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DEPARTMENT OF TRANSPORT

South West Freight Rail Alignment

Project Report

301012-01409 – 01409a02

3-Aug-11

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PROJECT REPORT

EXECUTIVE SUMMARY

To be completed for final report

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PROJECT 301012-01409 - SOUTH WEST FREIGHT RAIL ALIGNMENT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
0	Issued as draft	M R Wegg	D J Foster	D J Foster	3-Aug-11	N/A	

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1 INTRODUCTION

This report documents investigations undertaken by WorleyParsons for the Department of Transport (DoT) for a planning and engineering based assessment of the feasibility of moving the Kwinana-South West freight rail line. The rail line is proposed to be realigned to a new alignment immediately west of the proposed Tonkin Highway extension in Mundijong.

This investigation re-examines the current planning concept for Tonkin Highway from just north of Bishop Road to Mundijong Road to accommodate a new rail alignment on the western side of the existing Primary Regional Road reservation of Tonkin Highway. A planning design concept has been prepared for the realigned freight rail line, including an assessment of the suitability of locating an intermodal terminal adjacent to this.

The report contains the following sections:-

- Section 2 – Background and Data Review
- Section 3 – Site Investigation
- Section 4 – Alignment Review
- Section 5 – Planning Design Concept
- Section 6 – Intermodal Terminal

2 BACKGROUND

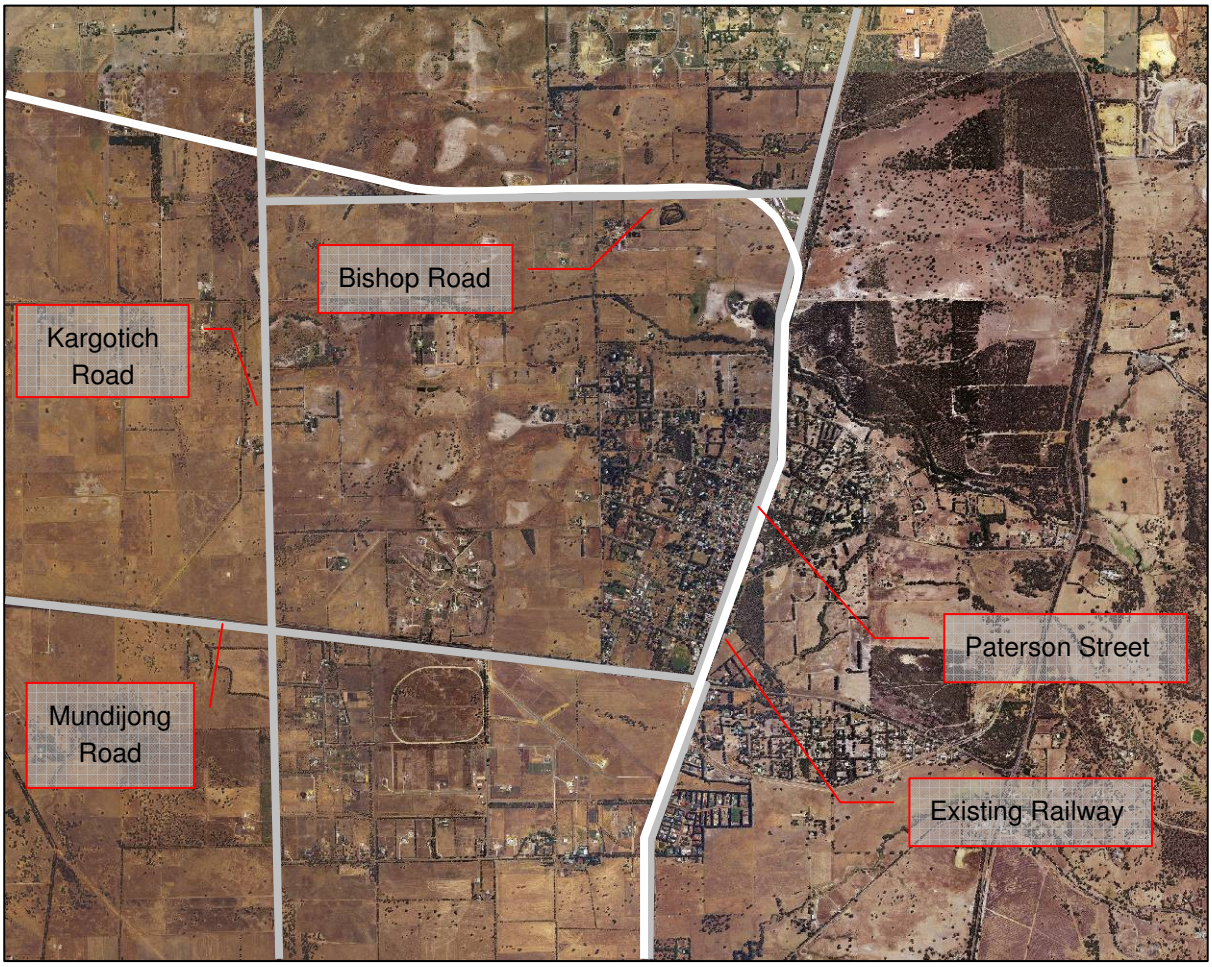
In November 2009 the Western Australian Planning Commission released the Industrial Land Strategy for Perth and Peel. Within this strategy, West Mundijong was identified as a possible strategic industrial area. It was recommended that land banking of this site be undertaken to allow for this potential use, subject to a feasibility investigation.

In March 2010, at the request of the Shire of Serpentine-Jarrahdale, representatives from the Department of Planning (DoP), DoT, Main Roads WA (MRWA) and the Shire's consultant met to discuss planning for the realignment of the freight rail line at West Mundijong and the potential creation of an intermodal terminal to the west of the existing town site. The matter was then formally discussed at the Shire's Council at a meeting held on 7 May 2010 where Council endorsed the Shire's position and formally requested the Western Australian Planning Commission's assistance to evaluate the proposal.

In order to facilitate an intermodal terminal at this location, the Kwinana-South West freight rail line will need to be relocated from its current alignment to a new alignment immediately west of the proposed Tonkin Highway extension. The purpose of this study is to provide a planning and engineering based assessment of the feasibility of this realignment.

The study area is shown in Figure 1 and is loosely defined as being between Mundijong town centre to the east and Kargotich Road to the west.

Figure 1 Study Area



2.1 Stakeholder Consultation and Data Review

WorleyParsons engaged with a number of stakeholders during the study to better understand their requirements and gather background information from them.

2.1.1 Main Roads WA

Main Roads WA are proposing to extend Tonkin Highway through the subject area, with Tonkin Highway ultimate connecting to South Western Highway in Mundijong. As part of this process, a concept a design for the extension has been prepared showing the alignment of Tonkin Highway and its connections to intersecting roads.

The concept design for Tonkin Highway in the vicinity of the subject site has been sourced and is included in Appendix 1. This design shows the alignment of Tonkin Highway and the intersection configurations with Mundijong Road to the south and Bishop Road to the north.

The current Tonkin Highway design concept was provided by Main Roads WA. This design has been overlaid onto an aerial photograph background and is shown in Appendix 1. Within the vicinity of the study area the design concept has the following features:-

- Parclo loop system (southern legs) at Bishop Road, with Tonkin Highway over Bishop Road;
- Diamond interchange at Mundijong Road, with Mundijong Road over Tonkin Highway;
- Interchange with southern legs of South Western Highway; and
- Four lane divided road.

2.1.2 Shire of Serpentine-Jarrahdale

The Shire of Serpentine-Jarrahdale is the local government authority for the study area. This investigation was initiated by the Shire who formally requested the Western Australian Planning Commission's assistance to evaluate the proposal to realign the freight railway.

The following documents were discussed with the Shire in the context of planning and considered within the investigation:

- Shire of Serpentine-Jarrahdale Rural Strategy
- Shire of Serpentine-Jarrahdale Town Planning Scheme No 2 (District Scheme)

These documents are contained in Appendix 2 and Appendix 3 respectively.

According to the Rural Strategy, approximately three-quarters of the area bounded by Mundijong Road to the south, the Tonkin Highway reserve to the east, Bishop Road to the north and Kargotich Road to the west is allocated as farmlet, which represents lots of between 4 – 40ha.

The Town Planning Scheme identifies the current land use zoning for the area. The main distinction between the Town Planning Scheme and the Rural Strategy is that the Rural Strategy indicates additional farmlets in some locations fronting Mundijong Road and Tonkin Highway. In the Town Planning Scheme these are identified as rural only. This current classification is expected to be more favourable in any potential acquisition of these areas, as land zoned rural is likely to consist of larger lots resulting in fewer affected land owners.

The Shire advised that the Mundijong urban area is to expand with some of this growth west of the current extent. As such, it is important that any realignment of the railway recognises this and is suitably separated from future urban area. Tonkin Highway is the western boundary for any expansion of the existing town site.

2.1.3 WestNet Rail

WestNet Rail is an independent rail infrastructure provider, responsible for access management, signalling and communication systems, train control and rail construction and maintenance throughout its network. WestNet Rail are supportive of the relocation provided that a number of design criteria can be achieved, including:

- The design should allow for potential future duplication of the track;
- An access road should be provided adjacent to the rail line, as is the existing case;
- A 40m corridor should be provided to allow for suitable clearance and width for infrastructure;
- A clearance height of 7.2m is required between the top of rail and the underside of a bridge to allow for the potential double stack of containers; and
- The opening at a bridge must allow for a dual track width.

2.1.4 Major Public Utilities

A review of the utilities in the area has identified the following:

- High voltage power lines located parallel to Kargotich Road; and
- Typical services along other roads within the area of interest.

The high voltage power lines represent a potential constraint due to the clearance required between the rail alignment and the power lines. This is required both for operational requirements and also to safeguard the power lines in the event of a train derailment.

The services along the local roads will need to be considered where the rail alignment will cross these roads. All road and rail crossings will be grade separated, with service relocation to be considered as part of these works.

3 SITE INVESTIGATION

To develop a further understanding of the study area and the opportunities and constraints for the realignment of the freight railway line and integration of an intermodal terminal, a number of investigations were undertaken. These investigations are documented herein and were centred around the following:-

- Geotechnical – review of potential geohazards;
- Environmental – identification of major drainage channels/infrastructure;
- Drainage;
- Property Access; and
- Land Take.

3.1 Geotechnical

A desktop assessment of geotechnical issues for the study area has been undertaken based on:

- Published maps including "1:50,000 Environmental Geology Series – Serpentine", GSWA, 1986 and "Sheet 4 of the Perth and Environs Geological maps, 1970, GSWA" (See attached); and
- Previous experience in the vicinity.

3.1.1 Surface Conditions

The Kwinana – South West freight rail line in Mundijong, at the site of the proposed realignment options occurs over the Swan Coastal plain. The alignments cross flood plain and alluvial terraces associated with the Manjedal and the Mardella Brook drainages. The plains and terraces are characterized by shallow groundwater tables, seasonal inundation and flooding. Much of the landscape has been cleared of native vegetation for agriculture or housing development purposes and includes at least two swamps/lakes associated with the Manjedal Brook flood plain.

3.1.2 Geology

The realignment options overly the eastern margin of the Swan Coastal plain, bounded to the east by the darling escarpment, and to the west by the coastal dune deposits. The site is underlain by Quaternary deposits associated with the coastal plain including deflated Pleistocene dunes, alluvium associated with sluggish drainage of rivers including the Serpentine and Canning Rivers.

The geological profile at the site consists of the following:

- Qha and Qrw – Recent alluvial and lacustrine deposits including Sand, Silt, Clay and Peat.

- Qpb/Qpa – Thin Bassendean Sand overlying Guildford Formation including Pleistocene aeolian and alluvial Sand, Silt and Clay

3.1.3 Foundation Conditions

The Guildford Formation comprises alluvium of varying grain size distribution, typically low permeability, low shrink-swell potential and medium (to high) bearing capacity. Investigations within the Guildford Formation produce varying results due to variations in the relative abundance of sand, silt and clay found locally within the unit, which is typical of alluvial deposits. Water tables range from less than a metre to a few metres below natural ground surface. Perched water tables sitting on low permeability layers are common within the unit and can result in groundwater seepage in excavations or cut slopes.

Foundation design over the Guildford Formation typically includes placement and compaction of engineered fill (usually sand), along with appropriate surface/subsurface drainage to overcome problems with inundation and high water tables. Fill or cut earthworks within thin Bassendean Sand over the Guildford Formation are typically no steeper than 2H:1V (26 degrees) for adequate stability

For shallow foundations on well compacted, cohesionless and uncemented Bassendean Sand or engineered sand fill of adequate thickness, an allowable or safe bearing pressure of 150 – 200 kPa may be adopted. The range of allowable bearing pressure is also applicable to shallow foundations on in-situ Guildford Formation that is classified as stiff (or better) and unaffected by groundwater. Considerations should be given to both total and differential settlements of foundations. Any peat materials encountered on the site should be removed.

Flexible pavements constructed over well compacted Bassendean Sand of at least 0.5m thickness may be designed on a subgrade CBR (California Bearing Ratio) of 12%. Where Guildford Formation forms the subgrade, a design CBR value of 5% may be adopted with sufficient consideration given to surface water drainage (e.g. table drains).

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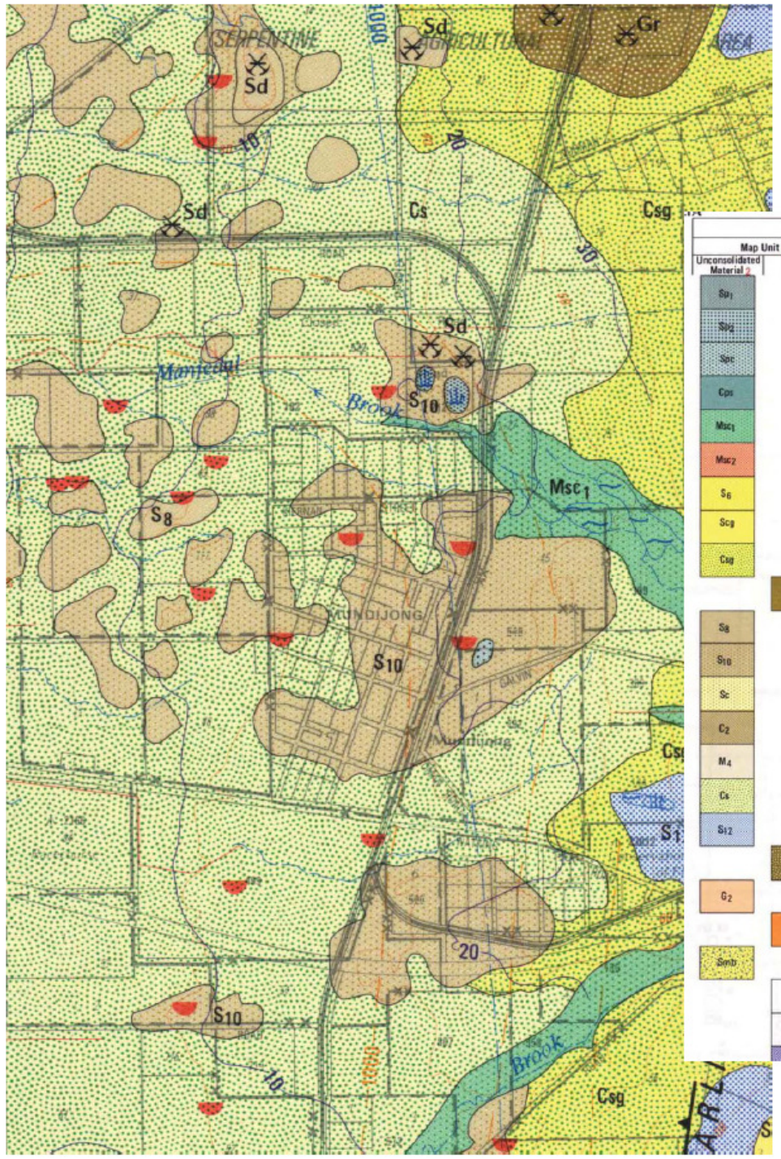
Figure 2 Environmental / Engineering Geology



Map Unit 1		GENERAL FEATURES				PHYSICAL PROPERTIES 6							CURRENT PROCESSES
Unconsolidated Material 2	Rock 2	Description	Equivalent units on geological maps	3 Relief; Slope 4	Rock-Mineral resources	Permeability	Corrosion Potential	Slope Stability	Ease of Excavation	Shrink-swell potential	Bearing capacity	SMEC 5	
Sp_1		PEATY SAND – grey to black, fine to medium-grained moderately sorted quartz sand, slightly peaty, of lacustrine origin	Swamp deposits (Qrw)	5–40 m; F		H	L–M	M	H	L	M	SW	Annual flooding
Sp_2		PEAT SAND – fine to medium-grained quartz sand with much brown to black organic material, grades to peat, of lacustrine origin		3–30 m; F	Peat	L–M	H	L	H	M–H	L	SW–PT	Perennial flooding
Spc		CLAYEY PEATY SAND – grey to black, quartz sand with variable organic content; minor clays, of lacustrine origin		10–40 m; F		L	M–H	L	H	L–M	L	SC–OL	Annual flooding
Cps		PEATY CLAY – dark grey and black, soft, variable organic content, some quartz sand in places, of lacustrine origin	Swamp deposits (Qhw)	5–15 m; F	Peat, diatomite	L	M–H	L	H	M–H	L	OH–CH	Flooding
Msc_1		CLAYEY SANDY SILT – pale brown, sand angular to rounded, low cohesion, of alluvial origin	Alluvium (Qha)	0–75 m; F		L	L	M	H	L	M	ML–MI	Sediment transport subject to flooding
Msc_2		CLAYEY SANDY SILT – fine to medium-grained angular quartz/feldspar sand, moderate cohesion, of alluvial origin	Alluvium (Qa)	80–315 m; F–G	Underlying pallid sandy silt and clay for brick and tile manufacture	L	L	L–M	H	L	L–M	ML–MI	Sediment transport
S_6		SAND – loose, white, pale grey to yellow, medium to coarse, moderately graded angular quartz, minor feldspar, of colluvial origin	Colluvial sands (Qs)	200–300 m; F–G	Potential construction sand	M–H	L	M–H	H	L	M–H	SP–SW	Sheet wash
Scg		GRAVELLY CLAYEY SAND – decomposed bedrock, gravel rock fragments, angular quartz/feldspar sand, clay minerals may flocculate to silt/sand size, of colluvial origin	Colluvium (Qc)	30 + m; M–S		L–M	L	M	H	V	V	SF clayey	Colluvial debris flow and wash
Csg		GRAVELLY SANDY CLAY – variable with lenses of silt and gravel, quartz sand sub-angular with eolian rounded component, heavy minerals common, gravel rounded, of colluvial origin		0–80 m; G–M	Gravel	L	L	H	L–H	M	M–H	SC clayey to GC clayey	Colluvial/alluvial piedmont deposit
FS_2		IRONSTONE – red-brown, grading from coffee rock through sandy, vuggy and pisolitic to massive, of alluvial origin		20–30 m; F		V	L	H	V	L	H	V	Watertable leaching/deposition
S_8		SAND – white to pale grey at surface, yellow at depth; fine to medium-grained, moderately sorted sub-angular to sub-rounded minor heavy minerals, of eolian origin	Bassendean Sand (Qpb)	5–55 m; F–G	Sandfill, construction and glass sand	M	L	M	H	L	M–H	SP–SW	Groundwater recharge Eolian transport
S_{10}		SAND – as S_8 over sandy clay to clayey sand of the Guildford Formation, of eolian origin	Thin Bassendean Sand over Guildford Formation (Qpb/Qpa)	5–50 m; F–G	Construction sand	H	L	M	H	L	M–H	SP–SW	Groundwater recharge Eolian transport
Sc		CLAYEY SAND – silty in part, pale grey-brown, medium to coarse, poorly sorted, sub-angular to rounded, frequent heavy minerals, rare feldspar, of alluvial origin	Guildford Formation (Qpa)	5–25 m; F		L–M	L	L–M	H	L	L–H	SF clayey	Groundwater recharge, some Eolian erosion
C_2		CLAY – strong brown and dark grey clay, plastic in places, soft when wet, variable silt content in matrix, of alluvial origin		2–10 m; F	Clays for brick, pipe and tile manufacture	L	L	L–M	H	L–M	L–M	CI	Flooding, stream flow, sediment transport
M_4		SILT – very pale brown silt, soft when moist, firm when dry, low clay content, of alluvial origin		5–8 m; F	Clays for brick, pipe and tile manufacture	L	L	L–M	H	L–M	L–M	ML–MI	Some flooding
Cs		SANDY CLAY – white, grey to brown, fine to coarse, sub-angular to rounded, clay of moderate plasticity; gravel and silt layers near scarp, of alluvial origin		5–55 m; F	Plastic clays and silt for brick manufacture	L	L	L–M	H	M	L	CI–SF clayey	Annual flooding
S_{12}		SAND – structureless, yellow, fine sub-angular and medium to coarse sub-rounded to rounded quartz, feldspar and heavy minerals common,minor silt and clay, of colluvial origin	Yoganup Formation (Qpr)	30–75 m; G	Construction and specification sand, "fatty" sand	M–H	L	M	H	L	H	SW	Eolian and fluvial erosion
FS_1		IRONSTONE – red-brown limonite gravel cemented in a quartz sand/limonite/silt matrix, of alluvial origin	Colluvium (Qpo)	50–80 m; G–M	Gravel	V	L	H	V	L	H	N/A	Stream erosion
G_2		GRAVEL – loose, fine (less than 19 mm) red-brown to black, pisolitic, moderately sorted, highly variable angular sand content, of colluvial origin	Laterite (Czl/Ql)	100 + m; F–M	Gravel	H	L	M	H	L	H	GP	Stream flow, sheet wash
LA_1		LATERITE – massive and vuggy to cemented pisolites up to 4 m thick; associated loose residual sandy pisolite gravel (G_2), of residual origin		200 + m; F–M	Bauxite, gravel, building stone	V	L	H	L(v)	L	H	N/A	Stream erosion lateritization active in wettest areas
Smb		BOULDERS in SILTY SAND – rounded boulders and gravel of Archaean rocks, coarse angular silty sand; firm, partly lateritized, of alluvial origin	Conglomerate (Rfg ?)	125–185 m; G–M	Fill	L–M	L	L	H	L	M	GF silty	Stream erosion, weathering
QT		QUARTZ – clear to milky white, massive quartz in sub-vertical veins up to several metres wide throughout the Proterozoic and Archaean rocks	Quartz veins (q)	80 + m; G–S	Ornamental gravel	L	L	H	L	L	H	N/A	
DQ		DOLERITE – fine to medium-grained, melanocratic in sub-vertical tholeiitic dykes up to 10 m wide	Dolerite dykes (d)	80 + m; G–S	Crushed rock aggregate	L	L	V	L	V	H	N/A	Weathering
		SHALE – brown, green to black, silty, thinly bedded with interbeds	Armadale Shale		Clay for brick and								

From 1:50,000 Environmental Geology – Serpentine. GSWA, 1986 (Jorden, J.E.)

3.2 Heritage

A desktop heritage review was undertaken, reviewing the presence of Aboriginal heritage areas, Native Title, and European heritage. This information is summarised below.

3.2.1 Aboriginal Heritage

Aboriginal Heritage areas are subject to the following legislation;

Aboriginal Heritage Act 1972 WA	Defines the meaning of "Aboriginal site" in Section 4 of the Act. Protects all Aboriginal sites whether or not they are recorded on the Register of Aboriginal Sites or otherwise known to the Registrar of Aboriginal Sites, Department of Indigenous Affairs or Aboriginal Cultural Material Committee Provides for "offences relating to Aboriginal sites" in Section 17.
Native Title Act 1993 (Cw'th)	Provides for the establishment of Native Title representative bodies that administer various functions under the Act, to assist and facilitate resolution of native title issues.

As Aboriginal Heritage Sites are protected in Western Australia, through the *Aboriginal Heritage* Act (1972), it is necessary for this scope of work to undertake a search through the DIA Register of Aboriginal Sites. In addition to this research into Registered Sites, it is necessary to establish if any Non-registered sites may also occur in the study area. This is done in consultation with the relevant Aboriginal communities and or Native Title Claimants. The appropriate avenue to begin such consultation is through the relevant Land Council for the region. For the States south-west, including the Perth Metropolitan area, the representative Native Title body is South West Aboriginal Land Council (SWALC). For information on the area from SWALC a formal assessment should be undertaken for the AOI and submitted..

The AOI has been surveyed according to the Aboriginal Heritage enquiry system. Reports of Aboriginal Heritage Sites Found within the area are located within Appendix 4.

In 1992 the Mabo decision in the High Court of Australia recognised native title over part of the Meriam peoples traditional lands in the Torres Straits. Following this decision the *Commonwealth Native Title Act* 1993 (Act) was enacted and provided a process for Aboriginal people to claim native title by lodging claims in the Federal Court. If claims passed a registration test it allowed certain legal rights to protect and negotiate over their traditional lands. The Act allows States and Territories to develop their own native title regimes that apply instead of the right to negotiate process where the Australian Government Minister determines that the regime complies with criteria set out in the Act. However, in Western Australia where there is by far the largest number of claims and mining titles, the State opted for using the Commonwealth process and the jurisdiction of the National Native Title

Tribunal. Native title claims ensure that the native title rights and interests of the Aboriginal traditional owners of the land are recognised by law. These rights and interests include the continued use and occupation of the land for traditional purposes such as ceremonies, hunting, fishing and procuring ochre and bush foods.

The AOI contains one determined native title area, namely the Gnaala Karla Booja [wc98/58]. This grant of tenure for rail purposes would require the proponent to reach an agreement with all relevant native title parties through which the rail alignment may pass.

3.2.2 European Heritage

Searches were undertaken of the Australian Heritage Places Inventory and the Register of the National Estate (RNE) to identify known locations of European Heritage. No places on the RNE were found to exist within the AOI. A search was also undertaken using the Department of Sustainability, Environment, Water, People and Communities (DSEWPaC) (formerly Department of Environment, Water Heritage and the Arts; DEWHA) Protected Matters Search Tool (*Department of Environment and Conservation 2008*); with no national or commonwealth heritage places listed with respect to the AOI.

3.3 Environmental

Using available information, WorleyParsons undertook a desktop review of environmental constraints within the project area to identify those likely to require formal assessment in the future or constrain alignment options for the railway. Figure 3 summarises key environmental constraints, the full environmental report is included as Appendix 4.

Figure 3 Environmental Summary

Constraints	Description of Applicability
Environmental Constraints	
Wetlands	The majority of the AOI has been classified as a wetland within the database including the Manjedal Brook .Approval from DEC will more than likely be required to develop around / within these water-bodies. It is expected due to significant land clearing and alterations to natural drainage within the area the conservation values applied to this area as a wetland may no longer exist. Contact should be made with the DEC and Bush Forever for planning approval for this area.
Acid Sulfate Soils	The AOI intercepts areas of PASS ranging from Medium to Low risk with some isolated High risk areas. An ASS investigation is recommended for areas of medium and/or high ASS risk.
RNE Areas	One registered site of RNE exists within the AOI (i.e. Reserve 23012), Watkins Rd, Mundijong, WA, Australia. Though this area is within the AOI, it is not expected that any proposed rail alignments will have a significant impact on Reserve 23012.
Flora species protected under the EPBC Act	Eight threatened flora species were found to have habitat or exist within the AOI.
Fauna species protected under the EPBC Act	Six threatened fauna species were found to exist or have habitat within the AOI.
Migratory species protected under the EPBC Act	Seven Migratory Species were found to exist or have habitat within the AOI.
DEC Listed Flora	Nine Declared Rare species were identified within the AOI. Further assessment of flora will be required once the preferred rail corridor is determined.
DEC listed Fauna	Five types of DEC Listed Fauna Species were identified within the AOI, species types and type of identification were provided by DEC.
Bush Forever Sites	There are a number of Bush Forever sites located within the AOI. These sites should be assessed for the impact of the proposed rail

Constraints	Description of Applicability
	alignment. Should a rail alignment intersect with these sites, appropriate approvals will need to be obtained from DEC.
Important Bird Areas	There are no IBAs within the AOI.

3.4 Drainage

A desktop assessment of hydrological issues is presented here, based on:

- Information contained within the Perth Groundwater Atlas, published online by the Department of Water (see attached);
- Information contained within the Australian Soil Resource Information System (ASRIS), with particular reference to Acid Sulfate Soils of Australia.
- Previous experience in the vicinity.

The area proposed for use by the proposed rail line realignment and intermodal freight terminal is located on palusplain. Palusplain is defined as a seasonally waterlogged flat land or plain, in this case the site is part of the Swan Coastal Plain.

Seasonally waterlogged means there is a high water table (within 2 metres of the surface) throughout the year and, while the water table is generally below the surface during the summer months, the ground becomes waterlogged during the wet months of the year as the water table rises. During wetter years it is not uncommon for the water table to reach the surface.

Given the nature of the site, the following issues will need to be addressed:

3.4.1 Surface drains

The area is bisected by Manjedal Brook and various other drains, all of which drain into Cardup Brook and, ultimately, the Peel Inlet. These waterways will have to be crossed with culverts or bridges without impeding the flow. Given the low topographic relief of the site, it is unlikely that drains will be able to be diverted so will have to be crossed where they are unless the grade of the drain can be maintained.

The level of service for the railway and freight terminal will need to be decided upon before a detailed study is undertaken to calculate the hydrological regime of the area and determine minimum floor and rail elevations as well as culvert/bridge configurations.

3.4.2 Stormwater runoff

Discharge of post development stormwater runoff must be kept to no more than 10% greater than pre development runoff. Thus, allowance needs to be made for the inclusion of detention basins in any development.

The quality of storm water leaving the site needs to be monitored to make sure that any fuel or other contaminant spills are captured and treated to the appropriate standards as specified by the Department of Water before being allowed to discharge to the environment.

3.4.3 Groundwater

As the site has a high level of the groundwater, consideration should be given to ensuring an adequate separation between the top of the water table and the base of any foundation.

This cannot be achieved by lowering the groundwater. The Department of Water will not allow the water table to be lowered as it will mobilise nutrients into the environment. In order to achieve the minimum separation, subsoil drainage pipes should be laid at no lower than the Average Annual Maximum Groundwater Level (AAMGL). Based on the configuration and layout of the drains, the maximum groundwater level can be calculated and, therefore, the amount of fill needed to achieve the minimum construction separation.

3.4.4 Dewatering

During construction it is likely that there will be temporary dewatering occurring. It is recommended that this water should be discharged to a settling and infiltration basin with an overflow directed to the nearest drain. Before being discharged off site, this water should be monitored, particularly for pH, to ensure that the water quality meets the appropriate standards as specified by the Department of Water.

3.5 Opportunities and Constraints Mapping

WorleyParsons prepared a high level land use opportunities and constraints map for the study area. The purpose of this map was to identify a range of physical constraints and opportunities across the site to as a simple reference for the development of rail alignment options. This map was used in conjunction with heritage and environmental constraints identified and mapped in the previous sections to develop the project teams understanding of the site and develop alignment options for the railway.

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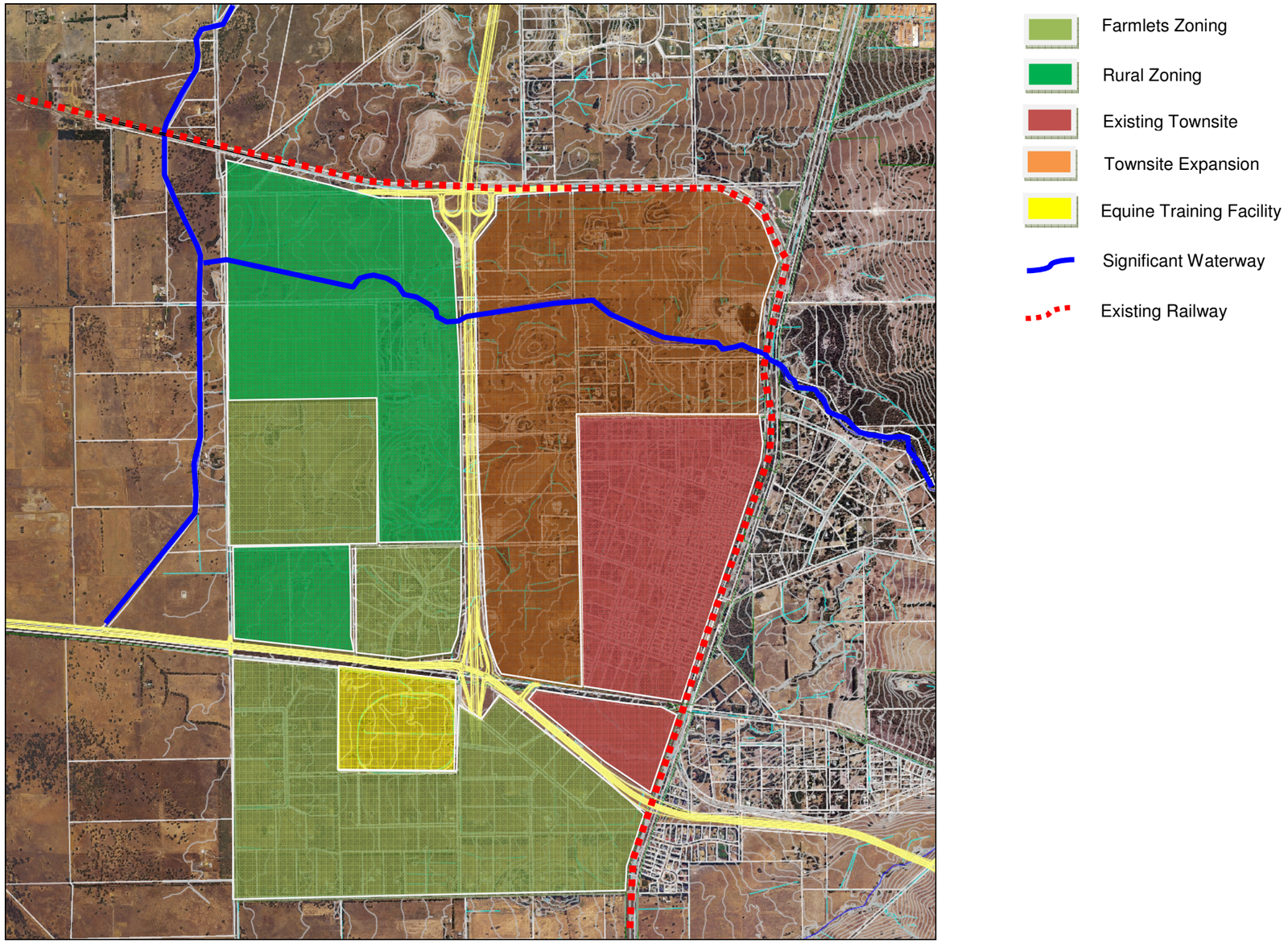
Figure 4 Land Use Opportunities and Constraints Map



4 ALIGNMENT REVIEW

WorleyParsons prepared a number of alignment options for the railway utilising design parameters provided by WestNet Rail. The intention of preparing these alignments was to ensure that all alignment options for the railway were considered and the best one selected. Having developed the options WorleyParsons facilitated a short workshop with DoT and key stakeholders to identify a preferred alignment.

4.1 Alignment Options

Through consideration of the items identified in the site investigation process and Main Roads WA Tonkin Highway Design Concept, a total of six alignment options were been developed. These options are shown in Appendix 5 and were developed to allow for an assessment exercise to confirm the preferred option, or mixture of options. The six options are summarised as:

1. Red route – Travels south immediately along the western boundary of the Tonkin Highway concept, before deviating east north of the Tonkin Highway/Mundijong Road interchange.
2. Green route – Travels south immediately along western boundary of Tonkin Highway concept, before deviating east south of the Tonkin Highway/Mundijong Road interchange.
3. Blue route – Travels south approximately 600m west of Tonkin Highway concept, before deviating east north of the Tonkin Highway/Mundijong Road interchange.
4. Purple route – Travels south along Kargotich Road alignment then crosses south over Mundijong Road and deviates east towards South Western Highway.
5. White route – Travels south approximately 600m west of Tonkin Highway concept, before deviating east south of the Tonkin Highway/Mundijong Road interchange.
6. Orange route – Travels south along Kargotich Road alignment then runs parallel to the southern side of Mundijong Road.

4.2 Assessment of Options

	Notes
Option Description	
Option 1	Easternmost alignment, closest to Mundijong townsite Runs straight alongside Tonkin Highway for approximately 1.5km Crosses Tonkin Highway north of Mundijong Road
Option 2	Same alignment as Option 1 for its northern half Runs straight alongside Tonkin Highway for approximately 2.3km Crosses Tonkin Highway south of Mundijong Road
Option 3	Similar to Option 1, except further setback from Tonkin Highway on its northern half 1km long straight section near Tonkin Highway Crosses Tonkin Highway north of Mundijong Road
Option 4	Westernmost alignment, furthest from Mundijong townsite Runs straight along Kargotich Road for approximately 2.5km
Option 5	Same alignment as Option 3 for northern half 2.5km long straight section near Tonkin Highway
Option 6	Same alignment as Option 4 for northern half Runs parallel immediately south of Mundijong Road

	Notes
Road Crossing Considerations	
Option 1	Bishop Road (road over rail) Tonkin Highway (road over rail) – Tonkin Highway/Mundijong Road interchange likely issue Mundijong Road (road over rail) – proximity to interchange not an issue
Option 2	Bishop Road (road over rail) Mundijong Road (road over rail) Tonkin Highway (road over rail) – significant issue here due to proximity of interchange
Option 3	Bishop Road (road over rail) Tonkin Highway (road over rail) – Tonkin Highway/Mundijong Road interchange likely impacted Mundijong Road (road over rail) – proximity to interchange not an issue
Option 4	Kargotich Road (road over rail) – realignment of Bishop Road also required Mundijong Road (road over rail) – proximity to interchange not an issue
Option 5	Bishop Road (road over rail) Mundijong Road (road over rail)
Option 6	Kargotich Road (road over rail) – realignment of Bishop Road required Mundijong Road (road over rail) Tonkin Highway (road over rail) – reconfiguration of interchange required

	Notes
Property Access Impacts	
Option 1	Scott Road cut, alternative access to properties from this road would be required.
Option 2	Scott Road cut, alternative access to properties from this road would be required. Impacts access to properties on Lampiter Drive cutting access from Webb Road also cuts access to equine training area.
Option 3	Does not impact any existing local roads
Option 4	Significant work would be required to maintain connection of Bishop Road and Kargotich Road. Will cut Malek Drive and impact properties south of Mundijong Road
Option 5	Would likely impact farmlets north west of Mundijong Road (Pure Steel Lane)
Option 6	Impacts access to properties on Lampiter Drive cutting access from Webb Road also cuts access to equine training area

	Notes
Land Requirements	
Option 1	Three semi-rural properties impacted to the west of Tonkin Highway Future urban area impacted east of Tonkin Highway Proximity of alignment to urban area (noise) Semi rural properties impacted south of Mundijong Road
Option 2	Three semi-rural properties impacted to the west of Tonkin Highway Impacts Equine Training Track Semi rural properties impacted south of Mundijong Road
Option 3	Three semi-rural properties impacted to the west of Tonkin Highway Future urban area impacted east of Tonkin Highway Proximity of alignment to urban area (noise) Semi rural properties impacted south of Mundijong Road
Option 4	Future urban area impacted east of Tonkin Highway Semi rural properties impacted south of Mundijong Road
Option 5	Five semi-rural properties impacted to the west of Tonkin Highway Impacts Equine Training Track Semi rural properties impacted south of Mundijong Road
Option 6	Impacts Equine Training Track Semi rural properties impacted south of Mundijong Road

	Notes
Impacts on Services	
Option 1	Will impact on minor services along Bishop Road and Mundijong Road
Option 2	Will impact on minor services along Bishop Road and in southern semi rural area
Option 3	Will impact on minor services along Bishop Road and Mundijong Road
Option 4	Will impact on minor services along Bishop Road and Mundijong Road Clearance to Western Power overhead lines parallel to Kargotich Road can be achieved
Option 5	Will impact on minor services along Bishop Road and in southern semi rural area
Option 6	Will impact on minor services along Bishop Road and Mundijong Road Clearance to Western Power overhead lines parallel to Kargotich Road can be achieved

4.3 Preferred Option

The six alignment options were presented to the project working group for the purpose of choosing a preferred alignment. The options were summarised as:

- Option 1 (Red) and Option 3 (Blue) both impact on the existing urban area to the east of Tonkin Highway;
- Option 2 (Green) and Option 6 (Orange) have significant impacts on the Tonkin Highway/Mundijong Road interchange;
- Option 5 (White) would potentially form a barrier between an intermodal terminal located on its eastern side and future industrial uses to the west of Tonkin Highway; and
- A hybrid option was developed based on Option 2 as a preferred alignment on the basis that:-
  - Its road crossings are simpler and likely to be less expensive

- Reduced impacts on future urban land to the east of Tonkin Highway
- Provides good opportunities for intermodal terminal and integration with future industrial uses
- It's only disadvantage are impacts to semi-rural properties and equine training area to the south of Mundijong Road

It was determined that option 2 (green route) was the preferred route, however it was considered to have issues with land acquisition south of Mundijong Road due to the angle at which it cuts through many farmlet lots. Accordingly, it was agreed to modify this option to essentially extend its alignment further south before deviating east towards and connecting to the existing railway. The effect of this is a lesser impact on the farmlet lots as it moves the deviation to a smaller number of larger rural lots, which are located south of Randell Road. It is expected that rural lots would be less expensive to acquire and therefore this was considered the preferred option. This option was agreed with the project working group and is developed further in Section 5.

5 PLANNING DESIGN CONCEPT

5.1 Overview

Following confirmation of a preferred rail alignment, WorleyParsons has developed a single planning design concept for the freight railway realignment. This design concept represents a refinement of the alignment developed in Section 4.

This alignment was prepared based on road and rail design standards as identified within the project brief, specifically:

5.1.1 Road Design Standards

- Design speed — 110km/hr (posted speed 100km/hr)
- Design vehicle — 27.5m B-double road trains
- Horizontal alignment — 660 absolute minimum radius based on f 0.12 des min. and 5% cross fall, 1100m desirable minimum radius based on f 0.12 des min. and 3% cross fall
- Vertical alignment — Maximum grade - 4% (desirable min.), - 5% (absolute max.)
  Minimum grade - 0.3%
  Crest vertical curve K value = 98 (desirable min.), 172 (absolute min. for zero height datum)
  Sag vertical curve K value = 50 (desirable min.)
- Vertical clearance — 5.8m general
- Cross section — 4 lane divided road
  Lane width = 3.5m
  Seal width = 10m each carriageway
  Median width = 15m (residual width 12m) to Mundijong Road
  9m (residual width 6m) south of Mundijong Road
  Shoulder width = 3.0m left, 1.5m median
  Pavement batter = 1.35m (based on 0.3m pavement thickness)
  Pavement cross fall = 3%
- Earthworks — Fill batter 4:1 (horizontal: vertical)
  Cut batter 3:1

5.1.2 Rail Design Standards

- Design speed 100km/hr
- Reservation width 40m (nominal)
- Horizontal alignment 1000m radii absolute minimum
- Vertical alignment 1 in 200 (0.5%) desirable minimum
  1 in 150 (0.67%) absolute maximum
- Vertical curve 10,000m radii desirable minimum
  5,000m radii absolute minimum
- Track centres 5.4

5.2 Highway / Railway Interaction

Interaction between the current Tonkin Highway planning design concept and the proposed rail alignment has been minimised due to the alignment selected. Key changes to the Tonkin Highway concept include:-

- Raising Bishop Road over the proposed rail alignment to the west of Tonkin Highway;
- Modification of the Mundijong Road interchange to allow the railway to pass under Mundijong Road to the west of Tonkin Highway;
- Extension of the existing Tonkin Highway concept south of Mundijong Road to show it passing over the proposed railway alignment.

All of these modifications to the existing road design concept have been achieved within the design guidelines and standards as provided by Main Roads WA to WorleyParsons.

5.3 Cut and Fill

WorleyParsons has endeavoured to balance the amount of cut and fill required along the length of the alignment. We have assumed a 150mm of topsoil removal would be required as part of construction. This results in the following for the alignment:-

- Cut = 52,770m^3
- Fill = 50,365m^3
- Topsoil Removal = 28,500m^3

5.4 Local Road Network Impacts

The preferred alignment impacts on a number of currently unused road reservations. It is assumed that these reserves can be deleted or modified in the future should this land be re-zoned to urban/industrial.

Scott Road is severed by both Tonkin Highway and the proposed railway alignment. Alternative access from Kargotich Road could be achieved through extension of the Scott Road west within its existing road reserve.

Access to the existing equine training facility and a number of farmlets to the south of Mundijong Road via Webb Road will be significantly impacted by both Tonkin Highway and the proposed railway. Alternative access to these properties from Mundijong Road to the east and west of Tonkin Highway will be required.

5.5 Land Requirements and Property Impacts

Based on the typical cross section supplied by WestNet Rail and applied to the rail alignment and total area of 269,000m^2 will be required as reservation for the proposed rail alignment.

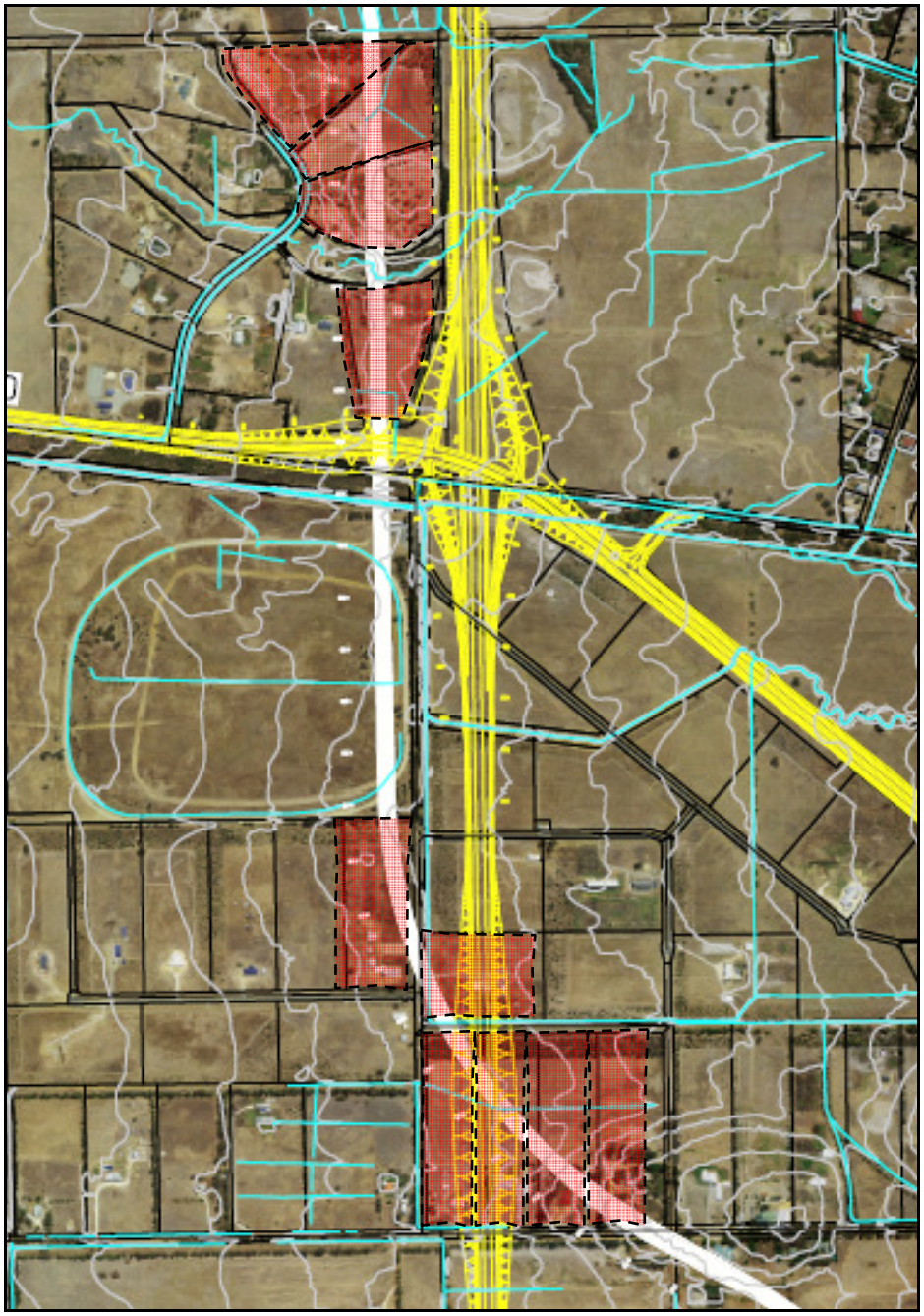
Much of this land is currently zoned rural and could be acquired and subdivided for future redevelopment leaving large usable lots.

In the north west corner of the Mundijong Road and Tonkin Highway interchange four existing famrles are significantly impacted by the proposed rail alignment. It is possible that two to three of these lots would be need to acquired in full by the WAPC to enable construction of the railway.

To the south of Mundijong Road the equine training facility is significantly impacted by the proposed alignment. The existing training track would need to be realigned and shortened to maintain its existing use, acquisition of the entire property would not be required.

Six farmlets are also impacted in this area, in some cases existing buildings are impacted and as such acquisition of entire properties is likely to be required. Two of these farmlets are already impacted by the future Tonkin Highway and as such would require acquisition as part of that project. Figure 5 illustrates the location and number of farmlets impacted by the proposed alignment.

Figure 5 Impacted Farmlet Properties



5.6 Utilities Impacts

The proposed alignment does not impact on major utilities (power lines) located along Kargotich Road. Smaller local utility services are impacted along local roads throughout the alignment. These services will include domestic power supply, water and telecommunications some of which are also impacted by the Tonkin Highway.

Further work will be required at the detailed planning stage to determine an appropriate servicing strategy for lots remaining after construction. This strategy will also need to take into account any proposed changes to land uses and the impacts that this might have on service requirements.Major Drainage Impacts

A number of existing drainage lines will be impacted by the alignment in the area between Bishop Road and Mundijong Road. These lines are also impacted by Tonkin Highway and will require culverts or bridges in order to maintain existing flows along them.

6 INTERMODAL TERMINAL

An intermodal freight terminal comprises a site used to transfer freight from one mode of transport to another, ie. rail to road, along with all the necessary support services and activities. There are a number of intermodal terminal facilities in the metropolitan area, with the most significant of these located Kewdale/Forrestfield.

Intermodal terminals throughout Australia vary in size between 2.0ha to more than 60ha. At the larger end of the spectrum, the general specification is that the terminal must be able to accommodate 1,800m interstate trains with sufficient width to cater for efficient container movement to and from the trains. The land area required considered appropriate for this is approximately 2km in length and 400m width. However, the size of each site should be assessed in terms of its own particular requirements. For the basis of comparison, freight trains in Western Australia currently have the following lengths:-

- Grain standard gauge 1,700m
- Grain narrow gauge 1,200m
- Interstate general freight 1,800m
- Long haul iron ore 1,800m
- Short haul container and some mineral trains 400 – 800m

Typical intermodal density traffic requires the upgrading of rail infrastructure consistent with the “Defined Interstate Rail Network” where long, heavy axle load trains and double stacked containers can be accommodated.

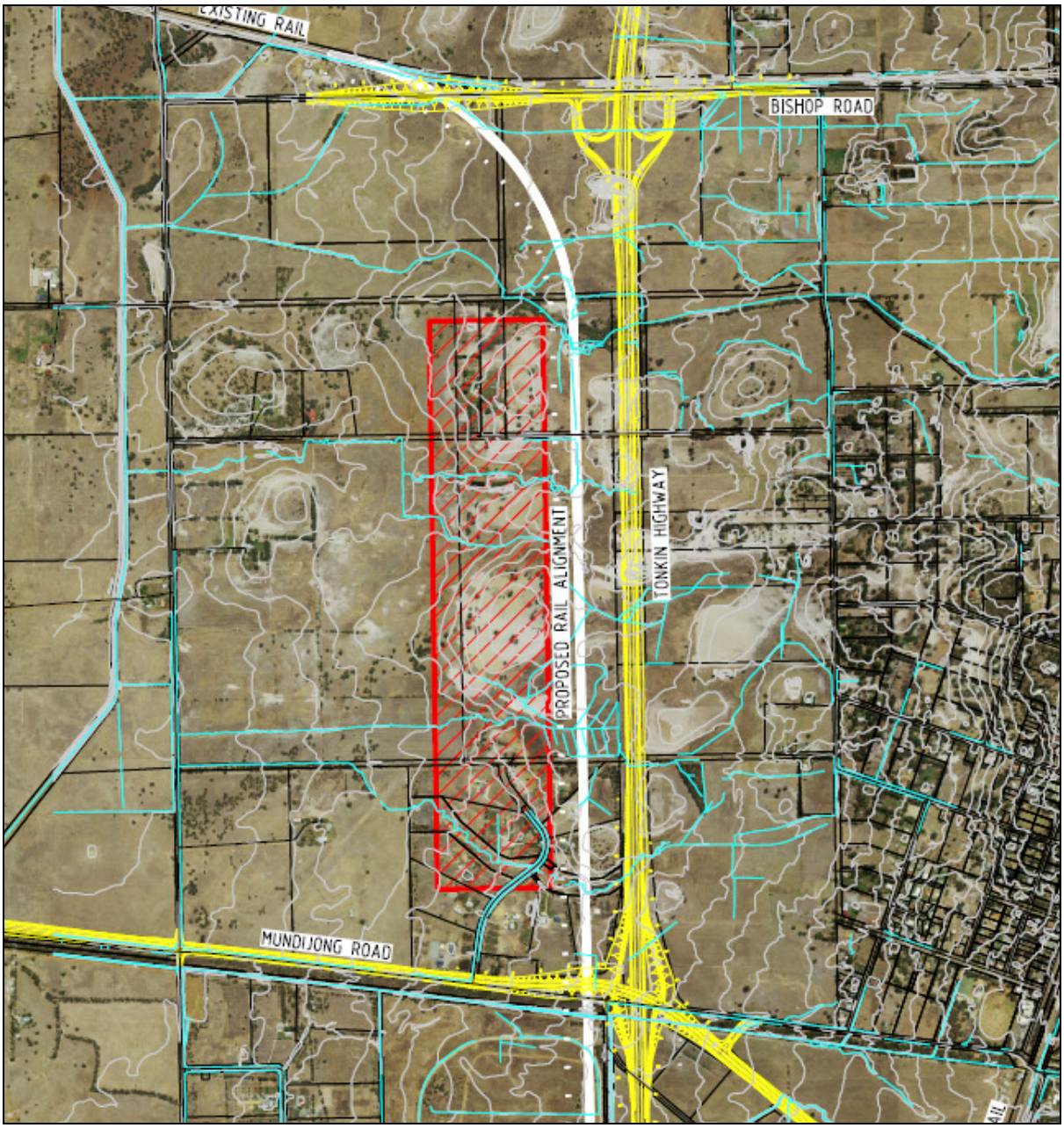
The distance between Mundijong Road and Bishop Road is 3.2km along the Tonkin Highway alignment and 3.0km along Kargotich Road. The straight section of the preferred alignment north of Mundijong Road is approximately 2.5km long. This length coupled with the available width is suitable for an intermodal terminal. The rail alignment through this area would run parallel with Tonkin Highway.

Figure 6 illustrates the preferred location for the intermodal terminal parallel to the proposed railway alignment on its western side. A terminal perpendicular to the proposed rail alignment was considered however a parallel alignment was preferred due to simplified operations with regard to access the railway. A perpendicular terminal would cross both Kartgotich Road and existing high voltage powerlines both of which would required realignment.

Access to the site could be provided from Kargotich Road, Mundijong Road and Bishop Road. Due to the proximity of the rail alignment to the future Tonkin Highway alignment, vehicles would be able to access Tonkin Highway efficiently. The site also affords good access to South West Highway (east of the site along Mundijong Road) and Kwinana Freeway (west of the site along Mundijong Road).

Land west of the intermodal terminal could be developed for compatible industrial purposes providing further benefits to the facility.

Figure 6 Potential Intermodal Terminal Location



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Appendix 1 Tonkin Highway Design Concept

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Appendix 2 Shire of Serpentine-Jarrahdale Rural Strategy

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Appendix 3 Shire of Serpentine-Jarrahdale Town Planning Scheme No 2

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Appendix 4 Desktop Environment and Heritage Review

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Appendix 5 Alignment Options

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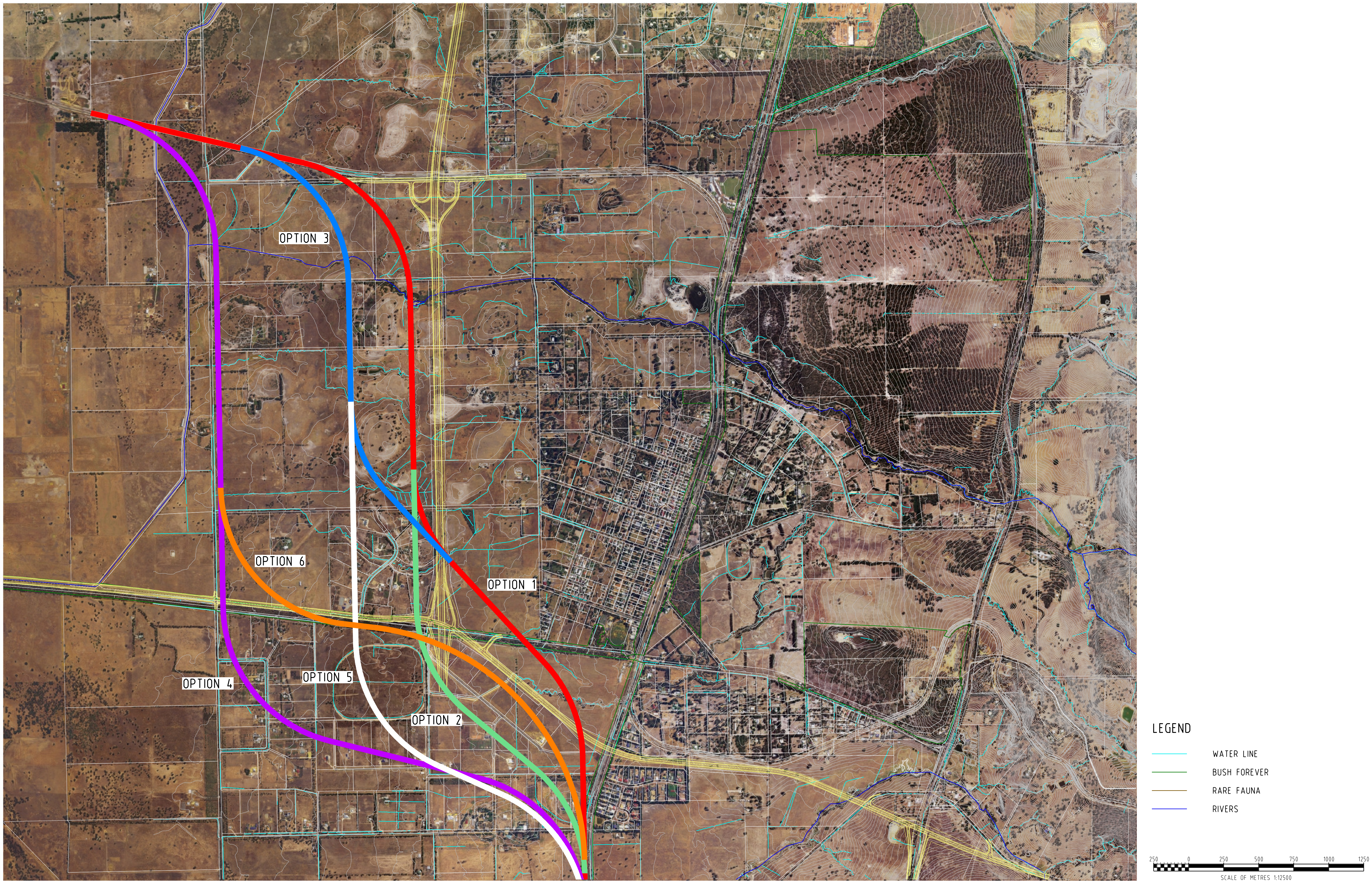

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A1 SHEET SCALE 1:12500

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CUSTOMER

SOUTH WEST FREIGHT RAIL
TONKIN HWY / MUNDIJONG ROAD
RAIL OPTIONS
CONCEPT PLAN

DRG No 301012-01409-CI-DSK-0001 REV

LOCATION: H:\301012\01409 South West Freight Rail\CAD\CI\SKT\301012-01409-CI-DSK-0001-tmp.dgn

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Desktop Assessment

Environment and Heritage of South West Freight Rail Expansion

301012-01409

2-Jun-11

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1 DESKTOP ENVIRONMENTAL AND HERITAGE REVIEW

1.1 Objective

The objective of the Desktop Environmental and Heritage Review for the South West Freight Rail Expansions (Area of Interest (AOI)) is to provide a summary of potential environmental and heritage constraints which may applicable to the project area. This desktop review also provides comment on further studies which may need to be undertaken for environmental approvals prior to the commencement of the project.

Note: Hydrogeology and geology are outside the scope of this review (please refer to accompanying reports).

1.2 Area of Interest

The AOI is part of the South West natural resources management catchment areas which are managed by the South West Catchments Council. The proposed AOI has been illustrated below in Figure 1.

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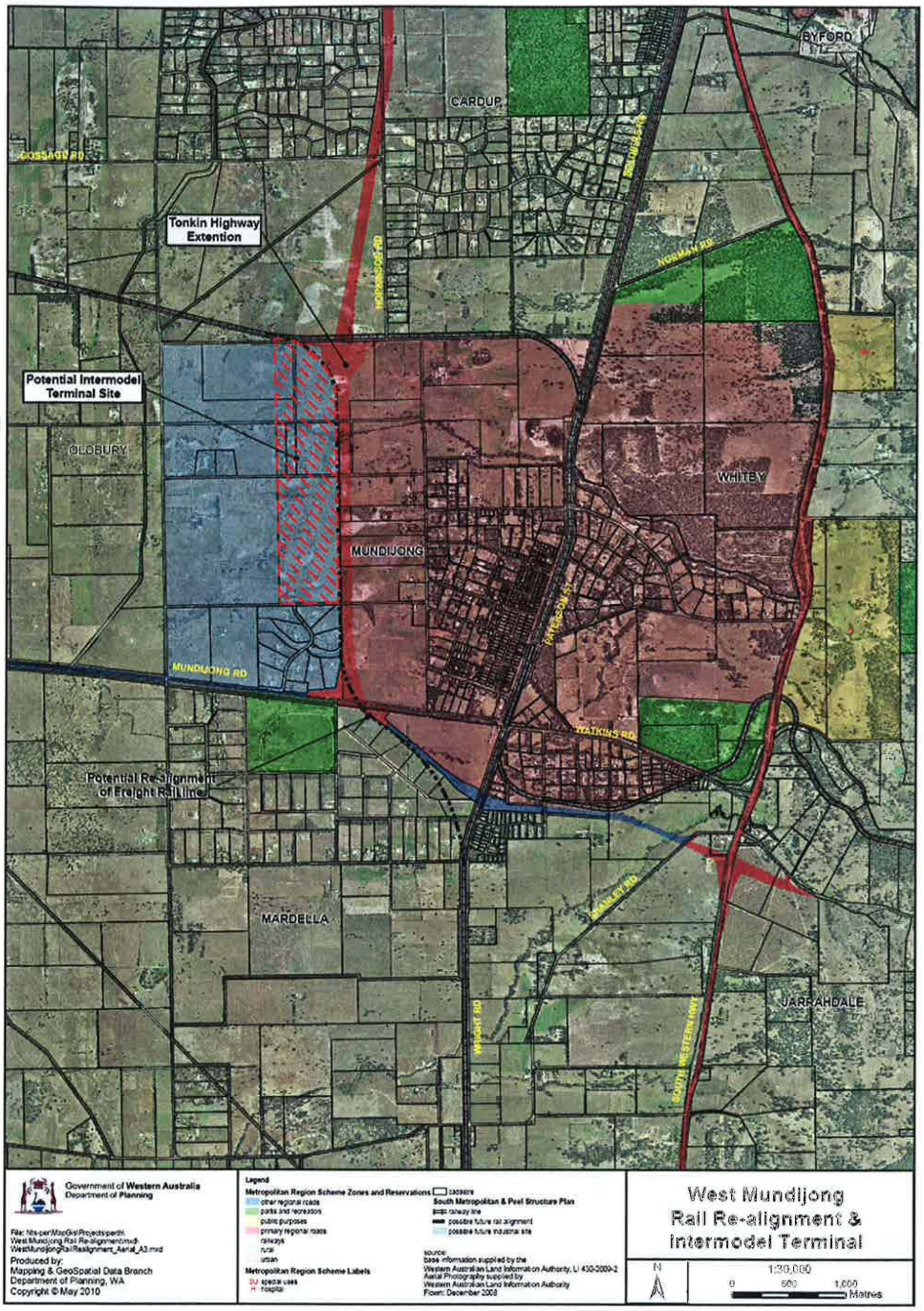

Figure 1: Area of Interest

2 SOCIAL CONSTRAINTS

2.1 Local Shire

The AOI lies within the Shire of Serpentine-Jarrahdale (The Shire) in a Local Government Area (LGA) approximately 45 km south east of Perth, Western Australia. The Shire is governed under the Town of Mundijong. The Shires population is estimated at 13,393 and is expected to continue to increase in coming years.

2.2 Land Uses

The Shire demonstrates a strong position on protecting the natural bush land within the area. Management plans within the area concentrate on protecting the existing environment, bush land areas and agricultural lands. Village developments are preferred to preserve agricultural lands.

2.3 Local Infrastructure

The AOI is located within predominantly cleared agricultural lands, the south east of the AOI comprises of residential areas including market gardens and reserves. LGA infrastructure within the AOI consists of a number of residential and main service roads (i.e. Mundijong Rd, Kargoticth Rd, Bishop Rd and Wright Rd).

To the north of the AOI lies the existing freight rail, which connects with a rail line to the east of the AOI; near to Mundijong Junction.

2.4 Aboriginal Heritage

Aboriginal Heritage areas are subject to the following legislation;

Aboriginal Heritage Act 1972 WA	Defines the meaning of "Aboriginal site" in Section 4 of the Act. Protects all Aboriginal sites whether or not they are recorded on the Register of Aboriginal Sites or otherwise known to the Registrar of Aboriginal Sites, Department of Indigenous Affairs or Aboriginal Cultural Material Committee Provides for "offences relating to Aboriginal sites" in

	Section 17.
Native Title Act 1993 (Cw'th)	Provides for the establishment of Native Title representative bodies that administer various functions under the Act, to assist and facilitate resolution of native title issues.

As Aboriginal Heritage Sites are protected in Western Australia, through the *Aboriginal Heritage* Act (1972), it is necessary for this scope of work to undertake a search through the DIA Register of Aboriginal Sites. In addition to this research into Registered Sites, it is necessary to establish if any Non-registered sites may also occur in the study area. This is done in consultation with the relevant Aboriginal communities and or Native Title Claimants. The appropriate avenue to begin such consultation is through the relevant Land Council for the region. For the States south-west, including the Perth Metropolitan area, the representative Native Title body is South West Aboriginal Land Council (SWALC). For information on the area from SWALC a formal assessment should be undertaken for the AOI and submitted..

The AOI has been surveyed according to the Aboriginal Heritage enquiry system. Reports of Aboriginal Heritage Sites Found within the area are located within Appendix A.

In 1992 the Mabo decision in the High Court of Australia recognised native title over part of the Meriam peoples traditional lands in the Torres Straits. Following this decision the *Commonwealth Native Title Act* 1993 (Act) was enacted and provided a process for Aboriginal people to claim native title by lodging claims in the Federal Court. If claims passed a registration test it allowed certain legal rights to protect and negotiate over their traditional lands. The Act allows States and Territories to develop their own native title regimes that apply instead of the right to negotiate process where the Australian Government Minister determines that the regime complies with criteria set out in the Act. However, in Western Australia where there is by far the largest number of claims and mining titles, the State opted for using the Commonwealth process and the jurisdiction of the National Native Title Tribunal. Native title claims ensure that the native title rights and interests of the Aboriginal traditional owners of the land are recognised by law. These rights and interests include the continued use and occupation of the land for traditional purposes such as ceremonies, hunting, fishing and procuring ochre and bush foods.

The AOI contains one determined native title area, namely the Gnaala Karla Booja [wc98/58]. This grant of tenure for rail purposes would require the proponent to reach an agreement with all relevant native title parties through which the rail alignment may pass.

2.5 European Heritage

Searches were undertaken of the Australian Heritage Places Inventory and the Register of the National Estate (RNE) to identify known locations of European Heritage. No places on the RNE were found to exist within the AOI. A search was also undertaken using the Department of Sustainability, Environment, Water, People and Communities (DSEWPaC) (formerly Department of Environment, Water Heritage and the Arts; DEWHA) Protected Matters Search Tool (*Department of Environment and Conservation 2008*); with no national or commonwealth heritage places listed with respect to the AOI.

3 ENVIRONMENTAL CONSTRAINTS

3.1 Wetlands

Australian Wetland Database (Wetland base) search was undertaken for the AOI. The majority of the site has been classified as wetland within the database (refer **Figure 3**). The following criteria are used for determining nationally important wetlands in Australia and therefore there inclusion into the wetlands database:

1. It is a good example of a wetland type occurring within a biogeographic region in Australia;
2. It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex;
3. It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail;
4. The wetland supports 1% or more of the national populations of any native plant or animal taxa;
5. The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level; and / or
6. The wetland is of outstanding historical or cultural significance.

Application of the criteria to individual wetland sites involves a degree of subjectivity. Not only may certain aspects of a site's significance be interpreted differently by different investigators, but information gaps often exist which make it difficult to judge whether or not a site meets a particular criterion.

Adoption of a bioregional approach to listing sites in the Directory is seen as one way of reducing the difficulty in applying the criterion relating to a system's uniqueness or representativeness. The Natural Resource Policies and Programs Committee in 2008 agreed to adopt the Australian Drainage Divisions system, along with IMCRA for marine ecosystems, as the best fit national regionalisation approach for aquatic ecosystems.

In Western Australia wetlands are governed by the Department of Environment and Conservation (DEC), the Department of Water and the Environmental Protection Authority of Western Australia (DoW). Some investigation may be required within these departments to outline the current status of this listed Wetland area prior to development. A number of small water-bodies exist within the AOI (refer Figure 2), aerial photographs indicate these may be personal dams or small wetlands existing on cleared agricultural properties. Manjedal Brook runs across the site from east to west. Manjedal Brook initiates near Langford Park and is

approximately 11.8 km in length. Manjedal Brook is highlighted in yellow on Figure 4 below. Wetland buffer zones may apply for approvals to develop around these water-bodies.

It is expected that due to the potential for this project to cause significant land clearing and alterations to the natural drainage within the AOI the conservation values applied to this area as a wetland may no longer exist. Contact should be made with the DEC for planning approval for this area prior to commencing with the project.

The AOI was also searched using the Protected Matters Search Tool (PMST) provided by DSEWPaC. The PMST report (Appendix B) indicates that part of the Peel Yalgorup Lake System (A Ramsar wetland) intersects with the AOI. Figure 5 illustrates the boundary of the Peel Yalgorup System, of which the AOI does not lie within.

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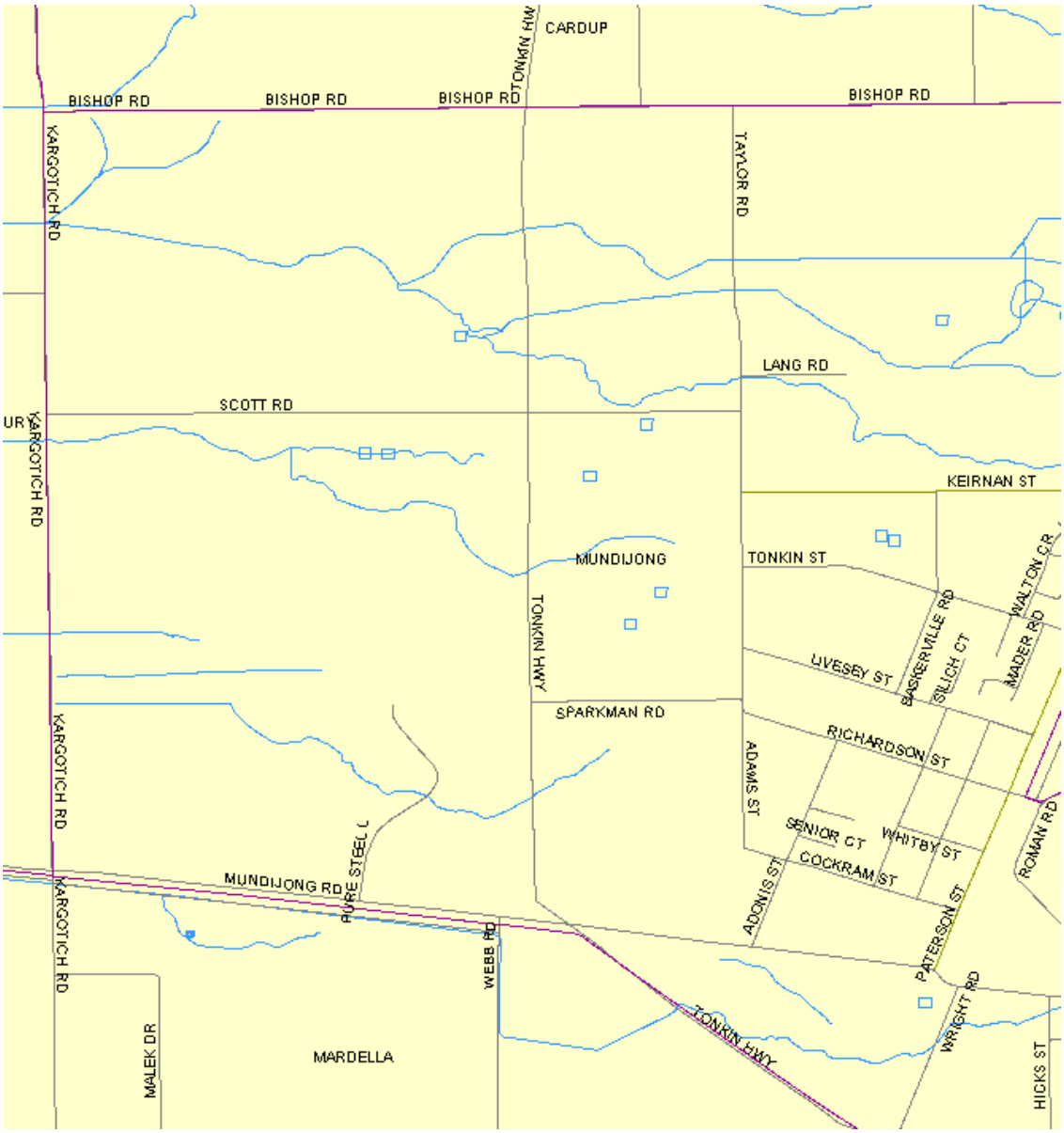

Figure 2: Water-bodies as defined by Perth Groundwater Atlas (AOI)

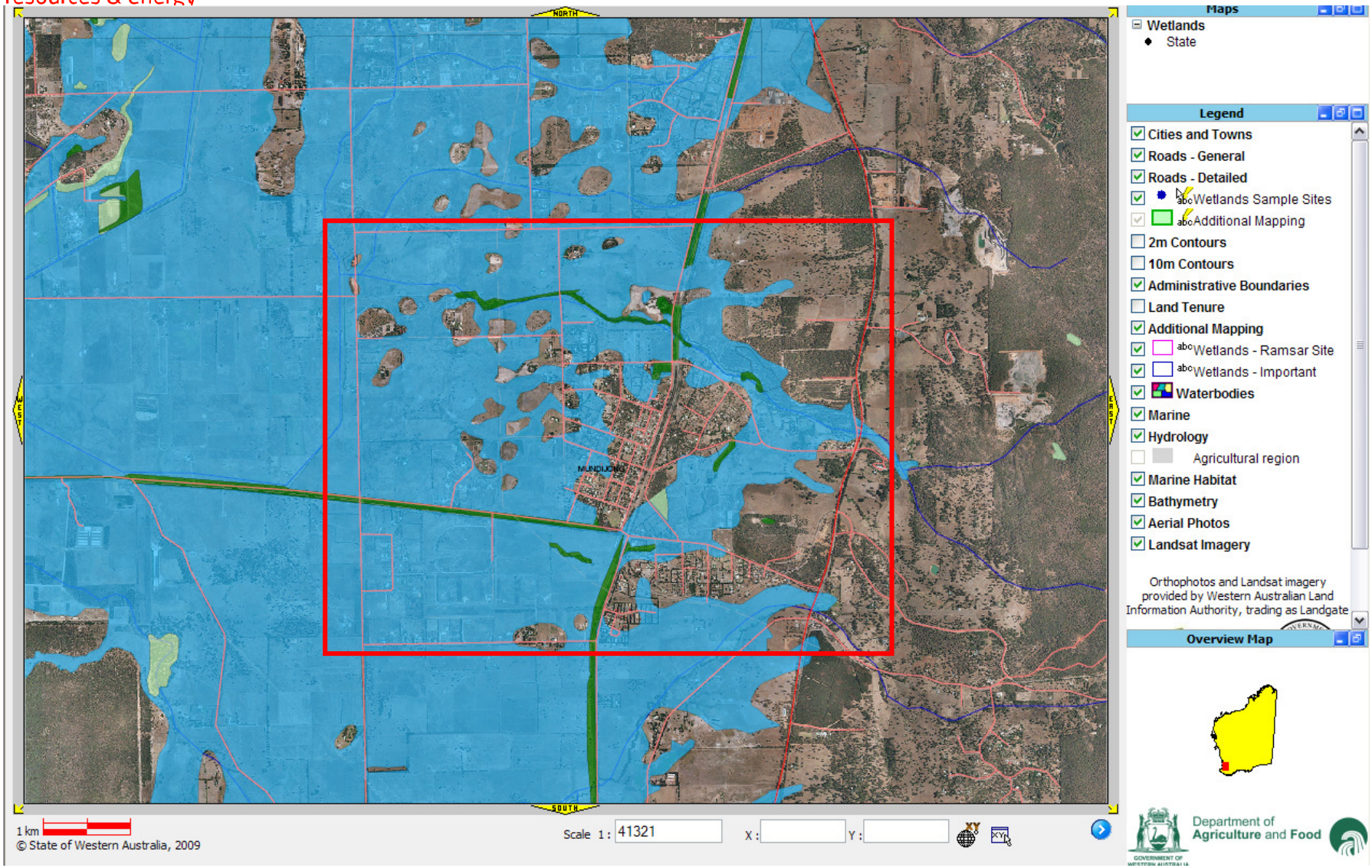

Figure 3: Wetlands (Australian Wetlands Database)

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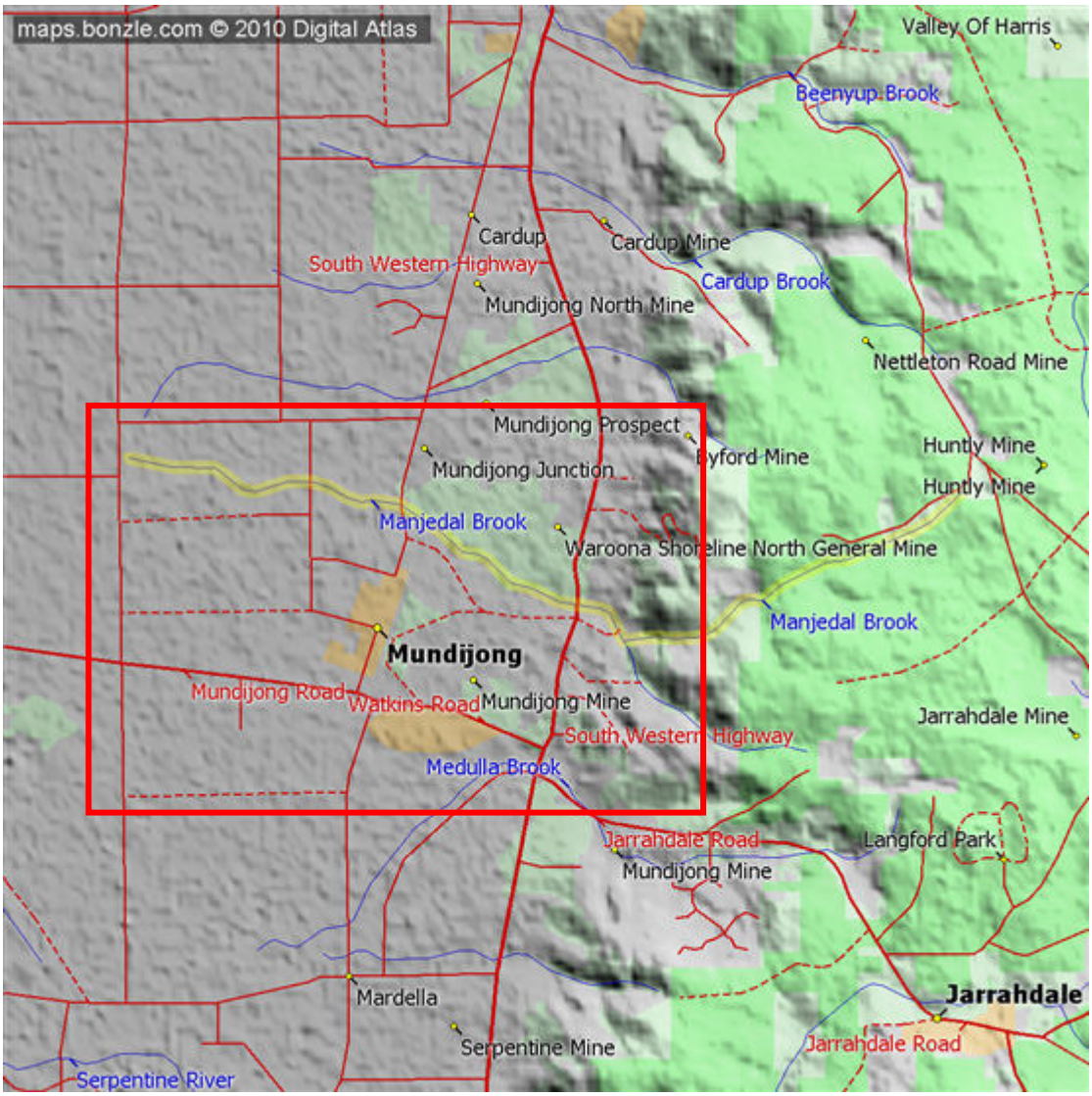

Figure 4: Manjedal Brook (yellow)

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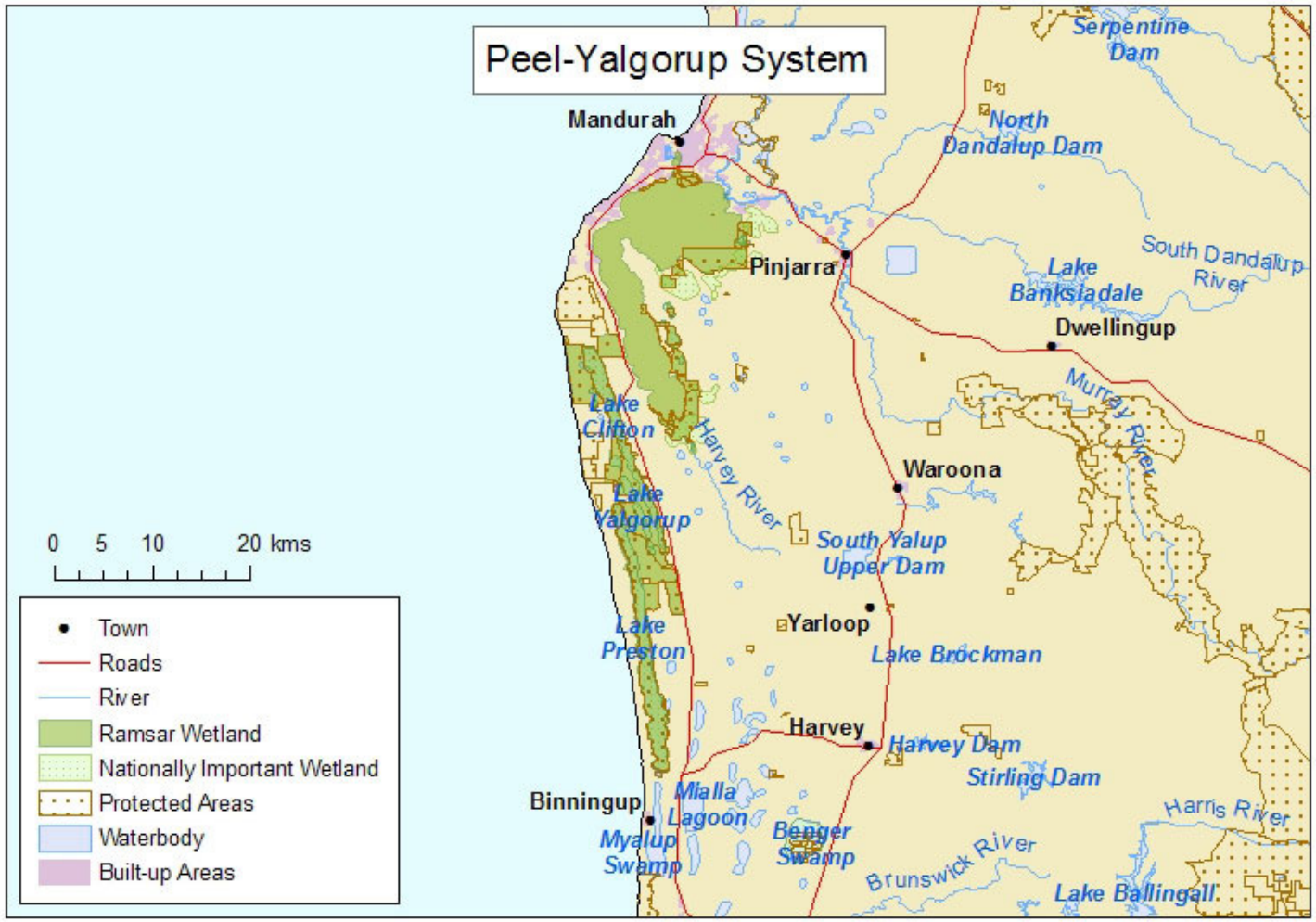

Figure 5: Peel-Yalgorup Boundary

3.2 Acid Sulfate Soils

Acid sulfate soils (ASS) is the common name given to naturally occurring soil and sediment containing iron sulfides. In Australia, the acid sulfate soils of most concern are those that formed in the Holocene geological period (i.e. the last 10,000 years). During the sea level rise new coastal landscapes were created as a result of rapid sedimentation, and acid sulfate soils were created when bacteria in these organically rich waterlogged sediments converted the sulfate from the seawater, and iron from the sediments, into iron sulfides. These naturally occurring iron sulfides are generally found in a layer of waterlogged soil or sediment, and are benign in their natural state. When disturbed and exposed to air they oxidise and produce sulfuric acid, iron precipitates, and concentrations of dissolved heavy metals such as aluminium, iron and arsenic.

The AOI intercepts areas of Possible Acid Sulfate Soil (PASS). which range from Medium to Low PASS (refer Figure 6) with some isolated areas of High risk. An ASS investigation is recommended for areas of medium to high ASS risk as per the Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DEC, 2009) if any earth works or dewatering is proposed for the project area.

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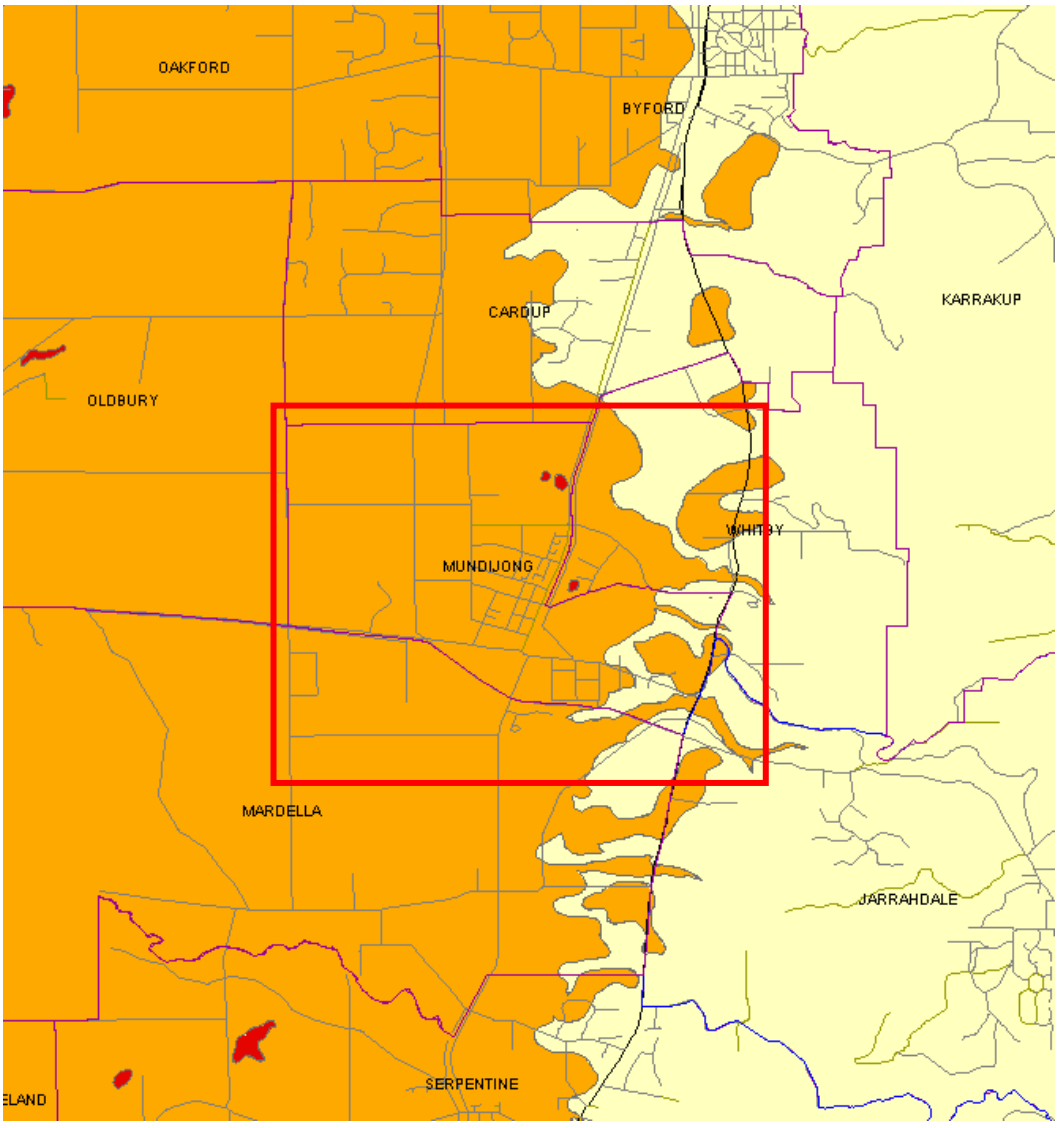

Figure 6: Acid Sulfate Soils Areas (Perth Groundwater Atlas)

3.3 Register of National Estate

The DSEWPaC (formerly DEWHA) Protected Matters Search Tool (*Department of Environment and Conservation 2008*) was used to identify any areas on the Register of National Estate (RNE). One registered site of RNE exists within the AOI; Reserve 23012, Watkins Rd, Mundijong, WA, Australia. The Place Details and Statement of Significance can be found in Appendix C.

Though this area is located within the AOI, it is not expected that any proposed rail alignments will have a significant impact on Reserve 23012.

3.4 Matters of National Environmental Significance (NES)

Matters of National Environmental Significance (NES) represent both nationally and internationally important flora, fauna, ecological communities and heritage places which are protected and managed under the Environmental Protection and Biodiversity Conservation (EPBC) Act 1999.

The DSEWPaC (formerly DEWHA) Protected Matters Search Tool (*Department of Environment and Conservation 2008*) was used to identify any potential matters of NES which may be impacted upon by the proposed project within the AOI.

The Protected Matters Search Tool did not identify any listed world heritage properties, national heritage places and/or commonwealth marine areas. One Wetland of International Significance was listed within the AOI; the Peel-Yalgorup Ramsar Wetland area. Two Threatened Ecological Communities were also noted to exist within the AOI. These are as follows;

1. *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain; listed as Endangered by the EPBC Act 1999.

   This community existed previously throughout the Swan Coastal Plain between Bunbury and Bullsbrook. Much of this community has been cleared and its now considered rare (Keighery and Trudgen 1992; Gibson *et al.* 1994, Department of Environmental Protection (DEP) 1996). It is expected 83 hectares of this community remains of this, about 51 hectares is on lands vested in Shire Councils, five hectares is vested with state government agencies, 25 hectares is on private land, and about two hectares is in unvested reserves.

2. *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain; Listed as Endangered by the EPBC Act

This community existed previously throughout the Swan Coastal Plain between Bunbury and Bullsbrook. Much of this community has been cleared and its now considered rare (Keighery and Trudgen 1992; Gibson *et al.* 1994, Department of Environmental Protection (DEP) 1996).

It is expected approximately 41 hectares of this community remains; of this, about four hectares occur on land vested in the Commonwealth, 27 hectares are on lands vested in Shire Councils, ten hectares are in unvested reserves or vacant Crown land, and about 0.3 hectares occur in a Nature Reserve.

Fifteen threatened species and seven migratory species were also identified through the database search (*Department of Environment and Conservation, 2010*). Results of the search are located in Appendix B.

3.4.1 Flora species protected under the EPBC Act, 1999

Eight threatened flora species were found to have habitat or exist within the AOI. These threatened flora species are as follows:

- *Andersonia gracilis*

Slender Andersonia [14470] Endangered Species or species habitat may occur within area

- *Centrolepis caespitosa*

[6393] Endangered Species or species habitat likely to occur within area

- *Darwinia foetida* Muchea Bell [83190] Critically Endangered Species or species habitat likely to occur within area

- *Drakaea elastica*

Glossy-leaved Hammer-orchid, Endangered Species or species habitat likely to occur within area Praying Virgin [16753]

- *Drakaea micrantha*

Dwarf Hammer-orchid [56755] Vulnerable Species or species habitat likely to occur within area

- *Grevillea curviloba subsp. incurva*

Narrow curved-leaf Grevillea Endangered Species or species habitat may occur within area [64909]

- *Lasiopetalum pterocarpum*

Wing-fruited Lasiopetalum Endangered Species or species habitat likely to occur within area [64922]

- *Synaphea sp. Fairbridge Farm (D.Papenfus 696)*

Selena's Synaphea [82881] Critically Species or species habitat likely to occur within area Endangered Verticordia plumosa var. pleiobotrya

3.4.2 Fauna species protected under the EPBC Act, 1999

Six threatened fauna species were found to exist or have habitat within the AOI. These threatened fauna species are as follows:

- *Calyptorhynchus banksii naso*
  Forest Red-tailed Black-Cockatoo [67034]
  Vulnerable Species or species habitat may occur within area
- *Calyptorhynchus baudinii*
  Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]
  Vulnerable Roosting known to occur within area
- *Calyptorhynchus latirostris*
  Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]
  Endangered Species or species habitat likely to occur within area
- *Dasyurus geoffroii*
  Chuditch, Western Quoll [330] Vulnerable Species or species habitat likely to occur within area
- *Phascogale calura*
  Red-tailed Phascogale [316] Endangered Species or species habitat may occur within area
- *Setonix brachyurus*
  Quokka [229] Vulnerable Species or species habitat may occur within area

3.4.3 Migratory species protected under the EPBC Act, 1999

Seven Migratory Species were found to exist or have habitat within the AOI. These migratory species are as follows:

- *Apus pacificus*
  Fork-tailed Swift [678] Species or species habitat may occur within area
- *Ardea alba*
  Great Egret, White Egret [59541] Species or species habitat may occur within area
- *Ardea ibis*
  Cattle Egret [59542] Species or species habitat may occur within area
- *Haliaeetus leucogaster*
  White-bellied Sea-Eagle [943] Species or species habitat likely to occur within area
- *Merops ornatus*
  Rainbow Bee-eater [670] Species or species habitat may occur within area
- *Ardea alba*

Great Egret, White Egret [59541] Species or species habitat may occur within area

- *Ardea ibis*

Cattle Egret [59542] Species or species habitat may occur within area

3.4.4 DEC Listed Threatened Flora Fauna and Ecological Communities

Field surveys would be required to validate these database searches and species lists. It would be the responsibility of Department of Transport to refer any proposal to the DSEWPaC (formerly DEWHA) under the EPBC Act *if they consider a proposal will have, or is likely to have a significant impact on a matter of NES.*

3.4.5 DEC Listed Flora

Nine Declared Rare species were identified to occur within the AOI, Search data was provided by DEC however species names were not included in this information (Appendix D). Further assessment of flora will be required once the preferred rail corridor is determined, prior to detailed design and construction. Refer to **Error! Reference source not found.** for specific locations.

3.4.6 DEC Listed Fauna

Five types of DEC Listed Fauna Species were identified to occur within the AOI, species types and type of identification were provided by DEC (Appendix D) and are listed in Table 1 below. Further assessment of fauna may be required once the preferred rail corridor is determined, prior to detailed design and construction. Refer to **Error! Reference source not found.** for specific locations.

Table 1: DEC Listed Fauna present within the AOI

Fauna Type	DEC Status		Identification Year	Type of Identification
Mammals	DECLARED THREATENED FAUNA	VU	2003	Dead
Mammals	PRIORITY FAUNA	P5	2004	Caught or trapped
Mammals	PRIORITY FAUNA	P5	2005	Dead
Birds	DECLARED THREATENED FAUNA	EN	2005	Dead
Arachnids	PRIORITY FAUNA	P1	2006	Definite signs

3.5 Bush Forever

Bush Forever is a Government initiative with the aim of fulfilling their commitment to prepare a strategic plan for urban bush land conservation as part of the Urban Bushland Strategy 1995 and the National Strategy for the Conservation of Australia's Biodiversity 1996. The Bush Forever plan aims to protect 10% of the 26 original vegetation complexes within the Swan Coastal Plain.

The West Australian Planning Commission released a map of Bush Forever Sites within the Swan Coastal Plain in July 2004. Bush Forever sites have been included on **Error! Reference source not found.**.

There is a number of Bush Forever sites located within the AOI. These sites should be assessed for the potential impact of the proposed rail alignment. Should the proposed rail

alignment intersect with these Bush Forever sites, appropriate approvals will need to be obtained from DEC prior to commencement of construction.

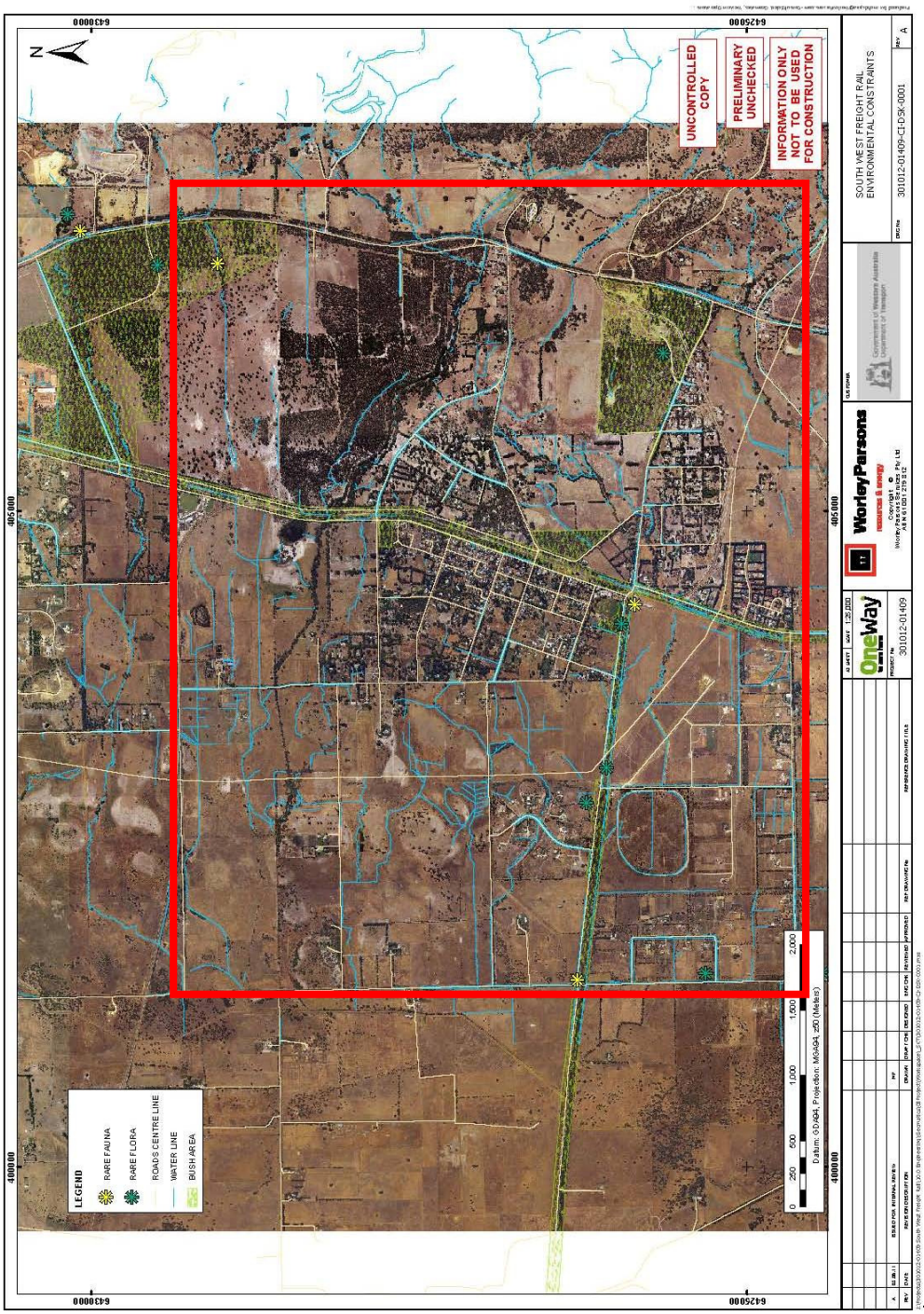

Figure 7: Flora, Fauna and Bush Forever Sites (data obtained from DoT)

3.6 Important Bird Areas

Birds Australia maintains a database of important bird areas (IBAs) with Australia. An important bird area, as defined by Birds Australia must meet one of four global criteria to be included in the database. The criteria are:

- *Globally threatened species*: the site must regularly support a Critical or Endangered species or at least 10 pairs of a vulnerable species, as categorised by the International Union for Conservation of Nature IUCN Red List;
- *Restricted-range species*: the site forms one of a set protecting 'restricted-range species' (birds with a global range of <50,000 km^2);
- *Biome-restricted species*: the site forms one of a set protecting all species restricted to a given biome. For this purpose, Australia has been divided into seven biomes using the following paper, (Hutchinson, McIntyre et al. 2005) (2005 Global Ecol. Biogeogr. 14: 197-212.); or
- *Congregations*: the site supports > 1% of the world population of a waterbird (matching Ramsar Convention criteria).

Based on the database search no IBAs were listed within the AOI.

4 DEKSTOP ENVIROENMNTAL AND HERITAGE REVIEW SUMMARY

Table 2 Desktop Environmental and Heritage Review Summary

Constraints	Description of Applicability
Social Constraints	
Land Use	The AOI is predominantly cleared agricultural lands, the south east of the AOI comprises of residential areas including market gardens and reserves.
Local Infrastructure	LGA infrastructure within the AOI consists of a number of residential roads and main service roads. To the north of the AOI lies the existing freight rail, which connects with a rail line to the east of the AOI; near to Mundijong Junction. A number of residential properties; inc. agricultural areas, small market gardens and dams exist within the AOI.
Aboriginal Heritage Areas	A total of six Listed Aboriginal Heritage Sites and eight Other Heritage Places existed within the AOI.
Native Title	The AOI contains one determined native title area, (i.e. Gnaala Karla Booja [wc 98/58]).
European Heritage	No places of European Heritage with respect to the RNE were found to exist within the AOI. Local heritage councils should be contacted prior to any alterations to existing buildings within the area to preserve any local heritage significant areas.
Environmental Constraints	
Wetlands	The majority of the AOI has been classified as a wetland within the database including the Manjedal Brook .Approval from DEC will more than likely be required to develop around / within these water-bodies. It is expected due to significant land clearing and alterations to natural drainage within the area the conservation values applied to this area as a wetland may no longer exist. Contact should be made with the DEC and Bush Forever for planning approval for this area.

Constraints	Description of Applicability
Acid Sulfate Soils	The AOI intercepts areas of PASS ranging from Medium to Low risk (Figure 6) with some isolated High risk areas. An ASS investigation is recommended for areas of medium and/or high ASS risk.
RNE Areas	One registered site of RNE exists within the AOI (i.e. Reserve 23012), Watkins Rd, Mundijong, WA, Australia. Though this area is within the AOI, it is not expected that any proposed rail alignments will have a significant impact on Reserve 23012.
Flora species protected under the EPBC Act	Eight threatened flora species were found to have habitat or exist within the AOI.
Fauna species protected under the EPBC Act	Six threatened fauna species were found to exist or have habitat within the AOI.
Migratory species protected under the EPBC Act	Seven Migratory Species were found to exist or have habitat within the AOI.
DEC Listed Flora	Nine Declared Rare species were identified within the AOI. Further assessment of flora will be required once the preferred rail corridor is determined.
DEC listed Fauna	Five types of DEC Listed Fauna Species were identified within the AOI, species types and type of identification were provided by DEC and are listed in Table 1. See **Error! Reference source not found.** for specific locations.
Bush Forever Sites	There are a number of Bush Forever sites located within the AOI. These sites should be assessed for the impact of the proposed rail alignment. Should a rail alignment intersect with these sites, appropriate approvals will need to be obtained from DEC.
Important Bird Areas	There are no IBAs within the AOI.

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APPENDICES

Appendix A: Aboriginal Heritage Inquiry System Reports

WorleyParsons
resources & energy

EcoNomics

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Appendix B: PMST Report

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Appendix C: Reserve 23012, Watkins Rd, Mundijong, WA , Australia; Place Details and Statement of Significance

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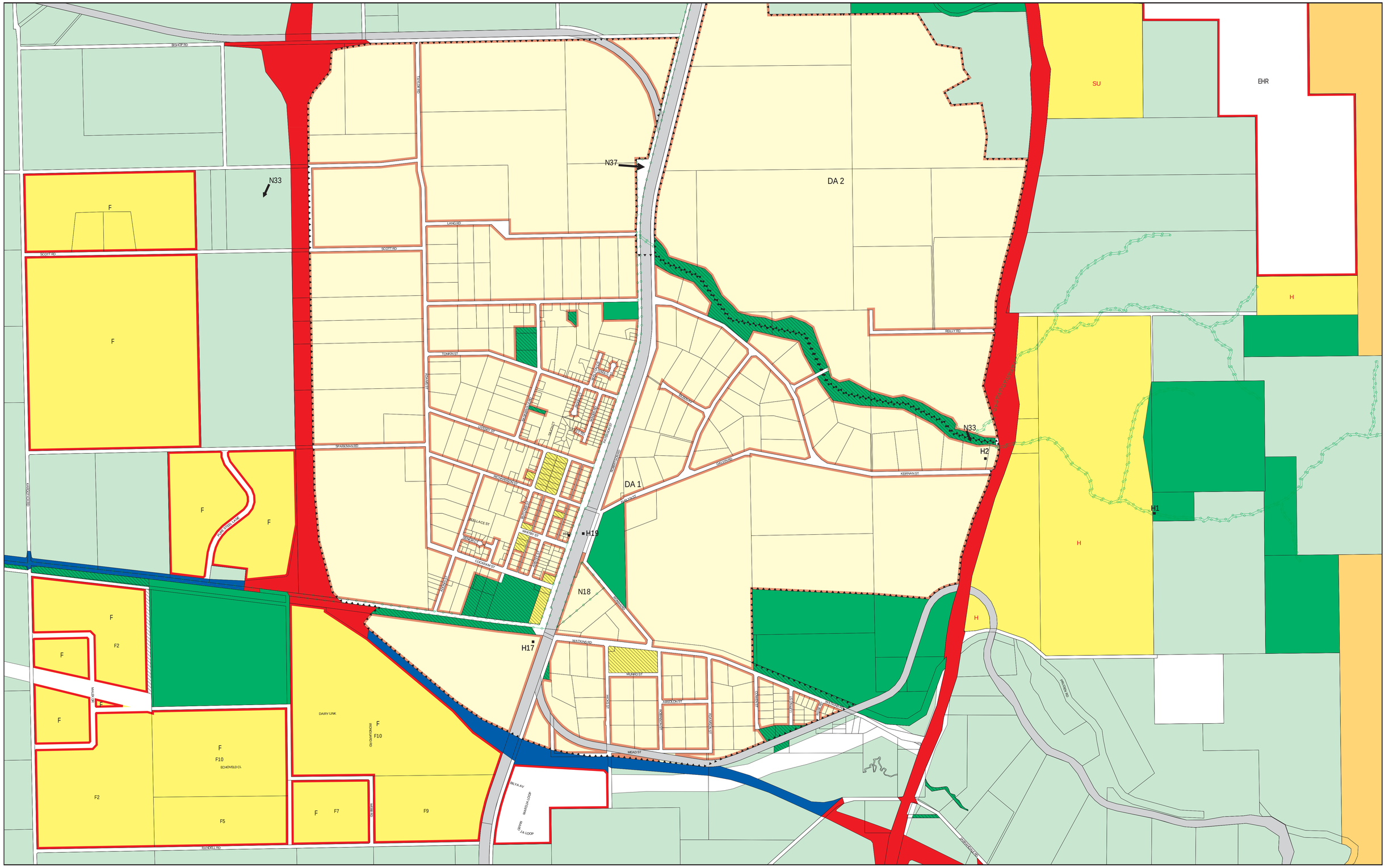
Appendix D: GIS Data (provided by DoT)



Produced by Mapping and GeoSpatial Data Branch, Department of Planning.

Whilst all care has been taken to accurately portray the current Scheme provisions, no responsibility shall be taken for any omissions or errors in this documentation.

Consultation with the respective Local Government should be made to view a legal version of the Scheme. Please advise the Department of Planning of any omissions or errors in the document.

Base Information Supplied by the Western Australian Land Information Authority, GL248-2007-2

SHIRE OF SERPENTINE-JARRAHDALE

TOWN PLANNING SCHEME NO 2

(DISTRICT SCHEME)

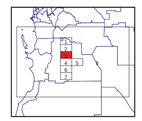
N

GDA GEOCENTRIC DATUM OF AUSTRALIA

SCALE 1:20000

0 500 m

MAP OVERVIEW



Authorised: Robyn Staggard
Plot date: 03 Nov 2010
G.Gazette: 04-August-1989

TOWN PLANNING SCHEME MAP No. 3 of 8

MAP : 2 - POLICY AREAS

OCM161.2/03/13

N

0 1 2 3

Kilometres

Derived from the Policy Areas Map 2 of the Shire of Serpentine - Jarrahdale Rural Strategy by Project Mapping Section, Land Information Branch, Ministry for Planning, Perth, Western Australia August 1997

plaliw05//strat_pol//serpjar//sj50897a3.dgn

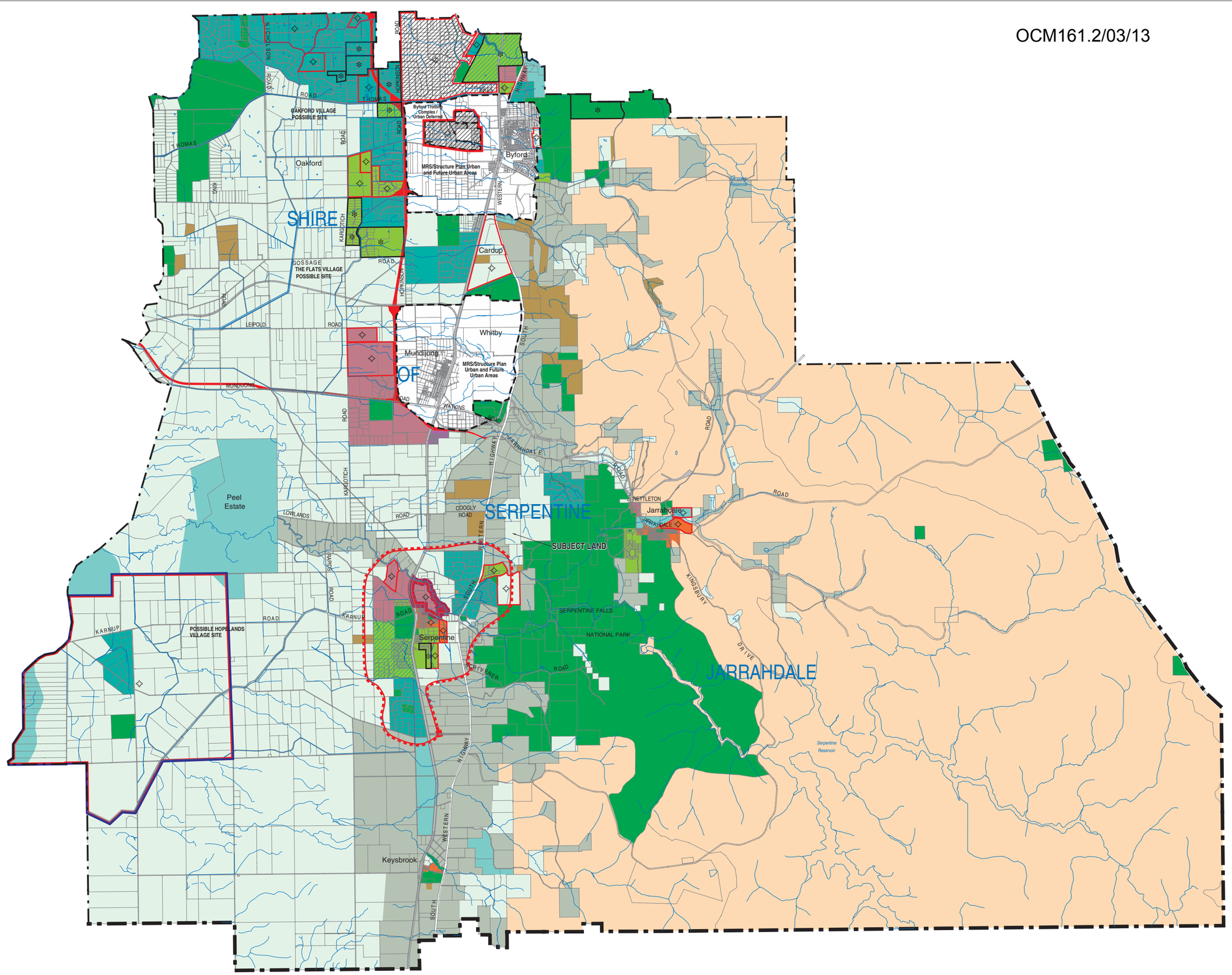
Cadastral data supplied by Department of Land Administration, Western Australia

STRATEGY REVIEW SCHEDULE	
Original Strategy	April 1994
Review	May 1996
Review	March 2002

LEGEND
Policy Areas

- Town and Village Urban
- Rural Living 'A' (4000m^2 to 1ha lots)
- Rural Living 'B' (2ha to 4ha lots)
- Rural Living 'A & B' (4000m^2 to 4ha lots)
- Farmlet (4ha to 40ha lots)
- Rural (minimum 40ha lots)
- Agricultural Protection (minimum 40ha lots)
- Residential and Stable (minimum 2ha lots)
- Parks & Recreation - Public Land (MRS and TPS N0.2)
- Conservation - Private Land
- State Forest
- Light Industrial
- Raw Materials Extraction
- Primary Regional Roads
- Other Regional Roads
- Railway
- Drainage / Reservoirs
- Townsite Urban Expansion Investigation Area
- Hopelands Rural Village Settlement and Environs Investigation Area
- Subject to Future Structure Planning
- Metropolitan Region Scheme Boundary
- Local Authority Boundary

- Land the subject of this designation has been included in the Policy Area by virtue of the 1996 Rural Strategy Review
- Land the subject of this designation has been included in the Policy Area, Future Structure Planning Area or Investigation Area by virtue of the 2002 Rural Strategy Review



SHIRE OF SERPENTINE - JARRAHDALE RURAL STRATEGY (APRIL 1994) - AS AMENDED

LEGEND

- WATER LINE
- BUSH FOREVER
- RARE FAUNA
- RIVERS

250 0 250 500 750 1000 1250

SCALE OF METRES 1:12500

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE

A1 SHEET SCALE 1:12500

OneWay™ to zero harm

WORLEYPARSONS PROJECT No.
301012-01409

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CUSTOMER

SOUTH WEST FREIGHT RAIL

DRG No 301012-01409-CI-DSK-0001 REV

DATE & TIME: 18/05/2011 4:01:45 PM USER NAME: tony.matulovic LOCATION: H:\301012\01409 South West Freight Rail\CAD\CIV\SKT\301012-01409-CI-DSK-0001-Tmp.dgn