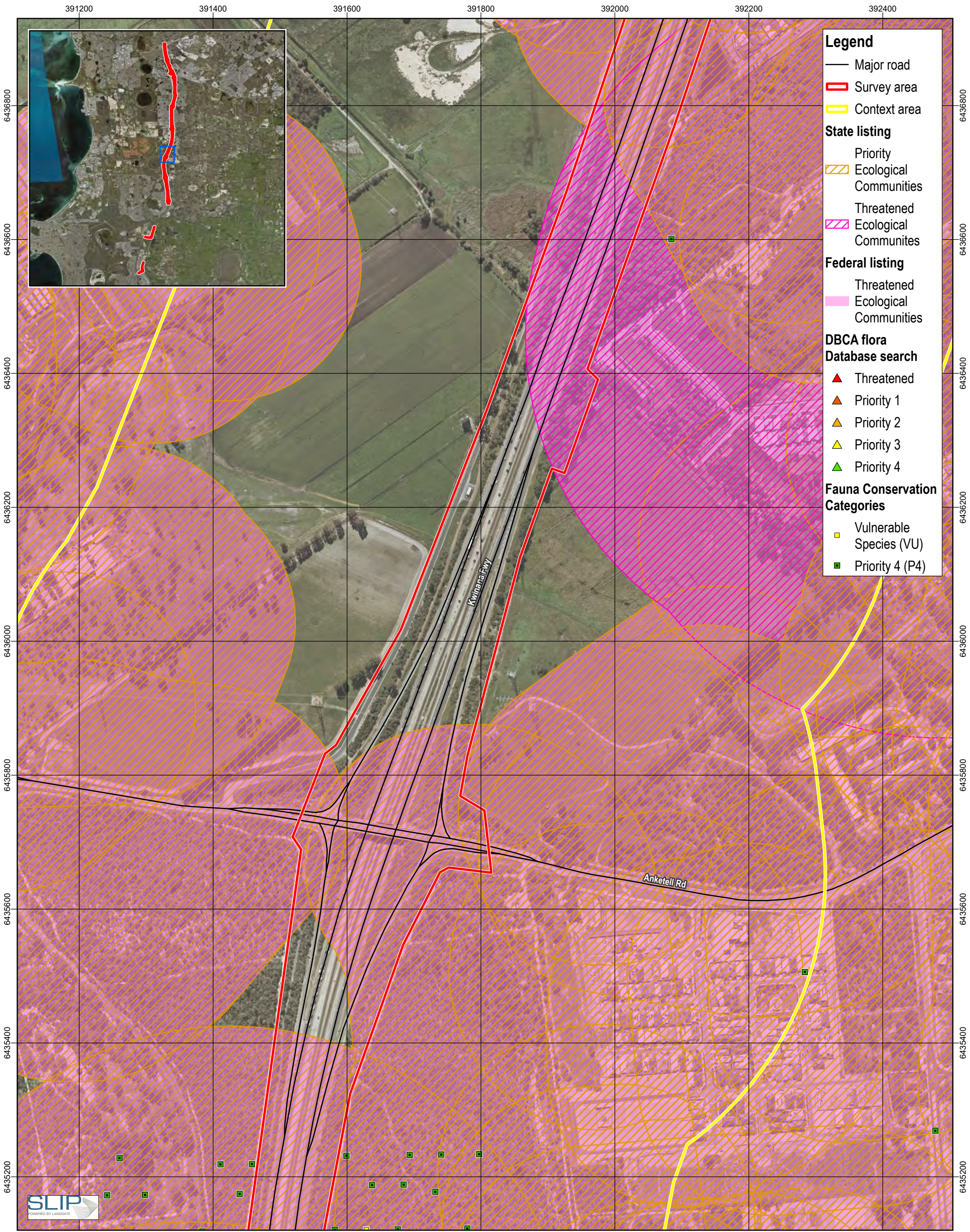
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Biological Constraints

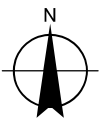
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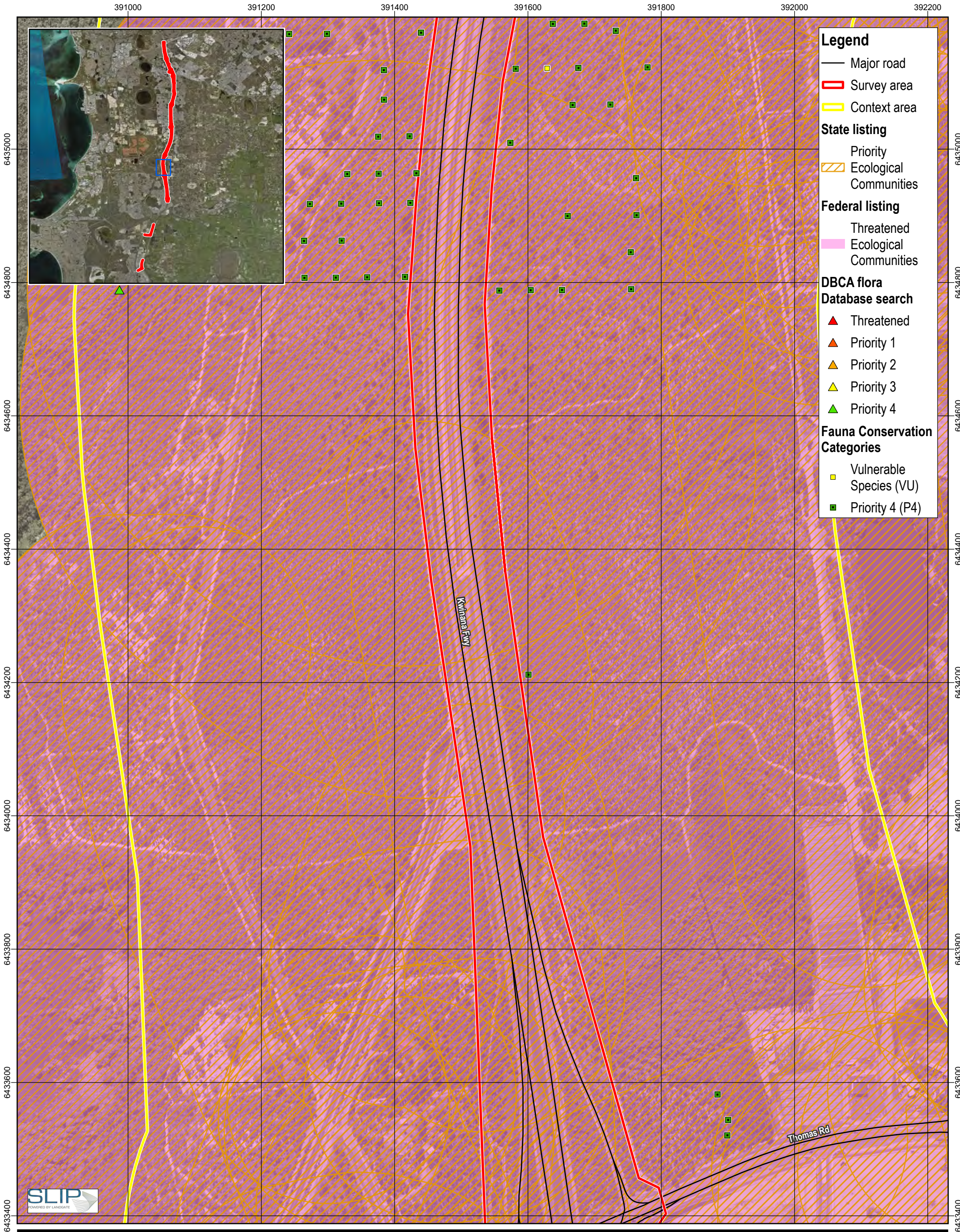
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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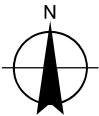
Biological Constraints

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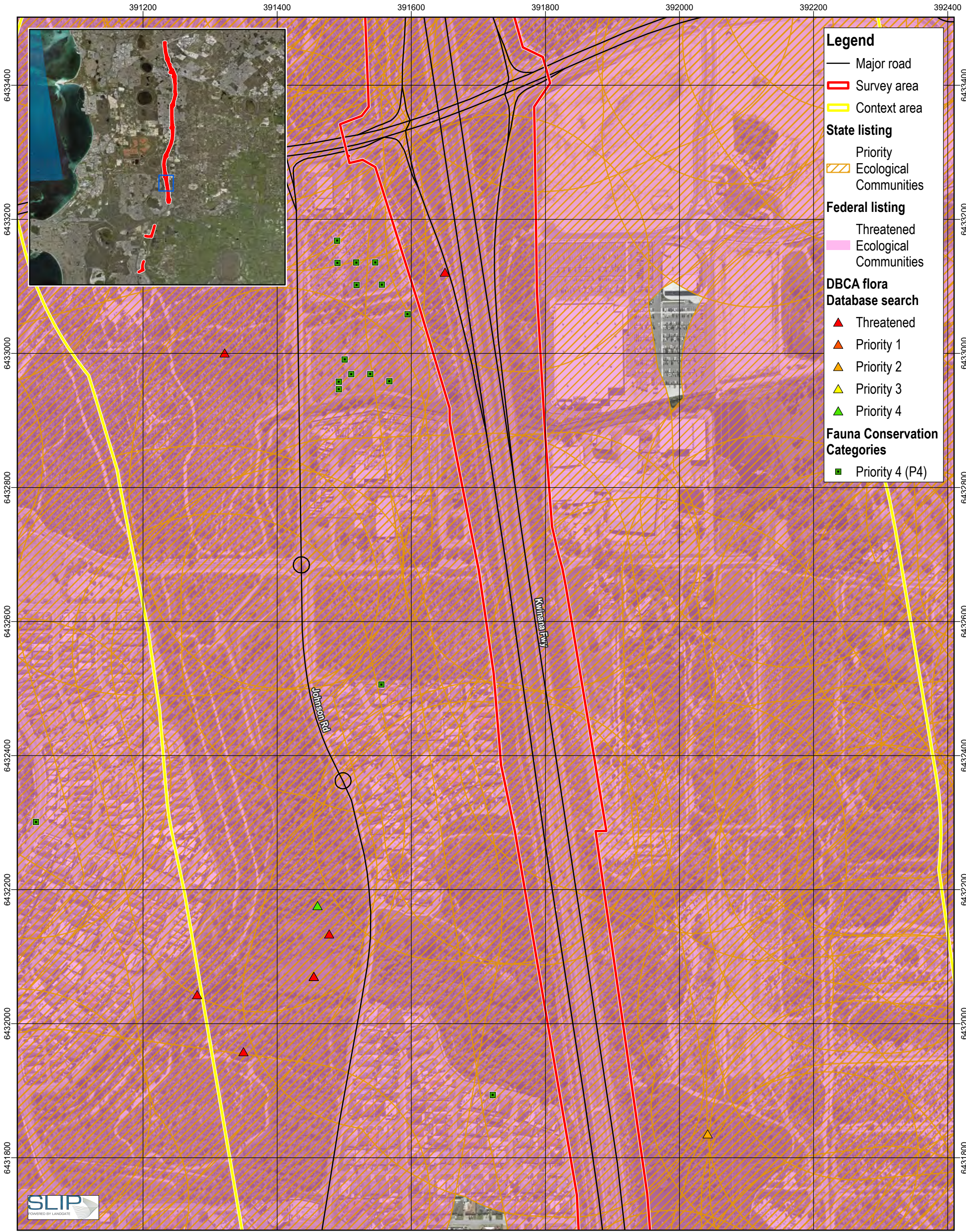
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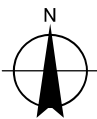
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Biological Constraints

FIGURE 5



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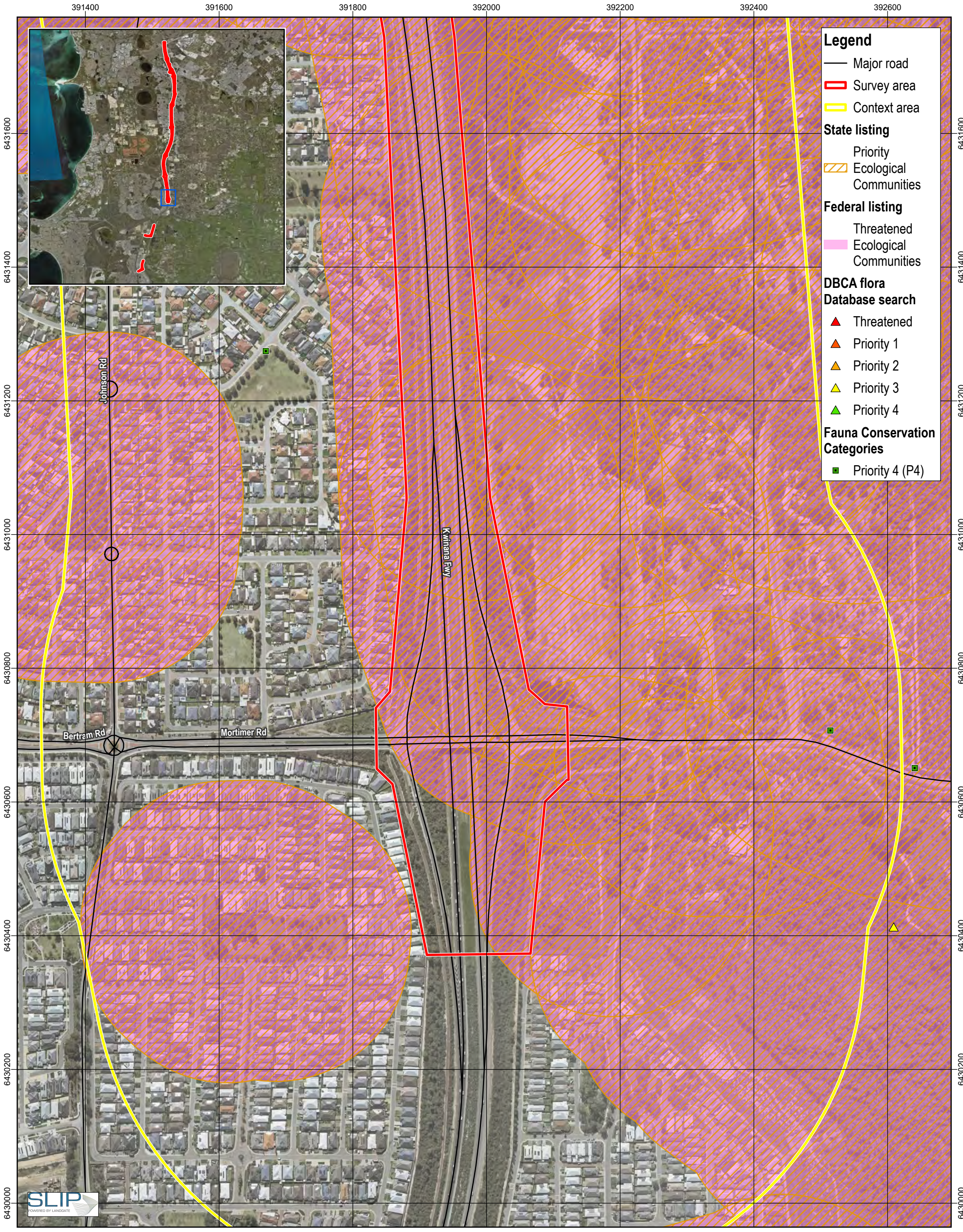
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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Biological Constraints

FIGURE 5



Legend

- Major road
- Survey area
- Context area

State listing

- Priority
- Ecological Communities

Federal listing

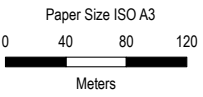
- Threatened
- Ecological Communities

DBCA flora Database search

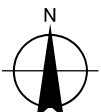
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- Priority 1
- Priority 2
- Priority 3
- Priority 4

Fauna Conservation Categories

- Priority 4 (P4)

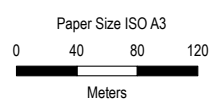
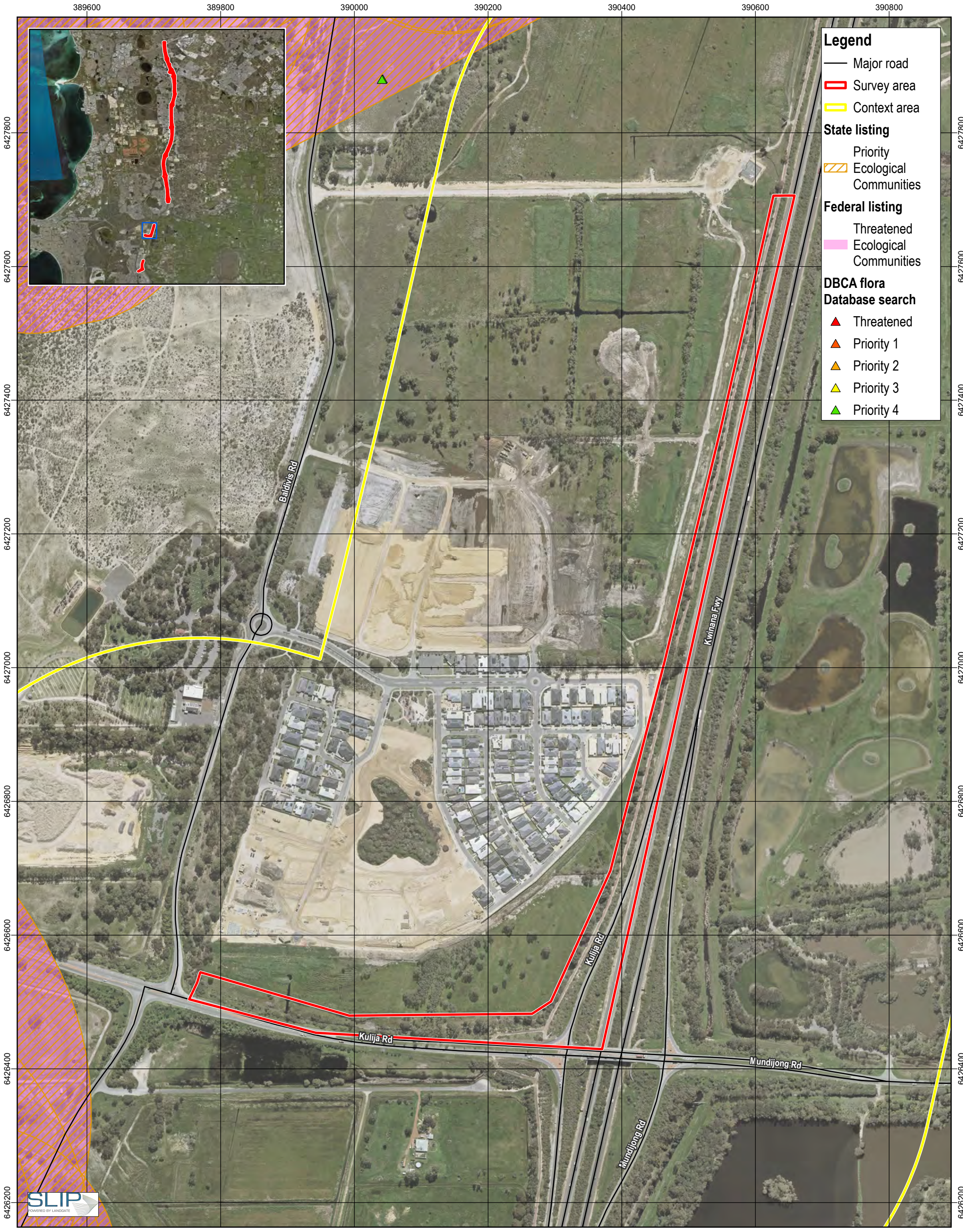


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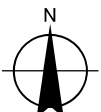


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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Map Projection: Transverse Mercator
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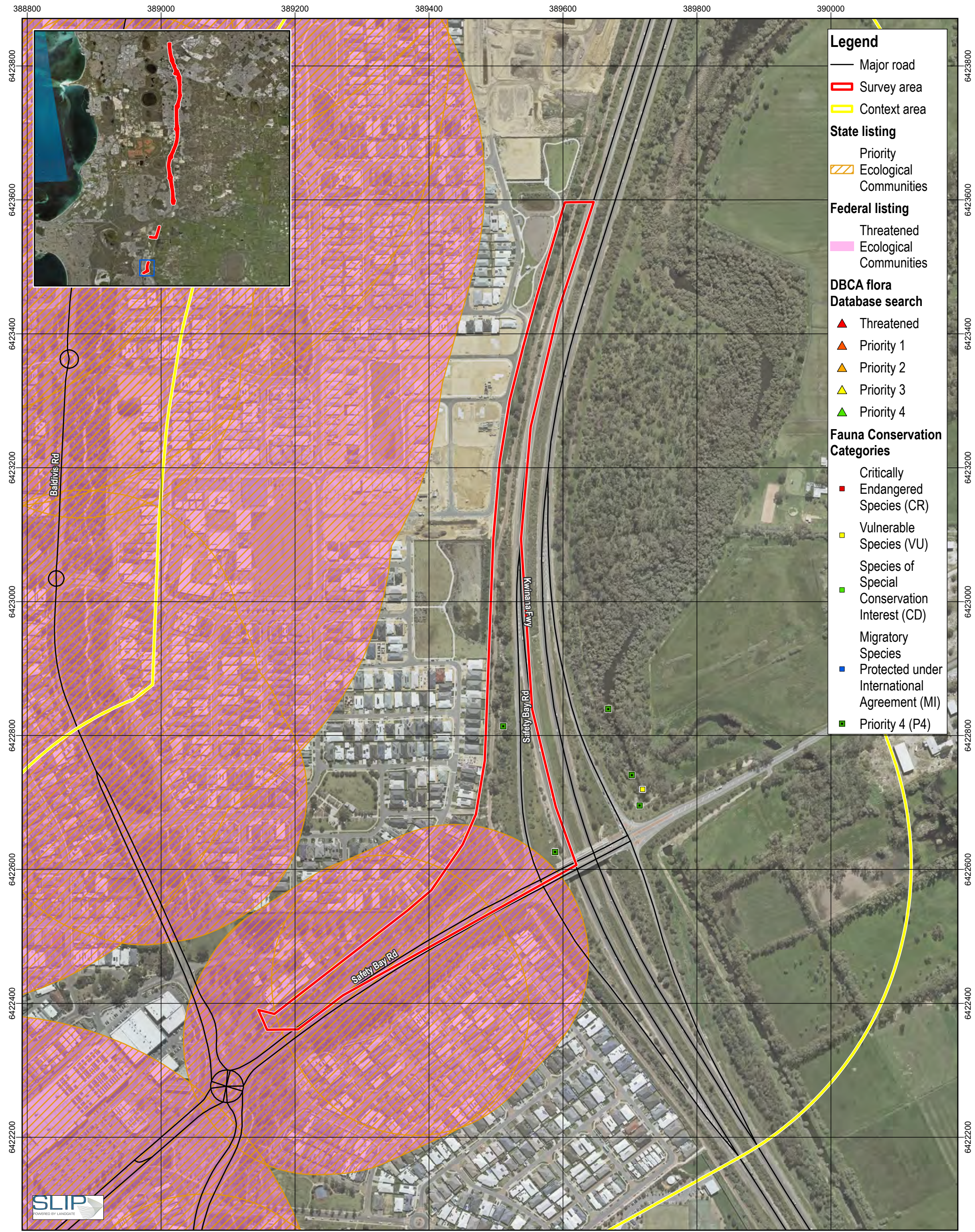
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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Biological Constraints

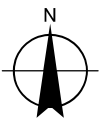
FIGURE 5



- Legend**
- Major road
 - Survey area
 - Context area
- State listing**
- Priority
 - Ecological Communities
- Federal listing**
- Threatened
 - Ecological Communities
- DBCA flora Database search**
- Threatened
 - Priority 1
 - Priority 2
 - Priority 3
 - Priority 4
- Fauna Conservation Categories**
- Critically Endangered Species (CR)
 - Vulnerable Species (VU)
 - Species of Special Conservation Interest (CD)
 - Migratory Species
 - Protected under International Agreement (MI)
 - Priority 4 (P4)

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Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



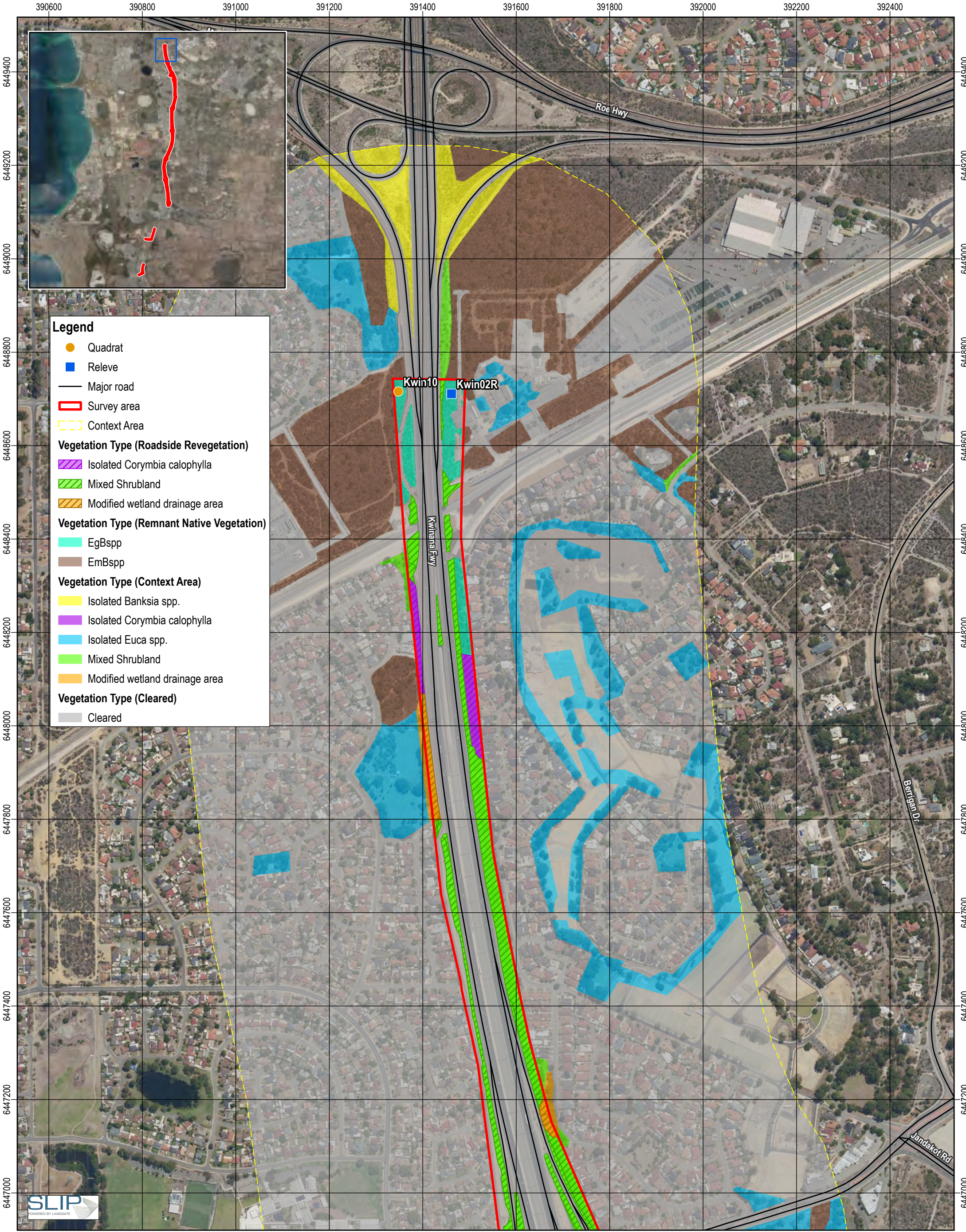
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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Biological Constraints

FIGURE 5



Legend

- Quadrat
- Releve
- Major road
- Survey area
- Context Area

Vegetation Type (Roadside Revegetation)

- Isolated *Corymbia calophylla*
- Mixed Shrubland
- Modified wetland drainage area

Vegetation Type (Remnant Native Vegetation)

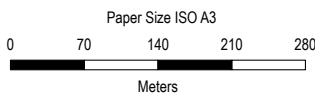
- EgBspp
- EmBspp

Vegetation Type (Context Area)

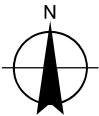
- Isolated *Banksia* spp.
- Isolated *Corymbia calophylla*
- Isolated *Euca* spp.
- Mixed Shrubland
- Modified wetland drainage area

Vegetation Type (Cleared)

- Cleared



Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

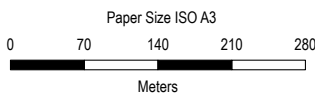
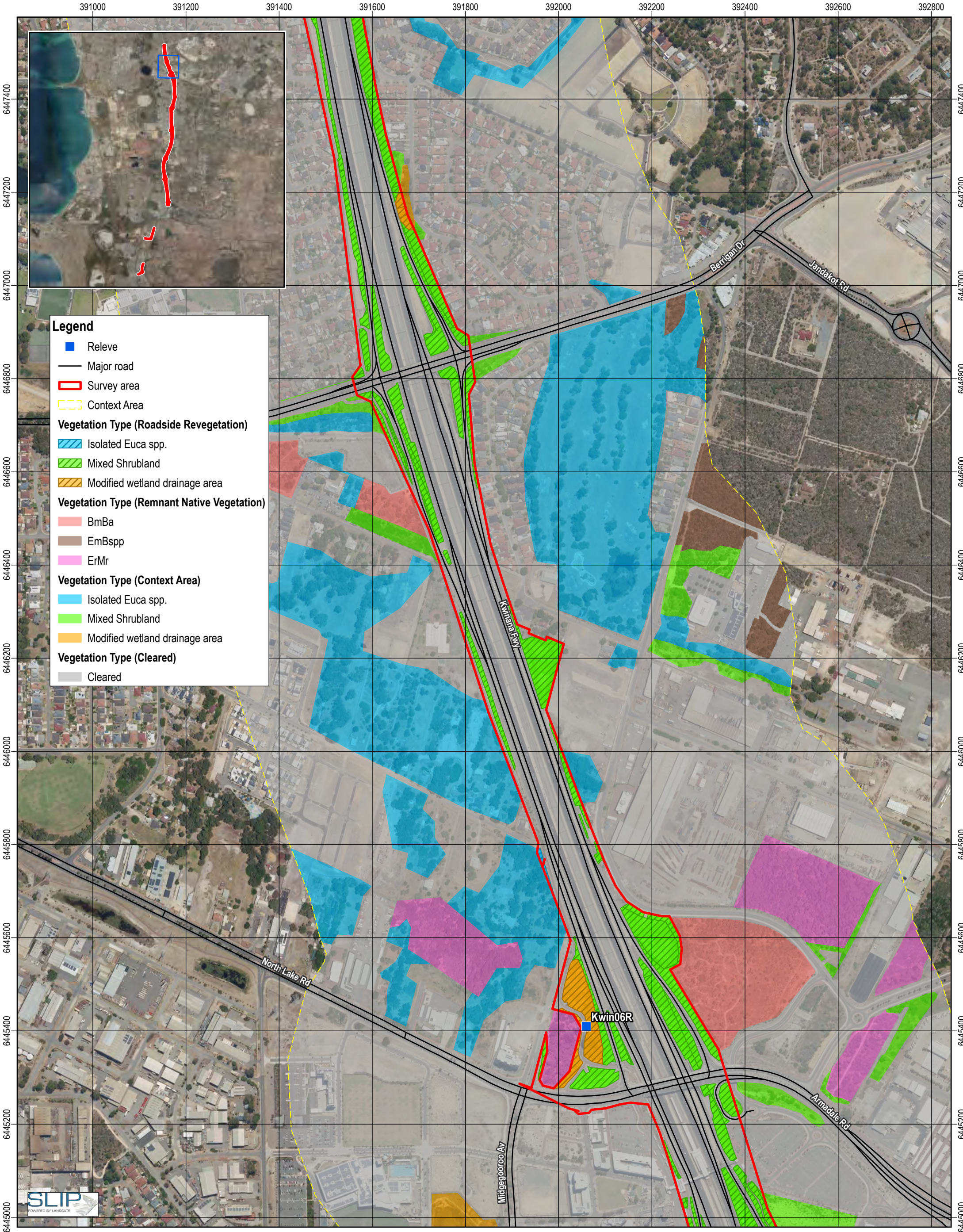


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

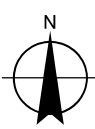
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Vegetation Types and Sample Sites

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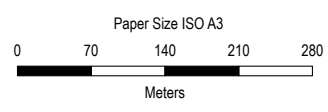
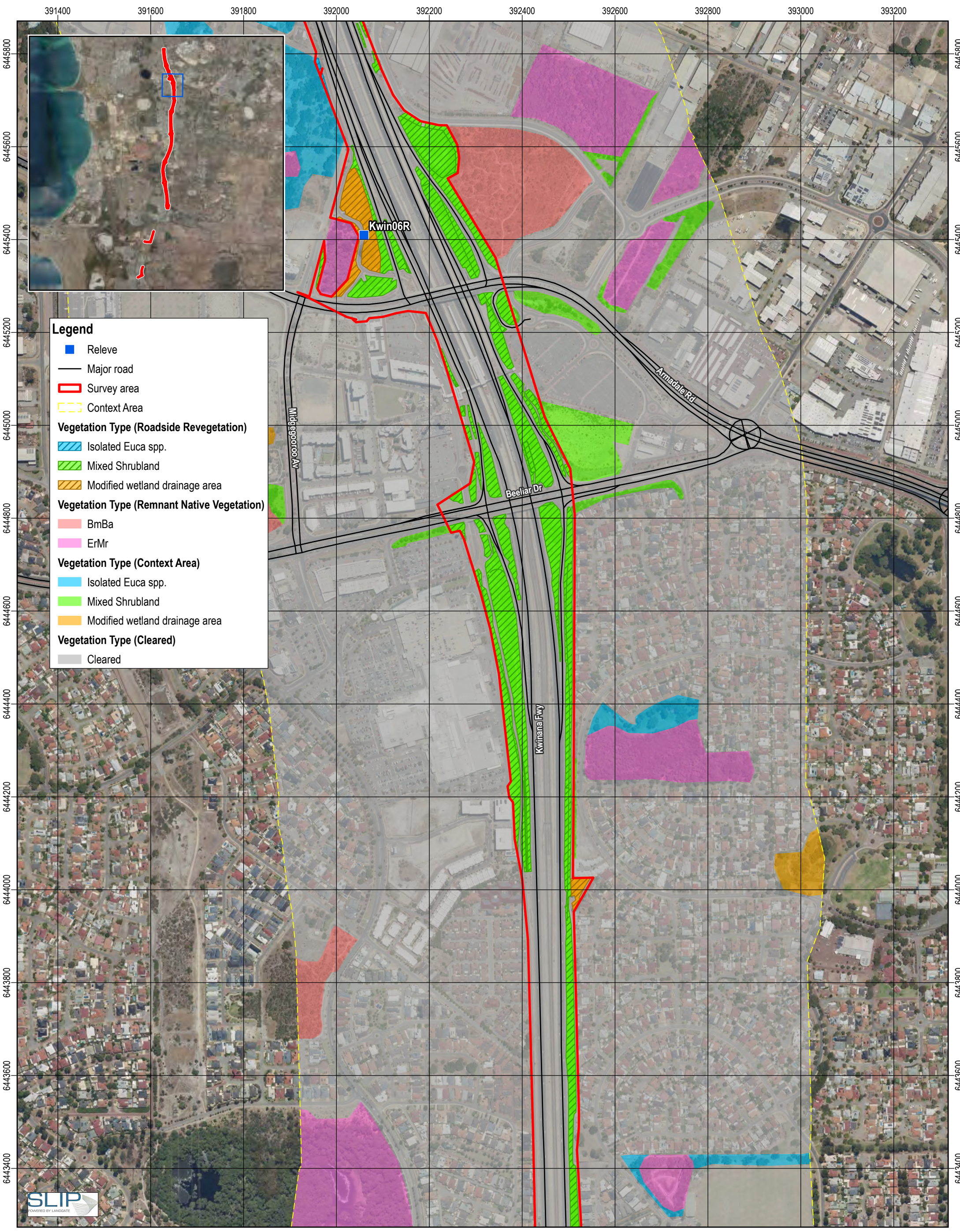
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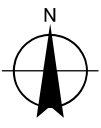
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

Vegetation Types and Sample Sites

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Grid: GDA2020 MGA Zone 50

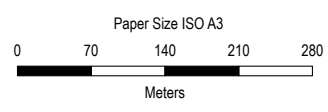
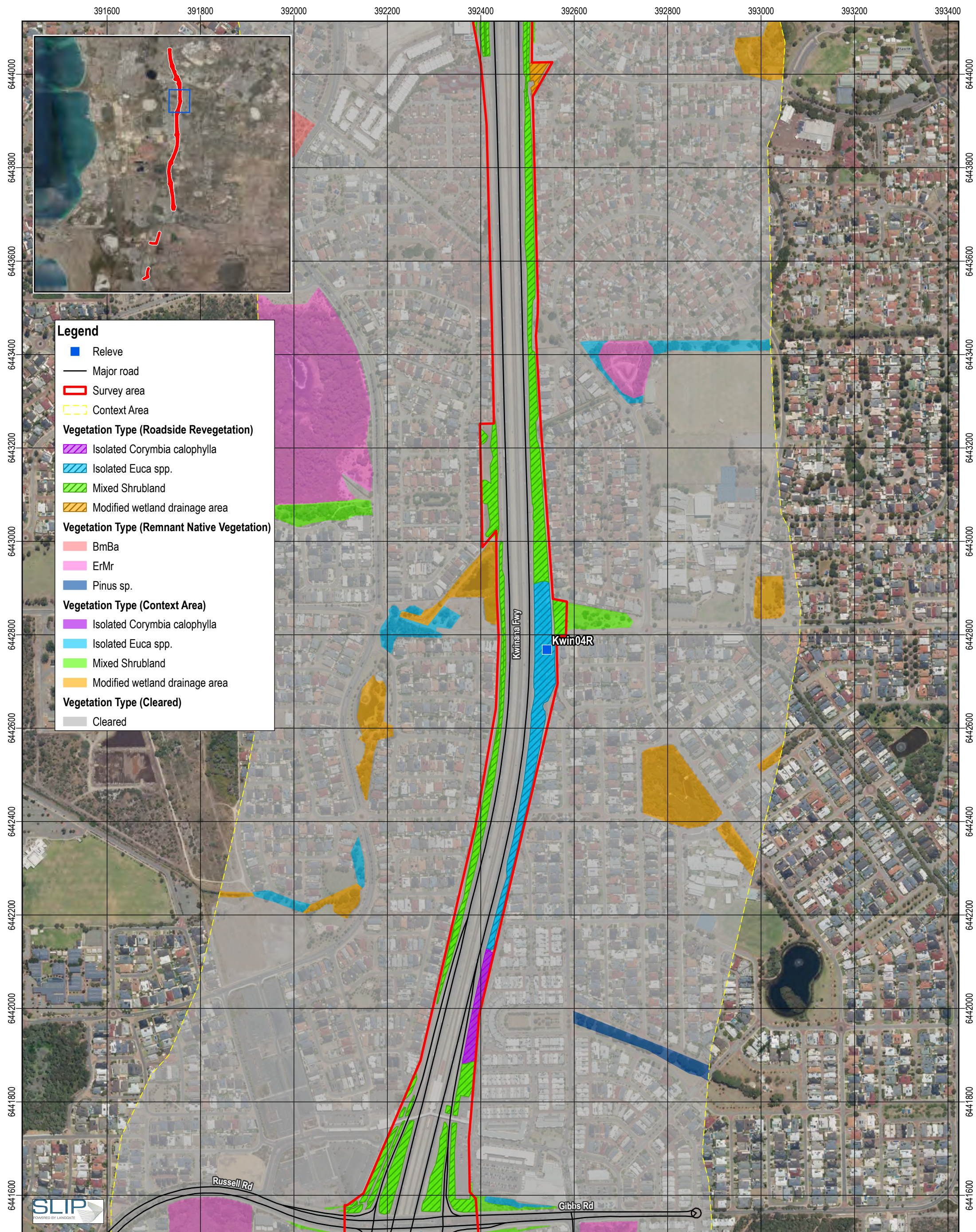


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Roe Hwy Widening Flora and Fauna Assessment

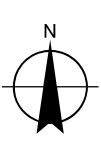
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Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

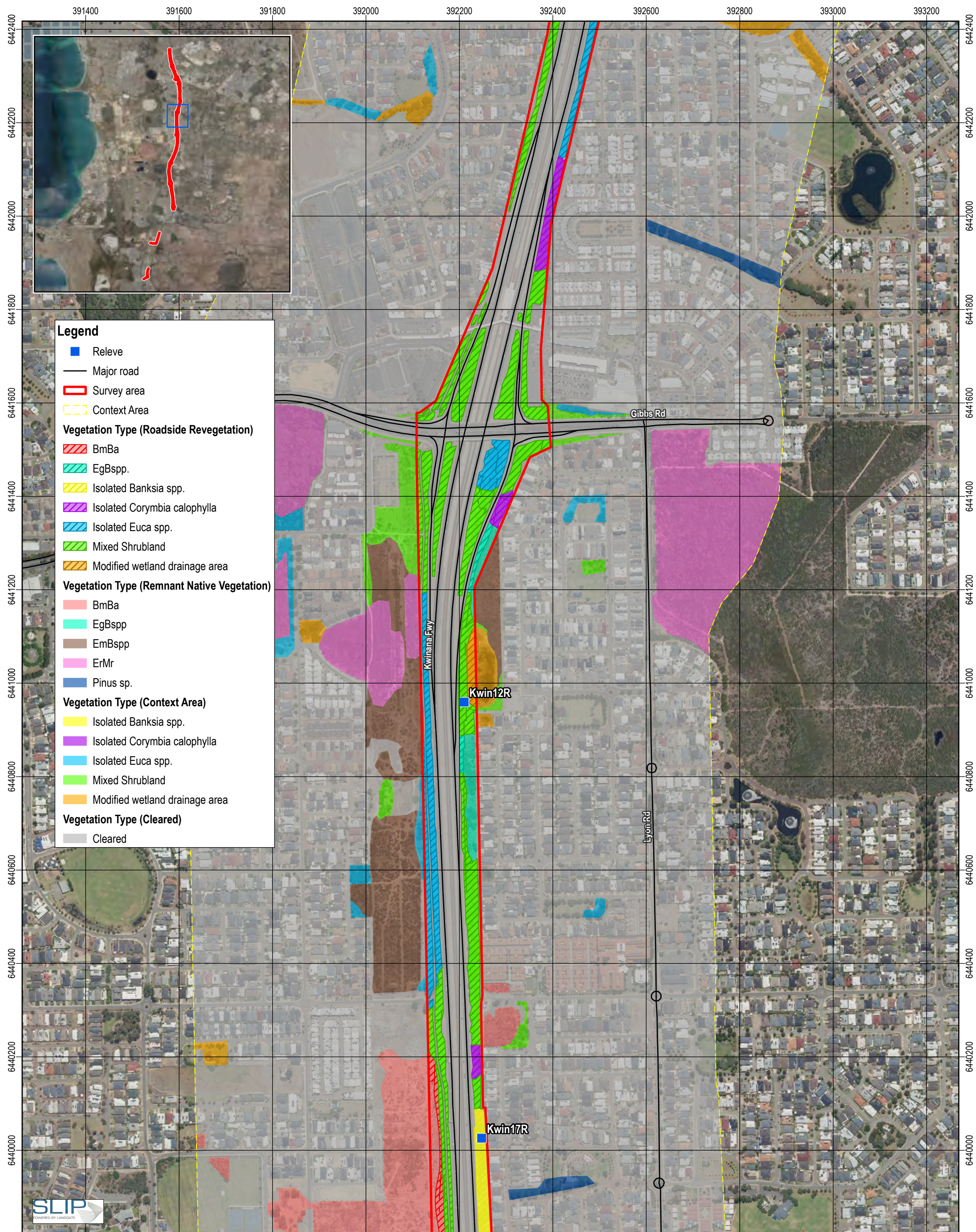


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Roe Hwy Widening Flora and Fauna Assessment

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Legend

- Releve
- Major road
- ▭ Survey area
- ▭ Context Area

Vegetation Type (Roadside Revegetation)

- ▨ BmBa
- ▨ EgBspp.
- ▨ Isolated Banksia spp.
- ▨ Isolated Corymbia calophylla
- ▨ Isolated Euca spp.
- ▨ Mixed Shrubland
- ▨ Modified wetland drainage area

Vegetation Type (Remnant Native Vegetation)

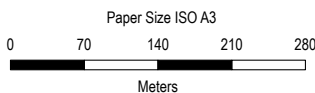
- BmBa
- EgBspp
- EmBspp
- ErMr
- Pinus sp.

Vegetation Type (Context Area)

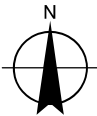
- Isolated Banksia spp.
- Isolated Corymbia calophylla
- Isolated Euca spp.
- Mixed Shrubland
- Modified wetland drainage area

Vegetation Type (Cleared)

- Cleared



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

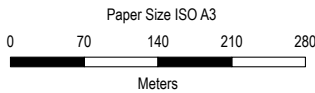
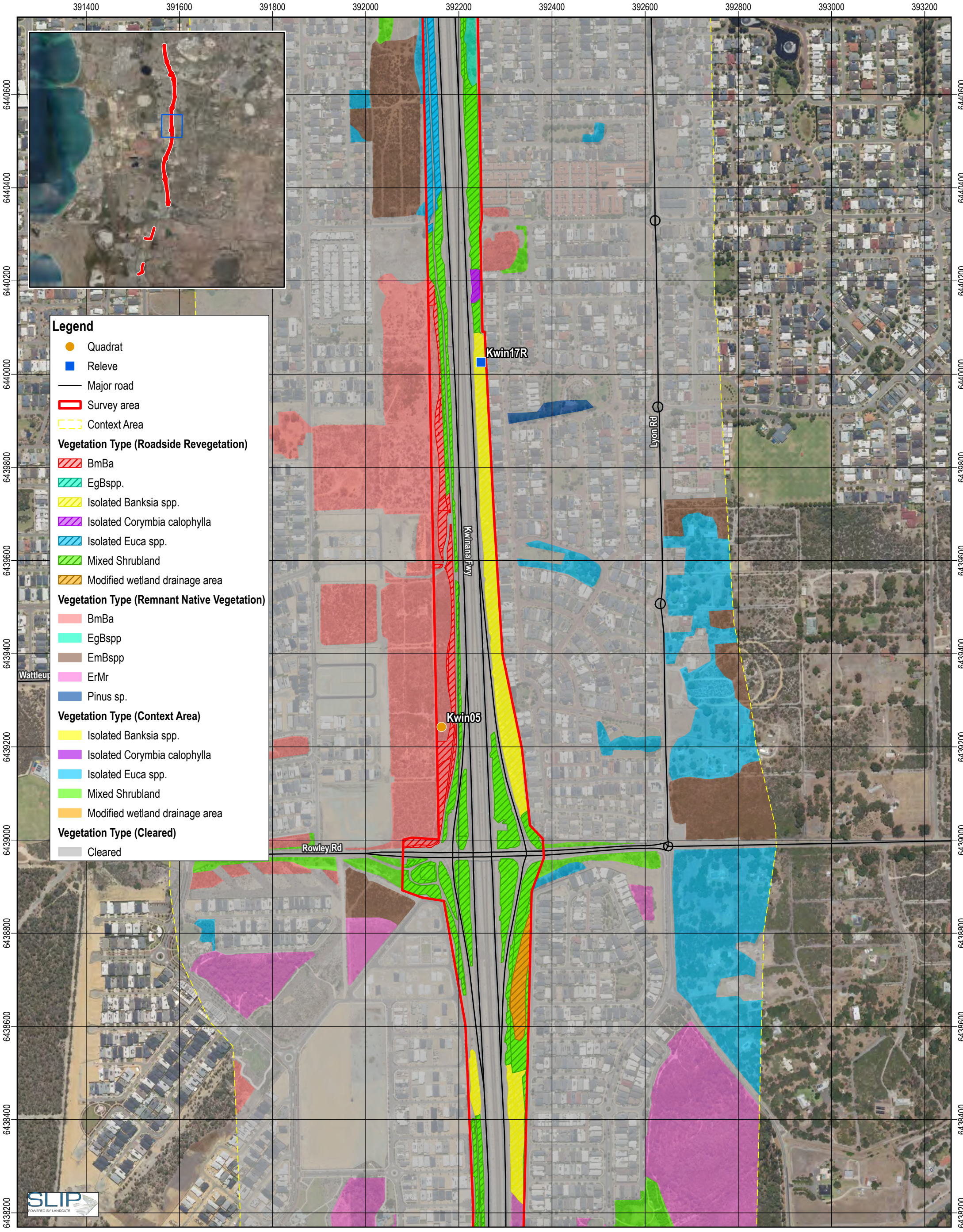


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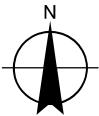
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Map Projection: Transverse Mercator
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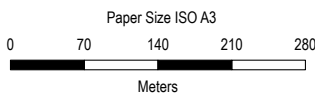
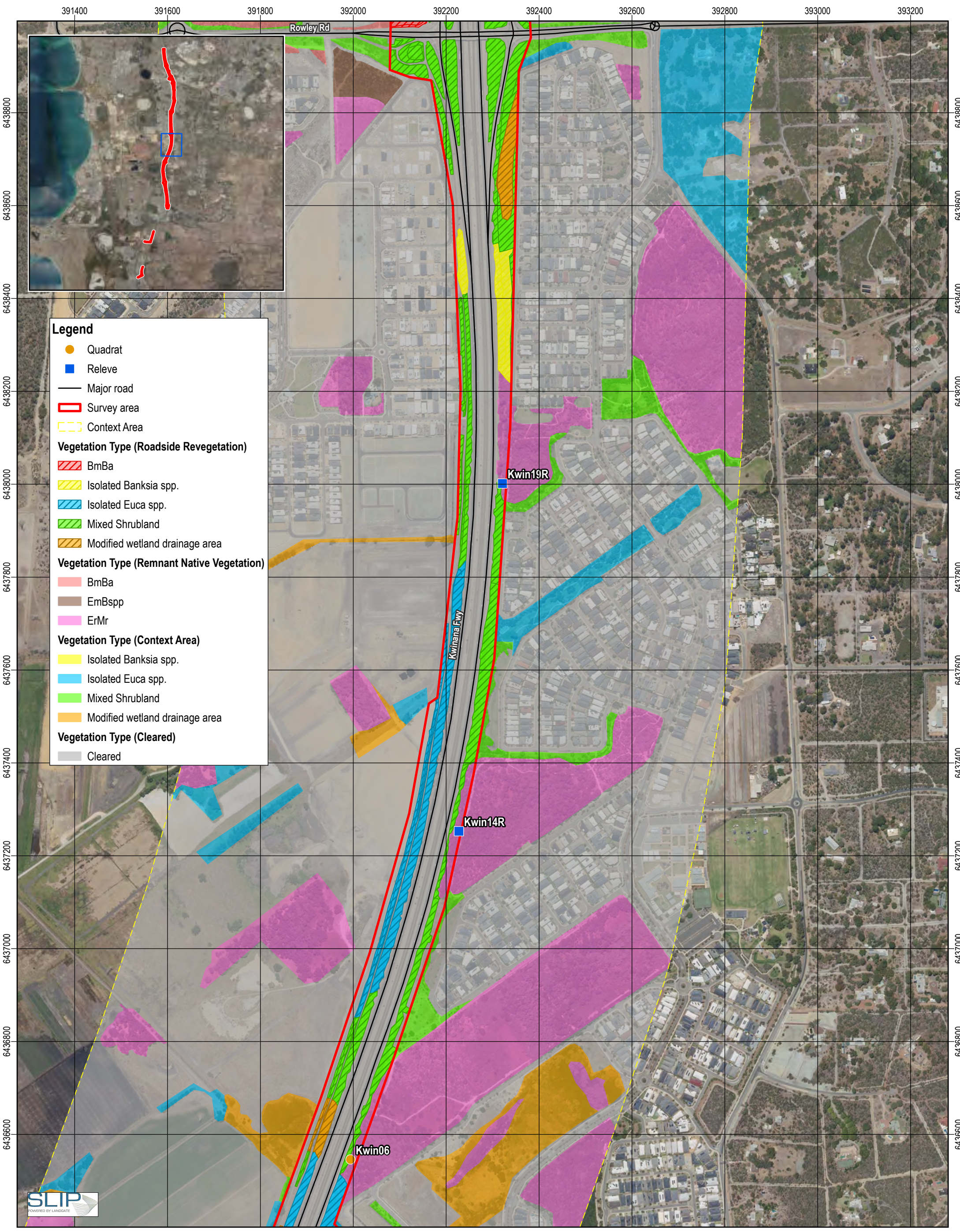


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

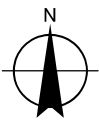
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FIGURE 6



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

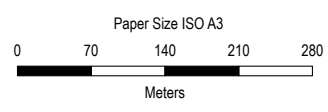
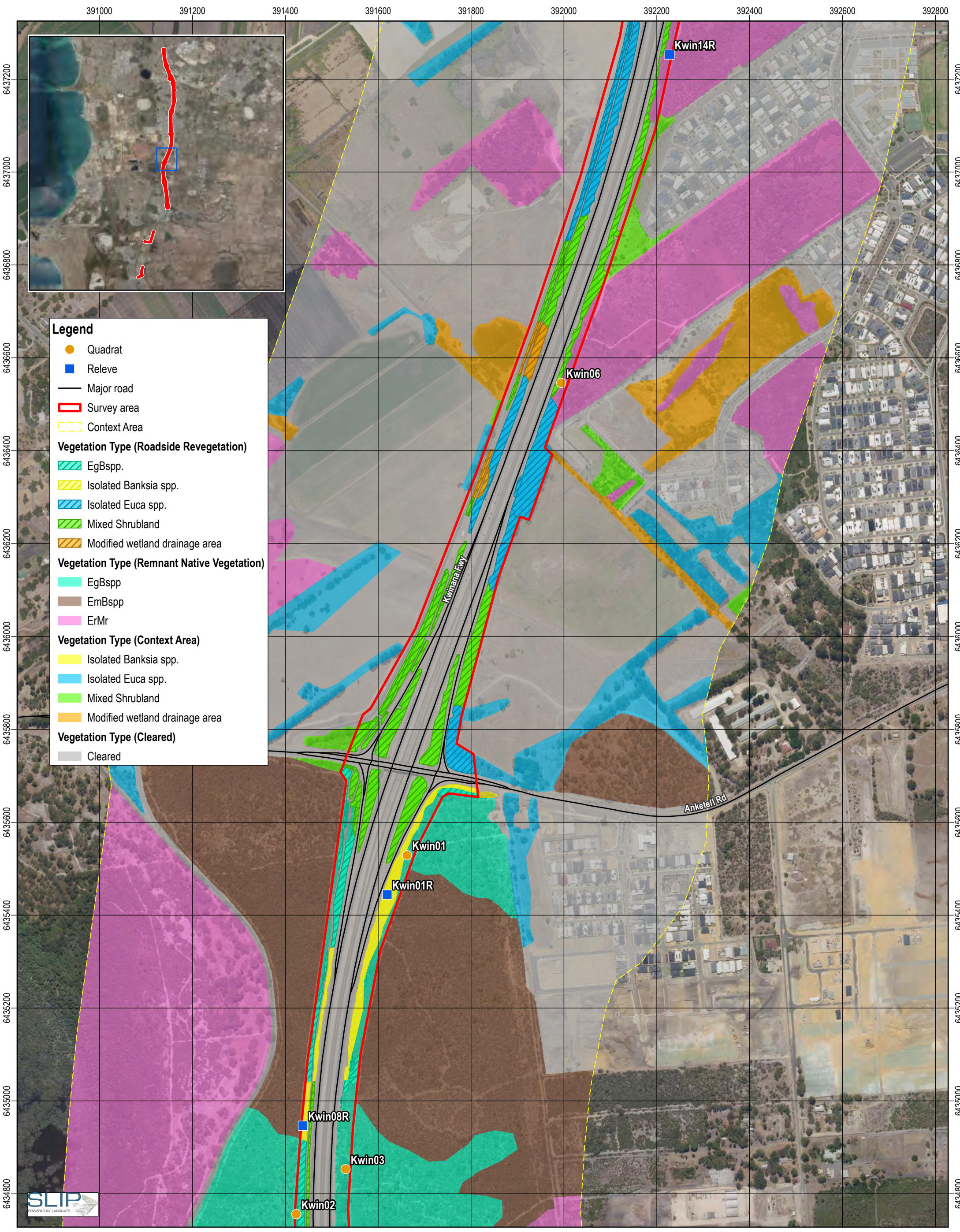


Main Roads
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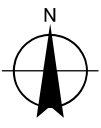
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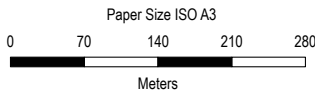
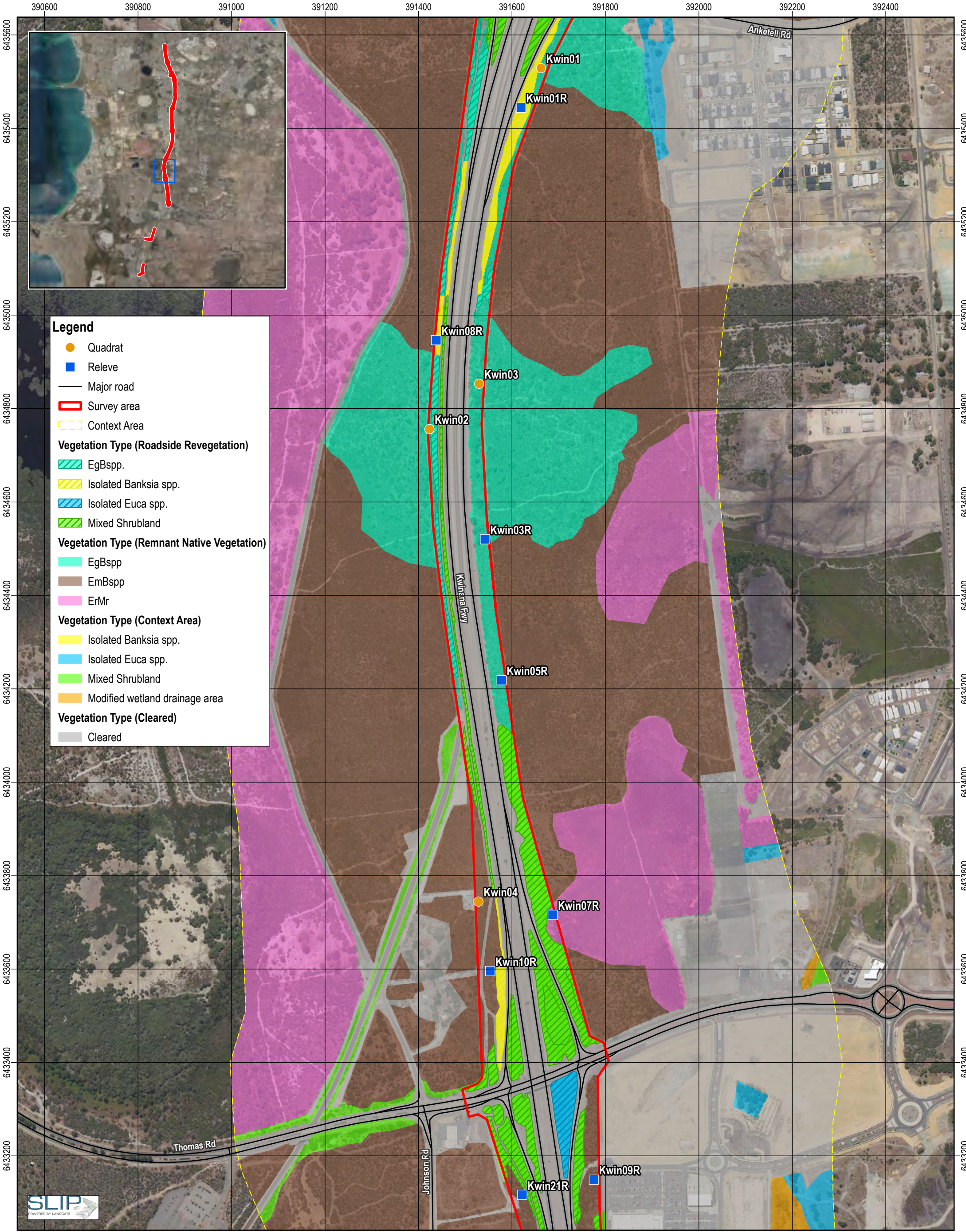
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Roe Hwy Widening Flora and Fauna Assessment

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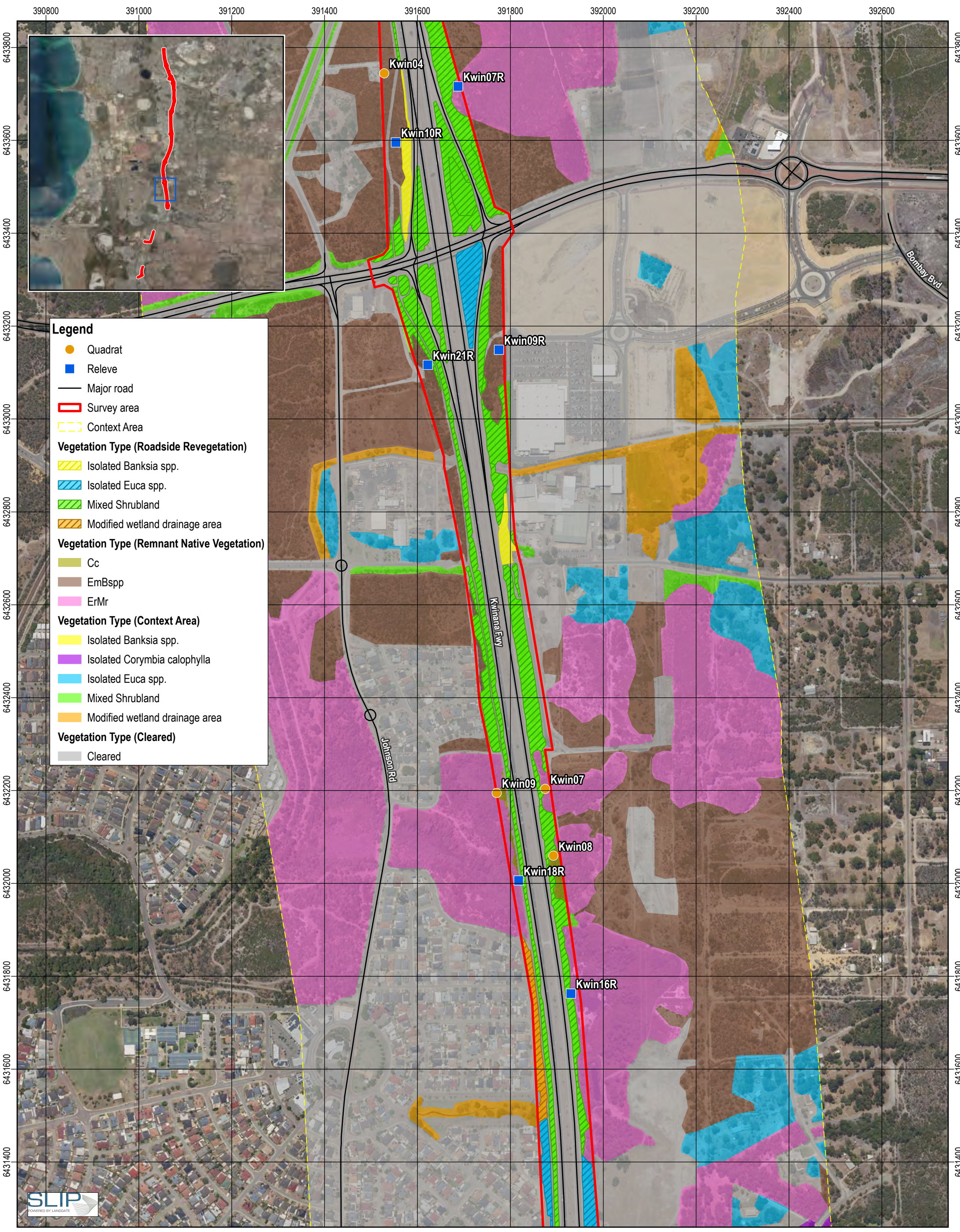
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Grid: GDA2020 MGA Zone 50



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Vegetation Types and Sample Sites



Legend

- Quadrat
- Releve
- Major road
- Survey area
- Context Area

Vegetation Type (Roadside Revegetation)

- Isolated Banksia spp.
- Isolated Euca spp.
- Mixed Shrubland
- Modified wetland drainage area

Vegetation Type (Remnant Native Vegetation)

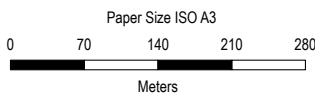
- Cc
- EmBspp
- ErMr

Vegetation Type (Context Area)

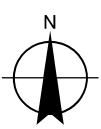
- Isolated Banksia spp.
- Isolated Corymbia calophylla
- Isolated Euca spp.
- Mixed Shrubland
- Modified wetland drainage area

Vegetation Type (Cleared)

- Cleared



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

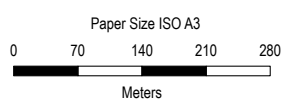
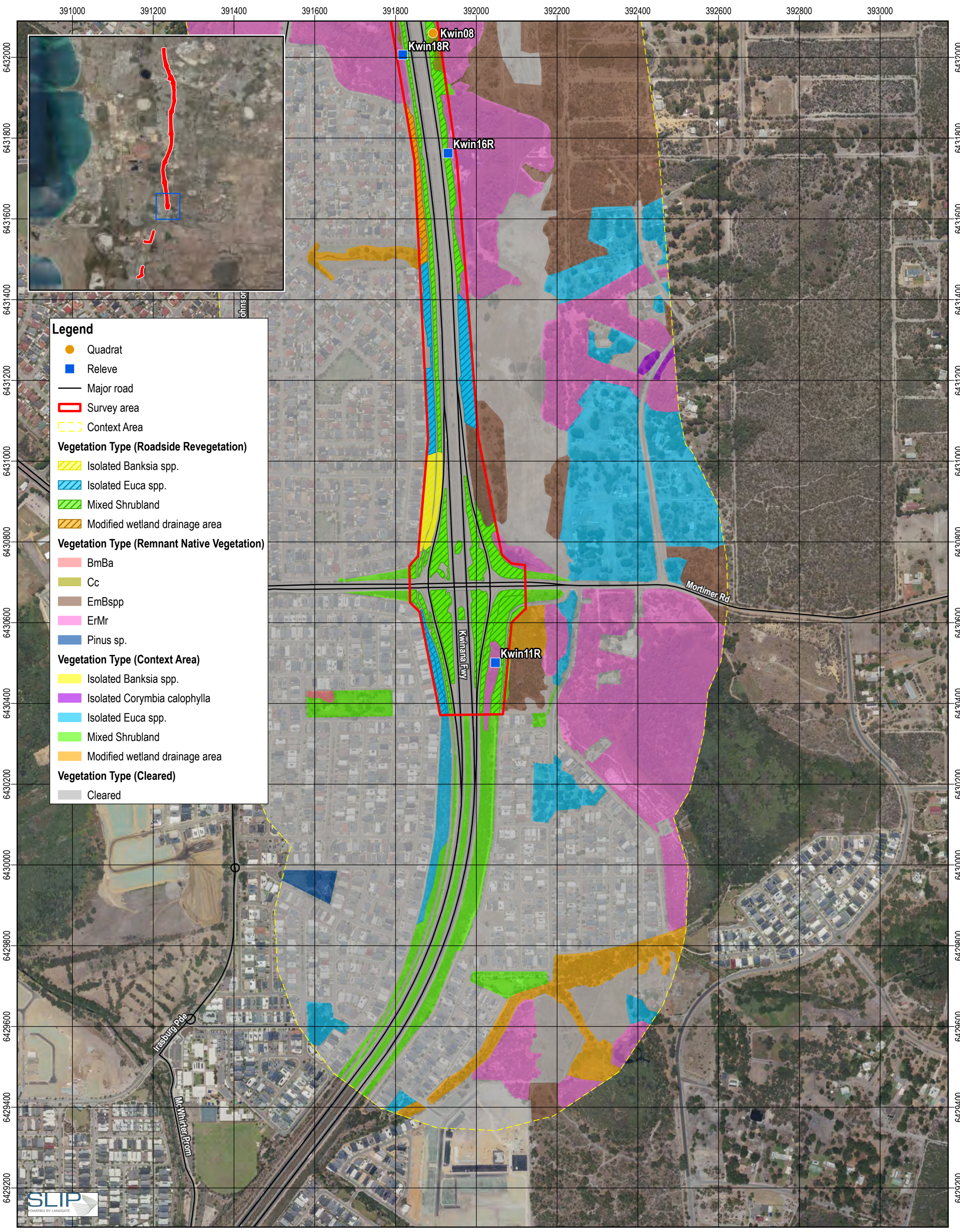


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Roe Hwy Widening Flora and Fauna Assessment

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Map Projection: Transverse Mercator
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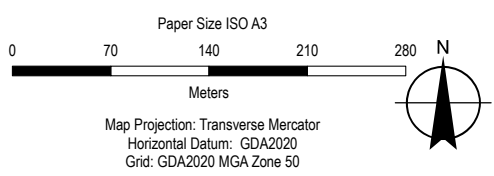
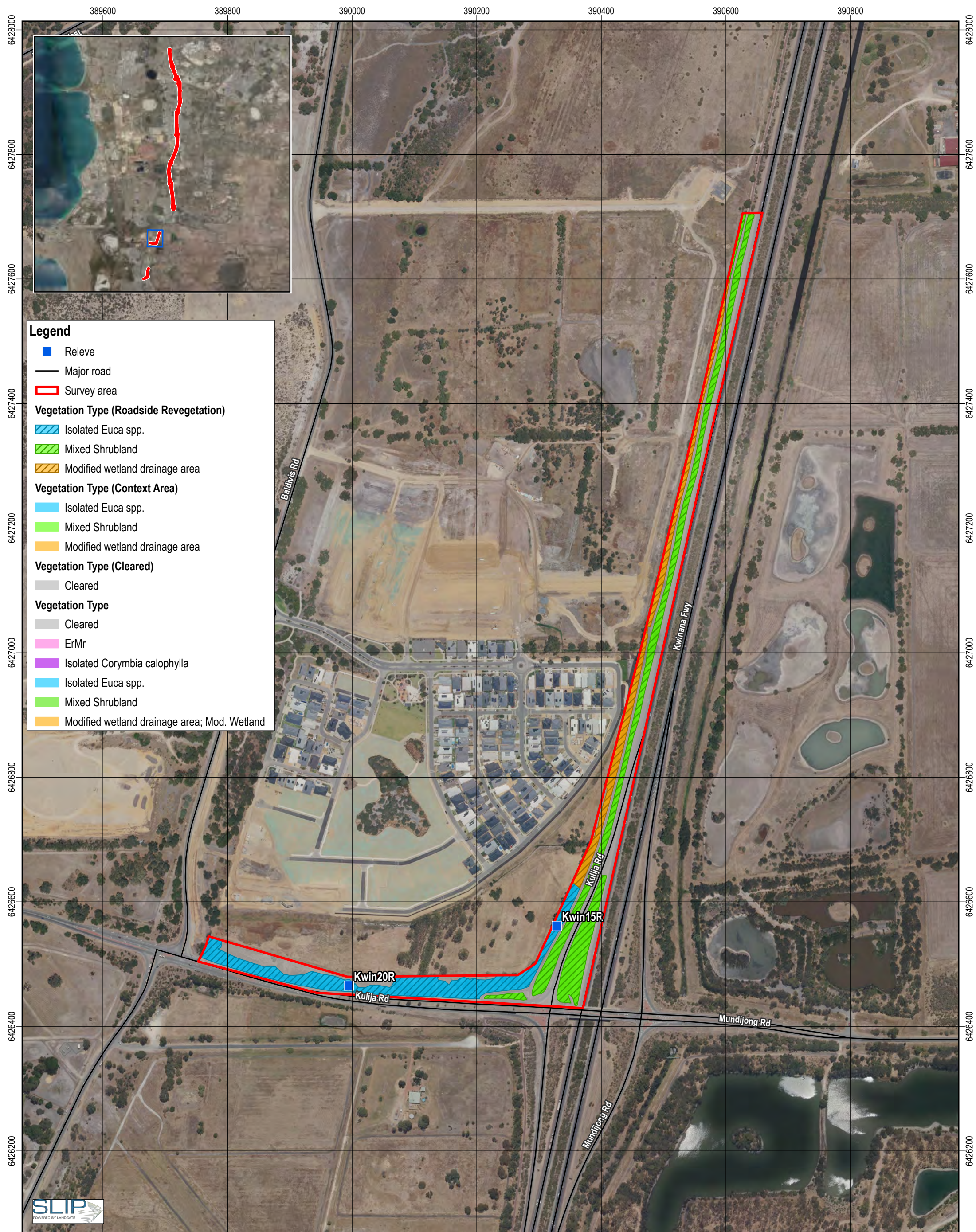


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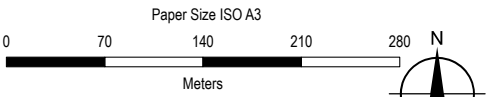
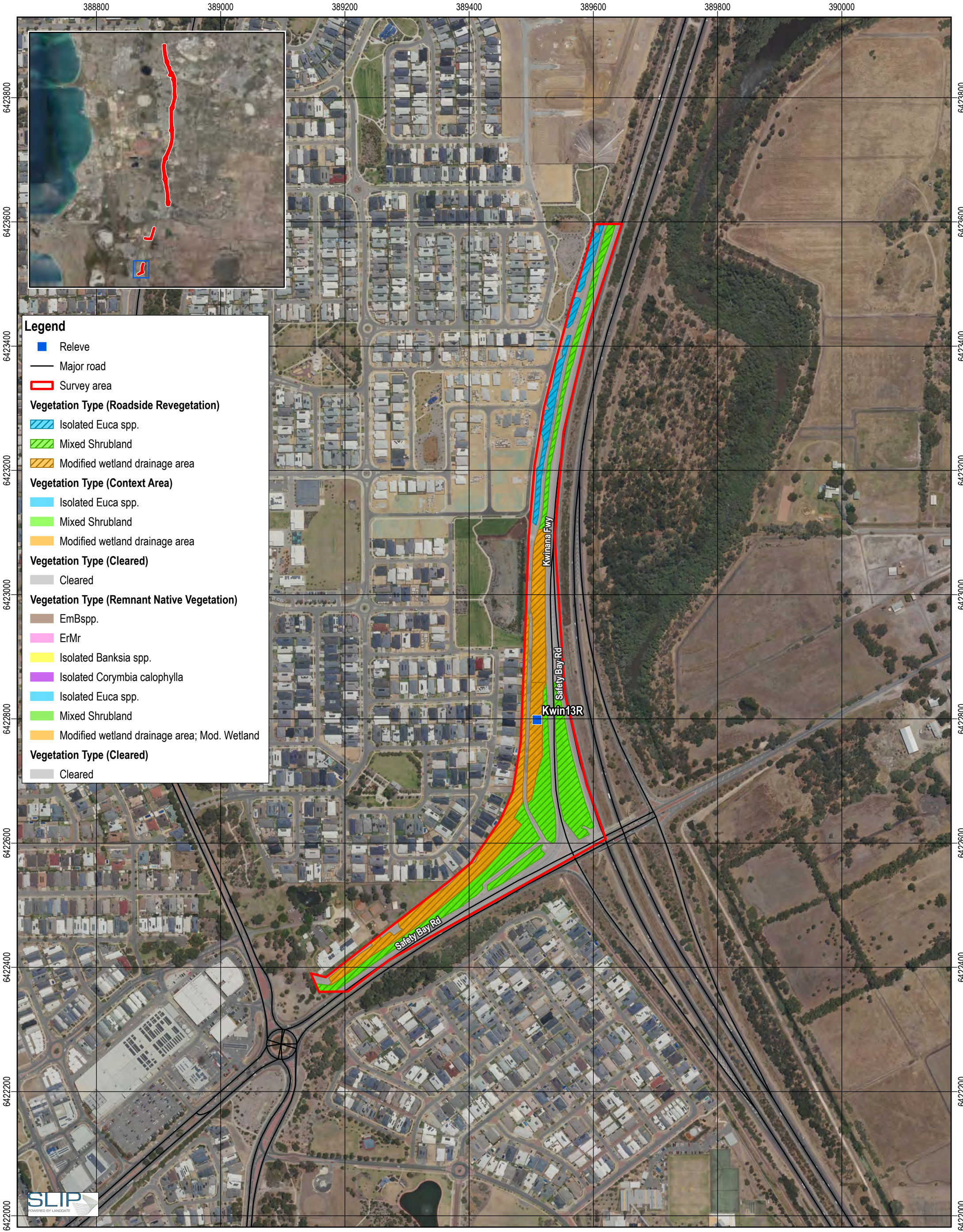
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Map Projection: Transverse Mercator
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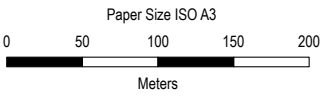
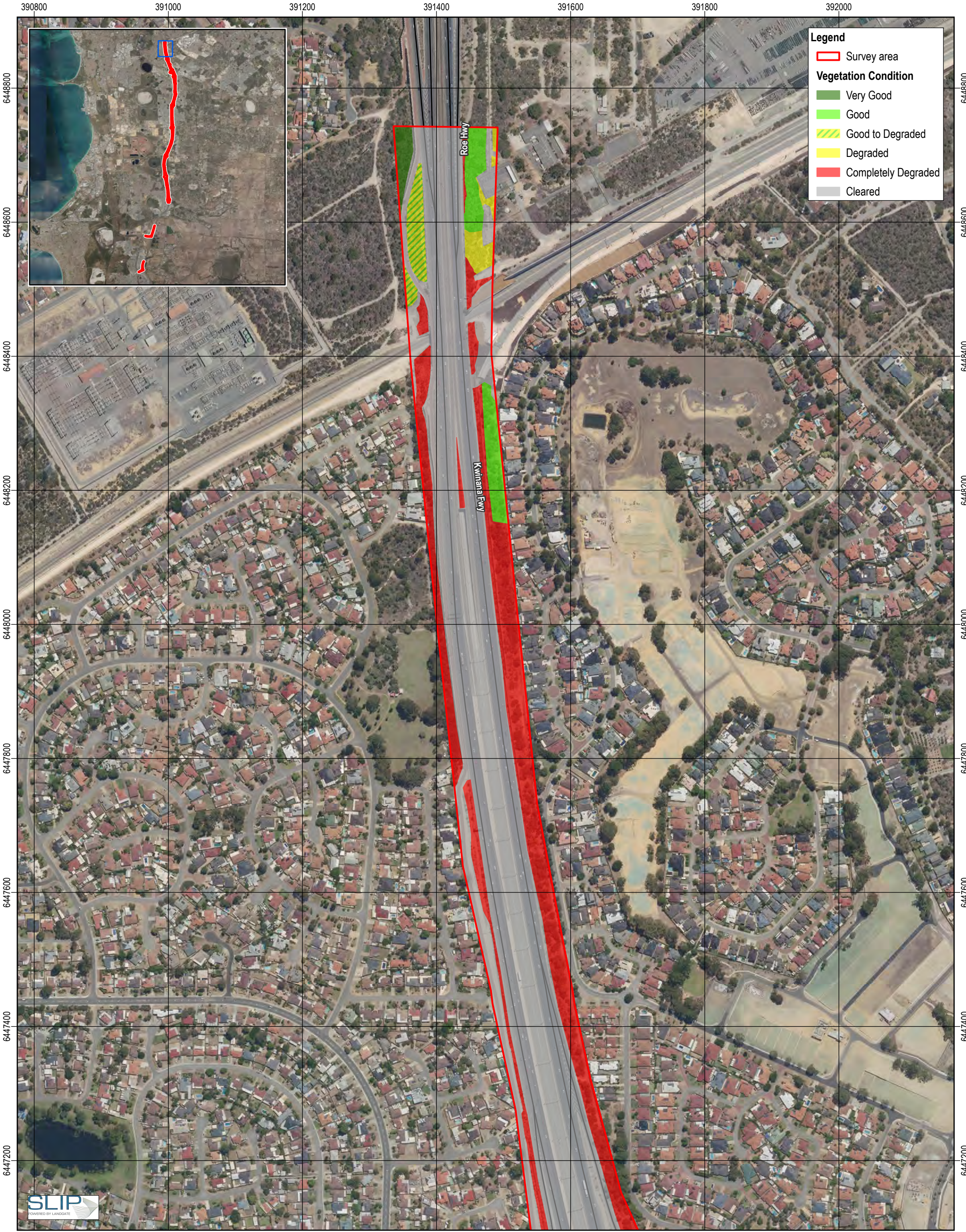


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Roe Hwy Widening Flora and Fauna Assessment

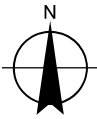
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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

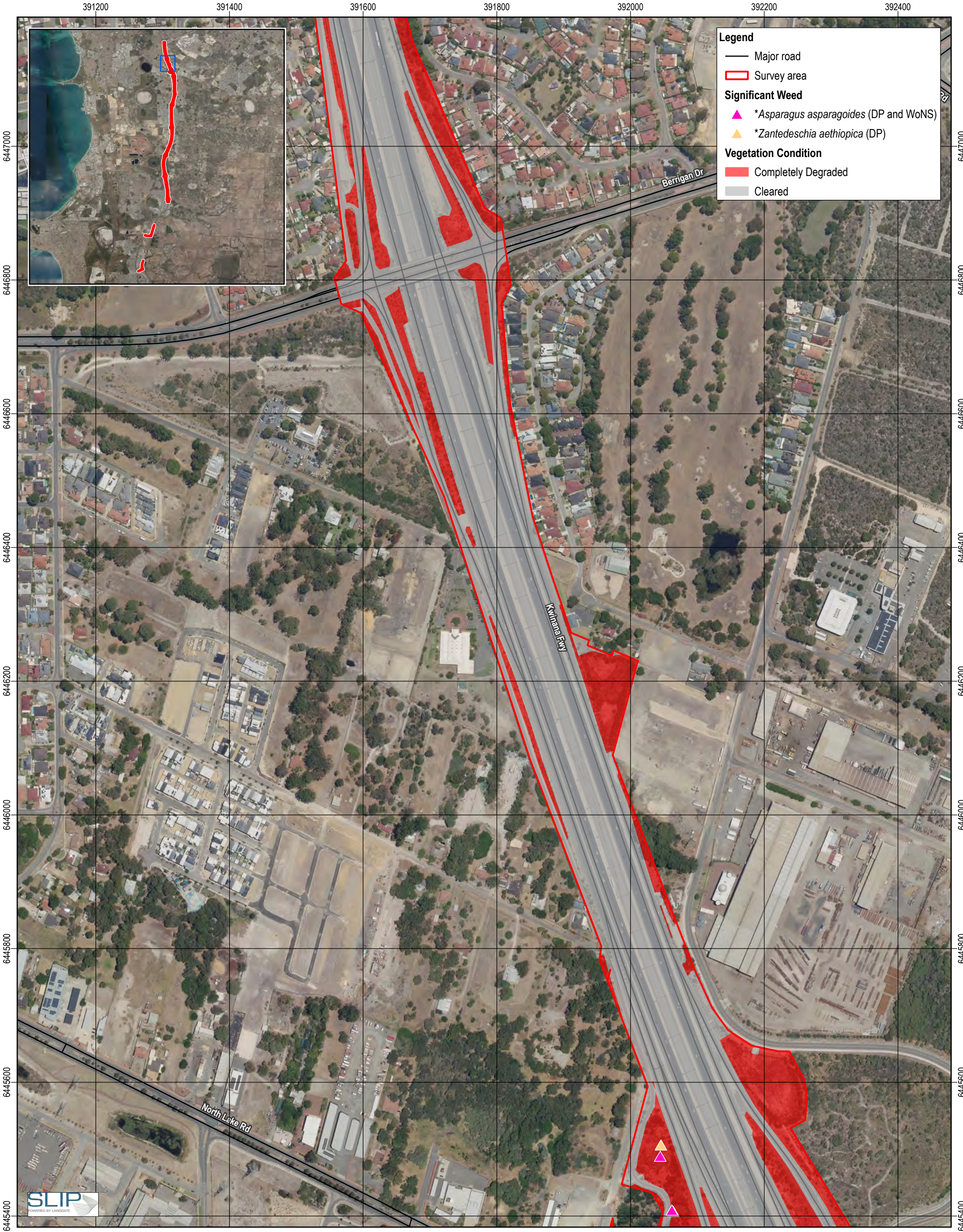


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Legend

— Major road

▭ Survey area

Significant Weed

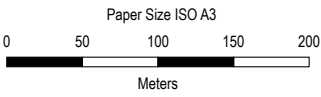
▲ **Asparagus asparagoides* (DP and WoNS)

▲ **Zantedeschia aethiopica* (DP)

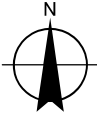
Vegetation Condition

Red Completely Degraded

Grey Cleared



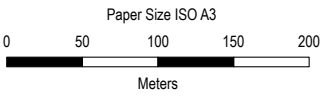
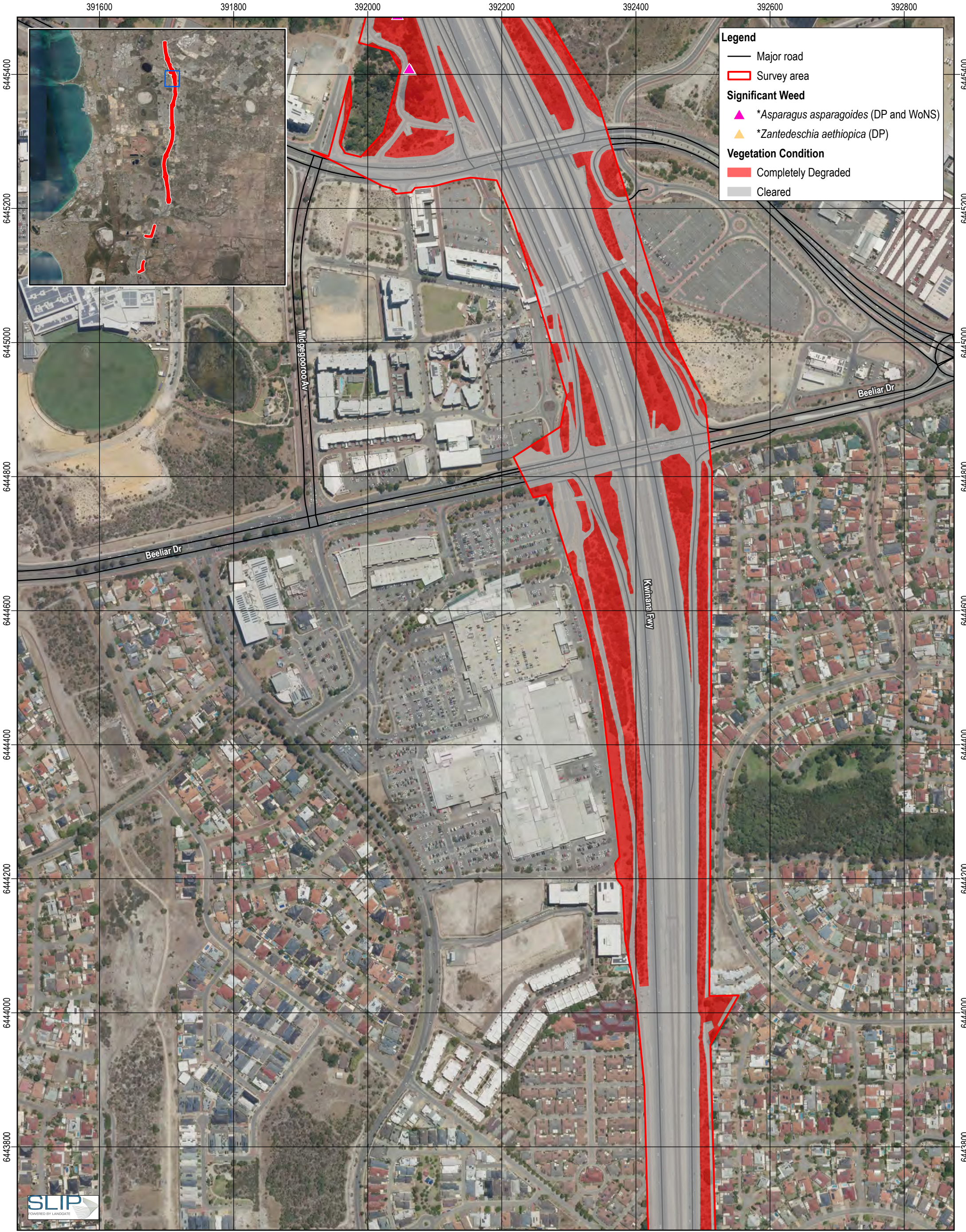
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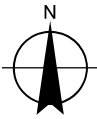
Main Roads
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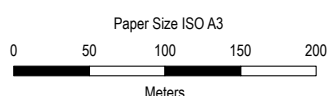
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Map Projection: Transverse Mercator
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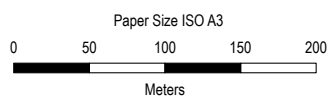
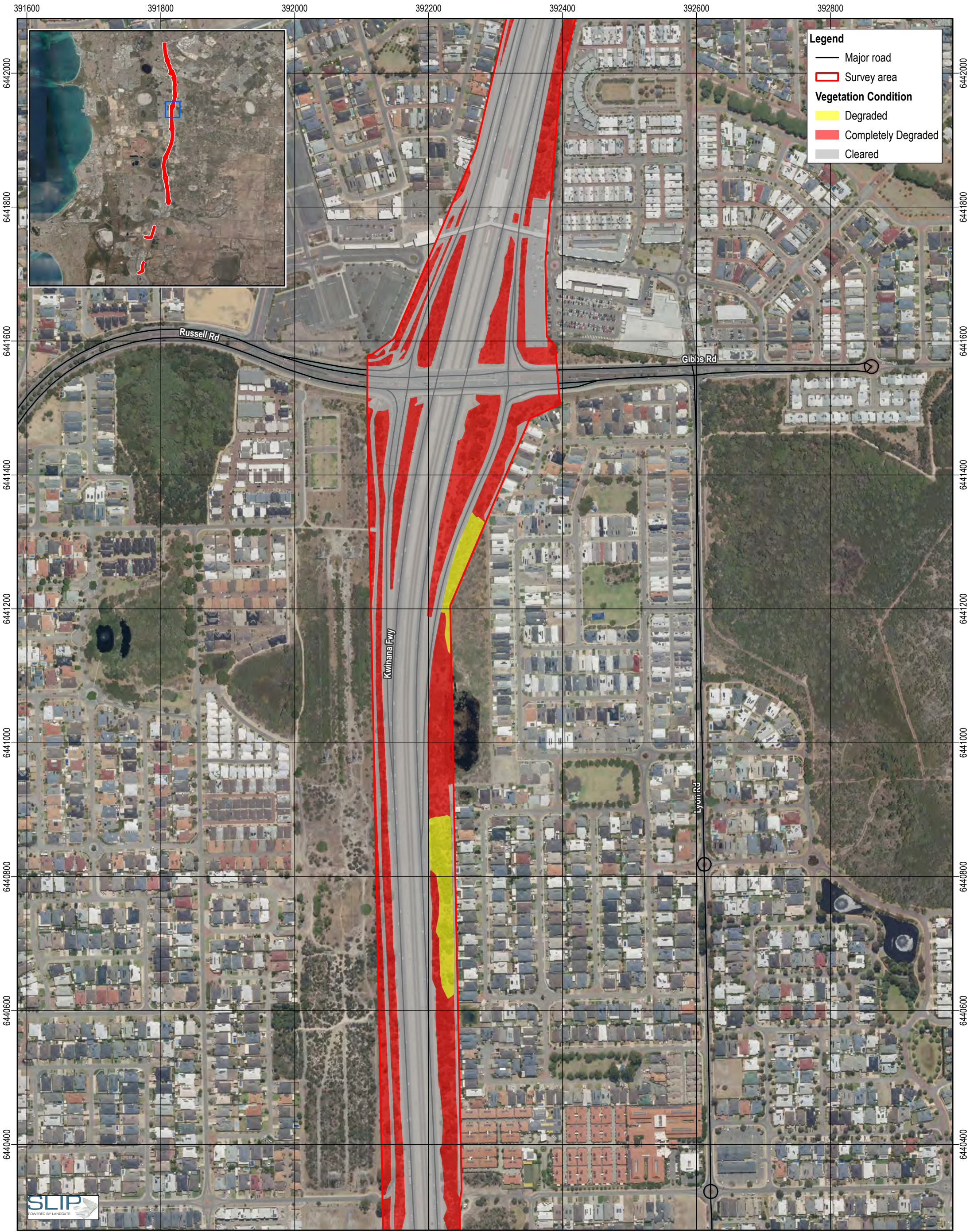


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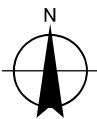
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Map Projection: Transverse Mercator
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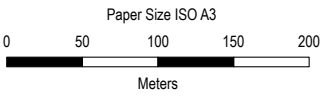
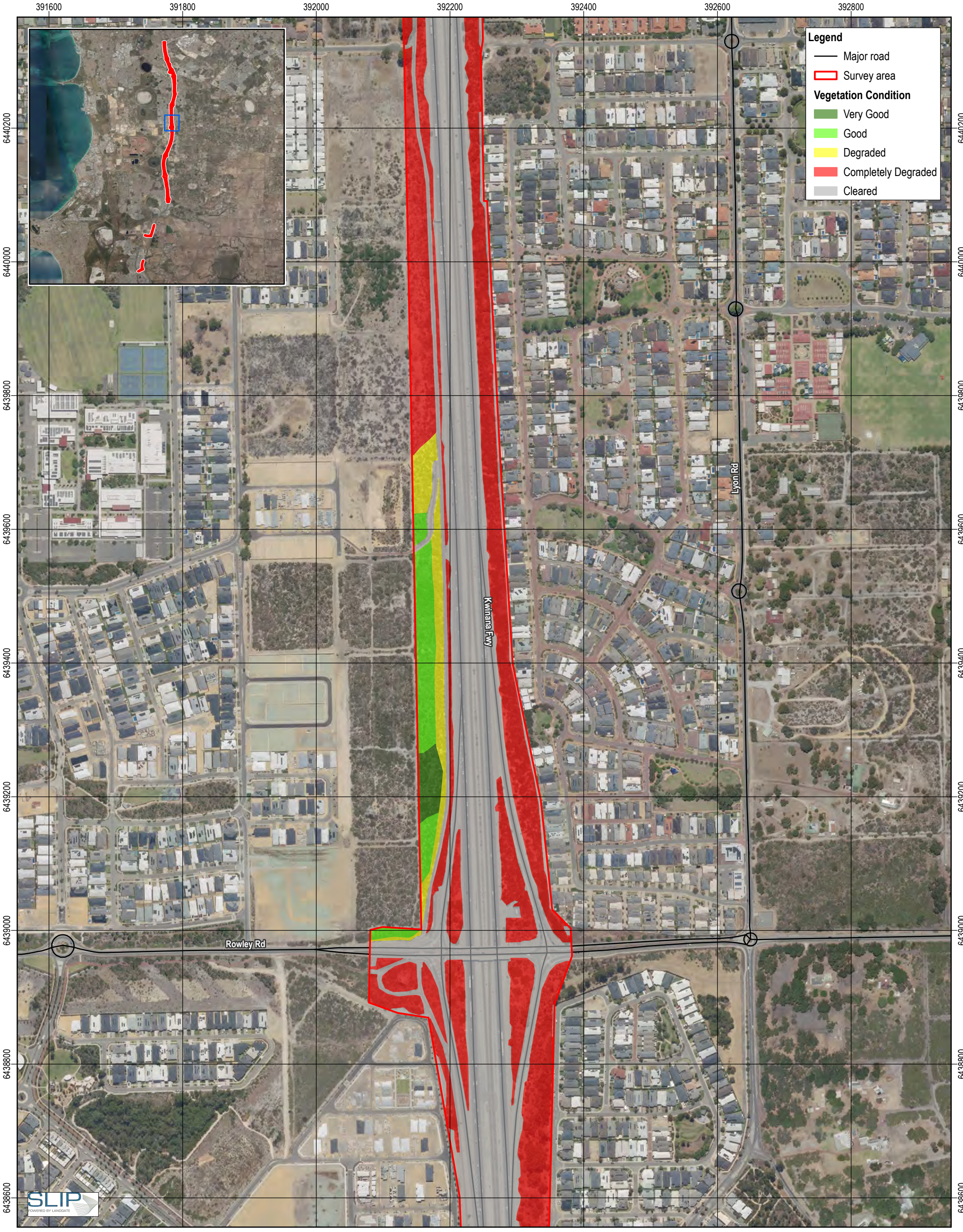


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

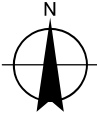
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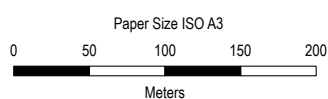
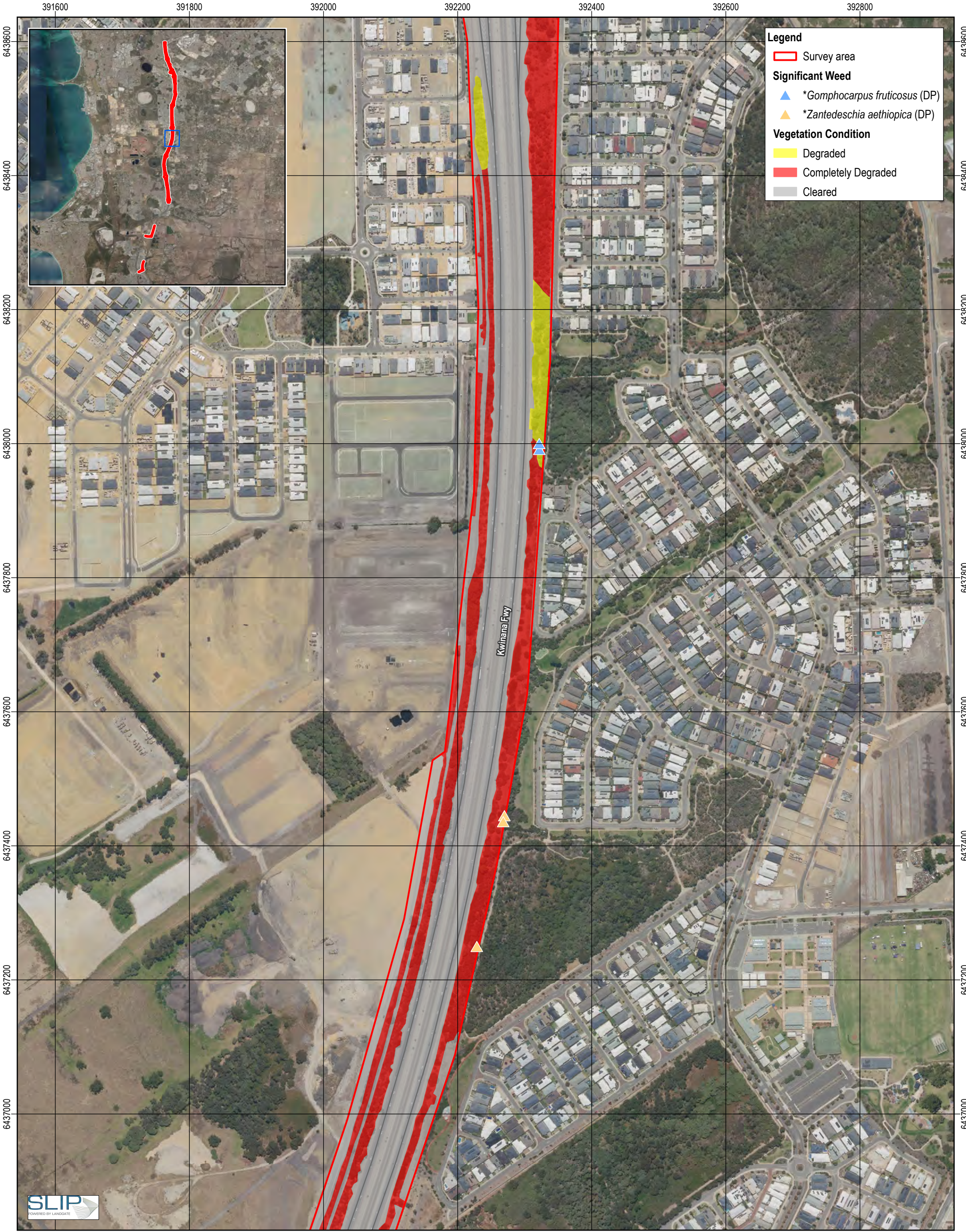
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Map Projection: Transverse Mercator
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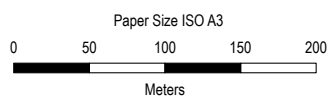
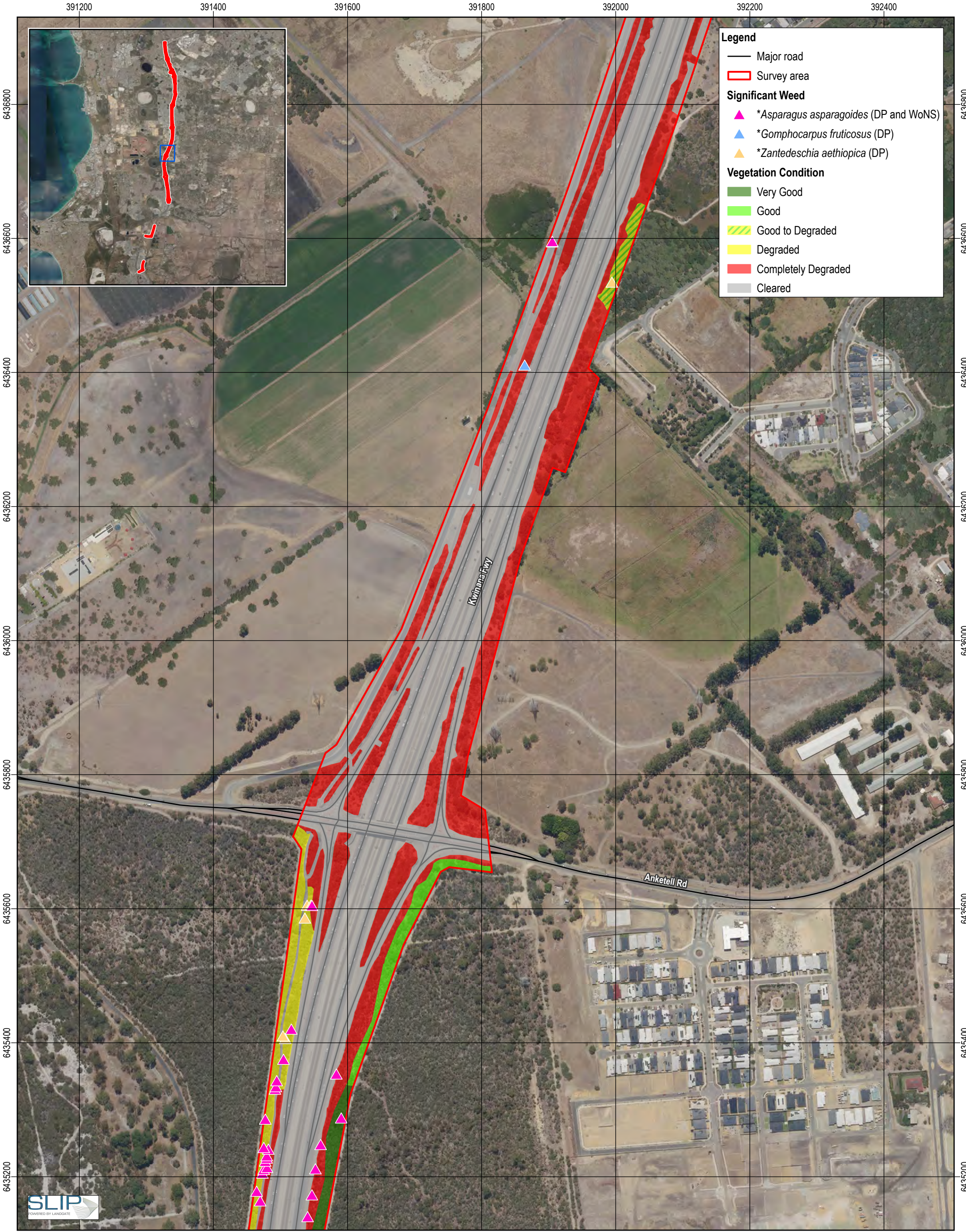


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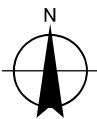
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Map Projection: Transverse Mercator
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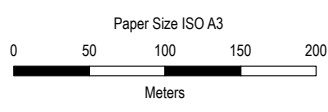
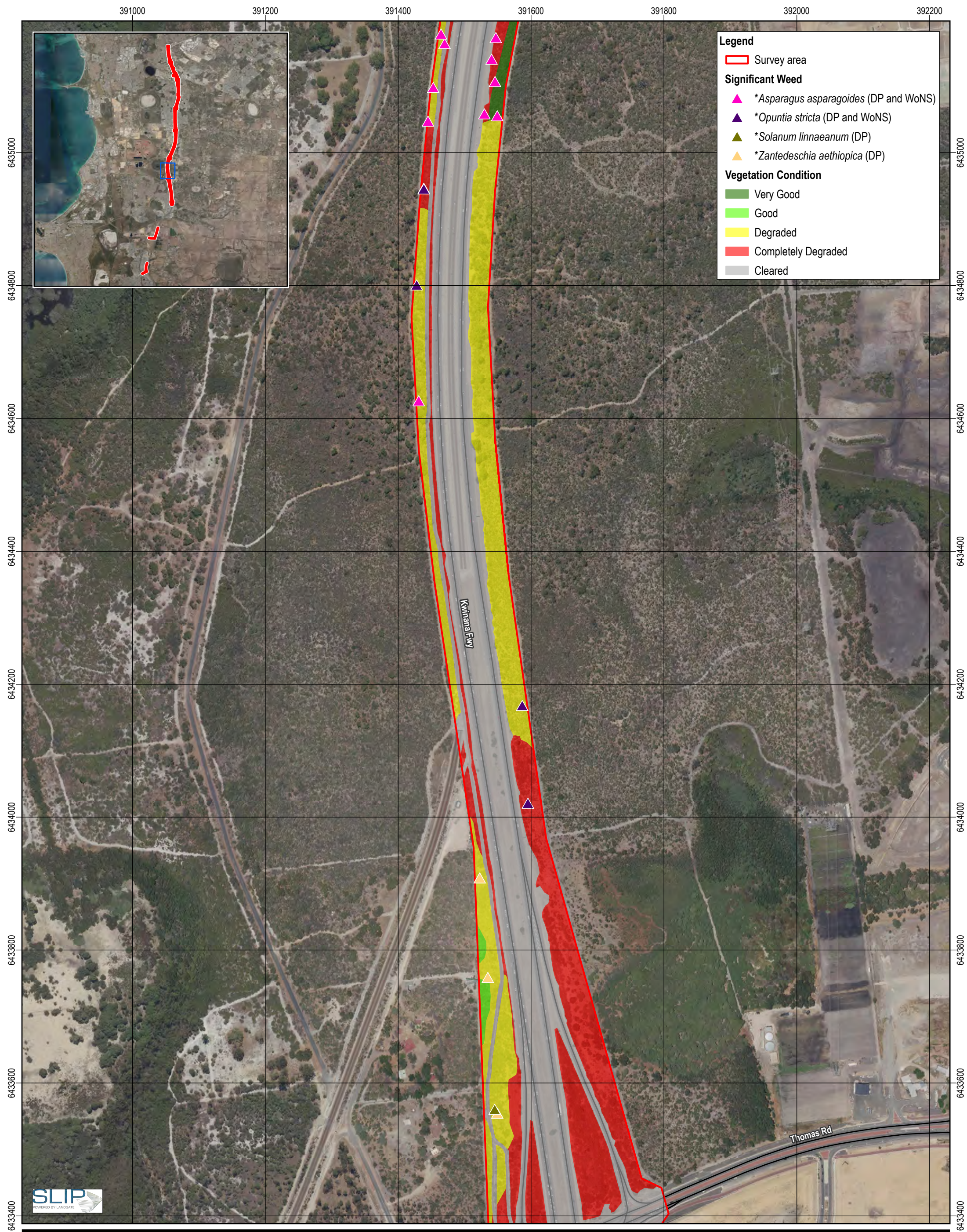


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Roe Hwy Widening Flora and Fauna Assessment

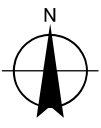
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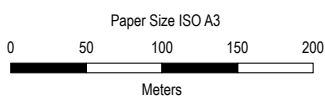
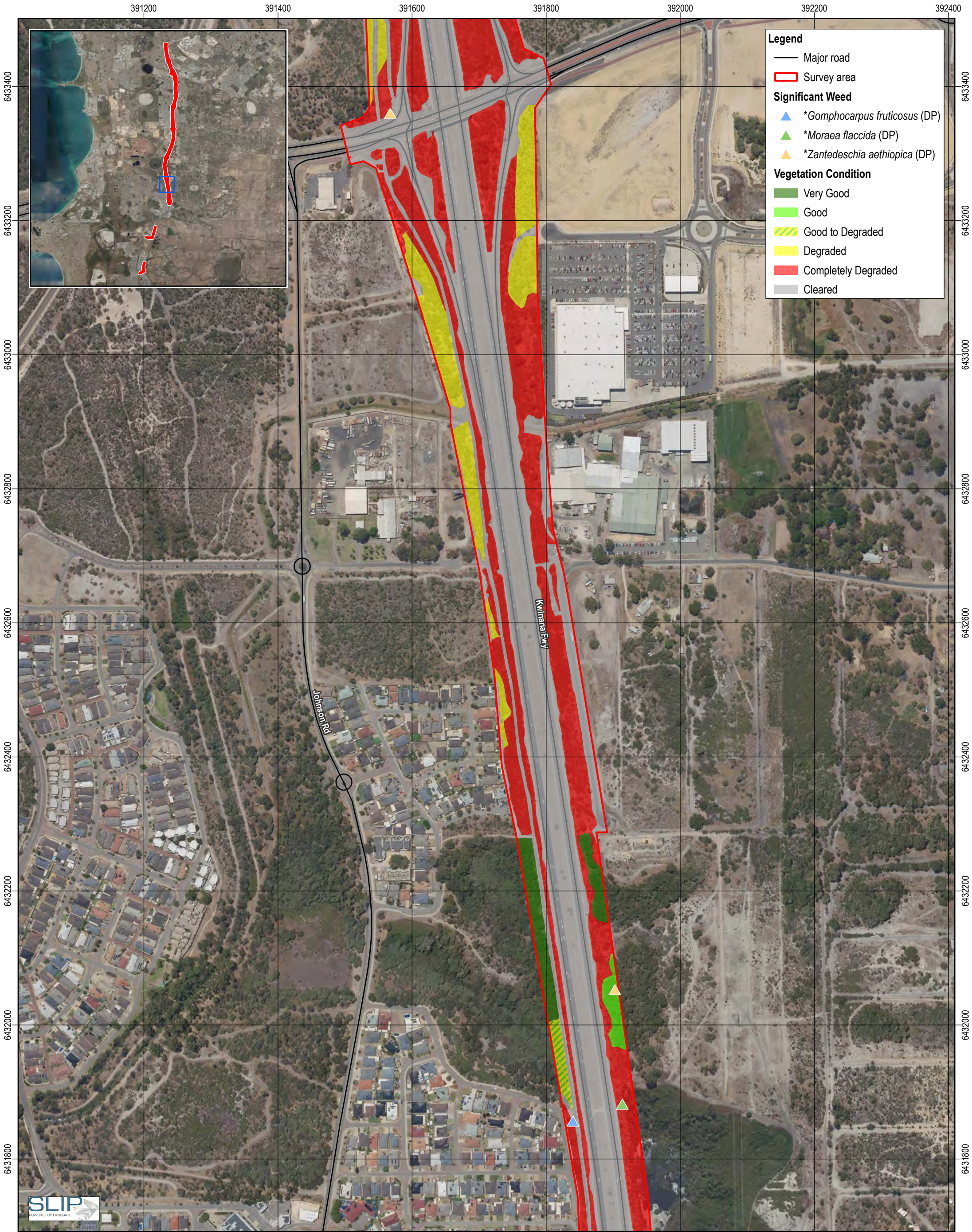
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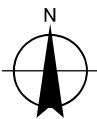
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Roe Hwy Widening Flora and Fauna Assessment

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Grid: GDA2020 MGA Zone 50

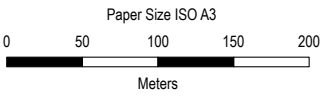
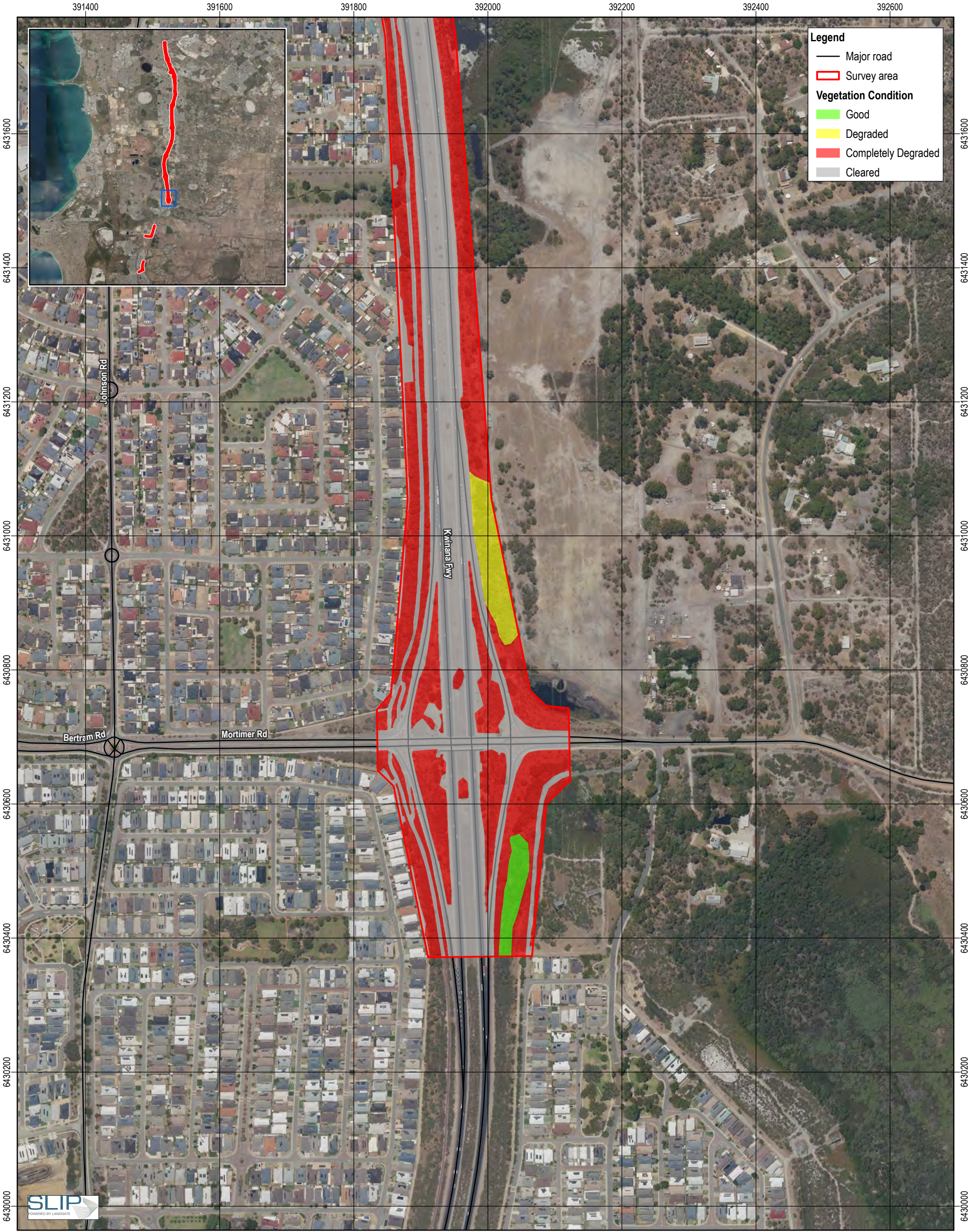


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

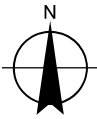
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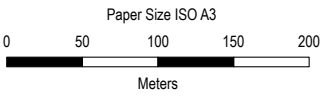
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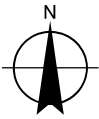
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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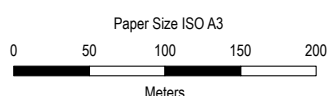
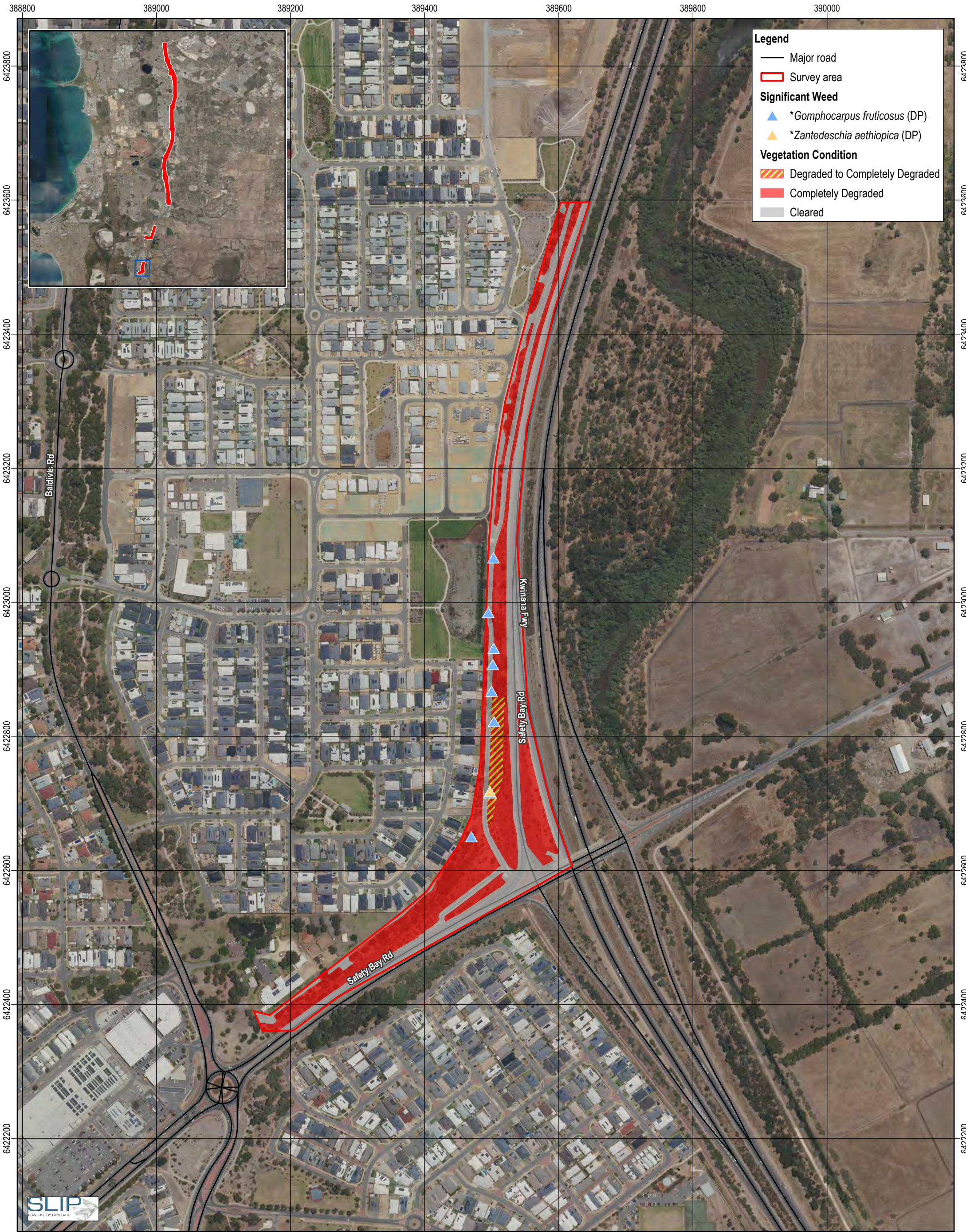
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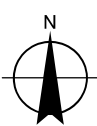
Main Roads
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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

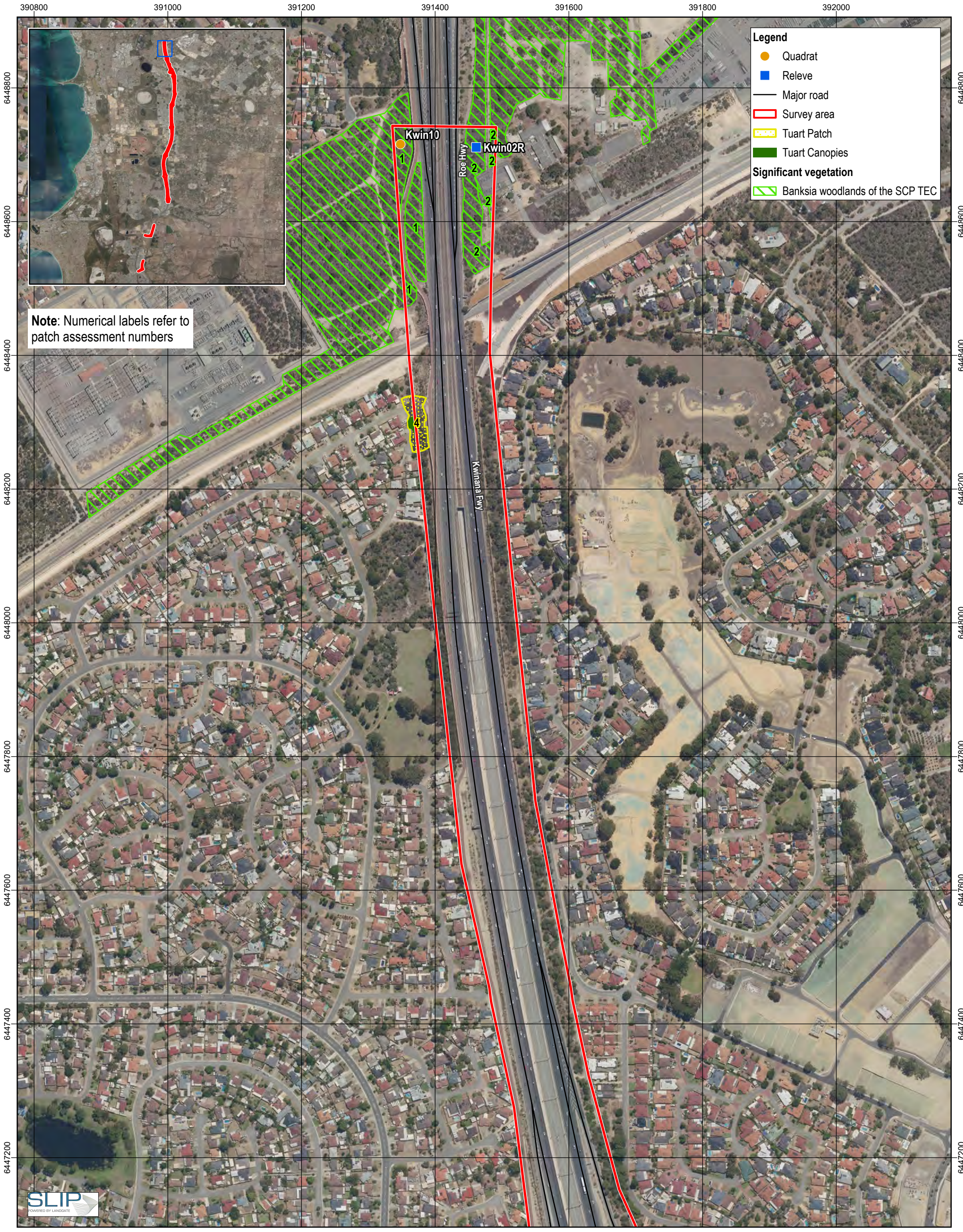


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

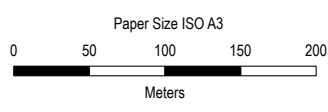
Vegetation Condition and Significant Weeds

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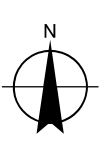
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FIGURE 7



Note: Numerical labels refer to patch assessment numbers



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

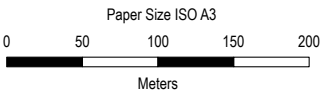
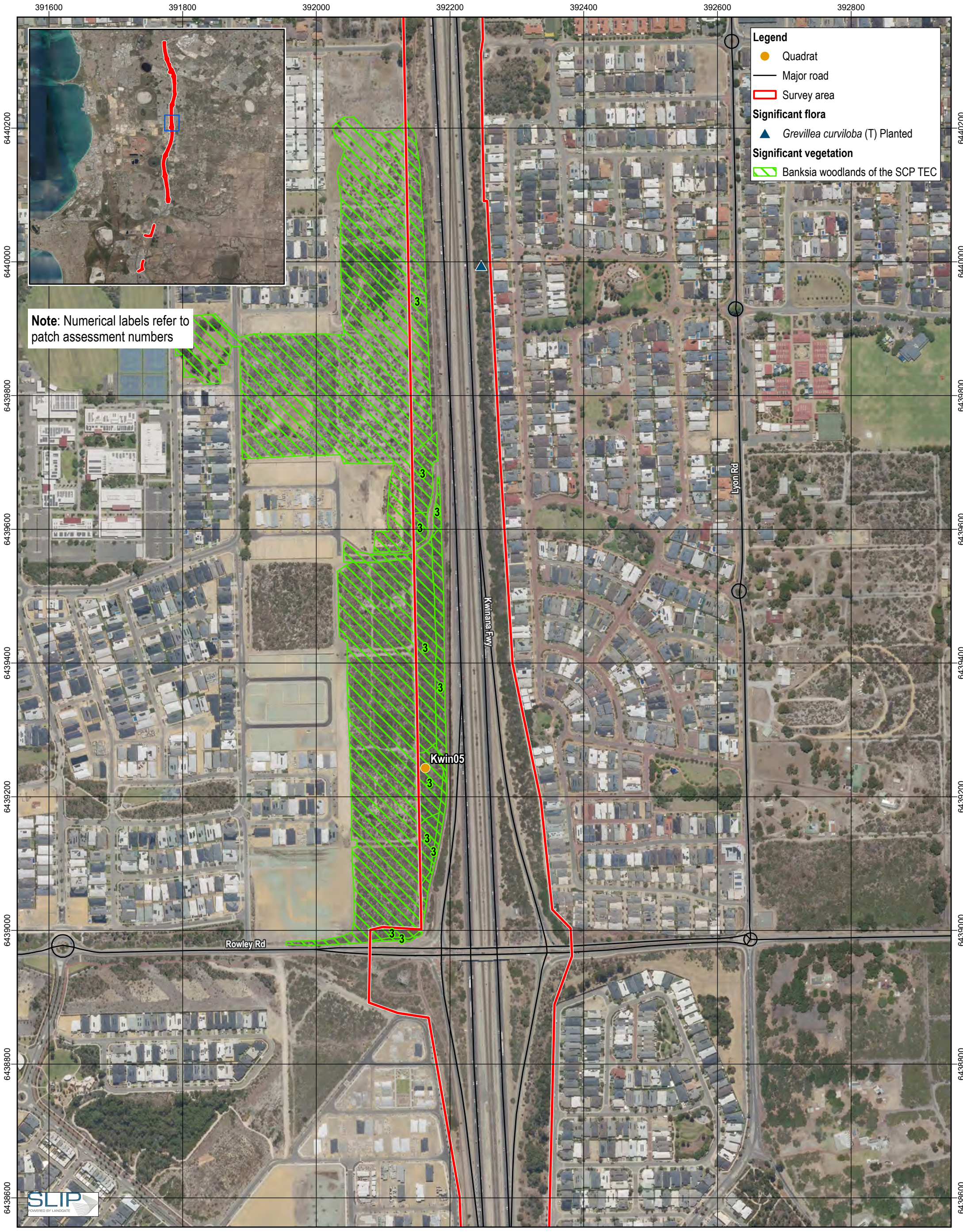


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

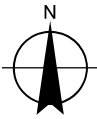
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Significant Vegetation and Flora

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FIGURE 8



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

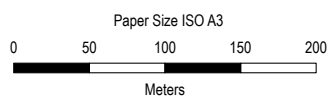
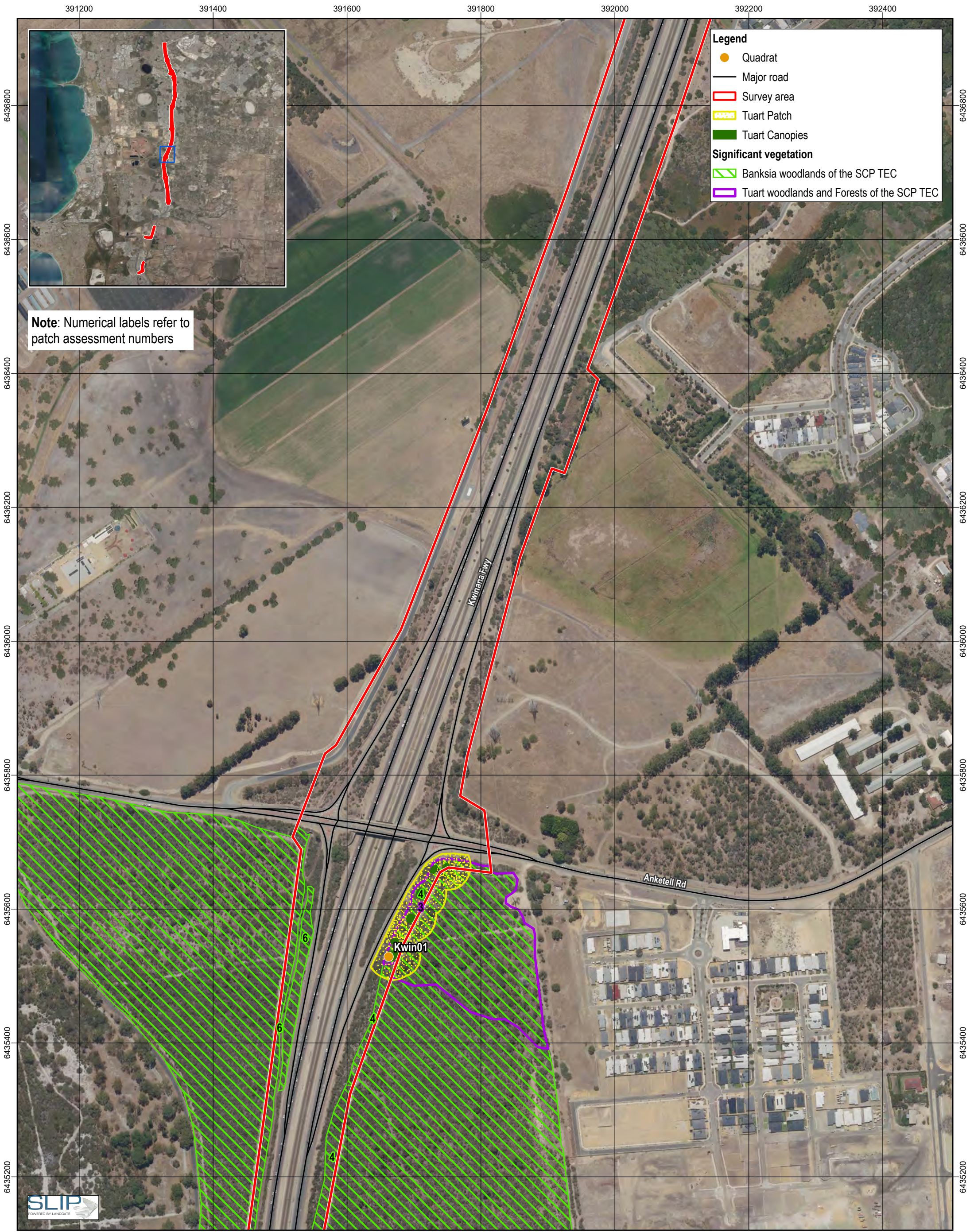


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

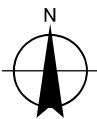
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FIGURE 8



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

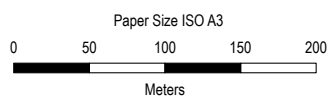
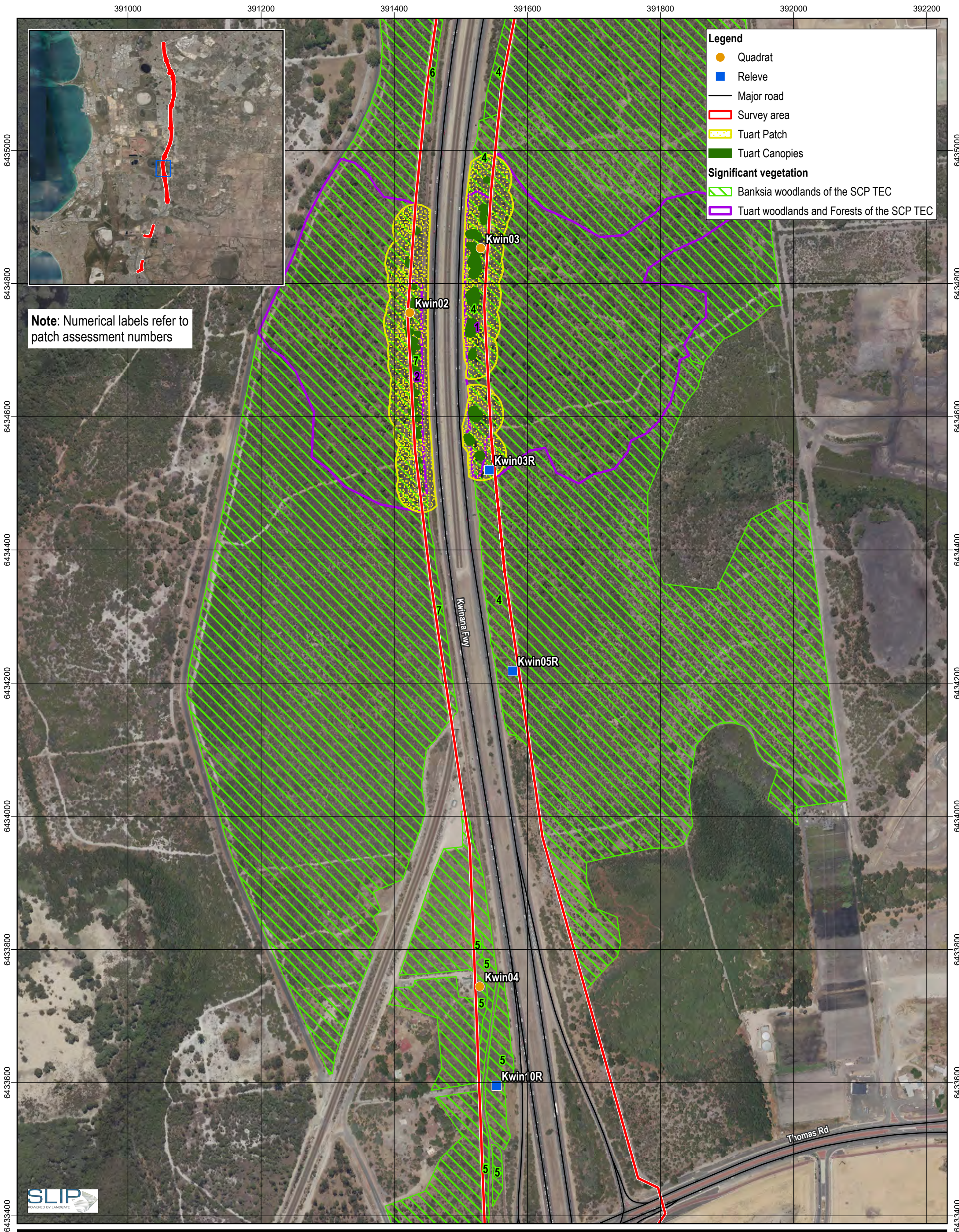


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

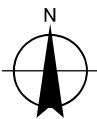
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FIGURE 8



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

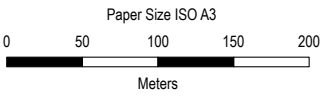
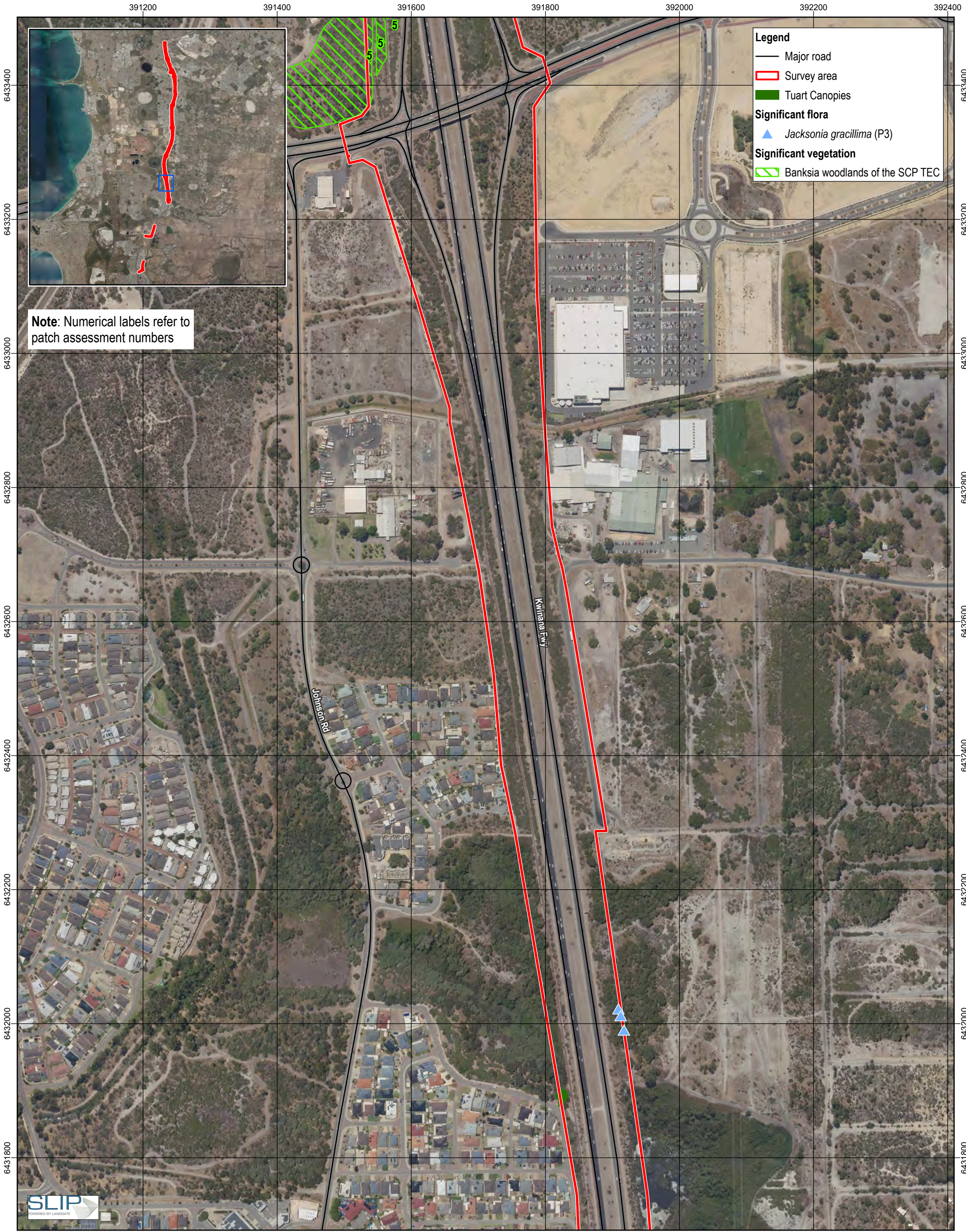


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

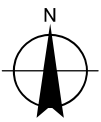
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Significant Vegetation and Flora

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FIGURE 8



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

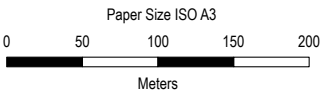
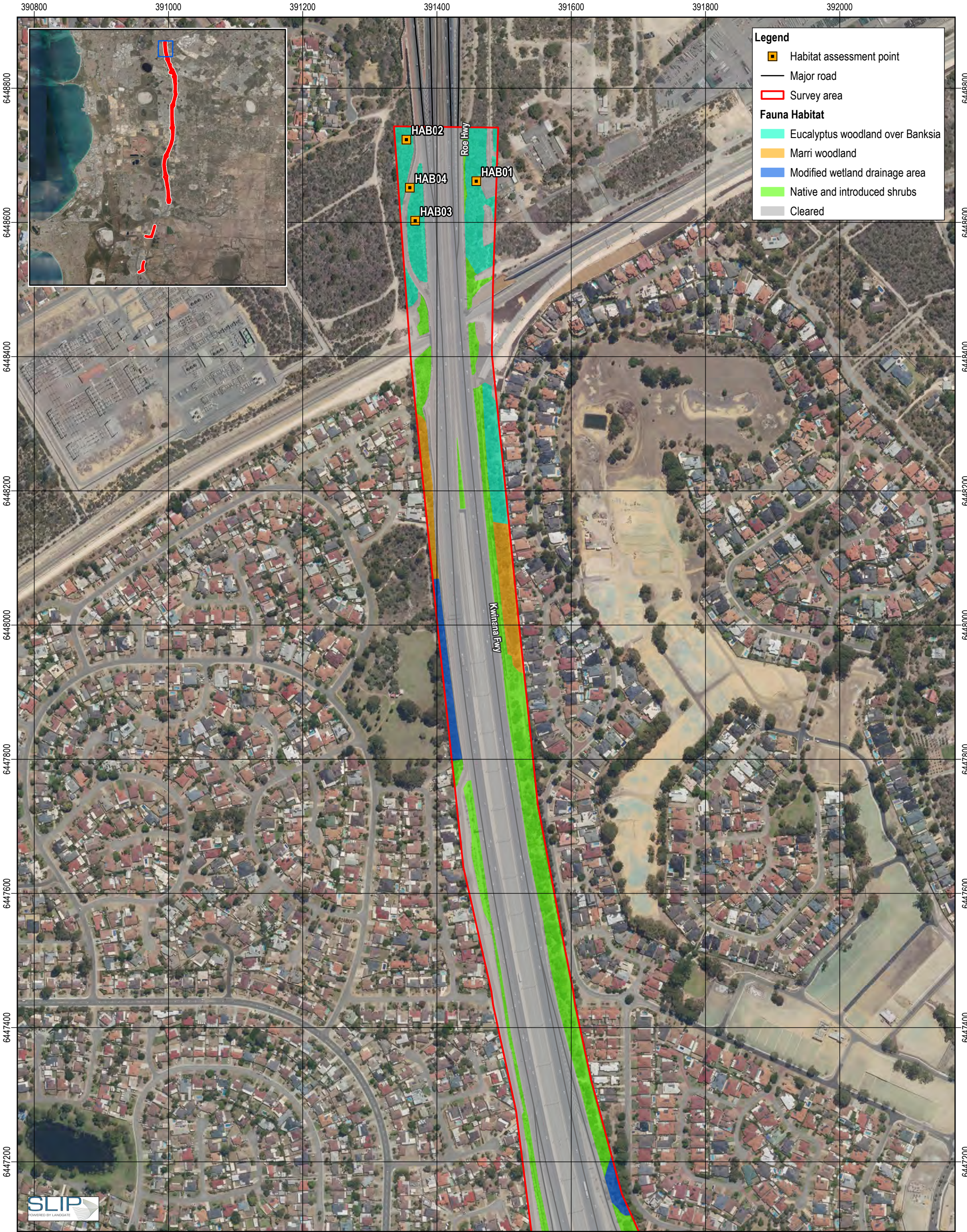


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

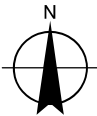
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Significant Vegetation and Flora

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FIGURE 8



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

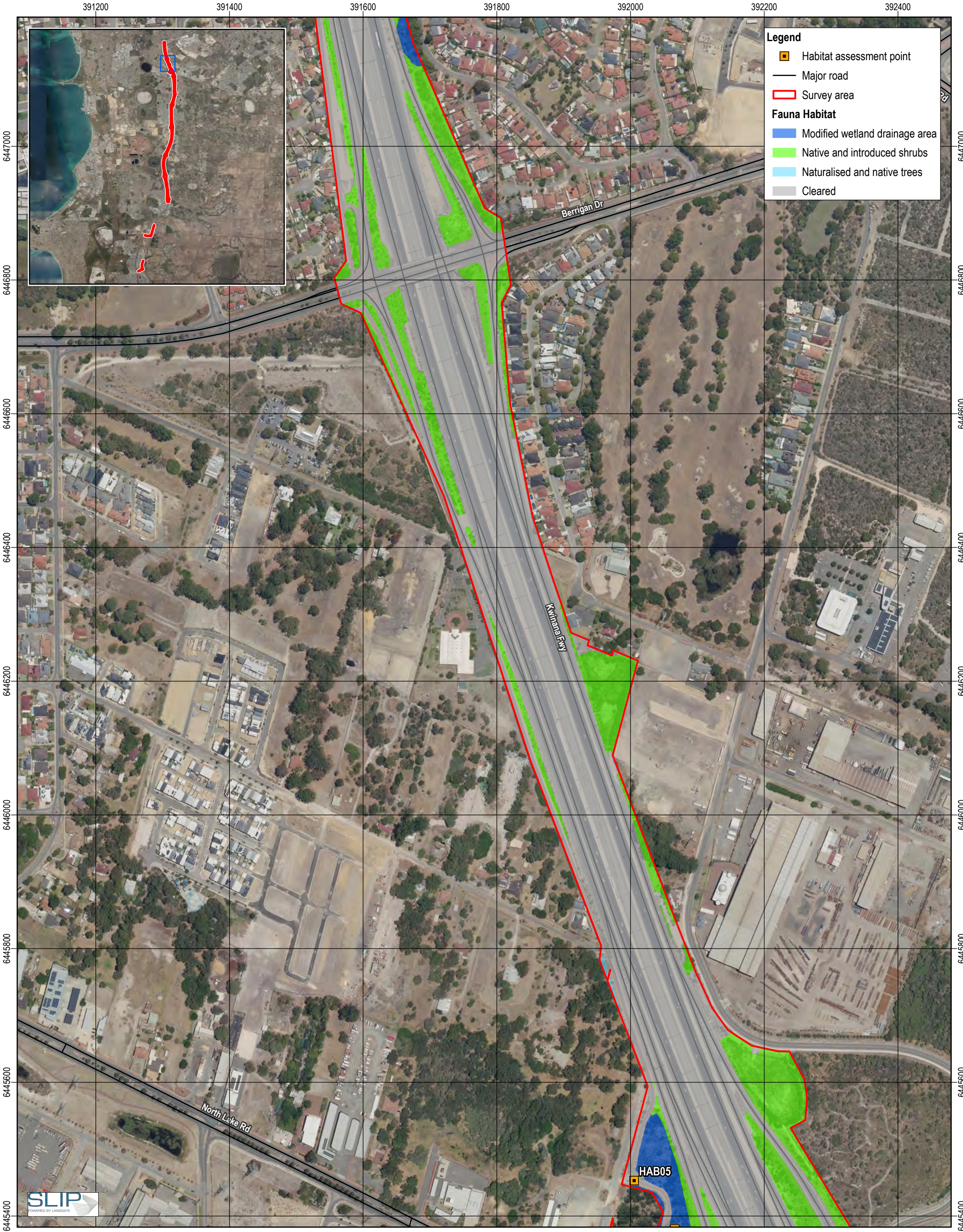


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

Fauna Habitats and
Significant Fauna

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FIGURE 9A

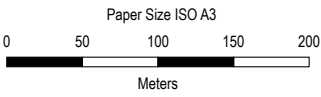


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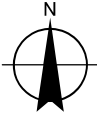
- Habitat assessment point
- Major road
- Survey area

Fauna Habitat

- Modified wetland drainage area
- Native and introduced shrubs
- Naturalised and native trees
- Cleared



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

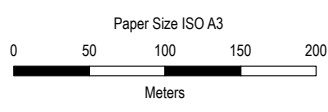
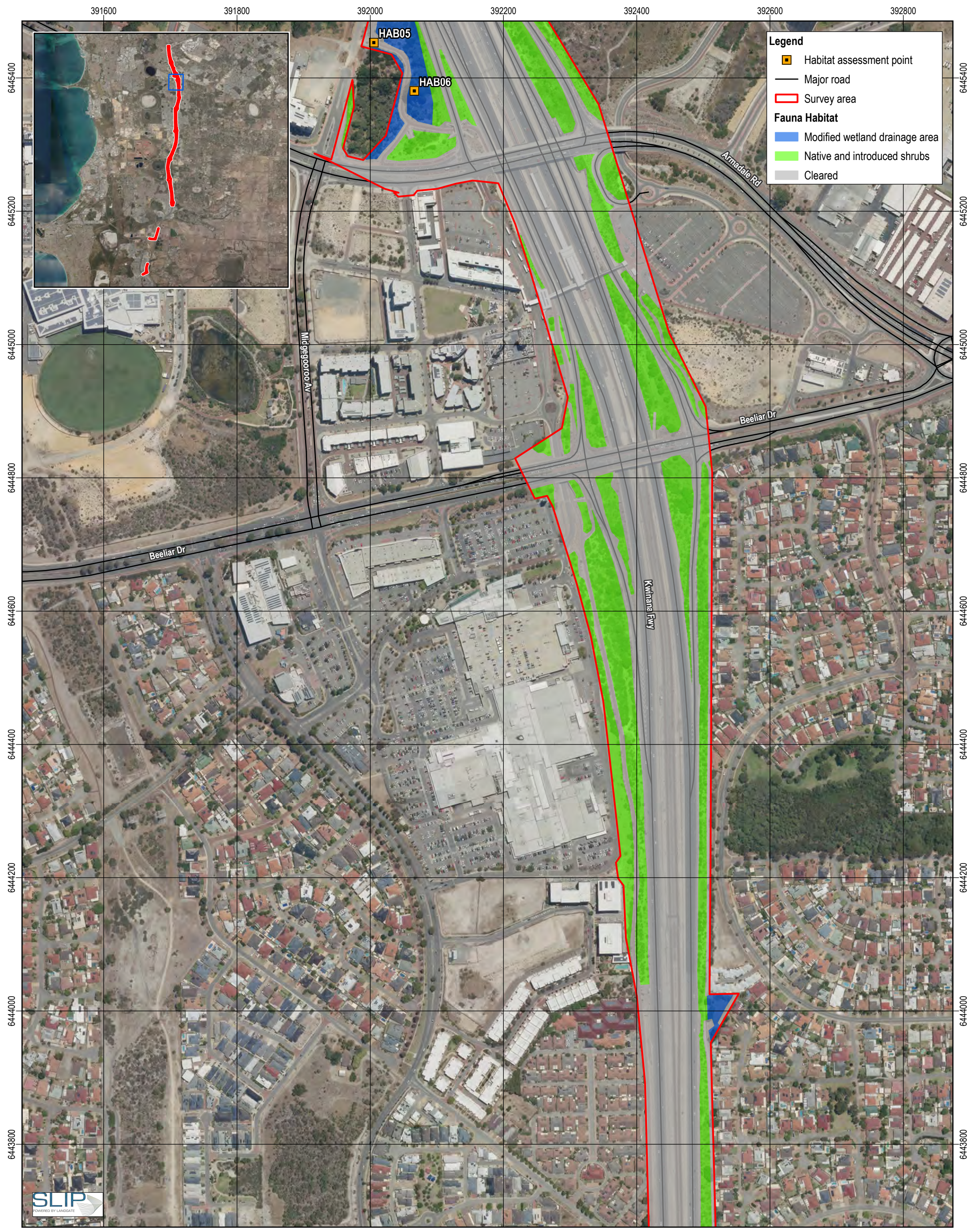


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

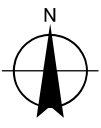
**Fauna Habitats and
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FIGURE 9A



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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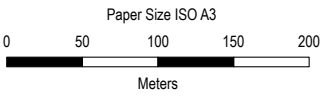
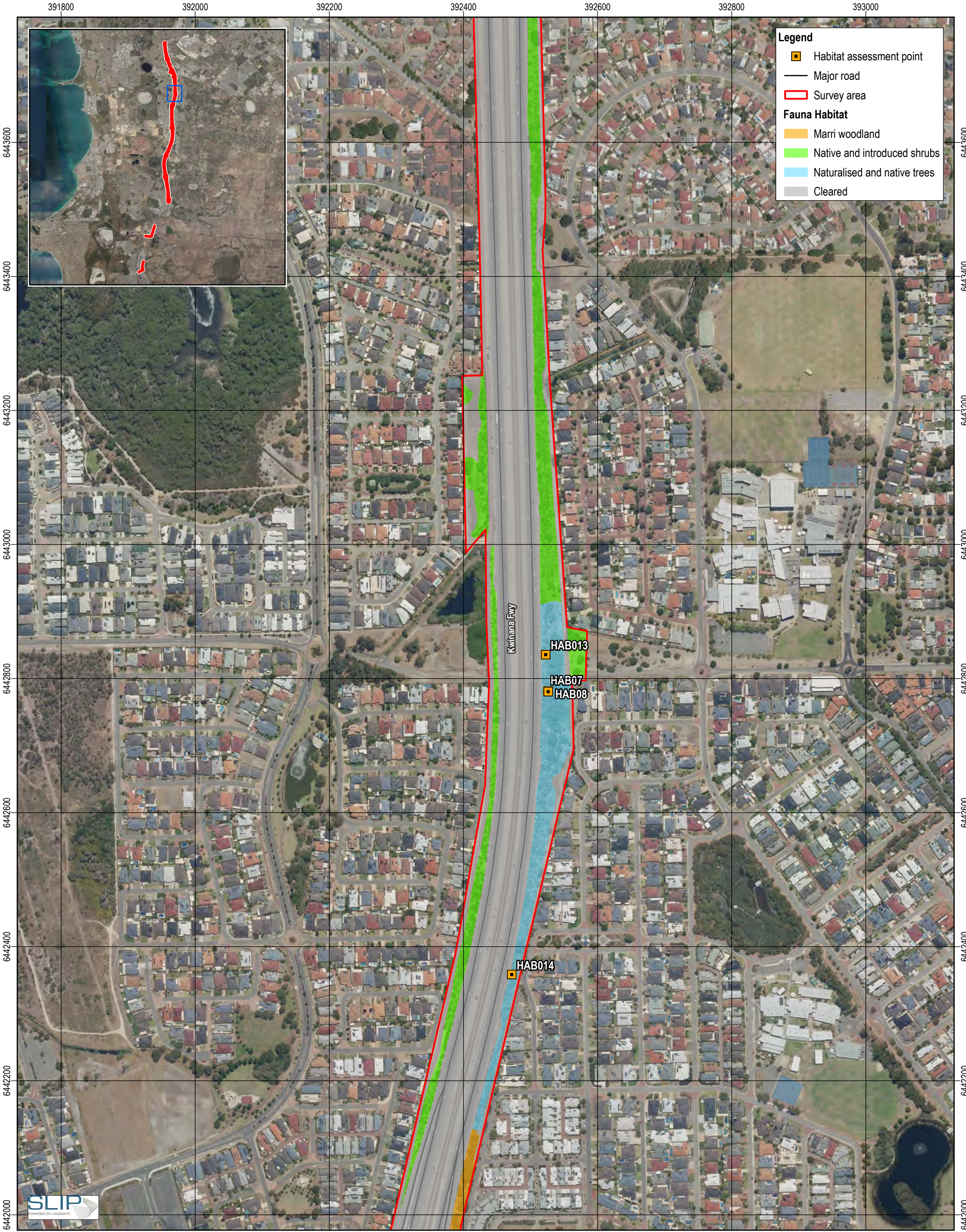


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

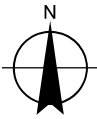
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FIGURE 9A



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

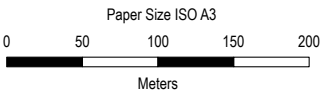
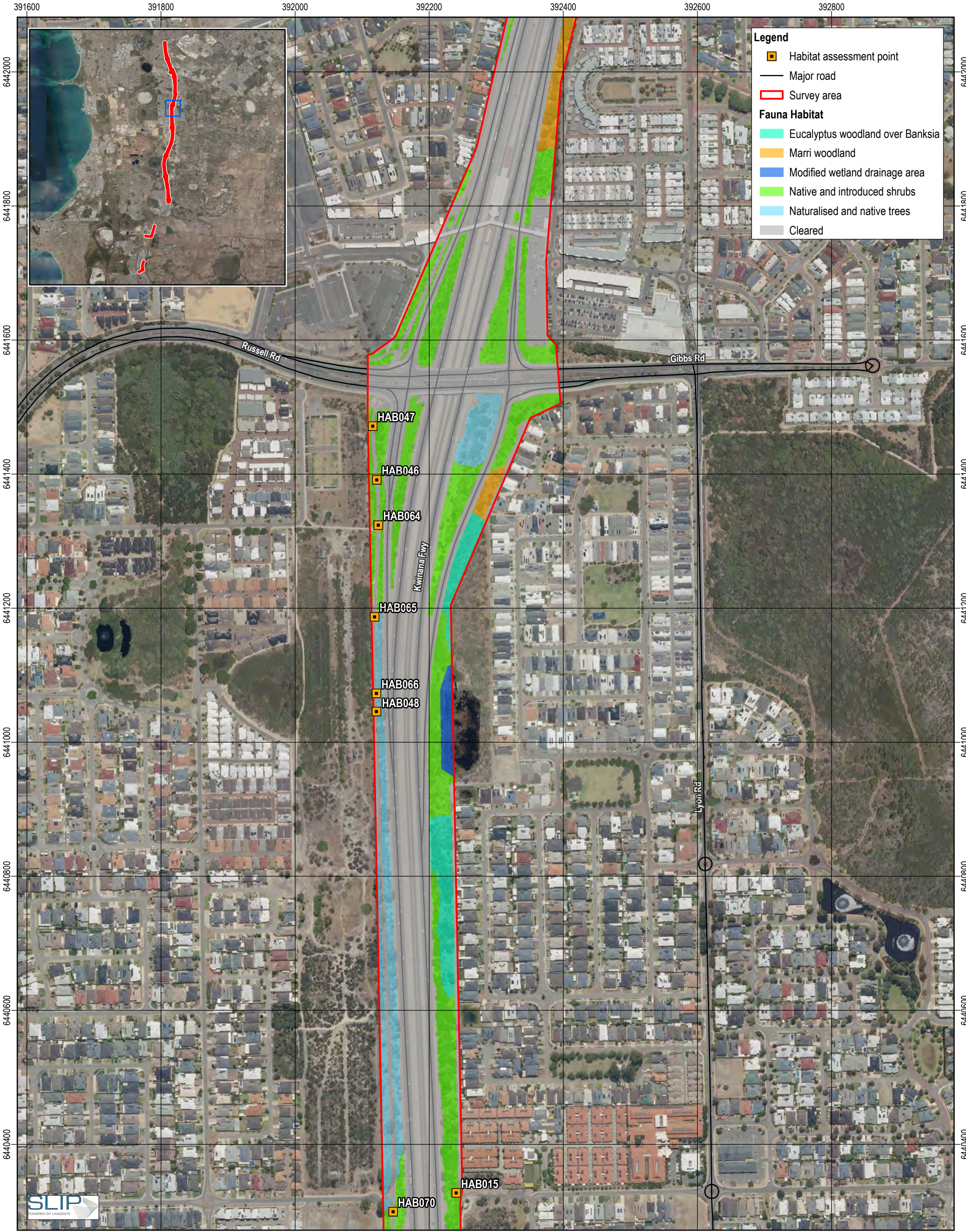


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

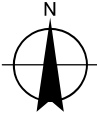
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FIGURE 9A



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

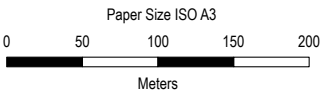
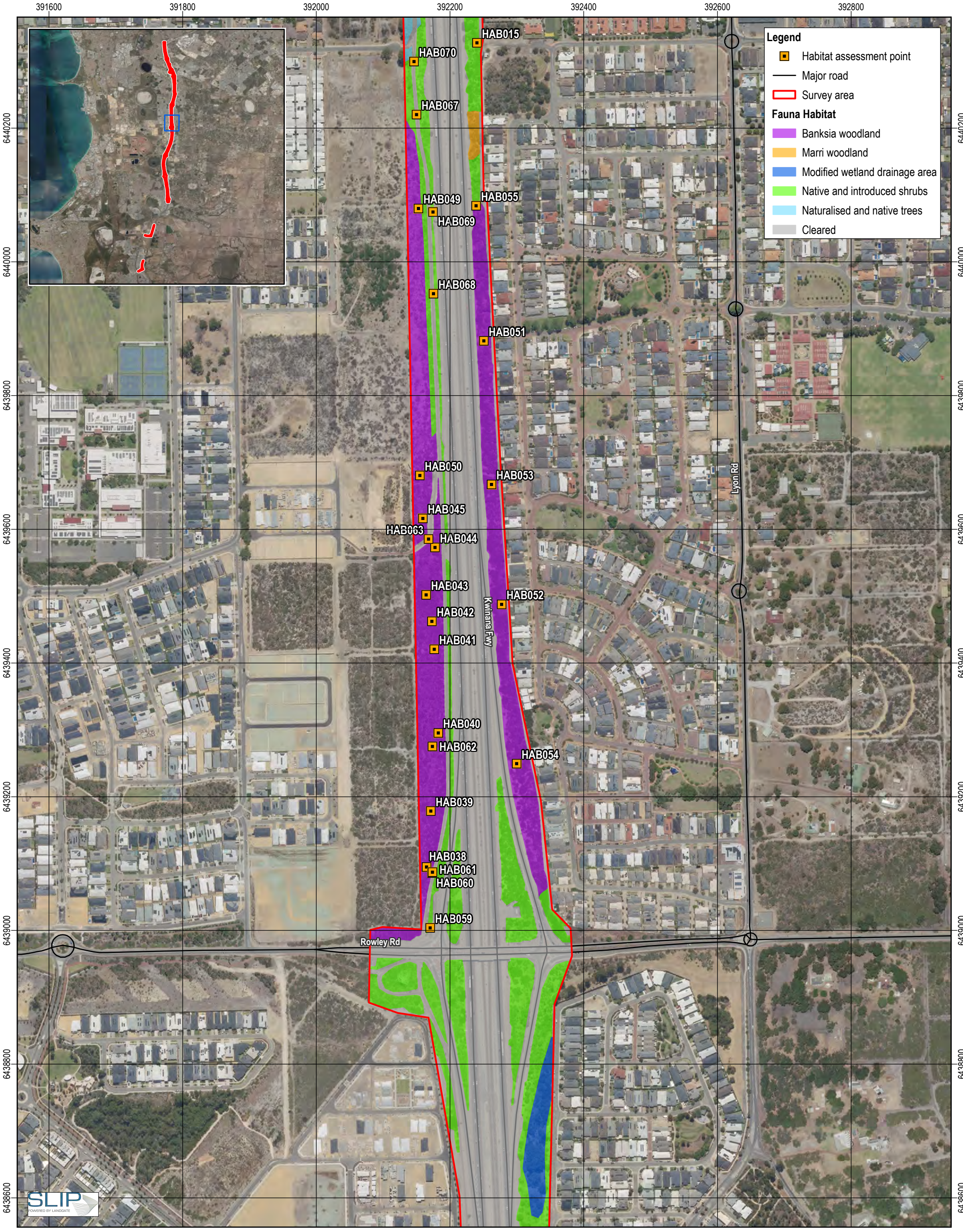


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

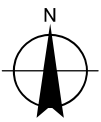
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FIGURE 9A



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

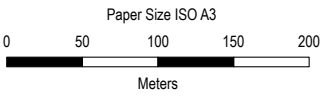
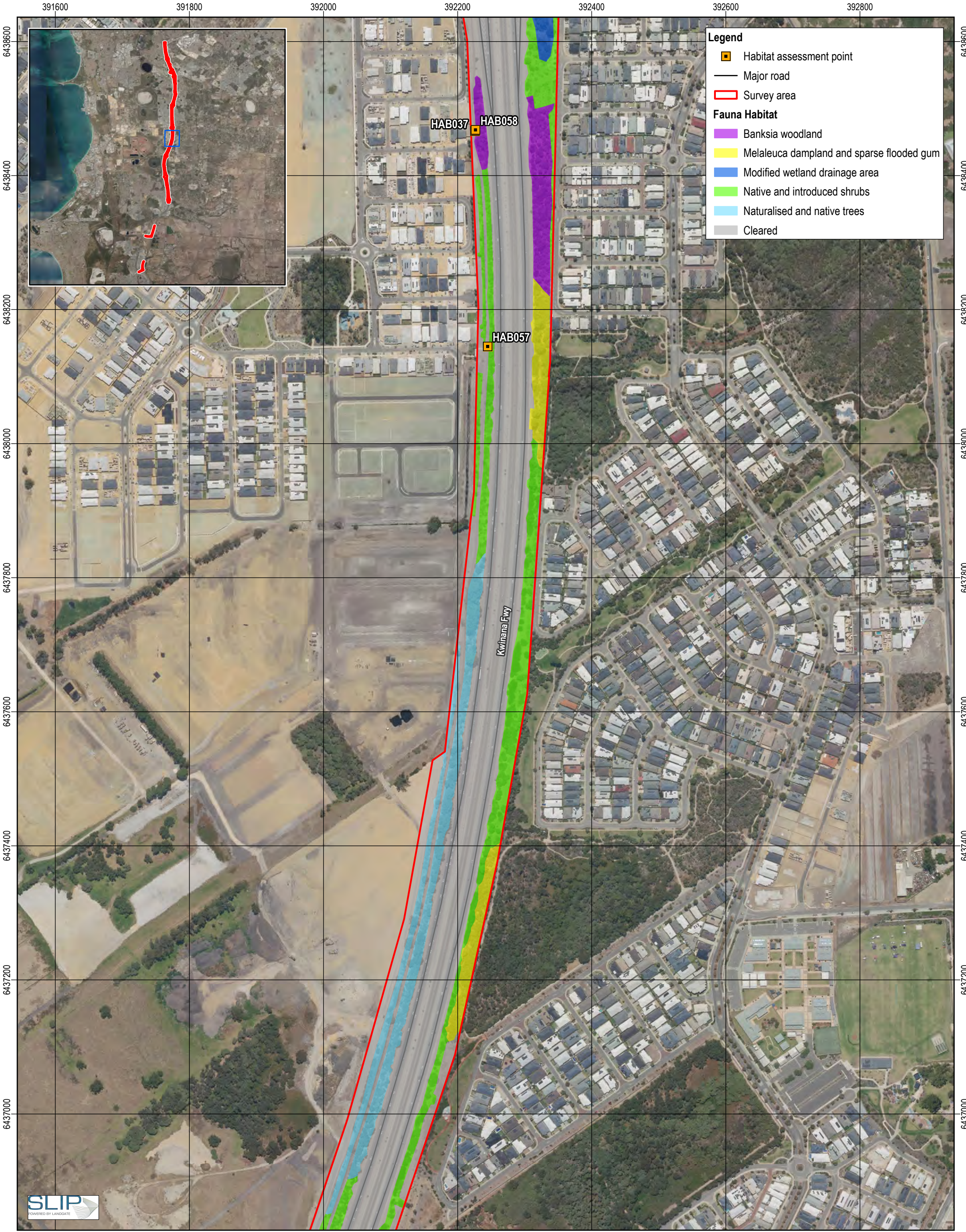


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

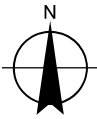
**Fauna Habitats and
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FIGURE 9A



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

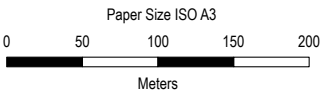
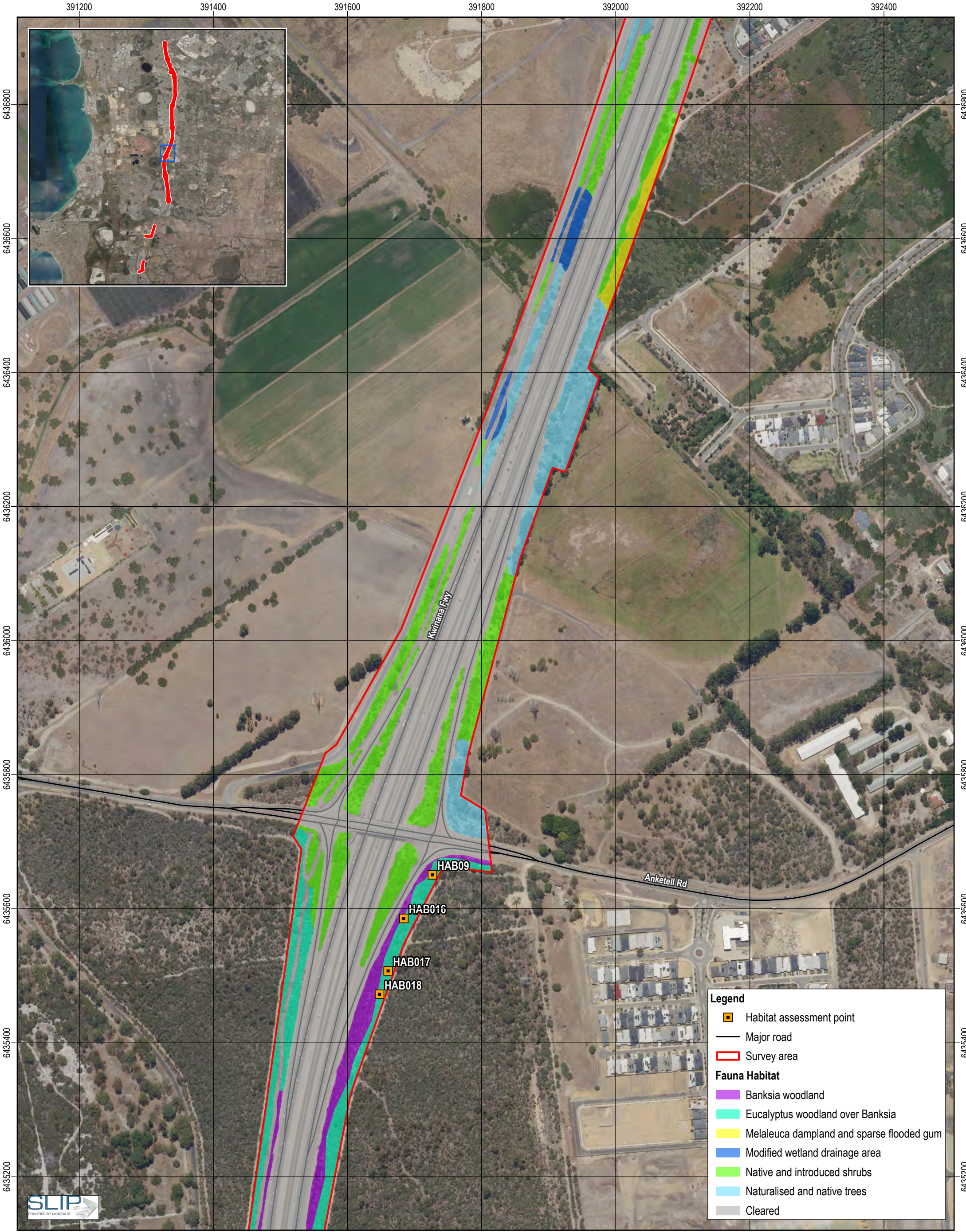


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

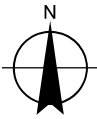
Fauna Habitats and
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FIGURE 9A



Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

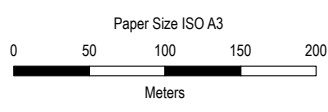
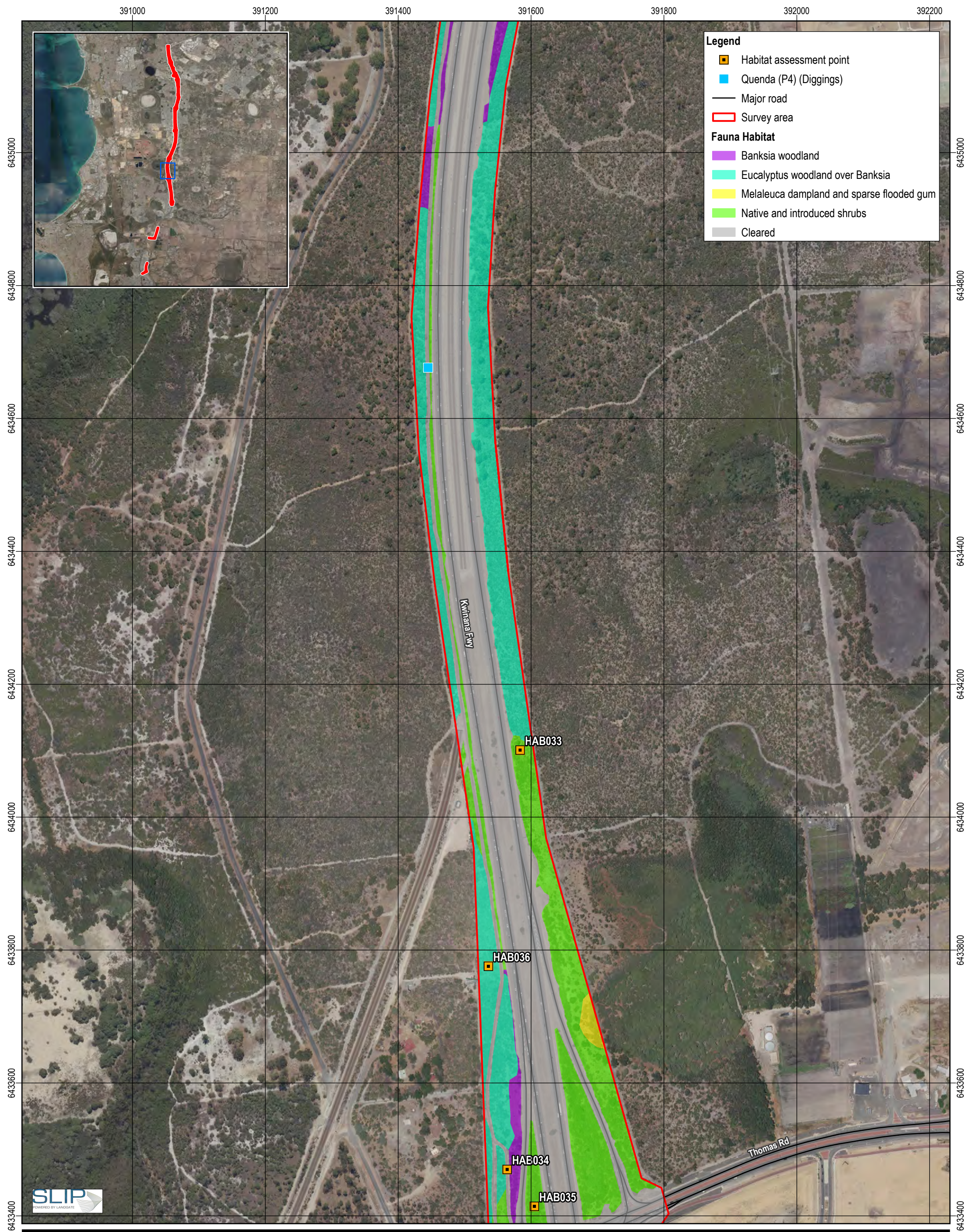


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

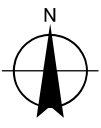
Fauna Habitats and
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FIGURE 9A



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

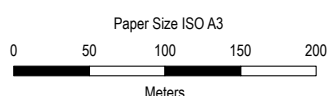
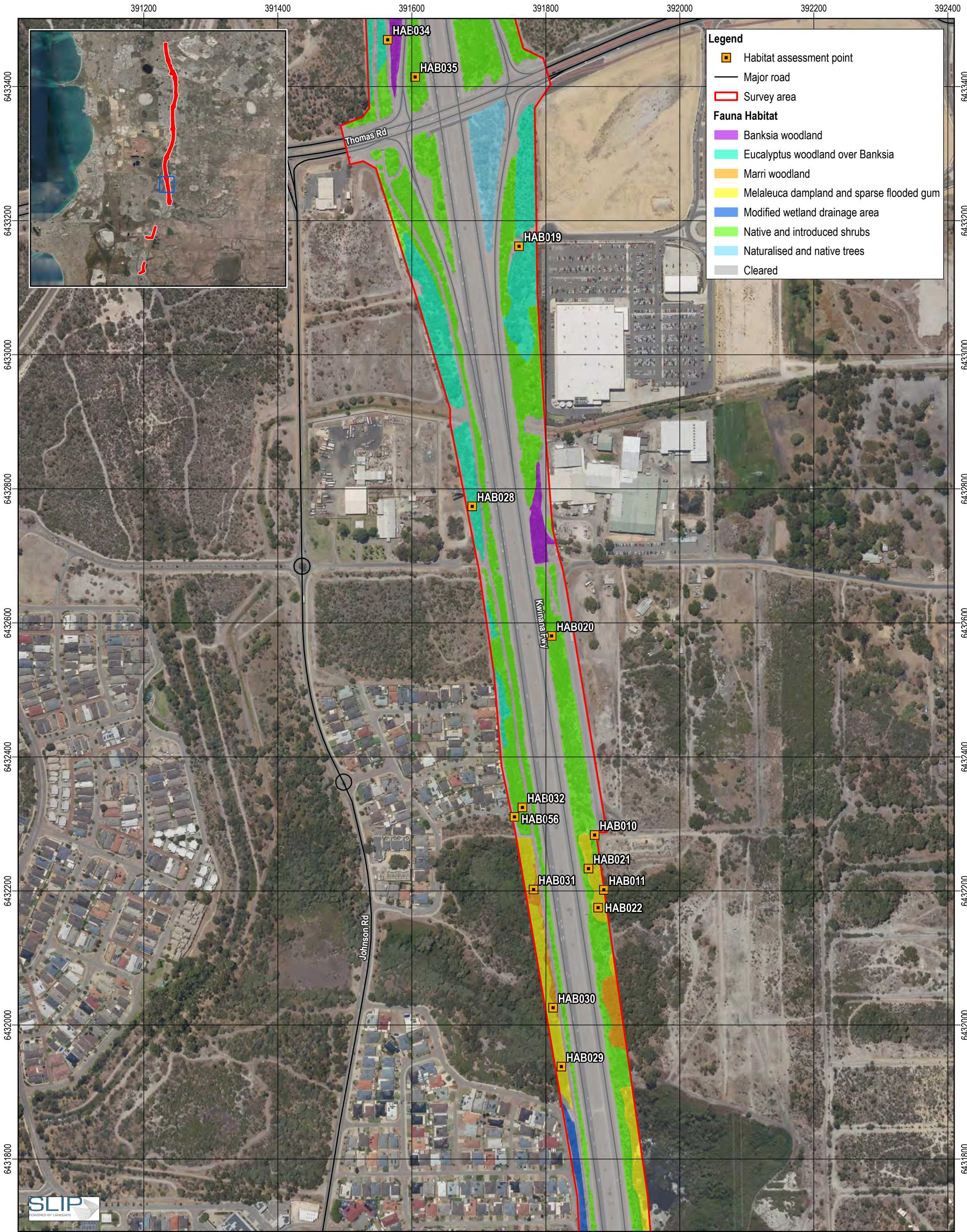


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

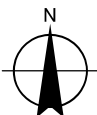
Fauna Habitats and
Significant Fauna

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FIGURE 9A



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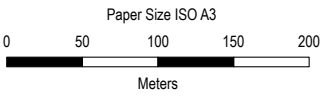
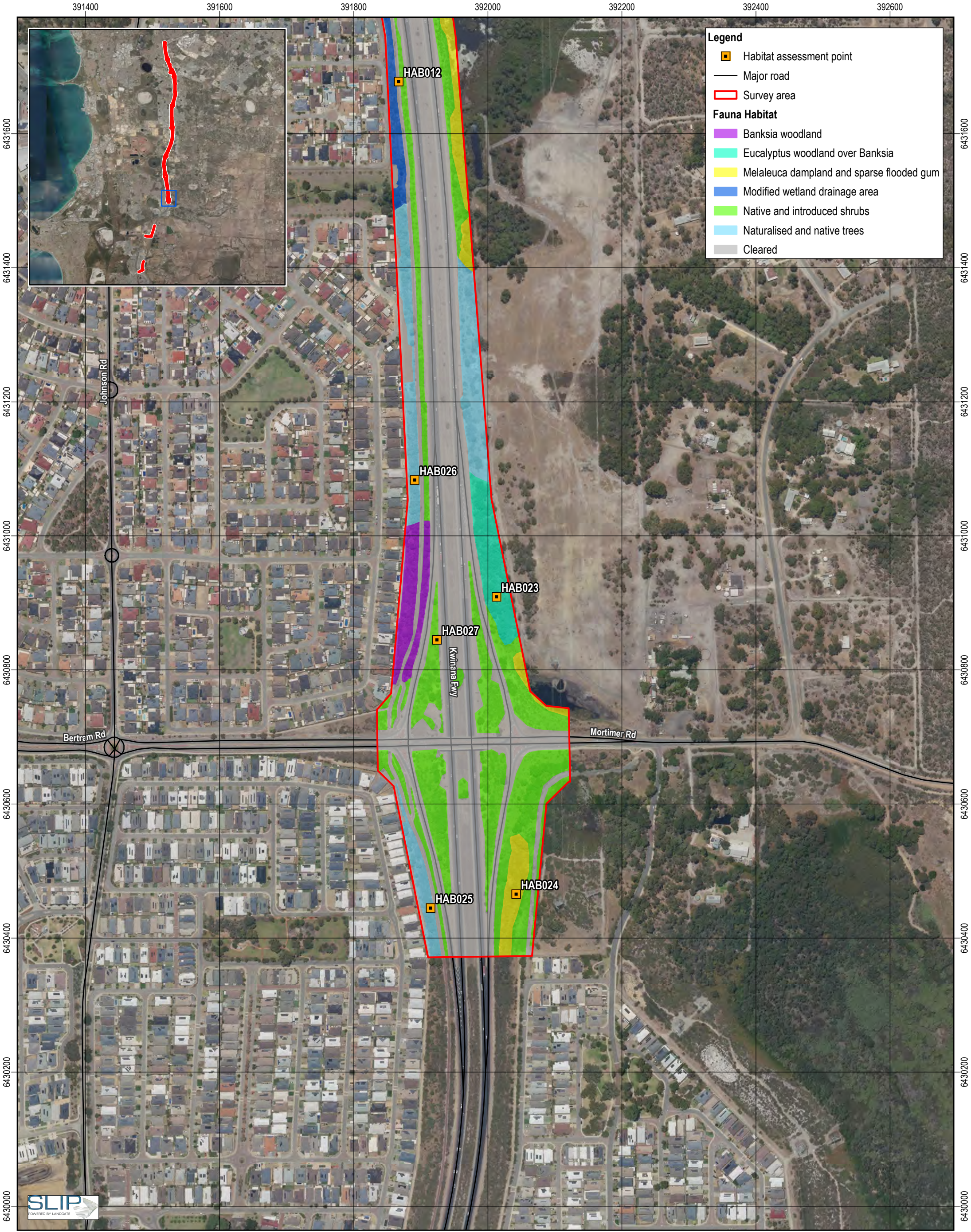


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

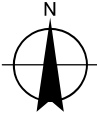
Fauna Habitats and
Significant Fauna

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FIGURE 9A



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

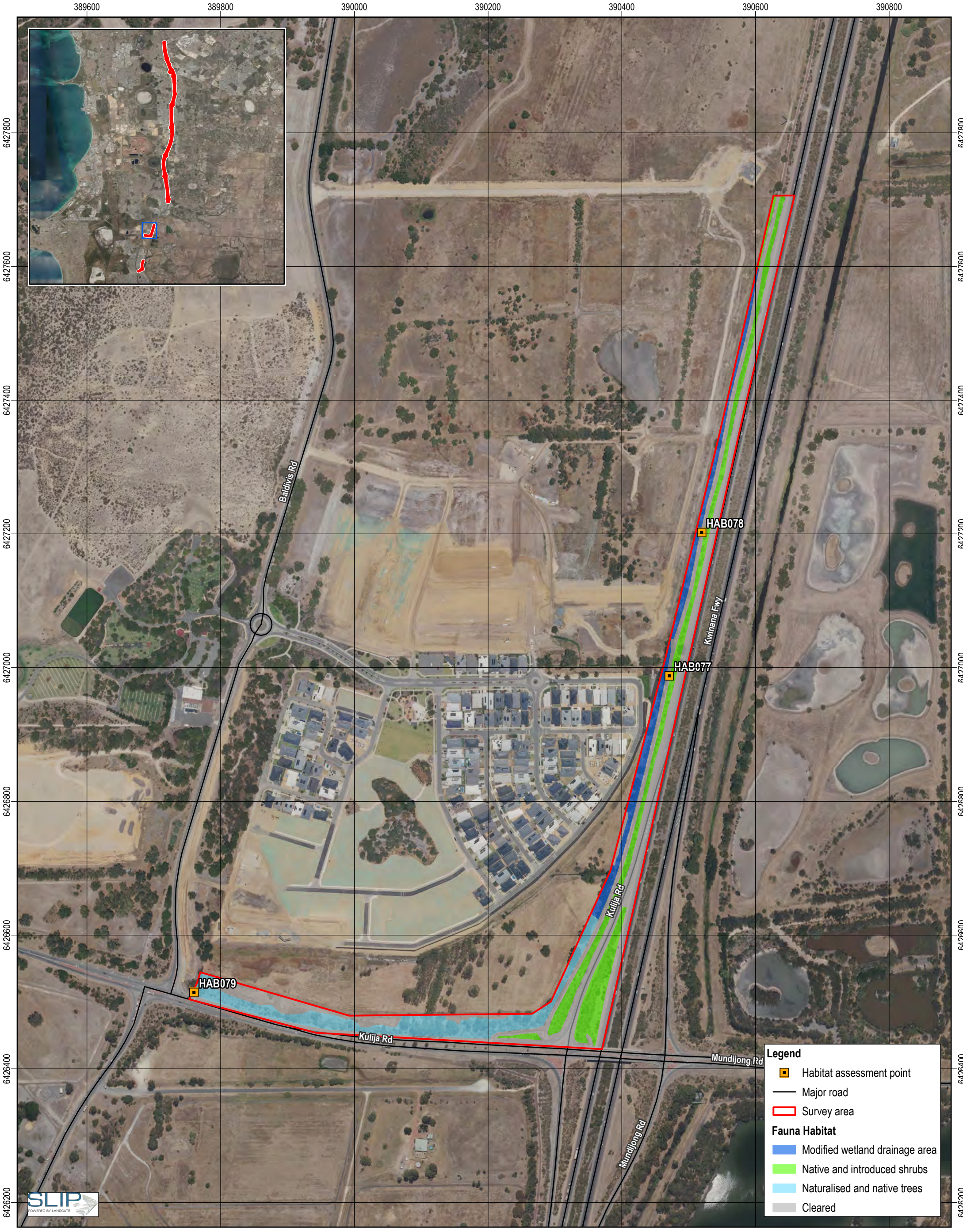


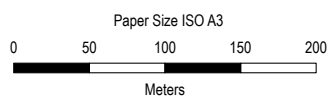
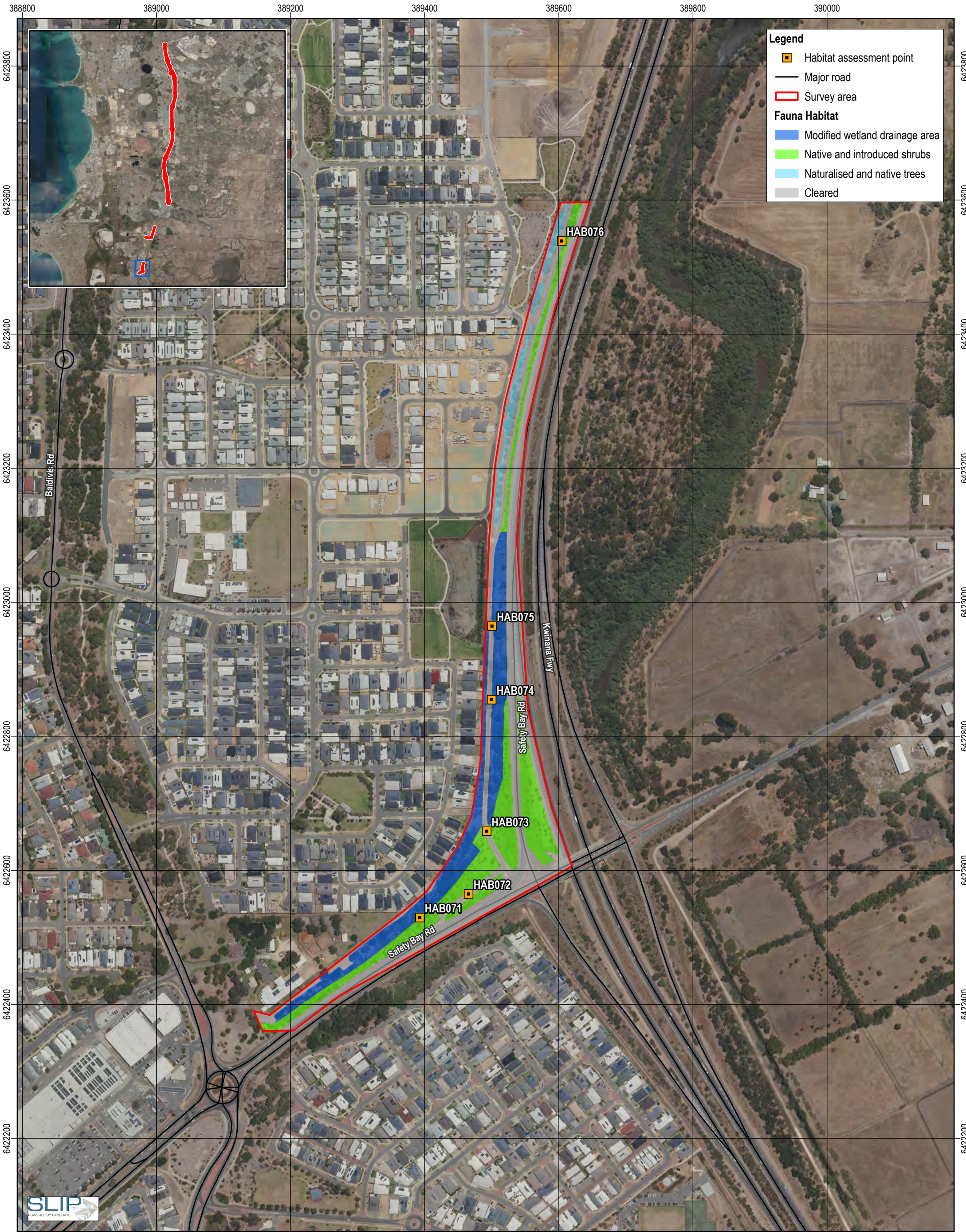
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

**Fauna Habitats and
Significant Fauna**

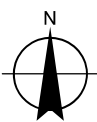
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FIGURE 9A





Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

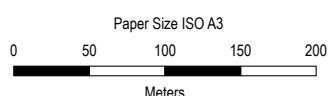
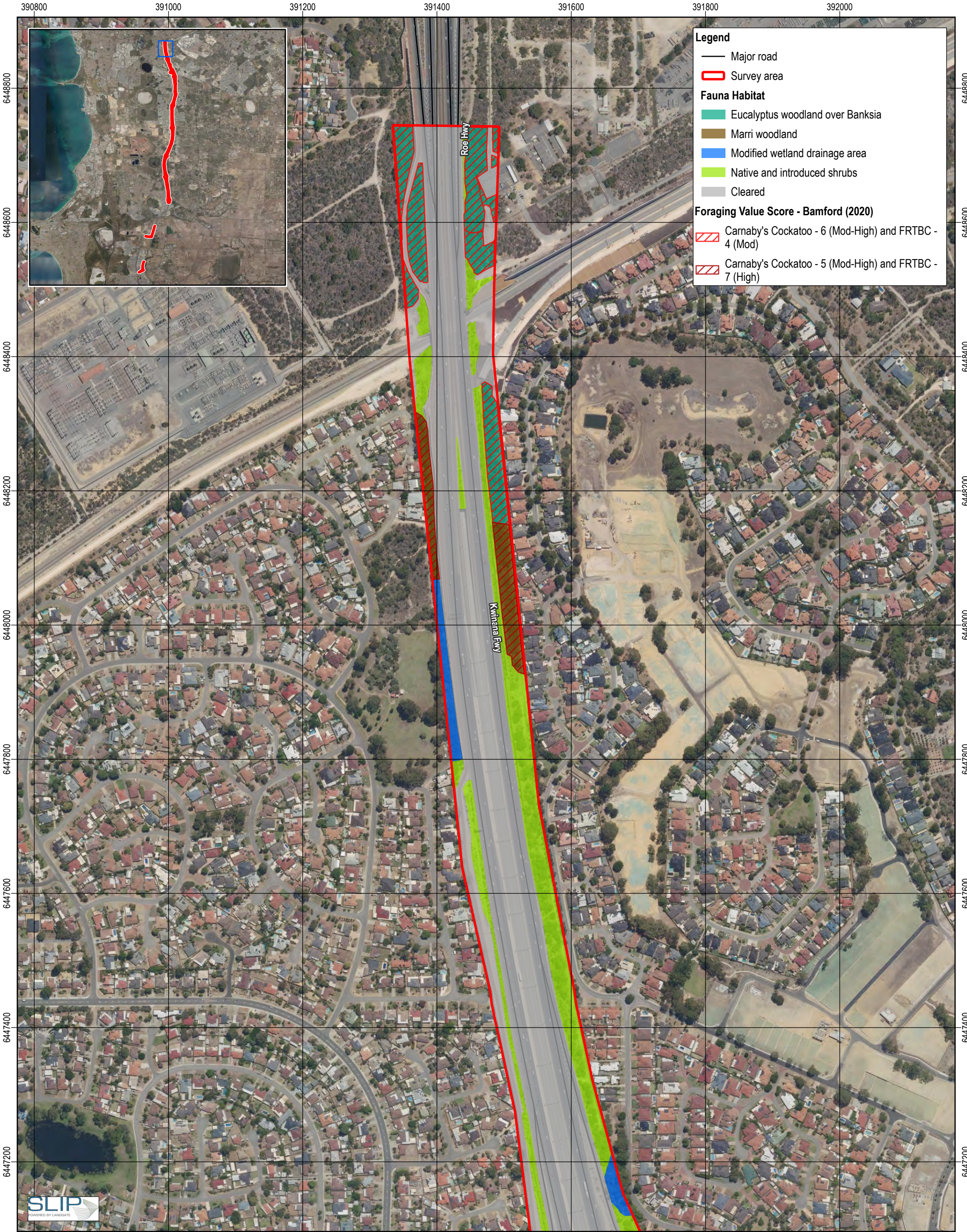


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

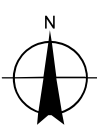
Fauna Habitats and
Significant Fauna

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FIGURE 9A



Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

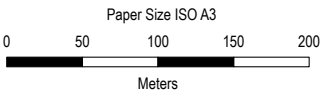
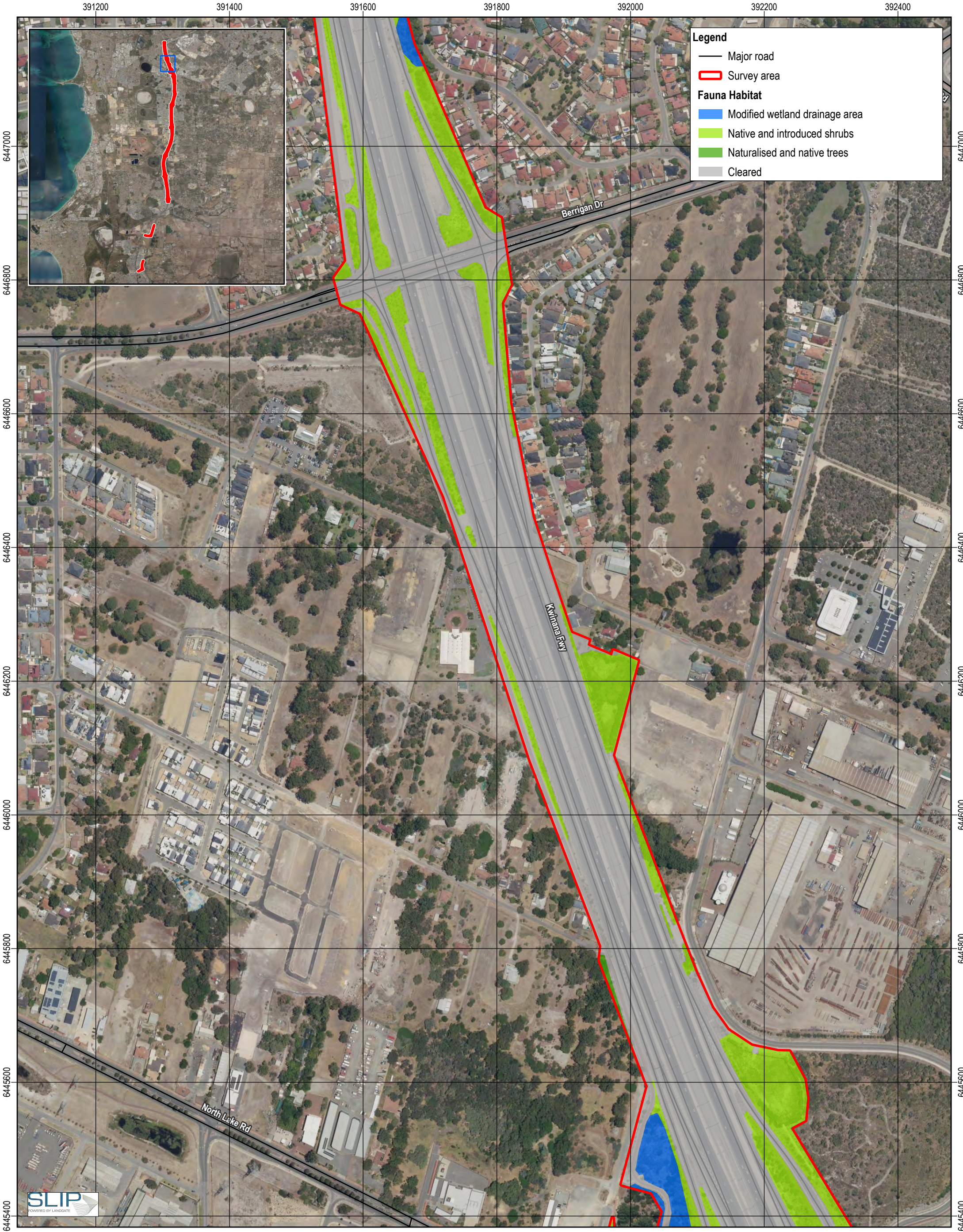


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

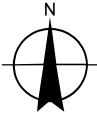
Black Cockatoo Foraging Habitat

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FIGURE 9B



Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

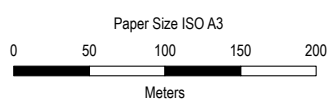
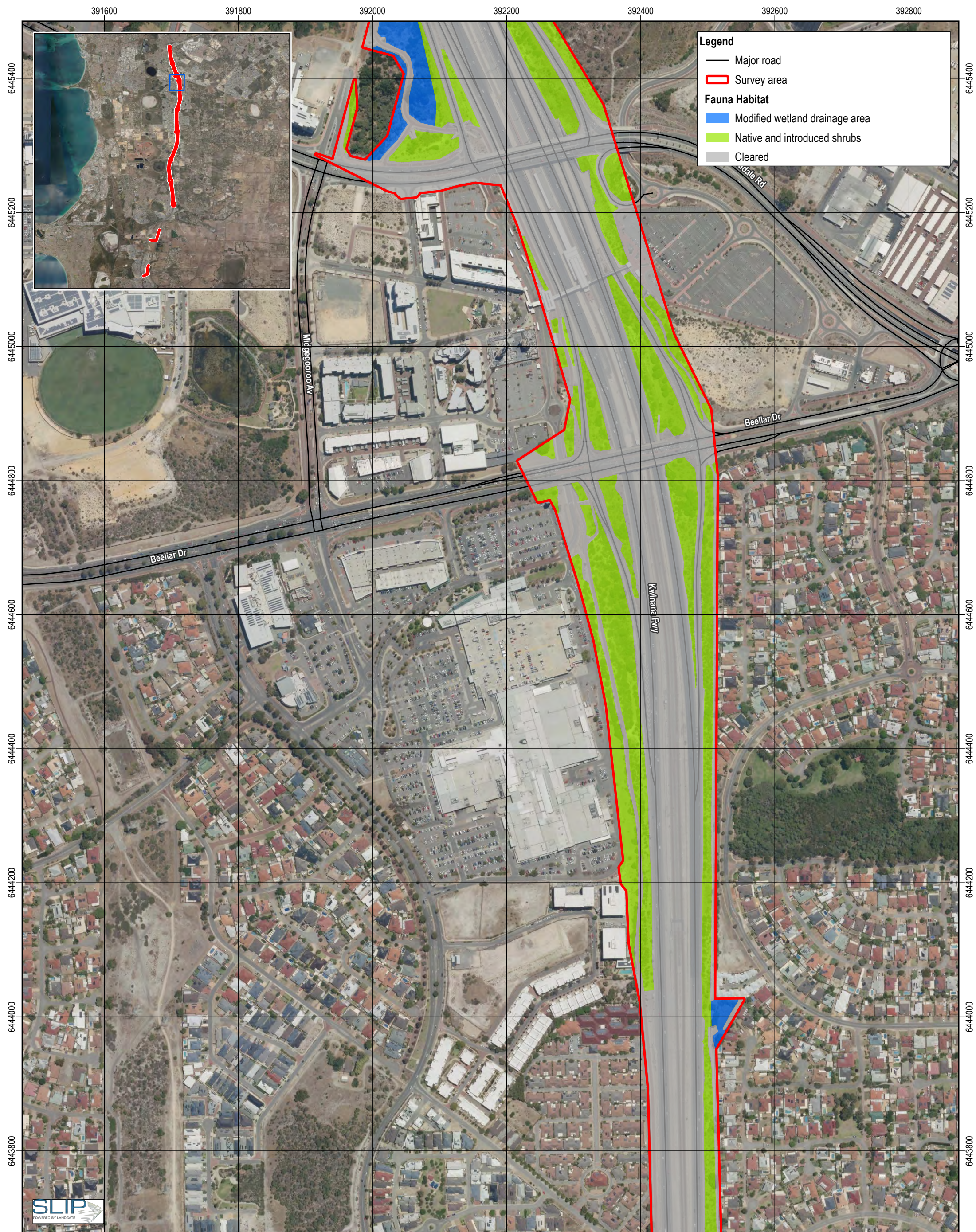


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

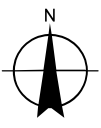
Black Cockatoo Foraging Habitat

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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

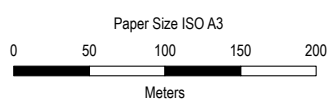
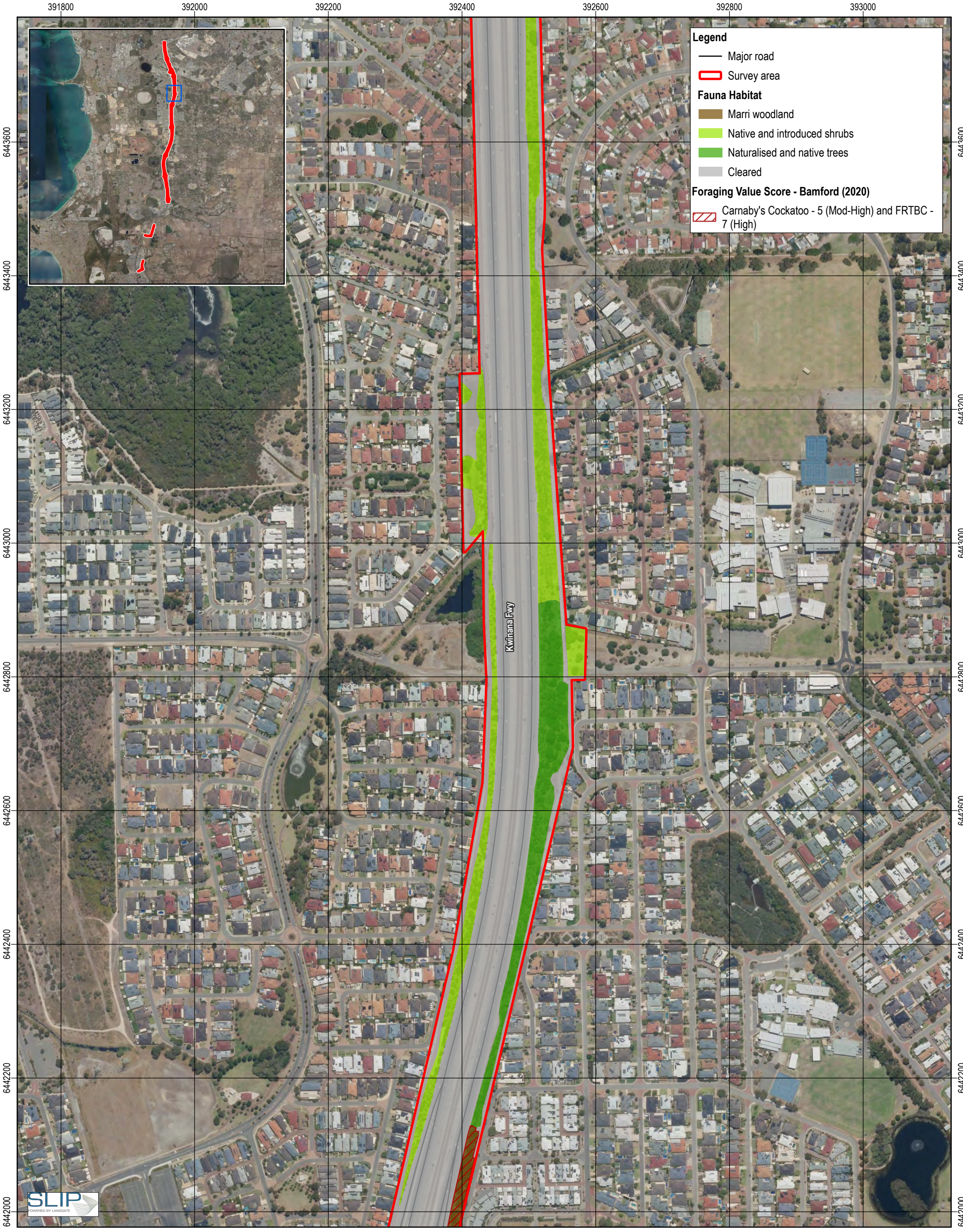


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

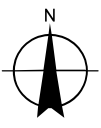
Black Cockatoo Foraging Habitat

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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

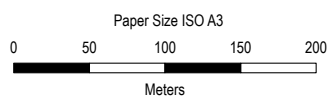
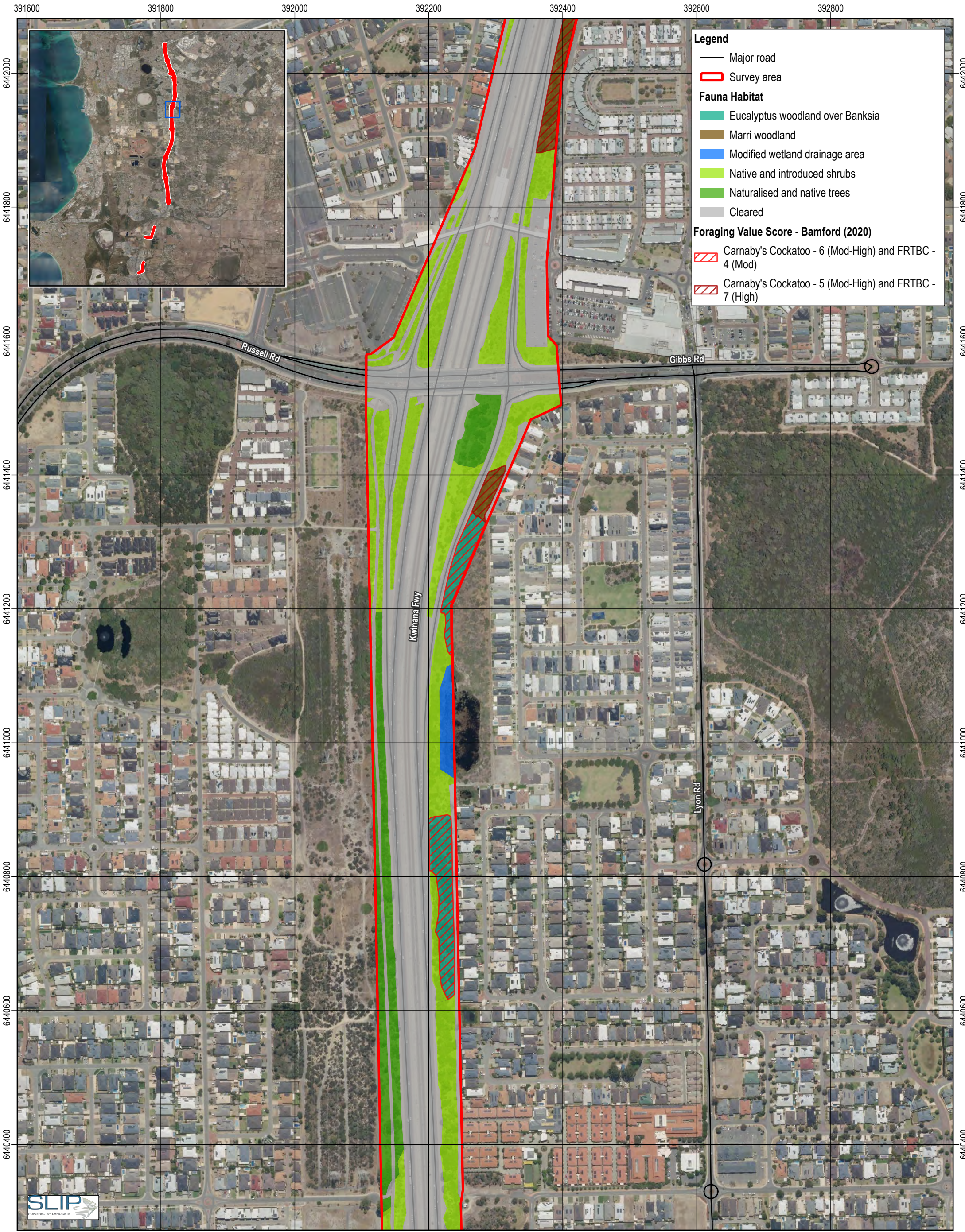


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

Black Cockatoo Foraging Habitat

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FIGURE 9B

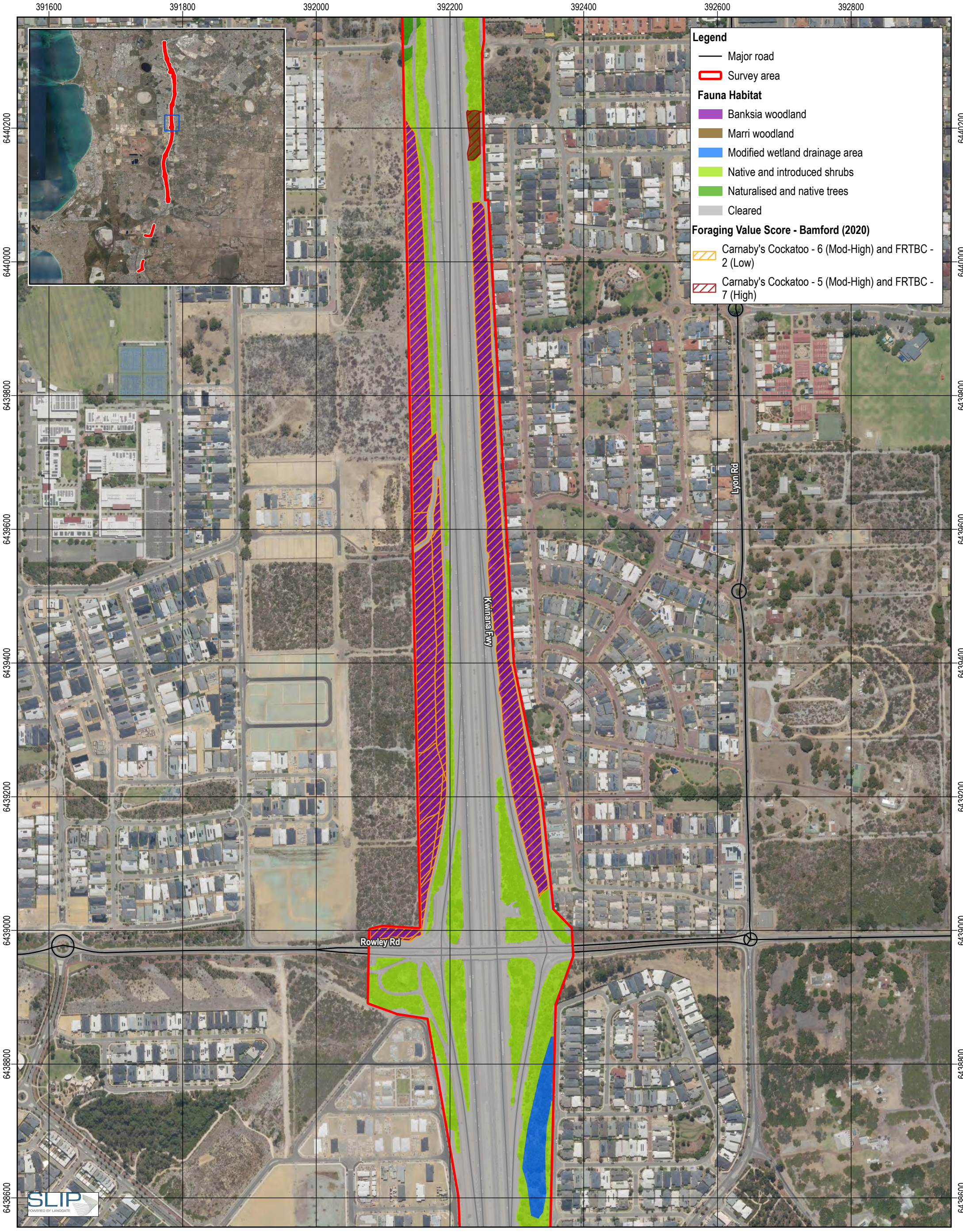


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Roe Hwy Widening Flora and Fauna Assessment

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Black Cockatoo Foraging Habitat

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FIGURE 9B



Legend

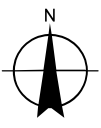
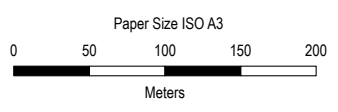
- Major road
- Survey area

Fauna Habitat

- Banksia woodland
- Marri woodland
- Modified wetland drainage area
- Native and introduced shrubs
- Naturalised and native trees
- Cleared

Foraging Value Score - Bamford (2020)

- Carnaby's Cockatoo - 6 (Mod-High) and FRTBC - 2 (Low)
- Carnaby's Cockatoo - 5 (Mod-High) and FRTBC - 7 (High)

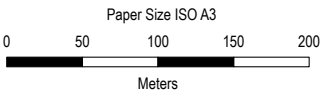
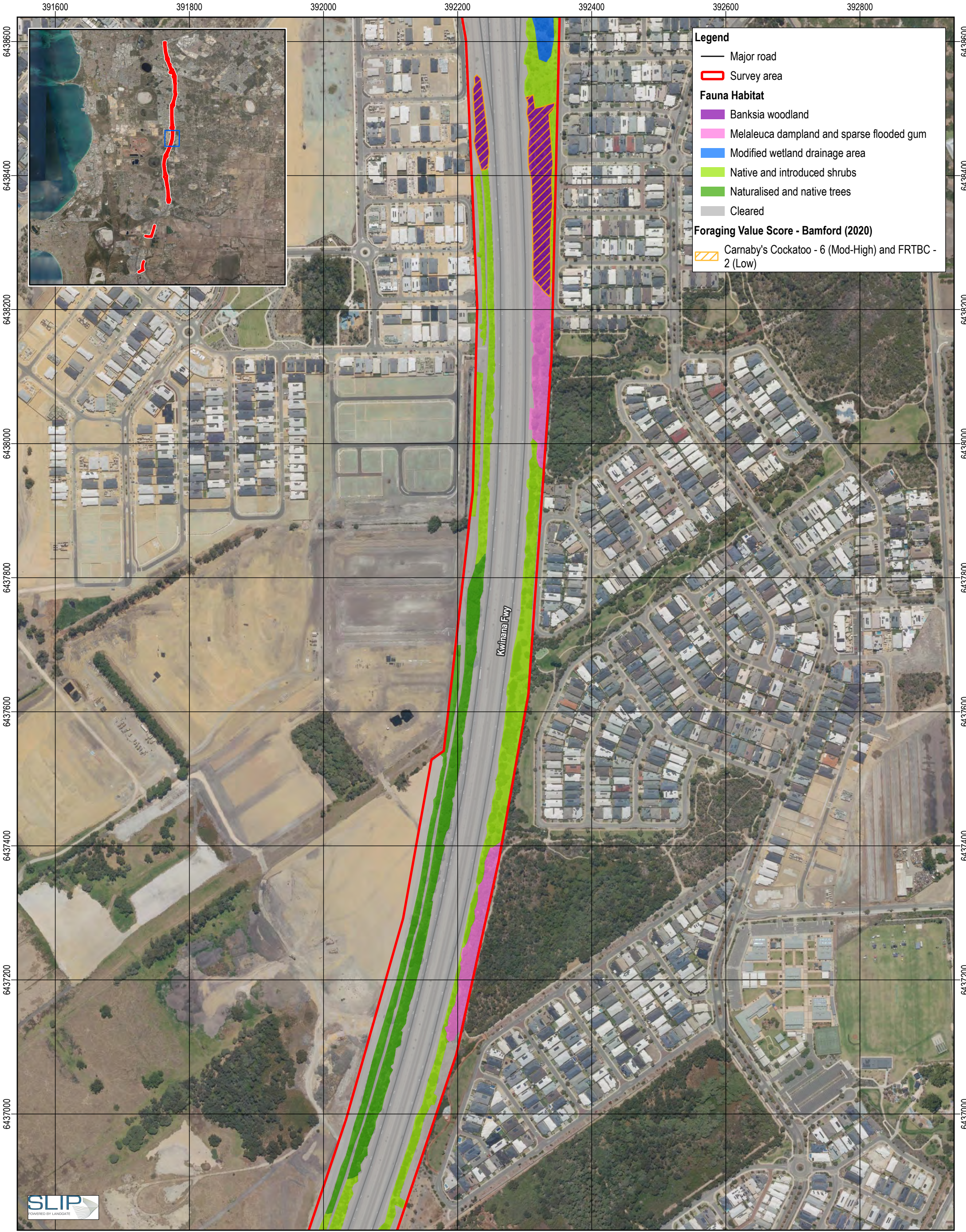


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

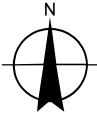
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Black Cockatoo Foraging Habitat

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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

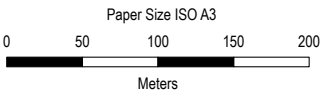
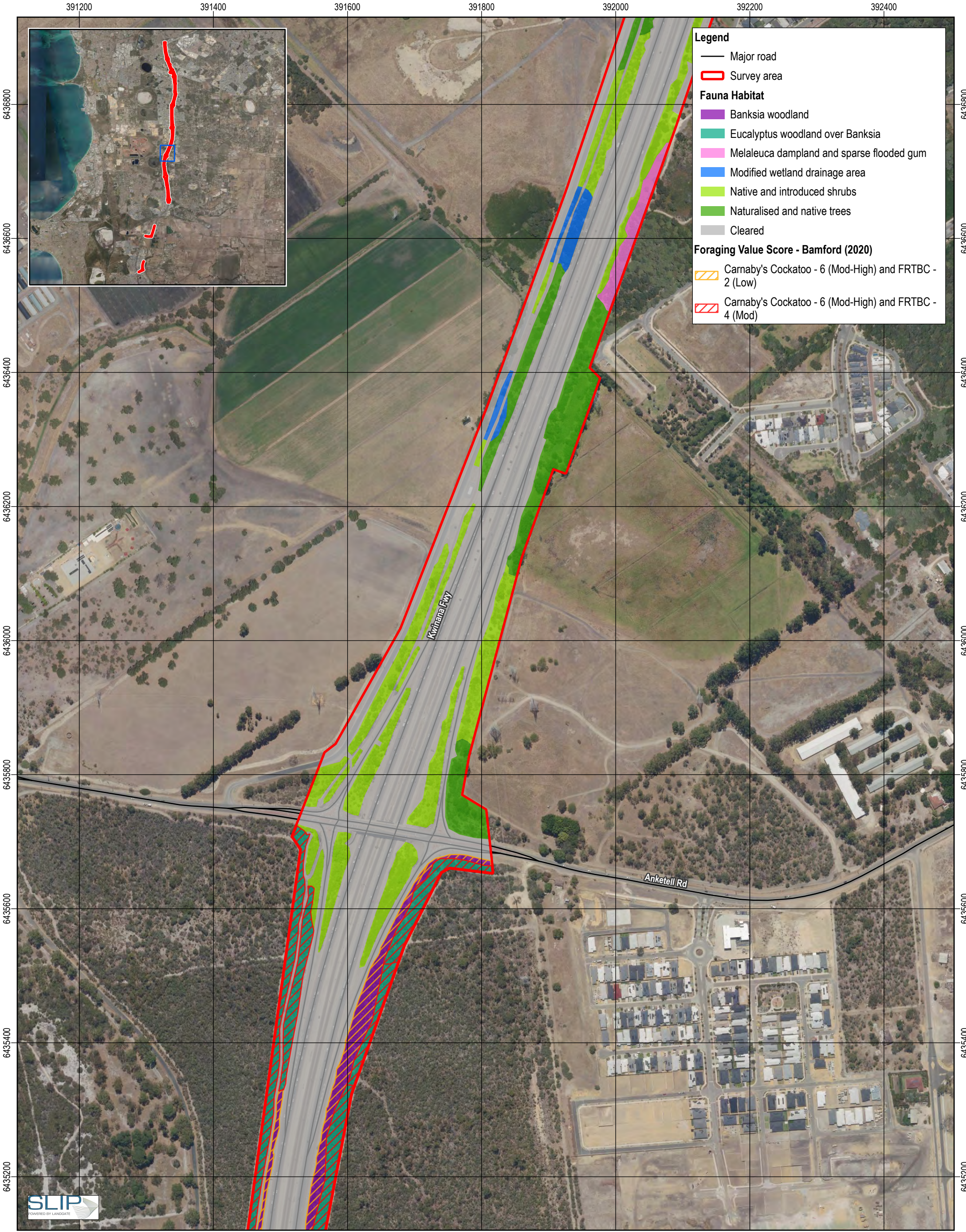


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

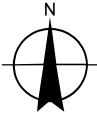
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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

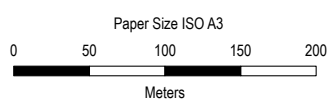
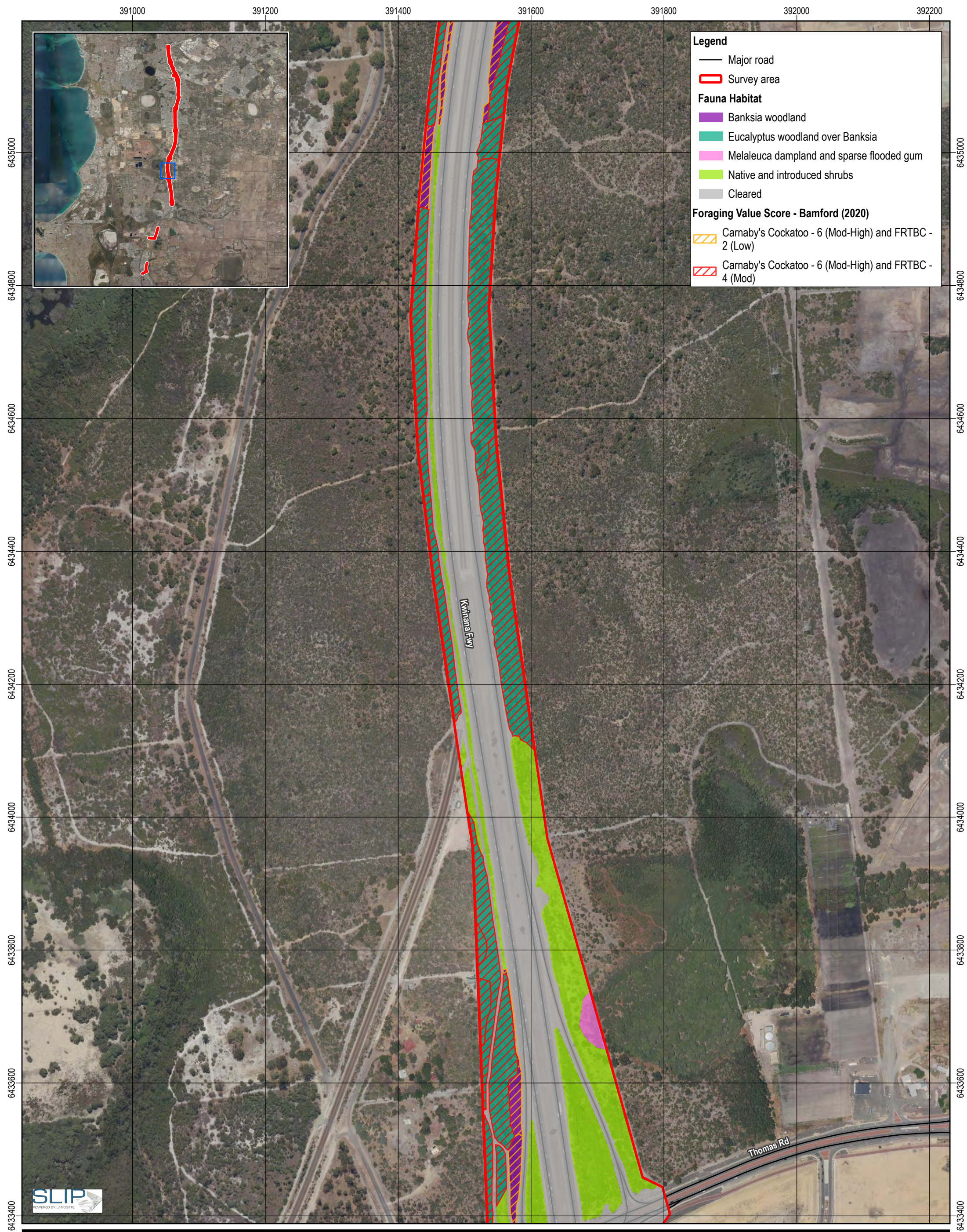


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

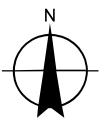
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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

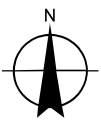
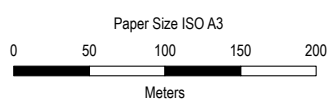
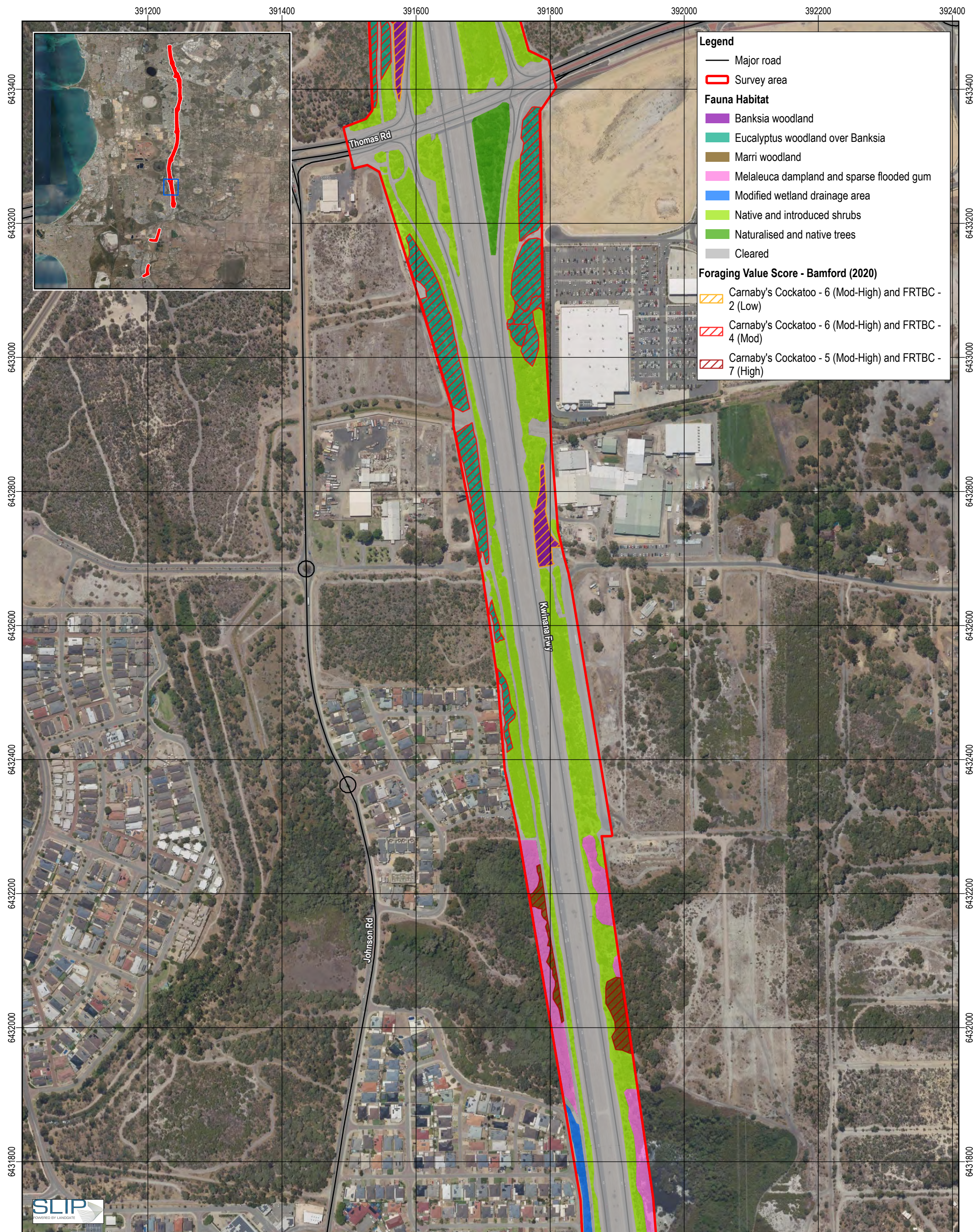


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Roe Hwy Widening Flora and Fauna Assessment

Black Cockatoo Foraging Habitat

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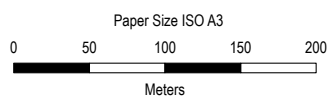
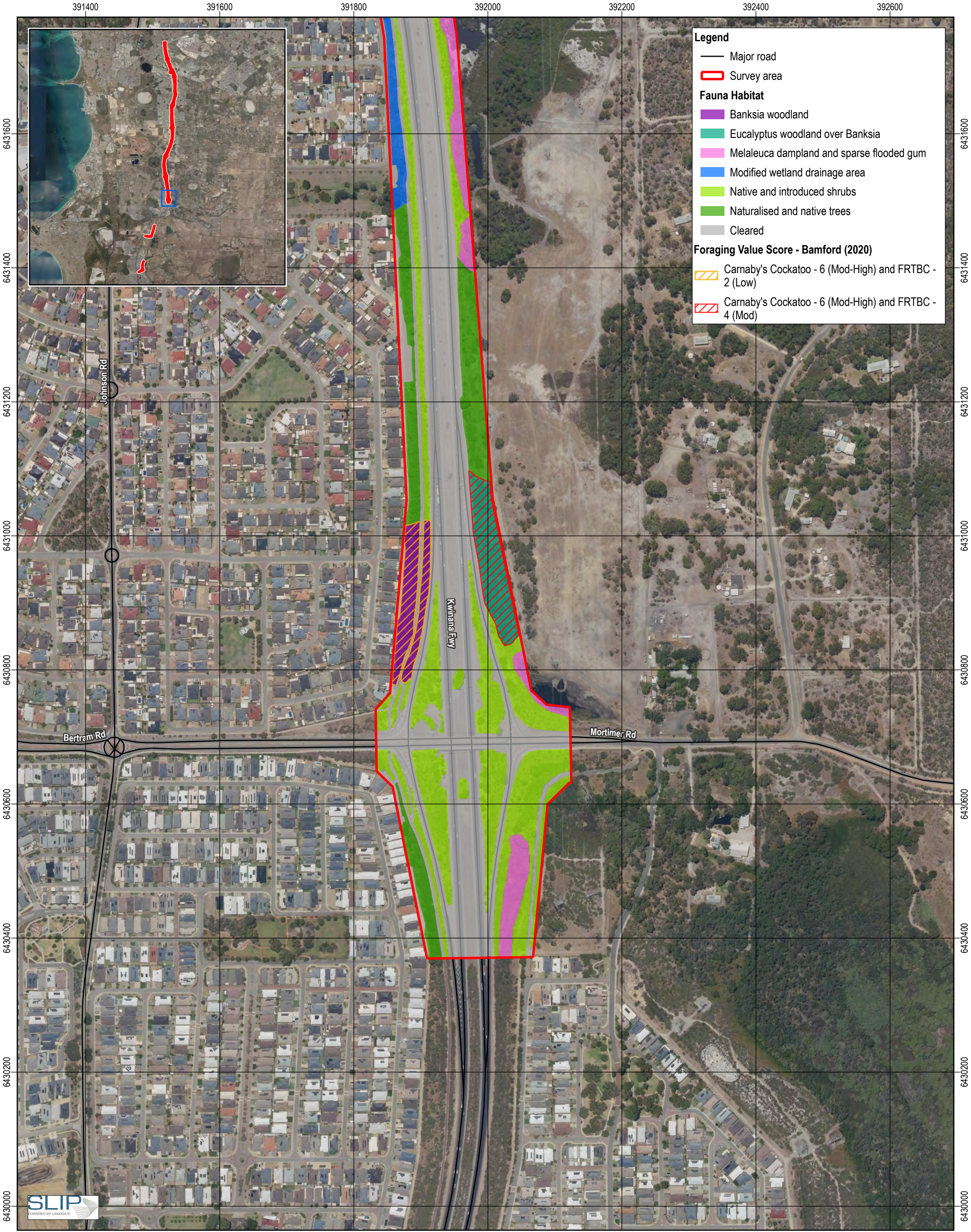


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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

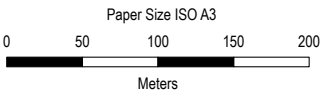
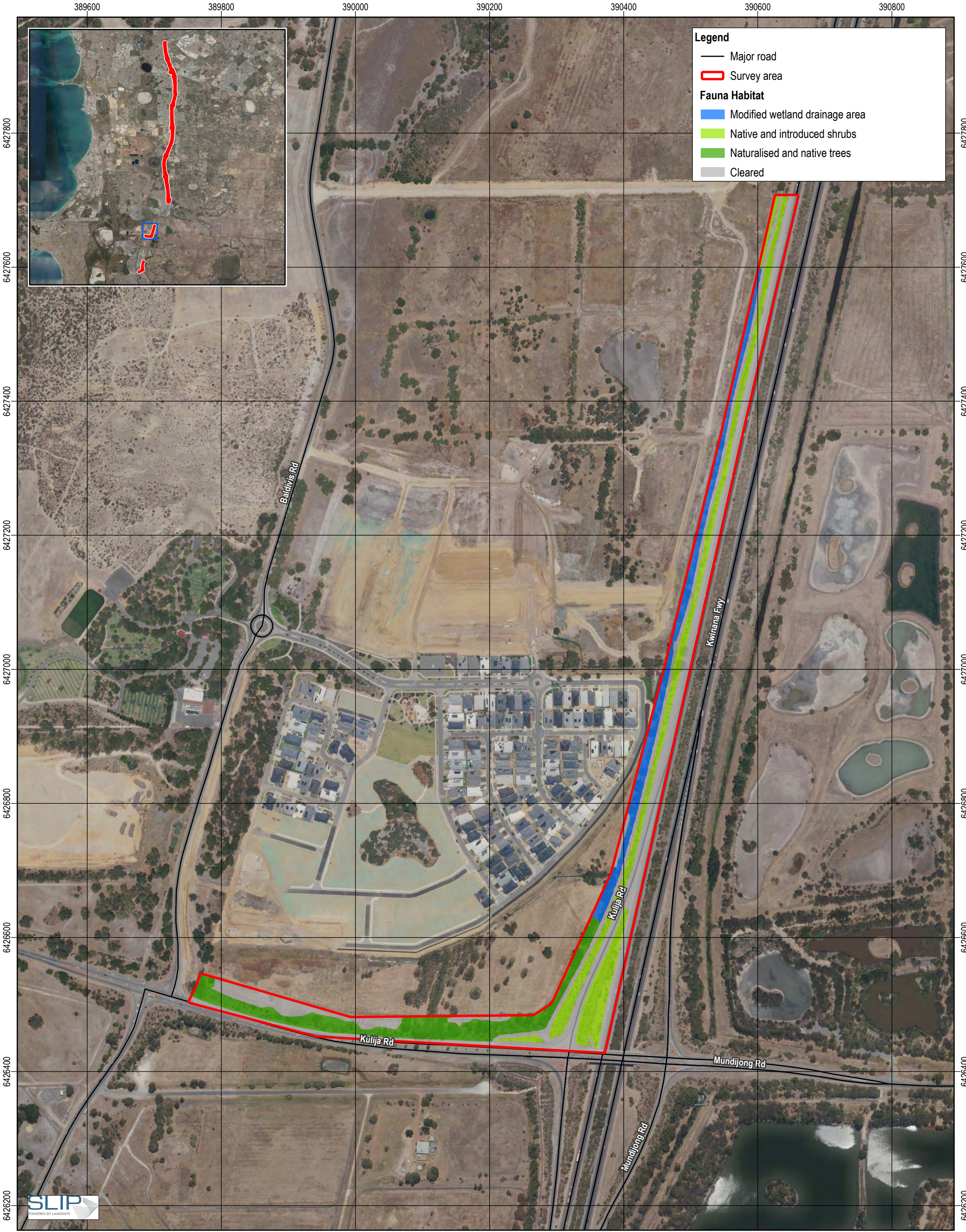


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Roe Hwy Widening Flora and Fauna Assessment

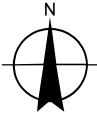
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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

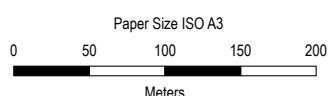
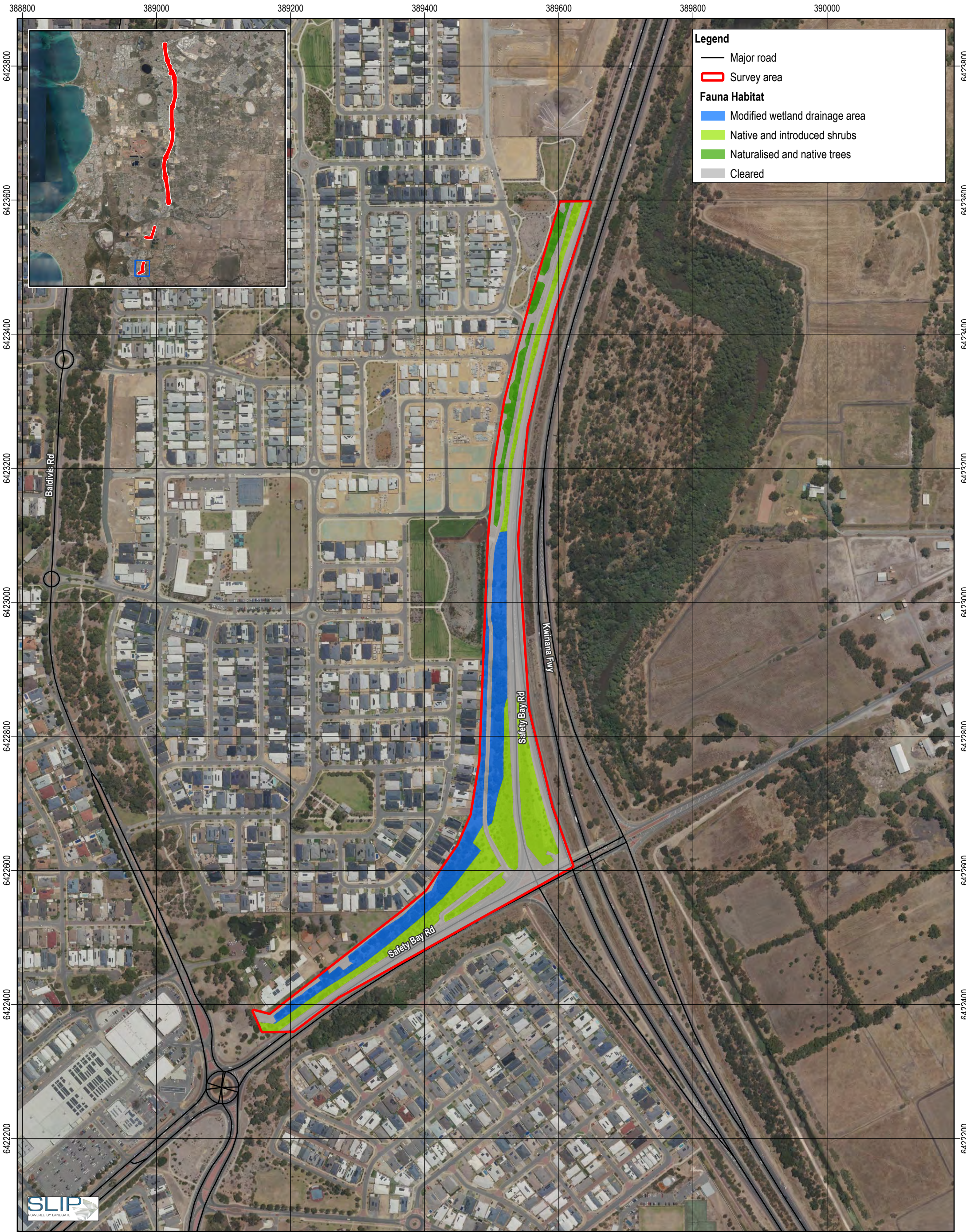


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

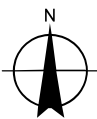
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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

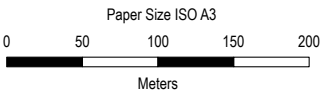
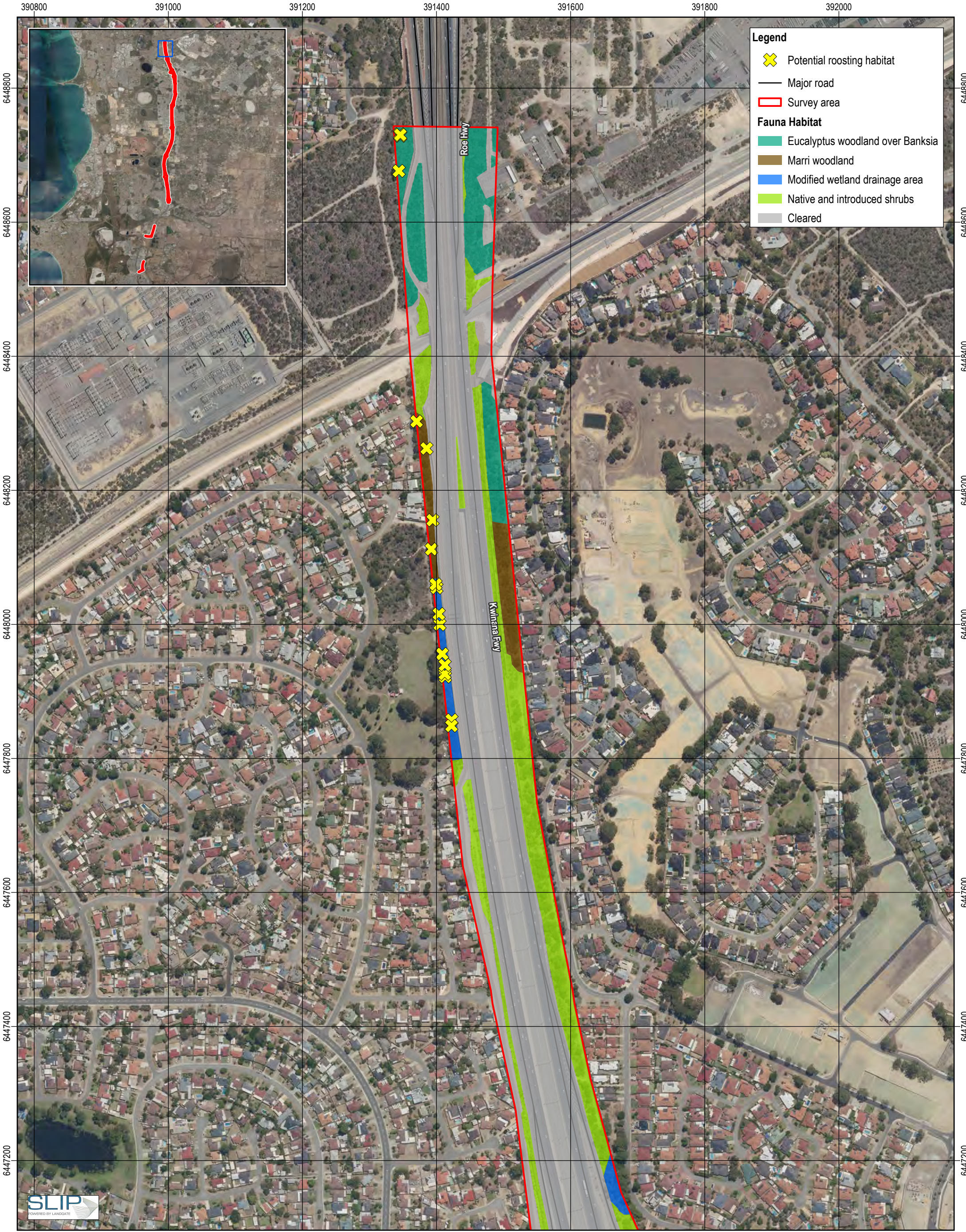


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

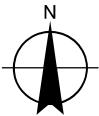
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FIGURE 9B



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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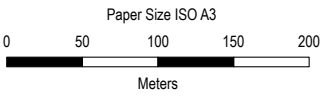
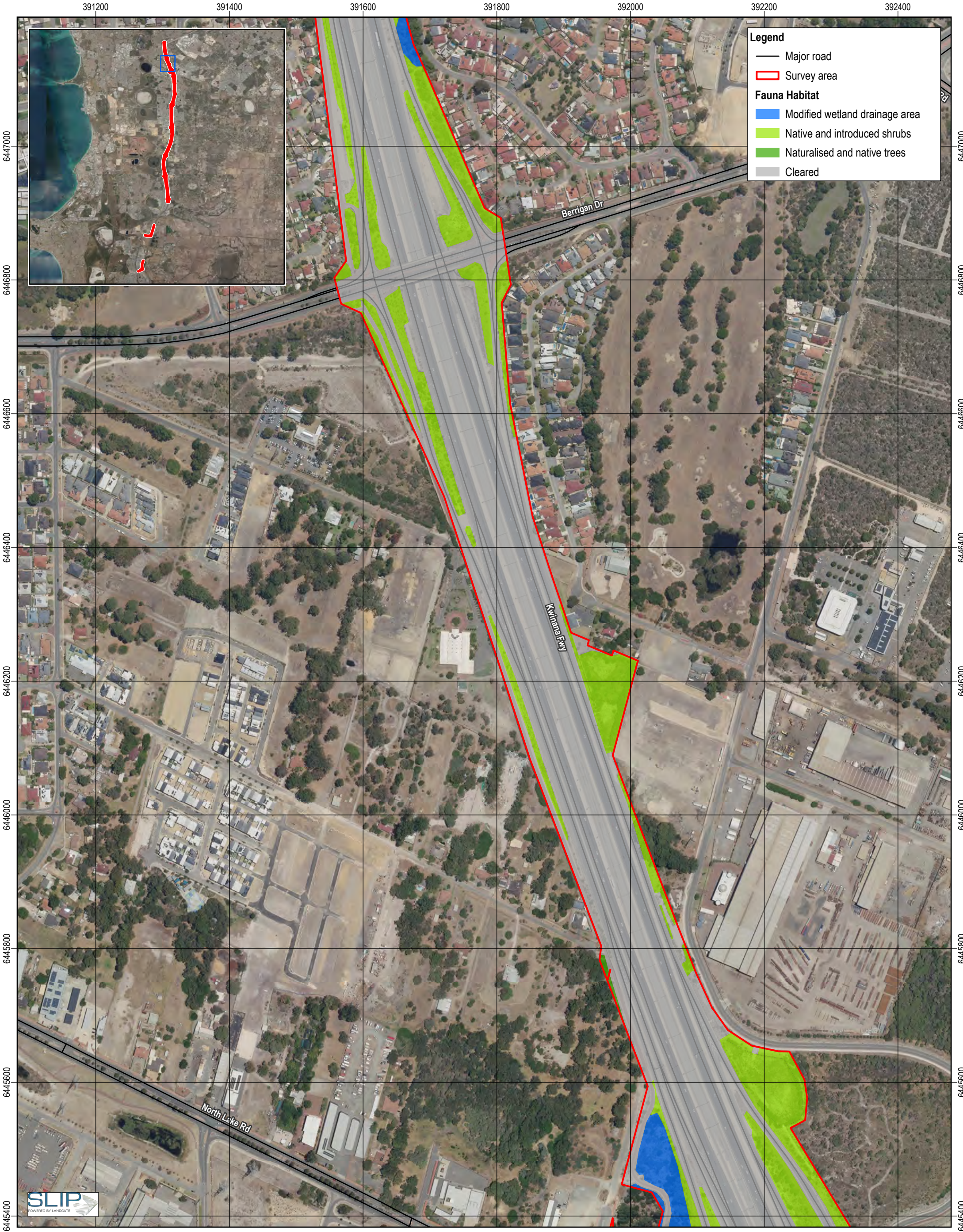


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

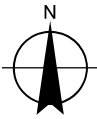
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FIGURE 9C



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

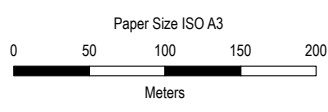
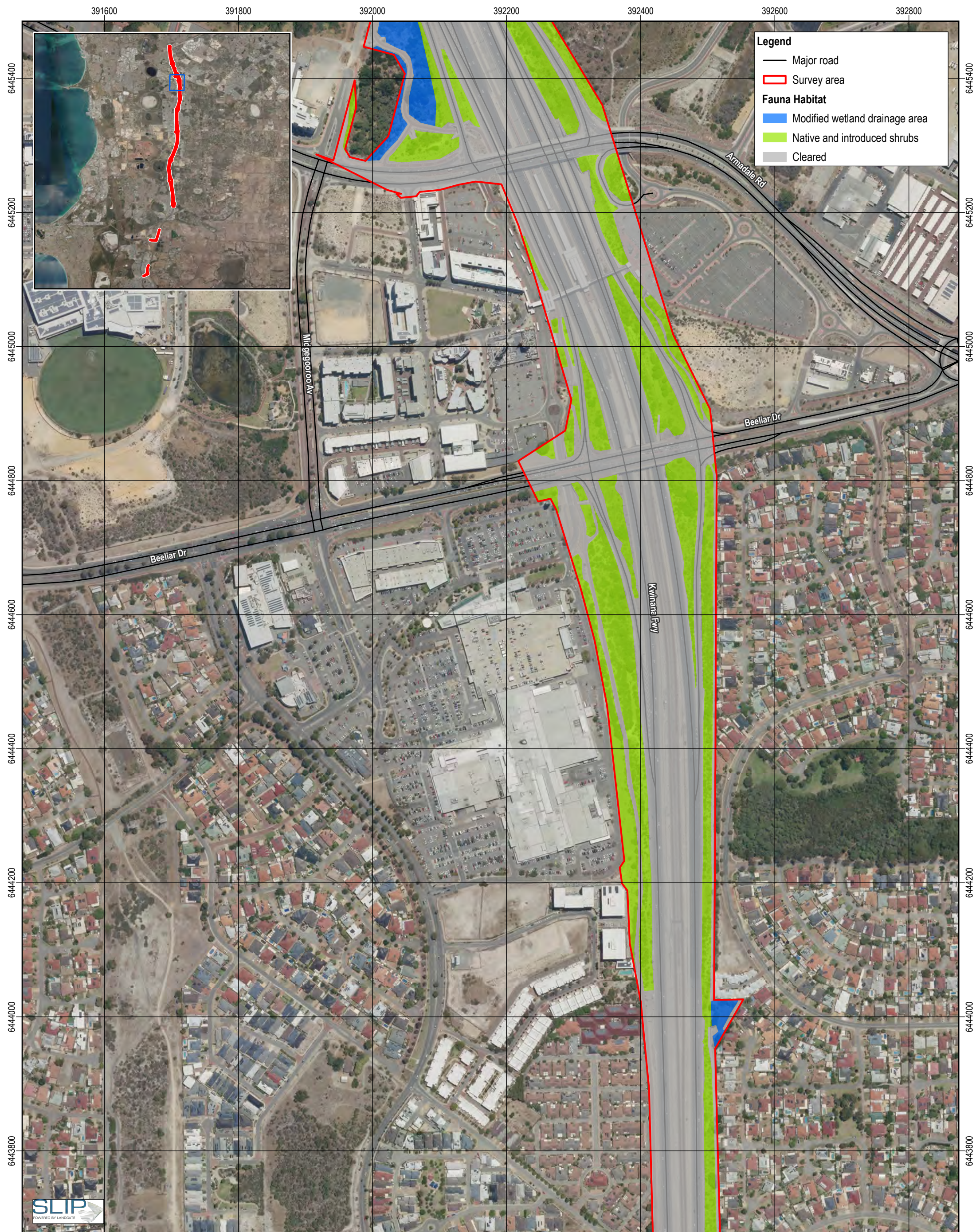


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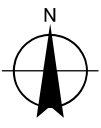
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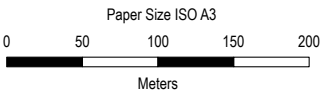
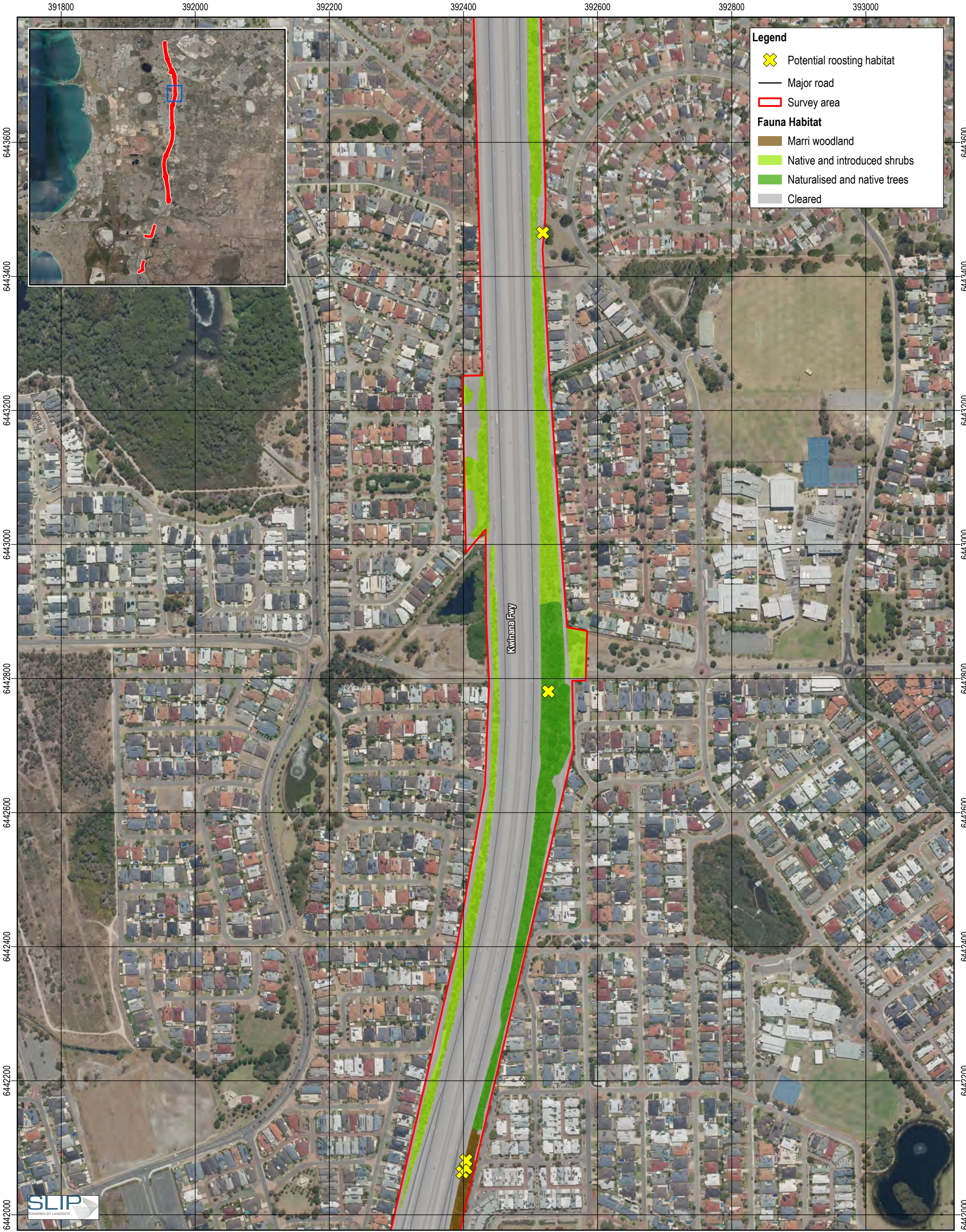
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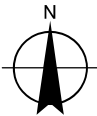
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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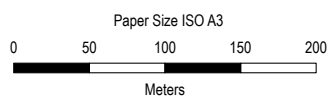
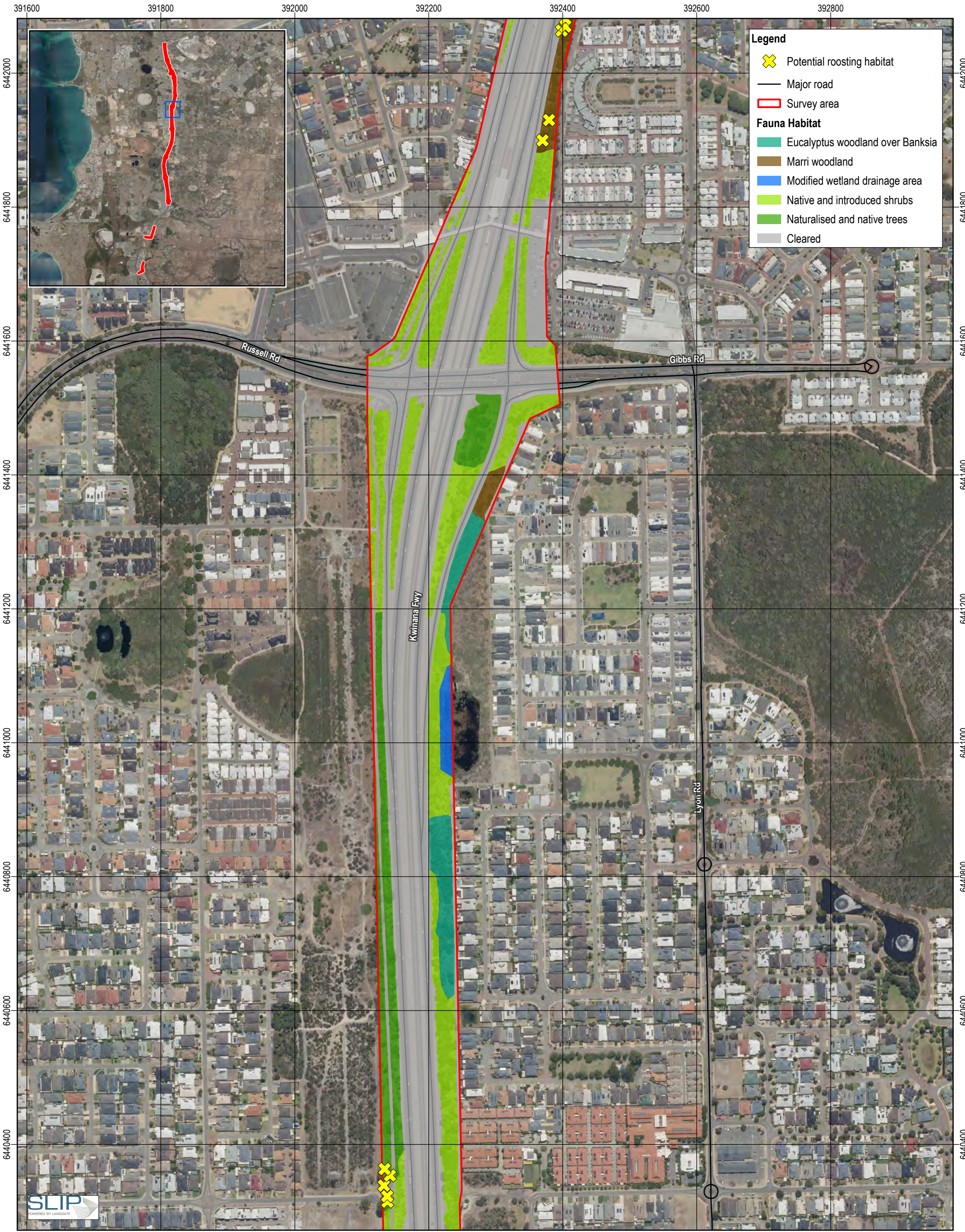
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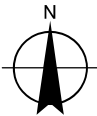
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Grid: GDA2020 MGA Zone 50

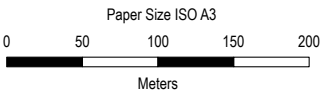
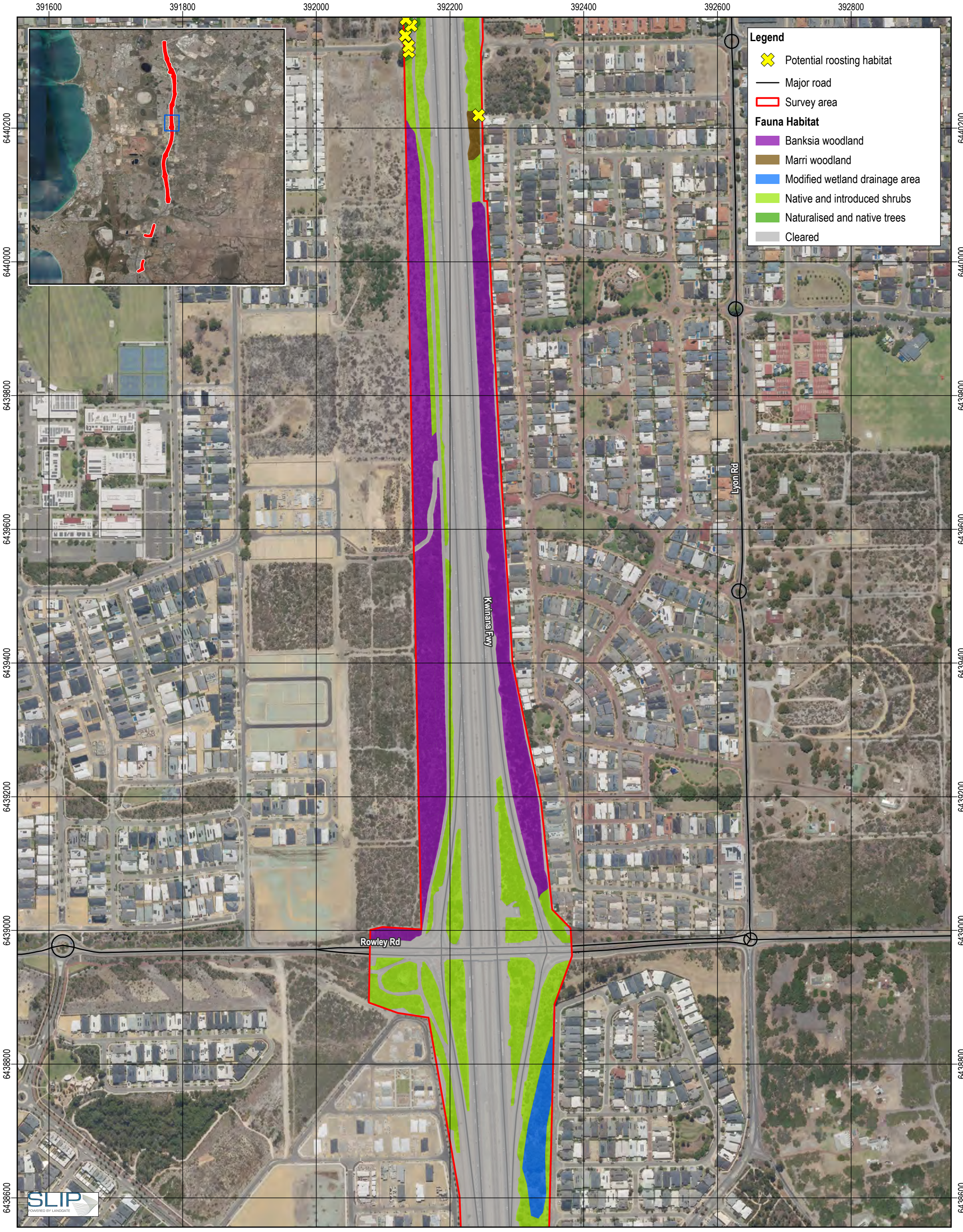


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Roe Hwy Widening Flora and Fauna Assessment

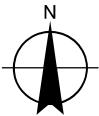
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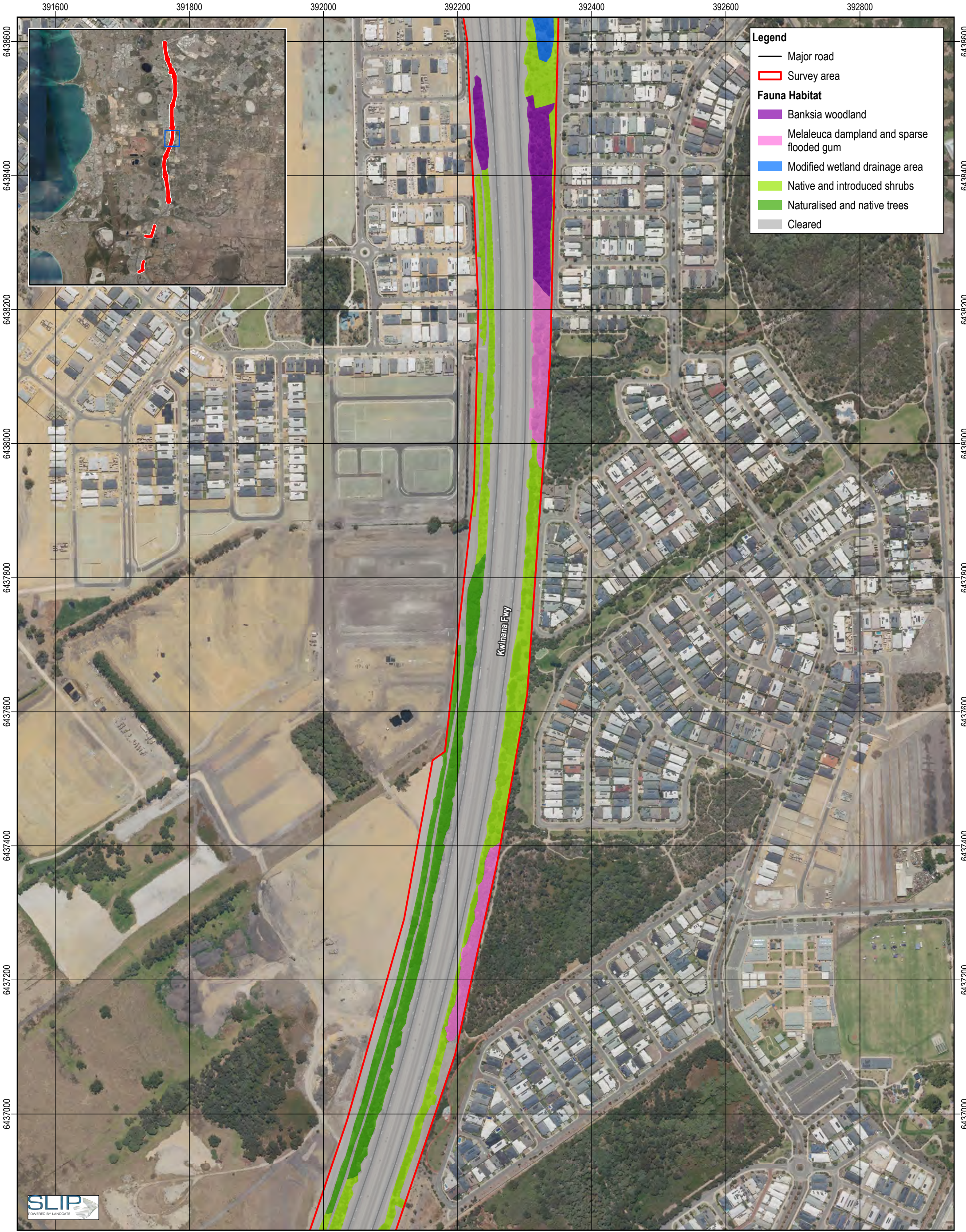
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Main Roads
Roe Hwy Widening Flora and Fauna Assessment

**Black Cockatoo Potential
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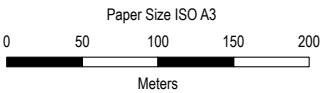
Legend

— Major road

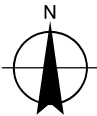
▭ Survey area

Fauna Habitat

- ▭ Banksia woodland
- ▭ Melaleuca dampland and sparse flooded gum
- ▭ Modified wetland drainage area
- ▭ Native and introduced shrubs
- ▭ Naturalised and native trees
- ▭ Cleared



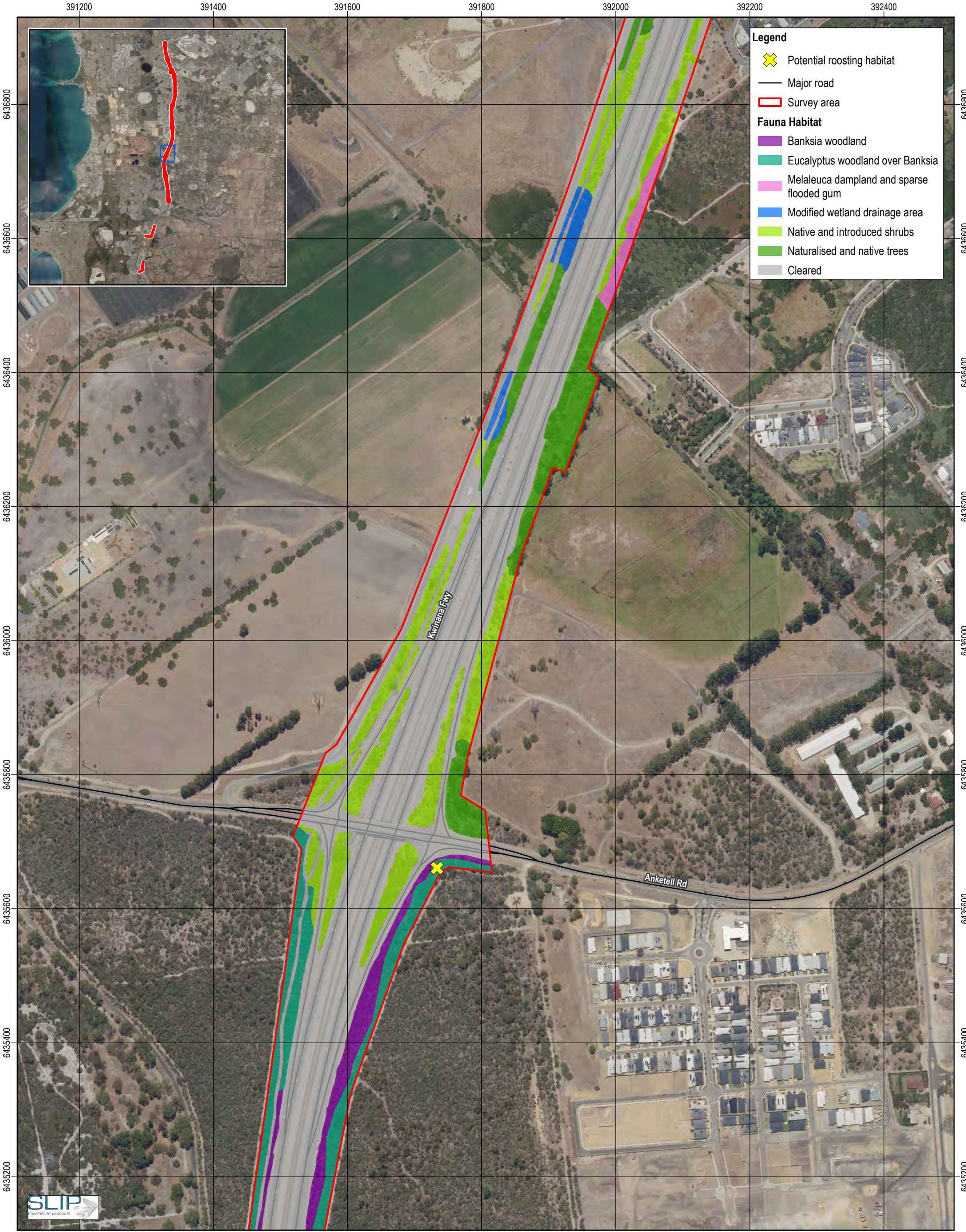
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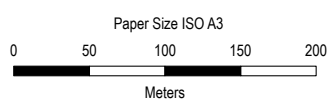
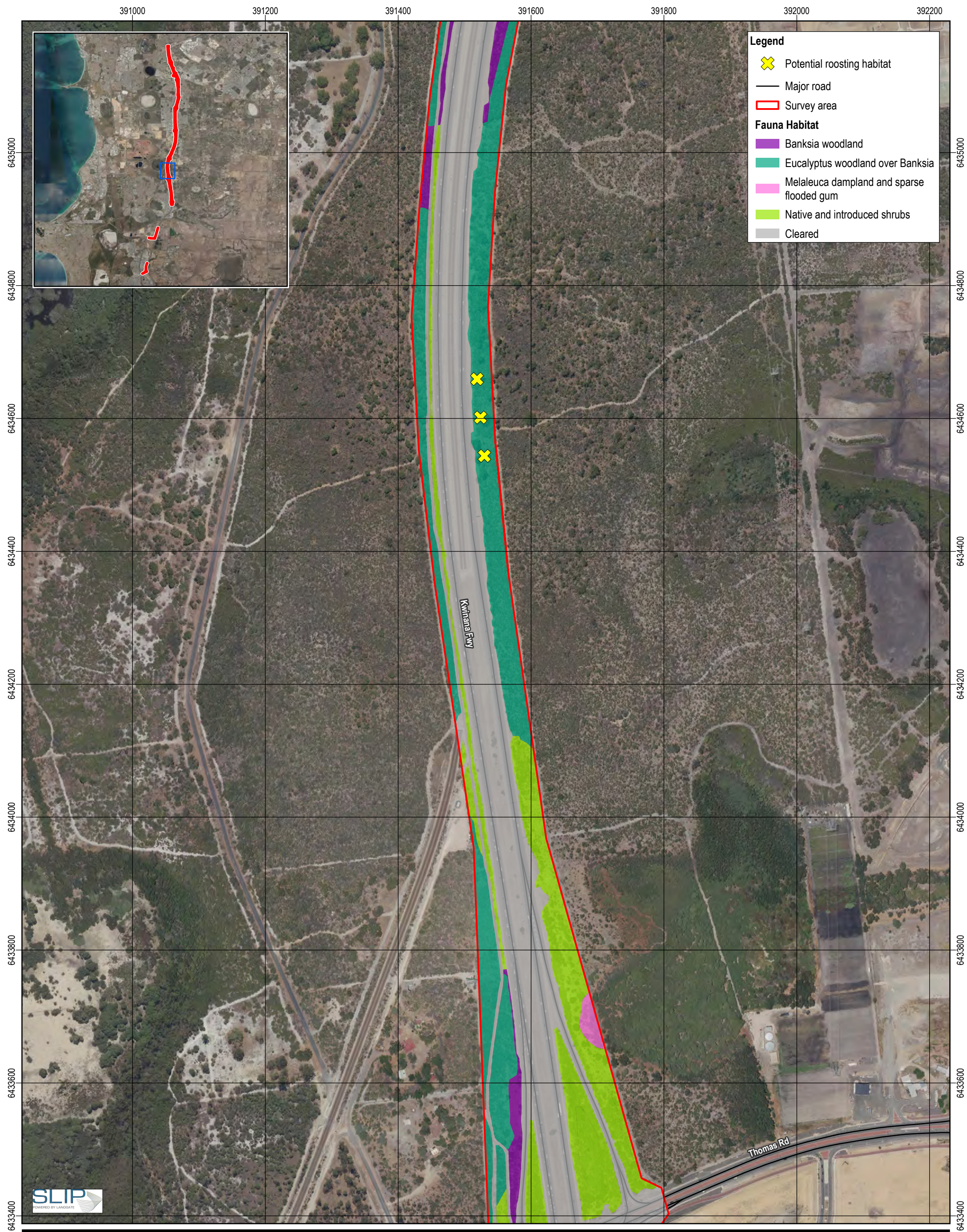


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

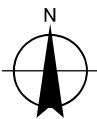
**Black Cockatoo Potential
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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

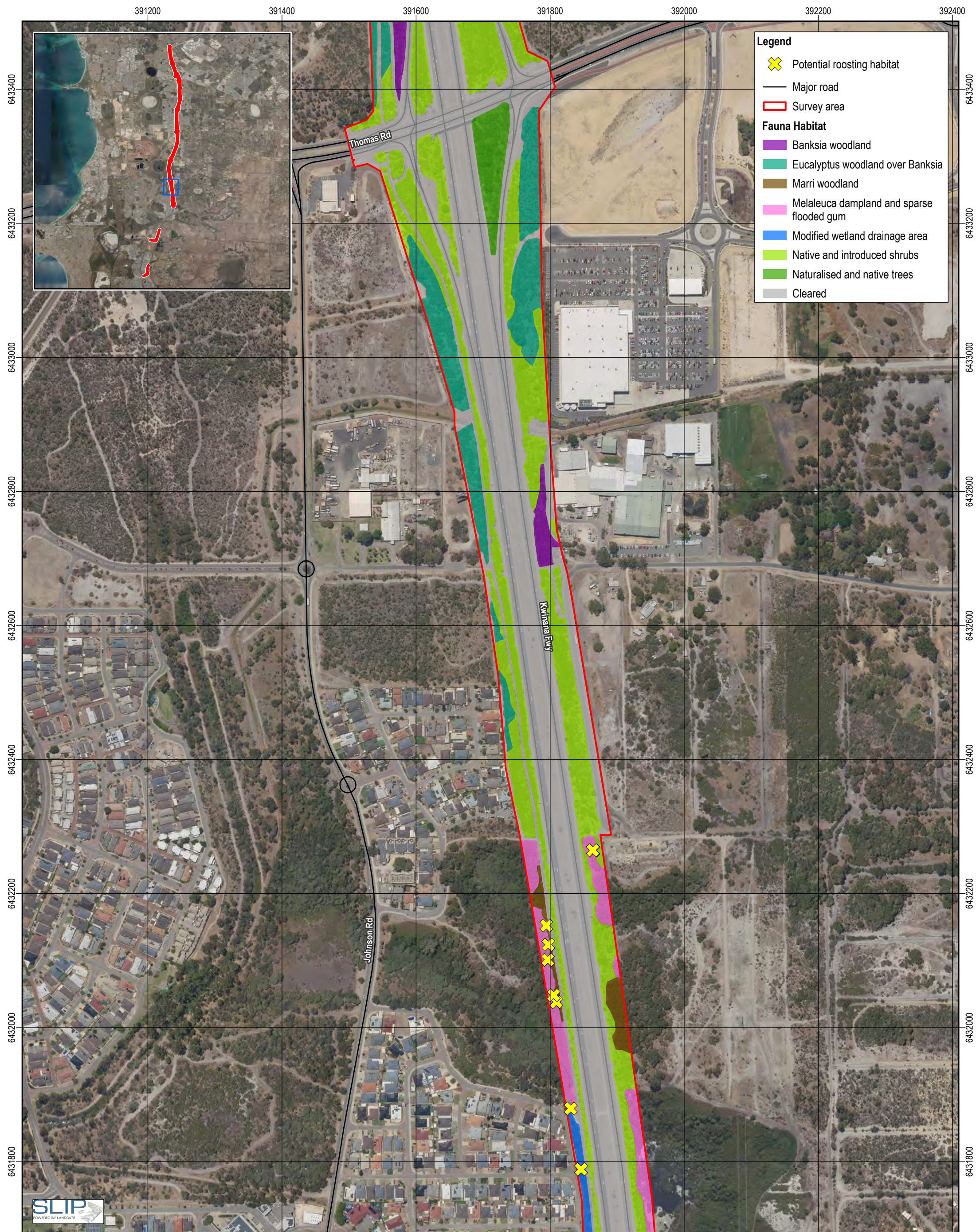


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**Black Cockatoo Potential
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FIGURE 9C



Legend

- Potential roosting habitat
- Major road
- Survey area

Fauna Habitat

- Banksia woodland
- Eucalyptus woodland over Banksia
- Marri woodland
- Melaleuca dampland and sparse flooded gum
- Modified wetland drainage area
- Native and introduced shrubs
- Naturalised and native trees
- Cleared

Paper Size ISO A3

0 50 100 150 200

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

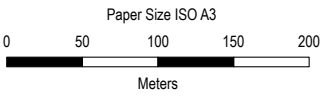
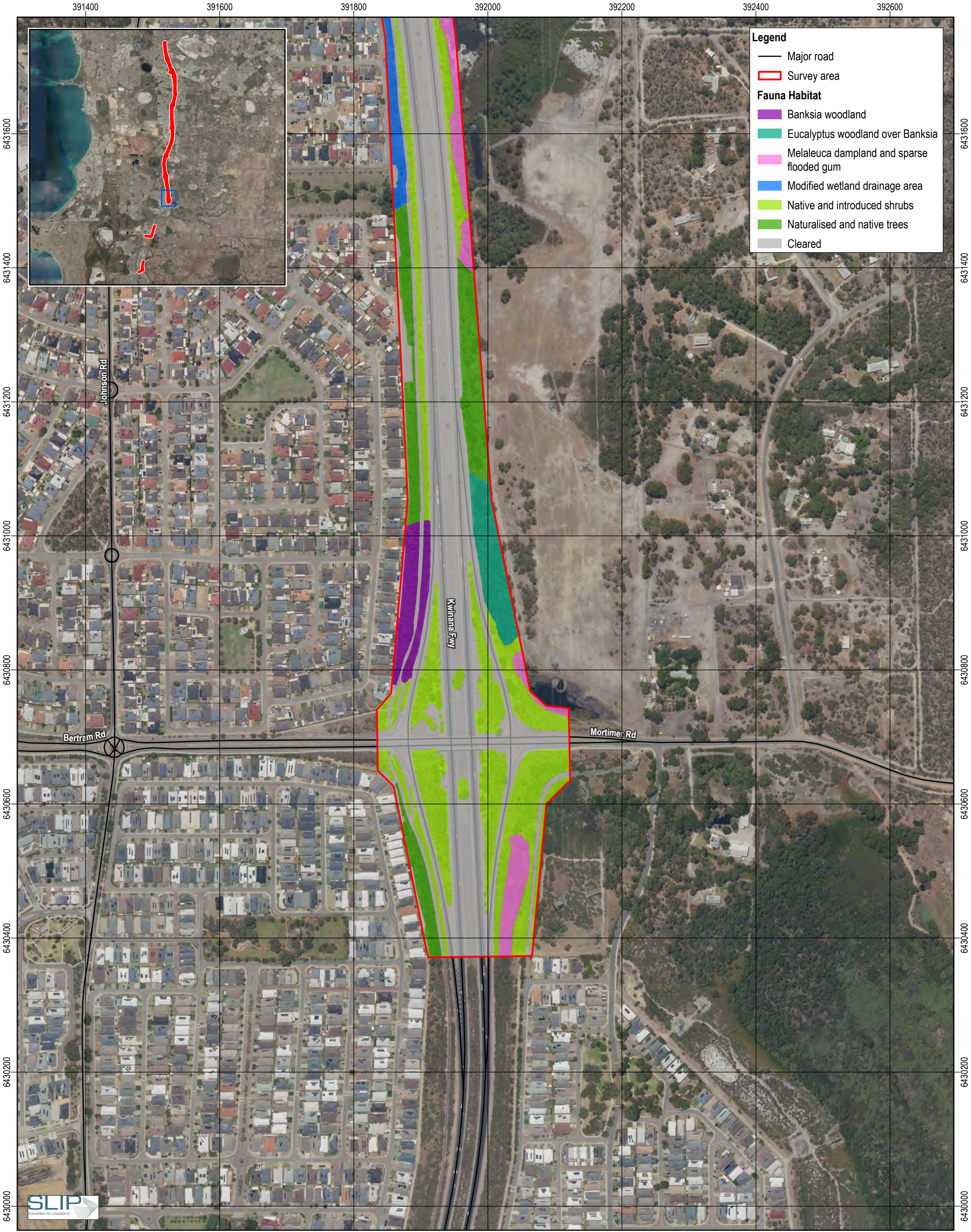


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Roe Hwy Widening Flora and Fauna Assessment

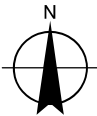
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FIGURE 9C



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

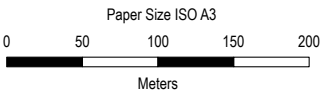
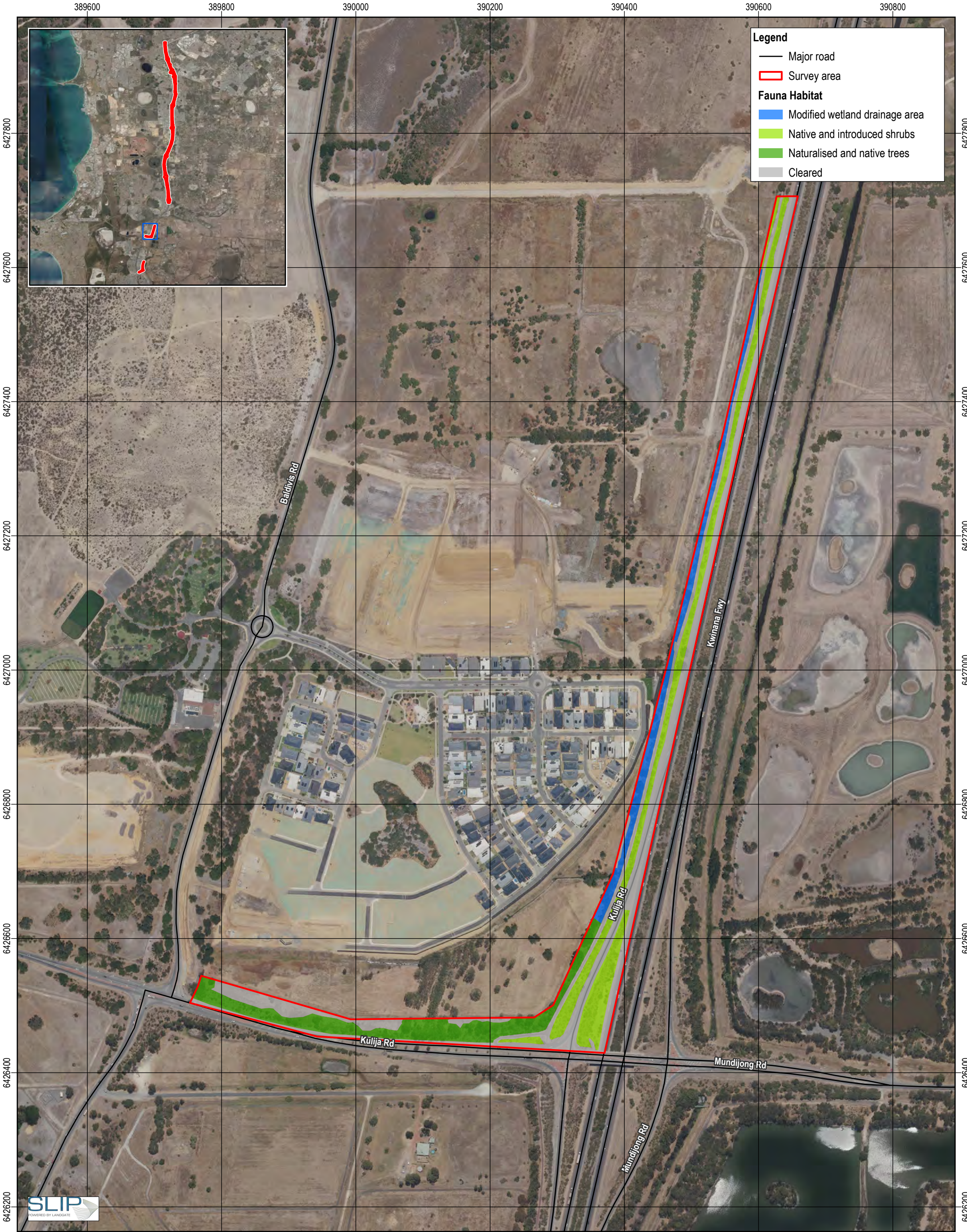


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

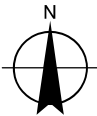
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FIGURE 9C



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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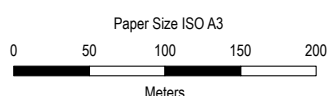
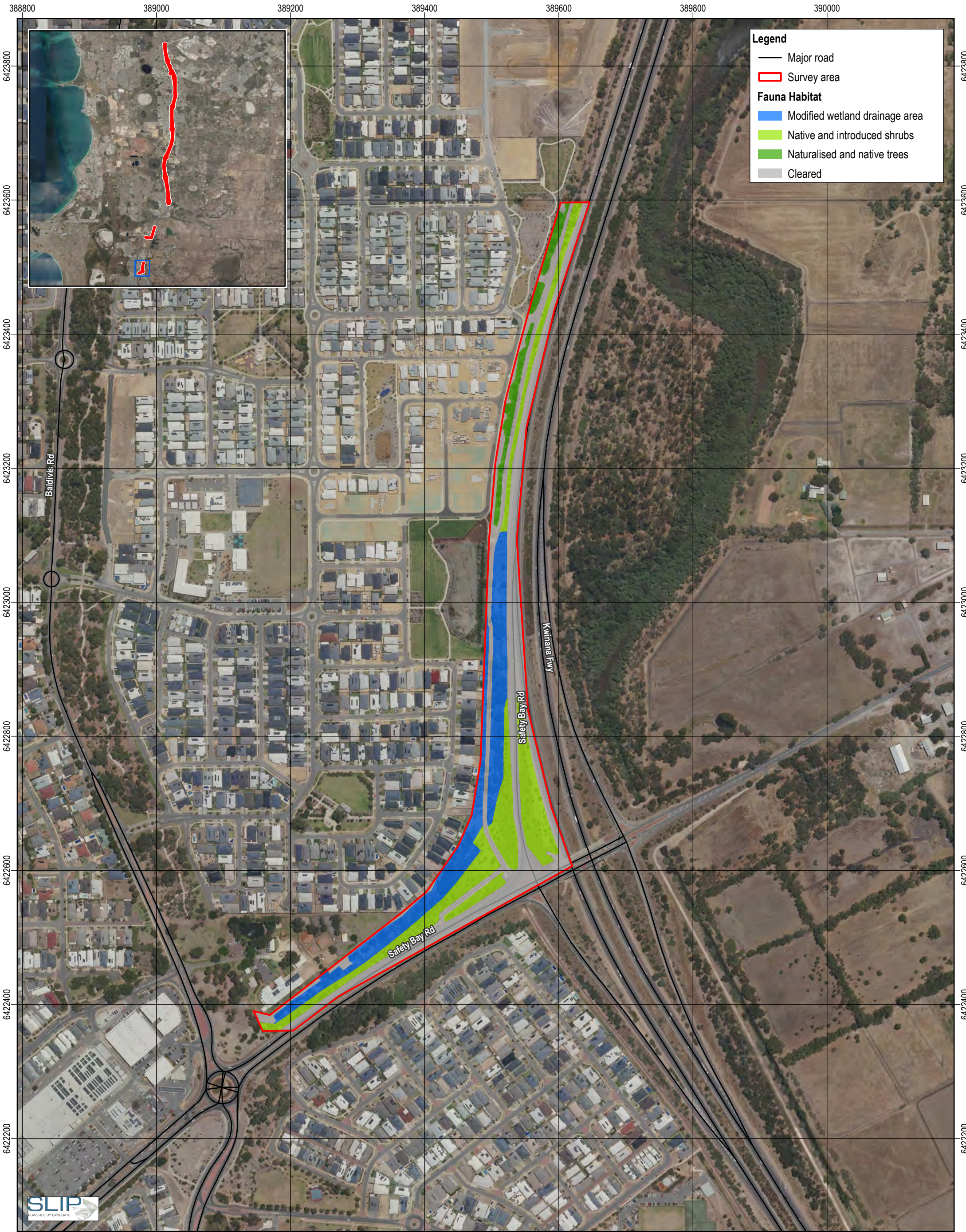


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

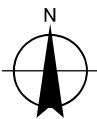
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FIGURE 9C



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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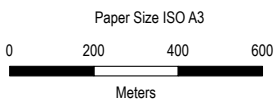
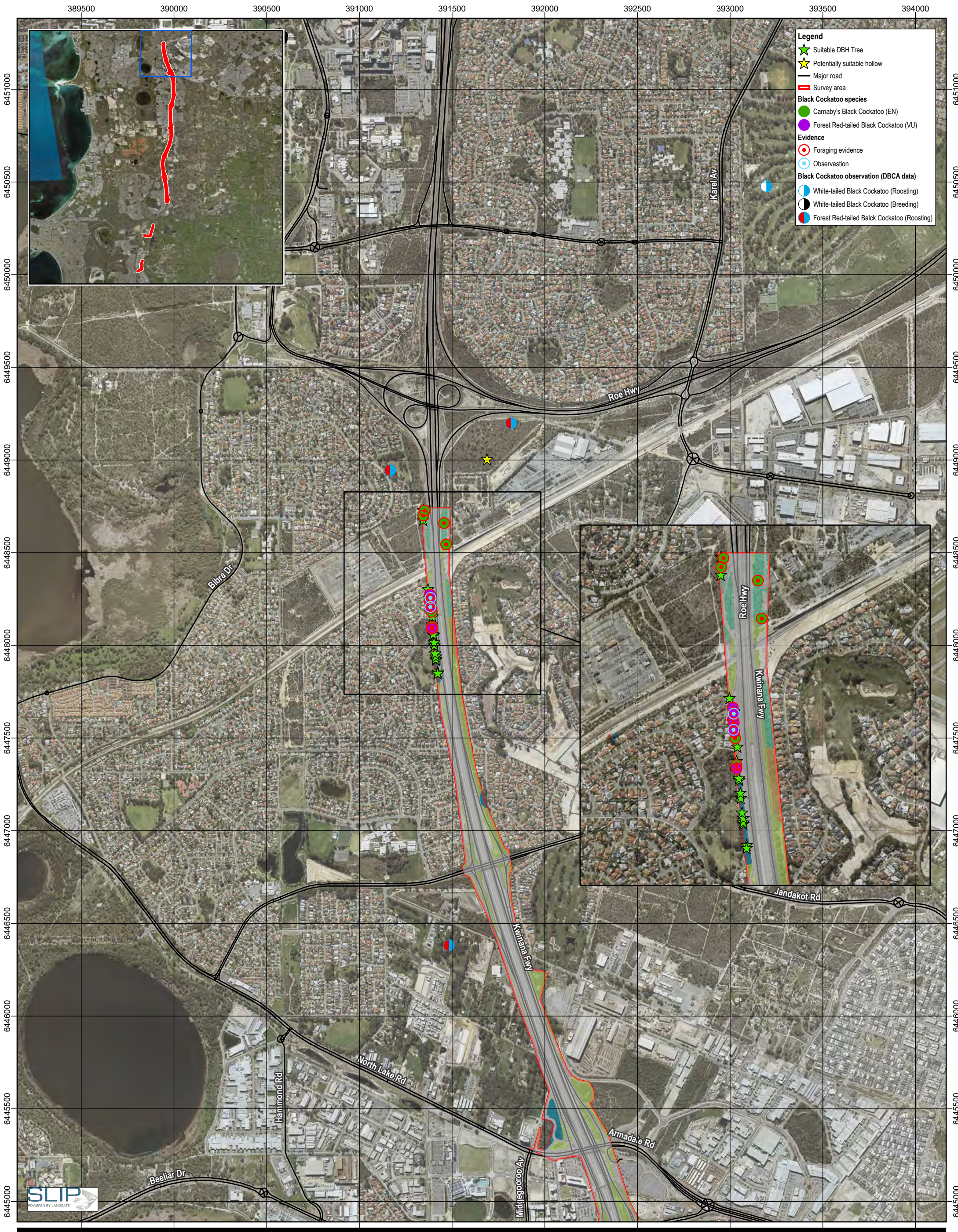


Main Roads
Roe Hwy Widening Flora and Fauna Assessment

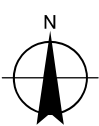
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Map Projection: Transverse Mercator
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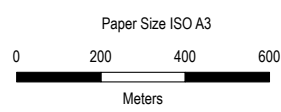
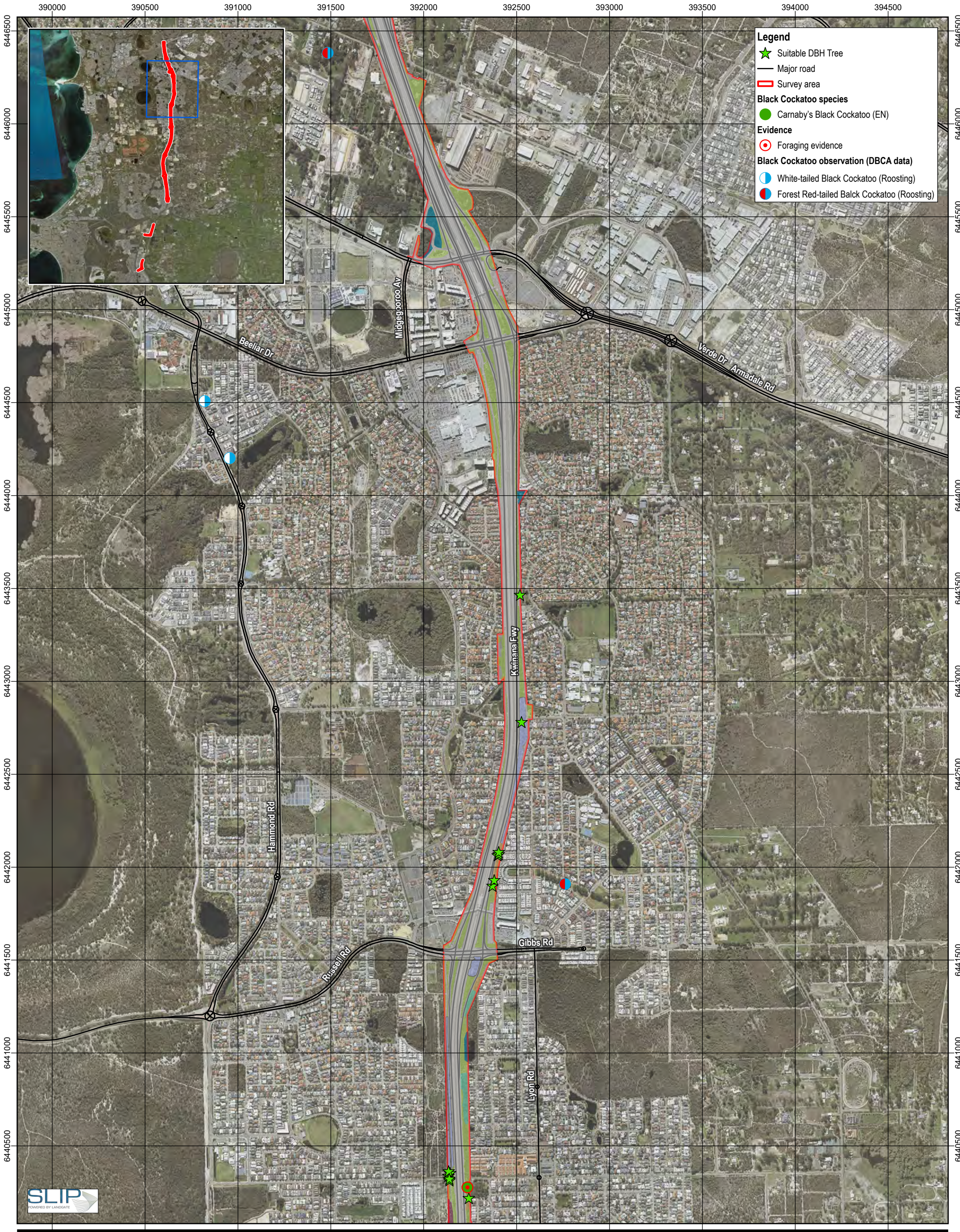
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

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Date 10/03/2025

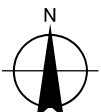
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FIGURE 10

Black Cockatoo records



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



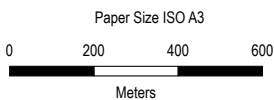
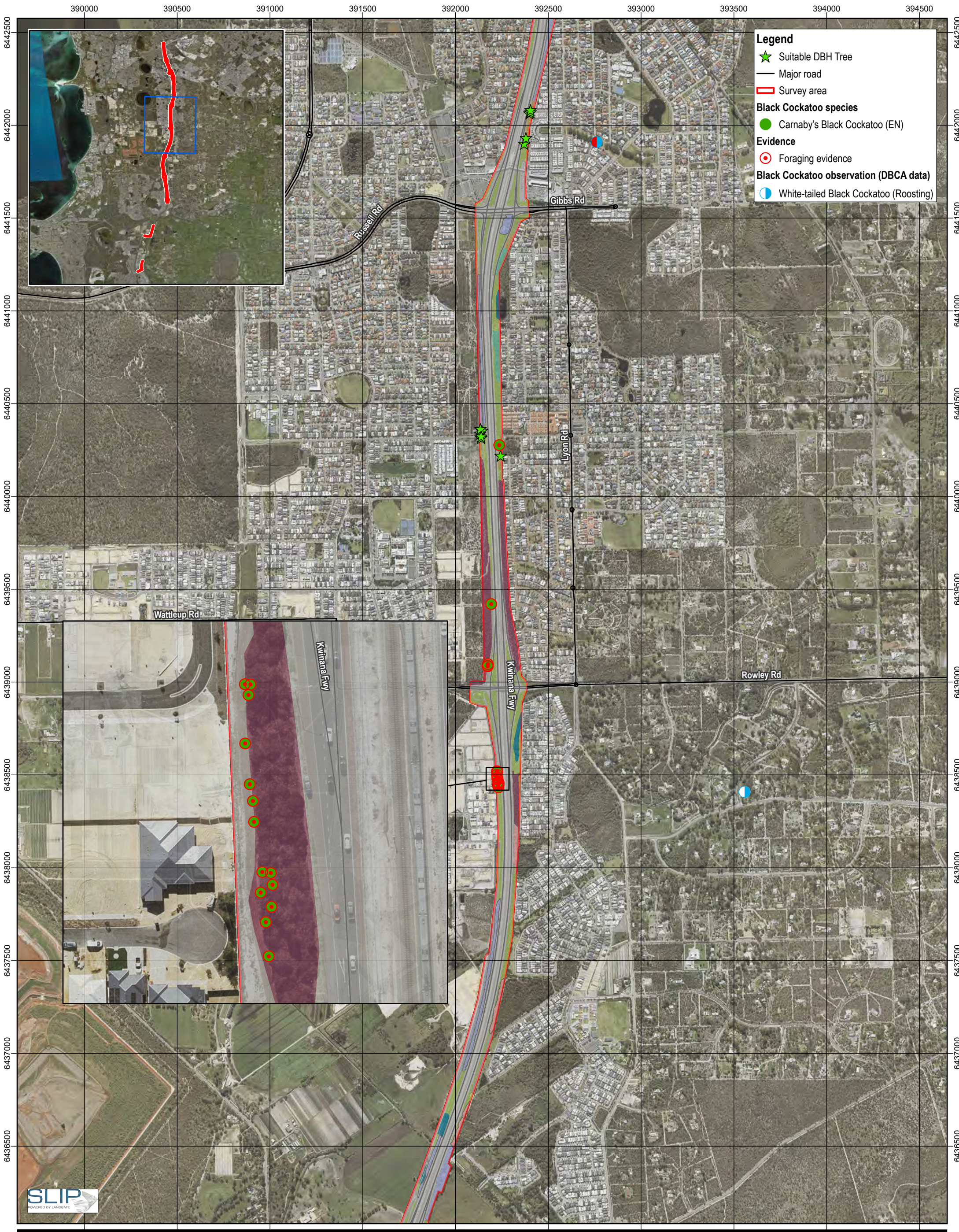
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

Project No. 12634226
Revision No. A
Date 10/03/2025

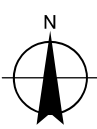
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Black Cockatoo records

FIGURE 10



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



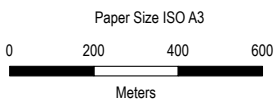
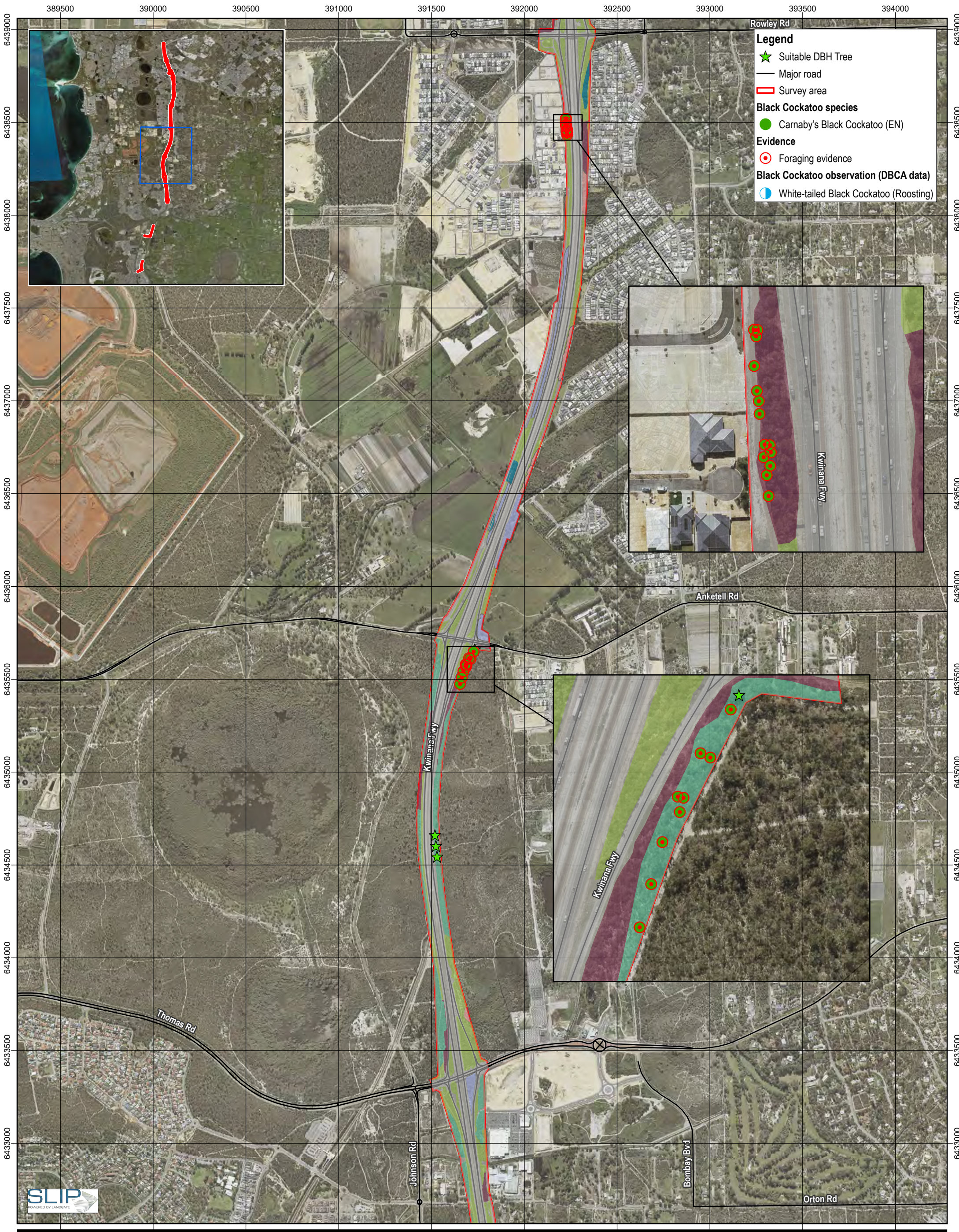
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

Project No. 12634226
Revision No. A
Date 10/03/2025

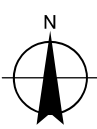
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Black Cockatoo records

FIGURE 10



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



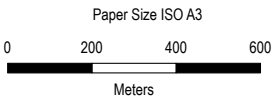
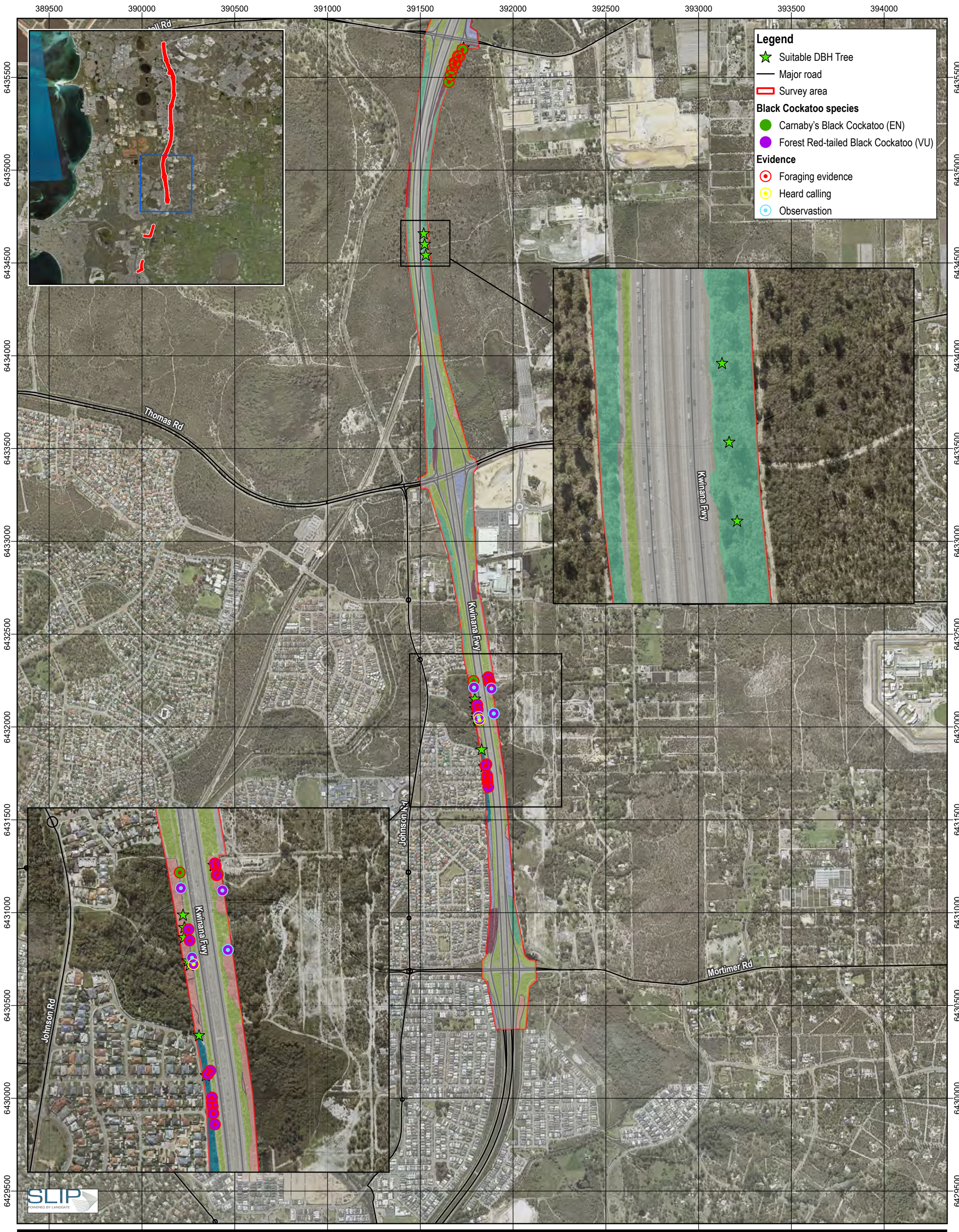
Main Roads
Roe Hwy Widening Flora and Fauna Assessment

Project No. 12634226
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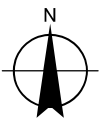
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Black Cockatoo records

FIGURE 10



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50



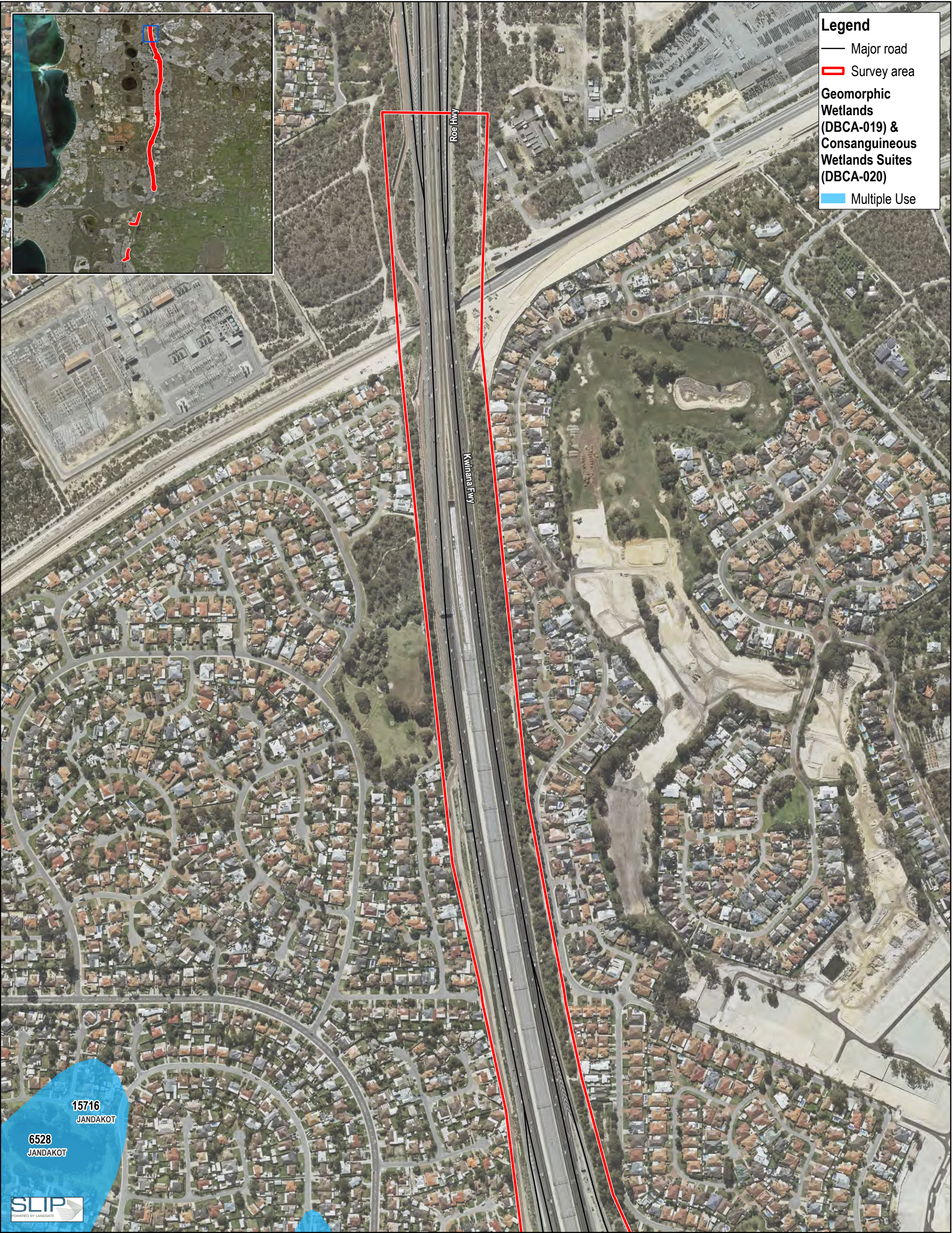
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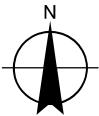
Black Cockatoo records

FIGURE 10



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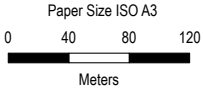
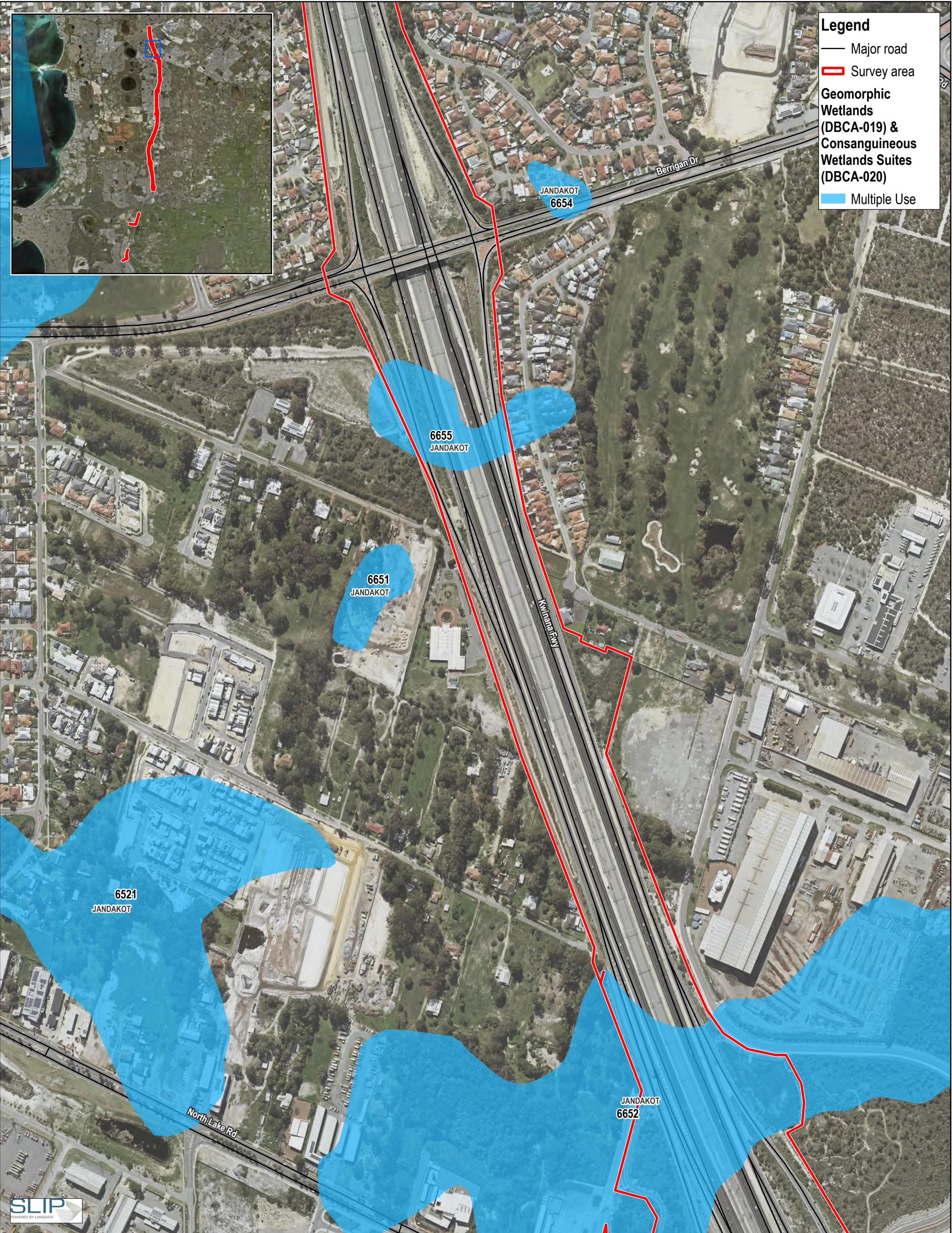
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Roe Hwy Widening Flora and Fauna Assessment

Wetland Assessment

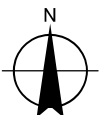
Project No. 12634226
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FIGURE 11



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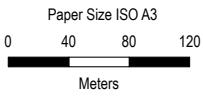
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Wetland Assessment

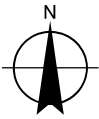
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FIGURE 11



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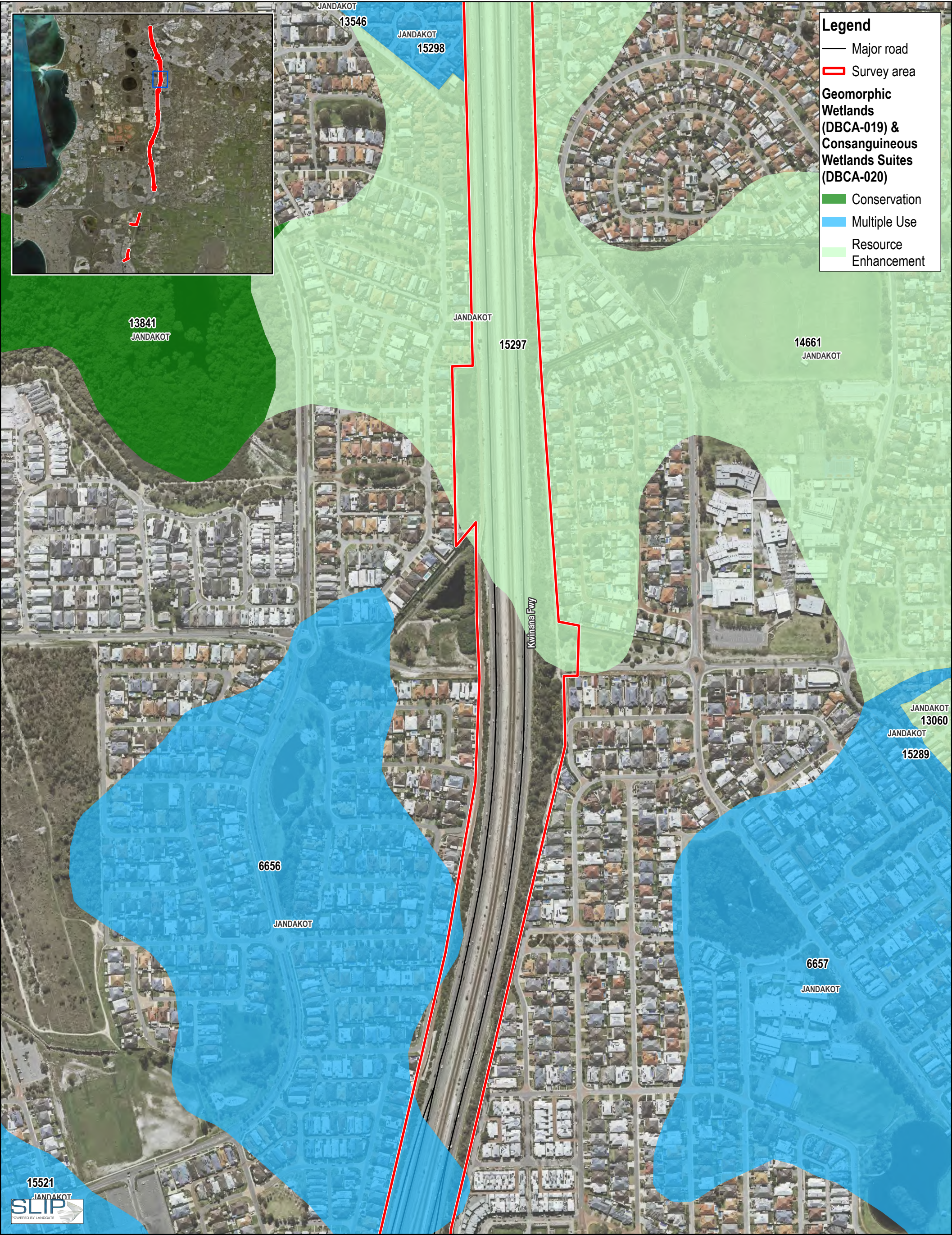
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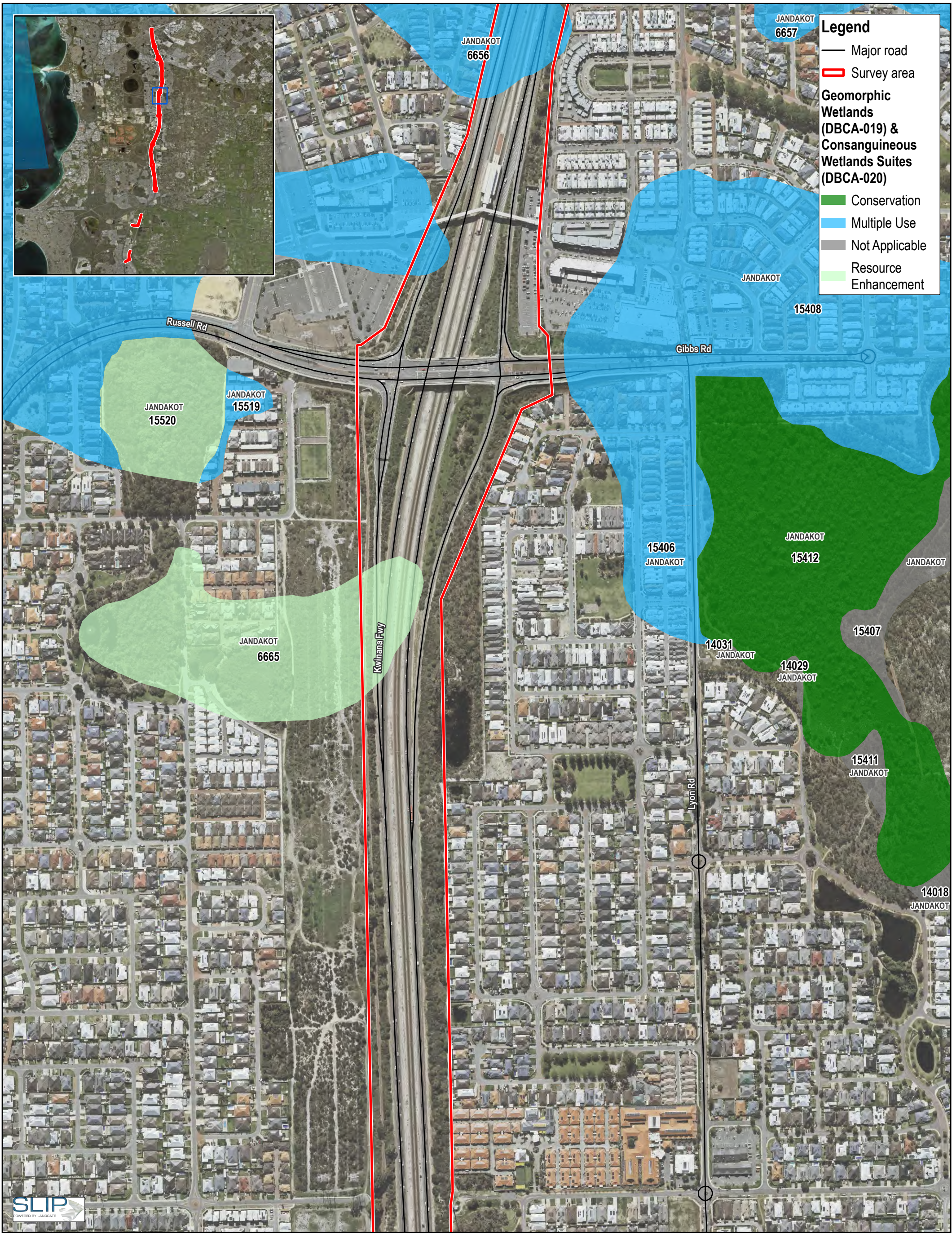
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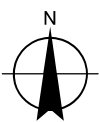
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FIGURE 11





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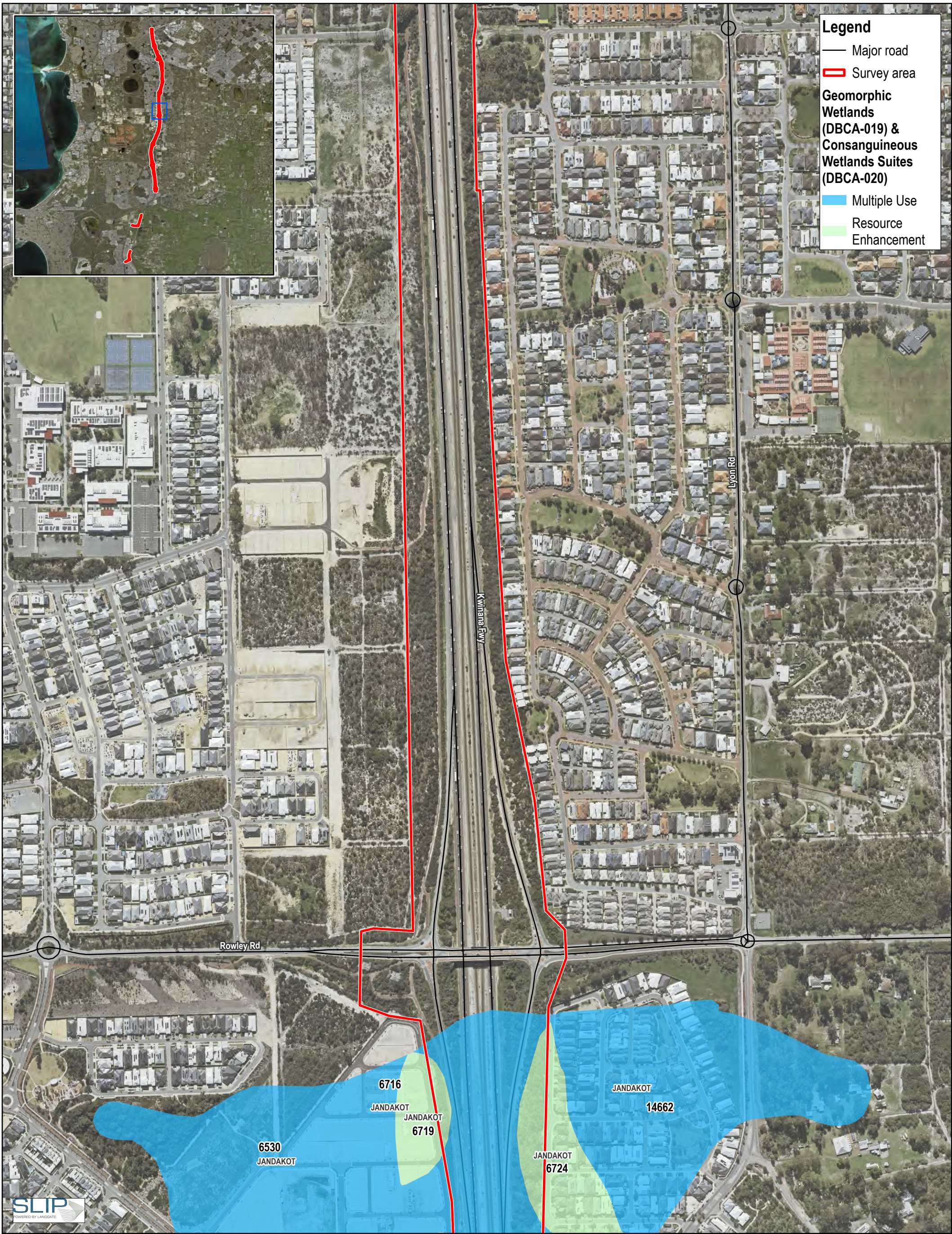
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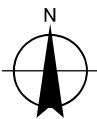
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FIGURE 11



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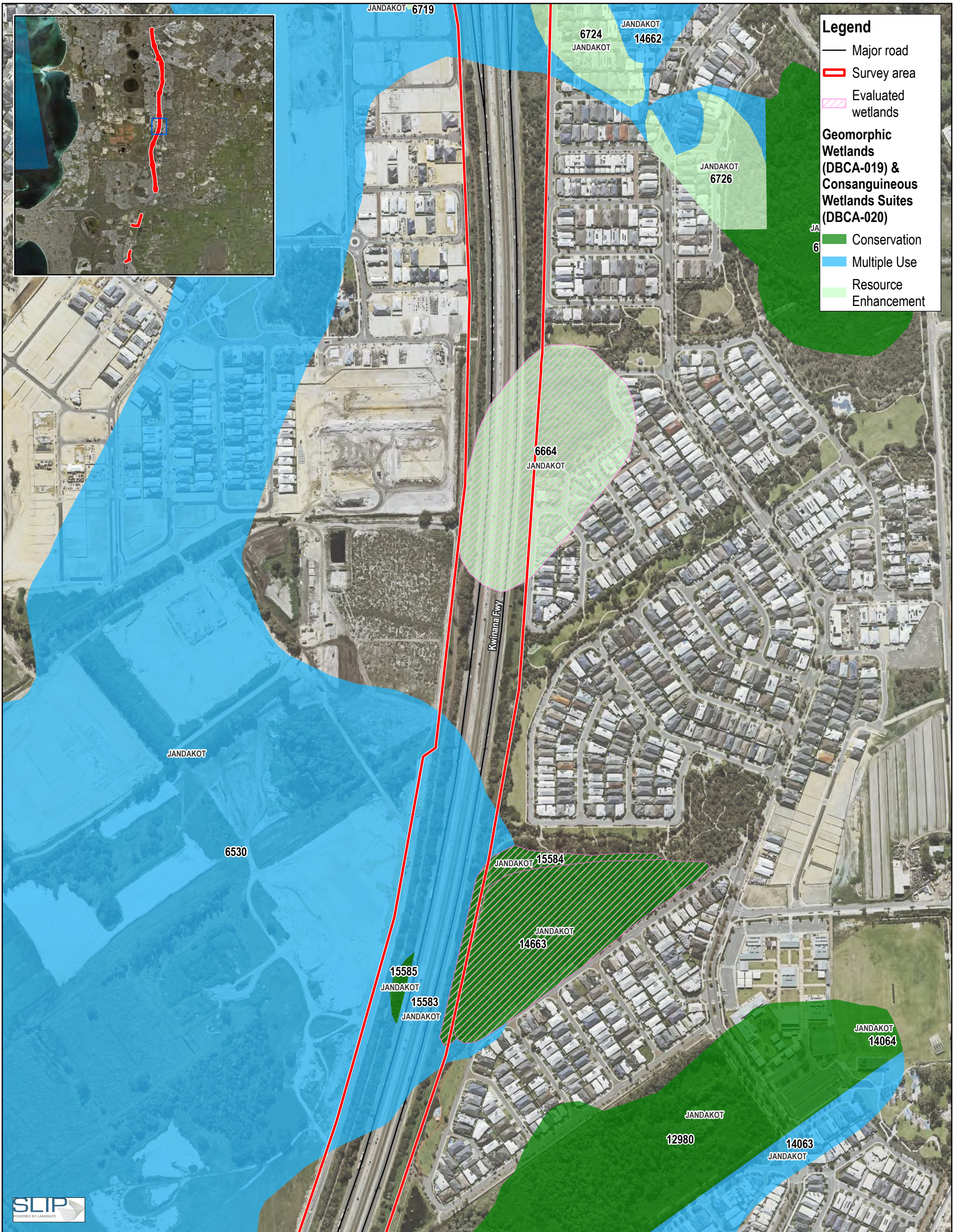
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Wetland Assessment

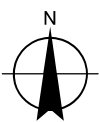
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FIGURE 11



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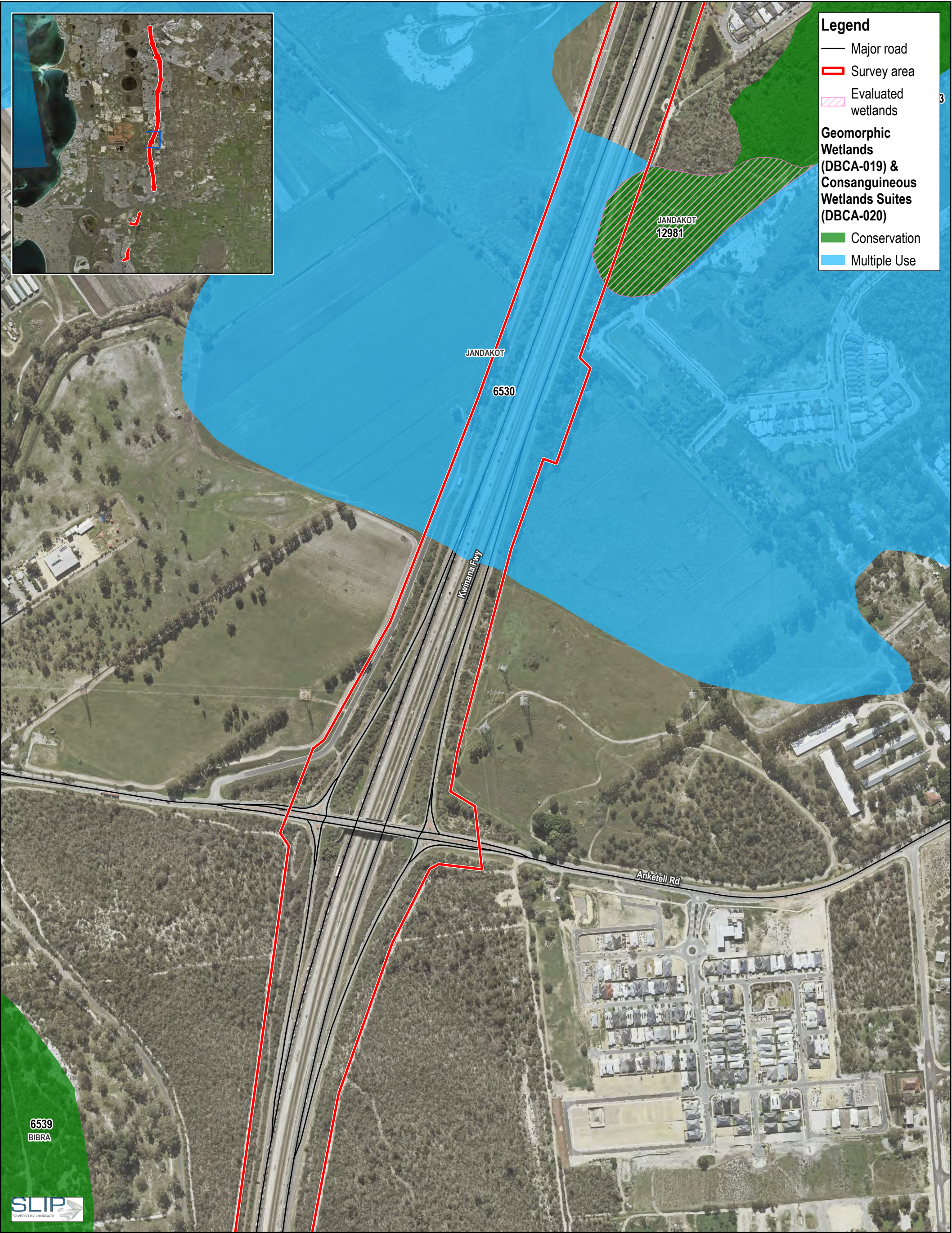
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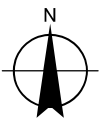
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FIGURE 11



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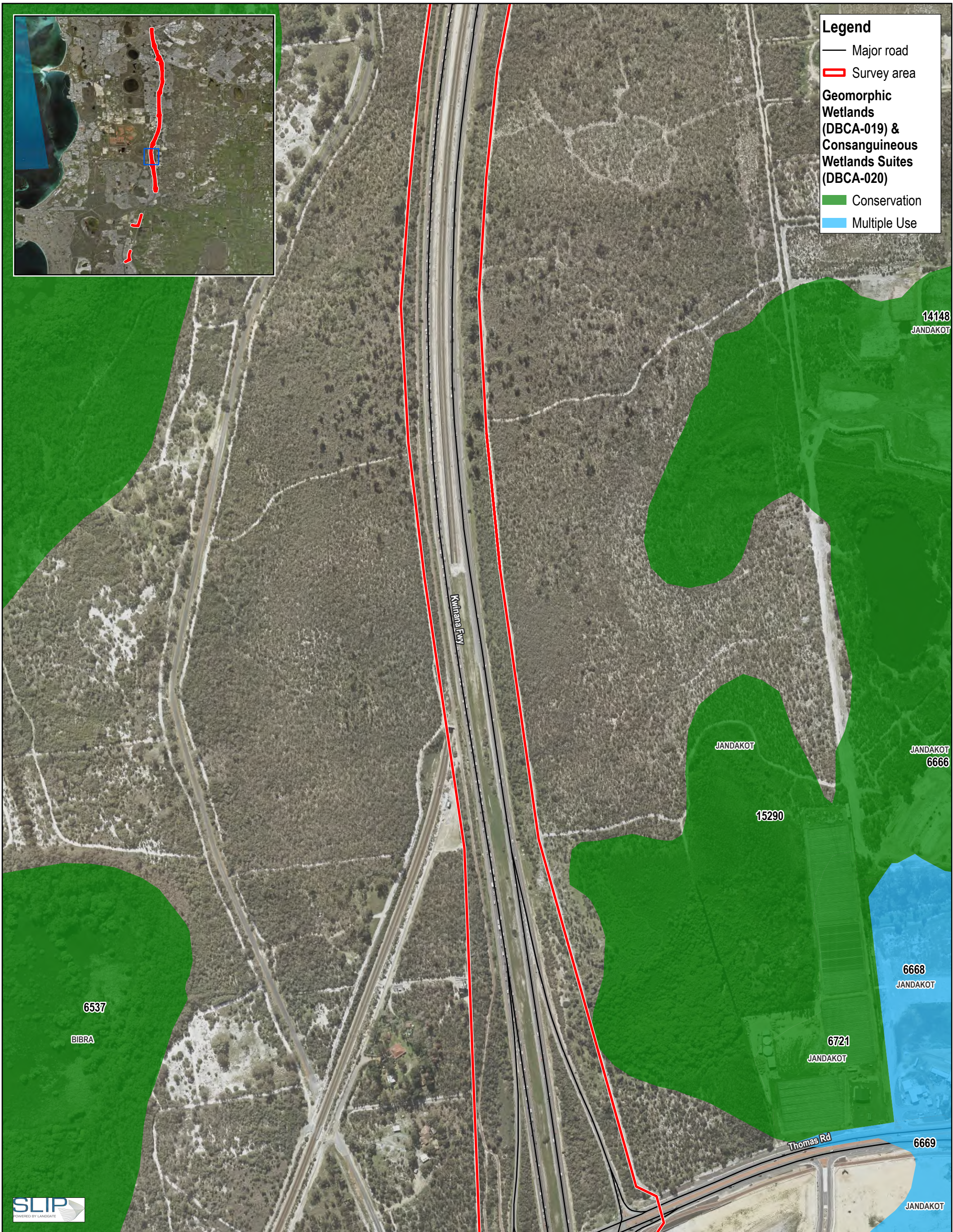
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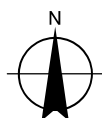
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FIGURE 11



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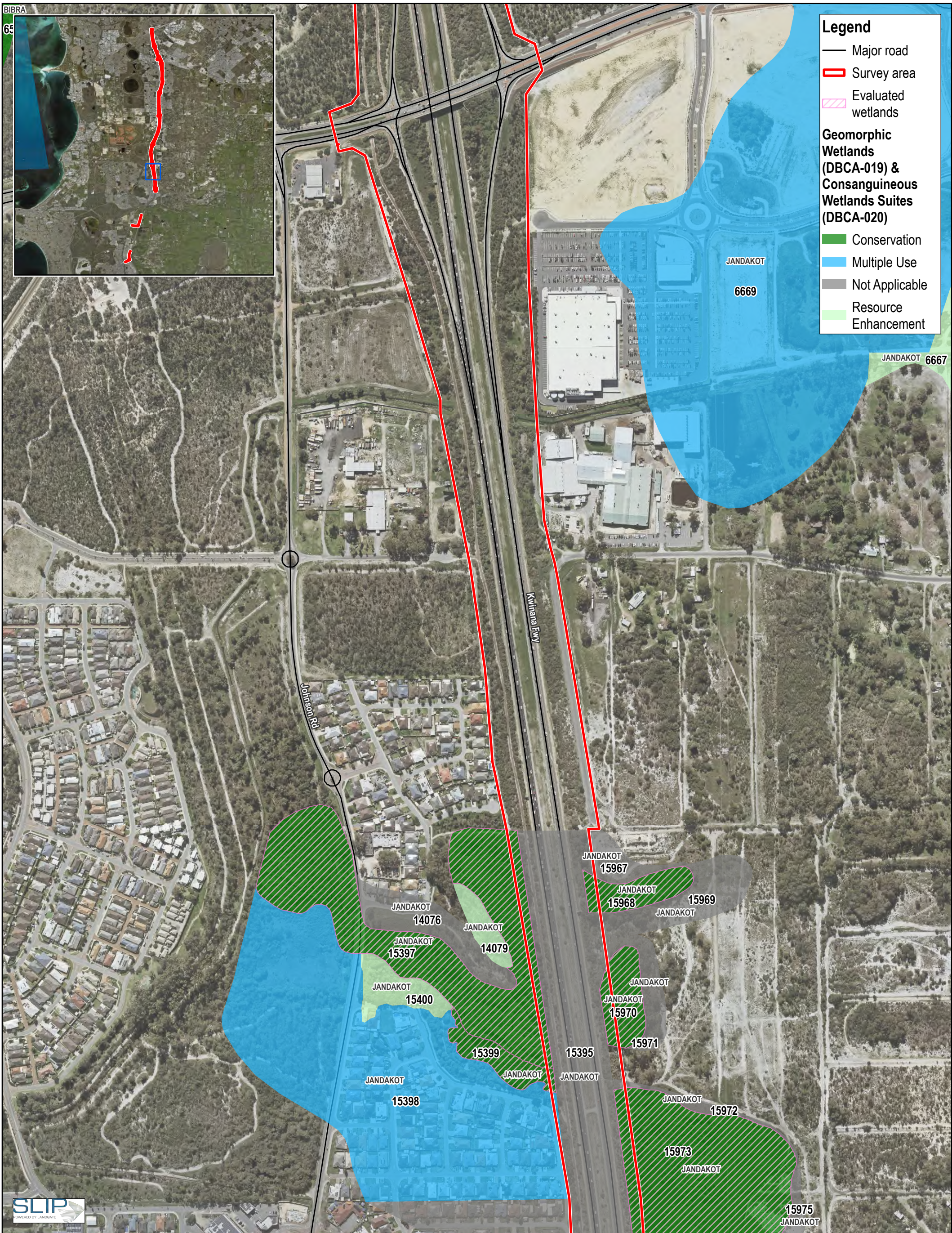
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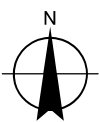
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FIGURE 11



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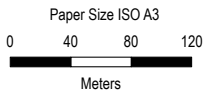
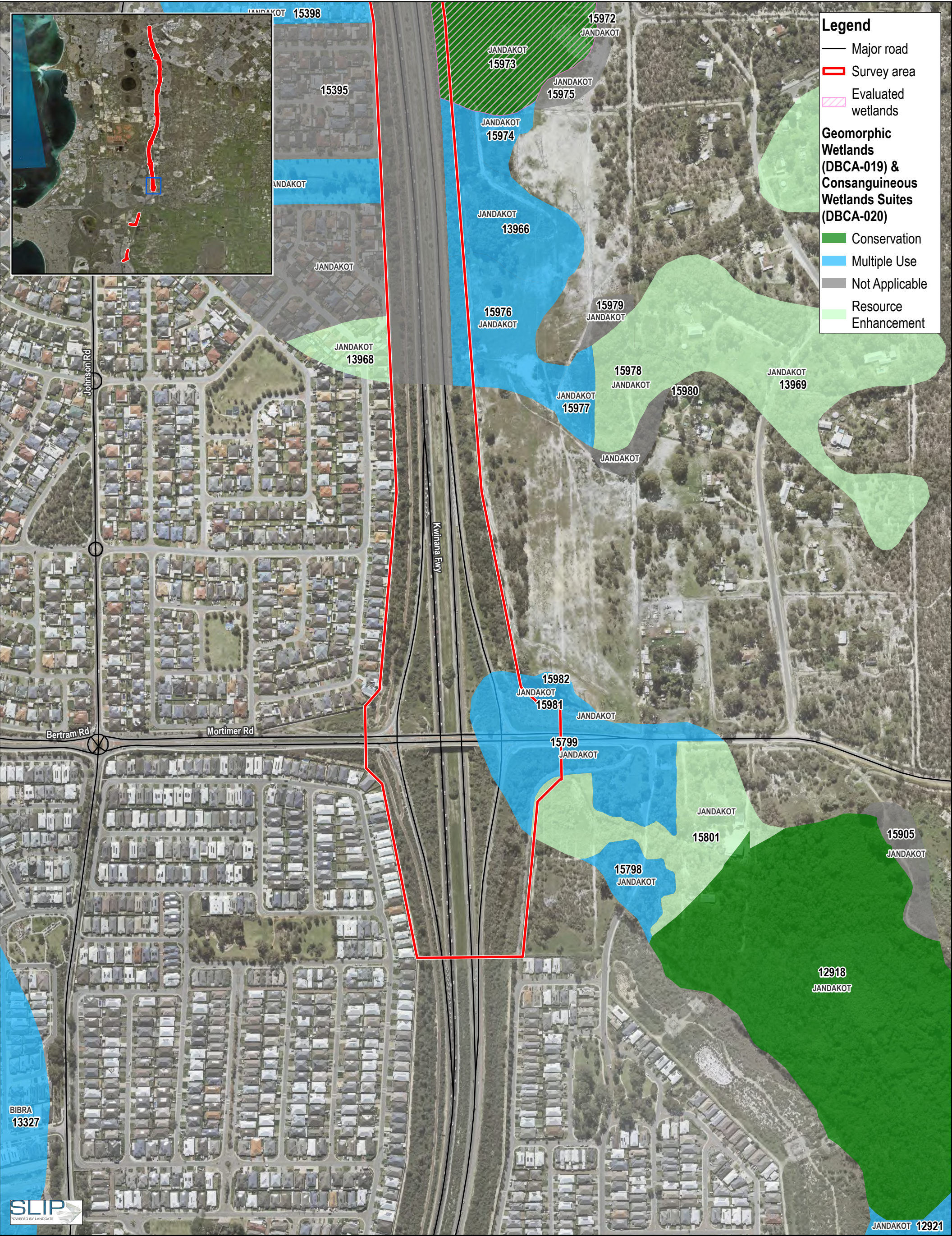
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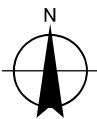
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FIGURE 11



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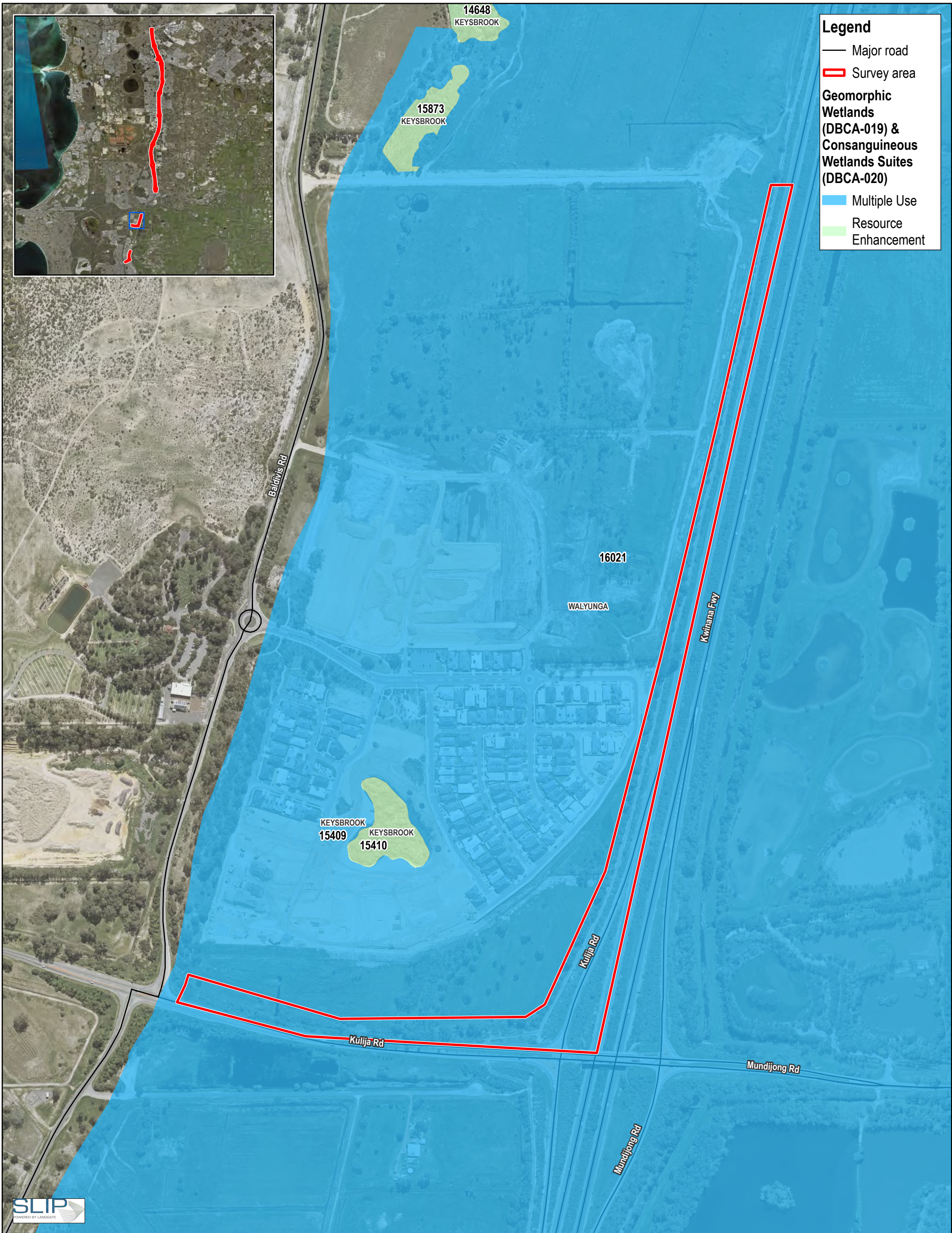
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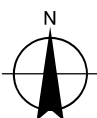
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FIGURE 11



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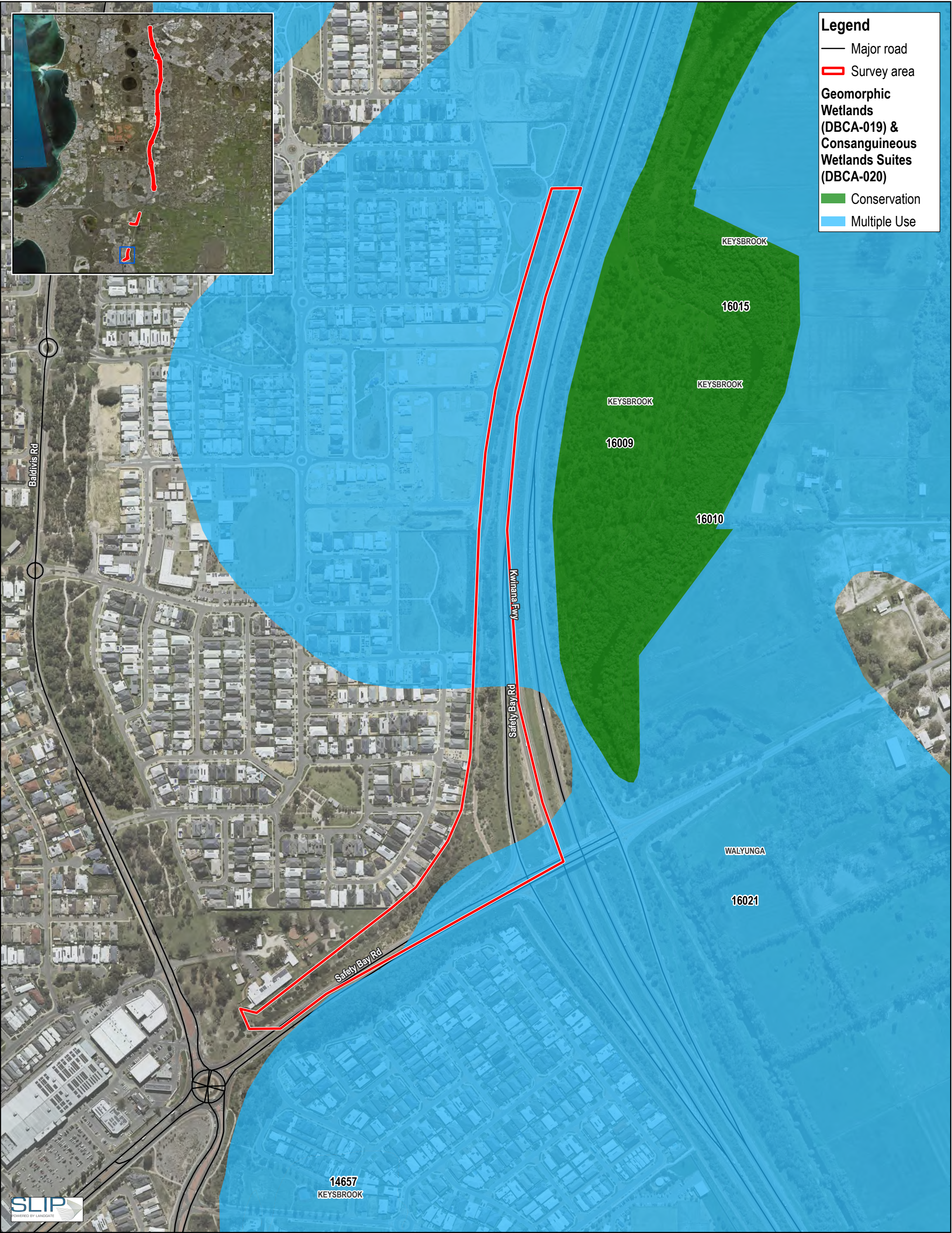
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FIGURE 11



Appendix B

**Relevant legislation, conservation codes
and background information**

Appendix C

Database searches

PMST search results

NatureMap results for flora and fauna

Appendix D

Flora data

Quadrat and relevé data

Tuart Patch Assessment

Banksia Patch Assessment

Flora species list by family

Flora species list by vegetation type

Significant flora and significant weed locations

GHD Dendrogram

Gibson Dendrogram

Keighery Dendrogram

Flora likelihood of occurrence assessment guidelines

Flora likelihood of occurrence assessment

Appendix E

Fauna data

Fauna field sampling data

Fauna species list

Significant fauna observations

Black Cockatoo potential breeding habitat tree

Foraging quality scoring tool for Black Cockatoo

Fauna Likelihood of Occurrence

Field sampling - Habitat assessment data

Object ID Number	Date	Habitat type	Landform	Soil type	Litter cover (%)	Fire age (yr)	Vegetation condition	Notes: % canopy cover of foraging species	Eastings	Northings
25	30/09/2024	Banksia shrubland	Sand plain	Sand	10-30%	10+	Very Good	Occasional <i>Banksia menziesii</i> and <i>Banksia attenuata</i> , 30% cover	391458	6448661
187	12/11/2024	Banksia shrubland	Sand plain	Sandy loam	30-70%	10+	Very Good	30% <i>Banksia attenuata</i> and small <i>Pinus</i> . sp. 10% cover of Grass trees	391354	6448723
188	12/11/2024	Banksia shrubland	Sand plain	Sandy loam	30-70%	10+	Very Good	30% cover of <i>Banksia attenuata</i> , and <i>Banksia menziesii</i>	391367	6448602
193	12/11/2024	Banksia shrubland	Sand plain	Sandy loam	nr	nr	nr	<i>Banksia attenuata</i> present	391359	6448651
196	12/11/2024	Melaleuca dampland	Dampland	sand	nr	nr	Degraded	Paperbark Melaleuca sp. and mixed Eucalyptus (Marri and others) and Acacia sp.	392066	6445380
205	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	Mostly Acacia trees and shrubs, some <i>Banksia menziesii</i> scattered 2% and Hakea sp. and <i>Eucalyptus camaldulensis</i> and some Marri	392522	6442835
206	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	One tall <i>Banksia attenuata</i> and <i>Eucalyptus camaldulensis</i> and Marri	392471	6442358
207	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	Scattered 5 meter tall <i>Banksia attenuata</i> and 6 meter tall <i>Banksia menziesii</i> but mostly Geraldton Wax and Kunzea sp. and other shrubs	392240	6440327
208	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Good	10 to 30% cover of <i>Banksia menziesii</i> and <i>Banksia attenuata</i> , planted Eucalypts. and occasional Jarrah. occasional tall 7 meter high Hakea sp.	391683	6435585
209	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Good	30 to 50% cover <i>B. attenuata</i> and 10% <i>Banksia menziesii</i> , planted Eucalyptus sp. and occasional Jarrah.	391660	6435507
210	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Good	30 to 50% cover <i>B. attenuata</i> and 10% <i>Banksia menziesii</i> , occasional Pinus sp. and Casuarina sp. Hillslope.	391647	6435472

Object ID Number	Date	Habitat type	Landform	Soil type	Litter cover (%)	Fire age (yr)	Vegetation condition	Notes: % canopy cover of foraging species	Eastings	Northings
211	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	30 to 50% cover <i>B. attenuata</i> and 10% <i>Banksia menziesii</i> , 4 meters to 6 meters tall.	391760	6433161
212	13/11/2024	Myrtaceous shrubland	Sand plain	Sandy loam	30-70%	10+	Good	Calothamnus sp. dominated. Myrtaceous shrubs.	391808	6432580
213	13/11/2024	Marri woodland	Sand plain	Sandy loam	>70%	10+	Good	Marri woodland and <i>Banksia menziesii</i> , 10% cover. 5 tall plants of <i>Banksia sessilis</i>	391863	6432233
214	13/11/2024	Dampland	Dampland	Sandy loam	>70%	10+	Very Good	Marri and <i>Eucalyptus rudis</i> and Paperbark Melaleuca sp. and grasses.	391878	6432175
215	13/11/2024	Marri woodland	Sand plain	Sandy loam	>70%	10+	Good	Marri woodland and <i>Banksia menziesii</i> 10% cover and <i>B. attenuata</i> 20 to 30% cover.	392012	6430909
216	13/11/2024	Dampland	Dampland	Sandy loam	30-70%	10+	Good	Acacia sp. trees and shrubs and Kunzea sp. and bottlebrush shrubs and occasional Marri and Flooded gum.	392042	6430465
217	13/11/2024	Sand plain	Sand plain	Sandy loam	30-70%	10+	Good	Kunzea and bottlebrush shrubs and occasional Marri	391914	6430444
218	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Good	Marri woodland and <i>B. attenuata</i> and <i>B. menziesii</i> 15% cover.	391890	6431083
219	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Good	Marri woodland and <i>B. attenuata</i> and <i>B. menziesii</i> 15% cover.	391924	6430844
220	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Good	Marri woodland and 20% <i>B. attenuata</i> and <i>B. menziesii</i> 15% cover.	391690	6432773
221	13/11/2024	Flooded Gum woodland	Dampland	Sandy loam	nr	10+	Good	<i>E. rudis</i> over bracken fern understorey. Paperbark Melaleuca trees.	391823	6431937
222	13/11/2024	Marri woodland	Sand plain	Sandy loam	nr	10+	Good	Marri over bracken ferns	391810	6432025
223	13/11/2024	Marri woodland	Sand plain	Sandy loam	nr	10+	Good	Marri and <i>B. menziesii</i> 10% cover, over Grass trees	391781	6432202
224	13/11/2024	Marri woodland	Sand plain	Sandy loam	nr	10+	Very Good	<i>B. menziesii</i> 2% and dense Melaleuca sp. shrubland	391765	6432324
225	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	30 to 50% cover of <i>B. attenuata</i> and 10% <i>B. menziesii</i> . 4m tall to 6m tall	391583	6434100
226	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Very Good	30 to 50% cover <i>B. menziesii</i> and 10% <i>Banksia grandis</i> 4m tall to 6m tall.	391564	6433469

Object ID Number	Date	Habitat type	Landform	Soil type	Litter cover (%)	Fire age (yr)	Vegetation condition	Notes: % canopy cover of foraging species	Eastings	Northings
227	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	30 to 50% cover <i>B. menziesii</i> and 10% <i>Banksia grandis</i> 4m tall to 6m tall	391605	6433414
228	13/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	30 to 50% cover <i>B. attenuata</i> and 10% <i>B. menziesii</i> . 4m tall to 6m tall	391535	6433775
229	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	<i>B. menziesii</i> 15 to 25% and 15% <i>B. attenuata</i> towards end at 6m tall and Grass trees 5% cover. occasional Eucalyptus sp. Really nice condition patch	392225	6438466
230	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	30% <i>B. attenuata</i> and 10% <i>B. menziesii</i> cover	392164	6439094
231	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	10% <i>B. attenuata</i> and <i>Adenathenos</i> sp. and Geraldton Wax and <i>Calothamnus</i> sp.	392171	6439178
232	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	20% <i>B. attenuata</i> and 10% <i>B. menziesii</i> 6 to 8 m tall and <i>Adenathenos</i> sp. and Geraldton Wax and <i>Calothamnus</i> sp. Grass trees 2% cover. Occasional Hakea trees and Pinus sp.	392182	6439295
233	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	10% <i>B. attenuata</i> and 20% <i>B. menziesii</i> 6 to 8m tall and <i>Adenathenos</i> sp. and Geraldton Wax and <i>Calothamnus</i> sp. Grass trees 2% cover. Occasional Hakea trees and Pinus sp.	392176	6439420
234	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Good	25% <i>B. attenuata</i> and 10% <i>B. menziesii</i> 6 to 8m tall and tall Pinus sp. at 20%	392172	6439462
235	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	40 to 50% <i>B. attenuata</i> and 10% <i>B. menziesii</i> 6 to 8m tall and tall Casuarina sp. 10%. and <i>B. sessilis</i> 5%	392164	6439501
236	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	10% <i>B. attenuata</i> and 10% <i>B. menziesii</i> and 10% grass trees	392177	6439572
237	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	10% <i>B. attenuata</i> and 10% <i>B. menziesii</i> and 10% grass trees and 5% <i>b. sessilis</i> , 5m tall. tall Hakea 5%	392159	6439616
238	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Degraded	2 <i>B. attenuata</i> plants and remained is mixed Acacia and Myrtaceous shrubland. one Casuarina sp.	392121	6441391
239	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Degraded	2 <i>B. attenuata</i> plants and a Nuytsia, and 3 plants <i>B. menziesii</i> , remained is mixed	392115	6441471

Object ID Number	Date	Habitat type	Landform	Soil type	Litter cover (%)	Fire age (yr)	Vegetation condition	Notes: % canopy cover of foraging species	Eastings	Northings
								Acacia and Myrtaceous shrubland. Some tall Casuarina sp.		
240	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	10-30%	10+	Good	Bottlebrush, Calothamnus sp, Acacia sp. shrubland and then <i>E. rudis</i> occasional small	392121	6441045
241	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Degraded	10% <i>B. menziesii</i> and 8% <i>B. attenuata</i> and <i>Nuytsia floribunda</i> .	392152	6440079
242	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	10% <i>B. attenuata</i> and 10% <i>B. menziesii</i> and 10% Grass trees and 5% <i>Banksia sessilis</i> , 5m tall. tall Hakea 5%	392154	6439680
243	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	40 to 50% <i>B. attenuata</i> 6 to 8m tall and <i>B. menziesii</i> 5 to 6m tall	392250	6439881
244	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	40 to 50% <i>B. attenuata</i> 6 to 8m tall and <i>B. menziesii</i> 5 to 6m tall	392277	6439487
245	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	40 to 50% <i>B. attenuata</i> 6 to 8m tall and <i>B. menziesii</i> 5 to 6m tall	392262	6439667
246	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	40 to 50% <i>B. attenuata</i> 6 to 8m tall and <i>B. menziesii</i> 5 to 6m tall	392299	6439249
247	14/11/2024	Banksia shrubland	Sand plain	Sandy loam	>70%	10+	Very Good	40 to 50% <i>B. attenuata</i> 6 to 8m tall and <i>B. menziesii</i> 5 to 6m tall	392238	6440083
252	14/11/2024	Banksia shrubland	Sand plain	sand	nr	nr	nr	Banksia 50%	392173	6439085
253	14/11/2024	Banksia shrubland	Sand plain	sand	nr	nr	nr	Banksia 50%	392173	6439087
254	14/11/2024	Banksia shrubland	Sand plain	sand	nr	nr	nr	Banksia 30%	392173	6439275
255	14/11/2024	Banksia shrubland	Sand plain	sand	nr	nr	nr	Banksia 40%	392167	6439585

Field sampling – Field notes⁷

Object ID Number	Date	Notes: % canopy cover of foraging species	Easting	Northing
41	12/11/2024	<i>Banksia attenuata</i> and Marri	391681	6447111
52	12/11/2024	<i>Eucalyptus rudis</i> lined	391421	6447818
54	12/11/2024	<i>Pinus</i> sp. <i>Banksia attenuata</i> and <i>B. menziesii</i> and fruiting <i>Corymbia</i> .	391385	6448198
55	12/11/2024	<i>B. menziesii</i> and <i>Corymbia</i> patch. can't access by foot. rail construction in way	391361	6448486
56	12/11/2024	Nuytsia x2. remnant <i>Eucalyptus</i> woodland . wall blocking view/ access	391563	6447617
57	12/11/2024	Marri woodland	391634	6447263
58	12/11/2024	<i>E.camaldulensis</i> and Marri	391589	6447419
59	12/11/2024	Marri and <i>Banksia attenuata</i> (20% in)	391735	6446976
60	12/11/2024	Marri woodland	391491	6448131
61	12/11/2024	<i>Eucalyptus rudis</i> and <i>E. camaldulensis</i>	392012	6445958
62	12/11/2024	<i>B. menziesii</i> a small patch	392453	6444996
63	12/11/2024	<i>Eucalyptus</i> saplings and <i>Acacia</i> shrubland	392200	6445588
64	12/11/2024	<i>B. menziesii</i> and Marri small.	392495	6444571
65	12/11/2024	<i>E.camaldulensis</i>	392515	6443989
67	12/11/2024	Marri, <i>E.camaldulensis</i> and <i>B. menziesii</i> , 1 every 20m	392514	6442552
68	12/11/2024	Marri, <i>E.camaldulensis</i> and <i>B. menziesii</i> , 1 every 20m and some <i>Banksia sessilis</i> .	392467	6442314
70	12/11/2024	<i>B. attenuata</i> 40% cover and <i>B. menziesii</i>	392219	6440772
71	12/11/2024	<i>B. attenuata</i> 40% cover and <i>B. menziesii</i>	392221	6440514
76	12/11/2024	<i>B. attenuata</i> 40% cover and <i>B. menziesii</i>	392298	6439053
77	13/11/2024	<i>B. menziesii</i> 40% cover and some <i>Banksia attenuata</i> . lots of young Marri. 5 to 8m	392331	6438412
78	12/11/2024	<i>Banksia attenuata</i> 40% cover and <i>B. menziesii</i> . lots of Marri	392323	6438162
79	13/11/2024	<i>Eucalyptus rudis</i> and Marri patch with scattered <i>Banksia grandis</i>	392194	6437138
80	12/11/2024	Paperbark <i>Melaleuca</i> and <i>Eucalyptus</i>	392004	6436554
81	12/11/2024	<i>Eucalyptus</i> sp.	391907	6436298
82	12/11/2024	40 to 50% <i>Banksia attenuata</i> and <i>B. menziesii</i> .	391627	6435436

⁷ these points assisted in the Black Cockatoo foraging score mapping and are represented for the purpose of evidence of foraging plants and % canopy cover. These notes have not been applied to the Figure as they are field mapping notes designed to be used as a reference for the field staff to attain a foraging score.

Object ID Number	Date	Notes: % canopy cover of foraging species	Easting	Northing
83	12/11/2024	40 to 50% <i>Banksia attenuata</i> and <i>B. menziesii</i> .	391559	6434366
84	12/11/2024	40 to 50% <i>Banksia attenuata</i> and <i>B. menziesii</i> .	391530	6434933
85	12/11/2024	40 to 50% <i>Banksia attenuata</i> and <i>B. menziesii</i> .	391569	6435239
87	12/11/2024	20% <i>Banksia attenuata</i> and <i>B. menziesii</i> .	391787	6432730
90	12/11/2024	Marri woodland	391965	6431472
91	12/11/2024	Marri woodland	391972	6431129
94	12/11/2024	Marri woodland	391928	6430403
96	12/11/2024	Marri woodland	391872	6431370
99	12/11/2024	Marri woodland and <i>b. attenuata</i> 25%	391640	6433027
102	12/11/2024	<i>Banksia attenuata</i> 40%	391462	6434376
103	12/11/2024	<i>Banksia attenuata</i> 40%	391531	6433875
104	12/11/2024	<i>Banksia attenuata</i> 25% and Marri	391440	6434923
105	12/11/2024	<i>Banksia attenuata</i> 25% and Marri	391516	6435458
106	12/11/2024	<i>Banksia attenuata</i> 25% and Marri	391544	6435650
108	12/11/2024	Acacia shrubland	392064	6437018
109	12/11/2024	<i>E. camaldulensis</i>	392218	6437705
113	12/11/2024	<i>Banksia attenuata</i> 15% and <i>Banksia sessilis</i> . Burnt recently	392152	6440006
114	12/11/2024	Marri woodland with 5% <i>B. menziesii</i> .	392134	6440667
115	14/11/2024	one large <i>B. attenuata</i>	392156	6441360
116	12/11/2024	Acacia shrubland	392341	6442184
117	12/11/2024	Acacia shrubland	392447	6442733
118	12/11/2024	Acacia shrubland	392405	6444127
119	12/11/2024	Acacia shrubland and Euc woodland	392360	6444588
120	12/11/2024	Acacia shrubland	391648	6446765
121	12/11/2024	dead tall <i>Banksia attenuata</i> over mixed shrub layer incl. <i>Kunzea</i> sp.	392048	6445499
122	13/11/2024	<i>Adenanthos</i> dominated. some Marri. Mostly <i>Calothamnus</i> sp.	392114	6438929
123	13/11/2024	10% <i>Banksia attenuata</i> 6m tall. <i>Adenanthos</i> and <i>Calothamnus</i> dominated.	392108	6438995
124	12/11/2024	mixed Acacia shrubland	392310	6438997

Object ID Number	Date	Notes: % canopy cover of foraging species	Easting	Northing
125	12/11/2024	<i>Banksia menziesii</i> 5% and young Marri	392341	6438869
126	12/11/2024	young <i>E. camaldulensis</i>	392318	6438655
127	13/11/2024	mixed Acacia shrubs and trees	392301	6437775
128	13/11/2024	mixed Acacia and Melaleuca sp.	392271	6437528
129	13/11/2024	mixed Acacia and Melaleuca sp.	392152	6437015
130	13/11/2024	15% <i>Banksia attenuata</i> and <i>Banksia menziesii</i> and Marri	391760	6435676
131	13/11/2024	20% <i>Banksia attenuata</i> and <i>Banksia menziesii</i> and Marri	391549	6435703
132	13/11/2024	<i>Banksia menziesii</i> 10%	391756	6433466
133	13/11/2024	Acacia shrubland	391694	6433448
134	13/11/2024	<i>Banksia menziesii</i> 10%	391774	6433345
135	13/11/2024	Kunzea sp. and Myrtaceous shrubland and planted young Eucalypts and occasional Marri	391772	6432937
136	13/11/2024	Remnant native bushland	391564	6433460
137	12/11/2024	<i>Banksia attenuata</i> 40%	391474	6434255
138	12/11/2024	<i>Banksia attenuata</i> 40% and Marri	391478	6435261
139	14/11/2024	Bottlebrush and Acacia shrubs and occasional <i>E. camaldulensis</i> small	391662	6435939
140	14/11/2024	Paperbark melaleucas and <i>E.camaldulensis</i> drainage line	391834	6436350
141	14/11/2024	Mixed planted Eucalyptus and <i>E. rudis</i> and Marri	391935	6436617
142	14/11/2024	Bottlebrush and Acacia shrubs and occasional <i>E. camaldulensis</i> small	391974	6436733
143	14/11/2024	Bottlebrush and Melaleuca sp. shrubs	392257	6438185
144	14/11/2024	Bottlebrush and Calothamnus sp. and Melaleuca sp. shrubs and young Marri	392240	6438313
152	26/11/2024	Dampland habitat	391938	6431783
153	26/11/2024	Road kill Quenda	392214	6437535

Fauna survey results – Black Cockatoo potential breeding habitat tree data

Object ID	Date	Tree species	Tree DBH (mm)	Hollow diameter (mm)	Tree category (1-7)	Easting	Northing
46	12/11/2024	Flooded Gum	600	no hollow	7	391423	6447857
47	12/11/2024	Flooded Gum	600	no hollow	7	391422	6447849
48	12/11/2024	Flooded Gum	800	no hollow	7	391413	6447922
49	12/11/2024	Flooded Gum	500	no hollow	7	391412	6447926
50	12/11/2024	Flooded Gum	600	no hollow	7	391412	6447939
51	12/11/2024	Flooded Gum	600	no hollow	7	391409	6447956
52	12/11/2024	Flooded Gum	500	no hollow	7	391405	6448000
53	12/11/2024	Flooded Gum	500	no hollow	7	391403	6448016
54	12/11/2024	Flooded Gum	500	no hollow	7	391400	6448055
55	12/11/2024	Marri	500	no hollow	7	391399	6448060
56	12/11/2024	Marri	500	no hollow	7	391392	6448112
57	12/11/2024	Marri	600	no hollow	7	391394	6448155
58	12/11/2024	Tuart	800	no hollow	7	391370	6448303
59	12/11/2024	Marri	520	no hollow	7	391385	6448262
60	12/11/2024	Tuart	670	no hollow	7	391345	6448731
61	12/11/2024	Tuart	1600	no hollow	7	391346	6448729
62	12/11/2024	Tuart	600	no hollow	7	391346	6448730
63	12/11/2024	Tuart	800	no hollow	7	391344	6448676
66	12/11/2024	Marri	700	no hollow	7	392518	6443465
67	12/11/2024	Marri	500	no hollow	7	392398	6442064
68	12/11/2024	Marri	500	no hollow	7	392404	6442070
69	12/11/2024	Marri	500	no hollow	7	392370	6441900
70	12/11/2024	Marri	500	no hollow	7	392380	6441930
71	12/11/2024	Marri	500	no hollow	7	392404	6442081
72	12/11/2024	Marri	600	no hollow	7	392527	6442781
73	12/11/2024	Marri	600	no hollow	7	392243	6440219
74	13/11/2024	Jarrah	900	no hollow	7	391733	6435661
75	13/11/2024	Marri	800	no hollow	7	391524	6434602
76	13/11/2024	Marri	800	no hollow	7	391519	6434659
77	13/11/2024	Marri	600	no hollow	7	391530	6434544
78	13/11/2024	Marri	550	no hollow	7	391865	6432264
79	13/11/2024	Marri	600	no hollow	7	391864	6432265
80	13/11/2024	Tuart	670	no hollow	7	391831	6431879
81	13/11/2024	Marri	500	no hollow	7	391809	6432038
82	13/11/2024	Marri	800	no hollow	7	391805	6432048
83	13/11/2024	Marri	500	no hollow	7	391797	6432101
84	13/11/2024	Marri	500	no hollow	7	391797	6432124
85	13/11/2024	Marri	500	no hollow	7	391794	6432152

Object ID	Date	Tree species	Tree DBH (mm)	Hollow diameter (mm)	Tree category (1-7)	Easting	Northing
86	14/11/2024	River Red Gum	900	no hollow	7	392133	6440339
87	14/11/2024	River Red Gum	800	no hollow	7	392138	6440315
88	14/11/2024	River Red Gum	670	no hollow	7	392142	6440354
89	14/11/2024	River Red Gum	500	no hollow	7	392134	6440363
90	14/11/2024	River Red Gum	800	no hollow	7	392138	6440323
91	12/11/2024	Flooded Gum	650	no hollow	7	391846	6431789

Carnaby's Cockatoo foraging habitat scores

Fauna Habitat Type	Area (ha)	Condition (out of 6)	Context (out of 3)	Density (out of 1)	Foraging Score (out of 10)
Banksia woodland	10.30	4	1	1	6
Eucalyptus woodland over Banksia	14.40	4	1	1	6
Melaleuca Dampland	3.94	1	0	0	1
Marri woodland	1.97	3	1	1	5
Naturalised and native trees	13.29	1	0	0	1
Native and introduced shrubs	61.27	1	0	0	1
Modified wetland drainage area	6.40	1	0	0	1
Cleared land	173.87	0	0	0	0

Average Carnaby's Cockatoo foraging habitat score for DE

Fauna Habitat	Area(ha)	Foraging Score	Area x Score
Banksia woodland	10.30	6	61.80
Eucalyptus woodland over Banksia	14.40	6	86.40
Marri woodland	1.97	5	9.85
Total	26.67		158.05
Average FHQS			5.93

Forest Red Tailed Black Cockatoo foraging habitat scores

Fauna Habitat Type	Area (ha)	Condition (out of 6)	Context (out of 3)	Density (out of 1)	Foraging Score (out of 10)
Banksia woodland	10.30	2	0	0	2
Eucalyptus woodland over Banksia	14.40	3	1	0	4
Melaleuca Dampland	3.94	1	0	0	1
Marri woodland	1.97	5	1	1	7
Naturalised and native trees	13.29	1	0	0	1
Native and introduced shrubs	61.27	1	0	0	1
Modified wetland drainage area	6.40	1	0	0	1
Cleared land	173.87	0	0	0	0

Average Forest Red-tailed Black Cockatoo foraging habitat score for DE

Fauna Habitat	Area(ha)	Foraging Score	Area x Score
Banksia woodland	10.30	2	20.60
Eucalyptus woodland over Banksia	14.40	4	57.60
Marri woodland	1.97	7	13.79
Total	26.67		91.99
Average FHQS			3.45

Fauna likelihood of occurrence assessment guidelines

Likelihood category	Description
Known	Species recorded during the field survey or from recent, reliable records from within or close proximity to the survey area.
Likely	Species are likely to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area. OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as unlikely include those species previously recorded within 10 km of the survey area however: There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. The suitable habitat within the survey area is isolated from other areas of suitable habitat and species has no capacity to migrate into the survey area. OR Those species that have a known distribution overlapping with the survey area however: There is limited habitat in the survey area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered highly unlikely to occur in the survey area include: Those species that have no suitable habitat within the survey area. Those species that have become locally extinct, or species are not known to have ever been present within the region of the survey area.

Definitions

Term	Description
study area	a 20 km buffer around the survey area
survey area	the area subject to the current survey
locality	the area within an approximate 20 km radius of the survey area
Conservation codes	
Cr	Critically endangered. Listed under BC Act and EPBC Act
En	Endangered. Listed under BC Act and EPBC Act
Vu	Vulnerable. Listed under BC Act and EPBC Act
Mi	Migratory. Listed under an international agreement
CD	Conservation dependant. Listed under BC Act
OS	Other specially protected fauna. Listed under BC Act
P1	Priority 1. Poorly known taxa. Not formally listed under BC Act but recognised as significant
P2	Priority 2. Poorly known taxa. Not formally listed under BC Act but recognised as significant
P3	Priority 3. Poorly known taxa. Not formally listed under BC Act but recognised as significant
P4	Priority 4 Rare, Near Threatened and other taxa in need of monitoring. Not formally listed under BC Act but recognised as significant

Fauna likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within the Kwinana Freeway to Tonkin Highway Widening survey are

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
BIRDS							
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI	The species utilizes a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. Generally the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands (Higgins & Davies 1996).	Unlikely The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines.	Unlikely. This species known to occur locally from database records including The Spectacles wetland reserve located within 1 km west of the survey area. The survey area is lacking specific habitat requirements such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence would be limited to occasional flyover during the seasonal occurrence of birds visiting local wetlands.	PMST, NatureMap, DBCA.
<i>Apus pacificus</i>	Fork-tailed Swift	MI	MI	The Fork-tailed Swift is common in coastal and sub coastal areas between Carnarvon and Augusta including near and offshore islands. There are scattered records along south coast from Denmark east to Cocklebidy on the Great Australian Bight, and sparsely scattered records inland. They are found across a range of habitats, from inland open plains to wooded areas. They are most often observed over inland plains in Australia, but sometimes recorded over coastal cliffs and beaches as well as urban areas. They have been recorded well out to sea as well as from offshore islands especially when on passage from Indonesia. This species is almost exclusively aerial (DCCEEW 2022).	Unlikely. Occurs locally on occasional/sporadic basis and only as aerial foraging.	Unlikely. Occurs locally on occasional basis however only aerial foraging or fly-over.	PMST, NatureMap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
<i>Arenaria interpres</i>	Ruddy Turnstone	MI	MI	The Ruddy Turnstone breeds in summer in the Arctic northern tundra areas of North America and Eurasia. During the Arctic winter (non-breeding season, it migrates to coastal southern and mid-latitude areas across the planet including many areas of the Australia coastline, and occasionally recorded in Perth-Peel area.	Unlikely. There are Database records for Woodman Point located approximately 10 km west of the survey area. Based on preliminary assessment from aerial imagery, the survey area is expected to lack suitable coastal habitat.	Unlikely. The survey area lacks suitable habitat namely coastal or near-coastal tidal shoreline. Occurrence would be limited to occasional flyover during the seasonal occurrence of birds within the region.	DBCA
<i>Botaurus dubius</i>	Australian Little Bittern	-	P4	In Australia, Australian Little Bitterns are found mostly in the lower Murray-Darling Basin (especially along the Murray River), but occasionally also elsewhere in the Murray-Darling Basin, up to south-eastern QLD. Occasionally they are also found in the Great Dividing Range and along the South and East coast of the continent, from about Cairns, QLD, in the North to about Adelaide, SA, in the South. There is also a small population on the south-western tip of WA, including Perth, and there are some reports of vagrants in various locations along the continent's North coast. Australian Little Bitterns are usually found in freshwater habitats, mostly in reeds around freshwater lakes, but also in reedbeds and other dense vegetation along creeks and in swamps. Sometimes they are also found in wetlands with brackish and saline water.	Unlikely. Based on preliminary assessment of aerial imagery, the survey area is expected to lack suitable habitat namely wetland with extensive dense emergent native reeds vegetation. There is a local record from South Lake approximately 3 km west of survey area.	Unlikely. Based on the field assessment, the survey area lacks suitable habitat namely wetland with dense emergent native vegetation.	DBCA
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	EN	The Australasian bittern occurs in temperate southern Australian environments, New Zealand and some Pacific Islands. It is a large bittern species that inhabits extensive areas freshwater wetland and occasional brackish estuarine areas and rely on dense vegetation, particularly rushes, reeds, and sedges for shelter. They are found in the temperate southeast and southwest of Australia, including	Unlikely. Based on preliminary assessment of aerial imagery, the survey area is expected to lack	Unlikely. The survey area lacks suitable habitat namely wetland with extensive emergent native vegetation.	DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				Victoria, Tasmania, New South Wales, South Australia, Western Australia, and Queensland. Its distributing has contracted due to habitat low and degradation and introduced predators. Post 1980s it is restricted to very few wetlands such as Forrestdale and Thomsons Lake (DBCA 2018b). Although these wetlands are also threatened by climate changes causing reduced rainfall leading to further reduction in suitable local habitat in the medium to long-term.	suitable habitat namely wetland with extensive emergent native reeds vegetation Historical record (1981) from Approx. 7 km NE survey area.		
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	VU, MI	VU, MI	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgeland and other ephemeral wetlands, but leave when they dry (DCCEEW 2022).	Unlikely Occurs locally during non-breeding season based on database records from Lake Thomsons Lake and historical records from North Coogee. The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines.	Unlikely. This species known to occur locally from database records including Thomsons Lake located approximately 3 km west of the survey area. However, the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence would be limited to seasonal flyover of birds visiting local wetlands.	PMST, Naturemap, DBCA
<i>Calidris alba</i>	Sanderling	MI	MI	The Sanderling occurs in coastal areas around Australia during its non-breeding summer migration. Inland records are uncommon although the species may fly over the continental interior areas on its way to coastal areas (Higgins & Davis 1996). Prefers to forage along coastlines of open sandy beaches wave-wash zone and amongst rotting seaweed. Also forages on exposed sandbars and spits and wave-washed rocky shores. It is gregarious usually observed in small to large flocks and will forage with other waders. Migrating flock tend to be less than a thousand (Higgins & Davies 1996). It is known for ability to accumulate	Unlikely. There are historical records from Coogee area, and known to occur in the region, however pending on-ground assessment, the survey area is expected to lack	Unlikely. The survey area lacks suitable shoreline habitat. Occurrence would be limited to seasonal flyover of birds visiting coastal areas along the Perth-Peel region.	DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				fat reserves as much as 60% of its post-migration body mass, in preparation for long-distance migration flights they make between breeding and non-breeding foraging grounds (Pringle 1987).	suitable shoreline habitat given the location.		
<i>Calidris canutus</i>	Red Knot	EN	EN	The Red Knot occurs along most northern Australian coastlines but records are less common to scattered in south-west Australia (Lane 1987) and occasionally recorded inland in all regions. In Australia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours. Occasionally recorded in recorded on artificial habitat such as sewage ponds and saltworks, but rarely use freshwater swamps, and rarely use inland lakes or swamps (Higgins & Davies 1996). Preferred foraging habitat is soft substrate near the edge of water on intertidal mudflats or sandflats exposed by low tide.	Unlikely. There are historical records from Coogee area, and known to occur in the region, however pending on-ground assessment, the survey area is expected to lack suitable shoreline habitat given the location.	Unlikely. The survey area lacks suitable shoreline habitat. Occurrence would be limited to seasonal flyover of birds visiting coastal areas along the Perth-Peel region.	DBCA
<i>Calidris falcinellus</i>	Broad-billed Sandpiper	MI	MI	A small migratory wader species spending the non-breeding season from easternmost Africa, through south and south-east Asia to Australasia. It is highly gregarious and will form flocks with other waders. It forages for food in soft coastal and estuarine muddy flats and shallow, mainly picking up insects and other small invertebrates.	Unlikely. Recorded at Thomsons Lake within 2 km of survey area. There are historical records including from Coogee area, and known to occur in the region, however pending on-ground assessment, the survey area is expected to lack suitable coastal shoreline habitat given the location.	Unlikely. The survey area lacks suitable shoreline habitat. Occurrence would be limited to seasonal flyover of birds visiting local wetlands and coastal areas along the Perth-Peel region.	DBCA
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR, MI	CR, MI	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often,	Unlikely The survey area is expected to lack suitable habitat:	Unlikely. This species known to occur locally from database records	PMST, Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (DCCEEW 2023).	such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Bore drains associated with road infrastructure may represent marginal habitat.	including Thompsons Lake located approximately 3 km west of the survey area. However, the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence would be limited to seasonal flyover of birds visiting local wetlands. Sumps associated with road drainage may represent marginal foraging habitat.	
<i>Calidris melanotos</i>	Pectoral Sandpiper	MI	MI	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands including heavily vegetated shallows(Higgins & Davies 1996).	Unlikely The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Bore drains associated with road infrastructure may represent marginal habitat.	Unlikely. This species known to occur locally from database records such as Yangebup Lake – Beeliar Regional Park regionally located 2 km west of the survey area. However, the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence may be limited to seasonal	PMST, Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
						flyover during bird's visitation of local wetlands.	
<i>Calidris pugnax</i>	Ruff	MI	MI	The Ruff is a medium sized wader of the Calidridinae family that is a regular seasonal but rare visitor to Australia. Its preferred habitat in Australia is fresh, brackish of saline wetlands with exposed mudflats, lakes, swamps, pools, lagoons, tidal rivers, shallow swampy fields. The Ruff is insectivorous throughout the breeding grounds however, it is omnivorous elsewhere during non-breeding season including Australia where it also feeds on plant material such as moss and seeds (Higgins and Davies 1996). It is both diurnal and nocturnal.	Unlikely There are occasional and historical records for the Perth-Peel region such as Coogee Beach. The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines.	Unlikely. The survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	DBCA
<i>Calidris ruficollis</i>	Red-necked Stint	MI	MI	The Red-necked Stint breeds in north-eastern Siberia and northern and western Alaska. It follows the East Asian-Australasian Flyway to spend the southern summer months in Australia. It is found widely in Australia, except in the arid inland. In Australia, Red-necked Stints are found on the coast, in sheltered inlets, bays, lagoons, estuaries, intertidal mudflats and protected sandy or coralline shores (Pizzey and Knight 2012).	Unlikely The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines.	Unlikely. This species known to occur in local wetlands including several database records from Beeliar Regional Park wetlands and Thompsons Lake Nature Reserve areas located within 2 to 3 km of the survey area. However, the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence may be	Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
						limited to occasional flyover of birds during the seasonal local visits to wetlands.	
<i>Calidris subminuta</i>	Long-toed Stint	MI	MI	In WA the species is found mainly along the coast, with a few scattered inland records. On the south coast the Long-toed Stint is found from Esperance to Albany and inland to Lake Cassencarry and Dumbleyung. On the south-west coast the species is known from the Vasse River estuary, Guraga Lake and the Namming Nature Reserve. The species has occasionally been recorded in the Gascoyne Region, around Lake Wooleen, Meeberrie Station and McNeill Claypan. It is widespread around the Pilbara region and the Kimberley Division between Karratha and Wyndham-Kununurra (DEE 2019b). It occurs in a variety of terrestrial wetlands. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds.	Unlikely This species known to occur locally such as recent record from Kogolup Lake in Beeliar Regional Park located approximately 3 km west of the survey area. The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines.	Unlikely. The survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	Naturemap, DBCA
<i>Calidris tenuirostris</i>	Great Knot	CR	CR	The largest of the Knots with wingspan attaining 58 cm (Higgins & Davies 1996). During the non-breeding season, the Great Knot forages along coastal or near-coastal shallow tidal mudflats, rarely inland areas. Birds that migrate to Australia probably stay in proximity of their arrival locations throughout the non-breeding season (Higgins & Davies 1996).	Unlikely. Known to occur locally from historical records from Coogee Beach area	Unlikely. The survey area is lacking preferred coastal shoreline habitat. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	DBCA
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo	VU	VU	The Forest Red-tailed Black Cockatoo inhabits the dense jarrah, karri, and marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (<i>E. patens</i>), Wandoo (<i>E. wandoo</i>), Tuart (<i>E. gomphocephala</i>), Albany	Present. Confirmed local occurrence based	Present. Confirmed based on observations of birds and extensive	PMST, Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				Blackbutt (<i>E. staeri</i>), Yate (<i>E. cornuta</i>), and Flooded Gum (<i>E. rudis</i>) (DEE 2017). Habitats tend to have an understorey of balga (<i>Xanthorrhoea</i> spp.), kingia (<i>Kingia australis</i>), snottygobble (<i>Persoonia</i> spp.), parrot bush (<i>Banksia sessilis</i>), holly-leaved mirbelia (<i>Mirbelia dilatata</i>), bull banksia (<i>B. grandis</i>), bullich (<i>Taxandria</i> spp.) and sheoak (<i>Allocasuraina fraseriana</i>). They are most common in the jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the Swan Coastal Plain, mainly in search of food the exotic white cedar (<i>Melia azedarach</i>). There are also several small, isolated populations in the eastern parts of its range (DAWE 2022).	on numerous local database records.	foraging signs during the field survey.	
<i>Chariadris cucullatus</i>	Hooded Plover	-	P4	The hooded plover is a small Australian beach nesting bird. It mainly occurs on wide beaches backed by dunes with large amounts of seaweed and jetsam, creek mouths and inlet entrances. Nests are found above the high-water mark on flat beaches, on stony terraces, or on sparsely vegetated dunes. As the hooded plover occurs on beaches, it is easily disturbed by human activities, particularly off-leash domestic dogs.	Unlikely There are occasional and historical local records, however based on preliminary assessment of aerial imagery, the survey area lacks suitable wetland habitat such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines.	Unlikely. This species known to occur regionally however the field assessment confirmed that the survey area is lacking suitable habitat. Occurrence may be limited to occasional vagrant visitation, or flyover.	DBCA
<i>Charadrius dubius</i>	Little Ringed Plover	MI	MI	While the majority of the population of Little Ringed Plovers will spend the northern winters in Africa, southward of the Sahara Desert, a small number will migrate to northern Australia. In Australia they are occasionally found along the coastline, mostly of the northern part of the continent. Outside the breeding season Little Ringed Plovers have a preference for beaches with sand dunes and marshes. They are also regularly found in sewage treatment plants.	Unlikely The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or	Unlikely. This species known to occur locally from database records such as Yangebup Lake 2 km west of the survey area. However, the survey area is lacking	PMST, DBCA, Naturemap.

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
					tidal estuarine or coastal shorelines.	extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	
<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU, MI	VU, MI	In Australia, the Greater Sand Plover occurs in coastal areas in all states, though the greatest numbers occur in northern Australia, especially the north-west (Marchant & Higgins 1993). In northern Australia, the species is especially widespread between Northwest Cape and Roebuck Bay in WA; there are sparsely scattered records from the largely inaccessible area between Roebuck Bay and Darwin, but it often occurs in the Top End of the Northern Territory, including on Groote Eylandt (DCCEEW 2022).	Unlikely There are historical records from 7 km northeast of the survey area. The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines.	Unlikely. This species known to occur regionally however the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines. Occurrence may be limited to occasional vagrant at best.	PMST, DBCA
<i>Charadrius mongolus</i>	Lesser Sand Plover	MI	MI	Within Australia, the Lesser Sand-Plover is widespread in coastal regions and has been recorded in all states. It mainly occurs in northern and eastern Australia, in southeastern parts of the Gulf of Carpentaria, western Cape York Peninsula and islands in Torres Strait, and along the entire east coast, though it occasionally also occurs inland. It is most numerous in Queensland and NSW. The species has also been recorded on Lord Howe Island, Norfolk Island and Christmas Island, Indian Ocean. In non-breeding grounds in Australia, this species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbors and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometime occurs in short saltmarsh or among mangroves. The species also	Unlikely The survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines.	Unlikely. This species known to occur regionally however the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines. Occurrence may be limited to occasional vagrant at best.	PMST, DBCA, Naturemap

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				inhabits saltworks and near-coastal saltpans, brackish swamps and sandy or silt islands in riverbeds (Marchant & Higgins 1993). In north-western Australia, the species appears to use the Port Hedland saltworks in preference to nearby beaches.			
<i>Chlidonias leucopterus</i>	White-winged Tern	MI	MI	White-winged Black Terns are non-breeding migrants to Australia from the North. They arrive anywhere along the tropical coast of Australia and disperse around basically the entire Australian seaboard, including the East coast of Tasmania and many small offshore islands. They can be found farther inland, in parts of the Great Dividing Range and in particular in the central part of the Murray-Darling Basin near the NSW/VIC border. There are also White-winged Black Terns in an area around Perth, WA. Elsewhere on the continent White-winged Black Terns are found only rarely, and never in the great deserts of WA/SA/NT or the Nullarbor. White-winged Black Terns live around lakes including ephemeral lakes, in estuaries and in coastal waters.	Unlikely The survey area is expected to lack suitable habitat: such as extensive lakes or flooded shallows.	Unlikely. This species known to occur including database record at Bibra Lake approximately 2km west of survey area regionally however the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines. Occurrence may be limited to occasional fly-over or vagrant visitation.	DBCA, Naturemap
<i>Falco peregrinus</i>	Peregrine Falcon	-	OS	The Peregrine Falcon is uncommon but wide ranging across Australia. Found everywhere from woodlands to open grasslands and coastal cliffs – though less frequently in desert regions – it feeds almost entirely on other birds. It also eats rabbits and other moderate sized mammals, bats and reptiles. The Peregrine Falcon is very territorial during breeding season, the male courting the female with an impressive display of aerobatics (DEE 2019b, Morcombe 2004).	Likely. Known to occurs locally from regular sightings and there are local database records including Bibra lake area 3 km west of survey area.	Likely. Trees within the survey area represent marginal nesting habitat. Likely to hunt within survey area on an occasional to regular basis.	DBCA, Naturemap
<i>Glareola maldivarum</i>	Oriental Pratincole	MI	MI	The Oriental pratincole has relatively short legs, long pointed wings and long forked tails. It hawks for insect prey in flight, although also feeding on the ground or occasionally coastal areas. It prefers open country, and they are often seen near water in the evening, hawking for insects. Within Australia the Oriental Pratincole is widespread in northern areas, especially the Pilbara, Kimberley regions, Northern Territory,	Unlikely. Occurs locally occasionally including historical records from Canning Vale	Unlikely. Occurs locally occasionally. Unlikely to occur but may hawk over the survey area on	DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				and the Gulf of Carpentaria. It is also widespread but scattered inland. There are occasional records in southern Australia, at sparsely scattered sites (Barrett et al. 2003).	Coogee Beach area.	occasional or vagrant basis.	
<i>Limosa lapponica</i>	Bar-tailed Godwit	MI	MI	The species has been recorded travelling over 13,000km from Alaska to Tasmania in only 11 days. During this flight they can lose almost half of their body weight. Adult birds mostly return to northern Arctic breeding grounds, although some birds (mostly young) remain for the year. Bar-tailed Godwits inhabit estuarine mudflats, beaches and mangroves. They are common in coastal areas around Australia. They are social birds and are often seen in large mixed flocks with other migratory waders.	Unlikely Occurs locally on locally based on two records from Swan River approx. 7 km NW of the survey area, and historical record from Coogee area Based on survey are location and preliminary aerial image assessment, the survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines	Unlikely. This species known to occur regionally however the survey area is lacking suitable coastal shorelines. Occurrence may be limited to occasional fly-over.	DBCA
<i>Limosa limosa</i>	Black-tailed godwit	EN, MI	EN, MI	Black-tailed Godwits arrive in Australia each year in August from breeding grounds in the northern hemisphere. Birds are more numerous in northern Australia. Black-tailed Godwits inhabit estuarine mudflats, beaches and mangroves. They are common in coastal areas around Australia. They are social birds and are often seen in large flocks and in the company of other waders (Birdlife Australia 2019). In Western Australia it is widespread around the coast, from Eyre to Derby, with a few scattered records elsewhere in the Kimberley Division. Populations have also been recorded in the Top End, from Darwin and Melville Island, east to the Alligator River and Croker Island (Marchant & Higgins, 1990). The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is	Unlikely. Occurs locally on locally based on historical record from Coogee area Based on survey are location and preliminary aerial image assessment, the survey area is expected to lack suitable habitat: such as extensive shallow wetlands, mudflats, seasonal	Unlikely. This species known to occur regionally however the survey area is lacking suitable coastal shorelines. Occurrence may be limited to occasional fly-over.	Naturemap DBCA, PMST

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats.	flooded shallows or tidal estuarine or coastal shorelines		
<i>Motacilla cinerea</i>	Grey Wagtail	MI	MI	A European and Asian species that migrates in winter south to Indonesia and New Guinea. Rarely reaches Australia. Occurs usually near fresh streams, but also on mown grass, ploughed land or near sewerage ponds. The Grey Wagtail is an opportunistic migrant to Australia. The species typically migrates to Indonesia occasionally landing in Australia. Most records for the species are from Northern Australia and South Australia (Morcombe 2004). The non-breeding habitat only of the Grey Wagtail has a strong association with water, particularly rocky substrates along water courses but also lakes and marshes (DAWE 2021e). It can be found mainly in banks and rocks in fast-running freshwater habitats: rivers, creeks, streams, and around waterfalls, both in forest and open country; but occurs almost anywhere during migration (Johnstone & Storr 2004).	Unlikely. A vagrant visitor to southern Australia. Rarely recorded locally.	Unlikely. A vagrant visitor to southern Australia. Rarely recorded locally.	PMST
<i>Numenius madagascarensis</i>	Eastern Curlew	CR, MI	CR, MI	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, sometimes within the mangroves, and in coastal saltworks and sewage farms. In the South-West, Eastern Curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet (Marchant & Higgins 1993). They are uncommon further south of Geraldton, but can be spotted in Alfred Cove, Peel Inlet and the Albany region (Nevill 2013).	Unlikely. Occasional and historical records from the Peel Inlet area.	Unlikely. The survey area is lacking suitable coastal or estuarine shorelines. Occurrence may be limited to occasional fly-over.	PMST, DBCA, Naturemap.
<i>Oxyura australis</i>	Blue-billed Duck	-	P4	The blue-billed Duck is a small Australian almost entirely aquatic duck, with both the male and female growing to a length of 40 cm. The male has a slate-blue bill which changes to bright blue during the breeding season. The Blue-billed Duck is endemic to Australia's temperate regions, ranging from the South-West of WA, extending to southern	Possible. There are numerous local records from local wetlands in proximity of the	Likely. Based on the site field assessment, the survey area has suitable habitat: Modified wetland	Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				Queensland, through New South Wales and Victoria, to Tasmania. The species is readily seen on freshwater lakes and billabongs where deep fresh water is present (Morcombe 2004).	survey area including Bibra, Thompsons and Beeliar Lakes	drainage areas that have either permanent or seasonal moderately deep pond areas that provide foraging habitat. This duck occurs locally and likely to visit this habitat on at least an occasional or seasonal basis.	
<i>Pandion haliaetus</i>	Osprey	MI	MI	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging (Marchant & Higgins 1993). They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range, but may also occur on low sandy, muddy or rocky shores and over coral cays.	Unlikely. There are numerous local records from local wetlands in proximity of the survey area including Bibra, Thompsons and Beeliar Lakes, although the survey area in un	Unlikely. This species known to occur locally from database records from local lakes including Thompsons Lake located approximately 3 km west of the survey area. However, the survey area lacks extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence would be limited to seasonal flyover of birds visiting local wetlands.	PMST, Naturemap, DBCA
<i>Phaethon rubricauda</i>	Red-tailed Tropic-bird	MI	MI	In Australia, it nests on Queensland's coral islands (including Raine Island and Lady Elliot Island), and Ashmore Reef and Rottneest Island off Western Australia, as well as Sugarloaf Rock at Cape Naturaliste and Busselton on the Western Australian coastline itself, and the offshore territories of the Cocos (Keeling) Islands, Norfolk and Lord Howe islands. In New Zealand territory it breeds on the Kermadec Islands. It	Highly Unlikely. Rare to vagrant visitor to southwest.	Unlikely. The survey area lacks suitable shoreline habitat. Occurrence would be limited to	DBCA, Naturemap

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				frequents areas of ocean with water temperatures from 24 to 30 °C (75 to 86 °F) and salinity under 35‰ in the southern hemisphere and 33.5‰ in the northern hemisphere. In the Pacific Ocean, the southern boundary of its range runs along the 22 °C (72 °F) summer surface isotherm. The warm waters of the Leeuwin Current facilitate the species nesting at Cape Leeuwin in southwestern Australia, yet is only a rare visitor to New South Wales at corresponding latitudes on the Australian east coast (Higgins et al 1990).		seasonal flyover of birds visiting coastal areas along the Perth-Peel region.	
<i>Plegadis falcinellus</i>	Glossy Ibis	MI	MI	The Glossy Ibis' preferred habitat for foraging and breeding are freshwater marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes, and coastal lagoons. Within Australia, the largest contiguous areas of prime habitat are in inland and northern floodplain areas (Marchant and Higgins 1990).	Possible. Known to occur locally on regular basis with records from lakes and Swan River within 2-7km of the survey area.	Unlikely. The survey area lacks suitable shallow wetland habitat. Modified wetland drainage sumps/ponds associated with the Kwinana Freeway is marginal and species' occurrence will be occasional to vagrant at most.	DBCA, Naturemap
<i>Pluvialis fulva</i>	Pacific Golden Plover	MI	MI	The Pacific Golden Plover breeds on the Arctic tundra in western Alaska. It winters in South America and islands of the Pacific Ocean to India, Indonesia and Australia. In Australia it is widespread along the coastline. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as <i>Sarcocornia</i> , or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks (DEE 2019b).	Unlikely. Occurs locally but survey area is not unlikely to have suitable coastal or tidal shoreline habitat based on location.	Unlikely. This species known to occur locally from database records including Thompsons Lake located approximately 3 km west of the survey area. However, the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence would	DBCA, Naturemap

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
						be limited to seasonal flyover of birds visiting local wetlands. Sumps associated with road drainage may represent marginal foraging habitat.	
<i>Pluvialis squatarola</i>	Grey Plover	MI	MI	The Grey Plover breeds around the Arctic regions and migrates to the southern hemisphere, being a regular summer migrant to Australia, mostly to the west and south coasts. It is generally sparse but not uncommon in some areas. It is occasionally found inland. It is almost entirely coastal, being found mainly on marine shores, inlets, estuaries and lagoons with large tidal mudflats or sandflats for feeding, sandy beaches for roosting, and also on rocky coasts (Birdlife Australia 2019).	Unlikely. Occurs locally from database records such as Yangebup Lake – Beeliar Regional Park regionally located 2 km west but survey area is unlikely to have suitable coastal or tidal shoreline habitat based on location.	Unlikely. This species known to occur locally from database records. However, the survey area is lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence may be limited to seasonal flyover during bird's visitation of local wetlands.	DBCA, Naturemap
<i>Thalasseus bergii</i>	Crested Tern	MI	MI	Crested Terns occur singularly or in flocks in coastal areas, estuaries, inlets, islands and occasionally on large inland lakes or rivers. They are often seen perching with gulls on beaches, sand spits or jetties. Crested Terns are widespread from the south coast of Africa north to Asia, south to Australia and east to Polynesia. They also occur on many islands in the Indian and Pacific Oceans (DEE 2018).	Unlikely. Local database records of this species from open water habitat such as Swan River and freshwater lakes. Based on preliminary aerial imagery, the survey area is not expected to have suitable wetland habitat.	Unlikely. This species known to occur in local wetlands including several database records from Beeliar Regional Park wetlands and Thompsons Lake Nature Reserve areas located within 2 to 3 km of the survey area. However, the survey area is lacking extensive shallow	DBCA, Naturemap

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
						wetlands, mudflats, seasonal flooded shallows or tidal estuarine shorelines. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	
<i>Tringa glareola</i>	Wood Sandpiper	MI	MI	The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. Wood Sandpipers are more numerous in the north than the south of Australia and are also found in New Guinea, Africa, the Indian subcontinent and South-east Asia. They breed widely across the north of Europe and Asia, mostly in Scandinavia, Baltic countries and Russia. They are the most abundant migratory wader in non-coastal areas of Asia (DEE 2019b).	Unlikely. This species known to occur locally from database records such as occasionally within Peel region. The survey area not likely to have suitable shoreline habitat	Unlikely. The survey area found to be lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	Naturemap, DBCA, PMST
<i>Tringa nebularia</i>	Common Greenshank	EN, MI	EN, MI	The Common Greenshank is a heavily built, elegant wader, 30–35 cm in length, with a wingspan of 55–65 cm and weight up to 190 g for both males and females. The bill is long and slightly upturned and the legs are long and yellowish-green. In flight, all plumages show uniformly dark upper wing and contrasting white rump extending in a white wedge up the back, whitish tail and tips of toes projecting slightly beyond the tip of the tail. The sexes are alike (Higgins & Davies 1996). The species is seen singly or in small to large flocks (sometimes hundreds) in a variety of coastal and inland wetlands. The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia (Higgins & Davies 1996). It occurs around most of	Unlikely. This species known to occur locally from database records such as Swan River and Thomsons Lake. However, the survey area is expected to lack extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines.	Unlikely. The survey area found to be lacking shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	PMST Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				the coast from Cape Arid in the south to Carnarvon in the north-west. In the Kimberley it is recorded in the south-west and the north-east, with isolated records from the Bonaparte Archipelago (Higgins & Davies 1996).			
<i>Tringa stagnatilis</i>	Marsh Sandpiper	MI	MI	The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In north Australia they prefer intertidal mudflats (Higgins & Davies 1996), although surveys in Kakadu National Park recorded more birds around shallow freshwater lakes than in areas influenced by tide. At the Top End they often use ephemeral pools on inundated freshwater and tidal floodplains (Higgins & Davies 1996). They are found infrequently around mangroves (Higgins & Davies 1996).	Unlikely. This species known to occur locally from database records such as Yangebup Lake 2 km west of the survey area. However, the survey area is expected to lack extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines.	Unlikely. The survey area found to be lacking extensive shallow wetlands, mudflats, seasonal flooded shallows or tidal estuarine or coastal shorelines. Occurrence may be limited to occasional flyover of birds during the seasonal local visits to wetlands.	Naturemap, DBCA
<i>Zanda baudinii</i>	Baudin's Cockatoo	EN	EN	Baudin's Black Cockatoo mainly occurs in eucalypt forests, especially jarrah, marri and karri forest that receives 750 mm of annual rainfall. The species is less frequently in woodlands of wandoo (<i>E. wandoo</i>), blackbutt (<i>E. patens</i>), flooded gum (<i>E. rudis</i>), yate (<i>E. cornuta</i>), partly cleared farmlands and urban areas. The range of the species extends from Albany northward to Giddegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup. Preferred roosts are in areas with a dense canopy close to permanent sources of water (DEE 2017).	Unlikely. Known to occur regionally on the Swan Coastal Plain including Perth Peel region based on foraging records, however not known to nest within or in proximity of the survey area.	Unlikely. Baudin's Cockatoo was not recorded during the survey but is known to occasionally forage and roost regionally. The survey area is located on the western edge of current known foraging distribution and lies outside the known breeding range of this species, which has a bearing on the habitat suitability and value for this cockatoo. Baudin's	PMST, Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
						Cockatoo should be considered an occasional visitor; however, this is only likely to be in the context of temporary fly-over activity or rare foraging activity.	
<i>Zanda latirostris</i>	Carnaby's Cockatoo	EN	EN	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum, wandoo, marri, jarrah and karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the jarrah-marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. It nests in trees older than 120-150 years (DEE 2017).	Known. Known to occur within the survey area based on database records.	Known. Recorded during the field survey within survey area at several locations including birds sighted and extensive foraging evidence.	PMST, Naturemap, DBCA
MAMMALS							
<i>Dasyurus geoffroii</i>	Chuditch	VU	VU	The Chuditch inhabits eucalypt forest (especially Jarrah, <i>E. marginata</i>), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2012). In Jarrah Forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck and Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented.	Possible. There is a database record from the vicinity of Jandakot Regional Park approximately 3 km east of the survey area.	Unlikely. There is a recent database record from the survey area. This species is re-appearing in some areas of its former range in the wider Perth-Peel area due to feral predator control. However, the lack of extensive and connected suitable habitat on local scale obviates occurrence within survey area,	PMST, Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
						although may occur as transient of vagrant visitation.	
<i>Falsistrellus mackenziei</i>	Western False Pipistrelle	-	P4	The Western False Pipistrelle occurs in wet sclerophyll forest dominated by Karri (<i>Eucalyptus diversicolor</i>), and in the high rainfall zones of the Jarrah (<i>E. marginata</i>) and Tuart (<i>E. gomphocephala</i>) forests. The species is restricted to areas in or adjacent to stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (<i>E. calophylla</i>), Sheoak (<i>Casuarina huegeliana</i>) and Peppermint (<i>Agonis flexuosa</i>) trees are often co-dominant at its collection localities (Churchill, 2008).	Possible. There are occasional and historic local database records such as Harry Waring Marsupial Park. The survey area represents the north-western edge of the species' range.	Unlikely. The survey area lacks suitable and growth forest favoured by this species. However it is highly mobile and may occur occasional of vagrant fly-over.	DBCA, Naturemap
<i>Hydromys chrysogaster</i>	Rakali, Water-rat	-	P4	The Water Rat (Rakali) lives in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck and Strahan 2008).	Unlikely. There are local records from attributed to database records along the Swan River and tributaries within 10 km of the survey area. However preliminary assessment of aerial imagery indicates survey area lacks suitable riparian habitat.	Unlikely. Based on the field assessment, the survey area lacks suitable riparian habitat.	DBCA, Naturemap
<i>Isoodon fusciventer</i>	Quenda	-	P4	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland close to dense cover (Van Dyck & Strahan 2008).	Known. Numerous local DBCA records including locations within the survey area.	Known. Recorded during field survey from several foraging digs and scat.	Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
<i>Myrmecobius fasciatus</i>	Numbat	EN	EN	Current Numbat populations occupy several different habitat types: upland Jarrah Forest, open eucalypt woodland, banksia woodland and tall closed shrubland. The only remaining original subpopulations are at Dryandra Woodland and the Upper Warren area (including Tone Perup Nature Reserve, Greater Kingston National Park, and adjoining State Forest). In WA there are nine translocation sites, including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (see DPaW 2015 for complete list and details). At Dryandra, numbats inhabit brown mallet (<i>Eucalyptus astringens</i>) plantations. Habitats usually have an abundance of termites in the soil, and hollow logs, tree hollows, burrows and branches for shelter (DEE, 2017; Van Dyck & Strahan, 2008).	Highly Unlikely. There are historical regional records, although the survey area is beyond the current range the species.	Highly Unlikely. There are historical regional records, although the survey area is beyond the current range the species.	Naturemap, DBCA
<i>Notamacropus irma</i>	Western Brush Wallaby	-	P4	The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DEC, 2012b; Van Dyck & Strahan, 2008).	Unlikely. There are regional database records, however based on preliminary aerial assessment, there is no extensive connected remnant bushland intersecting with the survey area.	Unlikely. There is a lack of suitable connected habitat within the survey area. Occurrence would be vagrant occurrence at best.	Naturemap, DBCA
<i>Phascogale tapoatafa wambenger</i>	Brush-tailed Phascogale	-	CD	This species favours dry sclerophyll forests and open woodlands with a generally sparse ground-storey, which contain suitable nesting resources such as tree hollows, rotted stumps and tree cavities (Van Dyck and Strahan, 2008). It occurs more rarely in wetter forests. Dated sub-fossil remains (210 ± 300 years BP) from Balladonia (WA) and an isolated record from Kalgoorlie (WA) implies that its previous extent of occurrence was more extensive than currently thought in Wildlife Australia.	Possible. There is a historical local record from Harry Warring Marsupial Reserve 2km west of the survey area.	Unlikely. The survey area lacks sufficient extensive connected bushland to support this species. Any occurrence would be vagrant or occasional at best.	DBCA, Naturemap
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	CR	CR	The Western Ringtail Possum occurs in and near coastal Peppermint Tree (<i>Agonis flexuosa</i>) forest and Tuart (<i>Eucalyptus gomphocephala</i>) dominated forest with a Peppermint Tree understorey from Bunbury to Albany. Also	Highly Unlikely. There are no local records and survey	Highly Unlikely. There are no local records and survey	PMST, DBCA, Naturemap

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				occurs in Jarrah (<i>Eucalyptus marginata</i>) forest and Jarrah-Marri (<i>Corymbia calophylla</i>) forest associated with Peppermint Tree (Van Dyck & Strahan 2008).	area is beyond the species' range.	area is beyond the species' range.	
<i>Setonix brachyurus</i>	Quokka	VU	VU	The current distribution of the Quokka includes Rottnest and Bald Islands, and at least twenty-five sites on the mainland, including Two Peoples Bay Nature Reserve and Torndirrup, Mt Manypeaks and Walpole-Nornalup National Parks, and swamp areas through the south-west forests from Jarrahdale to Walpole. The last known population on the Swan Coastal Plain occurs in Muddy Lakes near Bunbury. Quokkas have also been reintroduced to Karakamia Sanctuary (DEC 2012). They occupy dense forests and thickets, streamside vegetation, heaths, shrublands, Agonis linearifolia-dominated swamps in the Jarrah (<i>Eucalyptus marginata</i>) forest, and sometimes tea-tree thickets on sandy soils along creek systems. The northern extent on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, from where it extends southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 mm or more (DEC 2012; Van Dyck and Strahan 2008).	Highly Unlikely. There are no local records and survey area is beyond the species' range.	Highly Unlikely. There are no local records and survey area is beyond the species' range.	PMST,
REPTILES							
<i>Lerista lineata</i>	Perth Slider	-	P3	A slender species of skink endemic to Western Australia with two digits on forelimbs, three on hindlimbs, fused eyelids and broad, black lateral stripe. This species has a strong habitat preference for sandy, coastal heath and shrubland, particularly between Perth and Mandurah (Wilson & Swan, 2013). Occurs in remnant bushland areas and also recorded in disturbed areas such as residential land.	Likely. Several database records in close proximity to survey area (within and suitable remnant bushland habitat likely to occur.	Likely. Several database records in close proximity to survey area (within 1-3 km) and suitable remnant bushland habitat to occur.	Naturemap, DBCA
<i>Neelaps calonotos</i>	Black Striped Snake	-	P3	A small species of mildly venomous, burrowing snake species, reaching a maximum length of 280mm. Body colour is bright orange with a distinct black dorsal stripe extending full length from nape to tail tip. Feeds on fossorial skinks such as <i>Lerista</i> species that it hunts in loose sand and leaf litter. Given the strong burrowing characteristics of the species, it is restricted to sandy dune and sand plain, in areas which are dominated by Eucalypt and Banksia	Possible. Known to occur locally including recent database record 5km NE of the survey area.	Likely. Locally recorded and suitable habitat occurs within the survey area such as The Spectacles bushland reserve where area native	Naturemap, DBCA

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				woodlands (Wilson & Swan, 2013). Suitable habitat includes remnant bushland areas of sufficient habitat quality and area to support a subpopulation. It is endemic to the Coastal Plain between Mandurah and Lancelin (Wilson & Swan, 2013).		vegetation is of adequate size to support this species.	
INVERTEBRATE							
<i>Idiosoma sigillatum</i>	Swan Coastal Plain Shield-backed Spider	-	P3	This spider was recently described as part of a revision of Shield-back Trapdoor spider group (Rix et.al 2018). It has a relatively widespread distribution along the Swan Coastal Plain (SCP) of south-western Western Australia, from Dalyellup north to at least Ledge Point (including Rottnest Island and Garden Island. The eastern limit of its range along the sandy foothills of the Darling Escarpment, from Boyanup north to at least Gingin. Preferred habitat appears to be Banksia woodland and heathland on sandy soils. The vertical burrows are enhanced with a typical 'moustache-like' arrangement of twig-lines (Figs 16, 17). There are many early WAM since 1939 spread widely across the SCP but the expansion of Perth has significantly reduced and fragmented its former habitat area.	Possible. Several local and regional records including Beeliar area located 3 km northwest of the survey area.	Likely. The survey area intersects with suitable banksia woodland habitat in Anketell in the vicinity of the Spectacles Wetland area. Even though it was not detected during the field survey, it is likely to occur in remnant patches of Banksia woodland such as The Spectacles.	DBCA, Naturemap
<i>Leioproctus contrarius</i>	Short-tongued bee species	-	P3	The ecology of this little native bee is not well documented. It is known to be associated with <i>Scaevola repens</i> and <i>Lechenaultia</i> spp. (Houston 2000).	Possible. There is a recent record from Forrestdale approximately 8 km east of survey area.	Likely. Based on field assessment host plants <i>Scaevola repens</i> is present, and <i>Lechenaultia</i> species also present within the survey area.	DBCA
<i>Synemon gratiosa</i>	Graceful Sun Moth	-	P4	This sun moth is endemic to the Swan Coastal Plain. Previously thought to be restricted to a the Perth-Peel, its range has been extended from about Bunbury to Kalbarri. Host plants include <i>Lomandra hermaphrodita</i> found in <i>Banksia</i> woodlands of Bassendean Dunes, and <i>Lomandra matitima</i> which is common on coastal Quindalup Dunes. The moth completes its metamorphosis and emerges as adult moth in early Autumn (early March) and is active for several weeks to mate and complete life cycle before mortality. Eggs	Possible. Several local records from Perth-Peel region in areas of remnant Banksia woodland.	Likely. Host plants species namely <i>Lomandra hermaphrodita</i> recorded within the survey area, therefore the species is likely to occur.	DBCA, Naturemap

Taxon	Common Name	Status		Description and Habitat Requirements	Pre-survey likelihood	Post-survey likelihood	Source
		EPBC Act	BC Act /DBCA				
				are laid on host plants, and the larvae (grubs) remain in the plant for several years before reaching maturity.			
<i>Throscodectes xiphos</i>	Stylect Bush Cricket	-	P1	The ecology of this species is poorly known. The Stylect Cricket is a member of the diverse Katydid Family: Tettigoniidae and is endemic to the Swan Coastal Plain. The holotype of <i>Throscodectes xiphos</i> was collected from Banksia woodland located at Cutler Road, Jandakot on the Bassendean complex where it was originally collected in the axial leaf bases of grass trees (<i>Xanthorrhoea preissei</i>). It is a Confirmed SRE species and is currently classified by DBCA as a Priority 1 species (Rentz.1993).	Possible. Known to occur locally.	Likely. Potentially suitable Banksia woodland habitat within the survey area.	DBCA, Naturemap
<i>Westralunio carteri</i>	Carter's Freshwater Mussel	VU	VU	Carter's Freshwater Mussel is usually found in freshwater river pools. They are most common in areas with muddy, silty and sandy bottoms and flowing permanent water. Environmental tolerances of <i>W. carteri</i> are not precisely known but they can be found where water temperatures range from 4° C to over 30° C. The species has a low tolerance to salinity. It formerly occurred widely through the southwest including interior rivers of southwest such as Avon, Murray and Blackwood, however Salination of many waterways has rendered these waterways unsuitable which has severely reduced this species' distribution.	Possible. There are local records within 10 km of the survey area, however Based	Unlikely. The survey area lacks suitable waterway habitat.	PMST, Naturemap, DBCA

Appendix F

Wetland assessment

Wetlands of the survey area

Preliminary wetland assessment

Wetlands of the survey area

No.	UFI	Name	Category	Evaluated	Reason not evaluated
1	6664	Mandogalup Swamp Mid Nth	Resource Enhancement	Yes	N/A
2	12981	Mandogalup Swamp South	Conservation	Yes	N/A
3	14663	Mandogalup Swamp Mid Sth	Conservation	Yes (as part of neighbouring wetland 15584)	N/A
4	15397	Unknown	Conservation	Yes	N/A
5	15399	Unknown	Conservation	Yes (as part of neighbouring wetland 15397)	N/A
6	15584	Mandogalup Swamp Mid Sth	Conservation	Yes	N/A
7	15968	Unknown	Conservation	Yes	N/A
8	15970	Unknown	Conservation	Yes	N/A
9	15973	Unknown	Conservation	Yes	N/A
10	6530	Mandogalup Swamp South	Multiple Use	No	Aerial imagery shows the wetland has been cleared for agriculture
11	6652	Unknown	Multiple Use	No	Aerial imagery and ground truthing showed the wetland has been predominately cleared and is now a modified drainage area.
12	6655	Unknown	Multiple Use	No	Aerial imagery shows the wetland has been cleared for housing and roads
13	6656	Unknown	Multiple Use	No	Aerial imagery shows the wetland has been cleared for housing and roads.
14	6665	Unknown	Resource Enhancement	No	Aerial imagery shows the wetland has been predominantly cleared for housing and roads. The remaining remnant portion of the wetland is not reliant on the portion that occurs within the survey area.
15	6719	Mandogalup Swamp North	Resource Enhancement	No	Aerial imagery shows the wetland has been predominantly cleared for housing and roads. The remaining remnant portion of the wetland is not reliant on the portion that occurs within the survey area..
16	6724	Mandogalup Swamp North	Resource Enhancement	No	Aerial imagery shows the wetland has been predominantly cleared for housing and roads. The remaining remnant portion of the wetland is not

No.	UFI	Name	Category	Evaluated	Reason not evaluated
					reliant on the portion that occurs within the survey area.
17	13966	Unknown	Multiple Use	No	Aerial imagery shows the portion of the wetland within the survey area has been already cleared and is revegetation
18	14662	Mandogalup Swamp North	Multiple Use	No	Aerial imagery shows the wetland has been cleared for housing and roads.
19	15297	Unknown	Resource Enhancement	No	Aerial imagery shows the wetland has been cleared for housing and roads.
20	15298	Unknown	Multiple Use	No	Aerial imagery shows the wetland has been cleared for housing and roads.
21	15395	Unknown	Not Applicable	No	Aerial imagery shows the wetland has been cleared for housing and roads..
22	15398	Unknown	Multiple Use	No	Aerial imagery shows the wetland has been predominantly cleared for housing and roads. The remaining remnant portion of the wetland is not reliant on the portion that occurs within the survey area..
23	15521	Baler Court	Multiple Use	No	Aerial imagery shows the wetland has been cleared for housing and roads.
24	15583	Mandogalup Swamp Mid Sth	Multiple Use	No	Aerial imagery shows the wetland has been cleared for housing and roads.
25	15585	Mandogalup Swamp Mid Sth	Conservation	No	Aerial imagery shows the portion of the wetland within the survey area has been already cleared and is revegetation
26	15799	Unknown	Multiple Use	No	Aerial imagery shows the portion of the wetland within the survey area has been already cleared and is revegetation or road.
27	15801	Unknown	Resource Enhancement	No	The portion of the wetland within the survey area is dryland revegetation. The remaining remnant portion of the wetland is not reliant on the portion that occurs within the survey area

No.	UFI	Name	Category	Evaluated	Reason not evaluated
28	15967	Unknown	Not Applicable	No	Dryland; assigned category N/A.
29	15969	Unknown	Not Applicable	No	Dryland; assigned category N/A.
30	15971	Unknown	Not Applicable	No	Dryland; assigned category N/A.
31	15972	Unknown	Not Applicable	No	Dryland; assigned category N/A.
32	15976	Unknown	Multiple Use	No	Aerial imagery shows the wetland has been cleared and is now vacant grassland
33	15981	Unknown	Multiple Use	No	A highly modified drainage area. That aerial imagery and ground truthing showed holds no remaining wetland functions.
34	16021	Unknown	Multiple Use	No	A larger MUW that has been cleared for urban development.

Preliminary wetland evaluation

No.	Criteria	Wetland UFI							Comments
		6664	12981	15397 (inc. 15399)	15584 (inc. 14663)	15968	15970	15973	
1	The wetland is currently recognised as internationally or nationally significant for its natural values. Lists/registers include: The Ramsar Convention on Wetlands State Government endorsed candidate sites for the Ramsar Convention on Wetlands Directory of Important Wetlands in Australia National Heritage List or equivalent.	N	N	N	N	N	N	N	A search of the EPBC Protected Matters Database did not identify any of these features within the survey area (DCCEEW, 2024a). There are no Directory of Important Wetlands in Australia (DBCA, 2018) or National Heritage List sites (DCCEEW, 2024b) located within the survey area, however Spectacles Swamp (0.2 km west of the survey area) is listed on the Directory of Important Wetlands of Australia. The closest Ramsar-listed wetland is Thomson Lake (1.3 km west) (DBCA, 2017c).
2	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined by Keighery (1994) and is identified as significant for its natural values under one or more of the following: Conservation Reserves for Western Australia Systems 1, 2, 3, 5 Conservation Reserves for Western Australia, The Darling System – System 6 A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries	N	N	N	N	N	N	N	There are no Conservation Reserves for Western Australian Systems 1 to 6 within the survey area, however there are several EPA Redbook Recommended Conservation Reserves within two kilometres of the survey area (DBCA, 2017b, 2024b). The survey area is not located in the Busselton-Walpole region. No sites listed in The Environmental Significance of Wetlands in the Perth to Bunbury Region intersect the survey area (LeProvost,

No.	Criteria	Wetland UFI							Comments
		6664	12981	15397 (inc. 15399)	15584 (inc. 14663)	15968	15970	15973	
	of the Busselton – Walpole Region The Environmental Significance of Wetlands in the Perth to Bunbury Region Bush Forever, Swan Bioplan (including Peel Regionally Significant Natural Areas) or equivalent.								Semeniuk & Chalmer Environmental Consultants, 1987). The survey area does intersect Bush Forever site 270, however this site is not mapped as a geomorphic wetland (DBCA, 2024c; DPLH, 2019). No sites listed in the Swan Bioplan intersect the survey area (EPA, 2013).
3	The wetland supports a breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, <i>Environment Protection and Biodiversity Conservation Act 1999</i>, migratory bird agreements such as JAMBA, CAMBA and RoKAMBA) or the State (for example, threatened and specially protected fauna listed under the <i>Wildlife Conservation Act 1950</i>).	N	N	N	N	N	N	N	Of all State or Federally listed fauna species which have been previously recorded or are considered likely to occur in the survey area, none are likely to extensively use the wetland habitats available. Peregrine Falcon (OS) and the three black cockatoo species (EN, VU) may utilise the habitat for occasional feeding, but no evidence of breeding or roosting was observed. There are 23 species of Migratory shorebirds known to occur in local RAMSAR sites and other local wetlands, however this habitat is not extensive shallow water or tidal coastal/estuarine shoreline. Therefore, occurrence is considered unlikely.
4	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale	N	N	N	N	N	N	N	All wetlands evaluated are at least partially intersected by DBCA mapping of the Banksia Woodlands of the

No.	Criteria	Wetland UFI							Comments
		6664	12981	15397 (inc. 15399)	15584 (inc. 14663)	15968	15970	15973	
	outlined by Keighery (1994) and supports one or more of the following: an occurrence of a threatened ecological community a confirmed occurrence of a priority 1 or priority 2 ecological community a confirmed occurrence of a declared rare (threatened) flora species.								Swan Coastal Plain TEC buffer, however the field survey and statistical analysis of quadrats associated with these areas showed no affinities to the TEC. UFI 12981 is also intersected by mapping of the Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) TEC, however after a review of the field survey data and statistical analysis, the extent within the survey area is not considered representative of the TEC. No State or Federally listed flora were recorded within the survey area.
5	Equal to or greater than 90% of the wetland supports vegetation in a good or better condition using the vegetation condition scale outlined by Keighery (1994).	Y	Y	Y	Y	Y	Y	Y	As the shape of the survey area is a narrow road corridor, each wetland which intersects the survey area is not completely contained within it, and instead wetland-associated quadrats were installed near the perimeter of a given wetland in roadside vegetation. The vegetation condition at these roadside locations is negatively affected by proximity to the road, and as such is typically not representative of the entire wetland. For each wetland assessed, at least 90% of the area supported

No.	Criteria	Wetland UFI							Comments
		6664	12981	15397 (inc. 15399)	15584 (inc. 14663)	15968	15970	15973	
									vegetation in Good or better condition.
6	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined by Keighery (1994) and is known to support internationally, nationally or state-wide scientific values including geoheritage and geoconservation.	N	N	N	N	N	N	N	A search of the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) Geoheritage Sites database did not identify any geoheritage sites within the survey area (DEMIRS, 2024). The closest mapped Geoheritage Site is approximately 16 km to the east of the Mundijong Road site (Point Peron) (DEMIRS, 2024). A search of the EPBC Protected Matters Database did not identify any of these features within the survey area (DCCEEW, 2024a).
7	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined by Keighery (1994) and meets one of the following:	N	N	N	N	N	N	N	All wetlands assessed are dominated by vegetation in Good or better condition, however:



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