

Date: 5/06/2014

Environmental Protection Authority
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Project Info Line 1800 420 421
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ABN: 15 563 895 314

Subject: REFERRAL BY PROPONENT – MAIN ROADS WA - BERKSHIRE ROAD AND ROE HIGHWAY INTERCHANGE

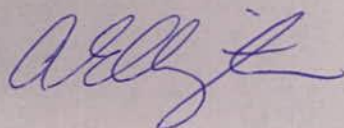
Main Roads WA (Main Roads) is proposing to upgrade the intersection of Roe Highway and Berkshire Road in Forrestfield which will be delivered by the Gateway WA Alliance team (Leighton Contractors, GHD, BG&E, AECOM, Georgiou and Main Roads). The work will upgrade the intersection from an offset, signalised T-junction to an interchange, with Roe Highway travelling over Berkshire Road, and has been proposed due to significant increases in traffic, particularly heavy vehicles, and associated safety issues. The Project will also include a Principal Shared Path (PSP), a noise wall constructed adjacent to affected residences along Roe Highway and fencing along the Project boundary. Drainage retention will also be required within the interchange area. The works will all be undertaken within road reserves, with the majority of the road reserve being vested in, and managed by, the Commissioner of Main Roads. A small section of Berkshire Road is under the control of the Shire of Kalamunda Local Government Area.

A total of 20.44 ha will be disturbed by the project, of which 11.85 ha of native vegetation of varying condition will be cleared. The key environmental factors of relevance to the project are clearing of native vegetation, noise and construction nuisance issues. Clearing will result in the removal of 19 plants of the Threatened (Declared Rare) species *Conospermum undulatum*, seven plants of the Priority 3 species *Isopogon drummondii*, 3.05 ha of Threatened Ecological Community and also the concurrent loss of 9.29 ha of feeding habitat for Threatened Black Cockatoo species. Clearing of vegetation for this project will also have a very minor impact on conservation significant areas including Bush Forever sites.

Given the variety of environmental aspects in relation to this project we are submitting this project for EPA consideration under section 38(1) of the *Environmental Protection Act 1986*. This document, as well as further supporting documentation is enclosed.

If you require any additional information please do not hesitate to contact me on (08) 9263 8420 or 0422 052 674.

Yours faithfully



Amy Elkington
Environmental Coordinator
Gateway WA

Office of the Environmental Protection Authority		14 JUN 2014	
File:		For Information	<input type="checkbox"/>
		For Discussion	<input type="checkbox"/>
		For Action	<input type="checkbox"/>
		Response please:	
	Dir. AC	GM Signature	<input type="checkbox"/>
	Dir. Bus Ops	Dir for GM (copy to GM)	<input type="checkbox"/>
	Dir. SPPD	Dir. Strategic	<input type="checkbox"/>
	Dir. Street Surv		<input type="checkbox"/>

Attachments:

- A: Referral for the Berkshire Road and Roe Highway Interchange
- B: CD with electronic copy of application and shapefiles

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Environmental Protection Authority

Referral of a Proposal by the Proponent to the Environmental Protection Authority under Section 38(1) of the *Environmental Protection Act 1986*.

EPA REFERRAL
FORM
PROONENT

PURPOSE OF THIS FORM

Section 38(1) of the *Environmental Protection Act 1986* (EP Act) provides that where a development proposal is likely to have a significant effect on the environment, a proponent may refer the proposal to the Environmental Protection Authority (EPA) for a decision on whether or not it requires assessment under the EP Act. This form sets out the information requirements for the referral of a proposal by a proponent.

Proponents are encouraged to familiarise themselves with the EPA's *General Guide on Referral of Proposals* [see Environmental Impact Assessment/Referral of Proposals and Schemes] before completing this form.

A referral under section 38(1) of the EP Act by a proponent to the EPA must be made on this form. A request to the EPA for a declaration under section 39B (derived proposal) must be made on this form. This form will be treated as a referral provided all information required by Part A has been included and all information requested by Part B has been provided to the extent that it is pertinent to the proposal being referred. Referral documents are to be submitted in two formats – hard copy and electronic copy. The electronic copy of the referral will be provided for public comment for a period of 7 days, prior to the EPA making its decision on whether or not to assess the proposal.

CHECKLIST

Before you submit this form, please check that you have:

	Yes	No
Completed all the questions in Part A (essential).	✓	
Completed all applicable questions in Part B.	✓	
Included Attachment 1 – location maps.	✓	
Included Attachment 2 – additional document(s) the proponent wishes to provide (if applicable).	✓	
Included Attachment 3 – confidential information (if applicable).	✓	
Enclosed an electronic copy of all referral information, including spatial data and contextual mapping but excluding confidential information.	✓	

Following a review of the information presented in this form, please consider the following question (a response is optional).

Do you consider the proposal requires formal environmental impact assessment?		
<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Not sure
If yes, what level of assessment?		
<input type="checkbox"/> Assessment on Proponent Information	<input type="checkbox"/> Public Environmental Review	

PROPONENT DECLARATION (to be completed by the proponent)

I, MARK HAZEBROEK, (full name) declare that I am authorised on behalf of MAIN ROADS WA (being the person responsible for the proposal) to submit this form and further declare that the information contained in this form is true and not misleading.

Signature <u>Mark Hazebroek</u>	Name (print) <u>MARK HAZEBROEK</u>
Position <u>SENIOR PROJECT DIRECTOR</u>	Company <u>MAIN ROADS WA</u>
Date <u>5/6/14</u>	

PART A - PROPONENT AND PROPOSAL INFORMATION

(All fields of Part A must be completed for this document to be treated as a referral)

1 PROPONENT AND PROPOSAL INFORMATION

1.1 Proponent

Name	Main Roads WA
Joint Venture parties (if applicable)	
Australian Company Number (if applicable)	860 676 021
Postal Address (where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State)	Waterloo Crescent, East Perth, WA
Key proponent contact for the proposal: <ul style="list-style-type: none">• name• address• phone• email	Mark Hazebroek Waterloo Crescent, East Perth, WA (08) 9323 4292 Mark.hazebroek@mainroads.wa.gov.au
Consultant for the proposal (if applicable): <ul style="list-style-type: none">• name• address• phone• email	Amy Elkington (Gateway WA) 651 Abernethy Rd, Forrestfield, WA 6058 (08) 9263 8420 or 0422 052 674 Amy.elkington@gatewaywa.com.au

1.2 Proposal

Title	Roe Highway / Berkshire Road Interchange, Perth
Description	Main Roads Western Australia is proposing to upgrade the intersection of Roe Highway and Berkshire Road in the eastern suburbs of Perth. The work will upgrade the existing intersection from an offset, signalised junction to an interchange, and has been proposed due to significant increases in traffic, particularly heavy vehicles. The Project will also include a Principal Shared Path (PSP), a noise wall constructed along the residences located on Roe Highway and fencing along the Project boundary.
Extent (area) of proposed ground disturbance.	The Project area covers 20.87 ha, of which 11.85 ha will require some native vegetation clearing.
Timeframe in which the activity or development is proposed to occur (including start and finish dates where applicable).	Works are expected to begin in August 2014 and to conclude by March 2016.
Details of any staging of the proposal.	Nil staging.
Is the proposal a strategic proposal?	No
Is the proponent requesting a declaration that the proposal is a derived proposal? If so, provide the following information on the strategic assessment within which the referred proposal was identified:	No

<ul style="list-style-type: none"> • title of the strategic assessment; • Ministerial Statement number. 	
<p>Please indicate whether, and in what way, the proposal is related to other proposals in the region.</p>	<p>Gateway WA Perth Airport and Freight Access project is in close proximity to this proposal.</p>
<p>Does the proponent own the land on which the proposal is to be established? If not, what other arrangements have been established to access the land?</p>	<p>The land is owned by the State, with Main Roads managing the asset. Main Roads will commission this proposal on behalf of the State. A small section of the land is vested in the Shire of Kalamunda.</p>
<p>What is the current land use on the property, and the extent (area in hectares) of the property?</p>	<p>Area is currently zoned as 'other regional roads' under the Metropolitan Regional Scheme with the majority of the road reserve being vested in, and managed by, the Commissioner of Main Roads. A small section of Berkshire Road is under the control of the Shire of Kalamunda.</p> <p>Property is approximately 22.09 ha, with approximately 20.87 ha required for this proposal. Within this 20.87 ha, only 11.85 ha will require native vegetation clearing.</p>

1.3 Location

Name of the Shire in which the proposal is located.	Shire of Kalamunda
<p>For urban areas:</p> <ul style="list-style-type: none"> • street address; • lot number; • suburb; and • nearest road intersection. 	<p>Street Address: nil (road reserve) Lot numbers (or Land ID where Lot numbers are unavailable):</p> <ul style="list-style-type: none"> - Lot 56 P006908 Maida Vale - Land ID: 3 601 782 - Land ID: 3 581 381 - Land ID: 3 601 757 - Land ID: 3 601 758 - Land ID: 3 600 879 - Lot 60 P006908, Forrestfield - Lot 61 P006908, Forrestfield - Land ID: 3 917 120 - Land ID: 3 917 129 - Lot 203 P039975, Forrestfield - Land ID: 3 917 123 - Land ID: 3 531 326 - Land ID: 3 459 803 - Lot 69 P006907, Forrestfield - Land ID: 3 599 119 - Lot 10124 P215187, Forrestfield - Lot 10253 P215187, Forrestfield - Lot 9947 P183309, Forrestfield <p>Suburb: Forrestfield Intersection: Roe Highway and Berkshire Road</p>
<p>For remote localities:</p> <ul style="list-style-type: none"> • nearest town; and • distance and direction from that town to the proposal site. 	N/A
<p>Electronic copy of spatial data - GIS or CAD, geo-referenced and conforming to the following parameters:</p> <ul style="list-style-type: none"> • GIS: polygons representing all activities and named; • CAD: simple closed polygons representing all activities and named; • datum: GDA94; • projection: Geographic (latitude/longitude) or Map Grid of Australia (MGA); • format: Arcview shapefile, Arcinfo coverages, Microstation or AutoCAD. 	Enclosed?: Yes / No

1.4 Confidential Information

Does the proponent wish to request the EPA to allow any part of the referral information to be treated as confidential?	Yes / No
If yes, is confidential information attached as a separate document in hard copy?	Yes ./ No

1.5 Government Approvals

Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.		Yes / No	
Is approval required from any Commonwealth or State Government agency or Local Authority for any part of the proposal? If yes, please complete the table below.		Yes / No	
Agency/Authority	Approval required	Application lodged Yes / No	Agency/Local Authority contact(s) for proposal
Department of the Environment	Referral under <i>Environment Protection and Biodiversity Conservation Act 1999</i>	No	Con Voutas
Western Australian Planning Commission	Application to clear Bush Forever	Yes	Not yet assigned
Department of Environment Regulation	Application to amend existing Clearing Permit CPS 5242/2 if EPA determines the project does not require formal assessment	No	Jane Clarkson
Department of Parks and Wildlife	Application to Take Rare Flora	No	Not yet assigned
Department of Water	Application to Take Water for construction purposes	No	Adam Viskovich

PART B - ENVIRONMENTAL IMPACTS AND PROPOSED MANAGEMENT

2. ENVIRONMENTAL IMPACTS

Describe the impacts of the proposal on the following elements of the environment, by answering the questions contained in Sections 2.1-2.11:

- 2.1 flora and vegetation;
- 2.2 fauna;
- 2.3 rivers, creeks, wetlands and estuaries;
- 2.4 significant areas and/ or land features;
- 2.5 coastal zone areas;
- 2.6 marine areas and biota;
- 2.7 water supply and drainage catchments;
- 2.8 pollution;
- 2.9 greenhouse gas emissions;
- 2.10 contamination; and
- 2.11 social surroundings.

These features should be shown on the site plan, where appropriate.

For all information, please indicate:

- (a) the source of the information; and
- (b) the currency of the information.

2.1 Flora and Vegetation

2.1.1 Do you propose to clear any native flora and vegetation as a part of this proposal?

[A proposal to clear native vegetation may require a clearing permit under Part V of the EP Act (Environmental Protection (Clearing of Native Vegetation) Regulations 2004)]. Please contact the Department of Environment and Conservation (DEC) for more information.

- (please tick) Yes **If yes**, complete the rest of this section.
 No **If no**, go to the next section

2.1.2 How much vegetation are you proposing to clear (in hectares)?

11.85 ha of native vegetation with a Condition Rating of 5 or better.

2.1.3 Have you submitted an application to clear native vegetation to the DEC (unless you are exempt from such a requirement)?

- Yes No **If yes**, on what date and to which office was the application submitted of the DEC?

However an application is intended to be submitted shortly.

2.1.4 Are you aware of any recent flora surveys carried out over the area to be disturbed by this proposal?

Yes

No

If yes, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

The two known surveys are included within the attached Environmental Impact Assessment and Environmental Management Strategy (Attachment A)

2.1.5 Has a search of DEC records for known occurrences of rare or priority flora or threatened ecological communities been conducted for the site?

Yes

No

If you are proposing to clear native vegetation for any part of your proposal, a search of DEC records of known occurrences of rare or priority flora and threatened ecological communities will be required. Please contact DEC for more information.

2.1.6 Are there any known occurrences of rare or priority flora or threatened ecological communities on the site?

Yes

No

If yes, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

Conospermum undulatum (DRF)

Isopogon drummondii (Priority Flora)

Some areas have close affinities to the TEC FCT SCP 20a *Banksia attenuata* woodland species rich dense shrubland. In one section there appears to be a gradient between the TECs FCT SCP20a and FCT 3a: *Eucalyptus calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain.

Gradient between FCT SCP20a and FCT 3a

2.1.7 If located within the Perth Metropolitan Region, is the proposed development within or adjacent to a listed Bush Forever Site? (You will need to contact the Bush Forever Office, at the Department for Planning and Infrastructure)

Yes

No

If yes, please indicate which Bush Forever Site is affected (site number and name of site where appropriate).

319 - Dundas Road Bushland

440 – Pioneer Park

2.1.8 What is the condition of the vegetation at the site?

Condition rating 4-5 under the Keighley scale

2.2 Fauna

2.2.1 Do you expect that any fauna or fauna habitat will be impacted by the proposal?

(please tick) Yes **If yes**, complete the rest of this section.

No **If no**, go to the next section.

2.2.2 Describe the nature and extent of the expected impact.

9.29 ha of Black Cockatoo foraging habitat will be impacted by the project, as well as 80 potential nesting trees, although no sign of nesting or hollows was noted and the area is outside the known breeding range of all three species.

Much of the Black Cockatoo habitat is sub-optimal, due to it being immediately adjacent to the highway.

Habitat for the Quenda was identified in strips of degraded Jarrah/Marri woodland and areas of Banksia woodland.

2.2.3 Are you aware of any recent fauna surveys carried out over the area to be disturbed by this proposal?

Yes No **If yes**, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

Provided within the attached Environmental Impact Assessment and Environmental Management Strategy (Attachment A)

2.2.4 Has a search of DEC records for known occurrences of Specially Protected (threatened) fauna been conducted for the site?

Yes No (please tick)

2.2.5 Are there any known occurrences of Specially Protected (threatened) fauna on the site?

Yes No **If yes**, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

Taxa	Common name	Status State; Federal	Likelihood of occurrence
Birds			
<i>Calyptorhynchus banksia naso</i>	Forest Red-tailed Black-Cockatoo	T; Vu	Present
<i>Calyptorhynchus latirostris</i>	Baudin's Black Cockatoo	T; Vu	Likely
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	T; En	Likely
Mammals			
<i>Isoodon obesulus fusciventer</i>	Quenda / Southern Brown Bandicoot	P5; -	Possible

2.3 Rivers, Creeks, Wetlands and Estuaries

2.3.1 Will the development occur within 200 metres of a river, creek, wetland or estuary?

(please tick)

Yes

If yes, complete the rest of this section.

No

If no, go to the next section.

2.3.2 Will the development result in the clearing of vegetation within the 200 metre zone?

Yes

No

If yes, please describe the extent of the expected impact.

Clearing will be required within mapped geomorphic wetlands as shown in Figure 2 of Attachment A. Very limited wetland dependent vegetation has been identified in the project area and the wetlands do not contain standing water, or even seasonal water.

One artificial drainage line (part of Crumpet Creek) crosses Roe Highway within the Project area through a culvert from the east before becoming a more natural drainage gully in the Bush Forever site west of the Highway, and dissipating shortly afterwards. The line crossing the highway will be cleared as part of these works.

Will the development result in the filling or excavation of a river, creek, wetland or estuary?

Yes

No

If yes, please describe the extent of the expected impact.

2.3.3 Will the development result in the impoundment of a river, creek, wetland or estuary?

Yes

No

If yes, please describe the extent of the expected impact.

2.3.4 Will the development result in draining to a river, creek, wetland or estuary?

- Yes No **If yes**, please describe the extent of the expected impact.

Currently, there is no treatment of road runoff along Roe Highway or Berkshire Road, with all runoff going directly into adjacent vegetation, table drains or the median. As part of the new intersection works, road runoff will be primarily captured and treated internally within the intersection, reducing the potential impact from hydrocarbon spills on vegetation or other assets along this section of the highway. There will therefore be no direct drainage into the adjacent mapped wetlands.

2.3.5 Are you aware if the proposal will impact on a river, creek, wetland or estuary (or its buffer) within one of the following categories? (please tick)

Conservation Category Wetland	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unsure
Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
Perth's Bush Forever site	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unsure
Environmental Protection (Swan & Canning Rivers) Policy 1998	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
The management area as defined in s4(1) of the <i>Swan River Trust Act 1988</i>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
Which is subject to an international agreement, because of the importance of the wetland for waterbirds and waterbird habitats (e.g. Ramsar, JAMBA, CAMBA)	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure

2.4 Significant Areas and/ or Land Features

2.4.1 Is the proposed development located within or adjacent to an existing or proposed National Park or Nature Reserve?

- Yes No **If yes**, please provide details.

2.4.2 Are you aware of any Environmentally Sensitive Areas (as declared by the Minister under section 51B of the EP Act) that will be impacted by the proposed development?

- Yes No **If yes**, please provide details.

A search of the Department of Environmental Regulation's online Native Vegetation Map Viewer indicated a number of ESAs covering the Project area (DER 2014). The ESAs are TECs and associated buffers, and the areas covered by vegetation within 50 m of declared rare flora (DRF).

2.4.3 Are you aware of any significant natural land features (e.g. caves, ranges etc) that will be impacted by the proposed development?

Yes ✓ No **If yes**, please provide details.

2.5 Coastal Zone Areas (Coastal Dunes and Beaches)

2.5.1 Will the development occur within 300metres of a coastal area?

(please tick) Yes **If yes**, complete the rest of this section.
 ✓ No **If no**, go to the next section.

2.5.2 What is the expected setback of the development from the high tide level and from the primary dune?

2.5.3 Will the development impact on coastal areas with significant landforms including beach ridge plain, cusped headland, coastal dunes or karst?

Yes No **If yes**, please describe the extent of the expected impact.

2.5.4 Is the development likely to impact on mangroves?

Yes No **If yes**, please describe the extent of the expected impact.

2.6 Marine Areas and Biota

2.6.1 Is the development likely to impact on an area of sensitive benthic communities, such as seagrasses, coral reefs or mangroves?

Yes ✓ No **If yes**, please describe the extent of the expected impact.

2.6.2 Is the development likely to impact on marine conservation reserves or areas recommended for reservation (as described in *A Representative Marine Reserve System for Western Australia*, CALM, 1994)?

Yes ✓ No **If yes**, please describe the extent of the expected impact.

2.6.3 Is the development likely to impact on marine areas used extensively for recreation or for commercial fishing activities?

Yes ✓ No **If yes**, please describe the extent of the expected impact, and provide any written advice from relevant agencies (e.g. Fisheries WA).

2.7 Water Supply and Drainage Catchments

2.7.1 Are you in a proclaimed or proposed groundwater or surface water protection area?

(You may need to contact the Department of Water (DoW) for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

Yes No **If yes**, please describe what category of area.

Proclaimed Groundwater Kalamunda Sub Area

2.7.2 Are you in an existing or proposed Underground Water Supply and Pollution Control area?

(You may need to contact the DoW for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

Yes No **If yes**, please describe what category of area.

2.7.3 Are you in a Public Drinking Water Supply Area (PDWSA)?

(You may need to contact the DoW for more information or refer to the DoW website. A proposal to clear vegetation within a PDWSA requires approval from DoW.)

Yes No **If yes**, please describe what category of area.

2.7.4 Is there sufficient water available for the proposal?

(Please consult with the DoW as to whether approvals are required to source water as you propose. Where necessary, please provide a letter of intent from the DoW)

Yes No (please tick)

See attached email (Attachment B)

2.7.5 Will the proposal require drainage of the land?

Yes No **If yes**, how is the site to be drained and will the drainage be connected to an existing Local Authority or Water Corporation drainage system? Please provide details.

2.7.6 Is there a water requirement for the construction and/ or operation of this proposal?

(please tick) Yes **If yes**, complete the rest of this section.

No **If no**, go to the next section.

2.7.7 What is the water requirement for the construction and operation of this proposal, in kilolitres per year?

Approximate figures suggest 99,900 kL per annum during construction.

2.7.8 What is the proposed source of water for the proposal? (e.g. dam, bore, surface water etc.)

Likely source will be from a number of groundwater bores, however other sources may be used if sufficient groundwater is unavailable.

2.8 Pollution

2.8.1 Is there likely to be any discharge of pollutants from this development, such as noise, vibration, gaseous emissions, dust, liquid effluent, solid waste or other pollutants?

(please tick) Yes **If yes**, complete the rest of this section.
 No **If no**, go to the next section.

2.8.2 Is the proposal a prescribed premise, under the Environmental Protection Regulations 1987?

(Refer to the EPA's *General Guide for Referral of Proposals to the EPA under section 38(1) of the EP Act 1986* for more information)

Yes No **If yes**, please describe what category of prescribed premise.

2.8.3 Will the proposal result in gaseous emissions to air?

Yes No **If yes**, please briefly describe.

Air pollution is not predicted to increase as a result of the interchange construction. There will be temporary risks during construction due to potential dust lift and construction traffic and this will be managed.

Ongoing air pollution is not predicted to increase as traffic volumes would increase with or without the interchange. Local pollution levels should, in fact, decrease, due to the removal of traffic lights and the subsequent improvements in traffic flow.

2.8.4 Have you done any modelling or analysis to demonstrate that air quality standards will be met, including consideration of cumulative impacts from other emission sources?

Yes No **If yes**, please briefly describe.

Air pollution is not predicted to increase as a result of the interchange construction. There will be temporary risks during construction due to potential dust lift and construction traffic and this will be managed.

Ongoing air pollution is not predicted to increase as traffic volumes would increase with or without the interchange. Local pollution levels should, in fact, decrease, due to the removal of traffic lights and the subsequent improvements in traffic flow.

2.8.5 Will the proposal result in liquid effluent discharge?

Yes No **If yes**, please briefly describe the nature, concentrations and receiving environment.

2.8.6 If there is likely to be discharges to a watercourse or marine environment, has any analysis been done to demonstrate that the State Water Quality Management Strategy or other appropriate standards will be able to be met?

Yes No **If yes**, please describe.

2.8.7 Will the proposal produce or result in solid wastes?

Yes No **If yes**, please briefly describe the nature, concentrations and disposal location/ method.

2.8.8 Will the proposal result in significant off-site noise emissions?

Yes No **If yes**, please briefly describe.

Significant off-site noise emissions are only anticipated during the construction phase of the project. All construction noise emissions will be managed in accordance with the Environmental Protection (Noise) Regulations 1997.

A noise investigation was undertaken (Lloyd George Acoustics, 2014) to assess the impacts of noise from the changes to Roe Highway. The primary change will be the construction of Roe Highway as an overpass, and of on-ramps which will be closer to houses than the current highway. This noise investigation will be used to assess the required noise walls to minimise traffic noise to sensitive receptors in line with the Environmental Protection (Noise) Regulations 1997.

Noise walls will be designed and installed based on final recommendations.

Additionally a new, smoother asphalt will be used as part of these works will also reduce operational noise significantly (as per the investigation).

2.8.9 Will the development be subject to the Environmental Protection (Noise) Regulations 1997?

Yes No **If yes**, has any analysis been carried out to demonstrate that the proposal will comply with the Regulations?

Please attach the analysis.

An assessment for predicted noise impacts during the operation of the interchange has been undertaken in order to determine suitable noise wall locations in order to meet EP(Noise) Regulation requirements.

During construction, if noisy works are required outside of standard construction hours as defined within the EP(Noise) Regulations, approval from the Shire of Kalamunda will be sought prior to undertaking these works.

2.8.10 Does the proposal have the potential to generate off-site, air quality impacts, dust, odour or another pollutant that may affect the amenity of residents and other “sensitive premises” such as schools and hospitals (proposals in this category may include intensive agriculture, aquaculture, marinas, mines and quarries etc.)?

Yes No **If yes**, please describe and provide the distance to residences and other “sensitive premises”.

There will be temporary risks during construction due to potential dust lift and construction traffic and this will be managed.

2.8.11 If the proposal has a residential component or involves “sensitive premises”, is it located near a land use that may discharge a pollutant?

Yes No Not Applicable

If yes, please describe and provide the distance to the potential pollution source

2.9 Greenhouse Gas Emissions

2.9.1 Is this proposal likely to result in substantial greenhouse gas emissions (greater than 100 000 tonnes per annum of carbon dioxide equivalent emissions)?

Yes No **If yes**, please provide an estimate of the annual gross emissions in absolute and in carbon dioxide equivalent figures.

2.9.2 Further, if yes, please describe proposed measures to minimise emissions, and any sink enhancement actions proposed to offset emissions.

2.10 Contamination

2.10.1 Has the property on which the proposal is to be located been used in the past for activities which may have caused soil or groundwater contamination?

Yes No Unsure **If yes**, please describe.

2.10.2 Has any assessment been done for soil or groundwater contamination on the site?

Yes No **If yes**, please describe.

2.10.3 Has the site been registered as a contaminated site under the *Contaminated Sites Act 2003*? (on finalisation of the CS Regulations and proclamation of the CS Act)

Yes No **If yes**, please describe.

2.11 Social Surroundings

2.11.1 Is the proposal on a property which contains or is near a site of Aboriginal ethnographic or archaeological significance that may be disturbed?

Yes No Unsure **If yes**, please describe.

Part of the project area intersects an Aboriginal Heritage site buffer. Poison Gully Creek (Site Number 25023) is a Registered Aboriginal Heritage site located to the north of the project (Figure 1), and focused on the Poison Gully creekline which is 2 km north of Berkshire Road. No other heritage sites were identified within 1 km of the project.

Following advice from the DAA, an approval is not required for the project, as the actual Poison Gully site is some distance to the north of the impact area.

2.11.2 Is the proposal on a property which contains or is near a site of high public interest (e.g. a major recreation area or natural scenic feature)?

Yes No **If yes**, please describe.

2.11.3 Will the proposal result in or require substantial transport of goods, which may affect the amenity of the local area?

Yes No **If yes**, please describe.

3. PROPOSED MANAGEMENT

3.1 Principles of Environmental Protection

3.1.1 Have you considered how your project gives attention to the following Principles, as set out in section 4A of the EP Act? (For information on the Principles of Environmental Protection, please see EPA Position Statement No. 7, available on the EPA website)

- | | | |
|--|---|-----------------------------|
| 1. The precautionary principle. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 2. The principle of intergenerational equity. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 3. The principle of the conservation of biological diversity and ecological integrity. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 4. Principles relating to improved valuation, pricing and incentive mechanisms. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 5. The principle of waste minimisation. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

3.1.2 Is the proposal consistent with the EPA's Environmental Protection Bulletins/Position Statements and Environmental Assessment Guidelines/Guidance Statements (available on the EPA website)?

Yes No

3.2 Consultation

3.2.1 Has public consultation taken place (such as with other government agencies, community groups or neighbours), or is it intended that consultation shall take place?

Yes

No

If yes, please list those consulted and attach comments or summarise response on a separate sheet.

Consultation has already been undertaken with the Shire of Kalamunda, the Department of Environment Regulation, Department of the Environment, Department of Water and commercial property owners on the western part of Berkshire Road. Further consultation with local residents and relevant interest groups will be undertaken shortly, including the Urban Bushland Council and Wildflower Society.

Berkshire Road and Roe Highway Interchange

Environmental Impact Assessment and Environmental Management Strategy

REVISION RECORDING

Rev	Date	By	Description of Revision	Approved
A	14 Mar 2014	RL	1 st draft	
B	09 April 2014	AN	2 nd Draft - review	
C	16 May 2014	AN	3 rd Draft – change of referral strategy	
D	5 June 2014	AE	Final	AN

EXECUTIVE SUMMARY

Main Roads is proposing to upgrade the staggered “T” intersections at Roe Highway and Berkshire Road with a grade-separated interchange, with Roe Highway to be built over Berkshire Road and ramps provided in each quadrant.

The works will be undertaken at the intersection of Roe Highway and Berkshire Road in Forrestfield in the Shire of Kalamunda Local Government Area. A total of 20.44 ha will be disturbed by the project, of which 11.85 ha of native vegetation will be cleared.

A Biological Survey and Impact Assessment was prepared by Gateway WA in March 2014 for the Berkshire Road and Roe Highway Intersection, based on previous field work done by GHD and more recent field assessment undertaken by Gateway WA (Appendix A).

This Environmental Impact Assessment (EIA) was completed utilising the Biological Survey and Impact Assessment, which included an assessment of potential environmental impacts based on government agency managed databases and viewing GIS shapefiles. A noise investigation report was also undertaken.

The key environmental factors of relevance to the project are clearing of native vegetation, noise and construction nuisance issues. Clearing will result in the removal of 19 plants of the Threatened (Declared Rare) species *Conospermum undulatum*, seven plants of the Priority 3 species *Isopogon drummondii*, 3.05 ha of Threatened Ecological Community and also the concurrent loss of 9.29 ha of feeding habitat for Threatened Black Cockatoo species. Clearing of vegetation for this project will also have a very minor impact on conservation significant areas including Bush Forever sites.

Details regarding native vegetation clearing and an assessment against the Ten Clearing Principles are provided in the Biological Survey and Impact Assessment report (Appendix A). The proposed clearing is considered to be ‘at variance with’ Principles (c) and (d), and ‘may be at variance with’ Principles (a), (b), (e) and (h).

Requirement for Referral under the *Environmental Protection and Biodiversity Conservation Act 1999* and *Environmental Protection Act 1986*

Black-cockatoo species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded in, or are likely to occur within, the project area. Under the referral guidelines for black-cockatoos, the proposed clearing of 9.29 ha of feeding habitat trees is considered to be a high risk of impact. In addition, the Project clearing will remove up to 19 plants of the Threatened plant species *Conospermum undulatum*.

On this basis, referral to Department of the Environment (DotE) is currently in progress, however it is considered likely that the project will be deemed ‘not a controlled action’, due to the relatively small areas impacted and its location in a highly altered area.

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1 INTRODUCTION

1.1 Assessment Scope

Main Roads Western Australia (Main Roads) commissioned Gateway WA to undertake a vegetation and flora survey of the Roe Highway and Berkshire Road intersection area (the Project area), in Forrestfield, and a subsequent impact assessment for the proposed intersection upgrade. Gateway WA is an alliance formed between Leighton Contractors, GHD, AECOM, BG&E, Georgiou and Main Roads to undertake the Gateway WA Perth Airport and Freight Access Project (Gateway WA project).

Main Roads is proposing to upgrade the staggered “T” intersections at Roe Highway and Berkshire Road with a grade-separated interchange, with Roe Highway to be built over Berkshire Road and ramps provided in each quadrant. The eastern part of Berkshire Road distributes traffic to the suburb of Forrestfield, while the western part provides access to a light industrial and commercial area, which supports a large amount of heavy vehicle traffic.

A Biological Survey and Impact Assessment was prepared by Gateway WA in March 2014 for the Berkshire Road and Roe Highway Interchange works (Gateway WAa). This Environmental Impact Assessment (EIA) was completed utilising Database searches from relevant agencies and the following Field Surveys:

- Biological Survey and Impact Assessment (includes both the GHD 2008 and Gateway WA 2014 surveys, as well as a dieback assessment) (Appendix A)
- Transportation Noise Assessment (Appendix B)

This report provides an assessment of the impacts of the proposed works, as well as management actions and commitments, such that the Office of the Environmental Protection Authority (EPA), and other agencies, can make a decision on the approval requirements for the project.

1.2 Project Description

The project area is located at the intersection of Berkshire Road and Roe Highway in the suburb of Forrestfield (Figure 1).

The work will upgrade the intersection from an offset, signalised T-junction to an overpass, with Roe Highway travelling over Berkshire Road, and has been proposed due to significant increases in traffic, particularly heavy vehicles. The Project will also include a Principal Shared Path (PSP), a noise wall constructed adjacent to affected residences along Roe Highway and fencing along the Project boundary. Drainage retention will also be required within the interchange area.

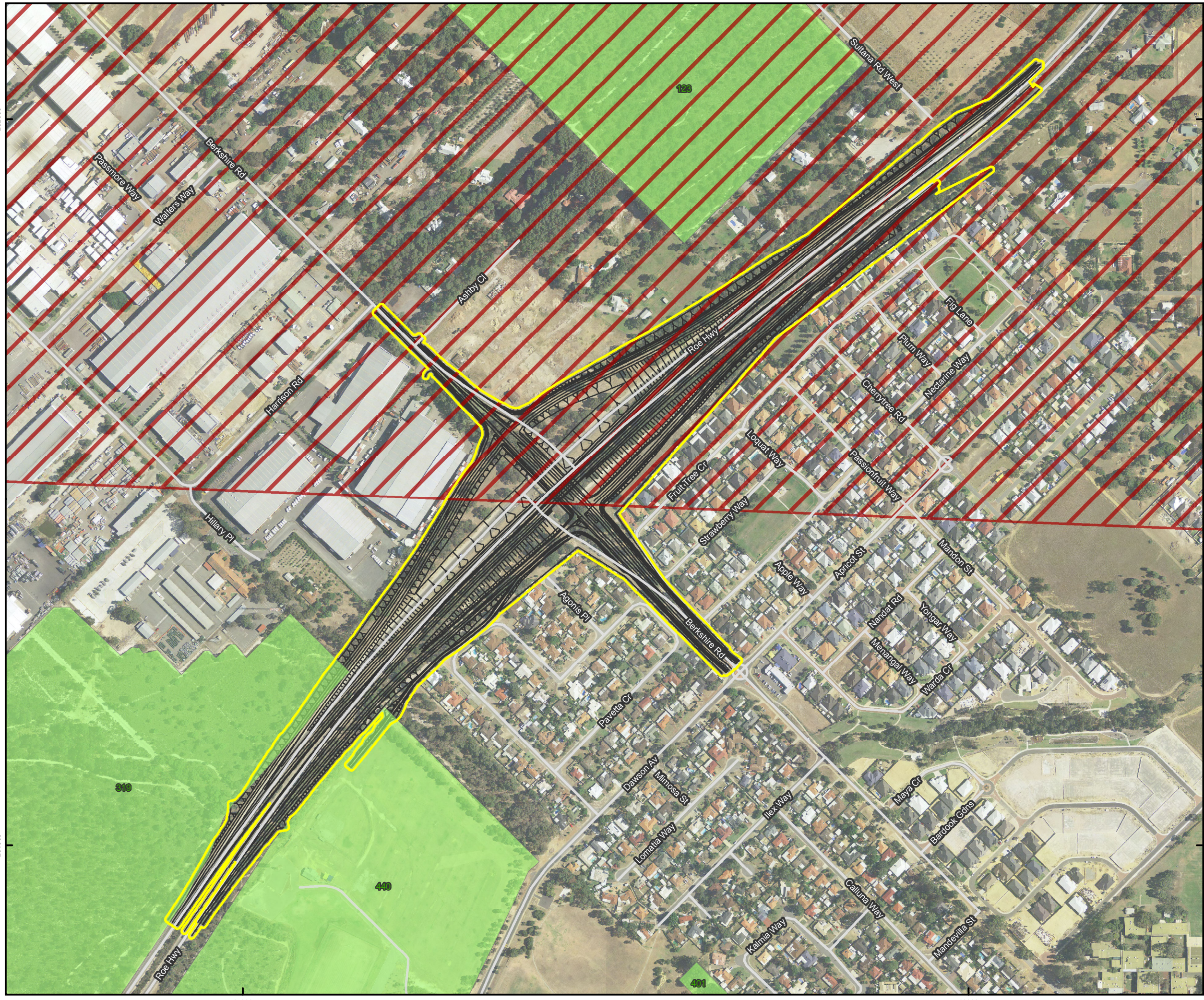
The works will all be undertaken within road reserves, with the majority of the road reserve being vested in, and managed by, the Commissioner of Main Roads. A small section of Berkshire Road is under the control of the Shire of Kalamunda.

Clearing will be via mechanical means utilising bulldozers and other machinery. The area will be cleared and the interchange constructed, with rehabilitation of batters and degraded areas adjacent to the road undertaken in the suitable season following construction.

Table 1 Key Project Characteristics

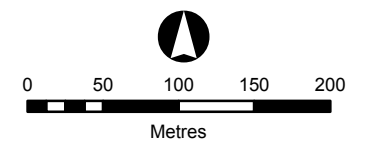
Aspect
Removal of signalised intersection at the Roe Highway and Berkshire Road junction
Construction of an interchange with Roe Highway being taken over Berkshire Road

Aspect
Construction of on ramps for all access options on and off Roe Highway
Construction of a Principal Shared Path along the eastern side of Roe Highway
Provision of noise walls/screen wall on Roe Highway adjacent to residences
Total land impact area – 20.44 ha
Total native vegetation clearing area (Condition 5 vegetation and better) – 11.85 ha



Project Location

Figure 1



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

-  Project design
-  Project area
-  Aboriginal heritage
-  Bush Forever sites

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2 METHODOLOGY

2.1 Desktop Assessment

This EIA was developed based on a range of desktop and field investigations. The desktop investigations involved searches of a number of online databases, which included a review of:

- the Department of the Environment (DotE) Protected Matters database using the Protected Matters Search Tool (PMST)¹ to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within 5 km of the Project area (DotE 2014).
- the Department of Parks and Wildlife (DPaW) Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) databases to determine the potential for TECs or PECs to be present within a 2 km buffer of the Project area.
- DPaW's *NatureMap* database for flora species previously recorded within a 5 km buffer of the Project area (DPaW 2007).
- the DPaW Threatened and Priority Flora database (TPFL) and Western Australian Herbarium database (WAHERB) for Threatened and Priority flora species listed under *Wildlife Conservation Act 1950* (WC Act) and listed by DPaW, previously recorded within a 5 km buffer of the Project area.
- the area's hydrology and identification of Environmentally Sensitive Areas (ESAs), Bush Forever sites, and conservation estate and reserves in the vicinity of the Project area
- the online contaminated sites database (DER 2014).
- the Department of Aboriginal Affairs' sites register
- the InHerit database and Shire of Kalamunda heritage database.

2.2 Field Ecological Survey

GHD undertook a biological survey of the Berkshire Road and Roe Highway intersection area in Spring 2008 during the peak flowering season for the Swan Coastal Plain. The assessment was undertaken for Main Roads by qualified ecologists from GHD. The area assessed for this survey consisted of the vegetation immediately surrounding the existing intersection for the previously proposed upgrade.

In 2014, Gateway WA undertook a further biological survey of the newly proposed road upgrade area, which included additional areas to the north and south of the intersection, along Roe Highway. The 2008 and 2014 biological studies identified the existing environment around the project and the local and regional context, and included an assessment against the Ten Clearing Principles. The methodology for the field survey is provided in Section 3 of the 2014 report (Gateway WA 2014a).

A detailed assessment of Black Cockatoo habitat was also undertaken by an experienced GHD ecologist. The Black Cockatoo assessment was undertaken according to the EPBC Act Significant Impact Guidelines 1.1 (DotE, 2012).

¹ 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 area. The records from DPaW searches of TECs, PECs, Threatened and Priority flora provide more accurate information for the general area. However, some records of collections can be dated and often misrepresent the current range of a species.

2.3 Noise Assessment

A Transportation Noise Assessment for the proposed interchange upgrade was undertaken by Lloyd George Acoustics in March 2014 (Lloyd George Acoustics, 2014).

The resulting report considered the potential noise impacts associated with the upgraded interchange by:

- Measuring existing noise levels at the intersection
- Constructing a noise model of the existing interchange and calibrating the predicted noise levels against the measured noise levels
- Using the calibration from the existing model, calculating noise levels for the proposed grade separated interchange for the year 2031
- Determining appropriate noise mitigation options to achieve compliant noise levels at surrounding residences for the 2031 year
- Using the calibration from the existing model to calculate the noise levels for the proposed interchange for the year 2050
- Determining appropriate noise mitigation options to achieve compliant noise levels at surrounding residences for the 2050 year.

Copies of the Biological Survey and Impact Assessment as well as the Transportation Noise Assessment are provided at Appendix A and B respectively.

3 ASSESSMENT OF ASPECTS AND IMPACTS

This section provides an evaluation of the potential impacts that the project may have on environmental aspects. The methodology for the assessment is detailed in Section 2 and in the Biological Survey and Impact Assessment Report (see Appendix A). Mapping for the relevant environmental aspects is also included below in Figures 1 to 6.

Proposed management of the actual and potential impacts will be based on the actions developed for the Gateway WA Construction Environmental Management Plan (CEMP) and are summarised in Section 6.

3.1 Soils and Landform

3.1.1 Topography

Berkshire Road is located within 5 km of the eastern edge of the Swan Coastal Plain and has a mildly undulating topography with ground levels between 25 and 50 m above sea level.

3.1.2 Geology

The Project area lies within the Bassendean Dune System (Wilde and Low, 1974), a geomorphic unit of the Swan Coastal Plain, and is situated at the base of the Darling Scarp. The dune system is approximately 15 km wide and consists of a series of shoreline deposits and coastal dunes running parallel to the coast. The underlying geology of the Swan Coastal Plain was formed by successive periods of sedimentation during Neocene and Quaternary times and was formed during erosion and deposition events associated with changing sea levels (Gozzard, 2007).

3.1.3 Soils

The dunes consist of a series of low hills of leached quartz dominated sand overlying a series of leached clay horizons. The dunes are interspersed with low-lying sandy swales often containing seasonal swamps or may contain clay based swamps with cracking clay or hard setting loam soils (Beard, 1979; Geological Survey of Western Australia, 1978).

Soils within the Project area belong to the Southern River unit (Churchward and McArthur, 1980), which is described as a sandplain with low dunes and many intervening swamps, with iron and humus podzols, peats and clays.

Recent geotechnical drilling undertaken by Gateway WA (Gateway WA, 2014b) in the project area has identified medium dense sandy clay soils to a depth of at least 10 m, with a patchy 'coffee rock' layer below the sand.

Assessment of impacts

The soil type in the project area will have no significant bearing on the construction or ongoing impacts of the interchange. The soils are relatively free draining, allowing road runoff to infiltrate into the groundwater. There are no likely requirements for rock removal or drilling through significant layers of ironstone as most of the works will occur above current ground level.

3.1.4 Acid Sulfate Soils

DPaW Acid Sulfate Soil (ASS) mapping indicates that the project area occurs in an area that has moderate to low risk of ASS occurring, with potential acid sulphate soil (PASS) occurring generally at depths of >3 m from the surface (Government of Western Australia 2012).

The Project area intersects three geomorphic wetlands, including Conservation Category Wetland (UFI 15077) and Multiple Use Wetland (UFI 15072) which are both located on the western side of Roe Highway in the south-western section of the project area. Resource Enhancement Wetland (UFI 13977) covers a large portion of the project area on the western side of Roe Highway both north and south of Berkshire Road. Historical aerial photography indicates that no basin or sumpland wetlands occurred in the area prior to development in the late 1950s. The wetland mapping is based on the area being palusplain and supporting seasonal damplands.

In 2013 ASS investigations were undertaken by SGS on behalf of AECOM which found no indications of ASS present within the first 2 m from the surface. Investigations undertaken by Gateway WA during 2012 and 2013 for the Gateway WA Perth Airport and Freight Access project have generally indicated PASS is only present below the historical groundwater level.

Assessment of impacts

As the road construction works will be primarily at or above existing ground level, the risks of intersecting ASS are low. Bridge pylons and drainage pipes may require excavation and footing construction to be >3m below ground but these will be very limited in area and only required for short periods of the construction phase.

Water extraction for construction works will occur and this has a small risk of drawing water from underground ASS soils into the bore. ASS management will be undertaken in accordance with the Gateway WA CEMP and associated ASS Management Plans, if required.

3.2 Conservation Areas and Environmentally Sensitive Areas

3.2.1 Conservation Reserves

No National Parks or 'A'-Class Reserves occur within the immediate vicinity of the Project area. The nearest conservation reserve is Dundas Nature Reserve, approximately 580 m south-west of the Project area. In addition, Bougainvillea Avenue Bushland (Class C) reserve is located approximately 650 m south-east of the Project area. Lesmurdie National Park is 3.7 km to the east of the Project area, on the Darling Scarp.

3.2.2 Bush Forever Sites

A total of six Bush Forever Sites are located within 2 km of the Project area (Table 2). Two Bush Forever sites are immediately adjacent to the Project area, being Pioneer Park (Site 440) on the eastern side of Roe Highway and Dundas Road (Site 319) on the western side (Government of Western Australia 2000a; 2000b; 2012). The location of these two sites, in relation to the Project area, is shown at Figure 1.

Table 2 Bush Forever sites within vicinity of Project area

Site	Description
45	Poison Gully Bushland, High Wycombe
123	Sultana Road West Bushland, High Wycombe
319	Dundas Road Nature Reserve, Forrestfield
386	Perth Airport and Adjacent Bushland
401	Bougainvillea Avenue Bushland, Forrestfield

Site	Description
440	Pioneer Park Bushland, Forrestfield

Assessment of impacts

Approximately 0.6 ha of impact in the Bush Forever sites is expected for this project. Approximately 0.4 ha of the Bush Forever area is within the existing Roe Highway road reserve and the remaining 0.2 ha is a primarily cleared area within Pioneer Park.

Minor widening of Roe Highway will occur within the road reserve adjacent to approximately 390 m of Pioneer Park and 427 m of Dundas Road Bush Forever site.

Gateway WA will apply to the WAPC and Shire of Kalamunda for approval to directly impact the small areas of Bush Forever land.

3.2.3 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) include areas covered by Threatened Ecological Communities (TECs) and associated buffers, a defined wetland and the area within 50 m of a wetland, the area covered by vegetation within 50 m of rare flora, areas on conservation estates, and Bush Forever Sites (for a full definition, see the Western Australian Government Gazette No. 55: *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*).

A search of the Department of Parks and Wildlife's online Native Vegetation Map Viewer indicated a number of ESAs covering the Project area (DPaW 2014). The ESAs are TECs and associated buffers, and the areas covered by vegetation within 50 m of declared rare flora (DRF). See Section 2.6.2 for TECs within the vicinity of the Project area, and Section 2.7.1 for rare flora recorded within the vicinity of the Project area. The following ESAs occur within, or their buffers occur within the project area:

- DRF – *Conospermum undulatum*
- TEC – Merge of TECs SPC3a and SPC20a
- Bush Forever Sites 319 and 440

Assessment of impacts

The impacts on ESAs are discussed with the relevant environmental aspects.

3.3 Adjacent Landuse

Land surrounding Berkshire Road is predominantly used for light industry and residential purposes.

Residential areas occur along the eastern side of parts of Roe Highway, with a small number of special rural lots on the western side, north of Berkshire Road.

The southern part of the proposed works along Roe Highway, on the eastern side is adjacent to bushland at Pioneer Park, which is a Bush Forever site and includes a completed landfill. On the western side, the highway abuts bushland which is part of a Bush Forever site.

3.3.1 Public Drinking Water Source Areas

No Public Drinking Water Supply Areas occur within 5 km of the Project area.

3.4 Groundwater and Wetlands

3.4.1 Groundwater and Surface Drainage

The project is within the Perth Groundwater Area and Shire of Kalamunda Sub-area proclaimed under the *Rights in Water and Irrigation Act 1914*. Therefore, impacts to any defined groundwaters are subject to assessment and approval of the impacts to downstream users.

Hydrological flows in the Project area are modified due to the existing road. The nearest creek is Poison Gully Creek located 2 km north of the Project area. One artificial drainage line (part of Crumpet Creek) crosses Roe Highway within the Project area through a culvert from the east before becoming a more natural drainage gully in the Bush Forever site west of the Highway, and dissipating shortly afterwards.

Groundwater levels are at depths of more than 15 m, based on bore monitoring work by Gateway WA personnel at the proposed bridge site. Drill holes were taken to 15 m and did not intersect the groundwater table (Gateway WA, 2014b).

Assessment of impacts

The Project is not expected to significantly impact surface water flows. Drainage will be taken into account during design and managed during construction. Most surface water infiltrates at source, due to the sandy soils in the Project area.

Groundwater from the project area will be utilised for construction and dust suppression. Due to the short timeframe of the project, and low levels of extraction required, no changes to groundwater level or quality are expected as a result of the project. Relevant licences for groundwater extraction will be obtained from the Department of Water.

3.4.2 Wetlands of International and National Significance

A search of the EPBC PMST did not identify any Ramsar listed sites within 5 km of the Project area. Three Nationally Important Wetlands occur within 5 km, being Munday Swamp on Perth Airport (3km), Runway Swamp on Perth Airport (3km) and the Brixton Street wetlands (4km). None of the surface drainage from the Project area feeds into these areas.

3.4.3 Geomorphic Wetlands

The project area intersects three geomorphic wetlands, including Conservation Category Wetland (UFI 15077) and Multiple Use Wetland (UFI 15072) which are both located on the western side of Roe Highway in the south-western section of the Project area, and Resource Enhancement Wetland (UFI 13977), which covers a large portion of the Project area on the western side of Roe Highway both north and south of Berkshire Road.

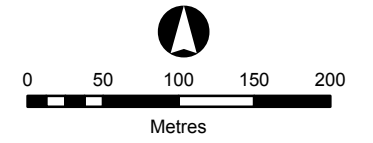
These wetlands are outlined in Table 3 and shown in Figure 2.

Table 3 Description of the geomorphic wetlands intersected by the Project area

Wetland	DPaW Geomorphic Wetlands Classification	Location within Project area
13977	Resource Enhancement	Western side of Roe Highway both north and south of Berkshire Road
15072	Multiple Use	South-western portion of Project area, western side of Roe Highway
15077	Conservation Category	South-western portion of Project area, western side of Roe Highway

Geomorphic Wetlands

Figure 2

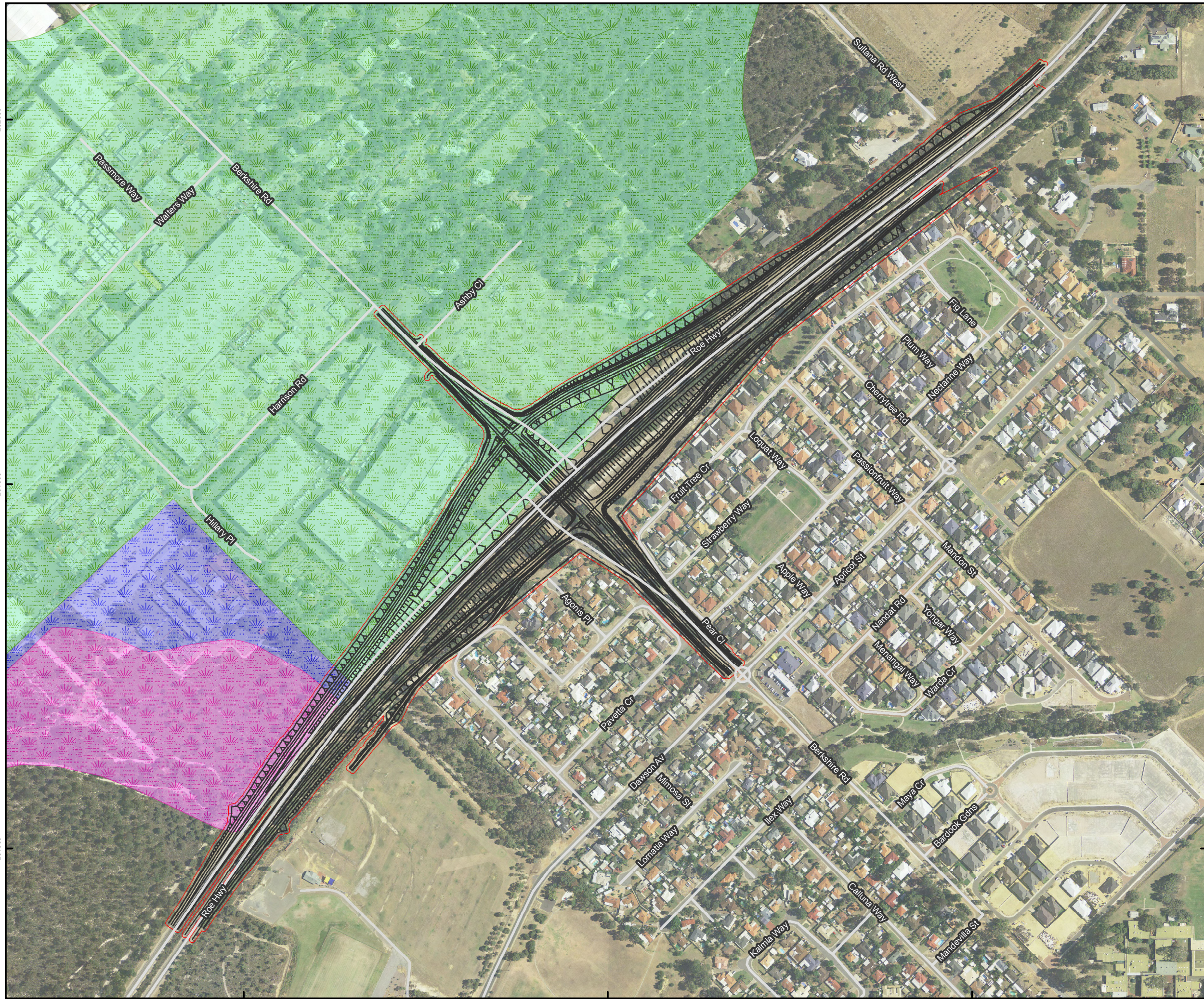


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GDA 1994 Perth Coastal Grid 1994

LEGEND

- Project design
- Project area
- Geomorphic wetlands**
 - Conservation
 - Multiple Use
 - Resource Enhancement



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Very limited wetland dependent vegetation has been identified in the project area and the wetlands do not contain standing water, or even seasonal water. A small clump of *Melaleuca raphiophylla* is present adjacent to Roe Highway south of the Berkshire Road intersection but no other wetland dependent species, or evidence of high water tables is present in, or immediately adjacent to, the project area. It is likely that the *Melaleuca raphiophylla* clump was planted along the roadside following the initial road construction and not associated with a wetland, as it is present in an area with minimal native understorey, and occurs with a number of non-native tree species.

Assessment of impacts

It is not considered that the road construction or ongoing drainage design will adversely impact the wetlands that are mapped as being adjacent to the project area or in the broader vicinity.

Currently, there is no treatment of road runoff along Roe Highway or Berkshire Road, with all runoff going directly into adjacent vegetation, table drains or the median. As part of the new interchange works, road runoff will be primarily captured and treated internally within the interchange through bioretention basins, reducing the potential impact from hydrocarbon spills on vegetation or other assets along this section of the highway.

Road construction drainage will be managed through the CEMP.

3.5 Contaminated Sites

A search of the DER Contaminated Sites Database indicated a contaminated site located 600 m south-east of the Project area at 547 Dundas Rd Forrestfield. This site involves hydrocarbon and volatile organic compound contamination of soil and groundwater. The extent of the contamination has not been determined to date.

Assessment of impacts

Groundwater will be utilised for dust suppression and soil compaction and bores will be installed at the Project area. Based on hydrological investigations undertaken during the Gateway WA works, it has been found that groundwater generally flows in a south and westerly direction, away from the Darling Scarp. It is therefore considered highly unlikely that groundwater extracted from within or near the Project area would contain contaminants from the known site in Forrestfield.

Groundwater testing will be undertaken at abstraction bores to monitor for potential contamination.

Management measures in the event of detection of contamination in the project area are included in the Gateway WA CEMP.

Given the distance between the works and the contaminated site, it is considered unlikely that associated soil contamination will occur within the project area.

3.6 Vegetation and Flora

3.6.1 Vegetation Types

Broad-scale vegetation communities have been mapped in the survey area by Beard (1979), and Heddle, *et al.* (1980). These overlap with smaller scale floristic communities described by Gibson, *et al.* (1994).

Beard (1979) indicates that the vegetation within the Project area consists of: Vegetation Association 1001: Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina.

Hedde, *et al.* (1980) places the Project area within the Southern River Complex consisting of an open-woodland of marri-jarrah-banksia on the elevated areas and a fringing woodland of *Eucalyptus rudis* (Flooded Gum) and *Melaleuca raphiophylla* (Swamp Paperbark) along streams.

Regional Vegetation Extent

Native vegetation types represented in the Project area, their regional extent and reservation status are generally drawn from Government of Western Australia (2013 and Shepherd *et al.* (2002), which are, in turn based on the broad-scale mapping undertaken by Beard. These are shown in Table 4.

Table 4 Extent of Beard (1979) vegetation associations within the Project area

Vegetation Association	Region	Pre-European Extent (ha)	Current Extent (ha)	% remaining	% current extent in IUCN Class I-IV Reserves
1001-Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	State	57,410.23	14,151.89	24.65%	4.61
	IBRA region (Swan)	57,410.23	14,151.89	24.65%	4.61
	IBRA sub-region (Perth)	57,410.23	14,151.89	24.65%	4.61
	Shire of Kalamunda LGA	1,473.91	121.10	8.22%	18.21

(Government of Western Australia, 2012 and 2014; Shepherd *et al.*, 2002)

On the basis of the current extent for the vegetation association 1001, the community is classified as Vulnerable (at the State, IBRA bioregion and IBRA sub-region scales). However, as the Project area is located within the constrained Perth metropolitan area (due to existing level of development) and the extent of vegetation association 1001 has more than 10 percent of its pre-European extent, it is not considered to be a critical asset.

At the local government scale (within the Shire of Kalamunda), Vegetation association 1001 has less than 10% of its pre-European extent, and is therefore considered to be Endangered. This vegetation unit is therefore considered to be a critical asset within the Shire of Kalamunda.

Regional Threatened Ecological Communities

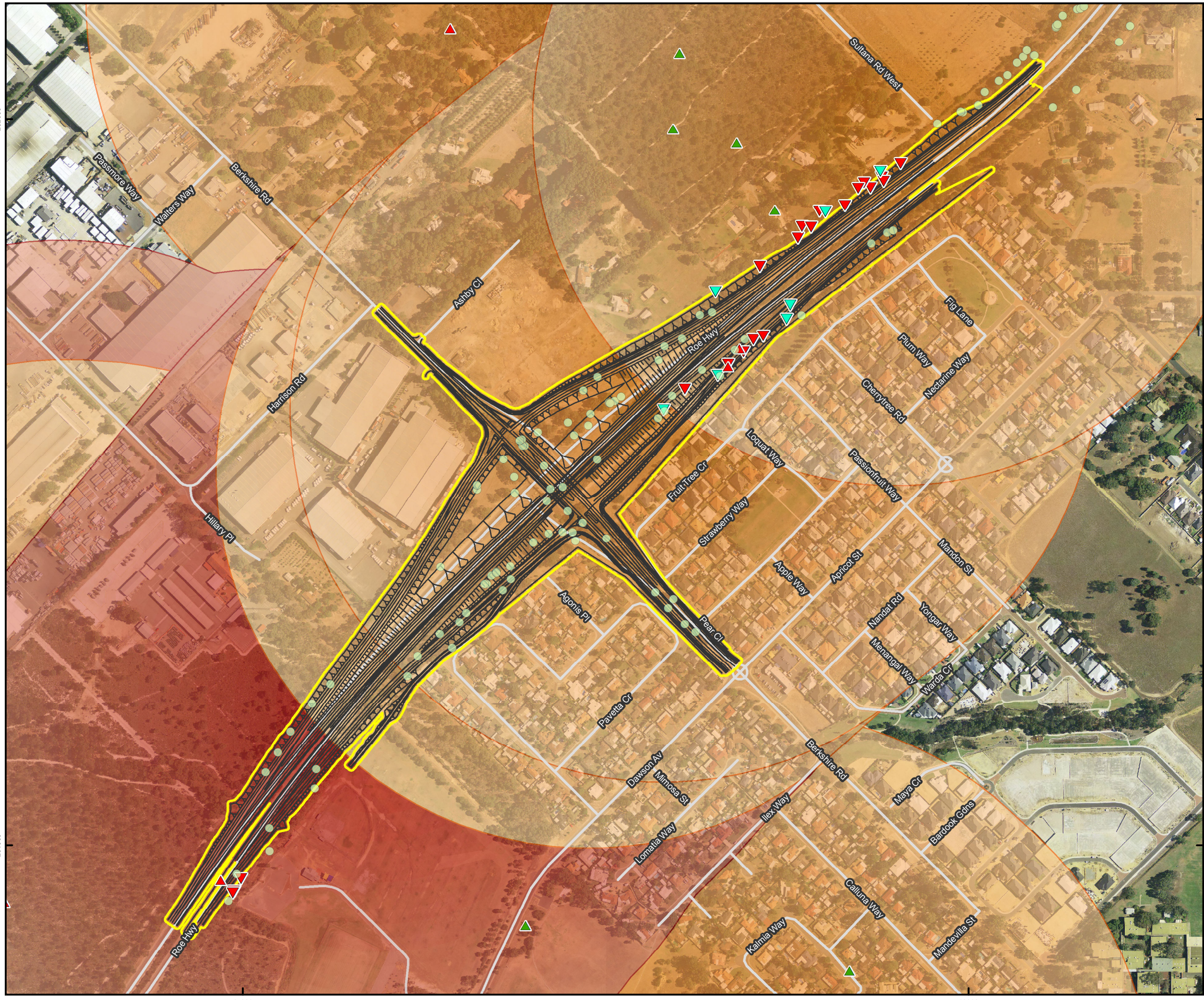
A search of the EPBC Act Protected Matters database (DotE 2014) identified three TECs that occur or could occur within 5 km of the Project area.

A search of the DPaW Threatened Ecological Communities database indicated that there are a number of known occurrences of TECs and one known occurrence of a Priority Ecological Community (PEC) recorded within the general vicinity of the Project area.

A summary of each of these conservation significant ecological communities and an assessment of their occurrence within the Project area is provided in Table 5, with locations shown in Figure 3.

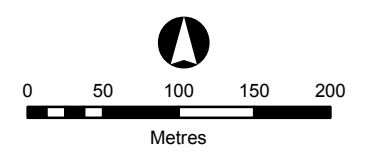
Table 5 Conservation significant communities occurring & possibly occurring within 5 km of the Project area

Conservation Significant Community	Status		Community Name	Presence within Project area	
	State (WC Act/DPaW listing)	Federal (EPBC Act listing)		Desktop (Buffer in Project area)	Found in field surveys
<i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain	Critically Endangered	Endangered	SCP3a	One occurrence within the Project area	Present
Claypans of the Swan Coastal Plain Including – Herb rich saline shrublands in clay pans (SCP07) Shrublands on dry clay flats (SCP10a)	Vulnerable Endangered	Critically Endangered		No No No	None present
Shrublands and Woodlands of the eastern Swan Coastal Plain	Critically Endangered	Endangered	SCP20c	No	None present
Southern wet shrublands, Swan Coastal Plain	Endangered		SCP02	No	None present
<i>Banksia attenuata</i> woodland over species rich dense shrublands	Endangered		SCP20a	Four occurrences within the Project area	Present
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain	Endangered		SCP20b	One occurrence within the Project area	Possible
<i>Corymbia calophylla</i> - <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain	Vulnerable		SCP3b	No	No intact vegetation present
<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain	Critically Endangered	Endangered	SCP3c	No	No intact vegetation present



Environmental constraints

Figure 3



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

- Cockatoo Tree Location
- Threatened and Priority Species**
- DPaW records**
- ▲ (T) Threatened Flora - Extant Taxa
- ▲ Priority 3 - Poorly Known Taxa
- Gateway WA surveyed rare flora**
- ▼ Declared RareFlora - *Conospermum*
- ▼ Priority 4 *Isopogon drummondii*
- Project design
- ▭ Project area
- Threatened Ecological Community**
- ▭ Critically Endangered
- ▭ Endangered

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Project area vegetation

The field investigations by GHD in 2008 (GHD, 2009) and Gateway WA in 2014 (Gateway WA, 2014, attached at Appendix A), have identified and mapped the vegetation communities within the Project area.



The Project area vegetation has been extensively degraded by previous clearing for agriculture, then road construction and maintenance. Despite this, a narrow strip of vegetation in good to excellent condition remains within the Project area, particularly along the eastern side of the Roe Highway road reserve. Six vegetation types were identified from the Project area, including two types defined as degraded – completely degraded vegetation.



The remnant vegetation within the Roe Highway road reserve (particularly the eastern side, north of Berkshire Road) is the least modified. One 10 m x 10 m quadrat was examined and indicates that one of the vegetation types within the Project area has close affinities to the floristic community type (FCT) of Gibson *et al.* (1994) SCP 20a *Banksia attenuata* woodland over species rich dense shrublands.



South of the Berkshire Road intersection in the Roe Highway road reserve on the eastern side, the vegetation appears to be a gradient between the FCT SCP 20a and FCT 3a: *Eucalyptus calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain. The understorey is relatively species rich and there is also a *Eucalyptus calophylla* overstorey. The area has had a range of disturbances, including previous clearing and the naturalisation of a number of planted, non-local native shrub species.

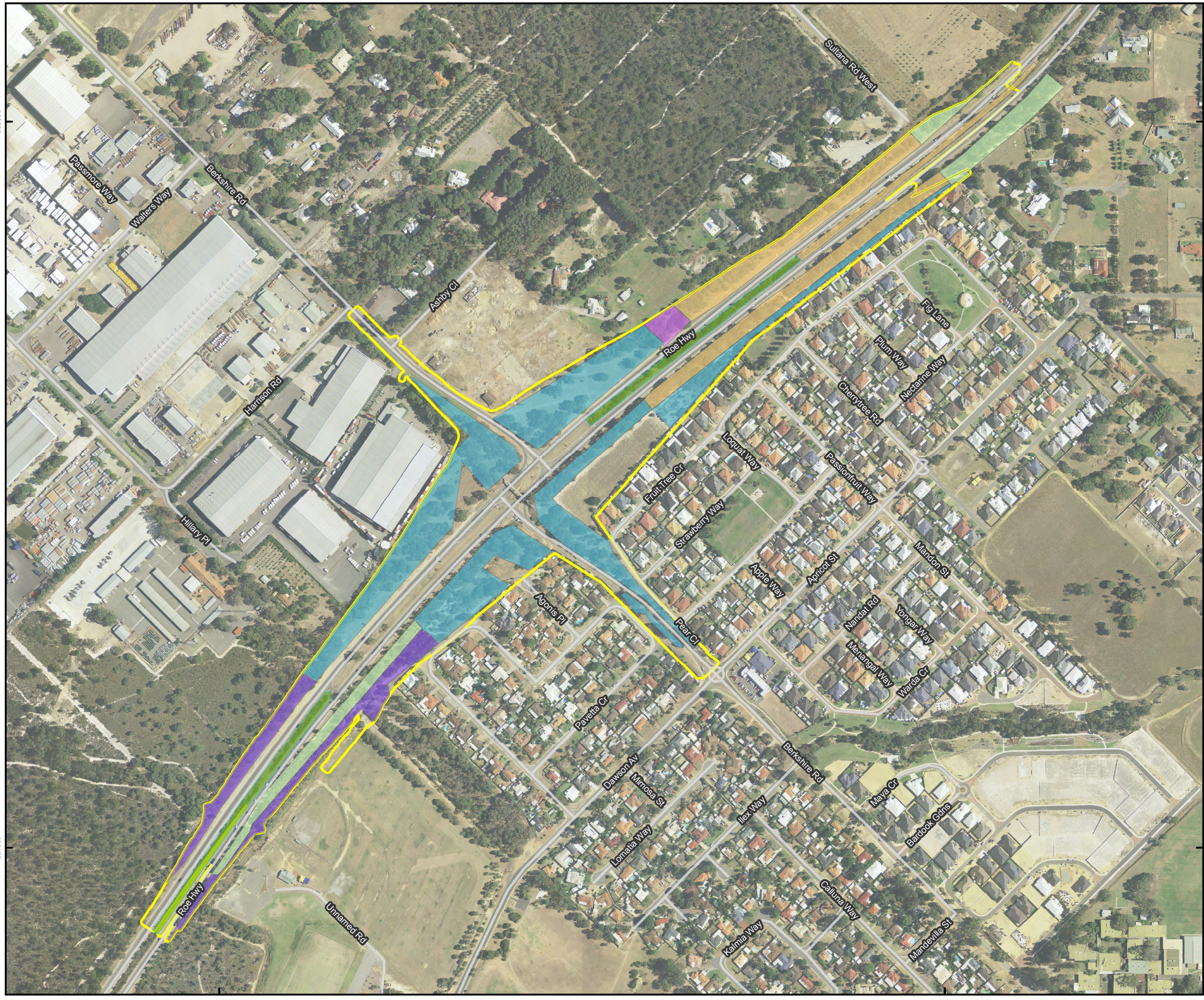
Project area vegetation types are described below in Table 6 and are mapped at Figure 4. Vegetation condition was also assessed and is shown at Figure 5.

Table 6 Project vegetation types and condition rating

No.	Description	Gibson, et al. (1994) equivalent Vegetation Type	Conservation Status	Vegetation Condition Rating	Representative Photo
1	<p><i>Banksia menziesii</i> open forest with scattered <i>Eucalyptus marginata</i> and patches of <i>Allocasuarina fraseriana</i> over dense low shrubland and dense herbs and sedges.</p>	<p>SCP 20a: <i>Banksia attenuata</i> woodland over species rich dense shrublands</p>	<p>TEC (Endangered – WA Criteria only)</p>	<p>2-3</p>	
2	<p><i>Corymbia calophylla</i> woodland with scattered <i>Eucalyptus marginata</i> and occasional <i>Allocasuarina fraseriana</i>, over mixed low shrubs over dense herbs and sedges.</p> <p>No <i>Kingia australis</i> present.</p>	<p>Possible transition between SCP20a and SCP3a <i>Eucalyptus</i> [<i>Corymbia</i>] <i>calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain</p>	<p>TEC (Endangered – WA Criteria only) and TEC (Endangered WA and EPBC Act)</p>	<p>2-4</p>	

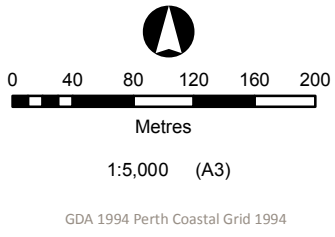
No.	Description	Gibson, <i>et al.</i> (1994) equivalent Vegetation Type	Conservation Status	Vegetation Condition Rating	Representative Photo
3	Mixed, scattered trees of Jarrah (<i>Eucalyptus marginata</i>), River Gum (<i>E.camaldulensis</i>) and Marri (<i>Corymbia calophylla</i>) with planted non-native trees and shrubs over introduced herbland	Nil	Nil	5-6 (small area of veg condition 3-4)	
4	Planted and natural Eucalypts and shrubs including <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> with patches of naturalised shrubs including Geraldton Wax (<i>Chamelaucium undulatum</i>), <i>Hakea trifurcata</i> , <i>Calothamnus</i> sp. and scattered, native understorey species.	Nil	Nil	4-5	

No.	Description	Gibson, <i>et al.</i> (1994) equivalent Vegetation Type	Conservation Status	Vegetation Condition Rating	Representative Photo
5	<i>Banksia sessilis</i> closed forest with occasional <i>Allocasuarina fraseriana</i> over very open mixed shrubs		Nil	3	
6	Tall, dense shrubland of mixed planted native and non-native species (median strip only).	Nil	Nil	5	No photo
	Degraded vegetation, non-native species (not mapped)	Nil	Nil	5-6	



Vegetation type

Figure 4



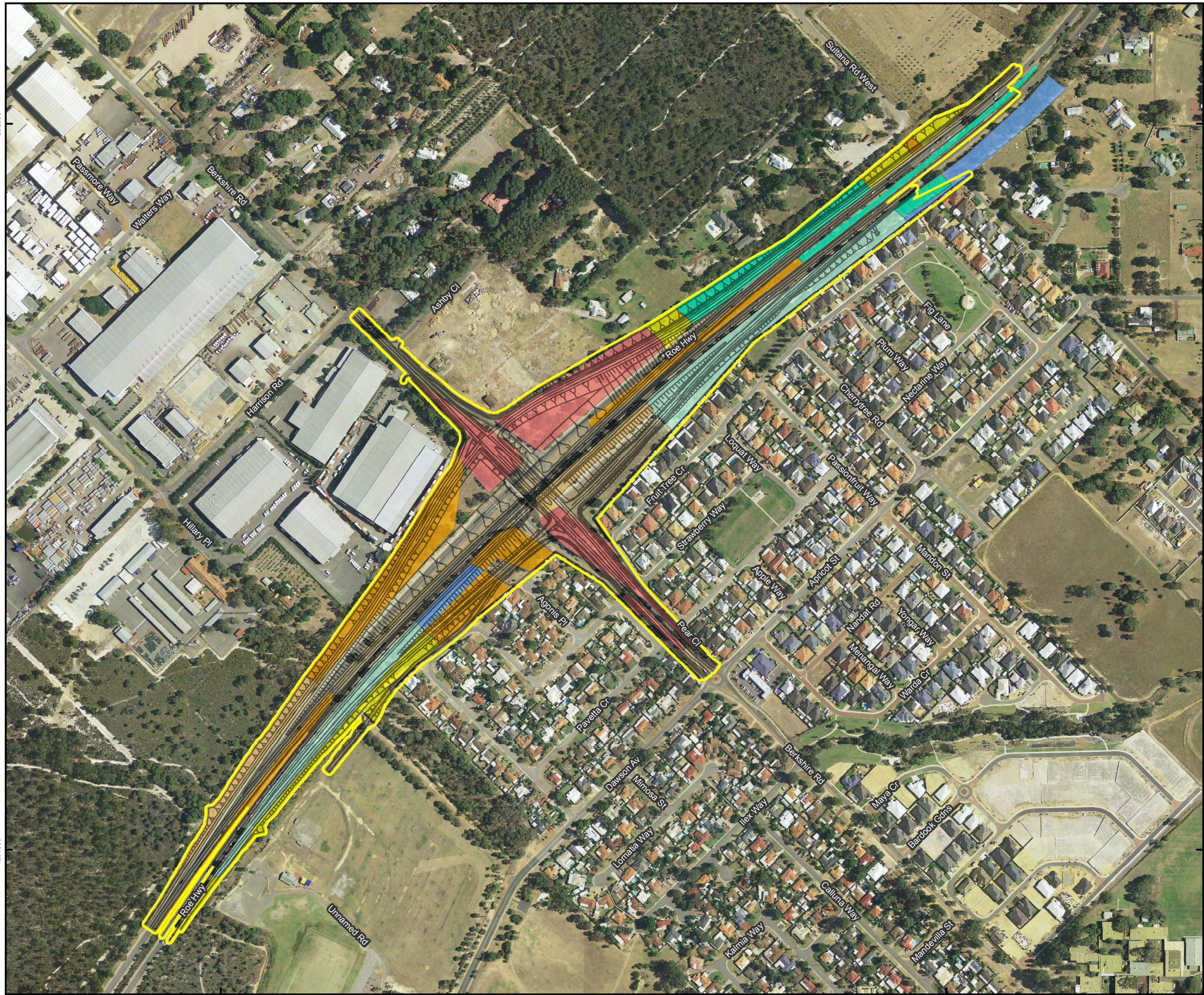
LEGEND

- Project area
 - Project design
- Vegetation type**
- Banksia menziesii* open forest with scattered *Eucalyptus marginata* and patches of *Allocasuarina fraseriana* over dense low shrubland and dense herbs and sedges
 - Corymbia calophylla* woodland with scattered *Eucalyptus marginata* and occasional *Allocasuarina fraseriana*, over mixed low shrubs over dense herbs and sedges
 - Mixed, scattered trees of Jarrah (*Eucalyptus marginata*), Flooded Gum (*E.camaldulensis*) and Marri (*Corymbia calophylla*) with planted non-native trees and shrubs over introduced hermland
 - Planted and natural Eucalypts and shrubs including *Eucalyptus marginata*, *Corymbia calophylla* with patches of naturalised shrubs including Geraldton Wax (*Chamelaucium undulatum*), *Hakea trifurcata*, *Calothamnus* sp. and scattered, native understorey species
 - Tall, dense shrubland of mixed planted native and non-native species
 - Banksia sessilis* closed forest with occasional *Allocasuarina fraseriana* over open mixed shrub

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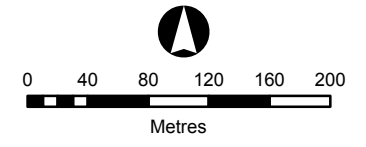
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Vegetation condition

Figure 5



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

- Project design
- Project area
- Vegetation Condition**
- 1. Pristine
- 1-2
- 2. Excellent
- 2-3
- 3. Very Good
- 3-4
- 4. Good
- 4-5
- 5. Degraded
- 5-6

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3.6.2 Flora

All visible species within the Project area were recorded, and where identification was uncertain, confirmation was made at the Western Australian State Herbarium.

The presence of Threatened or Priority Flora was recorded and the weed status of flora taxa was also noted.

The Project area is considered to have a moderate species diversity with a total of 104 native taxa recorded within the surveyed area. The total species list of 216 contains 40 deliberately planted taxa for use as ornamentals or rehabilitation purposes and 72 weed (exotic) taxa.

The dominant families (including families with introduced, planted and weed species) recorded from the area are:

- Myrtaceae (gums, Melaleuca etc.) 34 taxa
- Fabaceae (peas): 30 taxa
- Proteaceae (Banksia, Grevillea): 21 taxa
- Poaceae (grasses): 20 taxa
- Asteraceae (daisies): 12 taxa

The dominant genera recorded from the Project area are:

- *Eucalyptus* 10 taxa
- *Trifolium* 5 taxa
- *Corymbia* 4 taxa
- *Lomandra* 4 taxa
- *Daviesia* 4 taxa
- *Grevillea* 4 taxa

Two weed species Declared under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) were recorded in the Project area, Paterson's Curse (*Echium plantagineum*) and Prickly Pear (*Opuntia stricta*). Control of both species is not required by the BAM Act for the Project area; however weed management strategies will be developed and implemented in the project area.

A full list of flora species recorded is provided in the Biological Survey and Impact Assessment report (Gateway WA, 2014a).

Conservation Significant Species

Threatened Flora

A total of 49 conservation significant flora species were identified in the desktop searches of the Project area, and 14 of these were identified as potentially occurring in the general location and soil type.

One Threatened (Declared Rare) plant species was recorded during the field surveys: *Conospermum undulatum*. This species is also listed under the EPBC Act as Vulnerable. The species was found in three separate locations, on both sides of Roe Highway (see Figure 3). A total of 49 plants were recorded in the general Project area. This species is also known to occur in vegetation surrounding the Project area, including in the Bush Forever Sites indicated in Figure 1. There are in excess of 100 location records of the *Conospermum undulatum* within 1 km of the Project area (source DPaW and WAHERB rare flora database searches).

Conospermum undulatum was recorded at locations within the Project area where it was believed that this species has been previously identified. Flagging was noted (pers. obs.) around the plants to the north of Berkshire Road on the eastern side of Roe Highway, to indicate its presence and other DPaW records show plants in near proximity to those recorded during the survey.



Plate 1 The threatened species, *Conospermum undulatum*, recorded from the Project area



Plate 2 Location of two plants of *Conospermum undulatum* (arrowed), on embankment, adjacent to Roe Highway north of Berkshire Road

Priority Flora

Forty two (42) plants of the Priority 3 flora species (*Isopogon drummondii*) were recorded from the Project area, in a number of locations (see Figure 3).



Plate 3 The Priority 3 plant, *Isopogon drummondii*, recorded from the Project area.

Assessment of Impacts

A total of 19 plants of *Conospermum undulatum* will be impacted for the construction of the works, with a further 30 plants not within the construction area, but in adjacent bushland.

This species is known to occur in vegetation surrounding the Project area, including in the Bush Forever Sites. There are in excess of 100 location records of the *Conospermum undulatum* from within 1 km of the Project area (source DPaW and WAHERB rare flora database searches), giving a total of approximately 11,000 plants (DEC, 2009).

The loss of 19 plants constitutes approximately 0.17% of the known population.

It is apparent from this field survey and other investigations on the Gateway WA project that this species is not highly sensitive to disturbance, as it is surviving in good condition in a number of disturbed areas, including weedy damplands and roadside batters.

A total of seven plants of the Priority 3 *Isopogon drummondii* will be impacted, out of a total of 42 plants recorded. There are also in excess of 50 records of *Isopogon drummondii* from within 1 km of the Project area (source DPaW and WAHERB rare flora database searches).

3.7 Dieback

A formal *Phytophthora cinnamomi* (dieback) assessment of the Project has been undertaken (Glevan, 2014). No obvious evidence of dieback infestation was observed by an experienced dieback interpreter during field investigations, however, the majority of the Project area was considered uninterpretable, due to poor vegetation condition and lack of indicator species. Vegetation decline that is possibly related to *Phytophthora* dieback was observed in several sections of the study area, however most of these areas are unmappable and disease presence/distribution could not be confirmed.

Soil/root samples were taken from two locations, one within the project area returning a negative result, the other, taken outside of the project area near the southern end, returned a positive result. Some sections of vegetation believed to be uninfested were observed, however these sections were either too small or too fragmented to be considered protectable (Glevan 2014).

Based upon the inspection by the botanist and interpreter, the dieback status of the Project area is variable (Table 7).

Table 7 Project area visual Dieback assessment

Project Area	Visual Dieback Status
Berkshire Road (east of Roe Highway)	Uninterpretable/unmappable – vegetation predominantly cleared (altered), with no / few dieback susceptible (indicator) plants remaining.
Berkshire Road (west of Roe Highway)	Uninterpretable/unmappable – vegetation predominantly cleared (altered), with no / few dieback susceptible (indicator) plants remaining.
Roe Highway (eastern side of road reserve, north of Berkshire Road)	Uninterpretable/unmappable with intact vegetation appearing to be dieback free – vegetation relatively intact with dieback susceptible (indicator) plant species present (particularly at the northern half of surveyed area).
Roe Highway (eastern side of road reserve, south of Berkshire Road)	Intact vegetation appeared to be dieback free with a good range of dieback susceptible (indicator) plant species present in some areas. Other areas are uninterpretable/unmappable, due to clearing and highly disturbed vegetation. A positive dieback sample was, however, obtained from bushland in the adjacent Pioneer Park.
Roe Highway (western side of road reserve, north of Berkshire Road)	Some intact vegetation which appeared to be dieback free with a good range of dieback susceptible (indicator) plant species present. Other areas are uninterpretable/unmappable, due to clearing and highly disturbed vegetation. Although the intact vegetation appears dieback free, it is considered too small and isolated to be protectable.
Roe Highway (median strip, and western side of road reserve, south of Berkshire Road)	Uninterpretable/unmappable – vegetation predominantly cleared (altered) or planted, with no / few dieback susceptible (indicator) plants remaining.

Dieback infestations spread through bushland either naturally, through soil water movement, or artificially through vector movement of soil on vehicles, during fencing or firebreak/track maintenance and occasionally via foot traffic.

Assessment of Impacts

Majority of the Project area is considered unmappable. Where sections of vegetation were believed to be uninfested, they were found to be either too small or too fragmented to be considered protectable.

There is a dieback infested area outside the Project immediately to the south east.

3.8 Fauna

3.8.1 Fauna diversity

A NatureMap search (DPaW, 2014) identified 217 fauna species as previously recorded within 5 km of the project, of which 205 species are native and 12 are pest (introduced) or naturalised species. These results consisted of 97 birds (five introduced), 16 mammals (six introduced), 42 reptiles, nine amphibians, one fish and 52 invertebrate species.

Seven fauna species were identified during the 2008 opportunistic survey. This is obviously an underrepresentation of the fauna which may use the area, due to the single survey in a single season, and no trapping. The habitat present is relatively degraded, as well as occurring in a highly impacted, linear strip, adjacent to a busy road.

3.8.2 Conservation significant fauna

Thirteen conservation significant fauna species were identified as potentially occurring within the Project area during the desktop investigation (Gateway WA, 2014a). An assessment of the likelihood of these species occurring in the Project area was undertaken. This assessment was based on species' biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the area.

The assessment concluded that one species is known to occur, two species are likely to occur, one species may possibly occur and nine species are unlikely to occur.

A summary of this assessment is presented in Table 8.

Table 8 Fauna species likely to, or possibly, occurring within the Project area

Taxa	Common name	Status State; Federal	Likelihood of occurrence
Birds			
<i>Calyptorhynchus banksia naso</i>	Forest Red-tailed Black-Cockatoo	T; Vu	Present
<i>Calyptorhynchus latirostris</i>	Baudin's Black Cockatoo	T; Vu	Likely
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	T; En	Likely
Mammals			
<i>Isodon obesulus fusciventer</i>	Quenda / Southern Brown Bandicoot	P5; -	Possible

Migratory / Marine Species

Seven Migratory species, including one Vulnerable Migratory species, were identified as potentially occurring within 5 km of the Project according to the PMST as listed below:

- Fork-tailed Swift (*Apus pacificus*) – Migratory Terrestrial
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) Migratory Terrestrial
- Rainbow Bee-eater (*Merops ornatus*) – Migratory Terrestrial
- Great Egret (*Ardea alba*) – Migratory Wetland

- Cattle Egret (*Ardea ibis*) – Migratory Wetland
- Painted Snipe (*Rostratula benghalensis (sensu lato)*) – Migratory Wetland
- Malleefowl (*Leipoa ocellata*) – Migratory Terrestrial, Vulnerable

There is the potential for terrestrial migratory bird species, such as the Rainbow Bee-eater, to occur occasionally within the Project area. However, wetland birds are unlikely to occur in the Project area as it is a distance from suitable wetlands. The Malleefowl has never been recorded in this area of the Swan Coastal Plain and is therefore highly unlikely to be present.

There is minor potential for these species to be observed in the Project area as vagrants; however, it cannot be considered as significant habitat for migratory species.

Black Cockatoo habitat assessment

A general assessment of the potential for Black Cockatoo habitat within the Project area was undertaken by a GHD zoologist on the 28th January 2014.

The Black Cockatoo assessment was undertaken according to the EPBC Act Significant Impact Guidelines 1.1 (DotE, 2012). Information collected during the field survey included:

- Identification of foraging habitat: the location and extent of suitable Black Cockatoo foraging habitat was identified and mapped for the Project area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by cockatoos was recorded.
- Identification of potential breeding and roosting habitat: suitable breeding habitat for Black Cockatoos is defined by DotE (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 mm. For salmon gum and wandoo, suitable DBH is 300 mm (DotE, 2013). The location of all suitable breeding trees was recorded in the Project area and these are referred to as 'Significant Trees'. Additionally, details of tree species, size and number of hollows observed, evidence of use and any other significant observations were recorded for each tree.
- Opportunistic observations (both visual and aural) for the presence of Black Cockatoos within the Project area and surrounding region were also noted during the survey.

The above information was used to map and calculate the amount of foraging habitat, potential breeding habitat and roost sites within the Project area. The locations of relevant habitat are shown in Figure 6.

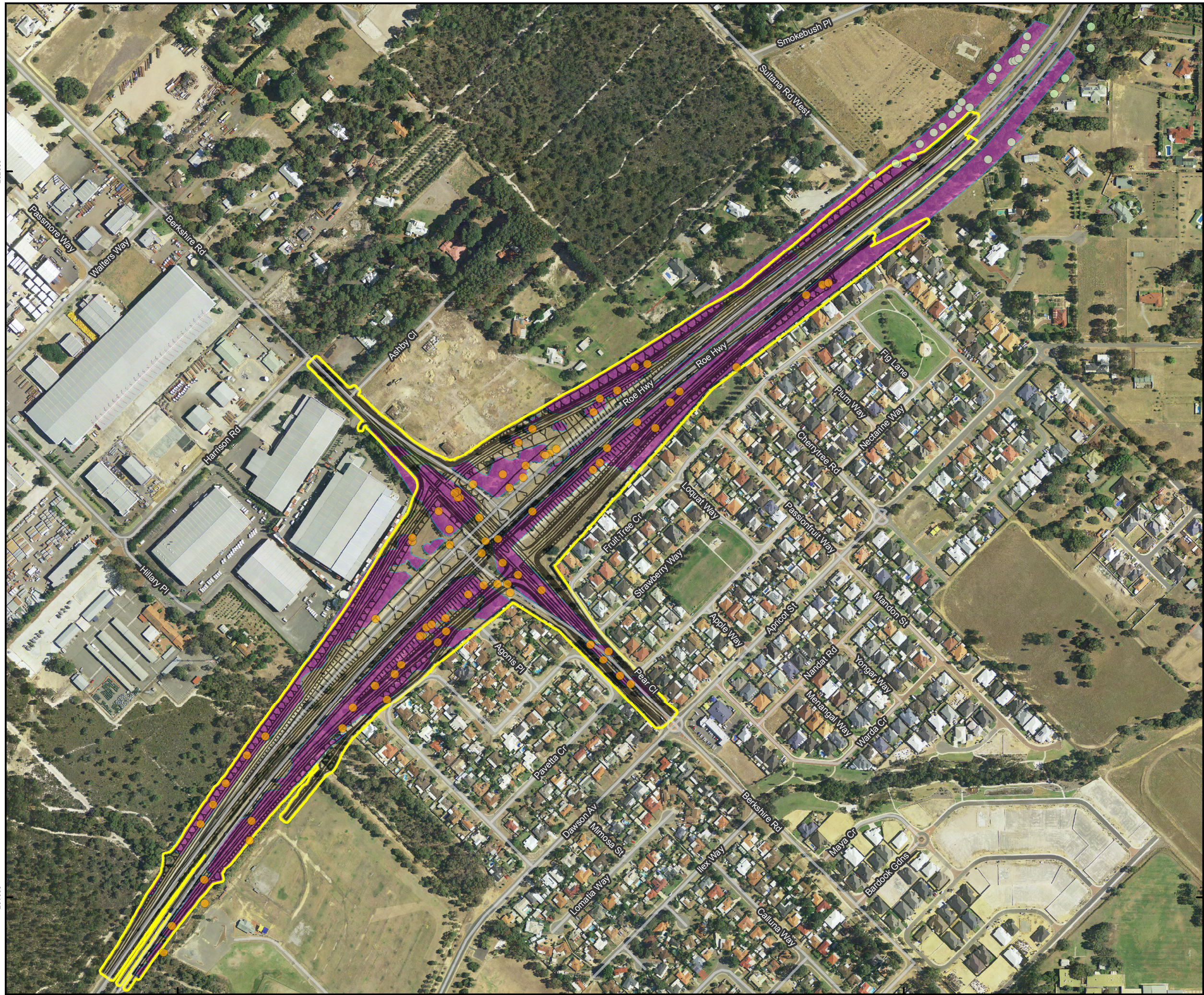
The area is not mapped as breeding habitat for the Baudin's or Forest Red Tailed Black Cockatoo, and is just outside the known range of breeding habitat for Carnaby's.

The field survey found that there is suitable foraging habitat for Black Cockatoos within the Project area, however only the Red-tailed Black Cockatoo was recorded. A number of suitable trees species with a DBH of over 500mm were recorded within and adjacent to the Project area, but only one supported a potentially suitable nesting hollow, and it is not within the impact area.

Assessment of Impacts

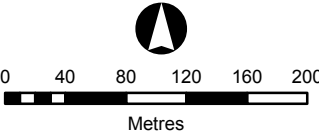
The vegetation assessment and investigation of Black Cockatoo habitat found that:

- 9.29 ha of potential Black Cockatoo foraging habitat will be impacted by the project, as well as 80 potential nesting trees, although no sign of nesting or hollows was noted
- Much of the Black Cockatoo habitat is sub-optimal, due to it being immediately adjacent to the highway
- Habitat for the Quenda was identified in strips of degraded Jarrah/Marri woodland and areas of Banksia woodland.



Black Cockatoo habitat

Figure 6



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

- Cockatoo Tree location
- Black Cockatoo Habitat Tree (DBH > 500 mm)
- Project design
- Project area
- Black Cockatoo Habitat

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3.9 Heritage

3.8.1 Aboriginal heritage

Part of the project area intersects an Aboriginal Heritage site buffer (DAA, 2014). Poison Gully Creek (Site Number 25023) is a Registered Aboriginal Heritage site located to the north of the project (Figure 1), and focused on the Poison Gully creekline which is 2 km north of Berkshire Road. No other heritage sites were identified within 1 km of the project.

Following advice from the DAA, an approval under Section 18 of the *Aboriginal Heritage Act 1972* is not required for the project, as the actual Poison Gully site is some distance to the north of the impact area (Appendix C).

3.9.2 European heritage

The Heritage Council InHerit database was consulted to identify any State and Municipal heritage sites within the project area. The nearest site identified is Pioneer Park, a municipal heritage site located adjacent to the works to the south of Berkshire Road. This is listed due to the historical use as a sand pit and hot rod track. Both the sand pit and track have since ceased use, and today the area now includes some remnant vegetation, as well as playing fields and a completed landfill. Approval to impact the Park will be required from the Shire of Kalamunda.

No other known heritage sites will be impacted.

Assessment of Impacts

A very minor impact on the municipal listed Pioneer Park will occur as a result of drainage and PSP requirements for the project. The impact will be on the edge of a cleared area of the existing playing fields outside the area of the old sand pit and hotrod track.

3.10 Construction Impacts

The construction and operation of the new interchange will have temporary and permanent impacts on the adjacent residential and industrial areas.

3.10.1 Noise

A noise investigation was undertaken (Lloyd George Acoustics, 2014 – Appendix B) to assess the impacts of noise from the changes to Roe Highway. The primary change will be the construction of Roe Highway as an overpass, and of on-ramps which will be closer to houses than the current highway.

Residential subdivisions are present adjacent to the north east and south east quadrants of the proposed interchange upgrade. Industrial and special rural properties are present in some areas to the west.

Assessment of Impacts

Noise monitoring was undertaken within project area to determine the current noise levels for day time and night time at the intersection. The results of this monitoring indicated that the most significant noise impacts in the area occur at night.

The noise modeling considered the potential night-time noise increases from current levels, to 2031, and 2050 with construction. This was also compared against 2050 without build and 2050 with noise mitigation measures.

Existing noise levels indicated that 22 residents at the intersection are already subject to noise which exceeds limits (as per the WAPC *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land use Planning*). Modeling indicates that this will increase to 49 residences in 2050 without build and 52 residences with build. The average difference between build 2050 and no build 2050 is approximately 1dB, which is not a discernable difference.

Similar modeling was undertaken for the proposed upgrade and found that there would be marginal decreases in noise to residences along Roe highway, due to the change to open-graded asphalt in the new works, but there would be increases of 1 to 2 dB to houses along Berkshire Road.

None of these increases require mandatory mitigation under the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land use Planning* (WAPC), however, the construction of noise walls in relevant locations will keep the noise impacts within current levels for all areas and improve them along sections of Roe Highway. Main Roads has aimed to meet the limits for noise levels for residents under this policy.

Noise walls are proposed to be constructed along all sections of Roe Highway and Berkshire Road which are adjacent to residential and special rural areas, which will improve the noise quality along most of these areas, in comparison to the predictions for noise levels due to natural traffic increases.

Construction noise will be a temporary nuisance which will be managed in accordance with relevant guidelines and in consultation with the Shire of Kalamunda.

3.10.2 Air Pollution

Air pollution is not predicted to increase as a result of the interchange construction. There will be temporary risks during construction due to potential dust lift and construction traffic and this will be managed.

Ongoing air pollution is not predicted to increase as traffic volumes would increase with or without the interchange. Local pollution levels should, in fact, decrease, due to the removal of traffic lights and the subsequent improvements in traffic flow.

3.10.3 Visual Impact

The permanent visual impact of the overpass and on-ramps has been considered. Removal of screening trees and lifting Roe Highway over Berkshire Road will create a visual change for residents along Roe Highway and has been considered in the road design.

Additional walls (not required for noise mitigation) have been proposed for Roe Highway, in order to visually screen houses along the highway from traffic. In addition, revegetation will focus on plantings which will create softening and screening in the medium to long term.

4 ADDITIONAL ACTIONS REQUIRED

The following table summarises what further assessment, approvals and management are required in relation to the project.

Table 9 Additional actions required

Aspect	Permit, Approval or Licence
Groundwater	Licence to extract groundwater.
European Heritage/Bush Forever	Approval from the Shire of Kalamunda and WAPC to impact vegetation associated with Pioneer Park.
Acid Sulfate Soils	Further assessment of Acid Sulfate Soils prior to and during construction
Noise	Approval from the Shire of Kalamunda for any work outside construction hours.
Signification Flora	Permit to Take Rare Flora from the Department of Parks and Wildlife for the <i>Conospermum undulatum</i> prior to removal from site.
Conservation Significant Flora	Consultation with DER and DotE will be undertaken regarding impacts to Bush Forever sites, conservation significant flora and Threatened Ecological Communities as required. An offset package will be developed to mitigate impacts to these environmental aspects
Threatened Ecological Communities	
Black Cockatoo Habitat	

5 ENVIRONMENTAL MANAGEMENT STRATEGY

A Construction Environmental Management Plan (CEMP) was developed for the nearby Gateway WA project area, and was approved by Federal Department of the Environment and the DER. The CEMP will be implemented by Gateway WA, who will likely construct the project under Gateway WA's approved Environmental Management System, which is certified under ISO14001. The aim of the CEMP is to minimise the environmental impacts associated with the proposed works as well as to identify areas of responsibilities required for the implementation of management strategies. All of the key aspects identified in this EIA were relevant to the Gateway WA CEMP and can therefore be managed through that document.

An extract of the CEMP can be found in Appendix D. This includes management measures, monitoring and contingency actions for environmental issues.

Gateway WA also has an existing Stakeholder and Community Engagement Plan which will be used for this project.

Management actions will be undertaken for the following aspects and impacts:

Vegetation and habitat

- Minimisation of vegetation clearing
- Control of clearing through the provision of temporary boundary fencing along bush zones
- Avoidance of Rare and Priority flora where possible
- Avoidance of Black Cockatoo feeding habitat and potential breeding trees where possible
- Management of the potential risk of dieback introduction or spread
- Weed control and hygiene management

Fauna protection

- Clearing outside of the Spring nesting season, if possible
- Pre-clearing trapping and relocation of reptiles and ground dwelling mammals
- Physical separation of remaining bushland adjacent to the works to minimise the risk of fauna injury
- Training of site staff in fauna protection

Wetland protection

- Physical protection of bushland in adjacent wetland areas through the placement of temporary fences
- Control of construction runoff through the provision of bunds, catch drains or silt fences where applicable
- Groundwater abstraction licences obtained and complied with
- No obstruction of naturally occurring surface water channels

Noise minimisation

- Adherence to standard construction noise requirements

- Approval for out of hours operations
- Noise monitoring where appropriate
- Complaints process and register

Dust management

- Use of water carts and polymer adhesives
- Regular street sweeping

6 COMMONWEALTH ASPECTS AND IMPACTS

An assessment involving a desktop analysis of Matters of National Environmental Significance (NES) and a site investigation was undertaken for this Project. The assessment and site investigation was used to determine whether the project significantly impacts on a matter of NES and would require referral to the Commonwealth.

The existing environment, nature and extent of impact or potential impact to the following nine matters of NES were assessed with regard to the project:

Table 10 Assessment of Existing Environment, Matters of National Environmental Significance (NES) and Likely Impact

Matter of NES	Existing Environment and Likely Impact
<p>Nationally listed threatened species or ecological communities</p>	<p>Threatened Flora A search of the EPBC Act PMST identified 24 federally listed flora species that have the potential to occur within 5 km of the Project area. The likelihood of occurrence assessment found that habitat for six of these species could be present in the Project area including:</p> <ul style="list-style-type: none"> • <i>Caladenia huegelii</i> (Endangered) • <i>Chamelaucium</i> sp. Gingin (N.G.Marchant 6) (Endangered) • <i>Conospermum undulatum</i> (Vulnerable) • <i>Drakaea micrantha</i> (Vulnerable) • <i>Grevillea curviloba</i> subsp. <i>Incurve</i> (Endangered) • <i>Macarthuria keigheryi</i> (Endangered) <p>The field assessments undertaken in 2008 and 2014 found only <i>Conospermum undulatum</i> present in the Project area. This species is also a State-listed Threatened species.</p> <p>Threatened Ecological Communities A search of the EPBC Act PMST identified three TECs that occur or could occur within 5 km of the Project area:</p> <ul style="list-style-type: none"> • <i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain (Endangered) • Claypans of the Swan Coastal Plain (Critically Endangered) • Shrublands and Woodlands of the eastern Swan Coastal Plain (Endangered) <p>One TEC was identified in the Project area. One of the vegetation types within the Project area has close affinities to the FCT of Gibson <i>et al.</i> (1994) SCP 20a <i>Banksia attenuata</i> woodland over species rich dense shrublands. It is located on both sides of Roe Highway north of Berkshire Road.</p> <p>An additional area of vegetation appears to be a gradient between the FCT SCP 20a and FCT SCP 3a: <i>Eucalyptus calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain. The understorey is relatively species rich and there is also a <i>Eucalyptus calophylla</i> overstorey but does not contain <i>Kingia australis</i> and has a denser canopy that usually occurring in SCP 3a. The area has had a range of disturbances, including previous clearing and the naturalisation of a number of planted, non-local native shrub species.</p> <p>Threatened Fauna A search of the PMST identified nine federally protected fauna species potentially present within 5 km of the Project area. Of these species, three species of Black Cockatoo were considered likely to occur based on the</p>

Matter of NES	Existing Environment and Likely Impact
	<p>habitat assessment.</p> <p>The Forest Red-tailed Black-Cockatoo (<i>Calyptorhynchus banksia naso</i>), listed as Vulnerable under the EPBC Act, was identified in the field assessment. Two additional Black Cockatoo species are considered likely to occur, Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>) (Endangered) and Baudin's Black Cockatoo (<i>Calyptorhynchus baudinii</i>) (Vulnerable). There is suitable foraging habitat for Black Cockatoos within the Project area, however only the Red-tailed Black Cockatoo was identified in both field assessments.</p>
<p><i>Justification of likely impact</i></p>	<p>Threatened Flora</p> <p>Forty nine plants of species were found in three separate locations, on both sides of Roe Highway, and 19 of these plants are likely to be impacted by the Project.</p> <p>This species is known to occur in vegetation surrounding the Project area, including in the Bush Forever Sites adjacent to the Project. There are in excess of 100 location records of the <i>Conospermum undulatum</i> from within 1 km of the Project area (source DPaW and WAHERB rare flora database searches). A total of approximately 11,000 plants of <i>Conospermum undulatum</i> have been previously recorded, many in the Perth area. This Project will impact approximately 0.17% of the known population (DEC, 2009).</p> <p>Impacts to other federally protected flora species are not anticipated as a result of these works.</p> <p>Threatened Ecological Communities</p> <p>Approximately 0.76 ha of vegetation which appears to be a gradient between TEC SCP 3a and State listed TEC SCP 20a is expected to be cleared for the Project. Native vegetation (including the TECs) in the local area are well represented in a number of Bush Forever Sites within 1 km of the Project area.</p> <p>Threatened Fauna</p> <p>The proposed project is likely to result in removal of 9.29 ha of suitable foraging habitat and 80 potential breeding trees; however the Project area is located outside the breeding range of both Baudin's Black Cockatoo and the Forest Red-tailed Black Cockatoo, and is just outside the known breeding range of the Carnaby's Black Cockatoo (DotE 2012). No roosting habitat was identified in the Project area.</p> <p>A total of 34,992 ha of remnant vegetation that may be suitable habitat for Black Cockatoos is present within 10 km of the Project area.</p> <p>An assessment against the Significant Impact Guidelines 1.1 (DotE, 2012) was conducted based on the guidelines for Endangered species (although the Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo are both listed as Vulnerable). The assessment found that the Project is unlikely to have a significant impact on Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo or Baudin's Cockatoo.</p>
<p><i>Methodology</i></p>	<ul style="list-style-type: none"> • DotE Protected Matters Search Report. • Field Assessment • GIS mapping
<p>Migratory species</p>	<p>Six Migratory species, and one species listed as both Vulnerable and Migratory, was identified as potentially occurring within 5 km of the Project according to the PMST as listed below:</p>

Matter of NES	Existing Environment and Likely Impact
	Fork-tailed Swift (<i>Apus pacificus</i>) – Migratory Terrestrial White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>) Migratory Terrestrial Rainbow Bee-eater (<i>Merops ornatus</i>) – Migratory Terrestrial Great Egret (<i>Ardea alba</i>) – Migratory Wetland Cattle Egret (<i>Ardea ibis</i>) – Migratory Wetland Painted Snipe (<i>Rostratula benghalensis (sensu lato)</i>) – Migratory Wetland Malleefowl (<i>Leipoa ocellata</i>) – Migratory Terrestrial, Vulnerable
<i>Justification of likely impact</i>	There is the potential for terrestrial migratory bird species, such as the Rainbow Bee-eater, to occur occasionally within the Project area. Wetland birds are unlikely to occur in the Project area as it is a distance from suitable wetlands. There is minor potential for these species to be observed in the Project area as vagrants; however, it cannot be considered as significant habitat for migratory species. The Malleefowl has never been recorded on the central and southern Swan Coastal Plain, and has not been recorded in any parts of the plain for over 60 years.
<i>Methodology</i>	DotE Protected Matters Search Report. Field Assessment
Wetlands of International Importance	The nearest Ramsar wetland is Forrestdale Lake, approximately 23km to the south west of the project area.
<i>Justification of likely impact</i>	No impact expected.
<i>Methodology</i>	DotE Protected Matters Search Report.
World Heritage properties	The nearest World Heritage Property is the Fremantle Prison, 26 km south west of the project area.
<i>Justification of likely impact</i>	No impact expected.
<i>Methodology</i>	DotE Protected Matters Search Report.
National Heritage places	The nearest National Heritage Place is Mundaring Weir, 15 km east in the Darling Range.
<i>Justification of likely impact</i>	No impact expected.
<i>Methodology</i>	DotE Protected Matters Search Report.
Commonwealth land or marine areas	The project is not located on Commonwealth land and is not near the ocean.
<i>Justification of likely impact</i>	No impact expected.
<i>Methodology</i>	DotE Protected Matters Search Report.
Nuclear Actions	Not relevant to the proposed activity.

Matter of NES	Existing Environment and Likely Impact
<i>Justification of likely impact</i>	No impact expected.
<i>Methodology</i>	N/A
Water Resource	Not relevant to the proposed activity.
<i>Justification of likely impact</i>	No impact expected.
<i>Methodology</i>	N/A

7 DECISION TO REFER

7.1 Referral to the Department of the Environment

This impact assessment has determined the project will have an impact on Matters of National Environmental Significance as outlined above, including Threatened flora and Black Cockatoo species. For this reason the project is in the process of being referred to the Commonwealth Department of the Environment.

7.2 Referral to the Environmental Protection Authority

This project is being referred to the Environmental Protection Authority, due to the loss of a small area of Threatened Ecological Community, State listed Threatened flora and Black Cockatoo habitat. There is also the potential for public interest in the project, due to the above impacts and to the impact on local residents in the adjacent part of Forrestfield.

8 STAKEHOLDER CONSULTATION

Stakeholder consultation has occurred with the Shire of Kalamunda, the Department of Environmental Regulation the Department of the Environment, the Department of Water and commercial property owners on the western part of Berkshire Road. Consultation with local residents and relevant interest groups will be undertaken shortly. Table 11 provides a summary of the actual and proposed consultation.

Table 11 Project Consultation

Name	Agency	Comments
Shire of Kalamunda	Local Government Authority	Land manager and key interest group.
Department of Water	State Regulator	During pre-construction activities with regard to groundwater extraction and drainage.
Department of Environment Regulation	State Regulator	Consultation has included discussion of recommended approvals pathway.
Department of Parks and Wildlife	State Regulator	To be undertaken
Urban Bushland Council	Local community group	To be undertaken
Wildflower Society	Local community group	To be undertaken

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Appendix A

Report for Berkshire Road and Roe Highway Interchange Biological Survey and Impact Assessment

Berkshire Road and Roe Highway Interchange

Biological Survey and Impact Assessment

REVISION RECORDING

Rev	Date	By	Description of Revision	Approved
A	11 Mar 2014	AN/RL	1 st draft	
1	07 Apr 2014	AN	Final for submission to Main Roads	AE
2	5 June 2014	AE	Final for submission to regulators	AN

EXECUTIVE SUMMARY

Main Roads Western Australia (Main Roads) commissioned Gateway WA to undertake a vegetation and flora survey of the Berkshire Road and Roe Highway intersection area (the Project area), in Forrestfield, and a subsequent impact assessment for the proposed road upgrade.

Main Roads is proposing to upgrade the staggered “T” intersections at Roe Highway and Berkshire Road with a grade-separated interchange, with Roe Highway to be built over Berkshire Road and ramps provided in each quadrant. The eastern part of Berkshire Road distributes traffic to the suburb of Forrestfield, while the western part provides access to a light industrial and commercial area, which supports a large amount of heavy vehicle traffic.

The project covers approximately 20.44 ha, and will require the clearing of approximately 11.85 hectares of native vegetation of varied condition.

GHD undertook a biological survey of the Berkshire Road and Roe Highway intersection area in spring 2008. The area assessed for this survey consisted of the vegetation immediately surrounding the existing intersection for the previously proposed upgrade. In 2014, Gateway WA undertook a further biological survey of the newly proposed road upgrade area, which included additional areas to the north and south of the intersection, along Roe Highway.

The following is a summary of the investigations:

- ▶ The project area intersects three geomorphic wetlands, including Conservation Category Wetland (UFI 15077) and Multiple Use Wetland (UFI 15072) which are both located on the western side of Roe Highway in the south-western section of the Project area, and Resource Enhancement Wetland (UFI 13977), which covers a large portion of the Project area on the western side of Roe Highway both north and south of Berkshire Road. No vegetation associated with wetlands is present in the Project area.
- ▶ The Project area occurs in a location where there is a moderate to low risk of acid sulphate soil (ASS) occurring in soils >3 m depth. Previous investigations found no signs of ASS within the first 2 m from the surface.
- ▶ The Project area intersects two Bush Forever Sites, Pioneer Park (Site 440) on the eastern side of Roe Highway and Dundas Road (Site 319) on the western side (Government of Western Australia 2000a; 2000b; 2012). Approximately 0.60 ha of vegetation associated with these Bush Forever sites will be cleared for the Project, including a narrow strip on Roe Highway and a small area of cleared land in Pioneer Park. A number of Environmentally Sensitive Areas (ESAs) were also identified covering the Project area (DER 2014). The ESAs are associated with Threatened Ecological Communities (TECs) and associated buffers and the areas covered by vegetation within 50 m of Declared Rare Flora (DRF).
- ▶ Six vegetation types were recorded within the Project area, ranging from areas that are Completely Degraded to Excellent - Very Good condition.
- ▶ Most of the vegetation within the Project area is considered to be *Uninterpretable* for the presence of *Phytophthora cinnamomi* (Dieback); however, vegetation in Very Good to Excellent condition on the Roe Highway road reserve appears to be Dieback free.
- ▶ Vegetation Association 1001 is classified as *Vulnerable* (at the State, Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and IBRA sub-region scales)

but is not considered to be a Critical Asset as it contains more than 10% remaining on a State, IBRA bioregion and IBRA sub-region level. At the local government scale (within the Shire of Kalamunda), Vegetation Association 1001 has less than 10% of its pre-European extent, and is therefore considered to be Endangered and a critical asset within the Shire of Kalamunda.

- ▶ Mapping of vegetation communities by Hedde *et al.* (1980) has identified the Project area within the Southern River Complex, which is also considered *Vulnerable* at the State, IBRA bioregion, IBRA sub-region and local government area levels.
- ▶ One Threatened Ecological Community was identified in the Project area. This vegetation type has close affinities to the floristic community type (FCT) of Gibson *et al.* (1994) Swan Coastal Plain (SCP) 20a *Banksia attenuata* woodland over species rich dense shrublands. Another vegetation type appears to be a gradient between the FCT SCP 20a and FCT 3a: *Eucalyptus calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain. Approximately 3.05 ha of vegetation associated with these floristic communities will be cleared for this Project.
- ▶ Forty nine plants of the Threatened flora species (*Conospermum undulatum*) were recorded within, and immediately adjacent to, the Project area. Nineteen of these plants are likely to be removed for this Project. There are over 100 separate records of this species within 1 km of the Project area.
- ▶ Forty two plants of the Priority Three Flora species (*Isopogon drummondii*) were recorded within, and adjacent to, the Project area. Seven of these plants will be removed during clearing for this Project
- ▶ One fauna species of conservation significance was heard within the vicinity of the Project area: the Vulnerable Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*). Two other species, the Endangered Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Vulnerable Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are considered likely to occur. The Quenda (*Isoodon obesulus fusciventer*) may possibly occur.
- ▶ Habitat for the Quenda was also identified in strips of degraded Jarrah/Marri woodland and areas of *Banksia* woodland.
- ▶ The Project area forms part of an ecological linkage along Roe Highway, which adjoins Bush Forever sites.
- ▶ A Black Cockatoo assessment was undertaken according to the EPBC Act Significant Impact Guidelines 1.1 (DotE, 2012). Based on this assessment, the Project is unlikely to have a significant impact on Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo or Baudin's Cockatoo.
- ▶ The assessment against the 10 Clearing Principles found the Project is at variance with two of the ten principles and may be at variance with a further four principles.

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1 INTRODUCTION

Main Roads Western Australia (Main Roads) commissioned Gateway WA to undertake a vegetation and flora survey of Roe Highway/Berkshire Road intersection area (the Project area), in Forrestfield, and a subsequent impact assessment for the proposed intersection upgrade.

Main Roads is proposing to upgrade the staggered “T” intersections at Roe Highway and Berkshire Road with a grade-separated interchange, with Roe Highway to be built over Berkshire Road and ramps provided in each quadrant. The eastern part of Berkshire Road distributes traffic to the suburb of Forrestfield, while the western part provides access to a light industrial and commercial area, which supports a large amount of heavy vehicle traffic.

The project covers approximately 20.44 ha, and will require the clearing of approximately 11.85 hectares of vegetation of varied condition.

GHD undertook a biological survey of the Berkshire Road and Roe Highway intersection area in spring 2008. The area assessed for this survey consisted of the vegetation immediately surrounding the existing intersection for a previously proposed upgrade. In 2014, Gateway WA undertook a further biological survey of the newly proposed road upgrade area, which included additional areas to the north and south of the intersection, along Roe Highway.

The biological survey is required to determine the impacts of clearing on any State or Federally listed species or communities, as well as to provide information for a Native Vegetation Clearing Permit application.

This report includes a desktop assessment of the environmental values of the Project area and an amalgamation of the results of the two field surveys. It also reports on the likely environmental impacts which could result from the construction of the intersection upgrade.

2 EXISTING ENVIRONMENT

The Project area is located within the Perth suburb of Forrestfield, in the Shire of Kalamunda, Western Australia. The Project area covers approximately 20.44 ha surrounding the offset 'T' intersection of Berkshire Road and Roe Highway (Figure 1).

2.1 Climate

The climate of the Project area is broadly described as Mediterranean, with warm dry summers and mild wet winters. Average annual rainfall for Perth Airport (the closest official Bureau of Meteorology station) is 773.7 mm (BoM, 2014). Most of this rain falls as a result of winter cold fronts across the coast between May and September.

Mean maximum temperatures range from 17.9°C in July to 31.9°C in February. Mean minimum temperatures range from 8.0°C in July to 17.5°C in February.

2.2 Surrounding Land Use

Land surrounding Berkshire Road is predominantly used for light industry and residential purposes. The southern part of the proposed works is adjacent to bushland at Pioneer Park, to the east, which is a Bush Forever site and which includes a completed landfill, and another Bush Forever site to the west

2.2.1 Areas of Ecological Significance

Conservation Reserves

No National Parks or 'A'-Class Reserves occur within the immediate vicinity of the Project area. The nearest conservation reserve is Dundas Nature Reserve, approximately 580 m south-west of the Project area. In addition, Bougainvillea Avenue Bushland (Class C) reserve is located approximately 650 m south-east of the Project area.

Lesmurdie National Park is 3.7 km to the east of the Project area, on the Darling Scarp.

Bush Forever Sites

A total of six Bush Forever Sites are located within 2 km of the Project area (Table 1). Two Bush Forever sites intersect the Project area, being Pioneer Park (Site 440) on the eastern side of Roe Highway and Dundas Road (Site 319) on the western side (Government of Western Australia 2000a; 2000b; 2012). The locations of these two sites, in relation to the Project area, are shown at Figure 1.

Table 1 Bush Forever sites within vicinity of Project area

Site	Description
45	Poison Gully Bushland, High Wycombe
123	Sultana Road West Bushland, High Wycombe
319	Dundas Road Nature Reserve, Forrestfield
386	Perth Airport and Adjacent Bushland
401	Bougainvillea Avenue Bushland, Forrestfield

Site	Description
440	Pioneer Park Bushland, Forrestfield

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) include areas covered by Threatened Ecological Communities (TECs) and associated buffers, a defined wetland and the area within 50 m of a wetland, the area covered by vegetation within 50 m of rare flora, areas on conservation estates, and Bush Forever Sites (for a full definition, see the Western Australian Government Gazette No. 55: *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*).

A search of the Department of Environmental Regulation's online Native Vegetation Map Viewer indicated a number of ESAs covering the Project area (DER 2014). The ESAs are TECs and associated buffers, and the areas covered by vegetation within 50 m of declared rare flora (DRF). See Section 2.6.2 for TECs within the vicinity of the Project area, and Section 2.7.1 for rare flora recorded within the vicinity of the Project area.

2.2.2 Public Drinking Water Source Areas

No Public Drinking Water Supply Areas occur within 5 km of the Project area.

2.3 Physical Characteristics

2.3.1 Topography

Berkshire Road is located within 5 km of the eastern edge of the Swan Coastal Plain and has a mildly undulating topography with ground levels between 25 and 50 m above sea level.

2.3.2 Geology

The Project area lies within the Bassendean Dune System (Wilde and Low, 1974), a geomorphic unit of the Swan Coastal Plain, and is situated at the base of the Darling Scarp. The dune system is approximately 15 km wide and consists of a series of shoreline deposits and coastal dunes running parallel to the coast. The underlying geology of the Swan Coastal Plain was formed by successive periods of sedimentation during Neocene and Quaternary times and was formed during erosion and deposition events associated with changing sea levels (Gozzard, 2007).

2.3.3 Soils

The dunes consist of a series of low hills of leached quartz dominated sand overlying a series of leached clay horizons. The dunes are interspersed with low-lying sandy swales often containing seasonal swamps or may contain clay based swamps with cracking clay or hard setting loam soils (Beard, 1979; Geological Survey of Western Australia, 1978).

Soils within the Project area belong to the Southern River unit (Churchward and McArthur, 1980), which is described as a sandplain with low dunes and many intervening swamps, with iron and humus podzols, peats and clays.

2.4 Wetlands

Wetlands not only include lakes with open water but areas of seasonally, intermittently or permanently waterlogged soil. Approximately 25% of the Swan Coastal Plain between Moore River and Mandurah is classified as wetland. Though extensive in area, not all wetlands retain significant ecological values due to the concentration of urban and agricultural development in the region. Most wetlands have been cleared, filled or developed over, leaving only 20% of all the wetlands that were present on the Swan Coastal Plain prior to

European settlement. Of these, an estimated 15% of the wetland area has retained high ecological values (Hill, *et al.*, 1996).

2.4.1 Wetlands intersected by the Project area

The project area intersects three geomorphic wetlands, including Conservation Category Wetland (UFI 15077) and Multiple Use Wetland (UFI 15072) which are both located on the western side of Roe Highway in the south-western section of the Project area, and Resource Enhancement Wetland (UFI 13977), which covers a large portion of the Project area on the western side of Roe Highway both north and south of Berkshire Road.

These wetlands are outlined in Table 2 and shown in Figure 2.

Table 2 Description of the geomorphic wetlands intersected by the Project area

Wetland	DPaW Geomorphic Wetlands Classification	Location within Project area
13977	Resource Enhancement	Western side of Roe Highway both north and south of Berkshire Road
15072	Multiple Use	South-western portion of Project area, western side of Roe Highway
15077	Conservation Category	South-western portion of Project area, western side of Roe Highway

2.5 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are naturally occurring soils and sediments containing iron sulphides. These soils are typically benign within the environment of their formation, which is geochemically “reduced,” or anaerobic. However, when they become oxidised through such processes as excavation and exposure, drainage or dewatering– impacts include an acidification of the soil profile, surface and ground waters. Additionally, the sulphuric acid breaks heavy metal bonds, releasing metals such as aluminium, iron, and arsenic into groundwater.

DPaW Acid Sulfate Soil (ASS) mapping indicates that the Project Area occurs in an area that has moderate to low risk of ASS occurring, with potential acid sulphate soil (PASS) occurring generally at depths of >3 m from the surface (Government of Western Australia 2012).

In 2013 ASS investigations were undertaken by SGS on behalf of AECOM which found no indications of ASS present within the first 2 m from the surface. Investigations undertaken by Gateway WA during 2012 and 2013 for the Gateway WA Perth Airport and Freight Access project have generally indicated PASS is only present below the historical groundwater level.

2.6 Vegetation

Broad-scale vegetation communities have been mapped in the survey area by Beard (1979), and Heddle, *et al.* (1980). These overlap with smaller scale floristic communities described by Gibson, *et al.* (1994).

Beard (1979) indicates that the vegetation within the Project area consists of: Vegetation Association 1001: Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina.

Hedde, *et al.* (1980) places the Project area within the Southern River Complex consisting of an open-woodland of marri-jarrah-banksia on the elevated areas and a fringing woodland of *Eucalyptus rudis* (Flooded Gum) and *Melaleuca raphiophylla* (Swamp Paperbark) along streams.

Gibson, *et al.* (1994) indicates that the floristic community types occurring in the Project area are from Supergroup 1 (Foothills/Pinjarra Plain) and Supergroup 3 (Uplands centred on Bassendean Dunes and Dandaragan Plateau).

There are a number of known vegetation plots from Gibson, *et al.* (1994) within five kilometers of the Project area, indicating that vegetation in the surrounding area may consist of: SCP20a: *Banksia attenuata* woodland over species rich dense shrublands, SCP3a: *Corymbia calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain; SCP02: Southern wet shrublands on the Swan Coastal Plain.

2.6.1 Vegetation Extent and Status

A vegetation type is considered to be under-represented if there is less than 30 percent of its original distribution remaining. From a biodiversity perspective, and taking no account of any other land degradation issues, there are several key criteria now being applied to vegetation in States where clearing is still occurring (EPA Position Statement No. 2, December 2000):

- ▶ The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-clearing extent of the vegetation type; and
- ▶ A level of 10% of the original vegetation extent is regarded as being a level representing “endangered”; and clearing which would put the threat level into the class below should be avoided.

Such vegetation community status can be delineated into five classes, where:

- Presumed extinct: Probably no longer present in the bioregion
- Endangered*: <10% of pre-European extent remains
- Vulnerable*: 10-30% of pre-European extent exists
- Depleted*: >30% and up to 50% of pre-European extent exists
- Least concern: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

* or a combination of depletion, loss of quality, current threats and rarity gives a comparable status

Beard Vegetation Extent

Native vegetation types represented in the Project area, their regional extent and reservation status are generally drawn from Government of Western Australia (2014) and Shepherd *et al.* (2002), which are, in turn based on the broad-scale mapping undertaken by Beard. These are shown in Table 3.

Table 3 Extent of Beard (1979) vegetation associations within the Project area

Vegetation Association	Region	Pre-European Extent (ha)	Current Extent (ha)	% remaining	% current extent in IUCN Class I-IV Reserves
1001-	State	57,410.23	14,151.89	24.65%	4.61

Vegetation Association	Region	Pre-European Extent (ha)	Current Extent (ha)	% remaining	% current extent in IUCN Class I-IV Reserves
Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	IBRA region (Swan)	57,410.23	14,151.89	24.65%	4.61
	IBRA sub-region (Perth)	57,410.23	14,151.89	24.65%	4.61
	Shire of Kalamunda LGA	1,473.91	121.10	8.22%	18.21

(Government of Western Australia, 2012 and 2014; Shepherd *et al.*, 2002)

On the basis of the current extent for the vegetation association 1001, the community is classified as Vulnerable (at the State, IBRA bioregion and IBRA sub-region scales). However, as the Project area is located within the constrained Perth metropolitan area (due to existing level of development) and the extent of vegetation association 1001 has more than 10 percent of its pre-European extent, it is not considered to be a critical asset.

At the local government scale (within the Shire of Kalamunda), Vegetation association 1001 has less than 10% of its pre-European extent, and is therefore considered to be Endangered. This vegetation unit is therefore considered to be a critical asset within the Shire of Kalamunda.

Hedde Vegetation Extent

Vegetation communities have also been mapped by Hedde *et al.* (1980), based on a pattern of vegetation at a regional scale as it reflects the underlying key factors of landforms, soils and climate.

The Project area falls within the Southern River Complex, which is also considered *Vulnerable* at the State, IBRA bioregion, IBRA sub-region and local government area scales (Table 4).

Table 4 Extent of Hedde *et al.* (1980) vegetation extent within Project area

Vegetation Complex	Region	Total Pre-European Extent (ha)	Present extent (ha)	Percent of pre-European extent remaining	Percent of pre-European extent with formal and informal protection
Southern River Complex	Swan Coastal Plain	57,171.55	11,254.99	19.69%	2.16% (formal protection) 6.61% (informal protection)
	Shire of Kalamunda	2,320	264.02	11.38%	0.96%

(Local Biodiversity Program (2013), Perth Biodiversity Project (2010))

Note – the values calculated in this table uses information from the Perth Biodiversity Project (2010) for each Local Government Area in the Perth to Peel region, and information from the Local Biodiversity Program (2013) for the Swan Coastal Plain.

Gibson Vegetation Extent

Floristic community types mapped by Gibson, *et al.* (1994) used information collected from plot data across the Swan Coastal Plain. Poorly Reserved types are those known from a single National Park or class A Nature Reserve, while Unreserved indicates that they are not known to occur in any National Park or class A Nature Reserve (Table 5).

Table 5 Vegetation status for likely Floristic Community Types with the Project area, after Gibson *et al.* (1994)

Floristic Community Type	Reservation Status	Conservation Status
SCP02	Poorly Reserved	Vulnerable
SCP3a	Unreserved	Vulnerable
SCP20a	Unreserved	Endangered

In this instance, *Endangered* indicates: A community in danger of severe modification or destruction throughout its range, if causal factors continue operating; and *Vulnerable* indicates: A community is likely to move into the endangered category in the near future if the causal factors continue operating.

2.6.2 Threatened Ecological Communities

Ecological communities are defined as ‘naturally occurring biological assemblages that occur in a particular type of habitat’ (English and Blythe, 1997). Threatened Ecological Communities (TECs) are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. *Presumed Totally Destroyed*, *Critically Endangered*, *Endangered*, and *Vulnerable* (Table 6).

Some TECs are protected under the EPBC Act. Although TECs are not formally protected under the State *Wildlife Conservation Act 1950 (WC Act)*, the loss of, or disturbance to, some TECs triggers the EPBC Act. Additionally, the Environmental Protection Authority’s (EPA’s) position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment.

Table 6 Category Definition of Threat for Ecological Communities

Presumed Totally Destroyed	-	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or

		rehabilitated.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.
Data Deficient	-	An ecological community for which there is inadequate data to assign it to one of the above categories and/or which is not yet evaluated with respect to status of threat.
Lower Risk	-	A community which has been adequately surveyed and evaluated and available information suggests that it does not qualify.

Possible TECs that do not meet survey criteria are added to Department of Parks and Wildlife (DPaW) Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

A search of the EPBC Act Protected Matters database (DotE 2014) identified three TECs that occur or could occur within 5 km of the Project area.

A search of the DPaW Threatened Ecological Communities database indicated that there are a number of known occurrences of TECs and one known occurrence of a Priority Ecological Community (PEC) recorded within the general vicinity of the Project area.

A summary of each of these conservation significant ecological communities and an assessment of their occurrence within the Project area is provided in Table 7.

Table 7 Conservation significant communities occurring & possibly occurring within 5 km of the Project area

Conservation Significant Community	Status		Community Name	Presence within Project area	
	State (WC Act/DPaW listing)	Federal (EPBC Act listing)		Desktop (Buffer in Project area)	Found in field surveys
<i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain	Critically Endangered	Endangered	SCP3a	One occurrence within the Project area	Present

Conservation Significant Community	Status		Community Name	Presence within Project area	
	State (WC Act/DPaW listing)	Federal (EPBC Act listing)		Desktop (Buffer in Project area)	Found in field surveys
Claypans of the Swan Coastal Plain Including – Herb rich saline shrublands in clay pans (SCP07) Shrublands on dry clay flats (SCP10a)	Vulnerable Endangered	Critically Endangered		No No No	None present
Shrublands and Woodlands of the eastern Swan Coastal Plain	Critically Endangered	Endangered	SCP20c	No	None present
Southern wet shrublands, Swan Coastal Plain	Endangered		SCP02	No	None present
<i>Banksia attenuata</i> woodland over species rich dense shrublands	Endangered		SCP20a	Four occurrences within the Project area	Present
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain	Endangered		SCP20b	One occurrence within the Project area	Possible
<i>Corymbia calophylla</i> - <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain	Vulnerable		SCP3b	No	No intact vegetation present
<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain	Critically Endangered	Endangered	SCP3c	No	No intact vegetation present

2.7 Flora

2.7.1 Conservation Significant Flora

Species of significant flora are protected under both Commonwealth and State Acts. Any activities that are deemed to have a significant impact on species that are recognised by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) and the Western Australian *Wildlife Conservation Act 1950* (the WC Act) can trigger referral to those authorities.

A description of Conservation Categories delineated under the EPBC Act is detailed in Table 8. These are applicable to threatened flora and fauna species.

Table 8 Conservation Categories and Definitions for EPBC Act Listed Flora and Fauna Species

Conservation Category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild	Taxa known to survive only in captivity.
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

The Department of the Environment (DotE) maintains a database of matters of national environmental significance that are protected under the EPBC Act. An EPBC Act Protected Matters Report was generated (from the website of the DotE), for the matters of significance that may occur in, or may relate to, the Project area.

A search of the EPBC Act Protected Matters (PMST) was undertaken and identified 24 Threatened flora species that potentially occur in the area (Appendix B).

In addition to the EPBC Act, significant flora in Western Australia is protected by the WC Act. This Act, which is administered by the Department of Parks and Wildlife (DPaW), protects Threatened flora species. The DPaW also maintains a list of Priority Flora species. Conservation codes for flora species are assigned by the DPaW to define the level of conservation significance. Priority Flora are not currently protected under the WC Act. Priority Flora may be rare or threatened, but cannot be considered for declaration as rare flora

until adequate surveys have been undertaken of known sites and the degree of threat to these populations clarified. A description of the Conservation Codes that relate to flora species is provided in Table 9.

Table 9 Conservation Codes and Descriptions for DPaW Threatened and Priority Flora Species

Conservation Code	Description
X: Presumed Extinct	Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.
R: Threatened Flora – Extant Taxa	Taxa which 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, and have been gazetted as such.
P1: Priority One – Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2: Priority Two – Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3: Priority Three – Poorly Known Taxa	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
P4: Priority Four – Taxa in need of monitoring	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.

The locations of Threatened and Priority Flora species known within the vicinity of the Project area are mapped at Figure 3 . Forty nine conservation significant flora species have the potential to occur within 5 km of the Project area according to Naturemap and the PMST. Of these, 14 are considered possibly occurring based on habitat requirements. Flora species considered likely to occur in the Project area are detailed in Table 10 below.

Table 10 Threatened and Priority Flora Species known to exist, or likely to occur within 5 km of the Project area

Taxon (species or subspecies)	EPBC Act Conservation Code	DPaW Conservation Code	Description (source: FloraBase)	Preferred Habitat	Habitat Present	EPBC Act Search	NatureMap Search
<i>Caladenia huegelii</i>	Endangered	Threatened	Tuberous, perennial, herb, 0.25–0.6 m high. Fl. green, cream, red, Sep–Oct.	Grey or brown sand, clay loam	Possible	x	
<i>Calectasia cyanea</i>		Threatened	Tufted annual, herb (forming a rounded cushion up to 25 mm across). Fl. Oct to Dec.	White sand, clay. Salt flats, wet areas.	Possible		x
<i>Chamelaucium</i> sp. <i>Gingin</i> (N.G.Marchant 6)	Endangered	Threatened	Erect open branching shrub, 1.5-2 m. Fl. white, white/pink, Sep to Dec.	Dry white/grey, yellow sand, dry red-brown gravel. Slope, hilltop.	Possible	x	
<i>Conospermum undulatum</i>	Vulnerable	Threatened	Erect, compact shrub, from 0.6 to 2 m high. Flowers white, grey, occurring May–Oct.	Grey or yellow-orange clayey sand.	Yes	x	x
<i>Drakaea micrantha</i>	Vulnerable	Threatened	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & yellow, Sep to Oct.	White-grey sand.	Yes	x	
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Endangered	Threatened	Prostrate to erect shrub, 0.1-2.5 m high. Fl. white-cream, Aug to Sep.	Sand, sandy loam. Winter-wet heath.	Possible	x	
<i>Grevillea thelemanniana</i> subsp. <i>thelemanniana</i>		P4	Spreading, lignotuberous shrub, 0.3-1.5 m high. Fl. pink-red, May to Nov.	Sand, sandy clay. Winter-wet low-lying flats.	Possible		x

Taxon (species or subspecies)	EPBC Act Conservation Code	DPaW Conservation Code	Description (source: FloraBase)	Preferred Habitat	Habitat Present	EPBC Act Search	NatureMap Search
<i>Haemodorum loratum</i>		P3	Bulbaceous, perennial, herb, 0.45–1.2(–2) m high. Fl. black, brown, green, Nov.	Grey or yellow sand, gravel	Yes		x
<i>Hypocalymma</i> sp. <i>Cataby</i> (G.J. Keighery 5151)		P2	Erect, spreading shrub, 0.5–1 m high, to 1 m wide. Fl. white, Aug.	Grey sand	Yes		x
<i>Isopogon drummondii</i>		P3	Erect, lignotuberous shrub, from 0.4 to 1 m high. Flowers yellow, cream, occurring Feb–Jun.	White, grey or yellow sand, often over laterite.	Yes		x
<i>Macarthuria keigheryi</i>	Endangered	Threatened	Erect or spreading perennial, herb or shrub, from 0.2 to 0.4 m high and 0.3 to 0.6 m wide. Flowers white, occurring Sep–Mar.	White or grey sand.	Yes	x	x
<i>Platysace ramosissima</i>		P3	Perennial, herb, to 0.3 m high. Fl. white, cream, Oct–Nov.	Sandy soils	Yes		x
<i>Thysanotus anceps</i>		P3	Rhizomatous, leafless perennial, herb, to 0.4 m high. Fl. purple, Oct–Dec.	White or grey sand, lateritic gravel, laterite	Possible		x
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>		P4	Erect shrub, 0.2–0.75 m high. Fl. pink, May/Nov–Jan.	Sand, sandy clay. Winter-wet depressions	Possible		x

2.8 Fauna

2.8.1 Fauna Diversity

A NatureMap search (DPaW, 2014) identified 217 fauna species as previously recorded within 5 km of the project, of which 205 species are native and 12 are pest (introduced) or naturalised species (Appendix B). These results consisted of 97 birds (five introduced), 16 mammals (six introduced), 42 reptiles, nine amphibians, one fish and 52 invertebrate species.

2.8.2 Conservation Significant Fauna

The conservation status of fauna species is assessed under Commonwealth and State Acts, by the EPBC Act and the WC Act.

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). A description of Conservation Categories delineated under the EPBC Act is Table 8. These are applicable to threatened flora and fauna species.

The EPBC Act also protects migratory species that are listed under the following International Agreements:

- Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a Range State under the Convention;
- The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA); and
- The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Listed migratory species also include species identified in other international agreements approved by the Commonwealth Environment Minister.

The WC Act uses a set of Schedules but also classifies species using some of the IUCN categories. These categories and schedules are described in Table 11. These may be trigger species in the EPBC Act.

Table 11 Western Australian Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Threatened Fauna (Fauna which is rare or likely to become extinct)
Schedule 2	S2	Fauna which is presumed extinct.
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Fauna that is otherwise in need of special protection.

In addition to species with a formal gazetted conservation status, the DPaW also maintains a Priority list of species that are restricted, vulnerable or too poorly known to be considered for

gazetting. These species have no special protection, but their presence would normally be considered. The taxon needs further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

In Western Australia, the DPAW also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the *WC Act*, but for which the Department feels there is a cause for concern. These species have no special legislative protection, but their presence would normally be considered. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Table 12.

Table 12 DPaW Priority Codes

Category	Code	Description
Schedule 1	S1	Threatened Fauna (Fauna which is rare or likely to become extinct)
Schedule 2	S2	Fauna which is presumed extinct.
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Fauna that is otherwise in need of special protection.

Threatened Fauna Searches

The DotE maintains a database of matters of national environmental significance that are protected under the EPBC Act. An EPBC Act Protected Matters Report was generated (from the website of the DotE), for the matters of significance that may occur in, or may relate to, the Project area. Purely marine species listed in this search were excluded from the list (Appendix B). It should be noted that some species that appear in the EPBC Act Protected Matters Search Tool (PMST) are often not likely to occur within the specified area, as the search provides an approximate guidance to matters of national significance that require further investigation. The records from the DPaW searches of threatened fauna provide more accurate information for the general area; however some records of sightings or trappings can be dated and often misrepresent the current range of threatened species.

A search of the NatureMap database for any threatened and priority species that may occur in the Project area was also undertaken (Appendix B).

The Naturemap and PMST identified 13 conservation significant species potentially occurring in the Project area. Significant fauna species occurring, or considered likely to occur, within the vicinity of the Project area are delineated in Table 13.

2.8.3 Likelihood of Occurrence of Conservation Significant Fauna Species

Thirteen conservation significant fauna species were identified as potentially occurring within the Project area during the desktop investigation. An assessment of the likelihood of these species occurring in the Project area was undertaken (Appendix C). This assessment is based on species' biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the area.

The assessment concluded that one species is known to occur, two species are likely to occur, one species may possibly occur and nine species are unlikely to occur.

A summary of this assessment is presented in Table 13, and the full assessment is provided in Appendix C.

Table 13 Fauna species likely to, or possibly, occurring within the Project area

Taxa	Common name	Status State; Federal	Likelihood of occurrence
Birds			
<i>Calyptorhynchus banksia naso</i>	Forest Red-tailed Black-Cockatoo	T; Vu	Present
<i>Calyptorhynchus latirostris</i>	Baudin's Black Cockatoo	T; Vu	Likely
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	T; En	Likely
Mammals			
<i>Isoodon obesulus fusciventer</i>	Quenda / Southern Brown Bandicoot	P5; -	Possible

Migratory / Marine Species

Seven Migratory species, including one Vulnerable Migratory species, were identified as potentially occurring within 5 km of the Project according to the PMST as listed below:

- ▶ Fork-tailed Swift (*Apus pacificus*) – Migratory Terrestrial
- ▶ White-bellied Sea-Eagle (*Haliaeetus leucogaster*) Migratory Terrestrial
- ▶ Rainbow Bee-eater (*Merops ornatus*) – Migratory Terrestrial
- ▶ Great Egret (*Ardea alba*) – Migratory Wetland
- ▶ Cattle Egret (*Ardea ibis*) – Migratory Wetland
- ▶ Painted Snipe (*Rostratula benghalensis (sensu lato)*) – Migratory Wetland
- ▶ Malleefowl (*Leipoa ocellata*) – Migratory Terrestrial, Vulnerable

There is the potential for terrestrial migratory bird species, such as the Rainbow Bee-eater, to occur occasionally within the Project area. However, wetland birds are unlikely to occur in the Project area as it is a distance from suitable wetlands. The Malleefowl has never been recorded in this area of the Swan Coastal Plain and is therefore highly unlikely to be present.

There is minor potential for these species to be observed in the Project area as vagrants; however, it cannot be considered as significant habitat for migratory species.

3 FIELD SURVEY METHODOLOGY

3.1 Field Assessment Timing

3.1.1 2008 Field Survey

On the 16th of October, 2008, an experienced GHD botanist undertook a vegetation and flora assessment of vegetation immediately surrounding the Roe Highway and Berkshire Road intersection (a smaller section of the existing Project area). This survey was undertaken in the season following greatest rainfall, which is identified by EPA (2004a) as the preferred period to undertake field surveys.

In conjunction with this an opportunistic fauna field survey (vertebrate only) was undertaken.

3.1.2 2014 Field Survey

An additional vegetation and flora survey and black cockatoo habitat assessment was undertaken for the updated Project area on the 28th January 2014, by Anna Napier, a botanist with over 30 years' experience in Western Australia and Laura Zimmerman, who has experience in fauna habitat mapping. This was undertaken through a comprehensive walk-through of the proposed Project area and included a vegetation assessment, flora species survey and detailed consideration of potential breeding habitat trees for Black Cockatoos.

3.2 Vegetation Assessment

The vegetation and flora field surveys were undertaken with regard to the EPA's Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (2004).

The vegetation was assessed to describe the differing communities and to determine the presence of any TECs within the Project area. Aerial photography was used to assist in the delineation of vegetation type and condition within the Project area.

The vegetation of the Project area was assessed primarily using walking transects due to the relatively narrow strips of vegetation being surveyed. One 10 m x 10 m quadrat was analysed in the 2008 survey.

3.2.1 Vegetation Condition

The vegetation condition of the Project area was rated using the vegetation condition rating scale developed by Keighery (1994) that recognises the intactness of vegetation, which is defined by the following:

- ▶ Completeness of structural levels;
- ▶ Extent of weed invasion;
- ▶ Historical disturbance from tracks and other clearing or dumping; and
- ▶ The potential for natural or assisted regeneration.

The scale consists of six rating levels as outlined below in Table 14.

Table 14 **Vegetation condition rating scale (after Keighery, 1994)**

Vegetation Condition Rating	Vegetation Condition	Description
1	Pristine or Nearly So	No obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but no in a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost without native species.

A visual assessment of the likely presence of *Phytophthora* dieback was undertaken by the Principal botanist, who has training and significant experience in dieback identification and mapping.

3.3 Flora

Following a review of threatened flora species present or likely to be present within the Project area, areas that were considered to reflect habitat for significant flora taxa were surveyed thoroughly.

Counts or estimates were made of the population size of any conservation significant species recorded in the field, and other details such as habitat and associated flora species were also noted.

A list of flora species was generated for the Project area.

3.3.1 Flora Identification

Collection of plant material was undertaken where field identification of plant taxa was not possible, or was uncertain. Specimens were collected in a systematic manner so that they could be later identified at the Western Australian Herbarium by comparison with the reference collection and use of identification keys.

Specimens were primarily identified by Joshua Foster and Anna Napier.

3.3.2 Nomenclature

Nomenclature used in this report follows that used by the DEC's *FloraBase* program as it is deemed to contain the most up-to-date species information for Western Australia.

3.4 Fauna

A reconnaissance survey (Level 1) was undertaken in conjunction with the botanical survey by a qualified zoologist on the 16th October 2008, in accordance with the *Terrestrial Fauna*

Surveys for Environmental Impact Assessment in Western Australia – Guidance Statement No. 56, EPA, Perth (EPA, 2004b). This survey involved an assessment of the fauna habitats and fauna habitat linkages as well as opportunistic searches for fauna species.

3.4.1 Targeted Black Cockatoo Survey

A general assessment of the potential for Black Cockatoo habitat within the Project area was also undertaken by a GHD zoologist on the 28th January 2014.

The Black Cockatoo assessment was undertaken according to the EPBC Act Significant Impact Guidelines 1.1 (DotE, 2012). Information collected during the field survey included:

- ▶ Identification of foraging habitat: the location and extent of suitable Black Cockatoo foraging habitat was identified and mapped for the Project area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by cockatoos was recorded.
- ▶ Identification of potential breeding and roosting habitat: suitable breeding habitat for Black Cockatoos is defined by DotE (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 mm. For salmon gum and wandoo, suitable DBH is 300 mm (DotE, 2013). The location of all suitable breeding trees was recorded in the Project area and these are referred to as 'Significant Trees'. Additionally, details of tree species, size and number of hollows observed, evidence of use and any other significant observations were recorded for each tree.
- ▶ Opportunistic observations (both visual and aural) for the presence of Black Cockatoos within the Project area and surrounding region were also noted during the survey.

The above information was used to map and calculate the amount of foraging habitat, potential breeding habitat and roost sites within the Project area.

3.4.2 Dieback (*Phytophthora*)

A separate Dieback (*Phytophthora*) assessment was undertaken by Simon Robinson from Glevan Consulting who is an accredited DPaW dieback assessor. This involved a site inspection as well as the laboratory testing of two samples for the presence or lack of dieback.

3.5 Limitations

3.5.1 Vegetation and Flora Limitations

Complete vegetation and flora surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present.

Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to the above factors. Therefore, while these flora surveys were relatively exhaustive, and was initially conducted at a time of year when the majority of the flora species would be able to be identified, there is the possibility that some species with low abundance in the area have been overlooked.

The flora surveys were also restricted to predominantly flowering plants, with consideration of some other vascular plants such as cycads. Non-vascular plants were not systematically searched for, as the information available on these plants is generally limited.

Sampling was conducted using quadrats, walking transects and intensive searching of areas likely to contain Threatened or Priority flora species. The majority of species would have been identified using these techniques, however, there is the possibility that species with a low abundance, or with a very restricted range in the Project area may have been overlooked.

3.5.2 Fauna Survey Limitations

Full variation of microhabitats within major habitats is unlikely to be represented in the survey regime, and some species specific to these habitats are unlikely to be sampled. The results of only a single survey is presented in this report, and as such, survey results are only a reflection of fauna communities sampled at the time of surveying. Additional surveys over multiple seasons and years would be required to gain a detailed understanding of fauna communities present within the site.

4 RESULTS OF FIELD SURVEYS

4.1 Vegetation Types



The Project area vegetation has been extensively degraded by previous clearing for agriculture, then road construction and maintenance. Despite this, a narrow strip of vegetation in good to excellent condition remains within the Project area, particularly along the eastern side of the Roe Highway road reserve. Six vegetation types were identified from the Project area, including two types defined as degraded – completely degraded vegetation.



The remnant vegetation within the Roe Highway road reserve (particularly the eastern side, north of Berkshire Road) is the least modified. One 10 m x 10 m quadrat was examined and indicates that one of the vegetation types within the Project area has close affinities to the floristic community type (FCT) of Gibson *et al.* (1994) SCP 20a *Banksia attenuata* woodland over species rich dense shrublands.



South of the existing Berkshire Road intersection in the Roe Highway road reserve on the eastern side, the vegetation appears to be a gradient between the FCT SCP 20a and FCT 3a: *Eucalyptus calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain. The understorey is relatively species rich and there is also a *Eucalyptus calophylla* overstorey. The area has had a range of disturbances, including previous clearing and the naturalisation of a number of planted, non-local native shrub species.

Project area vegetation types have been described below and are mapped at Figure 4, Appendix A. Vegetation condition was also assessed and is shown at Figure 5.

Table 15 Project area Vegetation Types and Condition Rating

No.	Description	Gibson, et al. (1994) equivalent Vegetation Type	Conservation Status	Vegetation Condition Rating	Representative Photo
1	<i>Banksia menziesii</i> open forest with scattered <i>Eucalyptus marginata</i> and patches of <i>Allocasuarina fraseriana</i> over dense low shrubland and dense herbs and sedges.	SCP 20a: <i>Banksia attenuata</i> woodland over species rich dense shrublands	TEC (Endangered – WA Criteria only)	2-3	
2	<i>Corymbia calophylla</i> woodland with scattered <i>Eucalyptus marginata</i> and occasional <i>Allocasuarina fraseriana</i> , over mixed low shrubs over dense herbs and sedges. No <i>Kingia australis</i> present.	Possible transition between SCP20a and SCP3a <i>Eucalyptus</i> [<i>Corymbia</i>] <i>calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain	TEC (Endangered – WA Criteria only) and TEC (Endangered WA and EPBC Act)	2-4	

No.	Description	Gibson, <i>et al.</i> (1994) equivalent Vegetation Type	Conservation Status	Vegetation Condition Rating	Representative Photo
3	Mixed, scattered trees of Jarrah (<i>Eucalyptus marginata</i>), River Gum (<i>E.camaldulensis</i>) and Marri (<i>Corymbia calophylla</i>) with planted non-native trees and shrubs over introduced herbland	Nil	Nil	5-6 (small area of veg condition 3-4)	
4	Planted and natural Eucalypts and shrubs including <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> with patches of naturalised shrubs including Geraldton Wax (<i>Chamelaucium undulatum</i>), <i>Hakea trifurcata</i> , <i>Calothamnus</i> sp. and scattered, native understorey species.	Nil	Nil	4-5	

No.	Description	Gibson, <i>et al.</i> (1994) equivalent Vegetation Type	Conservation Status	Vegetation Condition Rating	Representative Photo
5	<i>Banksia sessilis</i> closed forest with occasional <i>Allocasuarina fraseriana</i> over very open mixed shrubs		Nil	3	
6	Tall, dense shrubland of mixed planted native and non-native species (median strip only).	Nil	Nil	5	No photo
	Degraded vegetation, non-native species (not mapped)	Nil	Nil	5-6	

4.1.1 Threatened Ecological Communities

According to TEC mapping, the entire Project area is a TEC. Using flora data from Gibson *et al.* (1994) – where flora taxa occurred in at least 50% of plots used to assist in the definition of a floristic community type – a comparison was made with the vegetation within the Project area.

Analysis of the flora taxa within the surveyed quadrat, as well as further visual assessment during the 2014 survey suggests that vegetation at the northern end of the eastern side of the Roe Highway road reserve (north of Berkshire Road) and the northern section on the western side is most closely related to the TEC SCP20a (see Figure 3Figure 4). This TEC is known to occur to the northwest of the Project area, and is considered likely to have been continuous with the Project area vegetation prior to the construction of Roe Highway.

Although no quadrat was analysed for the Roe Highway road reserve south of Berkshire Road due the narrow strip of relatively vegetation, the vegetation in this area has some limited affinities with the TEC SCP 3a – due primarily to the *Corymbia calophylla* overstorey, which is known to occur to the southwest of the Project area. The vegetation in the Project area does not support *Kingia australis*, a key component of SCP 3a, has a more closed canopy and a different suite of understorey species to that of the known TEC areas. The vegetation in this area is considered to be a transition between SCP20a and SCP3a.

These floristic community types account for 3.05 ha (25.7%) of the total vegetation clearing area for the Project.

4.1.2 Vegetation Condition - *Phytophthora cinnamomi*

A formal *Phytophthora cinnamomi* (dieback) assessment of the Project has been undertaken (Glevan, 2014). No obvious evidence of dieback infestation was observed by an experienced dieback interpreter during field investigations, however, the majority of the Project area was considered uninterpretable, due to poor vegetation condition and lack of indicator species. Vegetation decline that is possibly related to *Phytophthora* dieback was observed in several sections of the study area, however most of these areas are unmappable and disease presence/distribution could not be confirmed.

Soil/root samples were taken from two locations, one within the project area returning a negative result, the other, taken outside of the project area near the southern end , returned a positive result. Some sections of vegetation believed to be uninfested were observed, however these sections were either too small or too fragmented to be considered protectable (Glevan 2014).

Based upon the inspection by the botanist and interpreter, the dieback status of the Project area is variable (Table 16).

Table 16 Project area visual Dieback assessment

Project Area	Visual Dieback Status
Berkshire Road (east of Roe Highway)	Uninterpretable/unmappable – vegetation predominantly cleared (altered), with no / few dieback susceptible (indicator) plants remaining.
Berkshire Road (west of Roe Highway)	Uninterpretable/unmappable – vegetation predominantly cleared (altered), with no / few dieback susceptible (indicator) plants remaining.

Roe Highway (eastern side of road reserve, north of Berkshire Road)	Uninterpretable/unmappable with intact vegetation appearing to be dieback free – vegetation relatively intact with dieback susceptible (indicator) plant species present (particularly at the northern half of surveyed area).
Roe Highway (eastern side of road reserve, south of Berkshire Road)	Intact vegetation appeared to be dieback free with a good range of dieback susceptible (indicator) plant species present in some areas. Other areas are uninterpretable/unmappable, due to clearing and highly disturbed vegetation. A positive dieback sample was, however, obtained from bushland in the adjacent Pioneer Park.
Roe Highway (western side of road reserve, north of Berkshire Road)	Some intact vegetation which appeared to be dieback free with a good range of dieback susceptible (indicator) plant species present. Other areas are uninterpretable/unmappable, due to clearing and highly disturbed vegetation. Although the intact vegetation appears dieback free, it is considered too small and isolated to be protectable.
Roe Highway (median strip, and western side of road reserve, south of Berkshire Road)	Uninterpretable/unmappable – vegetation predominantly cleared (altered) or planted, with no / few dieback susceptible (indicator) plants remaining.

Dieback infestations spread through bushland either naturally, through soil water movement, or artificially through vector movement of soil on vehicles, during fencing or firebreak/track maintenance and occasionally via foot traffic.

Assessment of Impacts

Majority of the Project area is considered unmappable. Where sections of vegetation were believed to be uninfested, they were found to be either too small or too fragmented to be considered protectable.

There is a dieback infested area outside the Project immediately to the south east.

4.2 Flora

A full list of species was recorded for the Project area, and where identification was uncertain, confirmation was made at the Western Australian State Herbarium (WAHERB).

The presence of Threatened or Priority Flora was recorded and the weed status of flora taxa was also noted.

The Project area is considered to have a moderate species diversity with a total of 216 taxa from 54 families recorded within the surveyed area. Of these taxa, 104 taxa are naturally occurring native flora taxa. The Project area also contains 40 deliberately planted taxa for use as ornamentals, or rehabilitation purposes. The remaining 72 taxa are weed (exotic) taxa.

A small number of plant species (7 species) occur in the Project area in more than one status, in either naturally occurring and deliberately planted forms, or deliberately planted forms and as weedy forms where these planted taxa have reproduced and are spreading in the Project area.

The dominant families (including families with introduced, planted and weed species) recorded from the area are:

▶ Myrtaceae (gums, Melaleuca etc.)	34 taxa
▶ Fabaceae (peas):	30 taxa
▶ Proteaceae (Banksia, Grevillea):	21 taxa
▶ Poaceae (grasses):	20 taxa
▶ Asteraceae (daisies):	12 taxa

The dominant genera recorded from the Project area are:

▶ <i>Eucalyptus</i>	10 taxa
▶ <i>Trifolium</i>	5 taxa
▶ <i>Corymbia</i>	4 taxa
▶ <i>Lomandra</i>	4 taxa
▶ <i>Daviesia</i>	4 taxa
▶ <i>Grevillea</i>	4 taxa

Appendix D provides a full list of flora species recorded in the Project area.

4.2.1 Conservation Significant Flora

Threatened Flora

One Threatened (Declared Rare) plant species was recorded from the Project area: *Conospermum undulatum*. This species is also listed under the EPBC Act as *Vulnerable*. The species was found in three separate locations, on both sides of Roe Highway (see Figure 3). A total of 19 plants were recorded in the Project impact area, with an additional 30 within the road reserve adjacent. This species is also known to occur in vegetation surrounding the Project area, including in the Bush Forever Sites indicated in Figure 1. There are in excess of 100 location records of the *Conospermum undulatum* within 1 km of the Project area (source DPaW and WAHERB rare flora database searches).

Conospermum undulatum was recorded at locations within the Project area where it was believed that this species has been previously identified. Flagging was noted (pers. obs.) around the plants to the north of Berkshire Road on the eastern side of Roe Highway, to indicate its presence and other DPaW records show plants in near proximity to those recorded during the survey.



Plate 1 The DRF, *Conospermum undulatum*, recorded from the Project area



Plate 2 Location of 2 plants of *Conospermum undulatum* (arrowed), on embankment, adjacent to Roe Highway north of Berkshire Road

Priority Flora

Forty two (42) plants of the Priority 3 flora species (*Isopogon drummondii*) were recorded from the Project area, in a number of locations (see Figure 3). There are also in excess of 50 records of *Isopogon drummondii* from within 1 km of the Project area (source DPaW and WAHERB rare flora database searches).

Seven plants will be impacted by the Project. This species is known to occur in vegetation surrounding the Project area, including in the Bush Forever Sites indicated in Figure 1.



Plate 3 The Priority 3 plant, *Isopogon drummondii*, recorded from the Project area.

Range Extensions

No flora taxa were recorded from the Project area exhibiting an extension to their known range.

4.2.2 Weeds / Introduced Species

A total of 72 weed species and 40 deliberately planted flora species were recorded during the field investigations, approximately 52% of the total number of plant species recorded from the Project area.

Deliberately planted flora species include those planted for fruit (including Almond, Citrus, Grape, and Olives); those planted for ornamental (street trees) purposes (including a number of *Eucalyptus* and *Corymbia* taxa), garden escapes, such as *Erythrina indica*, and those planted for rehabilitation purposes (including *Acacia saligna*, *Allocasuarina fraseriana*, and *Eucalyptus marginata*).

Weed species were dominated by Poaceae (grasses), Papilionaceae (peas – notably clovers) and Asteraceae (daisies). Many of the weed species present within the Project area were introduced as part of pasture for livestock. Weed species formed the dominant species of the understorey within the degraded vegetation areas of the Project area.

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WONS) is based on four major criteria: invasiveness; impacts; potential for spread; and socio-economic and environmental values.

No Weeds of National Significance were recorded from the Project area.

Declared Plants

Under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), a Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) is in force.

The Department of Agriculture and Food Western Australia (DAFWA) maintains a list of Declared Pests for Western Australia. If a Pest is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the specific category of control. Declared plants are gazetted under categories, which define the action required. The category may apply to the whole of the State, districts, individual properties or even paddocks. Categories of control are defined in Table 17. Among the factors considered in categorising Declared Pests are:

- ▶ The impact of the plant on individuals, agricultural production and the community in general
- ▶ Whether it is already established in the area
- ▶ The feasibility and cost of possible control measures

The BAM Act replaces the repealed *Agriculture and Related Resources Protection Act 1976*.

Table 17 Department of Agriculture and Food Declared Plant Control Classes

Control Class Code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Two weed species Declared under the BAM Act were recorded in the Project area (Table 18). Indicated below, are the locations to which the status of each taxa is applied. Those areas pertinent to this project are highlighted.

Table 18 Declared Plants recorded within the Project area

Scientific Name	Common Name	Status	Project Area
<i>Echium plantagineum</i>	Paterson's Curse	C3	Berkshire Road east Roe Highway median strip, south of Berkshire Road intersection
<i>Opuntia stricta</i>	Prickly Pear	C3	Outer edge of road reserve, along paddock fence, eastern side of Roe Highway, north of Berkshire Road intersection

Echium plantagineum (Paterson's Curse) has a C3 status for outside the Perth metropolitan area, and *Opuntia stricta* (Prickly Pear) has a C3 status for north of the 26th parallel. Control of both species is not required by the BAM Act for the Project area.



Plate 4 *Opuntia stricta* (Prickly Pear – left side) within Roe Highway Road reserve

Environmental Weeds

The Environmental Weed Strategy for Western Australia (1999) developed a set of criteria for the assessment and rating of weeds in terms of their environmental impact on biodiversity. The criteria were determined through a workshop involving participants from the (then) CALM, CSIRO, the (then) Agriculture Western Australia, the (then) Water and Rivers Commission and relevant community group representatives.

Weeds were rated in broad groups such as high impact, medium impacts and low impacts, rather than rank them from the worst to the least important weed. The final criteria arrived following workshop activities and review and evaluation by weed experts were:

- ▶ **Invasiveness** ability to invade bushland in good to excellent condition or ability to invade waterways. (Score as yes or no).
- ▶ **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world. (Score as yes or no).
- ▶ **Environmental Impacts** – ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community. (Score as yes or no).

The rating of each weed was to be determined by the following scoring system (Table 19).

Table 19 Environmental Weed Rating Definitions

Environmental Weed Rating	Definition
High	A weed species would have to score yes for all three criteria. Rating a weed species as high would indicate prioritising this

Environmental Weed Rating	Definition
	weed for control and/or research i.e. prioritising funding to it
Moderate	A weed species would have to score yes for two of the above criteria. Rating a weed species as moderate would indicate that control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).
Mild	A weed species scoring one of the criteria. A mild rating would indicate monitoring of the weed and control where appropriate.
Low	A weed species would score none of the criteria. A low ranking would mean that this species would require a low level of monitoring.

Weed species in Western Australia also include taxa that have yet to be advised of a rating level, and those taxa not considered by this process.

Within the Project area 60 of the 71 recorded weed taxa have been allocated an Environmental Weed Rating. The number of weed taxa recorded in the Project area by Environmental Weed Rating is as follows:

- ▶ High 8 taxa
- ▶ Moderate 23 taxa
- ▶ Mild 10 taxa
- ▶ Low 19 taxa

These Environmental Weed Rating levels are indicated in the Project area flora list (Appendix D).

4.3 Fauna

4.3.1 Fauna diversity

During the 2008 field survey, a total of eight fauna species were recorded within the Project area. This included five bird species, two mammal and one reptile species. The list of fauna species recorded from the Project area is provided in Appendix C.

4.3.2 Fauna Habitats

The Project area consists of a mixture of previously cleared road reserve vegetation, introduced / planted vegetation, and strips of remnant Jarrah/Marri and Banksia woodland. In the areas immediately surrounding the Roe Highway / Berkshire Road intersection, the majority of the vegetation has previously been cleared and consists predominantly of planted trees over weeds and grasses. These areas present limited habitat value for fauna species, apart from providing some feeding, and potential breeding, habitat for the conservation significant Black Cockatoo species.

Strips of degraded Jarrah/Marri woodland and areas of Banksia woodland which are relatively intact and retain structural and species diversity are present in areas further north and south of the road intersection. This intact vegetation is dominated by *Banksia* species (including *Banksia attenuata*, *B. menziesii* and *B. sessilis*) and Sheoak (*Allocasuarina fraseriana*), with scattered Jarrah and Marri trees. These species provide quality foraging habitat for the

conservation significant Black Cockatoo species. In some areas the understorey consists of relatively dense shrubs, sedges, herbs with thick leaf litter. These areas provide foraging opportunities and refuge areas for reptiles such as skinks, and ground-dwelling mammals such as the Quenda (Priority 5).

On the southern side of Berkshire Road, east of Roe Highway, the vegetation consists of Marri/Banksia woodland with some scattered Jarrah trees. The understorey in this area varies from patches that have previously been disturbed and/or cleared, to patches that retain remnant vegetation structure and diversity of species. On the western side of Roe Highway, the vegetation predominantly consists of planted eucalypts with some scattered Marri and River Gums, over weeds and grasses.

4.3.3 Fauna Habitat Linkages

Habitat linkages are important to allow animals to move between areas of resource availability. They are important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction. Fragmentation of habitat limits the resources available to species, particularly sedentary species, which means they may be more vulnerable to natural disasters or habitat changes over time. Fragmentation of habitat can also lead to edge effects, leading to degradation of the habitat.

The Western Australian Environmental Protection Authority aims to maintain representation, diversity, viability and ecological function at the species, population and assemblage level of intact naturally vegetated areas (EPA, 2013). Furthermore, the EPA recognises that large consolidated naturally vegetated areas are the most resilient and therefore effective in protecting. Biodiversity in the long term is higher and these areas generally have lower management requirements (costs) than smaller and fragmented areas of vegetation. The EPA recommends that development projects should aim to retain naturally vegetated areas in large consolidated blocks to avoid fragmentation or isolation. Where the distance between habitat fragments is small, species may still be able to move between these habitat areas (particularly birds), however, they may be more exposed to predation pressures in the cleared areas.

Locally, the Project area retains some limited habitat connectivity, consisting of narrow strips of vegetation east and west of Roe Highway. The vegetation along the eastern side of Roe Highway remains relatively intact and is linked to Pioneer Park (Bush Forever Site 440) to the south. On the western side of Roe Highway, north of Berkshire Road, the strip of Banksia woodland is connected through to Sultana Road West Bushland (Bush Forever Site 123), and south of Berkshire Road there is connectivity to Dundas Road Nature Reserve (Bush Forever Site 319) and associated areas of geomorphic wetlands.

Overall, the Project area forms part of Greenway 50, which is identified as a regional ecological linkage for the Perth Metropolitan Region (Alan Tingay and Associates, 1998). Greenways are networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural, aesthetic, or other purposes compatible with the concept of sustainable land use. Greenways link bushland remnants and are usually associated with bushland and wildlife corridors (actual or potential) (Alan Tingay and Associates, 1998).

4.3.4 Conservation Significant Fauna

One conservation significant fauna species was recorded from the Project area. The WC Act Schedule 1 and EPBC Act Vulnerable species *Calyptrorhynchus banksii naso* (Forest Red-tailed Black Cockatoo) was heard from (but not seen within) the Project area.

The Project area is located within the known distribution of all three species of Black Cockatoos, and may potentially utilise the habitats available within the Project area (DotE, 2012). The value of these habitats for Black Cockatoos is discussed further below.

Black Cockatoos

The Project area provides good suitable foraging habitat for Black Cockatoos, including a variety of suitable foraging species such as *B. attenuata*, *B. menziesii*, *B. sessilis*, *Eucalyptus marginata* (jarrah), *Corymbia calophylla* (marri), and *Allocasuarina fraseriana* (sheoak). There is approximately 9.24 ha of foraging habitat within the clearing area. All three species may opportunistically use the habitat within the Project area for foraging, and recent evidence of foraging was recorded within the Project area (chewed Marri nuts).

The Project area is located outside the breeding range of both Baudin's Black Cockatoo and the Forest Red-tailed Black Cockatoo, and is just outside the known breeding range of the Carnaby's Black Cockatoo (DotE 2012). Carnaby's Black Cockatoos nest in hollows in live or dead trees of *E. salmonophloia* (salmon gum), *E. wandoo* (wandoo), *E. gomphocephala* (tuart), jarrah, *E. rudis* (flooded gum), *E. loxophleba* subsp. *loxophleba* (York gum), *E. accedens* (powderbark), *E. diversicolor* (karri) and marri. Of these species, Jarrah, Marri and Flooded Gum were recorded within the Project area. Suitable breeding habitat for Black Cockatoos is defined by DotE (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow (for most tree species - DBH is 500 mm). A total of 80 potential breeding trees (DBH \geq 500 mm) were identified within the Project area (Figure 6). None of these trees contained hollows suitable for nesting, and no actual breeding was recorded.

No suitable roosting habitat or evidence of roosting was identified within the Project area during the field survey. Suitable roosting habitat is identified based on the presence of suitable tall trees, stem clippings (with leaves), excessive droppings, branch chewing, feathers, proximity to known roosting sites (Department of Planning, 2011) and presence of suitable foraging habitat. The closest known roosting site, as mapped by the Department of Planning (2011), is located approximately 3 km north of the Project area.

The details of the Black Cockatoo habitat within the Project area are summarized in Table 20.

Table 20 Black Cockatoo habitat within the Project area

Habitat Type	Presence
Actual breeding	No breeding events were recorded for Black Cockatoos.
Potential breeding (trees with a DBH > 500 mm which contain hollows currently suitable for breeding)	No breeding trees currently able to support Black Cockatoo breeding were recorded (no hollows).
Tree diameter at breast height (DBH) greater than 500 mm	80 trees were recorded with a DBH >500 and potentially may be used by Black Cockatoos for breeding in the future.
Foraging	9.29 ha of suitable Banksia woodland foraging habitat for

Habitat Type	Presence
	Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest Red-tailed Black Cockatoo.
Roosting	No roosting sites used by Black Cockatoos were recorded.

4.3.5 Introduced Fauna Species

Two introduced fauna species were recorded in the Project area during the field survey, the European Rabbits (*Oryctolagus cuniculus*) and Domestic Dog (*Canus lupis domesticus*). The Domestic Dog was recorded from tracks along firebreaks in the Project area.

4.3.6 Fauna Impacts

Construction within the Project area will have limited impacts on local fauna. Impacts include:

- ▶ Loss of habitat and feeding areas. This is not considered to be a substantial impact on current extent of habitat. Minor loss of refuge trees and associated foraging resources will occur.
- ▶ Removal of part of the Roe Highway vegetation corridor, which provides linkage for avian species from north to south between reserves.
- ▶ Harm/deaths/displacement of individual animals during construction will occur due to loss of trees.

5 ASSESSMENT OF REFERRAL GUIDELINES FOR BLACK COCKATOOS

Impacts to Black Cockatoo species are predicted as a result of these works. The majority of the vegetation within the Study area contains suitable foraging habitat for all Black Cockatoo species. This includes strips of degraded Jarrah/Marri woodland and areas of Banksia woodland which are relatively intact and retain structural and species diversity are present in areas further north and south of the road intersection. This intact vegetation is dominated by Banksia species (including *Banksia attenuata*, *B. menziesii* and *B. sessilis*) and Sheoak (*Allocasuarina fraseriana*), with scattered Jarrah and Marri trees.

On the southern side of Berkshire Road, east of Roe Highway, the vegetation consists of Marri/Banksia woodland with some scattered Jarrah trees. The understorey in this area varies from patches that have previously been disturbed and/or cleared, to patches that retain remnant vegetation structure and diversity of species. On the western side of Roe Highway, the vegetation predominantly consists of planted eucalypts with some scattered Marri and River Gums, over weeds and grasses.

The field assessment identified 9.29 ha of potential foraging habitat and 80 potential breeding trees (diameter at breast height of over 500 mm) inside the Project area. No roosting sites were identified.

Table 21 Assessment against the Significant Impact Guidelines 1.1

Referral Guidelines	Assessment
<p><i>An action is likely to have a significant impact on an endangered/threatened species if there is a real chance or possibility that it will:</i></p>	
<p>Lead to a long-term decrease in the size of a population of a species</p>	<p>Unlikely</p> <p>For the purpose of this assessment ‘population of a species’, in this case for the Endangered Carnaby’s Black Cockatoo (<i>Calyptorhynchus latirostris</i>), Vulnerable Baudin’s Black Cockatoo (<i>Calyptorhynchus baudinii</i>) and Vulnerable Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksia naso</i>), is the population of these species that may occur within the 10 km of the Project area. Approximately 34,992 ha of remnant native vegetation remains within 10 km of the Project (SLIP 2014).</p> <p>There is suitable foraging habitat for Black Cockatoo within the Project area, however only the Red-tailed Black Cockatoo was identified in both field assessments.</p> <p>The proposed project is likely to result in the removal of 9.29 ha of suitable foraging habitat and 80 potential breeding trees; however the Project area is located outside the breeding range of both Baudin’s Black Cockatoo and the Forest Red-tailed Black Cockatoo, and is just outside the known breeding range of the Carnaby’s Black Cockatoo (DotE 2012).</p> <p>The proposed Project is unlikely to result in a long term decrease in the size of a population of this species as it is unlikely to substantially:</p> <ul style="list-style-type: none"> • Reduce the overall area of available habitat to the

Referral Guidelines	Assessment
	<p>population</p> <ul style="list-style-type: none"> • Reduce the overall area of occupancy of the population • Create new barrier effects • Disrupt the breeding cycle of part of the population. <p>Larger, intact areas of vegetation containing a greater diversity occur within Bush Forever sites in the vicinity of the Project area. Roe Highway road reserve provides linkage between a range of reserves and bushland remnants. The clearing of native vegetation in these areas is not expected to significantly impact this linkage as it is the upgrade of an existing road and suitable vegetation is present surrounding the clearing area in the Bush Forever sites.</p> <p>Therefore, it is considered that clearance of 9.29 ha of potential foraging habitat is unlikely to lead to a long-term decrease in the size of the local population of Black Cockatoo.</p>
Reduce the area of occupancy of the species	<p>Unlikely</p> <p>The Project is unlikely to substantially reduce the area of occupancy of the population of Black Cockatoo within the local area or region. Only the Forest Red-tailed Black-Cockatoo was identified in the Project area in both field assessments, although the other two Black Cockatoo species are considered likely to occur. Black Cockatoos are known to occur throughout the greater bioregion. The estimated area of suitable foraging habitat available within 10 km of the Project area is 34,992.44 ha based on the remaining native vegetation in this area (SLIP 2014).</p> <p>The Project may reduce the overall area of habitat by 0.02% within 10 km of the Project area, a result of direct loss of habitat from clearing. Therefore removal of 9.29 ha of foraging habitat is not considered likely to be significant for the species, due to the presence of a large proportion of adjacent suitable habitat within the locality and region.</p>
Fragment an existing important population into two or more populations	<p>Unlikely</p> <p>The Project is unlikely to further fragment the population into two or more populations as it involves the upgrade of an existing road and clearing will be limited to the existing road reserve. The Project involves the removal of 9.29 ha of vegetation for the overpass. Roe Highway road reserve provides linkage between a range of reserves and bushland remnants. The clearing of native vegetation in these areas is not expected to significantly impact this linkage as it is the upgrade of an existing road and suitable vegetation is present in nearby Bush Forever sites. Based on the mobility of Black Cockatoos and the occurrence of good quality habitat adjacent to the Project area, fragmentation of potential populations is considered unlikely to be significant.</p>
Adversely affect habitat critical to the survival of a species	<p>Unlikely</p> <p>The Project is unlikely to affect habitat critical to the survival of a species.</p> <p>Only the Forest Red-tailed Black-Cockatoo was identified in the Project area, although the other two Black Cockatoo species are considered likely to occur. Up to 9.29 ha of Black Cockatoo habitat in the Project area will be cleared for this Project. Given that this habitat type is well represented adjacent to the Project</p>

Referral Guidelines	Assessment
	<p>area, the impacts of this clearing are not considered significant. This habitat is not considered to be critical to the survival of this species.</p>
<p>Disrupt the breeding cycle of a population</p>	<p>Unlikely</p> <p>The works associated with the Project are unlikely to disrupt the breeding cycle of any Black Cockatoos. The field assessment identified 80 suitable breeding trees (diameter at breast height of over 500 mm) throughout the Project area; however the Project is outside the known breeding range of the three Black Cockatoo species. In addition, given that only 0.02% of potential habitat for this species within the Project region will be impacted by the Project, it is considered unlikely that the Project will disrupt the breeding cycle of the population.</p>
<p>Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>Unlikely</p> <p>The works associated with the Project, may modify and destroy a small proportion (9.29 ha, or approximately 0.02% of the overall habitat within the Project region) of potential habitat for Black Cockatoos, but not to the point that these species would decline. Given that this habitat type is well represented in the Bush Forever sites adjacent to the Project, the impacts of this clearing are not considered significant.</p> <p>The proposed Project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</p>
<p>Result in invasive species that are harmful to the species becoming established in its habitat.</p>	<p>Unlikely</p> <p>The Project may potentially cause the introduction of additional invasive species (such as weeds and introduced predators) within the Project area however, the area is already severely impacted by a large range of weed species. It is considered unlikely that this factor would significantly impact the habitat remaining within the Project vicinity as a result of this Project. Weeds will be controlled and revegetation undertaken in accordance with the Gateway WA CEMP.</p>
<p>Introduce disease that may cause the species to decline</p>	<p>Unlikely</p> <p>A formal assessment of the Project site determined the area to be unmappable, mostly due to the lack of suitable indicator species and areas which are uninfested to be either too small or too fragmented to protect.</p> <p>Dieback could reduce the density of the remaining foraging species for Black Cockatoo's. Dieback prevention measures will be undertaken for this Project in accordance with the Gateway WA CEMP.</p>
<p>Interfere with the recovery of the species.</p>	<p>Unlikely</p> <p>The Project and its actions are unlikely to interfere substantially with or prevent the recovery of the Black Cockatoos due to the following reasons:</p> <ul style="list-style-type: none"> • The limited extent of the clearing required for this project • The availability of habitat in close proximity and in the region

Referral Guidelines	Assessment
	<ul style="list-style-type: none"> The mobility of the species
<p>Legend for Table 1 - For the purpose of this assessment:</p> <p>'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to an endangered species, occurrences include but are not limited to:</p> <ul style="list-style-type: none"> a geographically distinct regional population, or collection of local populations, or a population, or collection of local populations, that occurs within a particular bioregion (DotE 2013b) <p>'invasive species; is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation (DotE 2013b).</p> <p>'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:</p> <ul style="list-style-type: none"> for activities such as foraging, breeding, roosting, or dispersal for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species or ecological community. <p>Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DotE 2013b).</p>	

Based on this assessment, the Project is unlikely to have a significant impact on Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo or Baudin's Cockatoo.

6 ASSESSMENT AGAINST THE TEN CLEARING PRINCIPLES

Any clearing of native vegetation will require a permit under Part V of the *Environmental Protection Act* 1986, except where an exemption applies under Schedule 6 of the Act or is prescribed by regulation in the *Environmental Protection (Clearing of Native Vegetation) Regulations* 2004, and the proposed clearing is not in an Environmentally Sensitive Area (ESA).

Clearing applications are assessed against ten principles outlined in Schedule 5 of the *Environmental Protection Amendment Act* 2003. These principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

An examination of the Ten Clearing Principles applied against the finding of this vegetation and flora assessment is undertaken below (Table 22).

The project has been assessed to be at variance with Principles (c) and (d) and may be at variance with Principles (a), (b), (e) and (h).

Table 22 Assessment against the Ten Clearing Principles

Principle	Assessment	Outcome
<p>a) Native vegetation should not be cleared if it comprises a high level of biological diversity.</p>	<p>The Project area vegetation has been extensively degraded by previous clearing for agriculture, then road construction and maintenance. Despite this, a narrow strip of vegetation in Good to Excellent condition remains within the Project area, particularly along the eastern side of the Roe Highway road reserve. Six vegetation types were identified from the Project area, including two types defined as Degraded – Completely Degraded vegetation.</p> <p>One Threatened Ecological Community was identified in the Project area. One of the vegetation types within the Project area has close affinities to the floristic community type (FCT) of Gibson <i>et al.</i> (1994) SCP 20a <i>Banksia attenuata</i> woodland over species rich dense shrublands. It is located on both sides of Roe Highway north of Berkshire Road.</p> <p>An additional area of vegetation appears to be a gradient between the FCT SCP 20a and FCT SCP 3a: <i>Eucalyptus calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain. The understorey is relatively species rich and there is also a <i>Eucalyptus calophylla</i> overstorey but does not contain <i>Kingia australis</i> and has a denser canopy that usually occurring in SCP 3a. The area has had a range of disturbances, including previous clearing and the naturalisation of a number of planted, non-local native shrub species.</p> <p>The vegetation in the Project area is not considered to contain a higher diversity of terrestrial plant or fauna species than the remaining vegetation in reserves and Bush Forever sites in the local area.</p> <p>Flora Diversity</p> <p>The Project area is considered to have a moderate flora species diversity with a total of 216 taxa from 54 families recorded within the surveyed area. Of these taxa, 104 taxa are naturally occurring native flora taxa. The Project area also contains 40 deliberately planted taxa for use as ornamentals, or rehabilitation purposes. The remaining 72 taxa are weed (exotic) taxa.</p> <p>A small number of plant species (7 species) occur in the Project area in more than one status, in either naturally occurring and deliberately planted forms, or deliberately planted forms and as weedy forms where these planted taxa have reproduced and are spreading in the Project area.</p>	<p>Proposal may be at variance to this Principle.</p>

Principle	Assessment	Outcome
	<p>Forty nine conservation significant flora species have the potential to occur in the Project area according to Naturemap and the PMST. Of these, only 14 are considered possibly occurring based on habitat requirements. One Threatened (Declared Rare) plant species, <i>Conospermum undulatum</i>, and one Priority 3 flora species, <i>Isopogon drummondii</i>, was recorded in the Project area.</p> <p>Flora diversity in the Project area is moderate and considered to be better represented in adjacent Bush Forever sites.</p> <p>Fauna Diversity</p> <p>A NatureMap search (DPaW, 2014) identified 217 fauna species as previously recorded within 5 km of the project, of which 205 species are native and 12 are pest (introduced) or naturalised species. These results consisted of 97 birds (five introduced), 16 mammals (six introduced), 42 reptiles, nine amphibians, one fish and 52 invertebrate species.</p> <p>Desktop searches of the Naturemap tool and PMST found 13 conservation significant species potentially occurring in the Project area, of which two species were considered likely (Baudin's Black Cockatoo (<i>Calyptorhynchus baudinii</i>) and Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)) and one was considered possibly occurring (<i>Quenda (Isoodon obesulus fusciventer)</i>). During the 2008 field survey, a total of eight fauna species were recorded within the Project area. This included five bird species, two mammal and one reptile species. One conservation significant fauna species was recorded from the Project area. The WC Act Schedule 1 and EPBC Act Vulnerable species <i>Calyptorhynchus banksii naso</i> (Forest Red-tailed Black Cockatoo) was heard from (but not seen within) the Project area.</p> <p>The Project area is located within the known distribution of all three species of Black Cockatoos, and these are likely to utilise the habitats available within the Project area (DotE, 2012).</p> <p>Fauna diversity in the Project area is considered to be low due to the generally disturbed habitats and narrow strips of vegetation adjacent to built up areas.</p>	
b) Native vegetation should not be cleared if it comprises the whole or a part of, or is	The Project area consists of a mixture of previously cleared road reserve vegetation, introduced / planted vegetation and strips of remnant Jarrah/Marri and Banksia woodland. In the areas immediately surrounding the Roe Highway / Berkshire Road intersection, the	Proposal may be at variance to this Principle

Principle	Assessment	Outcome
<p>necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.</p>	<p>majority of the vegetation has previously been cleared and consists predominantly of planted trees over weeds and grasses. These areas present limited habitat value for fauna species, apart from providing some feeding and potential breeding, habitat for the conservation significant Black Cockatoo species. Approximately 11.85 ha of native vegetation is expected to be cleared, in a variety of conditions.</p> <p>Black-Cockatoo species were recorded from the Project area and 9.29 ha of feeding habitat was identified for this species, as well as 80 breeding trees. The breeding trees were identified in vegetation classified as Excellent to Completely Degraded, with the majority of vegetation as Degraded to Completely Degraded. This vegetation accounts for 0.02% of Black Cockatoo habitat available in the region.</p> <p>Larger, intact areas of vegetation containing a greater diversity occur within Bush Forever sites in the vicinity of the Project area, and the clearing of native vegetation is not considered to alter ecological functions and processes that protect significant habitat for fauna. An ecological linkage runs through the Project area, related to remnant native vegetation along the Roe Highway road reserve. The clearing of native vegetation in these areas is not expected to significantly impact this linkage as it is the upgrade of an existing road and suitable vegetation is present surrounding the clearing area in the Bush Forever sites.</p> <p>An assessment against the <i>EPBC Act referral guidelines for three threatened black cockatoo species</i>, found that the Project is unlikely to significant impact these species.</p>	
<p>c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.</p>	<p>Forty nine plants of the Threatened (Declared Rare) plant species <i>Conospermum undulatum</i> were recorded from the Project area and immediate surrounds. This species is also listed under the EPBC Act as Vulnerable. The species was found in three separate locations, on both sides of Roe Highway. This species is known to occur in vegetation surrounding the Project area, including in the Bush Forever Sites. There are in excess of 100 location records of the <i>Conospermum undulatum</i> from within 1 km of the Project area (source DPaW and WAHERB rare flora database searches).</p> <p>The clearing of native vegetation in the Project area will require the removal of 19 <i>Conospermum undulatum</i> plants of the 49 recorded in the immediate vicinity of the Project.</p> <p>Forty two plants of the Priority Three Flora species (<i>Isopogon drummondii</i>) were recorded from the Project area, and the Project will require the clearing of 7 of these plants. There are</p>	<p>Proposal is at variance to this Principle</p>

Principle	Assessment	Outcome
	<p>in excess of 50 records of <i>Isopogon drummondii</i> from within 1 km of the Project area (source DPaW and WAHERB rare flora database searches). This species is known to occur in the Bush Forever sites surrounding the Project.</p> <p>No locally or regionally significant flora, or flora species exhibiting an extension to the known range were recorded from the survey area.</p> <p>The Project area is not considered to be necessary for the continued existence of either <i>Conospermum undulatum</i> or <i>Isopogon drummondii</i>.</p>	
<p>d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.</p>	<p>The remnant vegetation within the Roe Highway road reserve has close affinities to the floristic community type (FCT) of Gibson <i>et al.</i> (1994) SCP 20a <i>Banksia attenuata</i> woodland over species rich dense shrublands. This TEC is known to occur to the northwest of the Project area, and is considered likely to have been continuous with the Project area vegetation prior to the construction of Roe Highway.</p> <p>South of the Berkshire Road intersection in the Roe Highway road reserve on the eastern side, the vegetation appears to be a gradient between the FCT SCP 20a and SCP 3a: <i>Eucalyptus calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain, although only <i>Eucalyptus calophylla</i> is present (no <i>Kingia</i>) and the understory structure does not match that of SCP 3a.</p> <p>These vegetation types account for 2.29 ha (FCT SCP 20a) and 0.76 ha (possible transition between SCP 20a and SCP 3a) of the total clearing area for the Project.</p> <p>No Priority Ecological Communities (PECs) were noted to occur within the vicinity of the Project area. All <i>Banksia</i> woodland has been considered to be SCP 20a.</p>	<p>Proposal is at variance to this Principle</p>
<p>e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</p>	<p>The Project is located in Beard vegetation association 1001 'Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina'. This association has 24.65% remaining at a State, IBRA region and IBRA sub-region level, and 8.22% remaining at a local government level. The clearing proposed for this Project will remove 11.85 ha of vegetation, of which only 3.50 ha is considered to be original vegetation, with the remainder being mixed, planted/naturalised tree and shrub species, many of which are not native to the area. The clearing proposed for this Project will remove 0.02% of the vegetation association remaining on a State, IBRA region and IBRA sub-region (Swan Coastal Plain) level and 3% of the</p>	<p>Proposal may be at variance to this Principle</p>

Principle	Assessment	Outcome
	<p>vegetation association remaining on a Local Government level.</p> <p>The vegetation complex (Southern River Complex) occurring in the Project area contains less than 30% of its original representation (19.69%) on the Swan Coastal Plain. The clearing proposed for this Project will remove 0.03% of the vegetation association remaining on the Swan Coastal Plain and 1.4% of the vegetation association remaining on a Local Government level.</p> <p>Native vegetation (including the TEC) in the local area is well represented in a number of Bush Forever Sites within 1 km of the Project area.</p>	
<p>f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.</p>	<p>Three wetlands are mapped as occurring in the Project area (ID 13977, 15072 and 15077). Wetland 15077 is a Conservation Category Wetland. The vegetation associated with this wetland is in Good to Degraded condition, however none of the vegetation identified in this area in the field assessment was congruent with wetland species.</p> <p>No vegetation occurs in the Project area that provides a buffer to wetland areas.</p> <p>The clearing of native vegetation in the Project area is not considered likely to adversely alter water tables within or adjacent to the Project area and as such will not impact on any ecological communities that are wetland or groundwater dependent.</p> <p>No native vegetation within the Project area is considered to be growing in a watercourse or wetland.</p>	<p>Proposal is not likely to be variance to this Principle</p>
<p>g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.</p>	<p>Short-term soil erosion may occur within this project due to road construction activities. Long-term soil erosion can be mitigated by use of appropriate drainage design and rehabilitation regimes.</p> <p>The majority of the Project area is considered to contain soils with "Medium Risk to low risk" of having Acid Sulphate Soils present at depths of > 3m from the soil surface.</p> <p>Soils in the Project area have a low risk of waterlogging. It is expected that waterlogging would not be altered by the clearing of native vegetation from the Project area.</p> <p>Soil salinity is not considered to be increased in the Project area (on or off site) by the clearing of native vegetation.</p>	<p>Proposal is not likely to be variance to this Principle</p>

Principle	Assessment	Outcome
<p>h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.</p>	<p>No National Parks or 'A'-Class Reserves occur within the immediate vicinity of the Project area. The nearest conservation reserve is Dundas Nature Reserve, approximately 580 m south-west of the Project area. In addition, Bougainvillea Avenue Bushland (Class C) reserve is located approximately 650 m south-east of the Project area.</p> <p>Two Bush Forever sites are immediately adjacent to the Project area, being Pioneer Park (Site 440) on the eastern side of Roe Highway and Dundas Road (Site 319) on the south-western side (Government of Western Australia 2000a; 2000b; 2012). Approximately 0.60 ha of vegetation associated with these Bush Forever sites will be cleared for the Project. The majority of the vegetation to be cleared is in areas which have been previously cleared and/or replanted within the Roe Highway Road reserve, and which is rated as Condition 4-5. It is not expected that clearing adjacent to the Bush Forever areas which are not part of the road reserve will have a significant impact on their environmental values due to the low risk of erosion and the fact that there is already a significant weed presence in most areas.</p> <p>A search of the Department of Environmental Regulation's online Native Vegetation Map Viewer indicated a number of ESAs covering the Project area (DER 2014). These ESAs are TECs and associated buffers, and the areas covered by vegetation within 50 m of declared rare flora (DRF).</p>	<p>Proposal may be at variance to this Principle</p>
<p>i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.</p>	<p>The clearing of native vegetation is not considered likely to alter the quality of surface or ground waters within the Project area. The clearing area is small in relation to the overall water catchment for the area and most rainfall infiltrates through the sandy soils.</p> <p>There are no public drinking water supply areas within 5 km of the Project area.</p> <p>The clearing of native vegetation is not considered likely to alter the water table within the Project area due to the small area and the influence of groundwater from a large upstream catchment.</p>	<p>Proposal is not likely to be variance to this Principle</p>
<p>j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.</p>	<p>The clearing of native vegetation is not considered to cause any alteration to flood duration or flood height. Additional clearing will cause some increased infiltration of rainfall to the water table but flooding is not an issue in the general area due to sandy soils and deep drainage construction which has directed water to stormwater drains and basins across the airport and surrounds.</p>	<p>Proposal is not likely to be variance to this Principle</p>

7 IMPACTS AND MANAGEMENT OF VEGETATION CLEARING

As the Project area will require the clearing of native vegetation that is at variance with two, and may be at variance with four of the 10 Clearing Principles and involves areas of good quality vegetation in an ESA (TEC SCP 20a), a discussion of impacts and management of clearing is included.

7.1 Impacts

The following impacts are expected for the Project:

- ▶ Clearing of approximately 3.50 ha of vegetation in Beard Vegetation Association 1001 'Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina', and Heddle's Southern River Complex. Both vegetation characterisations are considered to be critical assets on the Swan Coastal Plain and in the Shire of Kalamunda.
- ▶ Clearing of 2.29 ha of vegetation that is considered to be similar to DPaW listed Threatened Ecological Community FCT SCP20a: *Banksia attenuata* woodland over species rich dense shrublands.
- ▶ Clearing of 0.76 ha of vegetation that is considered a possible transition between DPaW listed FCT SCP20a and FCT SCP3a *Eucalyptus [Corymbia] calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain.
- ▶ Clearing of approximately 4 ha of *Good* or better condition vegetation.
- ▶ Clearing of 19 plants of the Declared Rare Flora *Conospermum undulatum*.
- ▶ Clearing of 7 plants of the Priority 3 Flora *Isopogon drummondii*.
- ▶ Clearing of 9.29 ha of potential Black Cockatoo foraging habitat.
- ▶ Clearing of 80 suitable nesting trees for Black Cockatoo species, although the Project area is located outside the breeding range of both Baudin's Black Cockatoo and the Forest Red-tailed Black Cockatoo, and is just outside the known breeding range of the Carnaby's Black Cockatoo (DotE 2012).

7.2 Management

The Gateway WA CEMP will be utilised to manage the potential impacts of this Project and includes measures to:

- ▶ Avoid impacts to remnant native vegetation in the Project area where possible and to vegetation in the adjacent Bush Forever sites.
- ▶ Implement hygiene management for equipment onsite to minimise risk of dieback spread or infestation.
- ▶ Avoid clearing of DRF *Conospermum undulatum*, Priority 3 *Isopogon drummondii* and TEC vegetation where possible.
- ▶ Manage weeds to prevent further spread into adjacent conservation areas.
- ▶ Avoid erosion impacts to adjacent bushland.
- ▶ Rehabilitate where required with native vegetation species.

8 SUMMARY AND CONCLUSIONS

GHD undertook a biological survey of the Berkshire Road and Roe Highway intersection area in spring 2008. The area assessed for this survey consisted of the vegetation immediately surrounding the existing intersection for the previously proposed upgrade. In 2014, experienced staff from Gateway WA and GHD undertook a further biological survey of the newly proposed road upgrade area, which included additional areas to the north and south of the intersection, along Roe Highway (Figure 1).

The following is a summary of the investigations:

- ▶ The project area intersects three geomorphic wetlands, including Conservation Category Wetland (UFI 15077) and Multiple Use Wetland (UFI 15072) which are both located on the western side of Roe Highway in the south-western section of the Project area, and Resource Enhancement Wetland (UFI 13977), which covers a large portion of the Project area on the western side of Roe Highway both north and south of Berkshire Road. No vegetation associated with wetlands is present in the Project area. There is no standing water in any of these wetlands, and the areas are only seasonally damp.
- ▶ The Project area occurs in a location where there is a moderate to low risk of acid sulphate soil (ASS) occurring in soils >3 m depth.
- ▶ The Project area adjoins two Bush Forever Sites, Pioneer Park (Site 440) on the eastern side of Roe Highway and Dundas Road (Site 319) on the western side (Government of Western Australia 2000a; 2000b; 2012). Approximately 0.60 ha of Good-Degraded condition vegetation associated with these Bush Forever sites will be cleared for the Project. A number of ESAs were also identified covering the Project area (DER 2014). The ESAs are TECs and associated buffers and the areas covered by vegetation within 50 m of Threatened flora.
- ▶ Six vegetation types were recorded within the Project area, ranging from areas that are Completely Degraded to Excellent-Very Good condition.
- ▶ Most of the vegetation within the Project area is considered to be *Uninterpretable* for the presence of *Phytophthora cinnamomi* (Dieback); however, the intact vegetation on the Roe Highway road reserve appears to be Dieback free.
- ▶ Vegetation Association 1001 is classified as Vulnerable (at the State, IBRA bioregion and IBRA sub-region scales) but is not considered to be a Critical Asset as it contains more than 10% remaining on a State, IBRA bioregion and IBRA sub-region level. At the local government scale (within the Shire of Kalamunda), Vegetation Association 1001 has less than 10% of its pre-European extent, and is therefore considered to be Endangered and a critical asset within the Shire of Kalamunda.
- ▶ Mapping of vegetation communities by Hedde *et al.* (1980) has identified the Project area within the Southern River Complex, which is also considered *Vulnerable* at the State, IBRA bioregion, IBRA sub-region and local government area levels.
- ▶ One Threatened Ecological Community was identified in the Project area. This vegetation type has close affinities to the floristic community type (FCT) of Gibson *et al.* (1994) Swan Coastal Plain (SCP) 20a *Banksia attenuata* woodland over species rich dense shrublands. Another vegetation type appears to be a gradient between the FCT SCP 20a and FCT 3a: *Eucalyptus calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal

Plain. Approximately 3.05 ha of vegetation associated with these floristic communities will be cleared for this Project.

- ▶ One Threatened flora species (*Conospermum undulatum*) was recorded within the Project area. Forty nine *Conospermum undulatum* plants were identified in the field assessment and nineteen (19) will be removed as a result of this Project.
- ▶ One Priority Three Flora species (*Isopogon drummondii*) was recorded within the Project area. Forty two *Isopogon drummondii* were identified in the field assessment and seven (7) will be removed during clearing for this Project.
- ▶ One fauna species of conservation significance was heard within the vicinity of the Project area: the Vulnerable Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*). Two other species, the Endangered Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Vulnerable Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are considered likely to occur. The Quenda (*Isoodon obesulus fusciventer*) may possibly occur.
- ▶ Habitat for the Quenda was also identified in strips of degraded Jarrah/Marri woodland and areas of Banksia woodland.
- ▶ The Project area forms part of an ecological linkage that provides vegetation along Roe Highway.
- ▶ A Black Cockatoo assessment was undertaken according to the EPBC Act Significant Impact Guidelines 1.1 (DotE, 2012). Based on this assessment, the Project is unlikely to have a significant impact on Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo or Baudin's Cockatoo.
- ▶ The assessment against the 10 Clearing Principles found the Project is at variance with two of the ten principles and may be at variance with four principles.

9 REFERENCES

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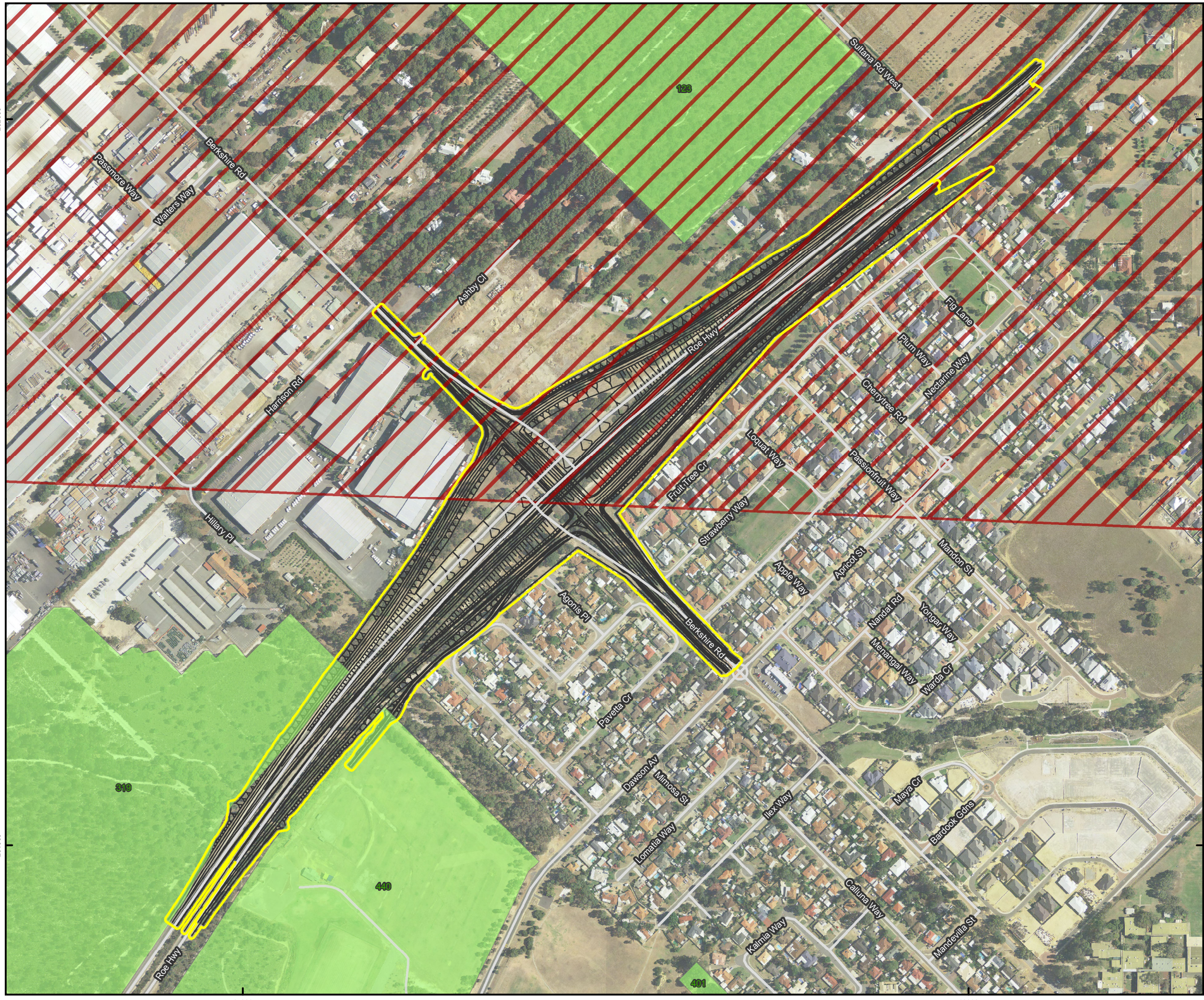
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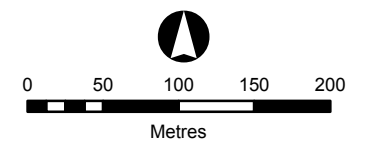
APPENDIX A: FIGURES

- | | |
|----------|---|
| Figure 1 | Project area location |
| Figure 2 | Geomorphic wetlands |
| Figure 3 | Project area environmental constraints |
| Figure 4 | Project area vegetation types |
| Figure 5 | Project area vegetation condition |
| Figure 6 | Project area Black Cockatoo habitat trees |



Project Location

Figure 1



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

-  Project design
-  Project area
-  Aboriginal heritage
-  Bush Forever sites

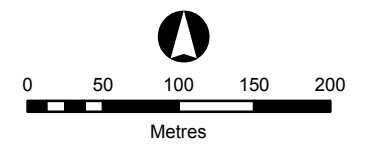
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Geomorphic Wetlands

Figure 2

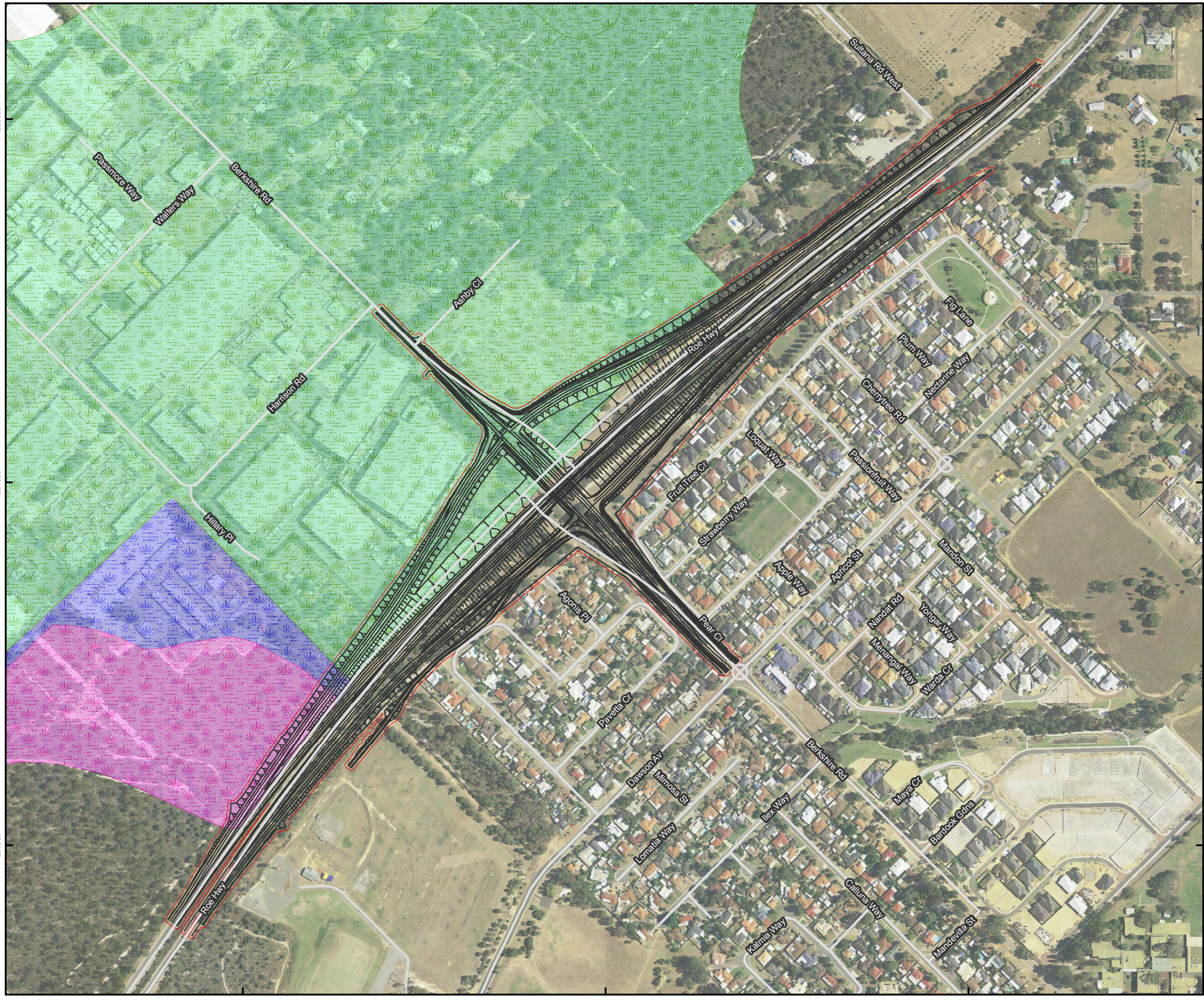


1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

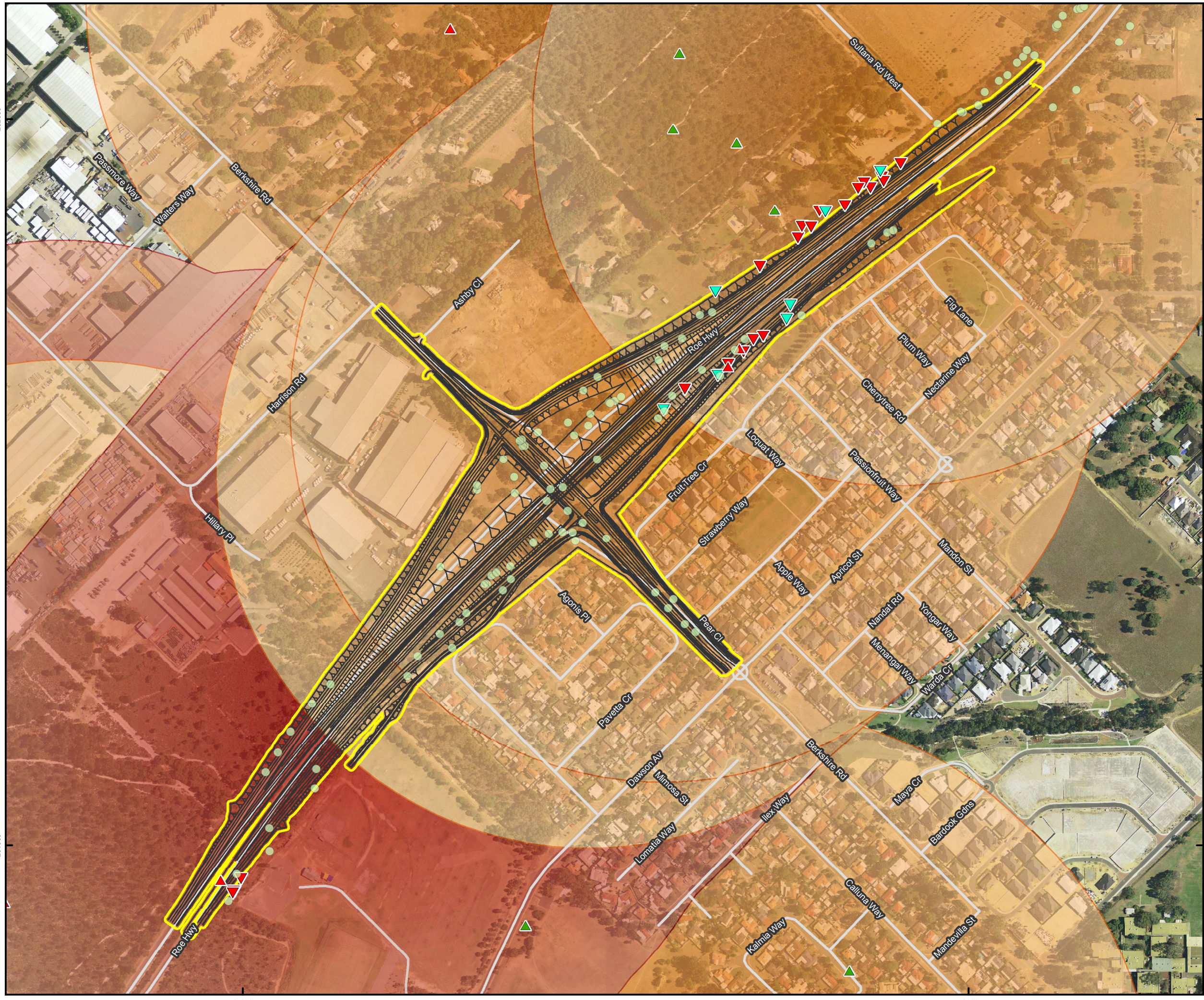
- Project design
- Project area
- Geomorphic wetlands**
 - Conservation
 - Multiple Use
 - Resource Enhancement



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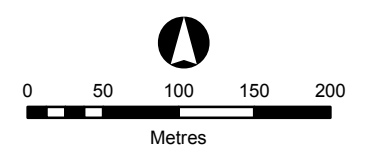
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Environmental constraints

Figure 3



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

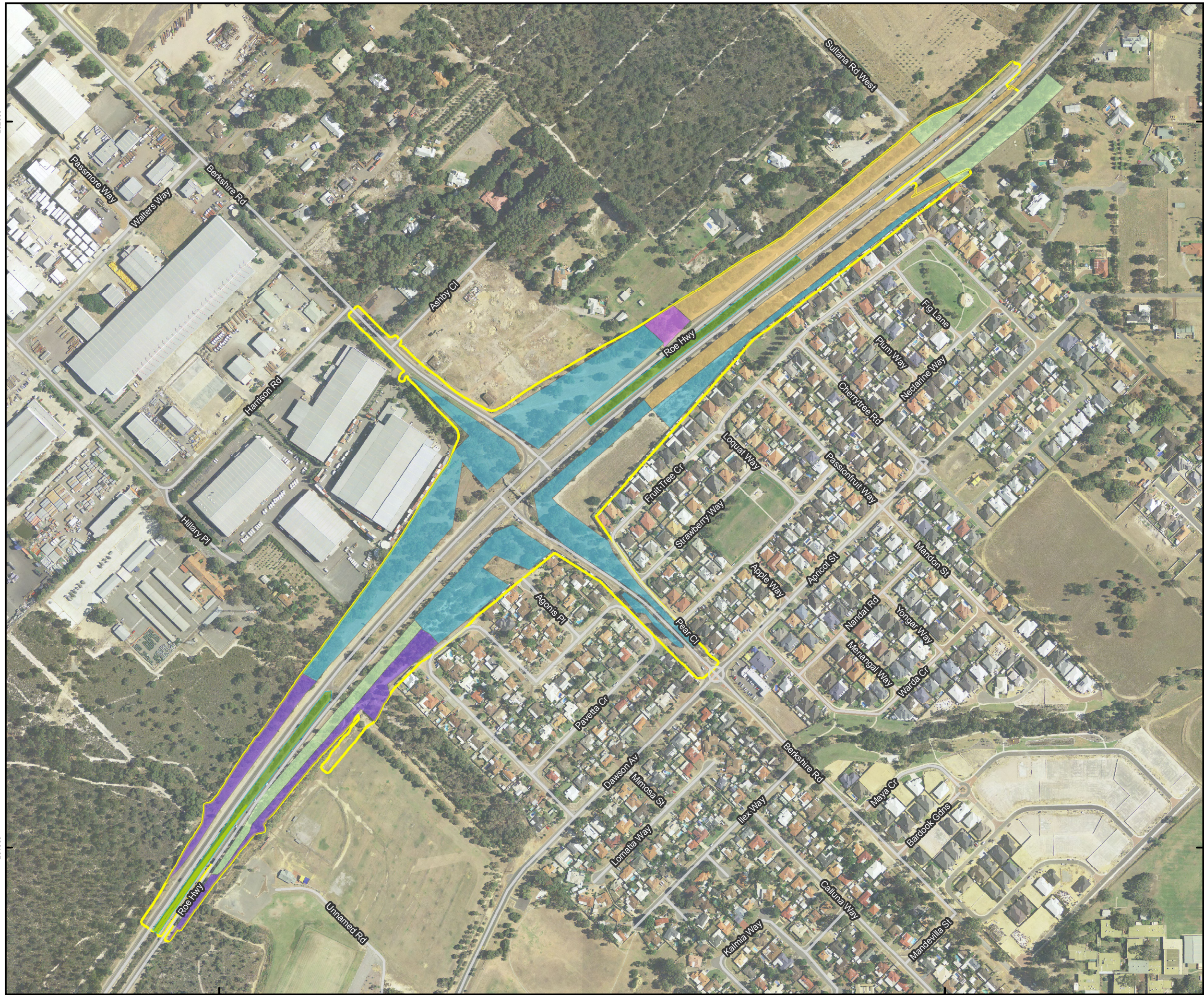
LEGEND

- Cockatoo Tree Location
- Threatened and Priority Species**
- DPaW records**
- ▲ (T) Threatened Flora - Extant Taxa
- ▲ Priority 3 - Poorly Known Taxa
- Gateway WA surveyed rare flora**
- ▼ Declared RareFlora - *Conospermum*
- ▼ Priority 4 *Isopogon drummondii*
- Project design
- ▭ Project area
- Threatened Ecological Community**
- ▭ Critically Endangered
- ▭ Endangered

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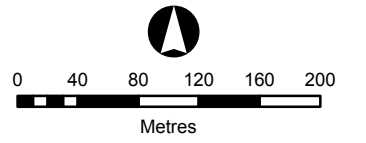
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Vegetation type

Figure 4



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

- Project area
- Project design

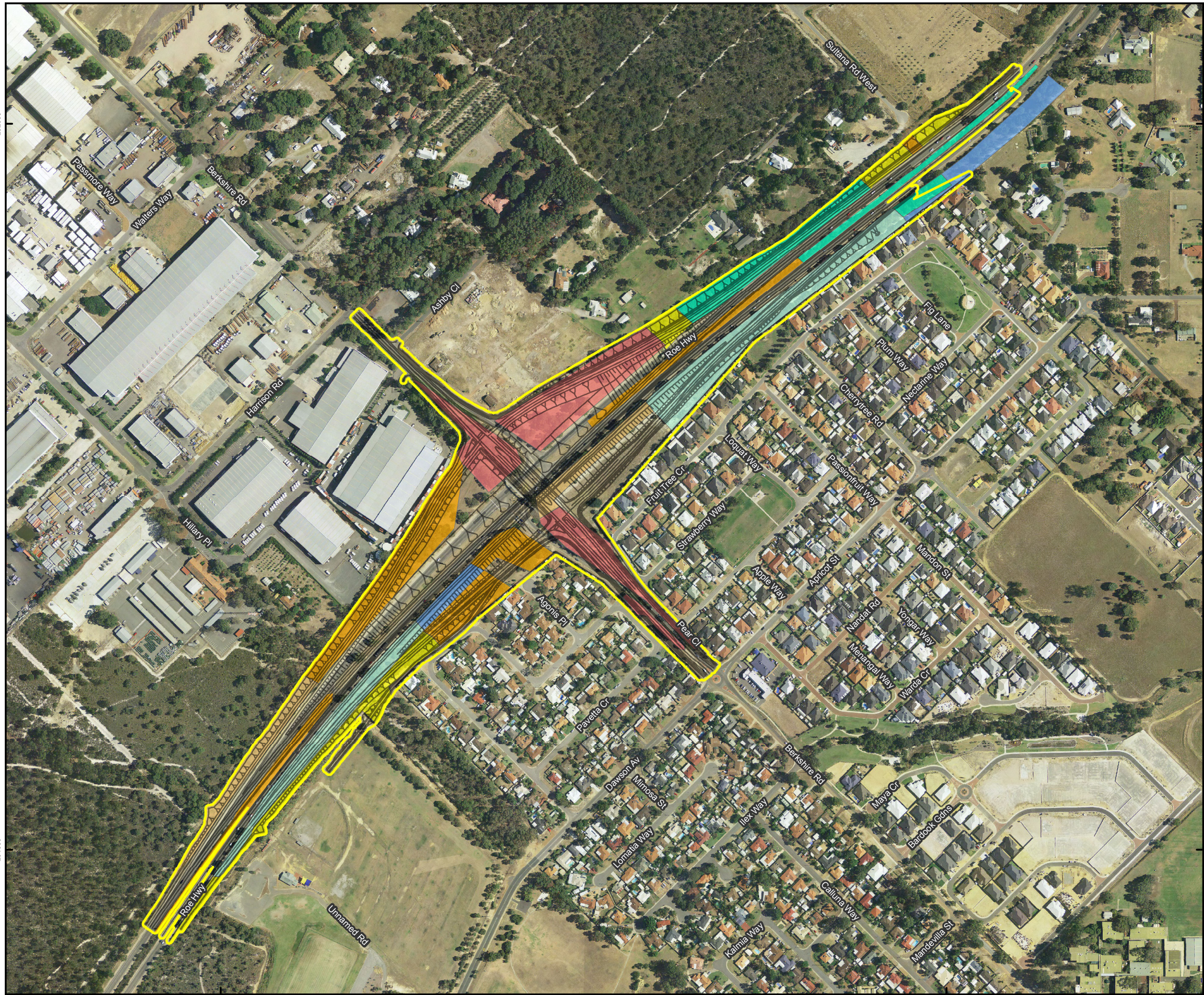
Vegetation type

- Banksia menziesii* open forest with scattered *Eucalyptus marginata* and patches of *Allocasuarina fraseriana* over dense low shrubland and dense herbs and sedges
- Corymbia calophylla* woodland with scattered *Eucalyptus marginata* and occasional *Allocasuarina fraseriana*, over mixed low shrubs over dense herbs and sedges
- Mixed, scattered trees of Jarrah (*Eucalyptus marginata*), Flooded Gum (*E.camaldulensis*) and Marri (*Corymbia calophylla*) with planted non-native trees and shrubs over introduced hermland
- Planted and natural Eucalypts and shrubs including *Eucalyptus marginata*, *Corymbia calophylla* with patches of naturalised shrubs including Geraldton Wax (*Chamelaucium undulatum*), *Hakea trifurcata*, *Calothamnus* sp. and scattered, native understorey species
- Tall, dense shrubland of mixed planted native and non-native species
- Banksia sessilis* closed forest with occasional *Allocasuarina fraseriana* over open mixed shrub

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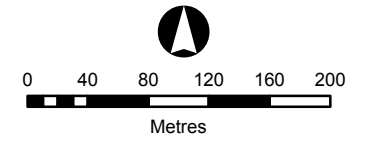
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Vegetation condition

Figure 5



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

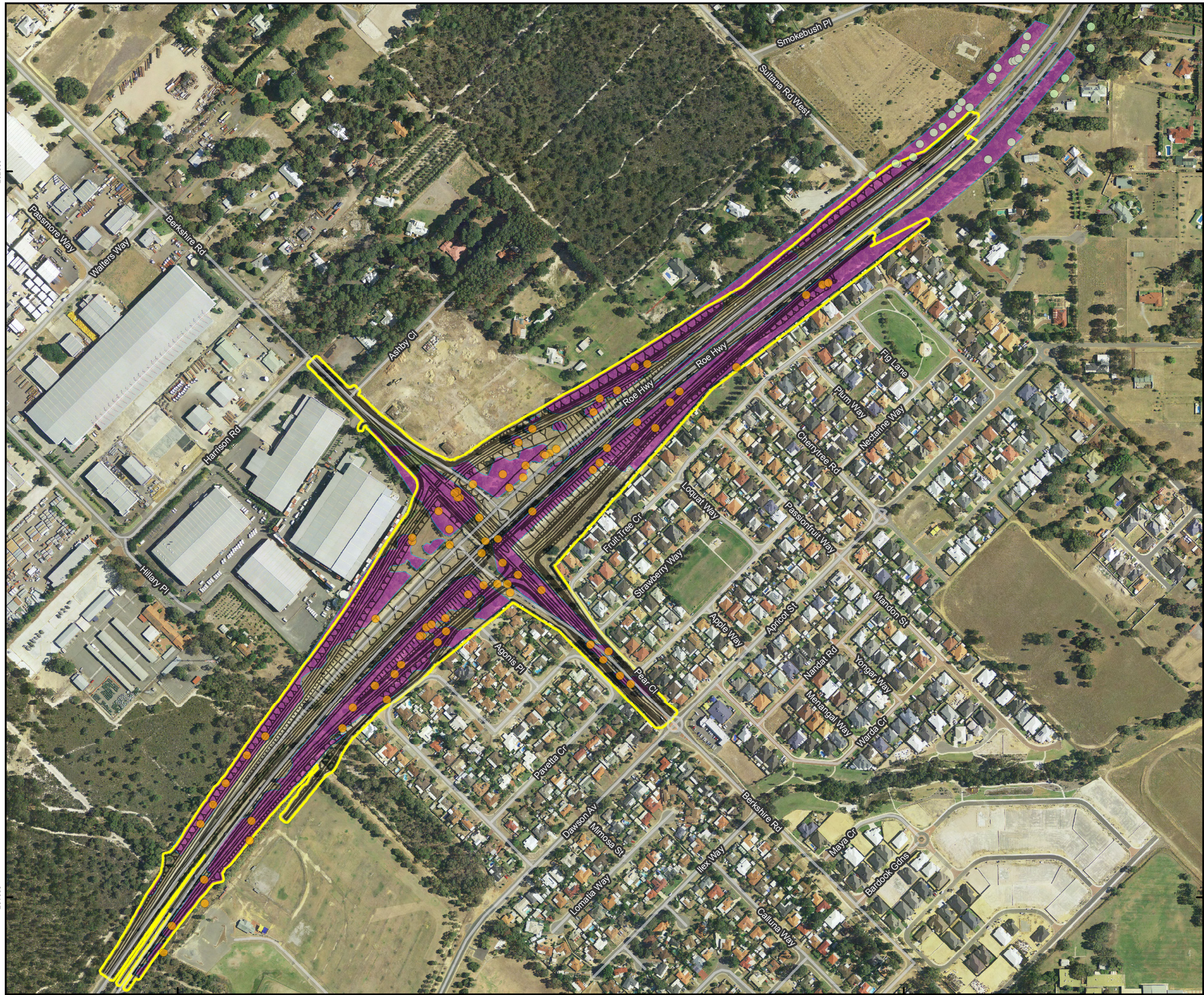
LEGEND

- Project design
- ▭ Project area
- Vegetation Condition**
- ▭ 1. Pristine
- ▭ 1-2
- ▭ 2. Excellent
- ▭ 2-3
- ▭ 3. Very Good
- ▭ 3-4
- ▭ 4. Good
- ▭ 4-5
- ▭ 5. Degraded
- ▭ 5-6

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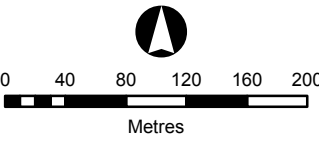
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Black Cockatoo habitat

Figure 6



1:5,000 (A3)

GDA 1994 Perth Coastal Grid 1994

LEGEND

- Cockatoo Tree location
- Black Cockatoo Habitat Tree (DBH > 500 mm)
- Project design
- Project area
- Black Cockatoo Habitat

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67000

68000

APPENDIX B: DESKTOP SEARCH RESULTS



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 23/01/14 15:49:22

[Summary](#)

[Details](#)

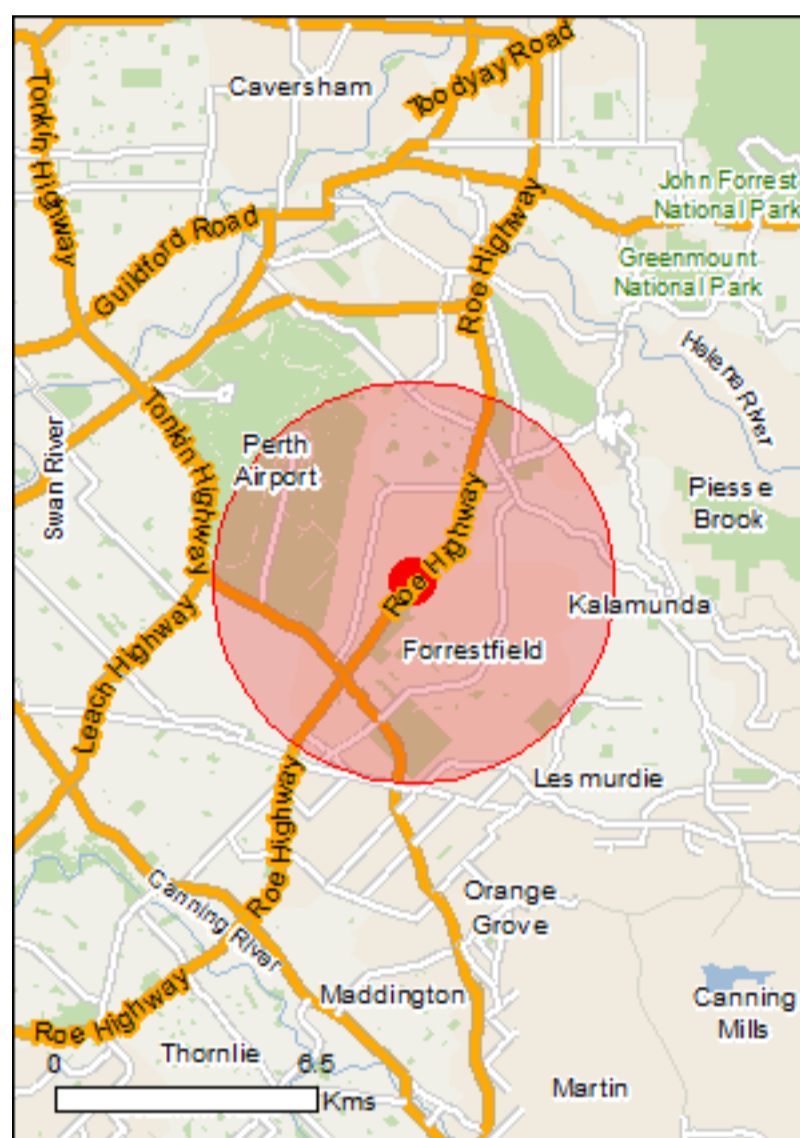
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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[Coordinates](#)

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	33
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	2
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	9
State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	43
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Claypans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Shrublands and Woodlands of the eastern Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
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	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Pseudocheirus occidentalis Western Ringtail Possum [25911]	Vulnerable	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat likely to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Banksia mimica Summer Honey-pot [82765]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Calytrix breviseta subsp. breviseta Swamp Starflower [23879]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [64649]	Endangered	Species or species habitat may occur within area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat likely to occur within area
Darwinia apiculata Scarp Darwinia [8763]	Endangered	Species or species habitat likely to occur within area
Darwinia foetida Mucea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D.Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat may occur within area
Thelymitra manginii K.Dixon & Batty ms. [67443]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area
Verticordia fimbrialepis subsp. fimbrialepis Shy Featherflower [24631]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land

[\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name

Commonwealth Land -
Defence - BUSHMEAD RIFLE RANGE
Defence - BUSHMEAD TRAINING AREA

Commonwealth Heritage Places

[\[Resource Information \]](#)

Name

State

Status

Natural

[Forrestfield Bushland](#)

WA

Indicative Place

[Munday Swamp and Surrounding Bushland](#)

WA

Indicative Place

Listed Marine Species

[\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name

Threatened

Type of Presence

Birds

[Apus pacificus](#)

Fork-tailed Swift [678]

Species or species habitat likely to occur within area

[Ardea alba](#)

Great Egret, White Egret [59541]

Species or species habitat known to occur within area

[Ardea ibis](#)

Cattle Egret [59542]

Species or species habitat likely to 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

[Pandion haliaetus](#)

Osprey [952]

Species or species habitat may occur within area

[Rostratula benghalensis \(sensu lato\)](#)

Painted Snipe [889]

Endangered*

Species or species habitat may occur within area

Extra Information

Places on the RNE [\[Resource Information \]](#)

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Midgegooroo and Kalleep Munday Heritage Precincts	WA	Indicative Place
Brixton Street and Associated Wetlands	WA	Registered
Bushmead Rifle Range Area	WA	Registered
Bushmead Rifle Range Commonwealth Area	WA	Registered
Forrestfield Bushland	WA	Registered
Lesmurdie Falls National Park	WA	Registered
Munday Swamp Bushland	WA	Registered
Munday Swamp and Surrounding Bushland	WA	Registered
Indigenous		
Forrestfield Scarred Tree	WA	Registered

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Kenwick Wetlands	WA
Lesmurdie Falls	WA
Unnamed WA23076	WA
Unnamed WA24657	WA
Unnamed WA29815	WA
Unnamed WA37997	WA
Unnamed WA49079	WA

Regional Forest Agreements [\[Resource Information \]](#)

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [\[Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within

Name	Status	Type of Presence area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake,		Species or species

Name	Status	Type of Presence
Cacing Besi [1258]		habitat likely to occur within area

Nationally Important Wetlands [\[Resource Information \]](#)

Name	State
Brixton Street Swamps	WA
Perth Airport Woodland Swamps	WA

Coordinates

-31.96954 116.00105

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

APPENDIX C: FAUNA

**Likelihood of occurrence of conservation significant
fauna within the Project area**

Fauna species recorded in the Project area

Table B Fauna species recorded in the Project area during 2008 survey

Family	Genus	Species	Common Name	Status
Birds				
<i>Cracticidae</i>	<i>Cracticus</i>	<i>tibicen dorsalis</i>	Australian Magpie	
<i>Meliphagidae</i>	<i>Anthochaera</i>	<i>carunculata</i>	Red Wattlebird	
<i>Psittacidae</i>	<i>Cacatua</i>	<i>roseicapilla</i>	Galah	
<i>Psittacidae</i>	<i>Calyptorhynchus</i>	<i>banksii naso</i>	Forest Red-tailed Black Cockatoo	Schedule 1 (WC Act) Vulnerable (EPBC Act)
<i>Psittacidae</i>	<i>Platycercus</i>	<i>zonarius semitorquatus</i>	Twenty-eight Parrot	
Mammals				
<i>Canidae</i>	<i>Canis</i>	<i>familiaris</i>	Domestic Dog	Introduced
Reptiles				
<i>Scincidae</i>	<i>Ctenotus</i>	sp.		

Table C Conservation significant fauna likelihood of occurrence assessment

Species Name	Common Name	Status (WC Act/DPaW; EPBC Act)	Search		Description and habitat requirements	Likelihood of occurrence
			Naturemap	PMST		
Birds						
<i>Calyptorhynchus banksia naso</i>	Forest Red-tailed Black-Cockatoo	T; Vu	X	X	Typically dense Jarrah (<i>Eucalyptus marginata</i>), Karri (<i>E. diversicolor</i>) and Marri (<i>Corymbia calophylla</i>) forests, however the species 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 Blackbutt, Yate (<i>E. cornuta</i>), and Flooded Gum (<i>E. rudis</i>) (DotE, 2012).	Present – This species was heard within the Project area during the 2008 field survey. There is suitable foraging and potential breeding habitat present within the Project area.
<i>Calyptorhynchus baudinii</i>	Baudin's Black Cockatoo	T; Vu	X	X	Baudin's Black Cockatoo occurs in high-rainfall areas, usually at sites that are heavily forested and dominated by Marri (<i>Corymbia calophylla</i>) and Eucalyptus species, especially Karri (<i>E. diversicolor</i>) and Jarrah (<i>E. marginata</i>). The species also occurs in woodlands of Wandoo (<i>E. wandoo</i>), Blackbutt (<i>E. patens</i>), Flooded Gum (<i>E. rudis</i>), and Yate (<i>E. cornuta</i>). Baudin's Black Cockatoo breeds in the Jarrah, Marri and Karri forests of the deep south-west in areas averaging more than 750 mm of rainfall annually (DotE, 2012).	Likely - There is suitable foraging and potential breeding habitat for this species present within the Project area.
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	T; En	X	X	This species mainly occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. The species also occurs in forests containing Marri (<i>Corymbia calophylla</i>), Jarrah (<i>Eucalyptus marginata</i>) or Karri (<i>E. diversicolor</i>). Breeding usually occurs in the Wheatbelt region of Western	Likely - There is suitable foraging and potential breeding habitat for this species present within the Project area.

Species Name	Common Name	Status (WC Act/DPaW; EPBC Act)	Search		Description and habitat requirements	Likelihood of occurrence
			Naturemap	PMST		
					Australia, with flocks moving to the higher rainfall coastal areas to forage after the breeding season. Feeds on the seeds of a variety of native plants, including Allocasuarina, Banksia, Dryandra, Eucalyptus, Grevillea and Hakea, and some introduced plants (DotE, 2012).	
Mammals						
<i>Dasyurus geoffroii</i>	Chuditch Western Quoll	T; Vu	X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, <i>Eucalyptus marginata</i>), dry woodland and mallee shrublands. In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Most diurnal resting sites in sclerophyll forest consist of hollow logs or earth burrows (Van Dyke & Strahan, 2008). The species can travel large distances, has a large home range and is sparsely populated through a large portion of its range.	Unlikely – Due to the small size and long linear nature of Project area, and the lack of connectivity to larger tracts of native vegetation, this species is unlikely to occur.
<i>Phascogale tapoatafa tapoatafa</i>	Southern Brush-tailed Phascogale	T; -	X		The Southern Brush-tailed Phascogale typically occur in dry sclerophyll forests and open woodlands with a sparse ground-storey, which contain suitable nesting resources such as tree hollows, rotted stumps and tree cavities (Van Dyck and Strahan, 2008).	Unlikely – There is no suitable habitat for this species within the Project area.
<i>Isodon obesulus fusciventer</i>	Quenda / Southern Brown Bandicoot	P5; -	X		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	Possible – There is some suitable habitat for this species, and given proximity to other areas of remnant bushland where this species is

Species Name	Common Name	Status (WC Act/DPaW; EPBC Act)	Search		Description and habitat requirements	Likelihood of occurrence
			Naturemap	PMST		
					basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan, 2008).	known to occur, it may possibly occur in the Project area.
<i>Hydromys chrysogaster</i>	Water-rat	P4; -	X		Water-rats live primarily in a wide variety of freshwater habitats, from sub-alpine streams and other inland waterways to lakes, swamps, farm dams and irrigation channels and are thought to be one of the few native species to have at least partially benefited from human encroachment (Van Dyck and Strahan, 2008).	Unlikely – There is no suitable habitat for this species within the Project area.
<i>Macropus irma</i>	Western Brush Wallaby	P4; -	X		The Western Brush Wallaby is a grazer 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. This species was once very common in the south-west of Western Australia but has undergone a reduction in range and a significant decline in abundance in its current habitat. (Van Dyke & Strahan, 2008).	Unlikely – Due to the small size and long linear nature of Project area, and the lack of connectivity to larger tracts of native vegetation, this species is unlikely to occur.
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	T; Vu		X	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 occurs in Jarrah (<i>Eucalyptus marginata</i>) forest and Jarrah-Marri (<i>Corymbia calophylla</i>) forest associated with Peppermint Tree (Van Dyck and Strahan, 2008).	Unlikely – The Western Ringtail Possum is known to occur southern Swan Coastal Plain, however it doesn't occur as far north as the Project area.
<i>Setonix brachyurus</i>	Quokka	T; Vu		X	Dense forests and thickets, streamside vegetation, heaths and shrublands <i>Agonis linearifolia</i> -dominated swamps in the Jarrah (<i>Eucalyptus</i>	Unlikely - There is no suitable habitat present for the

Species Name	Common Name	Status (WC Act/DPaW; EPBC Act)	Search		Description and habitat requirements	Likelihood of occurrence
			Naturemap	PMST		
					<i>marginata</i>) forest. The northern extent of the current distribution 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 millimetres or more (Van Dyck and Strahan, 2008).	Quokka within the Project area, and the species is not known to occur on the Swan Coastal Plain.
Reptiles						
<i>Neelaps calonotos</i>	Black-striped Snake	P3; -	X		This species is restricted to the sandy coastal strip, between Mandurah and Dongara. It occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands. This species is seriously threatened by increasing development and habitat loss within its restricted distribution (Wilson and Swan, 2013).	Unlikely – There is very limited suitable habitat for this species within the Project area.
<i>Pseudemydura umbrina</i>	Western Swamp Turtle tortoise	T; En	X		The species currently occurs in a single viable population in the wild, with a further two populations maintained by supplementation with translocated individuals. The Ellen Brook Nature Reserve population is the only viable, naturally occurring population in the wild. The Twin Swamps Nature Reserve and Mogumber Nature Reserve populations are maintained with translocated individuals. Habitat critical for the survival of this species includes land within the fox-proof fenced areas at Twin Swamps Nature Reserve and Ellen Brook Nature Reserve; all land within Mogumber Nature Reserve; land in which surface water catchments extend outside of the nature reserves; any land where wild populations are detected in	Unlikely – There is no suitable habitat for this species within the Project area.

Species Name	Common Name	Status (WC Act/DPaW; EPBC Act)	Search		Description and habitat requirements	Likelihood of occurrence
			Naturemap	PMST		
					the future; and land targeted for the introduction or reintroduction of this species (Burbridge & Kuching 2004).	
<i>Morelia spilota imbricata</i>	Carpet Python	Sch 4	X		The Carpet Python occurs in a large range of habitats including woodlands, forests and dense coastal scrub, on granite and limestone outcrops and along watercourses. The distribution of the species is from Geraldton and Yalgoo in the North east to Pinjin, Kalgoorlie, Fraser Range and most of the remaining south west. It is often arboreal and preys on birds, other reptiles and small to medium size mammals. The carpet python generally occurs in large, undisturbed bush; and areas, preferring coastal limestone and woodlands on the Swan Coastal Plain (Bush et al. 2010).	Unlikely – There is no suitable habitat for this species within the Project area.

APPENDIX D: FLORA

**Flora species recorded within Project area –
October 2008 and January 2014**

Flora species recorded within Project area – October 2008 and January 2014

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
Agavaceae	Agave	americana	Century Plant	*low	x							
Aizoaceae	Lampranthus	roseus	Rosy Dew Plant	*					x			
Anacardiaceae	Schinus	terebinthifolius	Pepper Tree	*					x			x
Apiaceae	Foeniculum	vulgare	Fennel	*				x				
Apiaceae	Trachymene	pilosa	Native Parsnip			x	x					
Aspargaaceae	Chamaescilla	corymbosa	Blue Squill			x	x					
Asparagaceae	Laxmannia	squarrosa							x			
Asparagaceae	Thysanotus	sparteus	Fringed Lily						x			
Asteraceae	Arctotheca	calendula	Capeweed	*mod	x	x				x	x	x
Asteraceae	Conyza	sumatrensis		*low		x						
Asteraceae	Cotula	turbinata	Funnel Weed	*low	x						x	
Asteraceae	Dimorphotheca	ecklonis	Veldt Daisy	*low				x				
Asteraceae	Gazania	linearis	Gazania	*low	x							
Asteraceae	Hedypnois	rhagalioides	Cretan Weed	*mild					x	x		
Asteraceae	Helichrysum	luteoalbum	Jersey Cudweed			x						
Asteraceae	Hypochaeris	glabra	Flatweed	*mod	x	x	x		x	x	x	x
Asteraceae	Podotheca	angustifolia	Sticky Longheads			x	x					
Asteraceae	Sonchus	oleraceus	Sowthistle	*mod	x	x				x		
Asteraceae	Urospermum	picroides	False Hawkbit	*mod	x							

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Ursinia	*mod		x	x			x		x
Boraginaceae	<i>Echium</i>	<i>plantagineum</i>	Paterson's Curse	*DP	x			x				
Brassicaceae	<i>Raphanus</i>	<i>raphanistrum</i>	Wild Radish	*mild	x				x			
Cactaceae	<i>Opuntia</i>	<i>stricta</i>	Prickly Pear	*DP	x	x						
Caryophyllaceae	<i>Cerastium</i>	<i>glomeratum</i>	Mouse Ear Chickweed	*low							x	
Caryophyllaceae	<i>Petrorhagia</i>	<i>dubia</i>		*mild	x							
Casuarinaceae	<i>Allocasuarina</i>	<i>fraseriana</i>	Sheoak		x	x	x					x
Casuarinaceae	<i>Allocasuarina</i>	<i>fraseriana</i>	Sheoak	+				x	x			
Casuarinaceae	<i>Allocasuarina</i>	<i>humilis</i>	Dwarf Sheoak			x			x			x
Centrolepidaceae	<i>Centrolepis</i>	<i>aristata</i>	Pointed Centrolepis			x	x		x			
Centrolepidaceae	<i>Centrolepis</i>	<i>drummondiana</i>				x	x					
Colchicaceae	<i>Burchardia</i>	<i>congesta</i>	Milkmaids			x	x					x
Convolvulaceae	<i>Ipomoea</i>	<i>cairica</i>	Morning Glory	*	x							
Cupressaceae	<i>Callitris</i>	<i>preissii</i>	Rottnest Island Pine	+				x				
Cyperaceae	<i>Caustis</i>	<i>dioica</i>	Chinese Puzzle Box			x			x			x
Cyperaceae	<i>Lepidosperma</i>	<i>squamatum</i>				x			x			x
Cyperaceae	<i>Lepidosperma</i>	<i>pubisquamatum</i>				x	x					
Cyperaceae	<i>Mesomelaena</i>	<i>pseudostygia</i>				x	x		x			x
Cyperaceae	<i>Mesomelaena</i>	<i>tetragona</i>	Semaphore Sedge			x	x		x			
Cyperaceae	<i>Schoenus</i>	<i>caespititius</i>							x			

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
<i>Cyperaceae</i>	<i>Schoenus</i>	<i>grandiflorus</i>	Bog Rush						x			
<i>Dasyopogonaceae</i>	<i>Dasyopogon</i>	<i>bromeliifolius</i>	Pineapple Bush			x	x		x			x
<i>Dasyopogonaceae</i>	<i>Lomandra</i>	<i>caespitosa</i>	Tufted Mat Rush			x						x
<i>Dasyopogonaceae</i>	<i>Lomandra</i>	<i>longifolia</i>	Spiny-headed Matrush	+							x	x
<i>Dasyopogonaceae</i>	<i>Lomandra</i>	<i>nigricans</i>				x	x					
<i>Dasyopogonaceae</i>	<i>Lomandra</i>	<i>preissii</i>	Preiss' Mat Rush			x	x					x
<i>Dilleniaceae</i>	<i>Hibbertia</i>	<i>huegelii</i>				x						
<i>Dilleniaceae</i>	<i>Hibbertia</i>	<i>hypericoides</i>	Yellow Buttercups			x	x		x			x
<i>Droseraceae</i>	<i>Drosera</i>	<i>erythrorhiza</i>	Red Ink Sundew			x	x					
<i>Droseraceae</i>	<i>Drosera</i>	<i>gigantea</i>	Giant Sundew						x			
<i>Droseraceae</i>	<i>Drosera</i>	<i>stolonifera</i>	Leafy Sundew						x			
<i>Ericaceae</i>	<i>Conostephium</i>	<i>?pendulum</i>				x						
<i>Ericaceae</i>	<i>Leucopogon</i>	<i>squarrosus</i>				x	x					
<i>Euphorbiaceae</i>	<i>Euphorbia</i>	<i>terracina</i>	Geraldton Carnation Weed	*high	x				x	x		
<i>Euphorbiaceae</i>	<i>Ricinocarpos</i>	<i>glaucus (cultivar)</i>	Wedding Bush	+							x	
<i>Fabaceae</i>	<i>Acacia</i>	<i>iteaphylla</i>	Flinders Range Wattle	*						x		
<i>Fabaceae</i>	<i>Acacia</i>	<i>podalyriifolia</i>		*low					x			
<i>Fabaceae</i>	<i>Acacia</i>	<i>saligna</i>	Coojong	+	x			x	x	x		x
<i>Fabaceae</i>	<i>Acacia</i>	<i>saligna</i>	Coojong			x			x			
<i>Fabaceae</i>	<i>Acacia</i>	<i>wildenowiana</i>	Grass Wattle						x			

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
<i>Fabaceae</i>	<i>Bossiaea</i>	<i>eriocarpa</i>	Common Brown Pea			x	x		x			x
<i>Fabaceae</i>	<i>Chamaecytisus</i>	<i>palmensis</i>	Tagasaste	*mild						x		x
<i>Fabaceae</i>	<i>Daviesia</i>	<i>decurrens</i>	Prickly Bitter-pea			x			x			
<i>Fabaceae</i>	<i>Daviesia</i>	<i>decurrens</i>	Prickly Bitter-pea	+					x			
<i>Fabaceae</i>	<i>Daviesia</i>	<i>incrassata</i>							x			
<i>Fabaceae</i>	<i>Daviesia</i>	<i>nudiflora</i>				x	x		x			x
<i>Fabaceae</i>	<i>Eutaxia</i>	<i>sp. cultivar</i>		+							x	
<i>Fabaceae</i>	<i>Gastrolobium</i>	<i>calycinum</i>	York Road Poison	+					x			
<i>Fabaceae</i>	<i>Gompholobium</i>	<i>knightianum</i>				x						
<i>Fabaceae</i>	<i>Gompholobium</i>	<i>confertum</i>				x			x			
<i>Fabaceae</i>	<i>Gompholobium</i>	<i>tomentosum</i>	Hairy Yellow Pea			x	x					
<i>Fabaceae</i>	<i>Hovea</i>	<i>trisperma var. trisperma</i>	Common Hovea			x	x		x			
<i>Fabaceae</i>	<i>Jacksonia</i>	<i>lehmannii</i>				x	x		x			
<i>Fabaceae</i>	<i>Jacksonia</i>	<i>floribunda</i>	Holly Pea						x			
<i>Fabaceae</i>	<i>Labichea</i>	<i>punctata</i>	Lance-leafed Cassia			x	x		x			
<i>Fabaceae</i>	<i>Lotus</i>	<i>angustissimus</i>	Narrowleaf Trefoil	*low	x							
<i>Fabaceae</i>	<i>Lupinus</i>	<i>cosentinii</i>	Western Australian Blue Lupin	*high	x	x				x	x	
<i>Fabaceae</i>	<i>Medicago</i>	<i>polymorpha</i>	Medic Burr	*mild	x							
<i>Fabaceae</i>	<i>Ornithopus</i>	<i>pinnatus</i>	Slender Serradella	*low	x							
<i>Fabaceae</i>	<i>Robinia</i>	<i>pseudoacacia</i>	Black Locust	+/*low	x							

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
Fabaceae	Trifolium	angustifolium	Narrowleaf Clover	*low	x				x	x		
Fabaceae	Trifolium	arvense	Hare's Foot Clover	*mod	x				x			
Fabaceae	Trifolium	campestre	Hop Clover	*mod	x					x	x	x
Fabaceae	Trifolium	hirtum	Rose Clover	*low	x					x		x
Fabaceae	Trifolium	scabrum	Rough Clover	*mild	x					x		
Geraniaceae	Erodium	cicutarium	Common Storksbill	*mod	x					x		
Geraniaceae	Erodium	moschatum	Musky Crowsfoot	*low	x							
Goodeniaceae	Dampiera	linearis	Common Dampiera			x	x		x			
Goodeniaceae	Lechenaultia	biloba	Blue Leschenaultia			x	x				x	
Goodeniaceae	Lechenaultia	expansa				x	x		x			x
Goodeniaceae	Scaevola	sp. (insufficient material)		+		x			x			
Goodeniaceae	Scaevola	crassifolia	Thick-leaved Fanflower	+							x	
Goodeniaceae	Scaevola	repens var repens							x			
Haemodoraceae	Anigozanthos	manglesii	Mangles Kangaroo Paw			x	x		x			
Haemodoraceae	Anigozanthos	sp. cultivar		+							x	
Haemodoraceae	Conostylis	juncea				x			x			
Haemodoraceae	Haemodorum	?laxum (insufficient material)							x			
Haemodoraceae	Haemodorum	spicatum	Mardja						x			
Haemodoraceae	Haemodorum	sp. (insufficient material)				x						
Hemerocalidaceae	Stypantra	glauca	Blind Grass			x						

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
<i>Hemerocalidaceae</i>	<i>Tricoryne</i>	<i>elator</i>	Yellow Autumn Lilly			x						xx
<i>Hyacinthaceae</i>	<i>Lachenalia</i>	<i>bulbifera</i>		+							x	
<i>Iridaceae</i>	<i>Babiana</i>	<i>sp. (insufficient material)</i>	Baboon Flower	*					x	x		
<i>Iridaceae</i>	<i>Chasmanthe</i>	<i>floribunda</i>	African Cornflag	*mod		x						x
<i>Iridaceae</i>	<i>Freesia</i>	<i>alba x leichtlinii</i>	Freesia	*					x			
<i>Iridaceae</i>	<i>Gladiolus</i>	<i>caryophyllaceus</i>	Wild Gladiolus	*mod					x			
<i>Iridaceae</i>	<i>Patersonia</i>	<i>occidentalis</i>	Purple Flags			x	x		x	x		x
<i>Iridaceae</i>	<i>Romulea</i>	<i>rosea</i>	Guildford Grass	*high	x	x	x		x	x		
<i>Lamiaceae</i>	<i>Hemandra</i>	<i>pungens</i>	Snakebush									
<i>Lauraceae</i>	<i>Cassytha</i>	<i>sp. (insufficient material)</i>							x			
<i>Malvaceae</i>	<i>Malva</i>	<i>parviflora</i>	Marshmallow	*low	x							
<i>Malvaceae</i>	<i>Thomasia</i>	<i>macrocarpa</i>	Large fruited Thomasia						x			
<i>Meliaceae</i>	<i>Melia</i>	<i>azedarach</i>	White Cedar	*	x				x			
<i>Myoporaceae</i>	<i>Eremophila</i>	<i>glabra</i>		+							x	
<i>Myrtaceae</i>	<i>Agonis</i>	<i>flexuosa (cultivar)</i>	Dwarf Peppermint	+							x	
<i>Myrtaceae</i>	<i>Baeckea</i>	<i>camphorosmae</i>	Camphor Myrtle			x			x			
<i>Myrtaceae</i>	<i>Callistemon</i>	<i>sp. cultivar</i>	Bottlebrush	+							x	
<i>Myrtaceae</i>	<i>Calothamnus</i>	<i>quadrifidus</i>	One-sided bottlebrush						x			
<i>Myrtaceae</i>	<i>Calothamnus</i>	<i>rupestris</i>	Mouse ears bottlebrush	+						x		x
<i>Myrtaceae</i>	<i>Calothamnus</i>	<i>sp. cultivar</i>	One-sided Bottlebrush	+				x	x	x		x

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
Myrtaceae	<i>Calytrix</i>	<i>?flavescens</i>	Summer starflower									x
Myrtaceae	<i>Chamelaucium</i>	<i>sp. cultivar</i>	Waxflower	+							x	
Myrtaceae	<i>Chamelaucium</i>	<i>uncinatum</i>	Geraldton Wax	*/+	x	x			x			x
Myrtaceae	<i>Corymbia</i>	<i>calophylla</i>	Marri		x	x			x	x		x
Myrtaceae	<i>Corymbia</i>	<i>citriodora</i>	Lemon-scented Gum	+*mod					x		x	
Myrtaceae	<i>Corymbia</i>	<i>ficifolia</i>	Red Flowering Gum	+	x							
Myrtaceae	<i>Corymbia</i>	<i>maculata</i>	Spotted Gum	+				x				
Myrtaceae	<i>Eremaea</i>	<i>pauciflora</i>				x						
Myrtaceae	<i>Eucalyptus</i>	<i>botryoides</i>	Southern Mahogany	+	x							
Myrtaceae	<i>Eucalyptus</i>	<i>camaldulensis</i>	River Red Gum	+	x							
Myrtaceae	<i>Eucalyptus</i>	<i>gracilis</i>	Yorrel	+	x							
Myrtaceae	<i>Eucalyptus</i>	<i>lane-poolei</i>	Salmon White Gum	+	x							
Myrtaceae	<i>Eucalyptus</i>	<i>lehmannii</i>	Bushy Yate	+	x						x	
Myrtaceae	<i>Eucalyptus</i>	<i>marginata</i>	Jarrah		x	x	x		x	x		x
Myrtaceae	<i>Eucalyptus</i>	<i>marginata</i>	Jarrah	+				x				x
Myrtaceae	<i>Eucalyptus</i>	<i>platypus</i>	Moort	+	x						x	
Myrtaceae	<i>Eucalyptus</i>	<i>rudis</i>	Flooded gum						x			
Myrtaceae	<i>Eucalyptus</i>	<i>sideroxylon</i>	Red Ironbark	+	x							
Myrtaceae	<i>Eucalyptus</i>	<i>websteriana</i>	Webster's Mallee	+	x							
Myrtaceae	<i>Kunzea</i>	<i>glabrescens</i>	Spearwood	+	x							

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
Myrtaceae	<i>Leptospermum</i>	<i>laevigatum</i>	Victorian Teatree	*high		x						
Myrtaceae	<i>Melaleuca</i>	<i>?brevifolia</i>		+					x	x		
Myrtaceae	<i>Melaleuca</i>	<i>huegelii</i>	Chenille Honey Myrtle	+	x			x	x	x		
Myrtaceae	<i>Melaleuca</i>	<i>lateritia</i>	Robin Redbreast Bush	+						x		
Myrtaceae	<i>Melaleuca</i>	<i>nesophila</i>	Mindiyed	+							x	
Myrtaceae	<i>Melaleuca</i>	<i>rhaphiophylla</i>	Swamp Paperbark						x	x		
Myrtaceae	<i>Scholtzia</i>	<i>involuta</i>	Spiked Scholtzia						x			
Myrtaceae	<i>Verticordia</i>	<i>densiflora</i>							x			
Nyctaginaceae	<i>Bougainvillea</i>	<i>glabra</i>	Bougainvillea	+	x							
Oleaceae	<i>Olea</i>	<i>europaea</i>	Olive	*	x				x	x	x	x
Onagraceae	<i>Oenothera</i>	<i>stricta</i>	Common Evening Primrose	*low	x				x	x		
Orchidaceae	<i>Disa</i>	<i>bracteata</i>	South African Orchid	*mod		x			x			
Orchidaceae	<i>Microtis</i>	<i>media</i>	Tall Mignonette Orchid			x						
Orchidaceae	<i>Thelymitra</i>	<i>crinita</i>	Blue Lady Orchid			x						
Orobanchaceae	<i>Orobanche</i>	<i>minor</i>	Lesser Broomrape	*mod	x							
Oxalidaceae	<i>Oxalis</i>	<i>corniculata</i>	Yellow Wood Sorrel	*							x	
Oxalidaceae	<i>Oxalis</i>	<i>glabra</i>		*mild	x	x			x			
Oxalidaceae	<i>Oxalis</i>	<i>pes-caprae</i>	Soursob	*mild	x	x					x	
Pinaceae	<i>Pinus</i>	<i>sp. (insufficient material)</i>	Pine	*low		x						
Pittosporaceae	<i>Billardiera</i>	<i>fraseri</i>	Elegant Pronaya			x			x			x

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
<i>Pittosporaceae</i>	<i>Billardiera</i>	<i>heterophylla</i>	Australian Bluebell			x						
<i>Plantaginaceae</i>	<i>Plantago</i>	<i>major</i>	Greater Plantain	*mild		x			x			
<i>Poaceae</i>	<i>Austrostipa</i>	<i>elegantissima</i>	Showy Feathergrass						x			
<i>Poaceae</i>	<i>Austrostipa</i>	<i>?semibarbata</i>				x	x					
<i>Poaceae</i>	<i>Avena</i>	<i>fatua</i>	Wild Oat	*mod	x				x			x
<i>Poaceae</i>	<i>Briza</i>	<i>maxima</i>	Blowfly Grass	*mod	x	x	x		x	x	x	x
<i>Poaceae</i>	<i>Briza</i>	<i>minor</i>	Shivery Grass	*mod	x	x						
<i>Poaceae</i>	<i>Bromus</i>	<i>diandrus</i>	Great Brome	*high	x				x	x		x
<i>Poaceae</i>	<i>Bromus</i>	<i>hordeaceus</i>	Soft Brome	*low						x		
<i>Poaceae</i>	<i>Cynodon</i>	<i>dactylon</i>	Couch	*mod	x				x	x		x
<i>Poaceae</i>	<i>Ehrharta</i>	<i>calycina</i>	Veldt Grass	*high	x	x	x		x	x		x
<i>Poaceae</i>	<i>Ehrharta</i>	<i>longifolia</i>	Annual Veldt Grass	*mod	x					x		x
<i>Poaceae</i>	<i>Eragrostis</i>	<i>curvula</i>	African Lovegrass	*high	x	x			x	x		x
<i>Poaceae</i>	<i>Hordeum</i>	<i>leporinum</i>	Barley Grass	*mod	x							
<i>Poaceae</i>	<i>Lagurus</i>	<i>ovatus</i>	Hare's Tail Grass	*high	x					x		x
<i>Poaceae</i>	<i>Lolium</i>	<i>rigidum</i>	Wimmera Ryegrass	*mod	x					x		x
<i>Poaceae</i>	<i>Neurachne</i>	<i>alopcuroides</i>	Foxtail Mulga Grass			x			x			x
<i>Poaceae</i>	<i>Pennisetum</i>	<i>clandestinum</i>	Kikuyu	*mod	x					x		
<i>Poaceae</i>	<i>Phleum</i>	<i>arenarium</i>		*low	x							x
<i>Poaceae</i>	<i>Poa</i>	<i>annua</i>	Annual Grass	*mild	x						x	

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
Poaceae	<i>Sorghum</i>	<i>halepense</i>	Johnson Grass	*low		x	x					
Poaceae	<i>Vulpia</i>	<i>bromoides</i>	Squirrel Tail Fescue	*mod	x	x	x					
Proteaceae	<i>Adenanthos</i>	<i>cygnorum</i>	Common Woollybush	+		x						
Proteaceae	<i>Banksia</i>	<i>attenuata</i>	Narrow leaf banksia			x			x			
Proteaceae	<i>Banksia</i>	<i>dallanneyi</i>	Couch Honeypot			x	x		x			x
Proteaceae	<i>Banksia</i>	<i>menziesii</i>	Firewood Banksia			x	x					x
Proteaceae	<i>Banksia</i>	<i>sessilis</i>	Parrot Bush			x						x
Proteaceae	<i>Conospermum</i>	<i>undulatum</i>	Wavyleaf Smokebush	DRF		x						x
Proteaceae	<i>Grevillea</i>	"Robyn Gordon"		+							x	
Proteaceae	<i>Grevillea</i>	<i>bipinnatifida</i>	Fuschia Grevillea	+		x						
Proteaceae	<i>Grevillea</i>	<i>bipinnatifida</i>	Fuschia Grevillea						x			x
Proteaceae	<i>Grevillea</i>	<i>olivacea</i>		+							x	
Proteaceae	<i>Hakea</i>	<i>lissocarpa</i>	Honey Bush						x		x	
Proteaceae	<i>Hakea</i>	<i>prostrata</i>	Harsh Hakea									x
Proteaceae	<i>Hakea</i>	<i>ruscifolia</i>	Candle Hakea			x						
Proteaceae	<i>Hakea</i>	<i>trifurcata</i>	Two-leaf Hakea						x			
Proteaceae	<i>Isopogon</i>	<i>drummondii</i>		P3		x	x					x
Proteaceae	<i>Lambertia</i>	<i>multiflora</i>	Many-flowered Honeysuckle			x	x					
Proteaceae	<i>Persoonia</i>	<i>saccata</i>	Snottygobble			x			x			
Proteaceae	<i>Petrophile</i>	<i>linearis</i>	Pixie Mops						x			

Family	Genus	Species	Common Name	Status	BR E	RH NE	Q1	RH Med	RH SE	RH SW	BR W	RH NW
Proteaceae	<i>Petrophile</i>	<i>macrostachya</i>				x						
Proteaceae	<i>Stirlingia</i>	<i>latifolia</i>	Blueboy			x	x		x			x
Proteaceae	<i>Synaphea</i>	<i>gracillima</i>				x	x					x
Proteaceae	<i>Synaphea</i>	<i>petiolaris</i>							x			
Restionaceae	<i>Alexgeorgea</i>	<i>nitens</i>							x			
Restionaceae	<i>Desmocladius</i>	<i>fasciculatus</i>				x	x		x			
Restionaceae	<i>Desmocladius</i>	<i>flexuosus</i>				x			x			
Restionaceae	<i>Lyginia</i>	<i>barbata</i>				x						
Rosaceae	<i>Prunus</i>	<i>dulcis</i>	Almond	+	x							
Rhamnaceae	<i>Spyridium</i>	<i>globulosum</i>	Basket Bush						x			
Rutaceae	<i>Citrus</i>	<i>limon</i>	Lemon Tree	+						x		x
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	Blackberry Nightshade	*mod		x						
Stylidiaceae	<i>Levenhookia</i>	<i>pusilla</i>	Midget Stylewort			x	x					
Stylidiaceae	<i>Stylidium</i>	<i>piliferum</i>	Common Butterfly Triggerplant			x	x					
Thymelaeaceae	<i>Pimelea</i>	<i>sp. (insufficient material)</i>				x						
Violaceae	<i>Hybanthus</i>	<i>calycinus</i>	Wild Violet			x						
Vitaceae	<i>Vitis</i>	<i>vinifera</i>	Grape Vine	+	x							
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>gracilis</i>				x			x			
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>preissii</i>	Grass Tree		x	x	x		x		x	x

Where: DRF = Declared Rare/Threatened Flora; P3 = Priority 3 Flora; + = planted ornamental / rehabilitation flora; * = introduced / weed species;
high/mod/mild/low = Environmental Weed Rating; DP = Declared Plant (noxious weed)

Where: BR = Berkshire Road; RH = Roe Highway; Q1 = Quadrat 1.

APPENDIX E: PHTOPHTHORA DIEBACK
OCCURRENCE ASSESSMENT

Gateway WA

Roe Berkshire Interchange

Phytophthora Dieback occurrence assessment



Disclaimer

This report has been prepared in accordance with the scope of work agreed between Gateway WA and Glevan Consulting and contains results and recommendations specific to the agreement. Results and recommendations in this report should not be referenced for other projects without the written consent of Glevan Consulting.

Procedures and guidelines stipulated in various Department of Environment and Conservation and Dieback Working Group manuals are applied as the base methodology used by Glevan Consulting in the delivery of the services and products required by this scope of work. These guidelines, along with overarching peer review and quality standards ensure that all results are presented to the highest standard.

Glevan Consulting has assessed areas based on existing evidence presented at the time of assessment. The Phytophthora pathogen may exist in the soil as incipient disease. Methods have been devised and utilised that compensate for this phenomenon; however, very new centres of infestation, that do not present any visible evidence, may remain undetected during the assessment.

Document version: Final

Author Simon Robinson

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2 Summary

Glevan Consulting conducted an assessment of the project area associated with the proposed Roe Highway / Berkshire Road intersection upgrade for the presence of Phytophthora Dieback. The project area covered 20.4 hectares, of which 15 hectares was assessed, this included both native and planted vegetation. The remaining 5.4 ha was void of vegetation and excluded from the assessment. The assessment was conducted on the 06-05-2014 by Simon Robinson and no records or evidence of previous Dieback assessments were found for the area.

The entire study area was observed to be unmappable, due to the significant disturbance associated with clearing and previous construction activities, which has subsequently led to high levels of weed invasion. The disturbed areas exhibited significantly reduced biomass, and a distinct lack of reliable indicator species, and the presence of the disease could not be determined, resulting in an unmappable classification.

No Phytophthora Dieback infestations were identified within the actual study area, although a positive sample result was recorded immediately south of the project area, and an area adjacent to the southern part of the project area is suspected of being infested.

Several small, fragmented uninfested sections of vegetation were identified during the assessment, but were found to be unprotectable, and have been mapped within the unmappable category. The largest of these sections measured 230m in length, but due to being narrow and not contiguous with any other area of uninfested vegetation, it only comprised a total of 0.4 ha and was deemed to be too small to be considered protectable.

The Phytophthora Dieback category mapping contained in the report is valid for 12 months and will expire on the 06-05-2015.

3 Introduction

3.1 Background

Glevan Consulting was commissioned by Gateway WA to conduct an assessment of the project area associated with the proposed Roe Highway / Berkshire Road intersection upgrade for the presence of Phytophthora Dieback. Gateway WA is proposing to upgrade the Roe Highway/Berkshire Road intersection, and this assessment is part of a broader environmental assessment being undertaken to minimise the potential environmental impacts of the project.

3.2 Location of Project Area.

The project area is located at the Roe Hwy and Berkshire Road intersection, in the suburb of Forrestfield, approximately 15km south east of Perth CBD. The project area is comprised of several relatively narrow sections of vegetation adjacent to the intersection, and covers an area of 20.4 hectares.

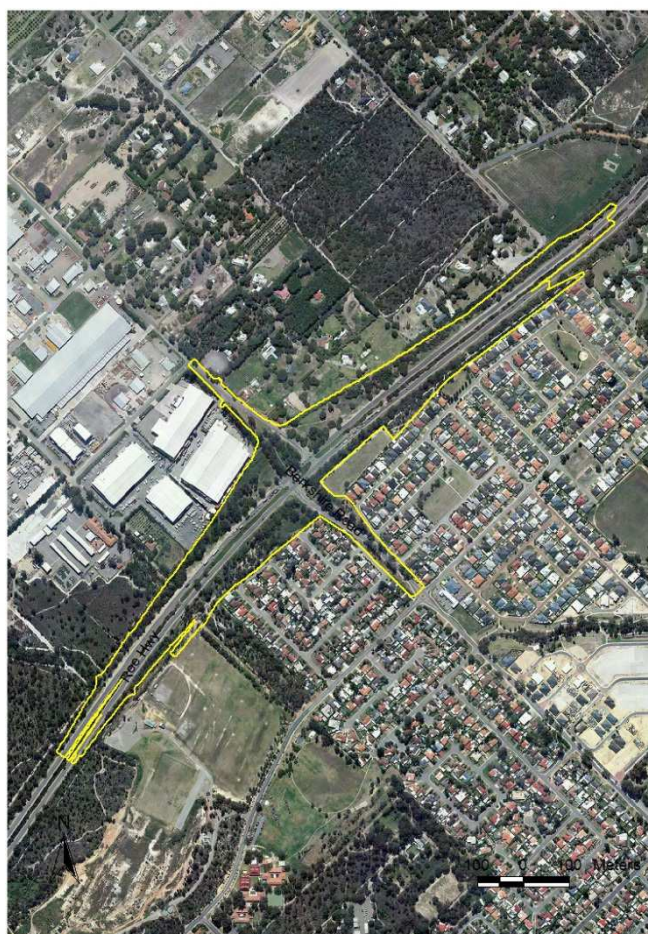


Figure 1 - Project Area

3.3 Historical land use and previous disturbances.

The study area is associated with a major Hwy intersection, and as such has been subjected to significant disturbance activities in the past, especially during construction. The study area is also adjacent to residential, commercial, and farming properties, which has also contributed to the disturbance levels present.

3.4 Study team

The assessment was conducted by Simon Robinson of Glevan Consulting on the 6th of May 2014. Mr Robinson is accredited by the Department of Parks and Wildlife in the detection, diagnosis and mapping of the Dieback disease. This accreditation recognises the skills and experience of Mr Robinson.

4 Methods

4.1 Pre survey desktop study

Known databases of *Phytophthora* locations retained by Vegetation Health Services (Department of Environment and Conservation) were searched to determine previous recoveries of *Phytophthora* within the project area.

4.2 Interpretation

During the assessment, the personnel involved in the field work will determine the presence of *Phytophthora Dieback* based on symptoms and disease signatures displayed in susceptible vegetation. These symptoms may be supported through the recovery of *Phytophthora* from soil and tissue samples taken during the assessment.

The detection of the plant pathogen *Phytophthora Dieback* involves the observation and interpretation of plant deaths (or reduction of biomass or perceived temporal change in vegetation structure) using a logical assessment of factors that imply pathogen presence above other possible causes of plant deaths or vegetation change. A combination of the following factors may indicate the presence of disease caused by *Phytophthora Dieback* or other *Phytophthora* species.

Deaths of disease indicating species:

An indicator species is a plant species, which is reliably susceptible to *Phytophthora Dieback* (i.e. will die). Common indicators include several species of *Banksia*, *Patersonia*, *Persoonia*, and *Xanthorrhoea*. The distribution and composition of indicator species will vary from place to place according to vegetation types.

Chronology of deaths:

As the pathogen spreads through an area, some or all susceptible plants become infected and die. Consequently there will be an age range from more recent deaths with yellowing or brown leaves through to older leafless stags to remnant stumps in the ground.

Pattern of deaths:

The topography, soil type, vegetation type and drainage characteristics of an area together with the influence of climatic patterns and disturbances will influence the shape or pattern of an infested area over time. A typical recent infestation may show a small cluster of dead indicator species which, in time, will spread to become a small circular shape ‘the ulcer effect’ and then begin lengthening towards natural drainage channels. A fringe of recent deaths is often seen around the edge of the infested area. Patterns may be further highlighted by a paucity of ground cover within the infested area.

Environmental factors:

Sites will vary in the way that disease is expressed both spatially and temporally. Environmental conditions can either favour or disfavour the growth and spread of the pathogen. Sites that are moist but not saturated are most favourable, sites that are well drained and mostly dry are least favourable.

Other causes of indicator species death:

Phytophthora cinnamomi is not the only agent to cause death of native vegetation. Other agents include, but are not limited to:

- other *Phytophthora* spp, *Armillaria luteobubalina*, various cankers, insects;
- drought, wind scorch, frost, salinity, water logging, fire and lightning;
- senescence, competition, physical damage;
- herbicides, chemical spills (for example fuel).

Based on the field assessment, the Project Area can be distributed to the following occurrence categories.

Table 1 - Phytophthora Dieback occurrence categories

Vegetated area	Infested	Areas that have plant disease symptoms consistent with the presence of Phytophthora Dieback
	Uninfested	Areas free of plant disease symptoms that indicate the presence of Phytophthora Dieback.
	Uninterpretable	Areas where indicator plants are absent or too few to determine the presence or absence of Phytophthora Dieback.

	Unmappable	Areas that are sufficiently disturbed so that Phytophthora Dieback occurrence mapping is not possible at the time of inspection.
	Not yet resolved	Areas where the interpretation process has not confidently determined the status of the vegetation.
Non-vegetated area	Excluded	Areas devoid of vegetation are excluded from the assessment area.

4.3 Landform and vegetation complexes.

Landform and vegetation types were taken into consideration when conducting the assessment, as both of these factors can significantly influence disease presence and distribution. Low-lying areas, and areas with highly susceptible vegetation are more likely to be infested, and are therefore targeted during the assessment. On the Swan Coastal Plain this means targeting interdunal depressions and Banksia Woodland.

4.4 Demarcation of hygiene boundaries

The Unmappable boundaries were denoted with black and pink tiger tape. The taped boundaries were positioned approximately 10m outside the unmappable areas, to provide the required buffer zone, and placed approximately 10m apart.

4.5 Soil and tissue sampling

Suspicious sites can have a representative soil and tissue sample taken to assist with the interpretation process. The laboratory result can confirm the presence of the *P. cinnamomi* pathogen. A negative result does not necessarily prove that the pathogen isn't present at the site, and should be supported by the field interpretation.

Sampling was conducted using the following procedure:

- All digging implements used were thoroughly sterilised prior to use with methylated spirits. The implements were then allowed to dry so that the integrity of the sample was not compromised.

- The area around the base of the plant/s to be sampled was cleared of vegetative matter to aid the digging process.
- The plant was dug to a satisfactory depth so that the tissue with the highest moisture content was obtained.
- Sections of the roots and stem base from all sides of the plant were taken and placed in a plastic bag. If any lesion was noticed on the tissue, it was also placed in the bag. A few handfuls of sand from various depths were also deposited in the plastic bag.
- The sample bags were irrigated with distilled water to try and simulate the optimum conditions for the *Phytophthora* to survive.
- Details, such as the date, sample number and interpreters were written on an aluminium tag, which was left at the site. The tag was demarcated with a strip of day-glow orange flagging tape.
- All digging implements used were again sterilised after each sample was taken to ensure that infected soil was not transported to the next sample site.

4.6 Mapping

Subsequent to hygiene boundary demarcation, the boundaries were again walked and recorded utilising a handheld GPS. The recorded data was then transferred to a desktop computer and used to produce the relevant maps.

4.7 Limitations of disease mapping

The assessment for the disease caused by *Phytophthora Dieback* is based on interpreting the vegetation for symptoms which can be ascribed to the disease presence. These observable factors must be present during the assessment period. Management recommendations may be included if it is considered that the disease may be cryptic, or the project area displays evidence of activities that are considered a high risk of introducing the disease.

5 Results

5.1 Phytophthora Dieback occurrence distribution

No Phytophthora Dieback infestations were mapped within the study area. An infested area was identified in close proximity to the south eastern boundary of the study area, and a large section of remnant vegetation adjacent to it is most likely infested also. The majority (74%) of the study area was observed to be unmappable due to a lack of reliable indicator species, and a further 26% of the study area was excluded from the assessment due to being void of vegetation (Table 2).

Table 2 - Area Summary

Category	Area (ha)	% of total area
Infested (with <i>P. cinnamomi</i>)	0.0 ha	0 %
Unmappable	15.0 ha	74 %
Uninfested	0.0 ha	0 %
Excluded	5.4 ha	26 %
TOTAL AREA	20.4 ha	

5.2 Soil and tissue samples

Two soil and tissue samples were taken during the assessment, one of which tested positive for the presence of *Phytophthora cinnamomi* (Table 3).

Table 3 – Project Area Sample Summary

Sample	Plant sampled	Easting	Northing	Result
1	<i>Xanthorrhoea preissii</i>	405905	6462804	<i>Negative</i>
2	<i>Xanthorrhoea preissii</i>	405115	6461825	<i>Positive</i>

6 Discussion

6.1 *Phytophthora Dieback* occurrence distribution

The entire 15.0 ha of vegetation assessed during the survey was observed to be unmappable, due to disturbance and an insufficient coverage of reliable indicator species. The remaining 5.4 ha of the project area was excluded from the survey due to being void of vegetation.

No infestations associated with *Phytophthora Dieback* were mapped within the study area. *Phytophthora Dieback* was identified however, immediately south of the project area through a positive sample result (sample two). The infested area identified is most likely associated with the large section of remnant vegetation that occurs immediately to the east of the project area that appears to be infested.

This section of remnant vegetation occurs on the eastern side of Roe Hwy, at the southern end of the project area, and exhibited a pattern of vegetation decline that is largely consistent with that normally associated with *Phytophthora Dieback*. Evidence supporting the presence of *Phytophthora Dieback* included reduced biomass, an absence of *Banksias*, and occasional *Eucalyptus marginata* deaths. However, no evidence of a disease front could be found, and only a single recently deceased ISD could be located (sample two). As a result, the boundaries of the infested area could not be delineated.

As a result of this large area to the east appearing to be infested in its entirety, and the confirmation of disease presence immediately south of the project area, a small section of potentially uninfested vegetation occurring within the southern extent of the project area, has been classified as unprotectable and included within the unmappable category.

Other vegetation decline that is possibly related to *Phytophthora Dieback* was observed in several sections of the study area, however most of these areas are highly disturbed and disease presence/distribution could not be mapped. As a result, these sections have been included within the unmappable category.

Several sections of vegetation believed to be uninfested were observed during the assessment, however these sections were either too small or too fragmented to be

considered protectable, and they have been included within the unmappable category. The largest of these sections measured 230m in length, but due to being narrow and not contiguous with any other area of uninfested vegetation, it comprised only 0.4 ha in area and was deemed to be too small to be considered protectable.

While several sections had a good coverage of the reliable indicator species *Banksia attenuata* and *B. menziesii*, most of these sections were also largely or completely void of an understorey, and disease presence/distribution cannot be determined or accurately mapped in such areas.

The median strip vegetation in the centre of the Roe Hwy was also classified as unmappable, as it does not contain a sufficient coverage of reliable indicator species. Several sections of the study area were also completely void of vegetation, and these areas were excluded from the assessment.

The large section of remnant vegetation on the western side of the Roe Hwy, adjacent to the southern end of the project area was almost completely void of *B. attenuata* and *B. menziesii*. However, it is thought that the area is naturally void of these species, and that the absence of these species is not associated with Phytophthora Dieback, as no other evidence present at the site suggested the presence of the disease.

6.2 Soil and tissue sampling strategies

Sample one was taken in a small section of vegetation exhibiting signs of decline, in an area of potentially protectable vegetation. The sample was required to confirm that the decline is not related to Phytophthora Dieback. The sample produced a negative result, supporting the view that the section of vegetation is uninfested, allowing for consideration to be given to classifying the section as protectable.

Sample two was taken on the eastern side of the Roe Hwy, immediately south of the project area, in an area exhibiting signs of vegetation decline that appeared to be consistent with the presence of Phytophthora Dieback. It is thought that the decline observed at the sample site may be an extension of that observed in the adjacent area that is thought to be infested. The sample produced a positive result, confirming disease presence in the immediate area, and supporting the belief that the large adjacent area is most likely infested.

7 Recommendations

- Vehicles and machinery should be clean upon entry into the project area.
- Soil and plant material of infested or unknown Dieback status should not be introduced to the project area.
- Soil and plant material should not be transported from the project area for use at any other protectable area.

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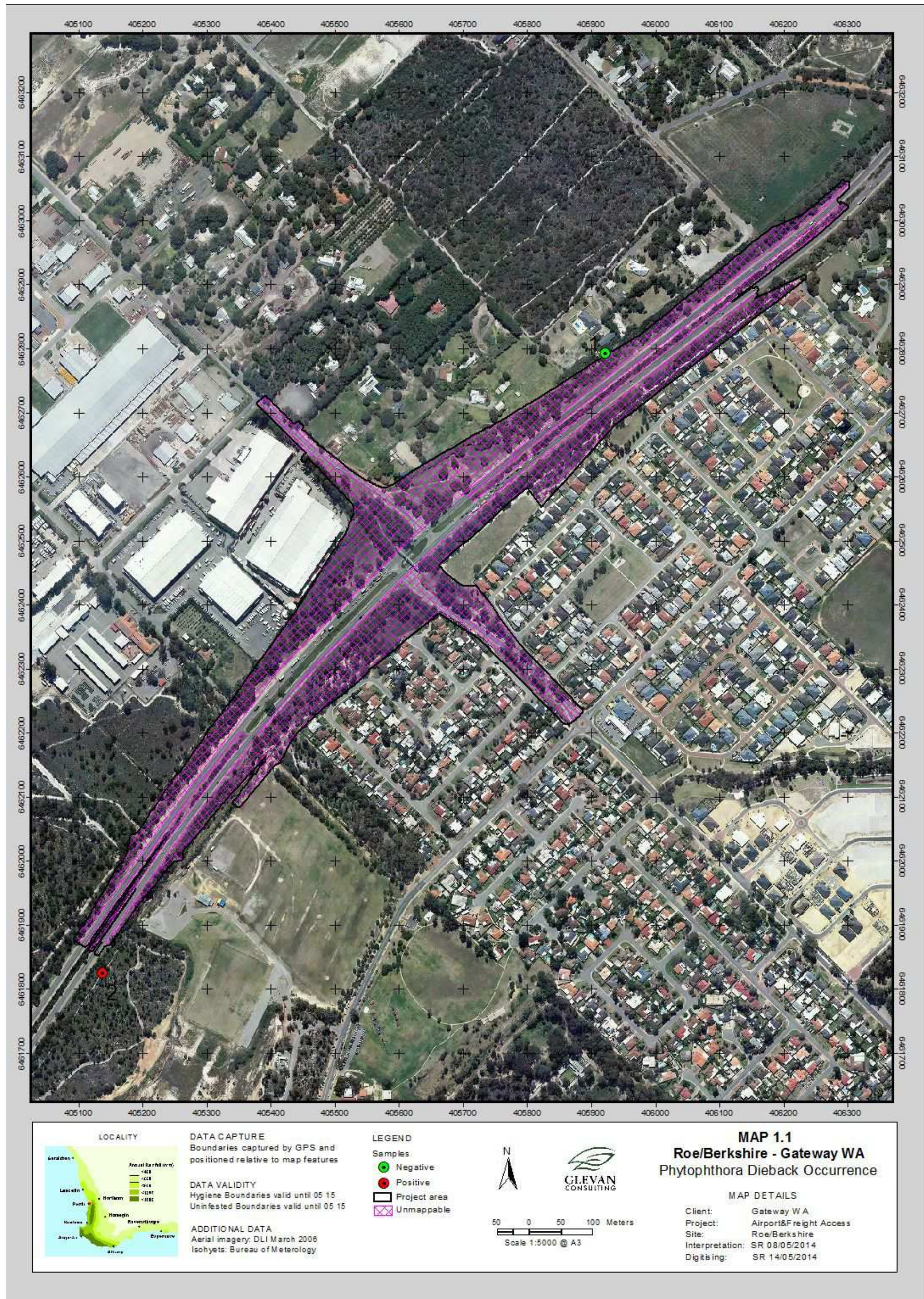
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9 Appendix – Phytophthora occurrence map



10 Appendix – Introduction to Phytophthora

Phytophthora Dieback is the name generally used in Western Australia to describe the disease symptoms of, and the causal agent, *Phytophthora cinnamomi*. This introduced soil-borne pathogen is a major threat to Australian vegetation, and in particular, the vegetation and dependent biota within the south west botanical province. This disease is listed as a key threatening process under the Environment Protection and Biodiversity Conservation Act 1999, with a subsequent threat abatement plan introduced in 2001 (Environment Australia 2001).

It is generally believed that Phytophthora Dieback was introduced to Australia during the early European settlement. From 1921, patches of healthy jarrah forest were observed to be dying, with Frank Podger and George Zentmyer establishing in 1964 that *Phytophthora cinnamomi* was the causal agent for the forest decline (DWG 2011).

The impact of the disease on the vegetation is dependent on climatic conditions along with host plant species and suitable soils (Keane and Kerr 1997). This relationship, shown in Figure 1, describes all aspects required to create the disease.

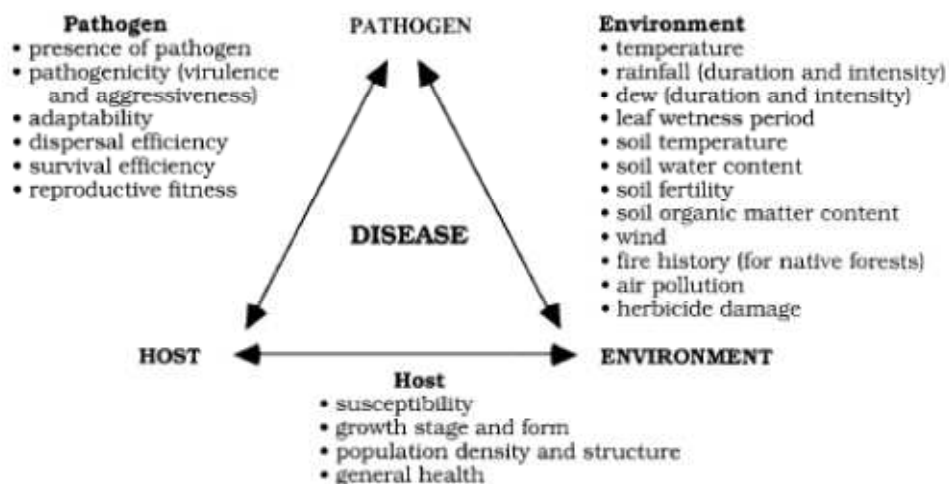


Figure 2 - Disease Triangle

This relationship is also described in Management of *Phytophthora cinnamomi* for Biodiversity Conservation in Australia Part 2 - National Best Practice Guidelines / Appendix 3

as the disease pyramid (O'Gara, et al. 2005). This figure includes the additional element of time to demonstrate the progressive impact of the disease on susceptible vegetation.

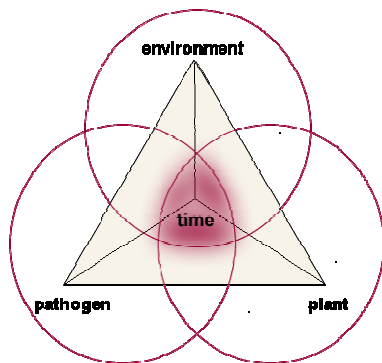


Figure 3 - Disease pyramid

It is recognised that *Phytophthora Dieback* has a greater and more widespread impact in areas of Western Australia where the average annual rainfall exceeds 600mm and the soil structure has a more acidic composition (Hardy, et al. 2001). The impact of the disease can be significant (but less widespread) in areas of lower rainfall if there are extra-ordinary rainfall events, or the pathogen is situated in a rainfall aggregating site, e.g. creek lines, water shedding from granite outcrops.

The impact of the pathogen on the Australian economy is significant, and is estimated to cost between \$160 million (Carter 2004) and \$200 million annually (EPA 2011).

The impact of the disease on animals is less understood, however the greatest impact is likely to be on those species that require relatively dense species-rich shrub lands or have restricted diets. There is a growing body of evidence that the dramatic impact of *Phytophthora Dieback* infestations on plant communities can result in major declines in some animal species due to the loss of shelter or food sources.

Appendix B
Transportation Noise Assessment – Roe Highway Berkshire Road
Interchange



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Transportation Noise Assessment

Roe Highway – Berkshire Road Interchange

Reference: 12072172-08 Roe-Berk Draft 2.docx

Prepared for:

Gateway WA



Member Firm of Association of Australian Acoustical Consultants

Report: 12072172-08 Roe-Berk Draft 2.docx

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Date:	5 June 2014

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A	Noise Wall Drawings
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1 INTRODUCTION

It is proposed to upgrade the Roe Highway – Berkshire Road interchange. Currently, the intersection is a staggered four way interchange (refer *Figure 1-1*) and is proposed to be a full grade separated interchange, with Roe Highway passing over Berkshire Road. This report considers the potential noise impacts associated with the upgraded interchange by:

- Measuring existing noise levels at the intersection;
- Constructing a noise model of the existing interchange and calibrating the predicted noise levels against the measured noise levels;
- Using the calibration from the existing model, calculate the noise levels for the proposed grade separated interchange for the year 2031.
- Determine appropriate noise mitigation options to achieve compliant noise levels at surrounding residences for the 2031 year.
- Using the calibration from the existing model, calculate the noise levels for the proposed grade separated interchange for the year 2050.
- Determine appropriate noise mitigation options to achieve compliant noise levels at surrounding residences for the 2050 year.

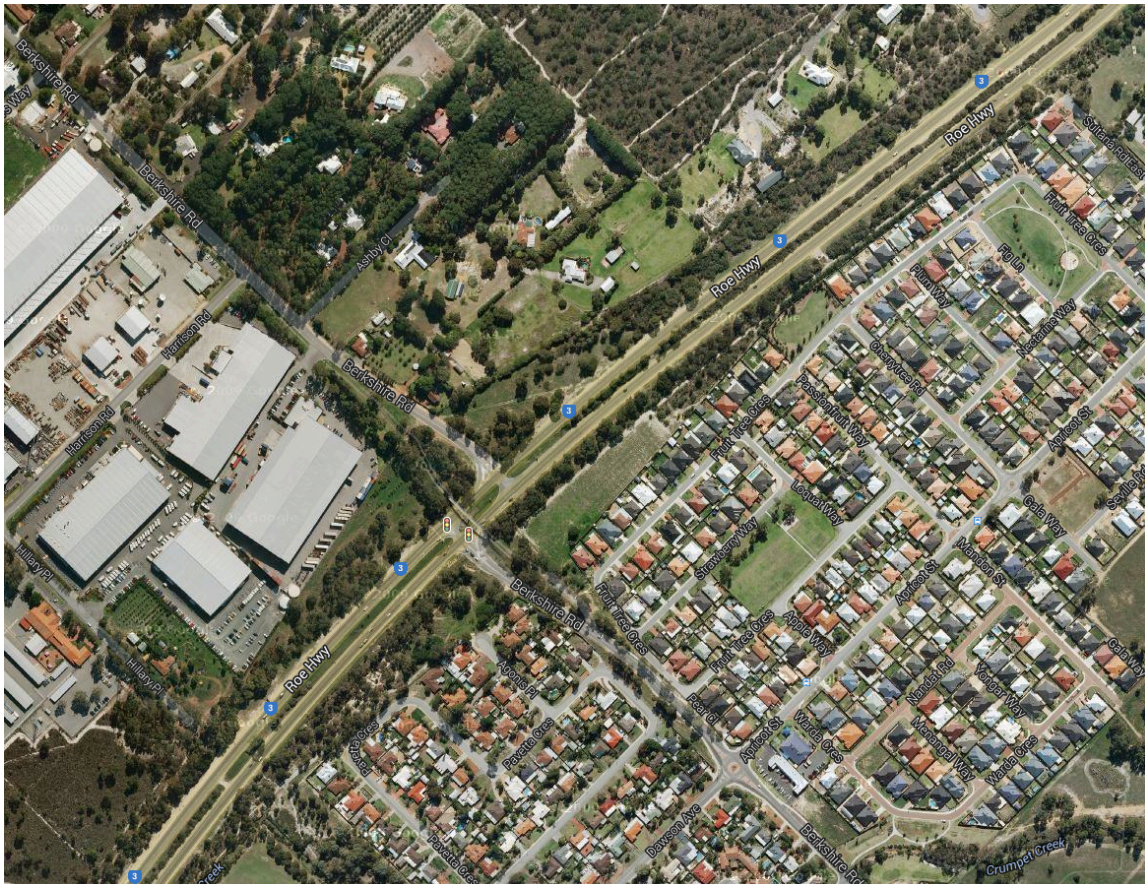


Figure 1-1 Road Project Locality

Appendix C contains a description of some of the terminology used throughout this report.

2 CRITERIA

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are to:

- Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals;
- Protect major transport corridors and freight operations from incompatible urban encroachment;
- Encourage best practice design and construction standards for new development proposals and new or redevelopment transport infrastructure proposals;
- Facilitate the development and operation of an efficient freight network; and
- Facilitate the strategic co-location of freight handling facilities.

For a major redevelopment, practicable noise management and mitigation measures should be considered, having regard to –

- The existing transport noise levels;
- The likely change in noise emissions resulting from the proposal; and
- The nature and scale of the works and potential for noise amelioration.

When considering the noise levels, the Policy's outdoor noise criteria, shown below in *Table 2-1*, can be used for some guidance. These criteria apply for new road projects rather than upgrades/modifications and at any point 1-metre from a ground floor habitable façade of a noise sensitive premises.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

Note: The 5 dB difference between the target and limit is referred to as the margin.

3 METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of the Policy as described below in *Sections 3.1 and 3.2*.

3.1 Site Measurements

Noise monitoring was undertaken at three (3) locations between 3 February to 12 February 2014, in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instruments used were ARL Type 316 noise data loggers, located at the following locations (refer *Figures 3-1 to 3-4*):

1. 9 Agonis Place, Forrestfield
2. 49 Fruit Tree Crescent, Forrestfield
3. Road Reserve Boundary, Rear of Ashby Close, High Wycombe residence

Note that the residence of concern on Ashby Close could not be contacted and therefore the logger was placed in the road reserve, in free-field conditions.

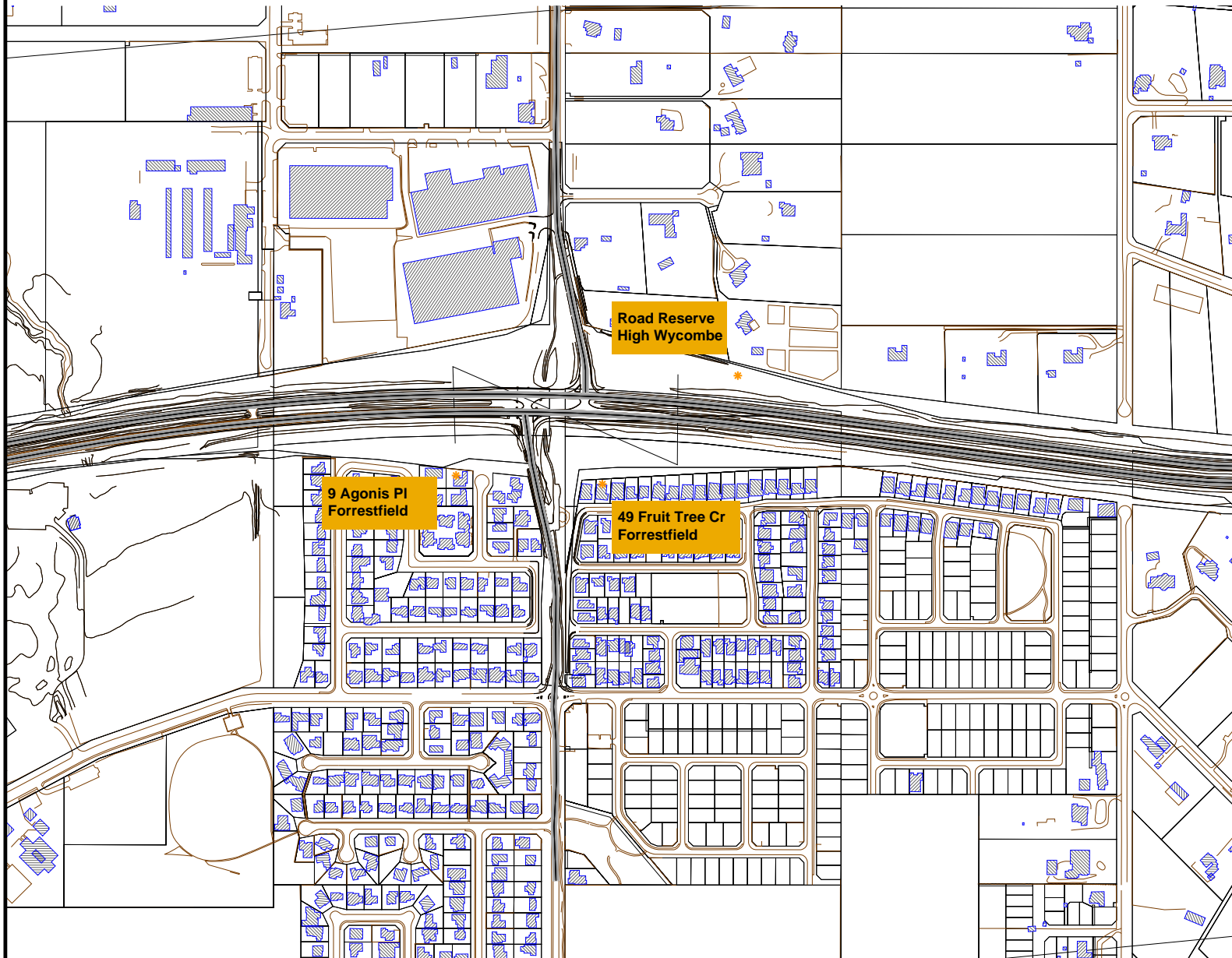
Each microphone was 1.4 metres above ground level. The logger was programmed to record hourly L_{A1} , L_{A10} , L_{A90} , and L_{Aeq} levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

The noise data collected was verified by inspection and professional judgement. Where hourly data was considered atypical, an estimated value was inserted and highlighted by bold italic lettering.

The weather conditions during the measurement period were obtained from the Bureau of Meteorology's, Perth Metro (Mount Lawley). This data was compared against the Main Roads Western Australia (MRWA) specifications for measurement conditions and any unacceptable conditions commented on.

Roe Highway - Berkshire Interchange Project
Locations of Noise Data loggers

Figure 3-1

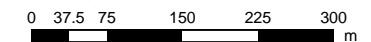


Signs and symbols

- Road
- ▨ Building
- * Noise Logger

21 February 2014

Length Scale 1:7500



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Figure 3-2 Photograph of 9 Agonis Place Noise Logger



Figure 3-3 Photograph of 49 Fruit Tree Crescent Noise Logger



Figure 3-4 Photograph of Road Reserve Noise Logger

3.2 Noise Modelling

The computer programme *SoundPLAN 7.2* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions as follows:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered. Note that corrections are applied to the exhaust of -8.0 dB (based on Transportation Noise Reference Book, Paul Nelson, 1987) and to the engine source of -0.8 dB, so as to provide consistent results with the CoRTN algorithms for the no barrier scenario.

Predictions are made at heights of 1.4 metres above ground floor level and at 1.0 metre from a building façade (resulting in a $+2.5$ dB correction due to reflected noise).

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed below.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical data was provided in digital format by the Gateway WA design team including the proposed road design (roeberkst ult_3d_with noise bund.dwg 3 April 2014) and the noise wall design (XR_08_047_NW_TOW_STRING.DWG).

It should be noted that the topographical information did not include the dwellings on the north side of Fruit Tree Crescent so these were interpolated from the local road levels.

Buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. All buildings are assumed to have a height of 3.5 metres.

3.2.2 Traffic Data

Traffic data includes:

- Road Surface – The noise relationship between different road surface types is shown below in *Table 3-1*.

Table 3-1 Noise Relationship Between Different Road Surfaces

Road Surfaces						
Chip Seal			Asphalt			
14mm	10mm	5mm	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	0.0 dB	-0.2 dB	-1.0 dB	-2.5 dB

The existing Roe Highway road surface is worn 14mm chip seal with dense graded asphalt closer to the intersection. Berkshire Road is assumed to be dense graded asphalt.

The future road surface of Roe Highway will be upgraded to open graded asphalt based on earlier noise mitigation studies, with the on/off ramps being dense graded asphalt. The road surface of Berkshire Road will remain unchanged.

- Vehicle Speed – The existing posted speed on Roe Highway is 100km/hr slowing to 80km/hr near the Berkshire Road intersection. In the future, Roe Highway will be a continuous posted speed of 100km/hr with on/off ramps being 80km/hr.

The posted speed on Berkshire Road is 60km/hr and will remain unchanged in the future.

- Traffic Volumes – Information used in the modelling is provided in *Tables 3-2 to 3-4*, being for the years 2014, 2031 & 2050.

Table 3-2 2014 Traffic Information Used in the Modelling

Road	Location	Direction	24-Hour Vehicles	Percentage Heavy	24-Hour Cars	24-Hour Trucks
Roe Highway	North of Berkshire	Northbound	22093	10	19884	2209
		Southbound	22685	10	20417	2269
	South of Berkshire	Northbound	19772	11	17597	2175
		Southbound	20259	11	18031	2228
Berkshire Road	East of Roe Hwy	Eastbound	5601	8	5153	448
		Westbound	4847	7	4508	339
	West of Roe Hwy	Eastbound	1847	14	1588	259
		Westbound	2226	15	1892	334

Table 3-3 2031 Traffic Information Used in the Modelling

Road	Location	Direction	24-Hour Vehicles	Percentage Heavy	24-Hour Cars	24-Hour Trucks
Roe Highway	North of Berkshire	Northbound	51990	10	46791	5199
		Southbound	50990	10	45891	5099
	South of Berkshire	Northbound	47570	11	42337	5233
		Southbound	46260	11	41171	5089
Berkshire Road	East of Roe Hwy	Eastbound	9500	8	8740	760
		Westbound	8950	7	8324	627
	West of Roe Hwy	Eastbound	2650	14	2279	371
		Westbound	3330	15	2831	500
Ramps	Off Ramp	Southbound	7200	6	6768	432
		Northbound	6000	14	5160	840
	On Ramp	Southbound	4400	15	3740	660
		Northbound	9600	6	9024	576

Table 3-4 2050 Traffic Information Used in the Modelling

Road	Location	Direction	24-Hour Vehicles	Percentage Heavy	24-Hour Cars	24-Hour Trucks
Roe Highway	North of Berkshire	Northbound	58290	10	52461	5829
		Southbound	54890	10	49401	5489
	South of Berkshire	Northbound	61070	11	54352	6718
		Southbound	54860	11	48825	6035
Berkshire Road	East of Roe Hwy	Eastbound	11600	8	10672	928
		Westbound	8950	7	8324	627
	West of Roe Hwy	Eastbound	2650	14	2279	371
		Westbound	3330	15	2831	500
Ramps	Off Ramp	Southbound	7200	6	6768	432
		Northbound	10200	14	8772	1428
	On Ramp	Southbound	7300	15	6205	1095
		Northbound	9600	6	9024	576

Note that in some instances, the traffic volumes in 2050 were shown to be less than those in 2031. In these cases, the 2031 traffic volumes were maintained through to 2050. Generally speaking however, traffic volumes in 2050 are marginally higher than in 2031 and as such noise levels will be higher in 2050 so that only 2050 noise levels are discussed in this report.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.20 (20%) for all roads and 0.8 (80%) elsewhere. Note 0.0 represents hard reflective surfaces such as water and 1.00 represents absorptive surfaces such as grass.

3.2.4 Parameter Conversion

The CoRTN algorithms used in the *SoundPlan* modelling package were originally developed to calculate the $L_{A10,18\text{hour}}$ noise level. The WAPC Policy however uses $L_{Aeq(\text{Day})}$ and $L_{Aeq(\text{Night})}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles).

As noise monitoring was undertaken, the relationship between the parameters is based on the results of the monitoring – refer *Section 4.1*.

4 RESULTS

4.1 Noise Monitoring

The results of the noise monitoring are summarised below in *Table 4-1*, with the full logger data sheets provided in *Appendix B*.

Table 4-1 Measured Average Noise Levels – Monitoring Locations

Location	Average Weekday Noise Level, dB			
	L _{A10,18hour}	L _{Aeq,24hour}	L _{Aeq (Day)}	L _{Aeq (Night)}
9 Agonis Place, Forrestfield	58.9	56.1	57.2	52.1
49 Fruit Tree Crescent, Forrestfield	56.8	54.1	55.3	49.7
Road Reserve Boundary, High Wycombe	64.8	61.4	62.6	57.6

The difference between the day and night L_{Aeq} values is around 5 dB and as such, no parameter is more critical in terms of compliance. For consistency with the Gateway WA project, it is the L_{Aeq(Night)} values that have been reported throughout.

4.2 Noise Modelling: Existing

The noise modelling is provided in *Figure 4-1* as an L_{Aeq(Night)} noise level contour plot being for the existing traffic conditions. Noise levels are also provided in tabular format for the nearest residences in *Table 4-2*.

Table 4-2 Existing L_{Aeq(Night)} Predicted Noise Levels

Receiver No. & Address	Calculated L _{Aeq(Night)} , dB	Receiver No. & Address	Calculated L _{Aeq(Night)} , dB
01 25 Pavetta Cr	57	23 47 Fruit Tree Cr	54
01 25 Pavetta Cr	55	23 47 Fruit Tree Cr	48
01 25 Pavetta Cr	55	24 49 Fruit Tree Cr	53
01 25 Pavetta Cr	57	25 51 Fruit Tree Cr	54
02 24 Pavetta Cr	54	26 53 Fruit Tree Cr	52
02 24 Pavetta Cr	54	27 55 Fruit Tree Cr	53
02 24 Pavetta Cr	56	28 57 Fruit Tree Cr	55
03 30 Pavetta Cr	55	29 59 Fruit Tree Cr	54
03 30 Pavetta Cr	53	30 61 Fruit Tree Cr	55
04 31 Pavetta Cr	54	31 63 Fruit Tree Cr	54
04 31 Pavetta Cr	50	32 65 Fruit Tree Cr	55

Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB	Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB
04 31 Pavetta Cr	55	33 67 Fruit Tree Cr	54
05 9 Agonis Pl	52	34 69 Fruit Tree Cr	54
05 9 Agonis Pl	52	35 71 Fruit Tree Cr	56
06 10 Agonis Pl	53	36 73 Fruit Tree Cr	56
06 10 Agonis Pl	55	37 75 Fruit Tree Cr	57
06 10 Agonis Pl	53	38 77 Fruit Tree Cr	55
07 8 Agonis Pl	52	39 79 Fruit Tree Cr	57
07 8 Agonis Pl	53	39 79 Fruit Tree Cr	58
08 55A Pavetta Cr	53	40 85 Fruit Tree Cr	59
09 55A Pavetta Cr	50	40 85 Fruit Tree Cr	57
10 57 Pavetta Cr	53	41 87 Fruit Tree Cr	58
10 57 Pavetta Cr	53	42 89 Fruit Tree Cr	57
10 57 Pavetta Cr	52	43 91 Fruit Tree Cr	57
11 56 Pavetta Cr	49	44 93 Fruit Tree Cr	56
11 56 Pavetta Cr	49	45 95 Fruit Tree Cr	57
12 60 Pavetta Cr	47	46 97 Fruit Tree Cr	57
12 60 Pavetta Cr	48	46 97 Fruit Tree Cr	58
12 60 Pavetta Cr	49	47 99 Fruit Tree Cr	56
13 59 Pavetta Cr	48	48 101 Fruit Tree Cr	54
13 59 Pavetta Cr	51	49 103 Fruit Tree Cr	54
13 59 Pavetta Cr	52	50 105 Fruit Tree Cr	57
14 226 Dawson Av	52	51 107 Fruit Tree Cr	53
14 226 Dawson Av	52	51 107 Fruit Tree Cr	59
14 226 Dawson Av	49	51 107 Fruit Tree Cr	56
15 7 Pearl Cl	53	52 109 Fruit Tree Cr	55
16 5 Pearl Cl	53	52 109 Fruit Tree Cr	58
16 5 Pearl Cl	53	52 109 Fruit Tree Cr	54

Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB	Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB
17 3 Pearl Cl	55	53 170 Sultana Rd West	53
18 1 Pearl Cl	55	54 168 Sultana Rd West	55
18 34 Fruit Tree Cr	54	55 166 Sultana Rd West	56
19 36 Fruit Tree Cr	54	56 15 Ashby Close	50
20 21 Strawberry Way	52	56 15 Ashby Close	51
20 21 Strawberry Way	52	57 13 Ashby Close	52
21 20 Strawberry Way	50	57 13 Ashby Close	52
21 20 Strawberry Way	48	57 13 Ashby Close	53
22 48 Fruit Tree Cr	51	58 11 Ashby Close	48
22 48 Fruit Tree Cr	48		

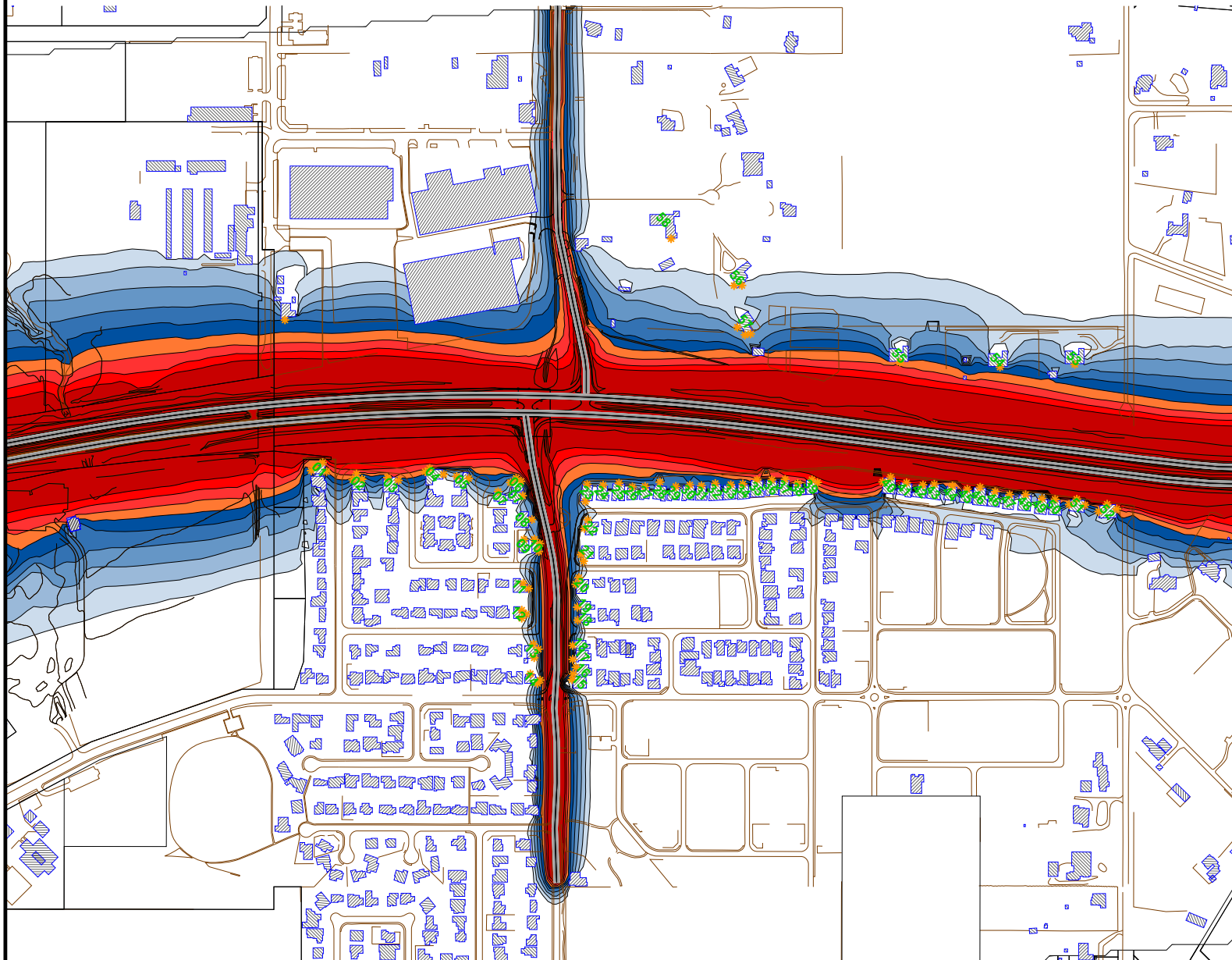
Note: Where there are multiple entries for the same residence, the varying noise levels are for different façades on the dwelling.

4.3 Noise Modelling: No Build 2050

The No Build Scenario represents the noise levels if no interchange work was undertaken but the 2050 traffic volumes were on the road. The results of this modelling is provided in *Figure 4-2* as an $L_{Aeq(Night)}$ noise level contour plot and in *Table 4-3*.

Roe Highway - Berkshire Interchange Project
 Noise Contour Plot - Existing 2014 LAeq(Night)

Figure 4-1



Noise levels
 LAeq,night dB

50 <=	< 50
51 <=	< 51
52 <=	< 52
53 <=	< 53
54 <=	< 54
55 <=	< 55
56 <=	< 56
57 <=	< 57
58 <=	< 58



Signs and symbols

-  Road
-  Building
-  Receivers

4 June 2014

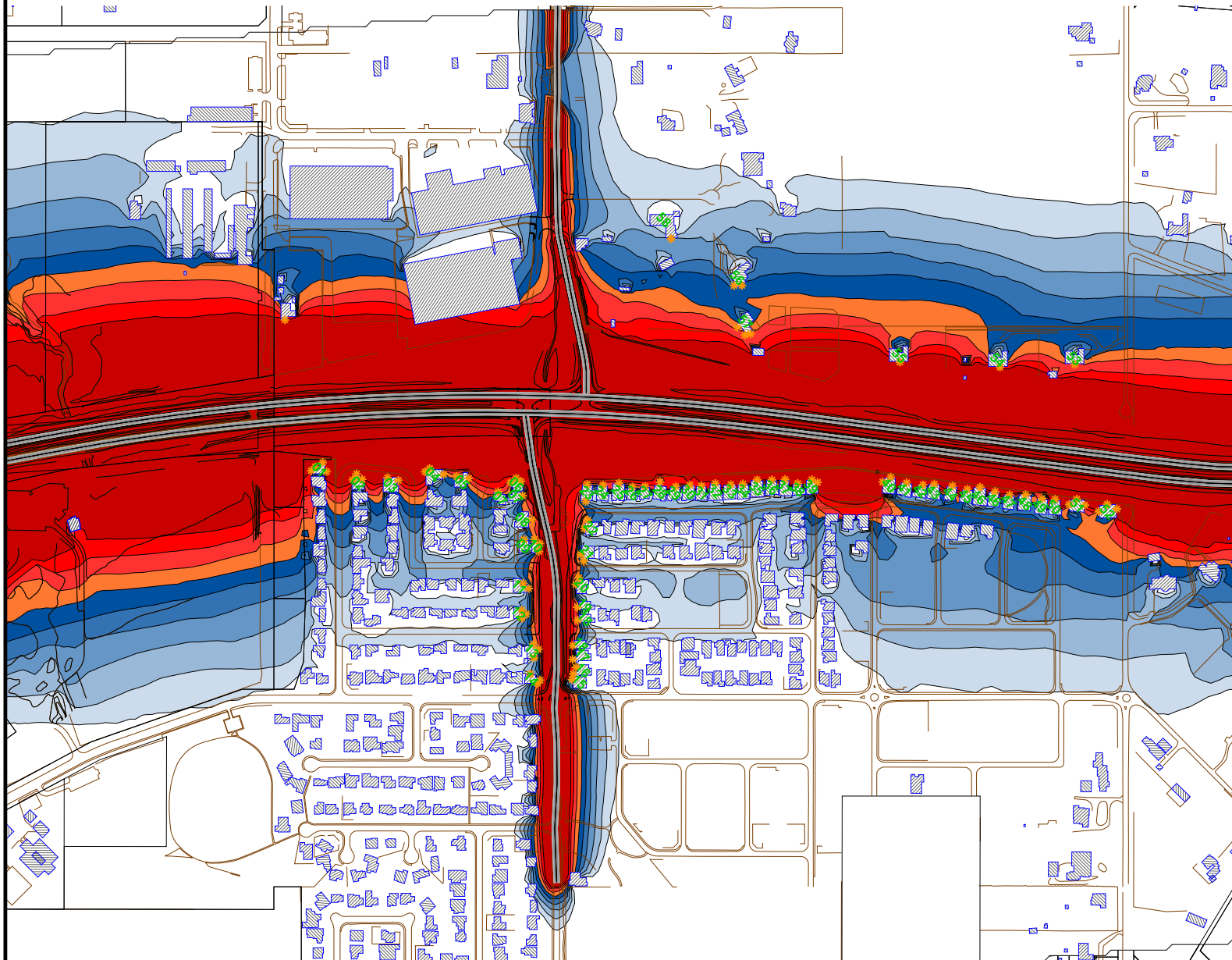
Length Scale 1:7500



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Roe Highway - Berkshire Interchange Project
 Noise Contour Plot - No Build 2050 LAeq(Night)

Figure 4-2



Noise levels
 LAeq,night dB

50 <=	< 50
51 <=	< 51
52 <=	< 52
53 <=	< 53
54 <=	< 54
55 <=	< 55
56 <=	< 56
57 <=	< 57
58 <=	< 58

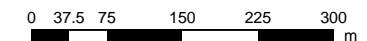


Signs and symbols

-  Road
-  Building
-  Receivers

4 June 2014

Length Scale 1:7500



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Table 4-3 No Build 2050 $L_{Aeq(Night)}$ Predicted Noise Levels

Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB	Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB
01 25 Pavetta Cr	61	23 47 Fruit Tree Cr	58
01 25 Pavetta Cr	60	23 47 Fruit Tree Cr	51
01 25 Pavetta Cr	60	24 49 Fruit Tree Cr	57
01 25 Pavetta Cr	62	25 51 Fruit Tree Cr	58
02 24 Pavetta Cr	59	26 53 Fruit Tree Cr	56
02 24 Pavetta Cr	58	27 55 Fruit Tree Cr	57
02 24 Pavetta Cr	61	28 57 Fruit Tree Cr	59
03 30 Pavetta Cr	60	29 59 Fruit Tree Cr	58
03 30 Pavetta Cr	57	30 61 Fruit Tree Cr	59
04 31 Pavetta Cr	58	31 63 Fruit Tree Cr	58
04 31 Pavetta Cr	54	32 65 Fruit Tree Cr	59
04 31 Pavetta Cr	60	33 67 Fruit Tree Cr	58
05 9 Agonis Pl	56	34 69 Fruit Tree Cr	58
05 9 Agonis Pl	56	35 71 Fruit Tree Cr	60
06 10 Agonis Pl	57	36 73 Fruit Tree Cr	60
06 10 Agonis Pl	59	37 75 Fruit Tree Cr	61
06 10 Agonis Pl	57	38 77 Fruit Tree Cr	59
07 8 Agonis Pl	56	39 79 Fruit Tree Cr	61
07 8 Agonis Pl	57	39 79 Fruit Tree Cr	62
08 55A Pavetta Cr	56	40 85 Fruit Tree Cr	63
09 55A Pavetta Cr	54	40 85 Fruit Tree Cr	61
10 57 Pavetta Cr	56	41 87 Fruit Tree Cr	62
10 57 Pavetta Cr	56	42 89 Fruit Tree Cr	61
10 57 Pavetta Cr	55	43 91 Fruit Tree Cr	61
11 56 Pavetta Cr	52	44 93 Fruit Tree Cr	60
11 56 Pavetta Cr	52	45 95 Fruit Tree Cr	61
12 60 Pavetta Cr	51	46 97 Fruit Tree Cr	61

Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB	Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB
12 60 Pavetta Cr	51	46 97 Fruit Tree Cr	63
12 60 Pavetta Cr	52	47 99 Fruit Tree Cr	60
13 59 Pavetta Cr	51	48 101 Fruit Tree Cr	58
13 59 Pavetta Cr	54	49 103 Fruit Tree Cr	58
13 59 Pavetta Cr	55	50 105 Fruit Tree Cr	61
14 226 Dawson Av	55	51 107 Fruit Tree Cr	57
14 226 Dawson Av	55	51 107 Fruit Tree Cr	63
14 226 Dawson Av	52	51 107 Fruit Tree Cr	60
15 7 Pearl Cl	56	52 109 Fruit Tree Cr	59
16 5 Pearl Cl	56	52 109 Fruit Tree Cr	62
16 5 Pearl Cl	56	52 109 Fruit Tree Cr	58
17 3 Pearl Cl	58	53 170 Sultana Rd West	57
18 1 Pearl Cl	58	54 168 Sultana Rd West	59
18 34 Fruit Tree Cr	57	55 166 Sultana Rd West	60
19 36 Fruit Tree Cr	57	56 15 Ashby Close	54
20 21 Strawberry Way	55	56 15 Ashby Close	55
20 21 Strawberry Way	55	57 13 Ashby Close	56
21 20 Strawberry Way	53	57 13 Ashby Close	56
21 20 Strawberry Way	52	57 13 Ashby Close	57
22 48 Fruit Tree Cr	55	58 11 Ashby Close	52
22 48 Fruit Tree Cr	52		

Note: Where there are multiple entries for the same residence, the varying noise levels are for different façades on the dwelling.

The above demonstrates that on average, there will be around a 4 dB increase through to the year 2050 due to increased traffic volumes, noting that those along Berkshire Road will be around 3 dB.

4.4 Noise Modelling: Build

The results of the 2050 Build Scenario, which includes the grade separated interchange, 2050 traffic volumes and open graded asphalt road surface to Roe Highway, is shown in *Figure 4-3* as an $L_{Aeq(Night)}$ noise level contour plot and in *Table 4-4*.

Gateway WA - Roe/Berkshire Interchange
 LAeq(Night) Noise Level Contours - Future (2050) Scenario


Figure 4-3

Noise levels
 LAeq,night dB

50 <=	< 51
51 <=	< 52
52 <=	< 53
53 <=	< 54
54 <=	< 55
55 <=	< 56
56 <=	< 57
57 <=	< 58
58 <=	

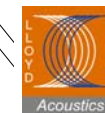
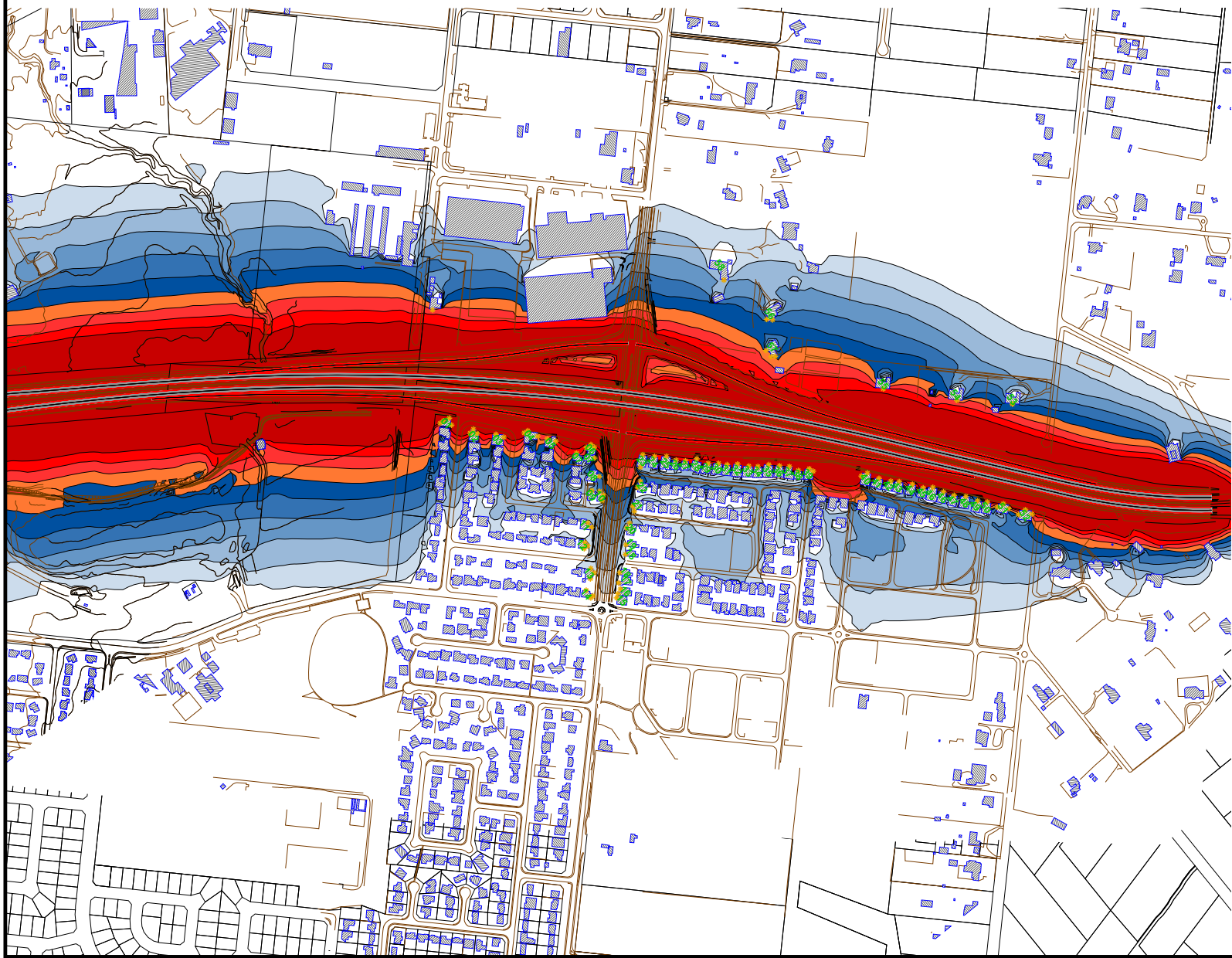


Signs and symbols

-  Road Source
-  Road Surface
-  Building
-  Receiver

4 June 2014

Length Scale 1:10000



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Table 4-4 Build 2050 $L_{Aeq(Night)}$ Predicted Noise Levels

Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB	Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB
01 25 Pavetta Cr	60	23 47 Fruit Tree Cr	58
01 25 Pavetta Cr	59	23 47 Fruit Tree Cr	53
01 25 Pavetta Cr	59	24 49 Fruit Tree Cr	58
01 25 Pavetta Cr	61	25 51 Fruit Tree Cr	58
02 24 Pavetta Cr	58	26 53 Fruit Tree Cr	58
02 24 Pavetta Cr	58	27 55 Fruit Tree Cr	58
02 24 Pavetta Cr	59	28 57 Fruit Tree Cr	59
03 30 Pavetta Cr	59	29 59 Fruit Tree Cr	59
03 30 Pavetta Cr	57	30 61 Fruit Tree Cr	59
04 31 Pavetta Cr	58	31 63 Fruit Tree Cr	59
04 31 Pavetta Cr	56	32 65 Fruit Tree Cr	59
04 31 Pavetta Cr	59	33 67 Fruit Tree Cr	59
05 9 Agonis Pl	58	34 69 Fruit Tree Cr	59
05 9 Agonis Pl	57	35 71 Fruit Tree Cr	60
06 10 Agonis Pl	57	36 73 Fruit Tree Cr	60
06 10 Agonis Pl	59	37 75 Fruit Tree Cr	60
06 10 Agonis Pl	57	38 77 Fruit Tree Cr	60
07 8 Agonis Pl	56	39 79 Fruit Tree Cr	59
07 8 Agonis Pl	58	39 79 Fruit Tree Cr	61
08 55A Pavetta Cr	56	40 85 Fruit Tree Cr	62
09 55A Pavetta Cr	54	40 85 Fruit Tree Cr	60
10 57 Pavetta Cr	56	41 87 Fruit Tree Cr	60
10 57 Pavetta Cr	56	42 89 Fruit Tree Cr	59
10 57 Pavetta Cr	55	43 91 Fruit Tree Cr	59
11 56 Pavetta Cr	53	44 93 Fruit Tree Cr	58
11 56 Pavetta Cr	54	45 95 Fruit Tree Cr	59
12 60 Pavetta Cr	51	46 97 Fruit Tree Cr	59
12 60 Pavetta Cr	52	46 97 Fruit Tree Cr	60
12 60 Pavetta Cr	53	47 99 Fruit Tree Cr	58
13 59 Pavetta Cr	50	48 101 Fruit Tree Cr	56

Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB	Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB
13 59 Pavetta Cr	56	49 103 Fruit Tree Cr	56
13 59 Pavetta Cr	56	50 105 Fruit Tree Cr	58
14 226 Dawson Av	52	51 107 Fruit Tree Cr	54
14 226 Dawson Av	52	51 107 Fruit Tree Cr	61
14 226 Dawson Av	52	51 107 Fruit Tree Cr	57
15 7 Pearl Cl	56	52 109 Fruit Tree Cr	56
16 5 Pearl Cl	55	52 109 Fruit Tree Cr	60
16 5 Pearl Cl	57	52 109 Fruit Tree Cr	55
17 3 Pearl Cl	58	53 170 Sultana Rd West	55
18 1 Pearl Cl	58	54 168 Sultana Rd West	57
18 34 Fruit Tree Cr	57	55 166 Sultana Rd West	58
19 36 Fruit Tree Cr	57	56 15 Ashby Close	54
20 21 Strawberry Way	56	56 15 Ashby Close	54
20 21 Strawberry Way	57	57 13 Ashby Close	55
21 20 Strawberry Way	54	57 13 Ashby Close	56
21 20 Strawberry Way	52	57 13 Ashby Close	56
22 48 Fruit Tree Cr	57	58 11 Ashby Close	52
22 48 Fruit Tree Cr	52		

Note: Where there are multiple entries for the same residence, the varying noise levels are for different façades on the dwelling.

In comparison to the No Build Scenario, for residences along Roe Highway, noise levels tend to decrease when further from the intersection because of the improved (quieter) road surface. As residences become closer to the intersection, there may be a slight increase in noise level due to the road being elevated and the new road alignment.

5 ASSESSMENT

Predicted noise levels for the Build Scenario, including the quieter open graded asphalt road surface, show that residences will experience noise levels above the *limit*. Although not mandatory under the Policy, since this project is considered a road upgrade, compliance with the *limit* at Roe Highway residences is considered to be practicable with the construction of noise walls. The wall drawings are provided in *Appendix A* and summarised in *Figure 5-1* and *Table 5-1*, noting that the walls have been designed to satisfy noise and screening requirements.

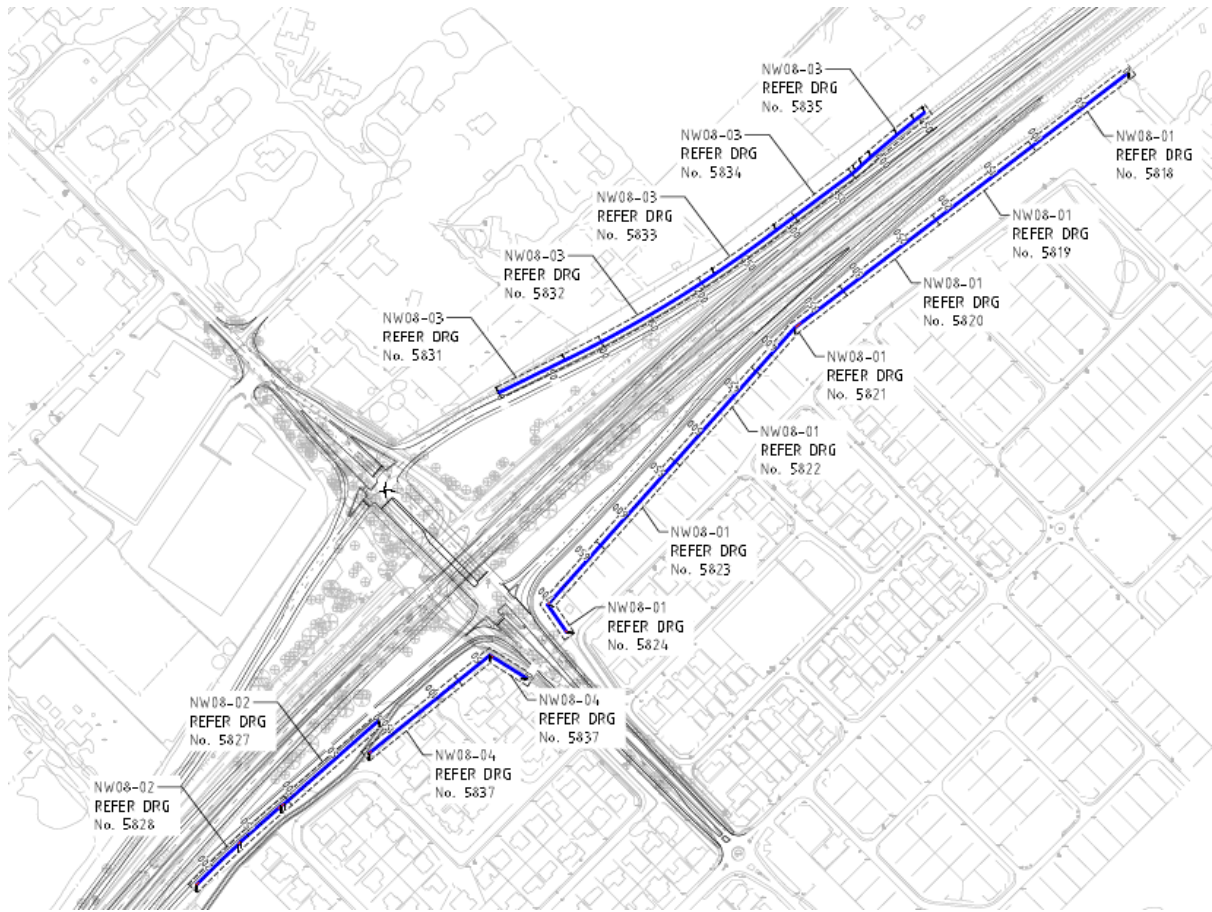


Figure 5-1 Wall Locality and Designation (Source: Gateway 08-047-NW-DG-5810)

Table 5-1 Wall Summary

Noise Wall Designation	Description
NW08-01	Located on the rear boundary of residences alongside Fruit Tree Crescent. Wall is panel and post construction using 125mm thick concrete. Wall height is 3.00m to 5.00m.
NW08-02	Located alongside the westbound onramp near Pavetta Crescent. Wall is panel and post construction using 125mm thick concrete. Wall height is 3.75m to 5.00m.
NW08-03	Located alongside the eastbound onramp near the Ashby Close/Sultana Road West residences. Wall is panel and post construction using 125mm thick concrete. Wall height is 2.75m to 3.00m.
NW08-04	Located on the boundary of residences alongside Agonis Place. Wall is panel and post construction using 125mm thick concrete. Wall height is 2.75m to 4.25m.

Note that the wall has been designed to satisfy both the acoustic requirements and screening requirements. Wall heights are relative to the bottom of panel, which will be slightly below ground level.

Table 5-2 and Figure 5-2 provide the predicted noise levels with the proposed walls in place. Where noise levels are above the *limit*, an additional noise level is provided in brackets, reflecting noise from Roe Highway only. That is, noise levels in brackets are without the influence of road traffic on Berkshire Road.

Table 5-2 Build 2050 $L_{Aeq(Night)}$ Predicted Noise Levels with Walls

Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB	Receiver No. & Address	Calculated $L_{Aeq(Night)}$, dB
01 25 Pavetta Cr	55	23 47 Fruit Tree Cr	52
01 25 Pavetta Cr	52	23 47 Fruit Tree Cr	53
01 25 Pavetta Cr	55	24 49 Fruit Tree Cr	52
01 25 Pavetta Cr	55	25 51 Fruit Tree Cr	52
02 24 Pavetta Cr	54	26 53 Fruit Tree Cr	53
02 24 Pavetta Cr	52	27 55 Fruit Tree Cr	53
02 24 Pavetta Cr	54	28 57 Fruit Tree Cr	53
03 30 Pavetta Cr	54	29 59 Fruit Tree Cr	54
03 30 Pavetta Cr	53	30 61 Fruit Tree Cr	54
04 31 Pavetta Cr	52	31 63 Fruit Tree Cr	54
04 31 Pavetta Cr	52	32 65 Fruit Tree Cr	53
04 31 Pavetta Cr	53	33 67 Fruit Tree Cr	54
05 9 Agonis Pl	52	34 69 Fruit Tree Cr	54
05 9 Agonis Pl	53	35 71 Fruit Tree Cr	54
06 10 Agonis Pl	50	36 73 Fruit Tree Cr	55
06 10 Agonis Pl	50	37 75 Fruit Tree Cr	55
06 10 Agonis Pl	52	38 77 Fruit Tree Cr	55
07 8 Agonis Pl	52	39 79 Fruit Tree Cr	54
07 8 Agonis Pl	55	39 79 Fruit Tree Cr	56 (56)
08 55A Pavetta Cr	55	40 85 Fruit Tree Cr	56 (56)
09 55A Pavetta Cr	54	40 85 Fruit Tree Cr	55
10 57 Pavetta Cr	56 (45)	41 87 Fruit Tree Cr	55
10 57 Pavetta Cr	56 (52)	42 89 Fruit Tree Cr	54
10 57 Pavetta Cr	55	43 91 Fruit Tree Cr	54
11 56 Pavetta Cr	53	44 93 Fruit Tree Cr	54
11 56 Pavetta Cr	54	45 95 Fruit Tree Cr	55
12 60 Pavetta Cr	51	46 97 Fruit Tree Cr	54
12 60 Pavetta Cr	52	46 97 Fruit Tree Cr	54
12 60 Pavetta Cr	53	47 99 Fruit Tree Cr	54
13 59 Pavetta Cr	50	48 101 Fruit Tree Cr	52

Receiver No. & Address	Calculated L _{Aeq(Night)} , dB	Receiver No. & Address	Calculated L _{Aeq(Night)} , dB
13 59 Pavetta Cr	56 (49)	49 103 Fruit Tree Cr	53
13 59 Pavetta Cr	56 (51)	50 105 Fruit Tree Cr	54
14 226 Dawson Av	52	51 107 Fruit Tree Cr	51
14 226 Dawson Av	52	51 107 Fruit Tree Cr	54
14 226 Dawson Av	52	51 107 Fruit Tree Cr	53
15 7 Pearl Cl	56 (49)	52 109 Fruit Tree Cr	53
16 5 Pearl Cl	55	52 109 Fruit Tree Cr	54
16 5 Pearl Cl	57 (50)	52 109 Fruit Tree Cr	53
17 3 Pearl Cl	58 (50)	53 170 Sultana Rd West	54
18 1 Pearl Cl	58 (50)	54 168 Sultana Rd West	55
18 34 Fruit Tree Cr	57 (50)	55 166 Sultana Rd West	54
19 36 Fruit Tree Cr	57 (51)	56 15 Ashby Close	53
20 21 Strawberry Way	56 (52)	56 15 Ashby Close	52
20 21 Strawberry Way	56 (53)	57 13 Ashby Close	52
21 20 Strawberry Way	54	57 13 Ashby Close	52
21 20 Strawberry Way	52	57 13 Ashby Close	52
22 48 Fruit Tree Cr	57 (55)	58 11 Ashby Close	52
22 48 Fruit Tree Cr	53		

Note: Noise levels in brackets are without the influence of road traffic on Berkshire Road

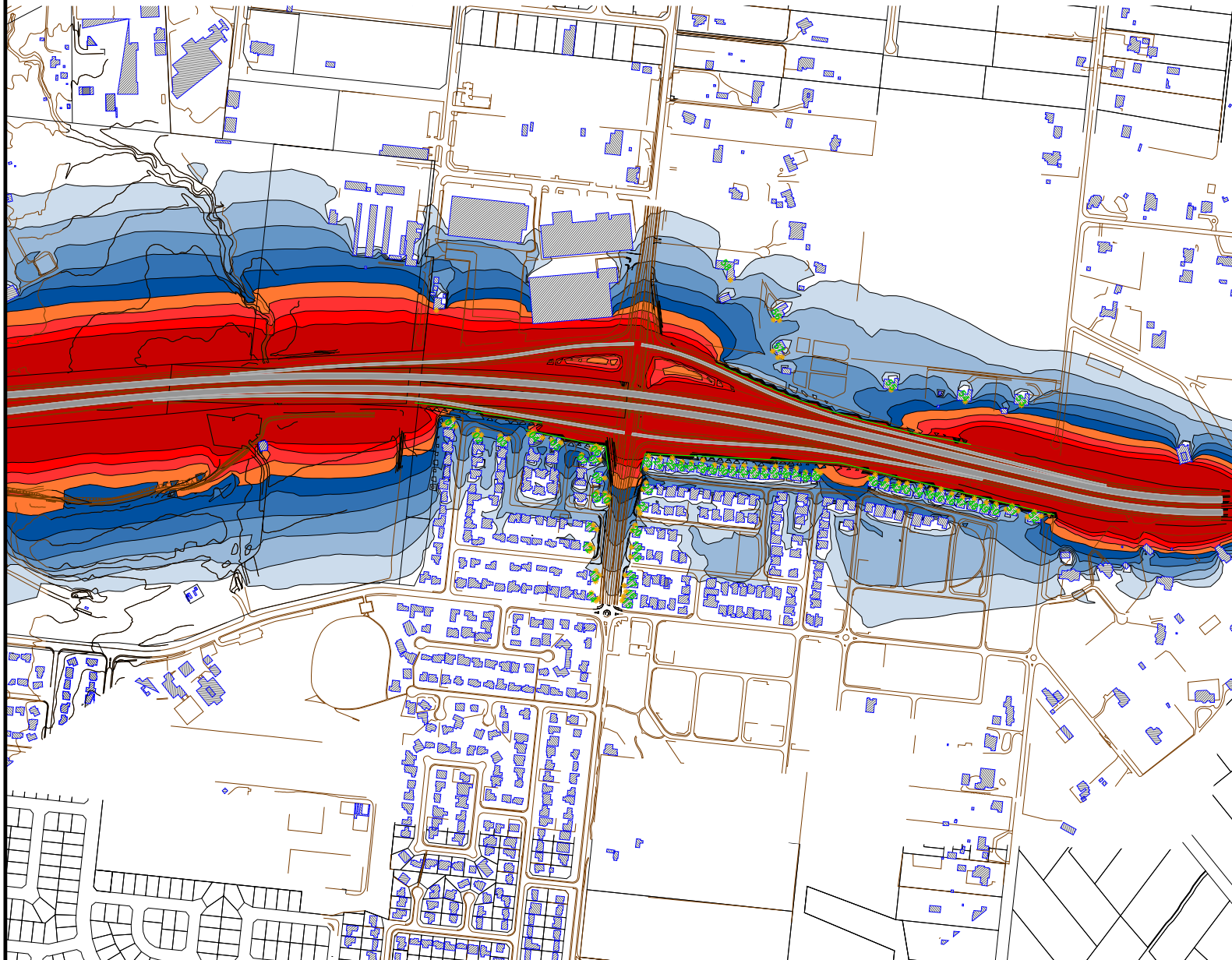
For residences along Berkshire Road, existing noise levels are below the *limit* but in some cases are predicted to increase to above the *limit* in the future (2050) without the road project (No Build Scenario) due to traffic growth. To trigger the Policy, one of the requirements is for urban roads to carry more than 20,000 vehicles per day based on a 15-20 year horizon. In 2031, traffic volumes are forecast to be 18,450 vehicles per day and therefore less than 20,000 and as such, the Policy is not automatically triggered. There is however a clause that states even if the road is not considered a major road, the Policy can still be applied at the discretion of the WAPC or local government. For the purposes of this report, it has been assumed that noise levels from Berkshire Road are not to be considered. Other than the Policy interpretation, this approach is commonly taken as similar noise levels will exist at residences outside the project area (south of Dawson Avenue) and no noise mitigation will be undertaken in these areas.

Irrespective of the Berkshire Road issue, two residences alongside Roe Highway (79 & 85 Fruit Tree Crescent) are predicted to experience future (2050) noise levels above the *limit*. As such, the wall at the rear of these two properties is to be increased by 0.25 metres.

Comparing the with wall noise levels (*Table 5-2*) with the no wall noise levels (*Table 4-4*), the walls on the south side of Roe Highway are typically providing a 5 dB reduction, whilst those on the north side provide an average 3 dB reduction.

Gateway WA - Roe/Berkshire Interchange
 LAeq(Night) Noise Level Contours - Future (2050) Scenario with Proposed Walls

Figure 5-2







Noise levels
 LAeq,night dB

50 <=	< 51
51 <=	< 52
52 <=	< 53
53 <=	< 54
54 <=	< 55
55 <=	< 56
56 <=	< 57
57 <=	< 58

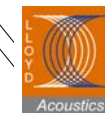


Signs and symbols

-  Road Surface
-  Building
-  Receiver
-  Noise Wall

5 June 2014

Length Scale 1:10000



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6 CONCLUSION

This assessment has considered the existing and future noise levels at residences in the vicinity of the Roe Highway and Berkshire Road interchange. The assessment has comprised noise monitoring at residences and 3D noise modelling. Recommendations are provided in order to minimise the noise impacts of the proposed interchange upgrade, through to the year 2050.

Existing noise levels at residences are above the *target* (50 dB $L_{Aeq(Night)}$) with some residences having noise levels above the *limit* (55 dB $L_{Aeq(Night)}$) as defined in the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*. If the road project was not to occur (No Build Scenario), noise levels will increase by around 4 dB at residences alongside Roe Highway through to the year 2050 due to increased traffic volumes. Along Berkshire Road, the increase for the No Build Scenario will be around 3 dB.

With the road project, noise levels at residences alongside Roe Highway but further from the interchange tend to decrease whilst noise levels at those residences closer to the interchange tend to increase. Whilst the realignment and grade separation will generally increase noise levels, the use of an improved (quieter) road surface results in the level increase being somewhat controlled.

Given that the road project is considered a major upgrade, it is desirable (where practicable) to satisfy the *limit* of the Policy. To achieve the *limit* at residences alongside Roe Highway through to the year 2050, the noise mitigation will comprise of both the quieter road surface and also the construction of walls. The walls will be located between the residences and Roe Highway, either on the residential boundary or alongside the onramps at heights ranging 2.75 metres to 5.00 metres. The walls serve as both noise barriers and visual screens and provide an average 5 dB reduction. Given the existing noise levels, No Build noise levels and the mitigation requirements to achieve the *limit*, achieving the *target* of the Policy is not considered practicable or necessary.

Analysis of the 15% wall design has shown that the wall sections at the rear of 79 & 85 Fruit Tree Crescent are to be increased by 0.25 metres in order to achieve the *limit* at these two properties. With this implemented, noise levels will achieve the *limit* at all residences alongside Roe Highway.

Other than a return wall near the interchange, no walls are to be constructed alongside Berkshire Road. The reasons for this are threefold:

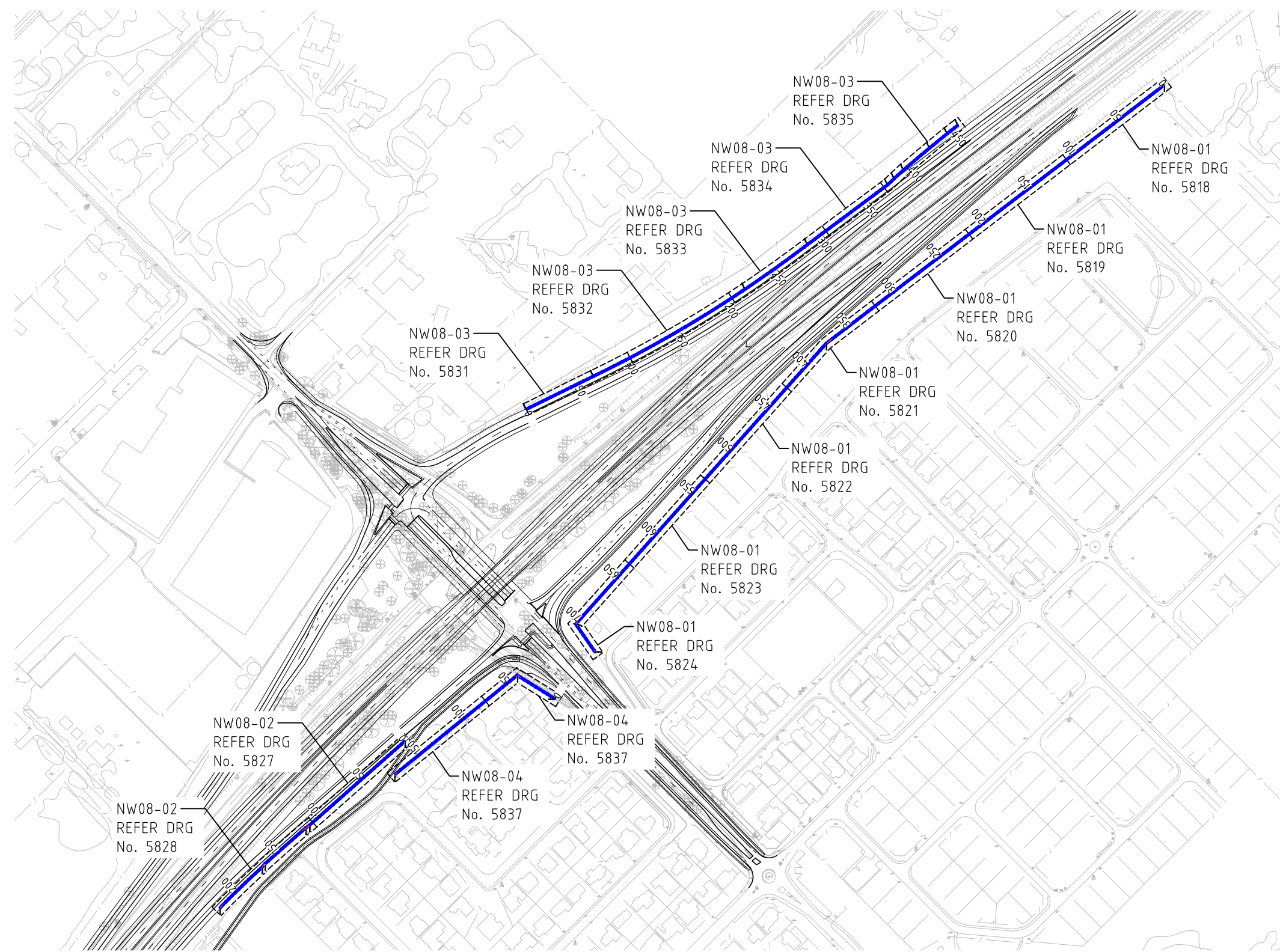
- The Policy is generally only applicable to major roads, being those that carry more than 20,000 vehicles per day. Current volumes are around 10,500 vehicles per day. The Policy does consider a 15-20 year horizon at which point, traffic volumes are projected to increase to around 18,500 vehicles per day. As the 20,000 vehicles per day is not exceeded, the road noise is not assessed;
- Noise levels would be much the same further away from the interchange as the traffic volumes will still be similar south of Dawson Avenue. No noise mitigation would be considered south of Dawson Avenue with the increase in noise level over time considered part of natural growth;
- Construction of noise walls alongside local roads is not considered a desirable outcome in terms of street amenity.

Appendix A

NOISE WALL DRAWINGS

NOTES:


1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
2. ALL POSTS ARE AT 4000 CENTRES U.N.O.



KEY PLAN
1:2000

SCALE 1:2000

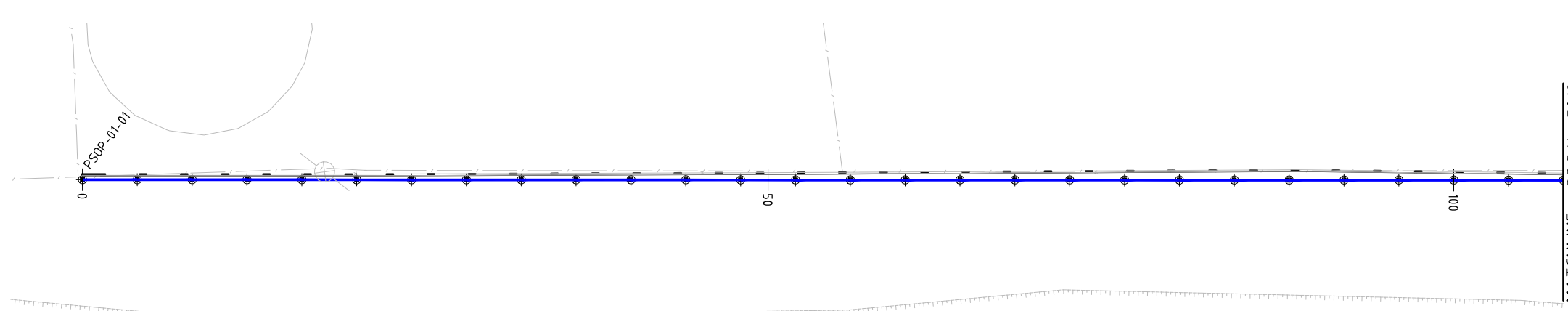
NOT FOR CONSTRUCTION

Rev.	B	16.05.14	ISSUED FOR 15% REVIEW	NSW	APPROVED	 <p>GatewayWA Perth Airport and Freight Access Project</p>	 <p>mainroads WESTERN AUSTRALIA</p>	DESIGNED	M. SWALES	Feb-14	VERIFIER		PROJECT TITLE GATEWAY WA	DRAWING TITLE AREA B - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS KEY PLAN	SHEET A1
	A	11.04.14	ISSUED FOR DCT					DRAWN	B. BURGESS	Feb-14	DESIGN MANAGER APPROVED				
								CHECKED	N. WESTMACOTT	Feb-14	ALLIANCE PROJECT DIRECTOR APPROVED		MRWA DRAWING No.		
								DRAWING PATH K:\ED Engineering & Design\ED105 CAD\ACAD_STR\08\5800-Noise Wall		DRAWING STATUS 15%		DRAWING NUMBER 08-047-NW-DG-5810		REV B	
LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA MAIN ROADS RESPONSIBILITY AREA METROPOLITAN															

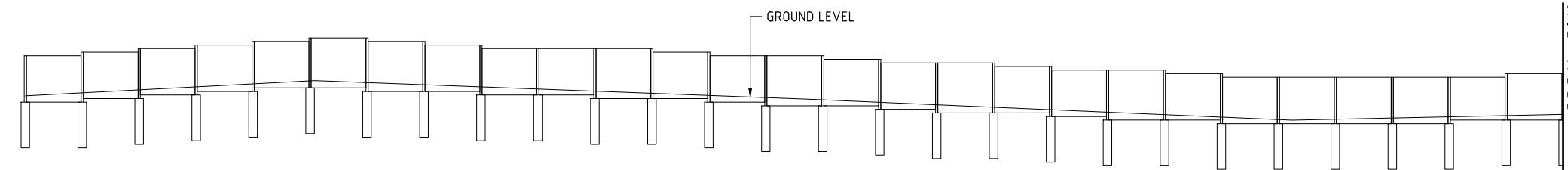
- NOTES:**
1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
 2. ALL POSTS ARE AT 4000 CENTRES U.N.O.

- LEGEND**
- STANDARD LENGTH PANEL (BLUE).
 - NON STANDARD LENGTH PANEL (RED).
 - - - DENOTES SERVICES (DERIVED FROM POTHOLING)
 - ▨ DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



PLAN
1:200



DATUM 32.000m

POST CHAINAGE (NOT TO BE USED FOR SETTING OUT)	0.00	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	44.00	48.00	52.00	56.00	60.00	64.00	68.00	72.00	76.00	80.00	84.00	88.00	92.00	96.00	100.00	104.00	108.00
EXISTING GROUND LEVEL	43.419	43.628	43.836	44.045	44.253	44.462	44.670	44.879	45.087	45.295	45.504	45.712	45.920	46.128	46.336	46.544	46.752	46.960	47.168	47.376	47.584	47.792	48.000	48.208	48.416	48.624	48.832	49.040
BASE OF PANEL RL	42.974	42.974	43.224	43.474	43.724	43.974	44.224	44.474	44.724	44.974	45.224	45.474	45.724	45.974	46.224	46.474	46.724	46.974	47.224	47.474	47.724	47.974	48.224	48.474	48.724	48.974	49.224	49.474
PANEL HEIGHT		3250	3250	3250	3250	3250	3500	3500	3250	3250	3250	3500	3250	3250	3500	3250	3250	3500	3250	3250	3500	3250	3250	3250	3250	3250	3000	3250
PANEL THICKNESS AND LENGTH (PANEL LENGTH 3946 U.N.O.)		125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
FOOTING DEPTH	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
PSOP	01-01																											

DEVELOPED ELEVATION - NW08-01 - FRONT FACE
1:200

NOT FOR CONSTRUCTION

B 16.05.14 A 11.04.14 Rev. DATE DESCRIPTION	ISSUED FOR 15% REVIEW ISSUED FOR DCT	NSW APPROVED	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94 HEIGHT DATUM: AHD		 Perth Airport and Freight Access Project	 INFRASTRUCTURE DELIVERY DIRECTORATE		DESIGNED M. SWALES Feb-14 VERIFIER	PROJECT TITLE GATEWAY WA	DRAWING TITLE AREA 8 - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS NOISE WALL NW08-01 PLAN AND PROFILE SHEET 1	SHEET A1
			DRAWN B. BURGESS Feb-14 DESIGN MANAGER APPROVED CHECKED N. WESTMACOTT Feb-14 ALLIANCE PROJECT DIRECTOR APPROVED	LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA MAIN ROADS RESPONSIBILITY AREA METROPOLITAN				DRAWING STATUS 15%			

Plot Date: Friday, 30 May 2014 10:03:43 AM Plotted by: Burgess, Brent

SCALE 1:200

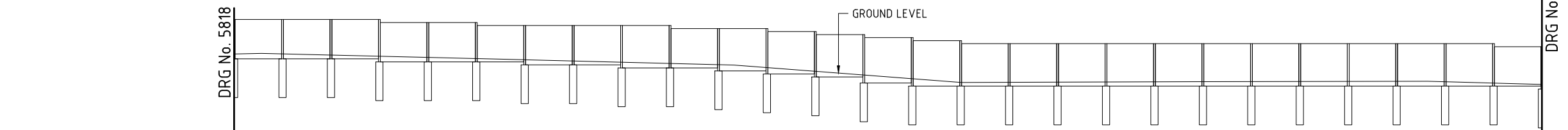
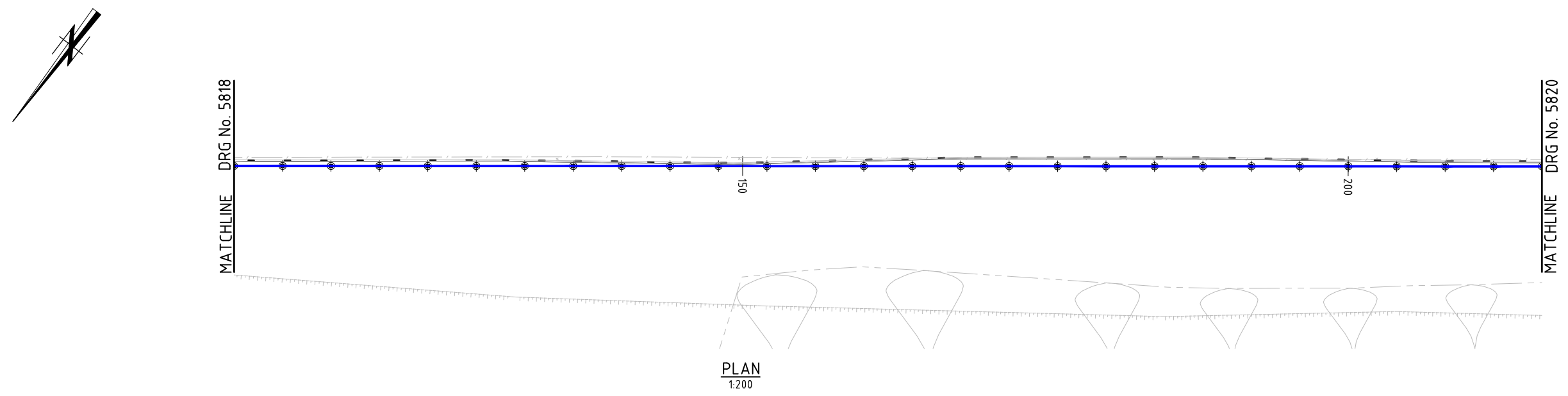
NOTES:

1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
2. ALL POSTS ARE AT 4000 CENTRES U.N.O.

LEGEND

- STANDARD LENGTH PANEL (BLUE).
- NON STANDARD LENGTH PANEL (RED).
- - - DENOTES SERVICES (DERIVED FROM POTHOLING)
- DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



DATUM 32.000m	
POST CHAINAGE (NOT TO BE USED FOR SETTING OUT)	3250 41.724 42.125 112.00
EXISTING GROUND LEVEL	3250 41.724 42.031 116.00
BASE OF PANEL RL	3250 41.724 41.937 120.00
PANEL HEIGHT	3250 41.474 41.843 124.00
PANEL THICKNESS AND LENGTH (PANEL LENGTH 3946 U.N.O.)	3250 41.474 41.749 128.00
FOOTING DEPTH	3000 41.474 41.651 132.00
PSOP	3250 41.224 41.549 136.00
	3250 41.224 41.448 140.00
	3500 40.974 41.346 144.00
	3250 40.974 41.244 148.00
	3500 40.724 41.003 152.00
	3500 40.474 40.697 156.00
	3500 40.224 40.391 160.00
	3750 39.724 40.085 164.00
	3750 39.474 39.778 168.00
	3500 39.474 39.787 172.00
	3500 39.474 39.800 176.00
	3500 39.474 39.814 180.00
	3500 39.474 39.828 184.00
	3500 39.474 39.840 188.00
	3500 39.474 39.846 192.00
	3500 39.474 39.852 196.00
	3500 39.474 39.857 200.00
	3500 39.474 39.863 204.00
	3500 39.474 39.827 208.00
	3500 39.474 39.716 212.00
	3250 39.474 39.605 216.00

DEVELOPED ELEVATION - NW08-01 - FRONT FACE
1:200

NOT FOR CONSTRUCTION

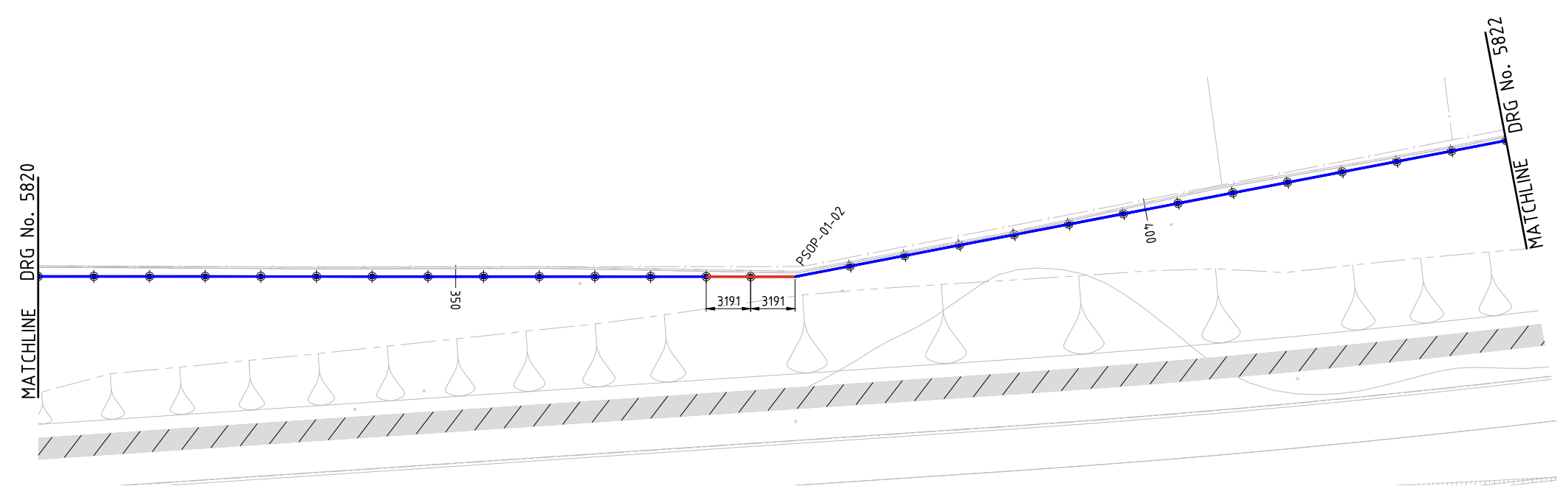
B A	16.05.14 11.04.14	ISSUED FOR 15% REVIEW ISSUED FOR DCT	NSW	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94	 Perth Airport and Freight Access Project	 INFRASTRUCTURE DELIVERY DIRECTORATE	DESIGNED M. SWALES Feb-14 VERIFIER	DRAWN B. BURGESS Feb-14 DESIGN MANAGER APPROVED	CHECKED N. WESTMACOTT Feb-14 ALLIANCE PROJECT DIRECTOR APPROVED	PROJECT TITLE GATEWAY WA	SHEET A1
				LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA						MAIN ROADS RESPONSIBILITY AREA METROPOLITAN	

SCALE 1:200

- NOTES:**
1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
 2. ALL POSTS ARE AT 4000 CENTRES U.N.O.

- LEGEND**
- STANDARD LENGTH PANEL (BLUE).
 - NON STANDARD LENGTH PANEL (RED).
 - - - DENOTES SERVICES (DERIVED FROM POTHOLES)
 - ▨ DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



PLAN
1:200

	DEVELOPED ELEVATION - NW08-01 - FRONT FACE																											
DATUM 32.000m																												
POST CHAINAGE (NOT TO BE USED FOR SETTING OUT)																												
EXISTING GROUND LEVEL																												
BASE OF PANEL RL																												
PANEL HEIGHT																												
PANEL THICKNESS AND LENGTH (PANEL LENGTH 3946 U.N.O.)																												
FOOTING DEPTH																												
PSOP																												

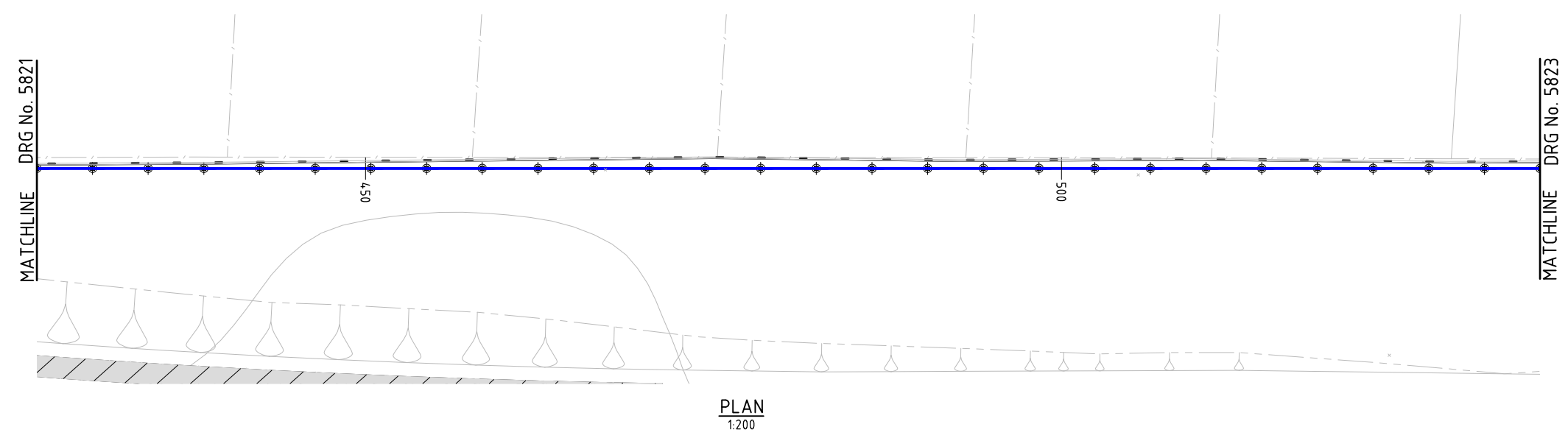
1:200

NOT FOR CONSTRUCTION

B 16.05.14 A 11.04.14 Rev. DATE DESCRIPTION	ISSUED FOR 15% REVIEW ISSUED FOR DCT	NSW APPROVED	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94 HEIGHT DATUM: AHD		 Perth Airport and Freight Access Project	 INFRASTRUCTURE DELIVERY DIRECTORATE		DESIGNED M. SWALES Feb-14 VERIFIER	DRAWN B. BURGESS Feb-14 DESIGN MANAGER APPROVED	CHECKED N. WESTMACOTT Feb-14 ALLIANCE PROJECT DIRECTOR APPROVED	DRAWING PATH K:\ED Engineering & Design\ED105 CAD\ACAD_STR\08\5800-Noise Wall	PROJECT TITLE GATEWAY WA	DRAWING TITLE AREA B - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS NOISE WALL NW08-01 PLAN AND PROFILE SHEET 4	SHEET A1
			LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA	MAIN ROADS RESPONSIBILITY AREA METROPOLITAN				DRAWING STATUS 15%	DRAWING NUMBER 08-047-NW-DG-5821	REV B				

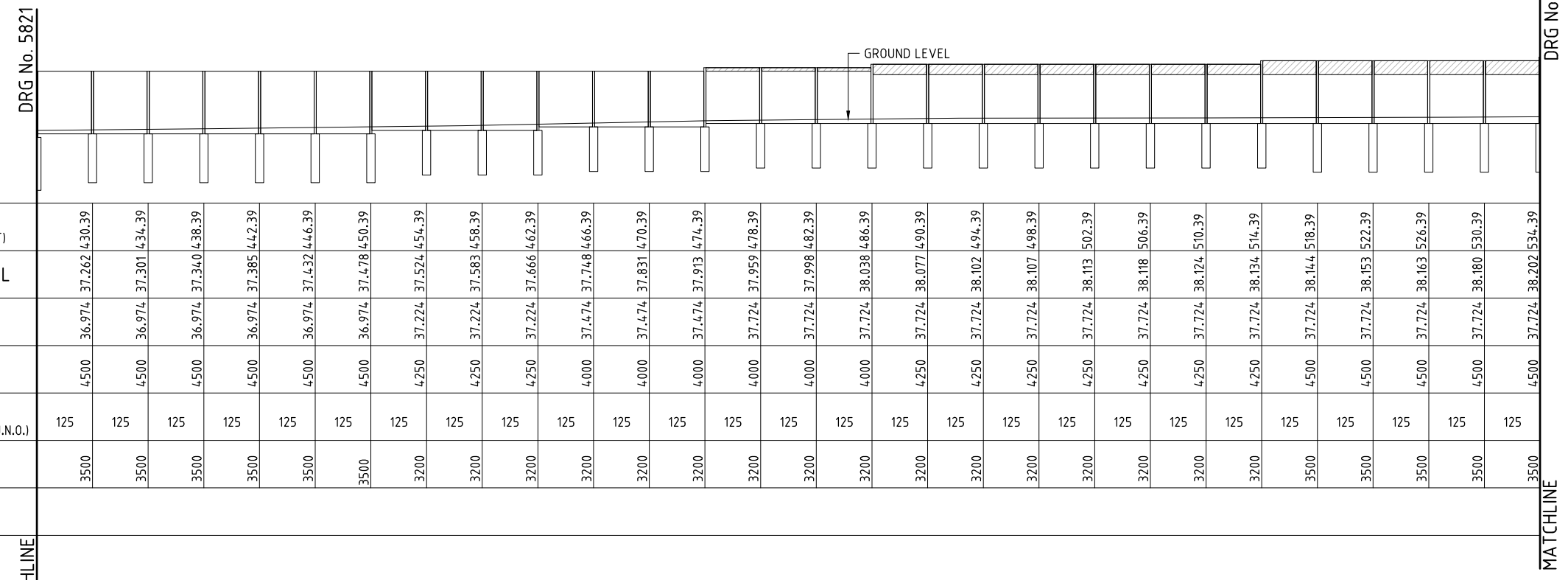
SCALE 1:200

- NOTES:**
1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
 2. ALL POSTS ARE AT 4000 CENTRES U.N.O.



- LEGEND**
- STANDARD LENGTH PANEL (BLUE).
 - NON STANDARD LENGTH PANEL (RED).
 - - - DENOTES SERVICES (DERIVED FROM POTHOLING)
 - ▨ DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



DATUM 32.000m																													
POST CHAINAGE (NOT TO BE USED FOR SETTING OUT)		430.39	434.39	438.39	442.39	446.39	450.39	454.39	458.39	462.39	466.39	470.39	474.39	478.39	482.39	486.39	490.39	494.39	498.39	502.39	506.39	510.39	514.39	518.39	522.39	526.39	530.39	534.39	
EXISTING GROUND LEVEL		37.262	37.301	37.340	37.385	37.432	37.478	37.524	37.583	37.666	37.748	37.831	37.913	37.959	37.998	38.038	38.077	38.102	38.107	38.113	38.118	38.124	38.134	38.144	38.153	38.163	38.180	38.202	
BASE OF PANEL RL		36.974	36.974	36.974	36.974	36.974	36.974	37.224	37.224	37.224	37.474	37.474	37.474	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	37.724	
PANEL HEIGHT		4500	4500	4500	4500	4500	4500	4250	4250	4250	4000	4000	4000	4000	4000	4000	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4500	
PANEL THICKNESS AND LENGTH (PANEL LENGTH 3946 U.N.O.)		125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	
FOOTING DEPTH		3500	3500	3500	3500	3500	3500	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3500	3500	
PSOP																													

DEVELOPED ELEVATION - NW08-01 - FRONT FACE
1:200

NOT FOR CONSTRUCTION

B 16.05.14 ISSUED FOR 15% REVIEW A 11.04.14 ISSUED FOR DCT	NSW APPROVED	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94 HEIGHT DATUM: AHD		Perth Airport and Freight Access Project	INFRASTRUCTURE DELIVERY DIRECTORATE		DESIGNED M. SWALES Feb-14	VERIFIER		PROJECT TITLE GATEWAY WA	SHEET A1
		DRAWN B. BURGESS Feb-14	DESIGN MANAGER APPROVED					DRAWING TITLE AREA 8 - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS NOISE WALL NW08-01 PLAN AND PROFILE SHEET 5 MRWA DRAWING No.			
Rev. DATE DESCRIPTION							CHECKED N. WESTMACOTT Feb-14	ALLIANCE PROJECT DIRECTOR APPROVED		LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA MAIN ROADS RESPONSIBILITY AREA METROPOLITAN	DRAWING STATUS 15% DRAWING NUMBER 08-047-NW-DG-5822 REV B

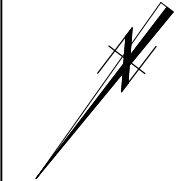
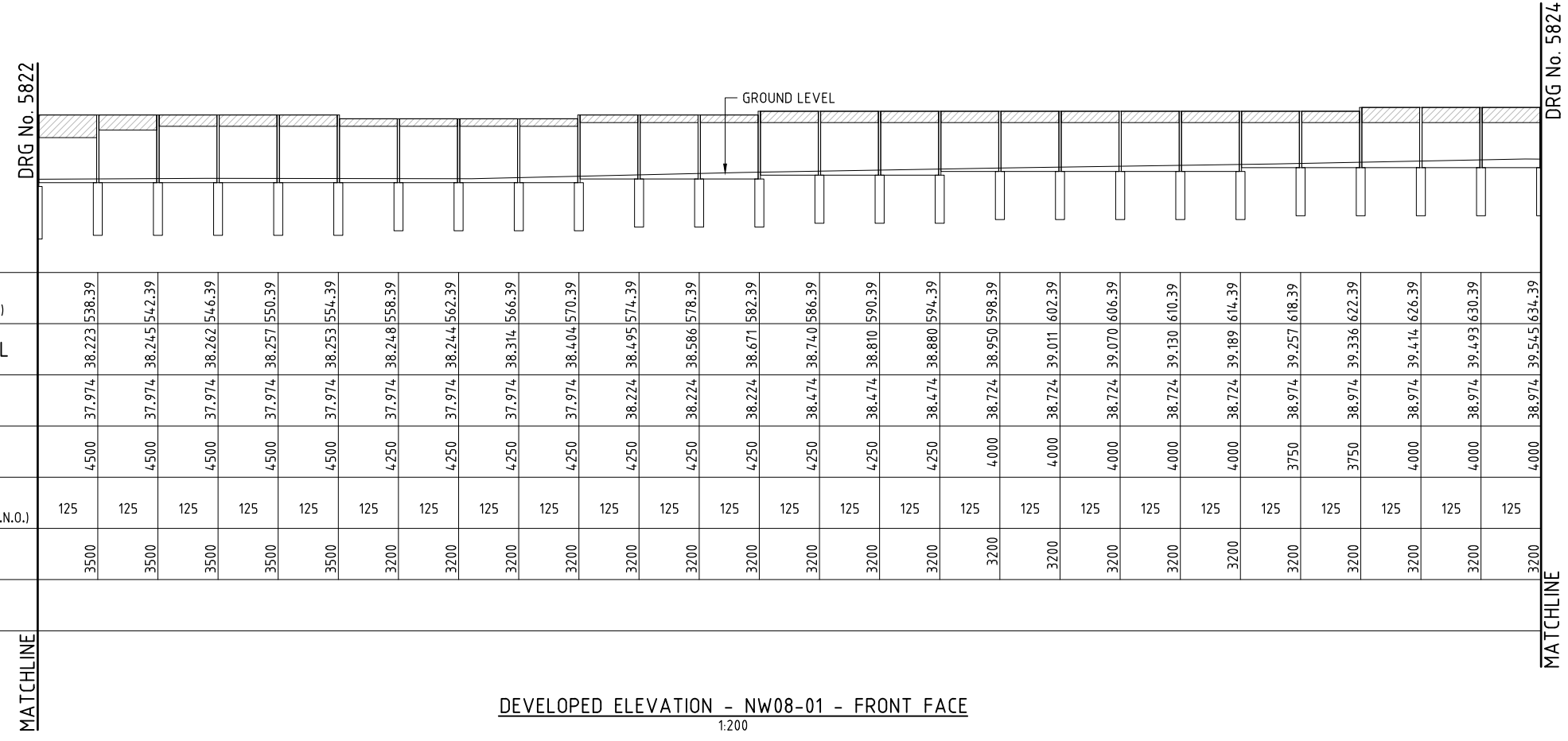
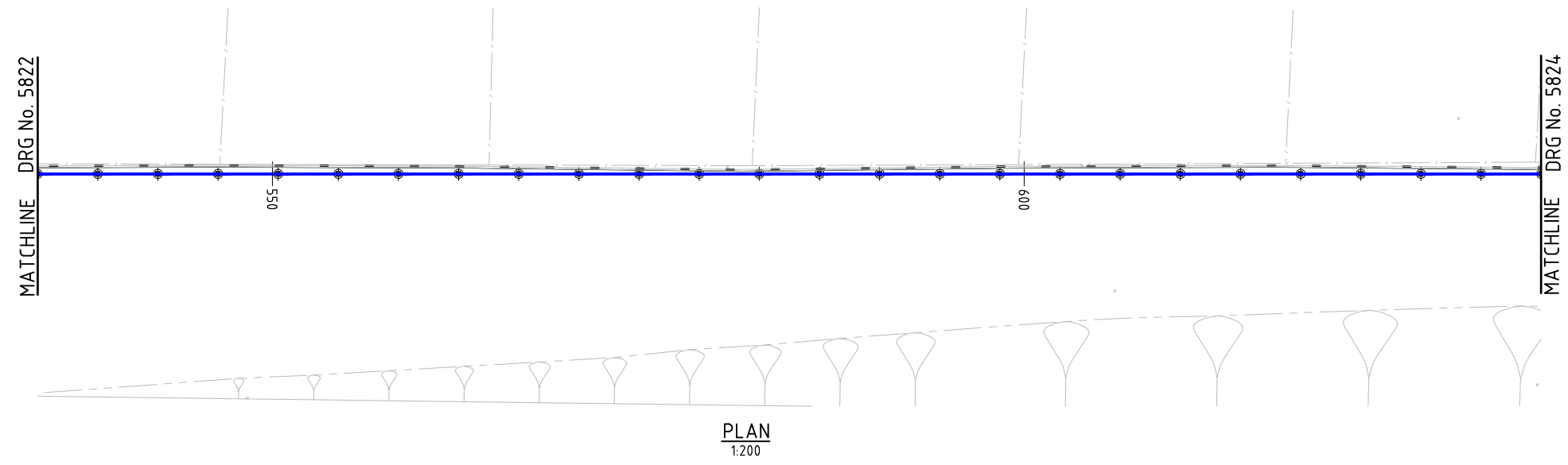
NOTES:

1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
2. ALL POSTS ARE AT 4000 CENTRES U.N.O.

LEGEND

- STANDARD LENGTH PANEL (BLUE).
- NON STANDARD LENGTH PANEL (RED).
- - - DENOTES SERVICES (DERIVED FROM POTHOLING)
- DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



NOT FOR CONSTRUCTION

B A Rev. DATE	16.05.14 11.04.14 ISSUED FOR 15% REVIEW ISSUED FOR DCT	DESCRIPTION NSW APPROVED	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94 HEIGHT DATUM: AHD	 Perth Airport and Freight Access Project	 INFRASTRUCTURE DELIVERY DIRECTORATE		DESIGNED M. SWALES Feb-14 DRAWN B. BURGESS Feb-14 CHECKED N. WESTMACOTT Feb-14	VERIFIER DESIGN MANAGER APPROVED ALLIANCE PROJECT DIRECTOR APPROVED	PROJECT TITLE GATEWAY WA	DRAWING TITLE AREA 8 - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS NOISE WALL NW08-01 PLAN AND PROFILE SHEET 6 MRWA DRAWING No.	SHEET A1
			LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA	MAIN ROADS RESPONSIBILITY AREA METROPOLITAN	DRAWING STATUS 15%	DRAWING NUMBER 08-047-NW-DG-5823	REV B				

SCALE 1:200

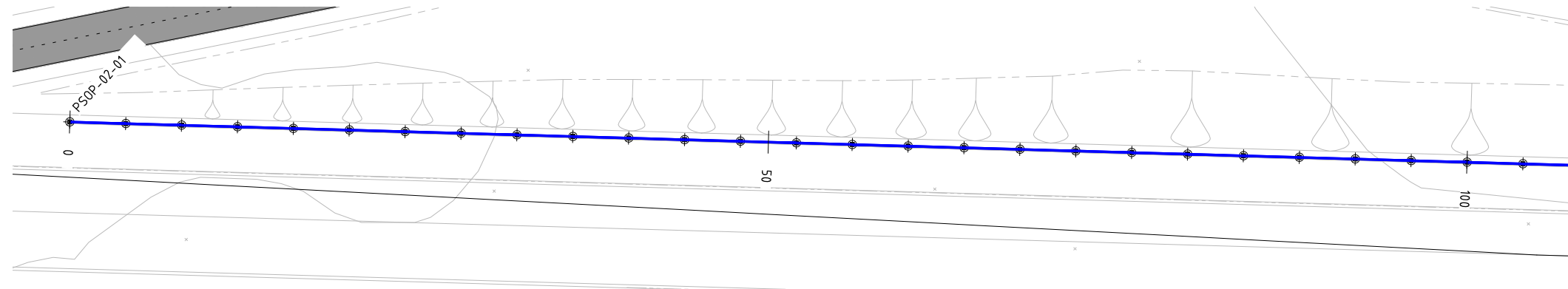
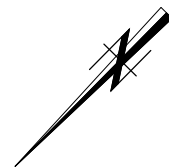
NOTES:

1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
2. ALL POSTS ARE AT 4000 CENTRES U.N.O.

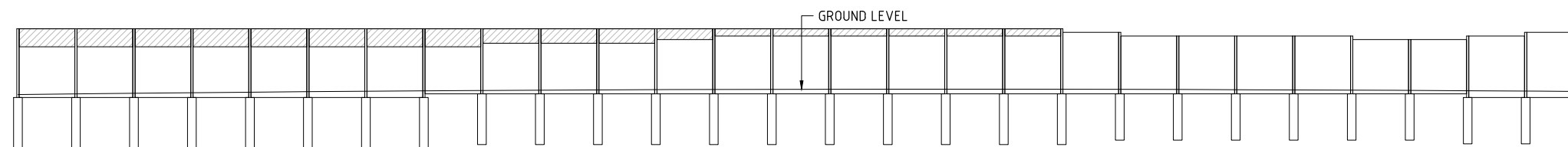
LEGEND

- STANDARD LENGTH PANEL (BLUE).
- NON STANDARD LENGTH PANEL (RED).
- - - DENOTES SERVICES (DERIVED FROM POTHOLING)
- DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



PLAN
1:200



DEVELOPED ELEVATION - NW08-02 - FRONT FACE
1:200

DATUM 31.000m																														
POST CHAINAGE (NOT TO BE USED FOR SETTING OUT)		0.00	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	44.00	48.00	52.00	56.00	60.00	64.00	68.00	72.00	76.00	80.00	84.00	88.00	92.00	96.00	100.00	104.00	108.00	
EXISTING GROUND LEVEL		31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
BASE OF PANEL RL		31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000	31.000
PANEL HEIGHT			4.750	4.750	4.750	4.750	4.750	4.750	4.750	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.250	4.000	4.000	4.000	4.000	3.750	3.750	4.250	4.500	
PANEL THICKNESS AND LENGTH (PANEL LENGTH 3946 U.N.O.)		125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	
FOOTING DEPTH		3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3500	3200	3200	3200	3200	3200	3200	3200	3200	3500	
PSOP	02-01																													

MATCHLINE DRG No. 5828

DRG No. 5828

MATCHLINE

NOT FOR
CONSTRUCTION

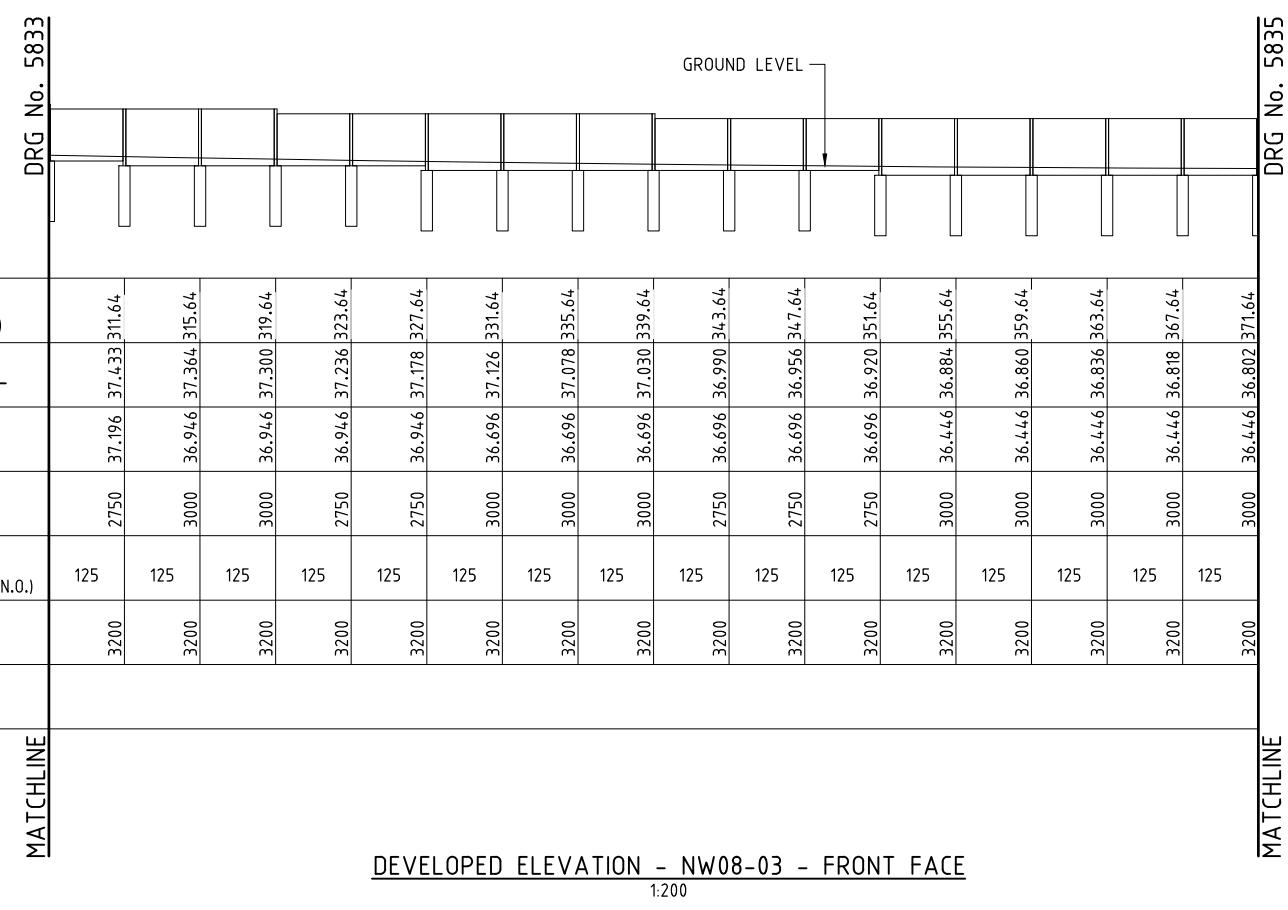
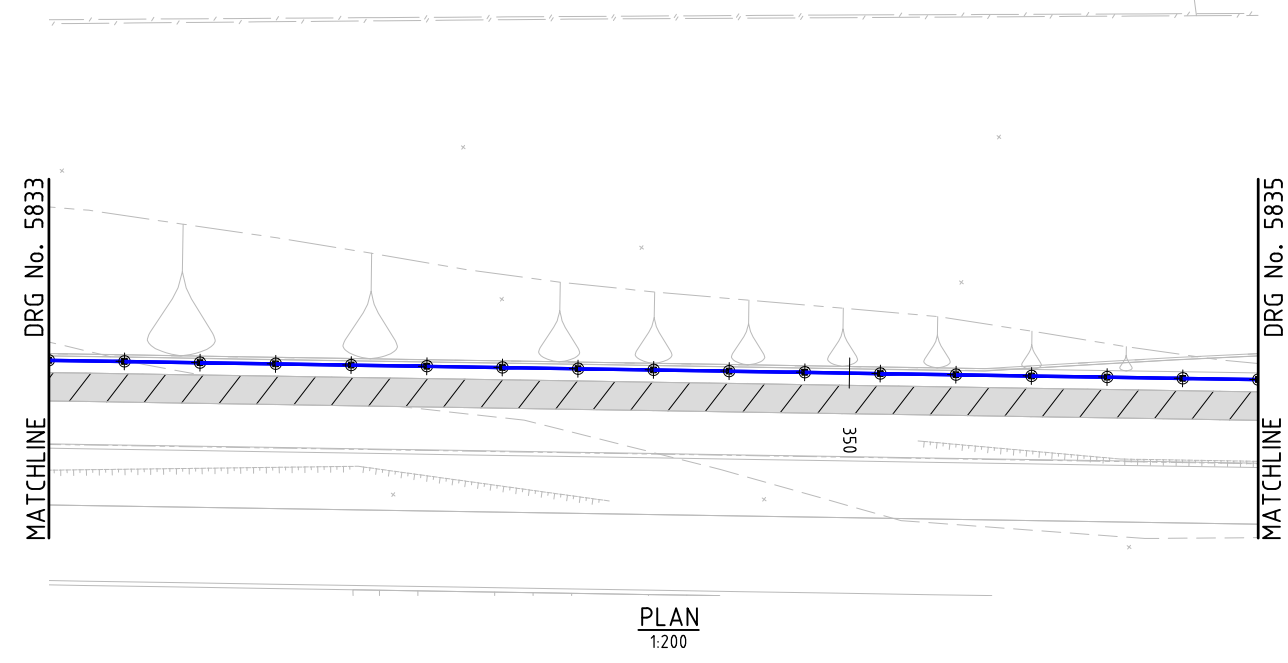
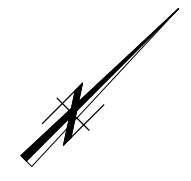
B A Rev. DATE	16.05.14 11.04.14	ISSUED FOR 15% REVIEW ISSUED FOR DCT	NSW APPROVED	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94 HEIGHT DATUM: AHD	 Perth Airport and Freight Access Project	 INFRASTRUCTURE DELIVERY DIRECTORATE		DESIGNED M. SWALES Feb-14 VERIFIER DRAWN B. BURGESS Feb-14 DESIGN MANAGER APPROVED CHECKED N. WESTMACOTT Feb-14 ALLIANCE PROJECT DIRECTOR APPROVED	PROJECT TITLE GATEWAY WA DRAWING TITLE AREA B - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS NOISE WALL NW08-02 PLAN AND PROFILE SHEET 1 MRWA DRAWING No.	SHEET A1
				DRAWING PATH K:\ED Engineering & Design\ED105 CAD\ACAD_STR\08\5800-Noise Wall	LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA MAIN ROADS RESPONSIBILITY AREA METROPOLITAN	DRAWING STATUS 15%	DRAWING NUMBER 08-047-NW-DG-5827	REV B		

SCALE 1:200

- NOTES:**
1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
 2. ALL POSTS ARE AT 4000 CENTRES U.N.O.

- LEGEND**
- STANDARD LENGTH PANEL (BLUE).
 - NON STANDARD LENGTH PANEL (RED).
 - - - DENOTES SERVICES (DERIVED FROM POTHOLES)
 - ▨ DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



DATUM 31.000m

POST CHAINAGE (NOT TO BE USED FOR SETTING OUT)		311.64	315.64	319.64	323.64	327.64	331.64	335.64	339.64	343.64	347.64	351.64	355.64	359.64	363.64	367.64	371.64
EXISTING GROUND LEVEL		37.433	37.364	37.300	37.236	37.178	37.126	37.078	37.030	36.990	36.956	36.920	36.884	36.860	36.836	36.818	36.802
BASE OF PANEL RL		37.196	36.946	36.946	36.946	36.946	36.696	36.696	36.696	36.696	36.696	36.446	36.446	36.446	36.446	36.446	36.446
PANEL HEIGHT		2750	3000	3000	2750	2750	3000	3000	3000	2750	2750	2750	3000	3000	3000	3000	3000
PANEL THICKNESS AND LENGTH (PANEL LENGTH 3946 U.N.O.)	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
FOOTING DEPTH	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
PSOP																	

DEVELOPED ELEVATION - NW08-03 - FRONT FACE
1:200

NOT FOR CONSTRUCTION

B 16.05.14 ISSUED FOR 15% REVIEW A 11.04.14 ISSUED FOR DCT	NSW APPROVED	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94 HEIGHT DATUM: AHD		GatewayWA Perth Airport and Freight Access Project	Government of Western Australia INFRASTRUCTURE DELIVERY DIRECTORATE	mainroads WESTERN AUSTRALIA	DESIGNED M. SWALES Feb-14 VERIFIER	PROJECT TITLE GATEWAY WA	DRAWING TITLE AREA B - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS NOISE WALL NW08-03 PLAN AND PROFILE SHEET 4	SHEET A1
		DRAWN B. BURGESS Feb-14 DESIGN MANAGER APPROVED CHECKED N. WESTMACOTT Feb-14 ALLIANCE PROJECT DIRECTOR APPROVED	LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA MAIN ROADS RESPONSIBILITY AREA METROPOLITAN				DRAWING STATUS 15%			
Rev. DATE DESCRIPTION		APPROVED HEIGHT DATUM: AHD		DRAWING PATH K:\ED Engineering & Design\ED105 CAD\ACAD_STR\08\5800-Noise Wall		LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA		MAIN ROADS RESPONSIBILITY AREA METROPOLITAN		SCALE 1:200

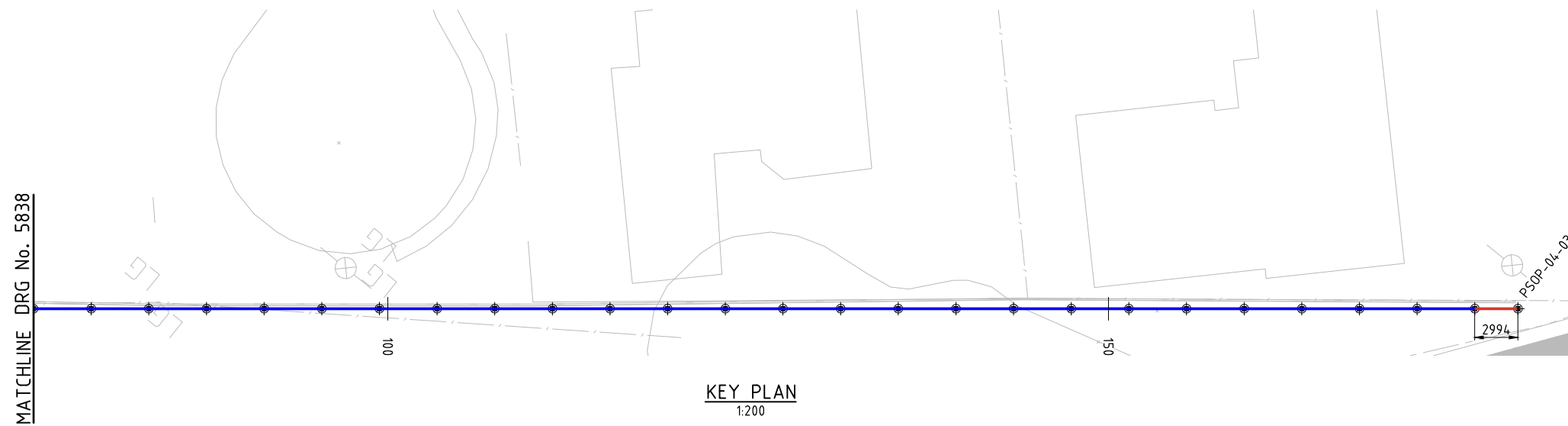
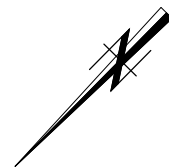
NOTES:

1. SET OUT COORDINATES ARE SHOWN WHERE THERE IS A CHANGE IN DIRECTION OF WALL ALIGNMENT, AT THE BEGINNING AND END OF WALL, OR WHERE THERE IS CHANGE IN PANEL THICKNESS.
2. ALL POSTS ARE AT 4000 CENTRES U.N.O.

LEGEND

- STANDARD LENGTH PANEL (BLUE).
- NON STANDARD LENGTH PANEL (RED).
- - - DENOTES SERVICES (DERIVED FROM POTHOLING)
- ▨ DENOTES PORTION ON PANEL THAT PROVIDES SCREENING

THE ORIGINAL OF THIS DRAWING WAS PRODUCED USING COLOUR SEPARATION FOR GREATER CLARITY. WORKING WITH A BLACK AND WHITE COPY MAY CAUSE ERRORS. IF THIS DRAWING IS NOT IN COLOUR THEN YOU DO NOT HAVE THE CORRECT PRESENTATION.



DRG No. 5838

MATCHLINE

	DEVELOPED ELEVATION - NW08-04 - FRONT FACE																										
DATUM 33.000m																											
POST CHAINAGE (NOT TO BE USED FOR SETTING OUT)																											
EXISTING GROUND LEVEL																											
BASE OF PANEL RL																											
PANEL HEIGHT																											
PANEL THICKNESS AND LENGTH (PANEL LENGTH 3946 U.N.O.)																											
FOOTING DEPTH																											
PSOP																											

DEVELOPED ELEVATION - NW08-04 - FRONT FACE
1:200

NOT FOR CONSTRUCTION

B 16.05.14 A 11.04.14 Rev. DATE DESCRIPTION	ISSUED FOR 15% REVIEW ISSUED FOR DCT	NSW APPROVED	METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: PCG94 HEIGHT DATUM: AHD		GatewayWA Perth Airport and Freight Access Project	Government of Western Australia INFRASTRUCTURE DELIVERY DIRECTORATE	mainroads WESTERN AUSTRALIA	DESIGNED M. SWALES Feb-14 VERIFIER	PROJECT TITLE GATEWAY WA	DRAWING TITLE AREA 8 - ROE HIGHWAY AND BERKSHIRE ROAD NOISE WALLS NOISE WALL NW08-04 PLAN AND PROFILE SHEET 2	SHEET A1
			DRAWN B. BURGESS Feb-14 DESIGN MANAGER APPROVED	CHECKED N. WESTMACOTT Feb-14 ALLIANCE PROJECT DIRECTOR APPROVED				LOCAL AUTHORITY (102) SHIRE OF KALAMUNDA			

1:200 SCALE

Appendix B

PRE-CONSTRUCTION NOISE MONTORING

Table B1 – Noise Monitoring Results: 9 Agonis Place, Forrestfield

Date	L_{A10,18hour}, dB	L_{Aeq,24hour}, dB	L_{Aeq(Day)}, dB	L_{Aeq(Night)}, dB
4 February 2014	59.0	56.6	57.4	54.2
5 February 2014	58.7	55.9	57.1	51.8
6 February 2014	58.5	55.7	56.8	51.6
7 February 2014	59.7	56.7	57.9	52.4
10 February 2014	59.5	56.7	58.0	51.5
11 February 2014	57.8	55.1	56.2	51.2
Average	58.9	56.1	57.2	52.1

Traffic Noise Measurement Data

Item	Details
LOCATION	
Project	Roe Highway - Berkshire Road Interchange
Street address	9 Agonis Place
Locality	Forrestfield
Occupier	
Dates	3 to 12 February 2014
Category	<i>Main Roads to provide this information</i>
SITE	
Distance from the microphone to the kerb	75m
Height of the road in relation to the ground	-1m
Road surface type	Worn Chip
Speed zone	80km/hr
Absorbing ground	70%
Angle of view	110
Road gradient	V. Slight Decline
Traffic flow	40000
Heavy vehicles	11.00%
House-Road orientation.	West-North-West
Carriageways & lanes.	2 cwys, 4lns
COMMENT	
Comment	Microphone located at northwest façade of dwelling. Microphone height 1.4m above ground level Local fence.
REFERENCES	
AMG Z50 E/N	<i>Main Roads to provide this information</i>
Road name	<i>Roe Highway</i>
EXCEL file	9 Agonis PI S1.xlsx
Raw data file	Logger 16-004-041 - 9 Agonis Place - back of house near pool - facing road_Sta.xlsx
EQUIPMENT	
Analyser number	16-004-041
Microphone number	16-004-041
Calibrator number	34883971
Calibrator values	93.8 / 93.7
Operator	Lloyd George Acoustics Pty Ltd - Matthew Moyle
WEATHER	
Wind	Wind acceptability based on Mt Lawley Data 4-Feb-14 - Winds light to moderate and negative. 5-Feb-14 - Winds light to moderate and generally negative. 6-Feb-14 - Winds moderate and generally negative. 7-Feb-14 - Winds light to moderate and negative. 10-Feb-14 - Winds light to moderate and negative. 11-Feb-14 - Winds moderate and negative.

Hourly Noise Level Data
9 Agonis Place, Forrestfield

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
4-Feb-14	1:00	60.0	55.2	51.4	42.8	0.0	90	13
4-Feb-14	2:00	63.1	58.0	54.5	46.9	0.0	80	11
4-Feb-14	3:00	62.9	57.0	53.5	44.1	0.0	90	11
4-Feb-14	4:00	62.8	56.9	53.4	45.0	0.0	80	9
4-Feb-14	5:00	62.4	57.9	55.0	48.8	0.0	100	11
4-Feb-14	6:00	64.6	61.2	58.5	53.6	0.0	120	8
4-Feb-14	7:00	66.2	62.6	60.2	55.4	0.0	110	9
4-Feb-14	8:00	66.2	62.5	60.1	55.3	0.0	100	9
4-Feb-14	9:00	64.9	60.3	57.9	52.1	0.0	80	13
4-Feb-14	10:00	63.9	59.8	57.1	51.2	0.0	60	18
4-Feb-14	11:00	61.9	58.8	55.8	50.1	0.0	60	17
4-Feb-14	12:00	63.0	59.3	56.9	53.4	0.0	60	11
4-Feb-14	13:00	63.3	59.2	57.1	53.6	0.0	50	9
4-Feb-14	14:00	61.8	59.0	56.5	53.2	0.0	40	5
4-Feb-14	15:00	62.9	58.7	56.5	53.3	0.0	130	11
4-Feb-14	16:00	63.7	60.4	58.1	54.2	0.0	220	18
4-Feb-14	17:00	63.8	60.5	57.9	52.2	0.0	210	21
4-Feb-14	18:00	62.8	60.1	57.5	52.4	0.0	220	18
4-Feb-14	19:00	62.8	60.0	57.1	51.2	0.0	220	15
4-Feb-14	20:00	62.4	58.9	56.0	50.3	0.0	220	15
4-Feb-14	21:00	60.4	57.2	54.2	48.5	0.0	200	15
4-Feb-14	22:00	60.3	56.9	54.1	48.6	0.0	210	15
4-Feb-14	23:00	58.5	55.2	51.6	45.1	0.0	200	15
4-Feb-14	0:00	58.1	52.7	49.6	43.2	0.0	190	11
5-Feb-14	1:00	57.6	51.9	48.8	42.2	0.0	190	9
5-Feb-14	2:00	57.8	50.6	47.4	39.7	0.0	190	8
5-Feb-14	3:00	60.7	52.5	50.2	40.8	0.0	180	8
5-Feb-14	4:00	59.1	53.1	49.6	41.1	0.0	200	9
5-Feb-14	5:00	60.6	56.2	52.5	42.4	0.0	200	8
5-Feb-14	6:00	62.6	60.1	56.9	50.6	0.0	160	11
5-Feb-14	7:00	63.2	60.7	58.0	52.3	0.0	180	11
5-Feb-14	8:00	64.0	60.0	57.6	51.0	0.0	190	9
5-Feb-14	9:00	62.4	59.4	56.8	50.3	0.0	180	9
5-Feb-14	10:00	64.9	60.0	57.0	49.8	0.0	220	5
5-Feb-14	11:00	61.8	58.8	55.9	49.7	0.0	200	9
5-Feb-14	12:00	62.1	59.6	57.2	53.8	0.0	200	11
5-Feb-14	13:00	63.0	60.2	57.9	54.4	0.0	250	15
5-Feb-14	14:00	63.3	60.2	58.1	54.6	0.0	250	13
5-Feb-14	15:00	63.6	61.0	58.5	54.6	0.0	220	17
5-Feb-14	16:00	63.5	61.2	58.8	55.0	0.0	230	17
5-Feb-14	17:00	62.7	60.5	57.7	52.1	0.0	210	24
5-Feb-14	18:00	63.0	60.4	57.6	51.8	0.0	210	21
5-Feb-14	19:00	62.2	59.4	56.5	51.2	0.0	210	18
5-Feb-14	20:00	61.0	57.8	55.0	48.2	0.0	230	15
5-Feb-14	21:00	61.3	56.8	54.4	47.9	0.0	230	11
5-Feb-14	22:00	60.0	55.5	52.9	46.8	0.0	210	11
5-Feb-14	23:00	58.7	54.2	51.4	43.7	0.0	190	5
5-Feb-14	0:00	58.7	51.3	48.6	40.0	0.0	170	9

Hourly Noise Level Data
9 Agonis Place, Forrestfield

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
6-Feb-14	1:00	56.8	50.9	47.4	40.2	0.0	140	11
6-Feb-14	2:00	57.8	49.9	46.8	39.0	0.0	150	13
6-Feb-14	3:00	57.0	49.4	46.3	38.5	0.0	160	11
6-Feb-14	4:00	58.7	52.1	48.6	39.4	0.0	170	13
6-Feb-14	5:00	63.0	55.7	53.3	43.5	0.0	160	13
6-Feb-14	6:00	63.3	59.6	56.4	49.3	0.0	160	11
6-Feb-14	7:00	63.7	60.5	58.0	52.2	0.0	150	9
6-Feb-14	8:00	62.9	59.6	57.7	50.4	0.0	160	11
6-Feb-14	9:00	63.0	58.9	56.1	48.9	0.0	170	13
6-Feb-14	10:00	62.9	58.6	55.6	48.9	0.0	150	9
6-Feb-14	11:00	62.3	58.2	55.1	47.7	0.0	150	13
6-Feb-14	12:00	63.3	59.4	57.2	53.5	0.0	200	4
6-Feb-14	13:00	63.2	59.0	57.0	53.5	0.0	140	9
6-Feb-14	14:00	63.2	60.1	58.2	54.4	0.0	240	17
6-Feb-14	15:00	64.0	61.0	58.7	55.1	0.0	230	18
6-Feb-14	16:00	65.2	61.3	59.0	54.7	0.0	230	18
6-Feb-14	17:00	63.2	60.5	57.6	51.6	0.0	240	18
6-Feb-14	18:00	63.2	60.0	57.1	51.5	0.0	220	18
6-Feb-14	19:00	62.6	59.0	56.3	50.2	0.0	220	15
6-Feb-14	20:00	60.6	57.8	54.7	49.3	0.0	220	15
6-Feb-14	21:00	59.3	56.2	53.2	48.6	0.0	220	11
6-Feb-14	22:00	58.9	54.8	51.6	45.2	0.0	170	5
6-Feb-14	23:00	59.5	54.2	51.5	44.4	0.0	140	17
6-Feb-14	0:00	60.1	53.8	51.6	43.8	0.0	120	9
7-Feb-14	1:00	58.4	53.4	50.4	42.2	0.0	120	11
7-Feb-14	2:00	57.8	51.3	49.0	40.6	0.0	130	11
7-Feb-14	3:00	56.4	49.1	45.9	35.5	0.0	120	11
7-Feb-14	4:00	58.4	51.9	48.6	36.2	0.0	130	9
7-Feb-14	5:00	59.6	55.2	51.1	41.4	0.0	140	9
7-Feb-14	6:00	63.5	59.7	56.7	49.2	0.0	130	11
7-Feb-14	7:00	63.5	60.6	58.3	51.8	0.0	130	11
7-Feb-14	8:00	63.6	60.0	57.2	50.3	0.0	120	13
7-Feb-14	9:00	63.5	59.1	56.4	49.5	0.0	90	9
7-Feb-14	10:00	62.3	58.6	55.6	48.4	0.0	170	13
7-Feb-14	11:00	62.1	57.9	54.9	47.5	0.0	110	13
7-Feb-14	12:00	62.3	59.4	57.2	53.6	0.0	170	13
7-Feb-14	13:00	63.8	60.0	57.9	54.6	0.0	190	13
7-Feb-14	14:00	63.2	60.3	58.0	54.3	0.0	210	17
7-Feb-14	15:00	64.8	62.0	59.9	56.2	0.0	210	18
7-Feb-14	16:00	63.8	61.3	59.1	55.4	0.0	210	24
7-Feb-14	17:00	64.6	61.0	58.4	52.7	0.0	210	24
7-Feb-14	18:00	64.3	61.5	58.9	53.3	0.0	210	22
7-Feb-14	19:00	64.9	61.8	59.3	54.4	0.0	220	22
7-Feb-14	20:00	65.2	60.2	59.2	51.8	0.0	210	18
7-Feb-14	21:00	64.1	59.8	56.9	50.0	0.0	210	17
7-Feb-14	22:00	61.6	58.0	55.2	48.7	0.0	200	17
7-Feb-14	23:00	60.6	57.1	54.5	49.7	0.0	190	13
7-Feb-14	0:00	59.1	56.0	53.4	49.0	0.0	190	17

Noise Logging - 9 Agonis Place, Forrestfield

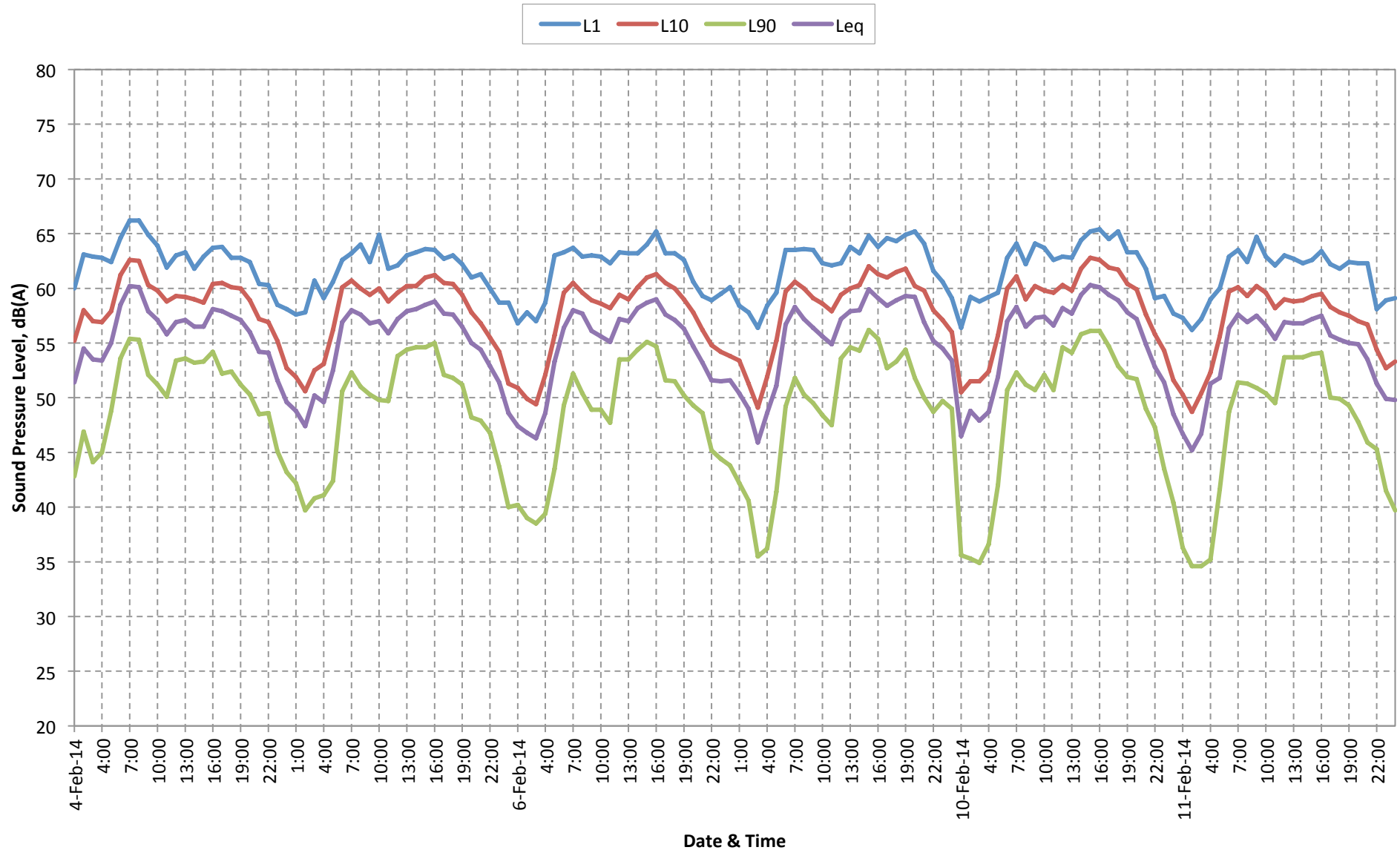


Table B2 – Noise Monitoring Results: 49 Fruit Tree Crescent, Forrestfield

Date	L_{A10,18hour}, dB	L_{Aeq,24hour}, dB	L_{Aeq(Day)}, dB	L_{Aeq(Night)}, dB
4 February 2014	57.7	55.6	56.6	52.6
5 February 2014	56.7	54.0	55.1	49.8
6 February 2014	56.6	53.9	55.2	49.4
7 February 2014	57.4	54.6	55.9	49.4
10 February 2014	57.0	54.2	55.5	48.6
11 February 2014	55.5	52.6	53.7	48.6
Average	56.8	54.1	55.3	49.7

Hourly Noise Level Data
49 Fruit Tree Crescent, Forrestfield

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
4-Feb-14	1:00	57.4	52.6	49.3	44.0	0.0	90	13
4-Feb-14	2:00	56.9	53.4	50.3	44.8	0.0	80	11
4-Feb-14	3:00	58.0	53.5	50.4	44.2	0.0	90	11
4-Feb-14	4:00	58.5	53.9	50.7	44.1	0.0	80	9
4-Feb-14	5:00	60.9	56.9	53.7	47.3	0.0	100	11
4-Feb-14	6:00	63.9	61.3	58.3	53.1	0.0	120	8
4-Feb-14	7:00	63.8	61.4	59.1	55.5	0.0	110	9
4-Feb-14	8:00	64.3	61.3	59.0	55.4	0.0	100	9
4-Feb-14	9:00	63.8	60.5	58.1	53.8	0.0	80	13
4-Feb-14	10:00	62.2	59.6	56.9	52.1	0.0	60	18
4-Feb-14	11:00	61.4	58.2	55.6	51.3	0.0	60	17
4-Feb-14	12:00	61.6	57.7	55.6	52.1	0.0	60	11
4-Feb-14	13:00	61.1	57.5	55.5	52.0	0.0	50	9
4-Feb-14	14:00	60.2	57.3	55.0	51.9	0.0	40	5
4-Feb-14	15:00	61.4	56.9	54.6	50.8	0.0	130	11
4-Feb-14	16:00	61.4	58.2	55.7	51.7	0.0	220	18
4-Feb-14	17:00	61.1	58.5	56.2	52.8	0.0	210	21
4-Feb-14	18:00	61.6	58.5	56.5	53.8	0.0	220	18
4-Feb-14	19:00	62.0	58.4	56.8	54.1	0.0	220	15
4-Feb-14	20:00	60.2	57.7	56.1	54.2	0.0	220	15
4-Feb-14	21:00	61.2	59.0	57.0	53.7	0.0	200	15
4-Feb-14	22:00	58.5	55.6	52.8	48.3	0.0	210	15
4-Feb-14	23:00	55.7	52.3	49.6	45.0	0.0	200	15
4-Feb-14	0:00	54.4	49.7	47.1	43.3	0.0	190	11
5-Feb-14	1:00	55.2	49.5	47.0	42.7	0.0	190	9
5-Feb-14	2:00	55.4	48.4	45.7	40.1	0.0	190	8
5-Feb-14	3:00	59.6	50.2	48.3	40.2	0.0	180	8
5-Feb-14	4:00	56.4	50.1	47.1	40.9	0.0	200	9
5-Feb-14	5:00	58.5	53.1	50.1	42.9	0.0	200	8
5-Feb-14	6:00	61.6	57.8	54.8	48.6	0.0	160	11
5-Feb-14	7:00	61.4	58.4	55.8	50.9	0.0	180	11
5-Feb-14	8:00	60.8	57.6	54.8	49.4	0.0	190	9
5-Feb-14	9:00	60.8	56.3	53.8	47.8	0.0	180	9
5-Feb-14	10:00	61.7	57.1	54.1	47.1	0.0	220	5
5-Feb-14	11:00	59.2	56.8	54.3	49.4	0.0	200	9
5-Feb-14	12:00	59.7	57.1	54.7	51.7	0.0	200	11
5-Feb-14	13:00	61.0	58.3	55.8	52.3	0.0	250	15
5-Feb-14	14:00	60.8	57.7	55.6	52.0	0.0	250	13
5-Feb-14	15:00	60.7	58.1	55.5	51.6	0.0	220	17
5-Feb-14	16:00	62.4	58.8	56.4	52.6	0.0	230	17
5-Feb-14	17:00	61.4	58.3	55.8	51.9	0.0	210	24
5-Feb-14	18:00	61.4	57.8	55.6	52.1	0.0	210	21
5-Feb-14	19:00	60.0	57.2	54.8	51.5	0.0	210	18
5-Feb-14	20:00	60.1	57.3	55.7	53.1	0.0	230	15
5-Feb-14	21:00	60.4	56.0	54.2	51.6	0.0	230	11
5-Feb-14	22:00	58.5	55.1	53.8	51.6	0.0	210	11
5-Feb-14	23:00	57.3	52.5	50.0	45.5	0.0	190	5
5-Feb-14	0:00	56.2	50.3	47.6	43.4	0.0	170	9

Hourly Noise Level Data
49 Fruit Tree Crescent, Forrestdfield

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
6-Feb-14	1:00	54.3	49.9	46.8	42.8	0.0	140	11
6-Feb-14	2:00	54.7	48.7	46.1	42.6	0.0	150	13
6-Feb-14	3:00	53.7	46.4	44.0	38.8	0.0	160	11
6-Feb-14	4:00	55.8	49.7	46.3	39.4	0.0	170	13
6-Feb-14	5:00	57.3	52.2	49.0	40.0	0.0	160	13
6-Feb-14	6:00	60.8	57.2	54.2	47.2	0.0	160	11
6-Feb-14	7:00	62.9	58.3	56.0	50.6	0.0	150	9
6-Feb-14	8:00	60.8	57.2	54.4	49.2	0.0	160	11
6-Feb-14	9:00	60.3	56.0	53.5	47.7	0.0	170	13
6-Feb-14	10:00	59.6	55.7	52.7	46.5	0.0	150	9
6-Feb-14	11:00	60.8	56.3	53.1	45.9	0.0	150	13
6-Feb-14	12:00	62.0	57.5	55.4	52.0	0.0	200	4
6-Feb-14	13:00	60.8	57.3	55.3	52.2	0.0	140	9
6-Feb-14	14:00	61.4	58.1	56.0	52.5	0.0	240	17
6-Feb-14	15:00	62.6	58.9	56.6	52.8	0.0	230	18
6-Feb-14	16:00	62.6	59.9	57.4	53.5	0.0	230	18
6-Feb-14	17:00	61.9	59.3	56.8	52.9	0.0	240	18
6-Feb-14	18:00	61.8	58.3	56.4	52.6	0.0	220	18
6-Feb-14	19:00	59.6	56.9	55.0	52.3	0.0	220	15
6-Feb-14	20:00	58.2	56.2	54.2	51.5	0.0	220	15
6-Feb-14	21:00	58.0	55.3	53.9	52.0	0.0	220	11
6-Feb-14	22:00	57.7	53.1	51.4	47.4	0.0	170	5
6-Feb-14	23:00	56.0	52.3	50.1	46.6	0.0	140	17
6-Feb-14	0:00	56.4	51.9	49.7	43.9	0.0	120	9
7-Feb-14	1:00	54.8	50.5	47.2	42.1	0.0	120	11
7-Feb-14	2:00	54.7	47.7	45.5	41.2	0.0	130	11
7-Feb-14	3:00	53.5	48.1	45.3	41.0	0.0	120	11
7-Feb-14	4:00	55.4	49.7	46.5	41.1	0.0	130	9
7-Feb-14	5:00	56.9	52.4	49.0	43.3	0.0	140	9
7-Feb-14	6:00	60.6	56.9	54.2	48.4	0.0	130	11
7-Feb-14	7:00	61.3	58.0	55.7	51.0	0.0	130	11
7-Feb-14	8:00	61.1	57.5	54.7	50.0	0.0	120	13
7-Feb-14	9:00	60.8	56.6	54.0	48.6	0.0	90	9
7-Feb-14	10:00	60.0	57.2	54.9	51.9	0.0	170	13
7-Feb-14	11:00	59.6	56.6	54.5	51.7	0.0	110	13
7-Feb-14	12:00	60.4	57.7	55.4	52.3	0.0	170	13
7-Feb-14	13:00	61.4	58.0	55.9	52.8	0.0	190	13
7-Feb-14	14:00	61.4	58.5	56.3	53.5	0.0	210	17
7-Feb-14	15:00	63.1	60.2	58.0	54.3	0.0	210	18
7-Feb-14	16:00	62.3	59.5	57.5	54.6	0.0	210	24
7-Feb-14	17:00	63.3	58.9	57.0	52.3	0.0	210	24
7-Feb-14	18:00	62.9	59.4	57.1	52.6	0.0	210	22
7-Feb-14	19:00	63.3	59.1	56.7	51.7	0.0	220	22
7-Feb-14	20:00	62.9	57.6	56.0	51.4	0.0	210	18
7-Feb-14	21:00	61.9	57.1	54.7	50.3	0.0	210	17
7-Feb-14	22:00	59.3	55.4	52.7	48.0	0.0	200	17
7-Feb-14	23:00	56.9	53.1	50.2	45.4	0.0	190	13
7-Feb-14	0:00	56.7	52.0	49.4	43.6	0.0	190	17

Hourly Noise Level Data
49 Fruit Tree Crescent, Forrestfield

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
4-Feb-14	1:00	57.4	52.6	49.3	44.0	0.0	90	13
4-Feb-14	2:00	56.9	53.4	50.3	44.8	0.0	80	11
4-Feb-14	3:00	58.0	53.5	50.4	44.2	0.0	90	11
4-Feb-14	4:00	58.5	53.9	50.7	44.1	0.0	80	9
4-Feb-14	5:00	60.9	56.9	53.7	47.3	0.0	100	11
4-Feb-14	6:00	63.9	61.3	58.3	53.1	0.0	120	8
4-Feb-14	7:00	63.8	61.4	59.1	55.5	0.0	110	9
4-Feb-14	8:00	64.3	61.3	59.0	55.4	0.0	100	9
4-Feb-14	9:00	63.8	60.5	58.1	53.8	0.0	80	13
4-Feb-14	10:00	62.2	59.6	56.9	52.1	0.0	60	18
4-Feb-14	11:00	61.4	58.2	55.6	51.3	0.0	60	17
4-Feb-14	12:00	61.6	57.7	55.6	52.1	0.0	60	11
4-Feb-14	13:00	61.1	57.5	55.5	52.0	0.0	50	9
4-Feb-14	14:00	60.2	57.3	55.0	51.9	0.0	40	5
4-Feb-14	15:00	61.4	56.9	54.6	50.8	0.0	130	11
4-Feb-14	16:00	61.4	58.2	55.7	51.7	0.0	220	18
4-Feb-14	17:00	61.1	58.5	56.2	52.8	0.0	210	21
4-Feb-14	18:00	61.6	58.5	56.5	53.8	0.0	220	18
4-Feb-14	19:00	62.0	58.4	56.8	54.1	0.0	220	15
4-Feb-14	20:00	60.2	57.7	56.1	54.2	0.0	220	15
4-Feb-14	21:00	61.2	59.0	57.0	53.7	0.0	200	15
4-Feb-14	22:00	58.5	55.6	52.8	48.3	0.0	210	15
4-Feb-14	23:00	55.7	52.3	49.6	45.0	0.0	200	15
4-Feb-14	0:00	54.4	49.7	47.1	43.3	0.0	190	11
5-Feb-14	1:00	55.2	49.5	47.0	42.7	0.0	190	9
5-Feb-14	2:00	55.4	48.4	45.7	40.1	0.0	190	8
5-Feb-14	3:00	59.6	50.2	48.3	40.2	0.0	180	8
5-Feb-14	4:00	56.4	50.1	47.1	40.9	0.0	200	9
5-Feb-14	5:00	58.5	53.1	50.1	42.9	0.0	200	8
5-Feb-14	6:00	61.6	57.8	54.8	48.6	0.0	160	11
5-Feb-14	7:00	61.4	58.4	55.8	50.9	0.0	180	11
5-Feb-14	8:00	60.8	57.6	54.8	49.4	0.0	190	9
5-Feb-14	9:00	60.8	56.3	53.8	47.8	0.0	180	9
5-Feb-14	10:00	61.7	57.1	54.1	47.1	0.0	220	5
5-Feb-14	11:00	59.2	56.8	54.3	49.4	0.0	200	9
5-Feb-14	12:00	59.7	57.1	54.7	51.7	0.0	200	11
5-Feb-14	13:00	61.0	58.3	55.8	52.3	0.0	250	15
5-Feb-14	14:00	60.8	57.7	55.6	52.0	0.0	250	13
5-Feb-14	15:00	60.7	58.1	55.5	51.6	0.0	220	17
5-Feb-14	16:00	62.4	58.8	56.4	52.6	0.0	230	17
5-Feb-14	17:00	61.4	58.3	55.8	51.9	0.0	210	24
5-Feb-14	18:00	61.4	57.8	55.6	52.1	0.0	210	21
5-Feb-14	19:00	60.0	57.2	54.8	51.5	0.0	210	18
5-Feb-14	20:00	60.1	57.3	55.7	53.1	0.0	230	15
5-Feb-14	21:00	60.4	56.0	54.2	51.6	0.0	230	11
5-Feb-14	22:00	58.5	55.1	53.8	51.6	0.0	210	11
5-Feb-14	23:00	57.3	52.5	50.0	45.5	0.0	190	5
5-Feb-14	0:00	56.2	50.3	47.6	43.4	0.0	170	9

Hourly Noise Level Data
49 Fruit Tree Crescent, Forresterfield

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
6-Feb-14	1:00	54.3	49.9	46.8	42.8	0.0	140	11
6-Feb-14	2:00	54.7	48.7	46.1	42.6	0.0	150	13
6-Feb-14	3:00	53.7	46.4	44.0	38.8	0.0	160	11
6-Feb-14	4:00	55.8	49.7	46.3	39.4	0.0	170	13
6-Feb-14	5:00	57.3	52.2	49.0	40.0	0.0	160	13
6-Feb-14	6:00	60.8	57.2	54.2	47.2	0.0	160	11
6-Feb-14	7:00	62.9	58.3	56.0	50.6	0.0	150	9
6-Feb-14	8:00	60.8	57.2	54.4	49.2	0.0	160	11
6-Feb-14	9:00	60.3	56.0	53.5	47.7	0.0	170	13
6-Feb-14	10:00	59.6	55.7	52.7	46.5	0.0	150	9
6-Feb-14	11:00	60.8	56.3	53.1	45.9	0.0	150	13
6-Feb-14	12:00	62.0	57.5	55.4	52.0	0.0	200	4
6-Feb-14	13:00	60.8	57.3	55.3	52.2	0.0	140	9
6-Feb-14	14:00	61.4	58.1	56.0	52.5	0.0	240	17
6-Feb-14	15:00	62.6	58.9	56.6	52.8	0.0	230	18
6-Feb-14	16:00	62.6	59.9	57.4	53.5	0.0	230	18
6-Feb-14	17:00	61.9	59.3	56.8	52.9	0.0	240	18
6-Feb-14	18:00	61.8	58.3	56.4	52.6	0.0	220	18
6-Feb-14	19:00	59.6	56.9	55.0	52.3	0.0	220	15
6-Feb-14	20:00	58.2	56.2	54.2	51.5	0.0	220	15
6-Feb-14	21:00	58.0	55.3	53.9	52.0	0.0	220	11
6-Feb-14	22:00	57.7	53.1	51.4	47.4	0.0	170	5
6-Feb-14	23:00	56.0	52.3	50.1	46.6	0.0	140	17
6-Feb-14	0:00	56.4	51.9	49.7	43.9	0.0	120	9
7-Feb-14	1:00	54.8	50.5	47.2	42.1	0.0	120	11
7-Feb-14	2:00	54.7	47.7	45.5	41.2	0.0	130	11
7-Feb-14	3:00	53.5	48.1	45.3	41.0	0.0	120	11
7-Feb-14	4:00	55.4	49.7	46.5	41.1	0.0	130	9
7-Feb-14	5:00	56.9	52.4	49.0	43.3	0.0	140	9
7-Feb-14	6:00	60.6	56.9	54.2	48.4	0.0	130	11
7-Feb-14	7:00	61.3	58.0	55.7	51.0	0.0	130	11
7-Feb-14	8:00	61.1	57.5	54.7	50.0	0.0	120	13
7-Feb-14	9:00	60.8	56.6	54.0	48.6	0.0	90	9
7-Feb-14	10:00	60.0	57.2	54.9	51.9	0.0	170	13
7-Feb-14	11:00	59.6	56.6	54.5	51.7	0.0	110	13
7-Feb-14	12:00	60.4	57.7	55.4	52.3	0.0	170	13
7-Feb-14	13:00	61.4	58.0	55.9	52.8	0.0	190	13
7-Feb-14	14:00	61.4	58.5	56.3	53.5	0.0	210	17
7-Feb-14	15:00	63.1	60.2	58.0	54.3	0.0	210	18
7-Feb-14	16:00	62.3	59.5	57.5	54.6	0.0	210	24
7-Feb-14	17:00	63.3	58.9	57.0	52.3	0.0	210	24
7-Feb-14	18:00	62.9	59.4	57.1	52.6	0.0	210	22
7-Feb-14	19:00	63.3	59.1	56.7	51.7	0.0	220	22
7-Feb-14	20:00	62.9	57.6	56.0	51.4	0.0	210	18
7-Feb-14	21:00	61.9	57.1	54.7	50.3	0.0	210	17
7-Feb-14	22:00	59.3	55.4	52.7	48.0	0.0	200	17
7-Feb-14	23:00	56.9	53.1	50.2	45.4	0.0	190	13
7-Feb-14	0:00	56.7	52.0	49.4	43.6	0.0	190	17

Noise Logging - 49 Fruit Tree Crescent, Forrestfield

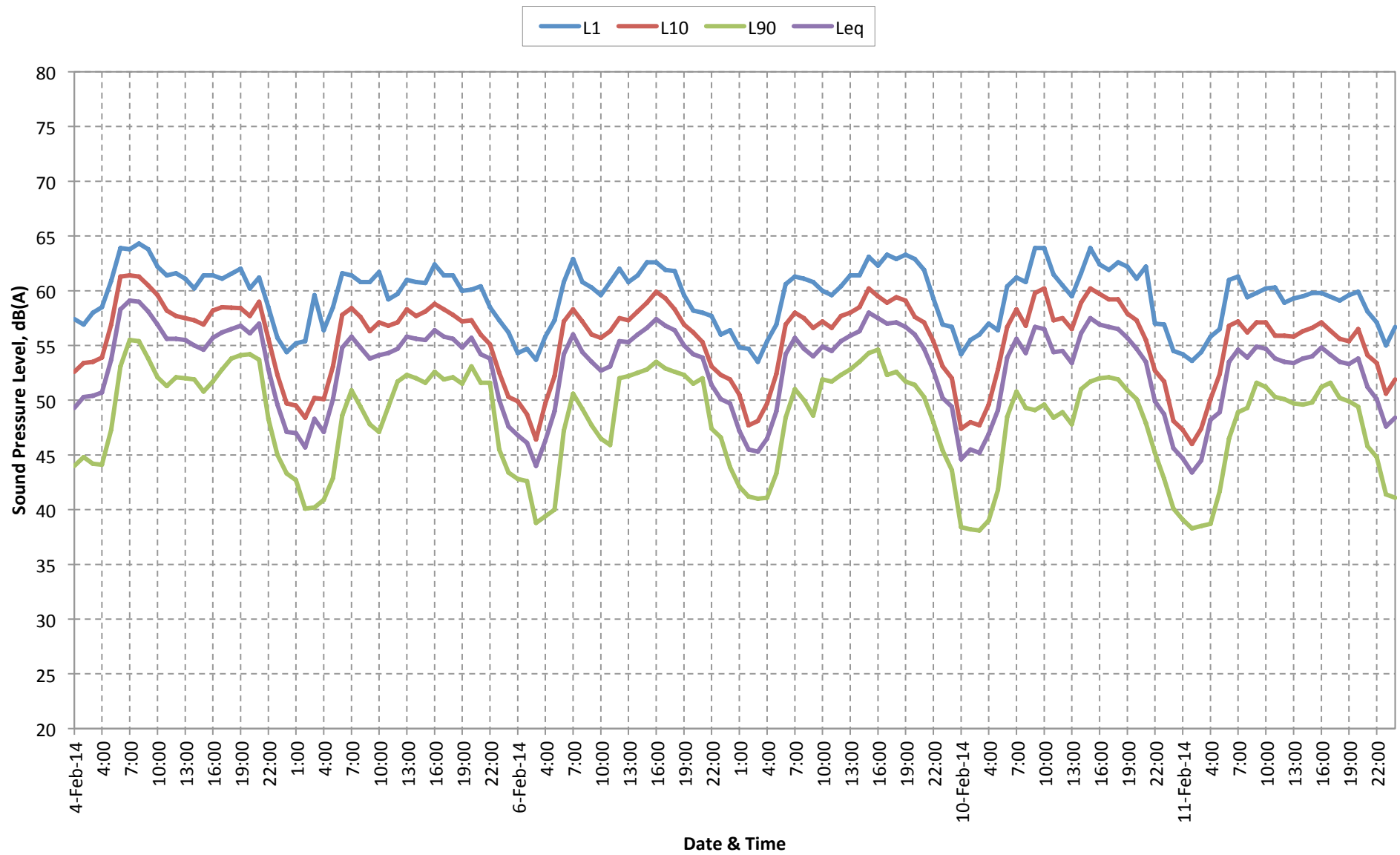


Table B3 – Noise Monitoring Results: Road Reserve Rear of Ashby Close, High Wycombe

Date	L_{A10,18hour}, dB	L_{Aeq,24hour}, dB	L_{Aeq(Day)}, dB	L_{Aeq(Night)}, dB
4 February 2014	64.5	61.2	62.3	57.8
5 February 2014	64.3	61.0	62.1	57.6
6 February 2014	64.5	61.0	62.1	57.2
7 February 2014	65.4	61.8	62.9	57.7
10 February 2014	65.1	61.7	62.9	57.6
11 February 2014	65.2	61.9	63.1	58.0
Average	64.8	61.4	62.6	57.6

Traffic Noise Measurement Data

Item	Details
<i>LOCATION</i>	
Project	Roe Highway - Berkshire Road Interchange
Street address	Road Reserve Rear of Ashby Close
Locality	High Wycombe
Occupier	
Dates	3 to 12 February 2014
Category	<i>Main Roads to provide this information</i>
<i>SITE</i>	
Distance from the microphone to the kerb	35m
Height of the road in relation to the ground	-0.5m
Road surface type	Worn Chip
Speed zone	80km/hr
Absorbing ground	50%
Angle of view	120
Road gradient	Flat
Traffic flow	45000
Heavy vehicles	10.00%
House-Road orientation.	East-South-East
Carriageways & lanes.	2 cwys, 4lns
<i>COMMENT</i>	
Comment	Microphone located in freefield conditions. Microphone height 1.4m above ground level 15m road side of reserve fence.
<i>REFERENCES</i>	
AMG Z50 E/N	<i>Main Roads to provide this information</i>
Road name	<i>Roe Highway</i>
EXCEL file	Road Reserve Ashby CI S1.xlsx
Raw data file	Logger 15-301-468 - road reserve 15m from fence_Sta.xlsx
<i>EQUIPMENT</i>	
Analyser number	15-301-468
Microphone number	15-301-468
Calibrator number	34883971
Calibrator values	93.9 / 93.8
Operator	Lloyd George Acoustics Pty Ltd - Matthew Moyle
<i>WEATHER</i>	
Wind	Wind acceptability based on Mt Lawley Data 4-Feb-14 - Winds light to moderate and positive. 5-Feb-14 - Winds light to moderate and generally positive. 6-Feb-14 - Winds moderate and generally positive. 7-Feb-14 - Winds light to moderate and positive. 10-Feb-14 - Winds light to moderate and positive. 11-Feb-14 - Winds moderate and positive.

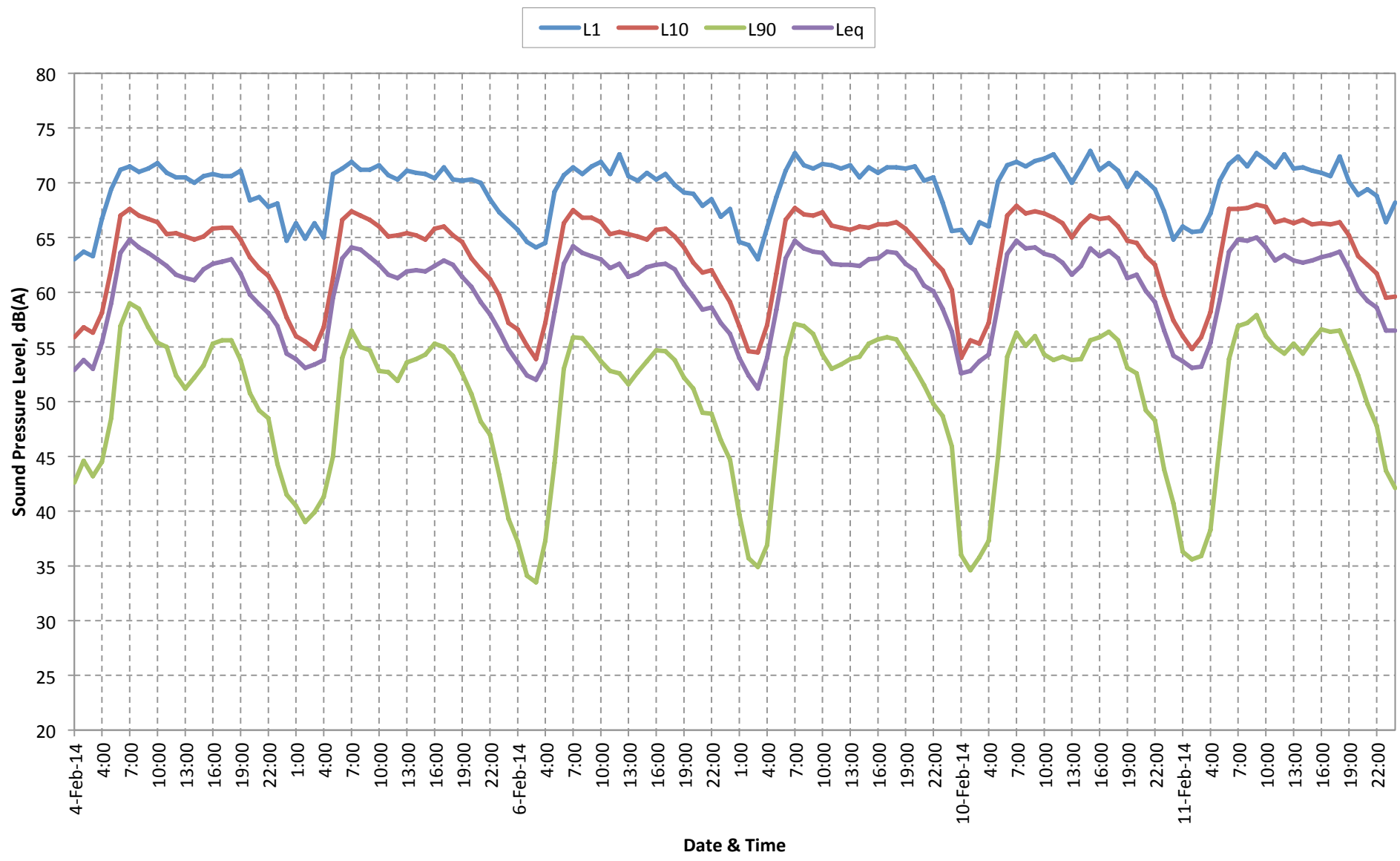
Hourly Noise Level Data
Road Reserve Boundary, Rear of Ashby Close

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
4-Feb-14	1:00	63.0	55.9	52.9	42.6	0.0	90	13
4-Feb-14	2:00	63.7	56.8	53.8	44.6	0.0	80	11
4-Feb-14	3:00	63.3	56.3	53.0	43.2	0.0	90	11
4-Feb-14	4:00	66.7	58.1	55.4	44.5	0.0	80	9
4-Feb-14	5:00	69.4	62.1	59.0	48.5	0.0	100	11
4-Feb-14	6:00	71.2	67.0	63.6	56.9	0.0	120	8
4-Feb-14	7:00	71.5	67.6	64.8	59.0	0.0	110	9
4-Feb-14	8:00	71.0	67.0	64.1	58.5	0.0	100	9
4-Feb-14	9:00	71.3	66.7	63.6	56.8	0.0	80	13
4-Feb-14	10:00	71.8	66.4	63.0	55.4	0.0	60	18
4-Feb-14	11:00	70.9	65.3	62.4	55.0	0.0	60	17
4-Feb-14	12:00	70.5	65.4	61.6	52.4	0.0	60	11
4-Feb-14	13:00	70.5	65.1	61.3	51.2	0.0	50	9
4-Feb-14	14:00	70.0	64.8	61.1	52.2	0.0	40	5
4-Feb-14	15:00	70.6	65.1	62.1	53.3	0.0	130	11
4-Feb-14	16:00	70.8	65.8	62.6	55.3	0.0	220	18
4-Feb-14	17:00	70.6	65.9	62.8	55.6	0.0	210	21
4-Feb-14	18:00	70.6	65.9	63.0	55.6	0.0	220	18
4-Feb-14	19:00	71.1	64.8	61.7	53.8	0.0	220	15
4-Feb-14	20:00	68.4	63.2	59.8	50.8	0.0	220	15
4-Feb-14	21:00	68.7	62.2	58.9	49.2	0.0	200	15
4-Feb-14	22:00	67.8	61.5	58.1	48.5	0.0	210	15
4-Feb-14	23:00	68.1	60.0	56.9	44.3	0.0	200	15
4-Feb-14	0:00	64.7	57.7	54.4	41.5	0.0	190	11
5-Feb-14	1:00	66.3	56.0	53.9	40.5	0.0	190	9
5-Feb-14	2:00	64.9	55.5	53.1	39.0	0.0	190	8
5-Feb-14	3:00	66.3	54.8	53.4	39.9	0.0	180	8
5-Feb-14	4:00	65.0	56.8	53.8	41.3	0.0	200	9
5-Feb-14	5:00	70.8	61.3	59.5	45.0	0.0	200	8
5-Feb-14	6:00	71.3	66.6	63.1	54.0	0.0	160	11
5-Feb-14	7:00	71.9	67.4	64.1	56.5	0.0	180	11
5-Feb-14	8:00	71.2	67.0	63.9	55.0	0.0	190	9
5-Feb-14	9:00	71.2	66.6	63.2	54.7	0.0	180	9
5-Feb-14	10:00	71.6	66.0	62.5	52.8	0.0	220	5
5-Feb-14	11:00	70.7	65.1	61.6	52.7	0.0	200	9
5-Feb-14	12:00	70.3	65.2	61.3	51.9	0.0	200	11
5-Feb-14	13:00	71.1	65.4	61.9	53.6	0.0	250	15
5-Feb-14	14:00	70.9	65.2	62.0	53.9	0.0	250	13
5-Feb-14	15:00	70.8	64.8	61.9	54.3	0.0	220	17
5-Feb-14	16:00	70.4	65.8	62.4	55.3	0.0	230	17
5-Feb-14	17:00	71.4	66.0	62.9	55.0	0.0	210	24
5-Feb-14	18:00	70.3	65.2	62.5	54.2	0.0	210	21
5-Feb-14	19:00	70.2	64.6	61.4	52.6	0.0	210	18
5-Feb-14	20:00	70.3	63.1	60.5	50.7	0.0	230	15
5-Feb-14	21:00	70.0	62.1	59.1	48.2	0.0	230	11
5-Feb-14	22:00	68.5	61.2	58.0	47.0	0.0	210	11
5-Feb-14	23:00	67.3	59.7	56.5	43.3	0.0	190	5
5-Feb-14	0:00	66.5	57.2	54.8	39.3	0.0	170	9

Hourly Noise Level Data
Road Reserve Boundary, Rear of Ashby Close

Date	Time	L1	L10	Leg	L90	Rain mm	Wind degrees	Wind km/h
6-Feb-14	1:00	65.7	56.6	53.6	37.2	0.0	140	11
6-Feb-14	2:00	64.6	55.1	52.4	34.1	0.0	150	13
6-Feb-14	3:00	64.1	53.9	52.0	33.5	0.0	160	11
6-Feb-14	4:00	64.5	57.2	53.6	37.3	0.0	170	13
6-Feb-14	5:00	69.2	61.7	58.2	44.4	0.0	160	13
6-Feb-14	6:00	70.7	66.3	62.6	53.0	0.0	160	11
6-Feb-14	7:00	71.4	67.5	64.2	55.9	0.0	150	9
6-Feb-14	8:00	70.8	66.8	63.6	55.8	0.0	160	11
6-Feb-14	9:00	71.5	66.8	63.3	54.8	0.0	170	13
6-Feb-14	10:00	71.9	66.4	63.0	53.7	0.0	150	9
6-Feb-14	11:00	70.8	65.3	62.2	52.8	0.0	150	13
6-Feb-14	12:00	72.6	65.5	62.6	52.6	0.0	200	4
6-Feb-14	13:00	70.6	65.3	61.4	51.6	0.0	140	9
6-Feb-14	14:00	70.2	65.1	61.7	52.7	0.0	240	17
6-Feb-14	15:00	70.9	64.8	62.3	53.7	0.0	230	18
6-Feb-14	16:00	70.3	65.7	62.5	54.7	0.0	230	18
6-Feb-14	17:00	70.8	65.8	62.6	54.6	0.0	240	18
6-Feb-14	18:00	69.8	65.1	62.1	53.8	0.0	220	18
6-Feb-14	19:00	69.1	64.1	60.7	52.2	0.0	220	15
6-Feb-14	20:00	69.0	62.7	59.6	51.2	0.0	220	15
6-Feb-14	21:00	67.9	61.8	58.4	49.0	0.0	220	11
6-Feb-14	22:00	68.5	62.0	58.6	48.9	0.0	170	5
6-Feb-14	23:00	66.9	60.5	57.2	46.5	0.0	140	17
6-Feb-14	0:00	67.6	59.1	56.2	44.7	0.0	120	9
7-Feb-14	1:00	64.6	56.9	54.0	39.7	0.0	120	11
7-Feb-14	2:00	64.3	54.6	52.4	35.7	0.0	130	11
7-Feb-14	3:00	63.0	54.5	51.2	34.9	0.0	120	11
7-Feb-14	4:00	65.9	57.0	54.0	36.9	0.0	130	9
7-Feb-14	5:00	68.7	61.7	58.4	45.5	0.0	140	9
7-Feb-14	6:00	71.1	66.6	63.1	54.0	0.0	130	11
7-Feb-14	7:00	72.7	67.7	64.7	57.1	0.0	130	11
7-Feb-14	8:00	71.6	67.1	64.0	56.9	0.0	120	13
7-Feb-14	9:00	71.3	67.0	63.7	56.2	0.0	90	9
7-Feb-14	10:00	71.7	67.3	63.6	54.3	0.0	170	13
7-Feb-14	11:00	71.6	66.1	62.6	53.0	0.0	110	13
7-Feb-14	12:00	71.3	65.9	62.5	53.4	0.0	170	13
7-Feb-14	13:00	71.6	65.7	62.5	53.9	0.0	190	13
7-Feb-14	14:00	70.5	66.0	62.4	54.1	0.0	210	17
7-Feb-14	15:00	71.4	65.9	63.0	55.3	0.0	210	18
7-Feb-14	16:00	70.9	66.2	63.1	55.7	0.0	210	24
7-Feb-14	17:00	71.4	66.2	63.7	55.9	0.0	210	24
7-Feb-14	18:00	71.4	66.4	63.6	55.7	0.0	210	22
7-Feb-14	19:00	71.3	65.8	62.6	54.4	0.0	220	22
7-Feb-14	20:00	71.5	64.9	62.0	53.0	0.0	210	18
7-Feb-14	21:00	70.2	63.9	60.6	51.5	0.0	210	17
7-Feb-14	22:00	70.5	62.9	60.1	49.8	0.0	200	17
7-Feb-14	23:00	68.2	62.0	58.5	48.7	0.0	190	13
7-Feb-14	0:00	65.6	60.2	56.4	45.9	0.0	190	17

Noise Logging - Road Reserve Rear of Ashby Close, High Wycombe



Appendix C

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)

The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1

An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}

An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the “intrusive” noise level.

L_{90}

An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the “background” noise level.

L_{eq}

The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$

The $L_{A10,18hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The CoRTN algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$

The $L_{Aeq,24hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

$L_{Aeq,8hour} / L_{Aeq} (Night)$

The $L_{Aeq} (Night)$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour} / L_{Aeq} (Day)$

The $L_{Aeq} (Day)$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

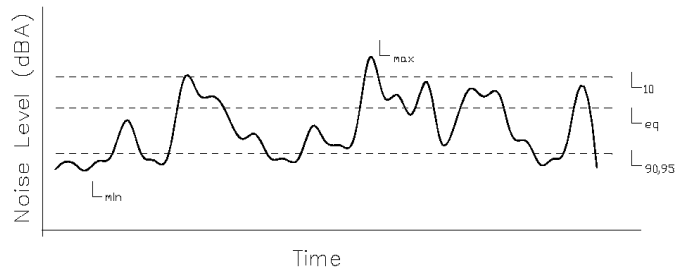
Satisfactory Design Sound Level

The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

Maximum Design Sound Level

The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

Chart of Noise Level Descriptors



Austrroads Vehicle Class

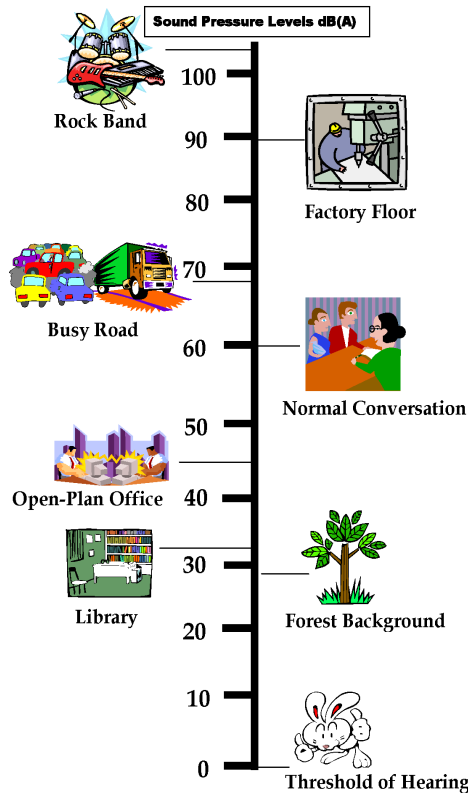
AUSTROADS Vehicle Classification System

Level 1 Length (logarithmic)	Level 2		Vehicle Type	AUSTROADS Classification		
	Axes	Groups		Class	Parameters	Typical Configuration
Short up to 5.0m	1 or 2	1	Short Sedan, Wagon, 4WD, Utility, Light Van, Bicycle, Motorcycle, etc.	1	d(1) > 3.2m and axes = 2	
	3, 4 or 5	3	Short - Towing Trailer, Caravan, Boat, etc.	2	groups = 3 d(1) > 2.1m, d(1) > 3.2m, d(2) > 1.2m and axes = 3, 4 or 5	
Medium 5.0m to 14.0m	2	2	Two Axle Truck or Bus	3	d(1) > 3.2m and axes = 2	
	3	2	Three Axle Truck or Bus	4	axes = 3 and groups = 2	
	>3	2	Four Axle Truck	5	axes > 3 and groups = 2	
Long 11.0m to 19.0m	3	3	Three Axle Articulated Three axle articulated vehicle, or Rigid vehicle and trailer	6	d(1) > 3.2m, axes = 3 and groups = 3	
	4	>2	Four Axle Articulated Four axle articulated vehicle, or Rigid vehicle and trailer	7	d(2) < 3.1m or d(1) < 2.1m or d(1) > 3.2m, axes = 4 and groups > 2	
	5	>2	Five Axle Articulated Five axle articulated vehicle, or Rigid vehicle and trailer	8	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m, axes = 5 and groups > 2	
	>6	>2	Six Axle Articulated Six axle articulated vehicle, or Rigid vehicle and trailer	9	axes = 6 and groups > 2 or axes = 6 and groups = 3	
Medium Combination 17.0m to 36.0m	>6	4	B Double B Double, or Heavy truck and trailer	10	groups = 4 and axes > 6	
	5 or 6	6	Double Road Train Double road train, or Medium articulated vehicle and one or two trailers (M A D)	11	groups = 5 or 6 and axes = 6	
Large Combination Over 33.0m	>6	>6	Triple Road Train Triple road train, or Heavy truck and three trailers	12	groups = 6 and axes = 6	

Definitions:
Group: Axle group, where adjacent axles are less than 2.1m apart
Groups: Number of axle groups
Axes: Number of axles (maximum axle spacing of 10.0m)

d(1): Distance between first and second axle
d(2): Distance between second and third axle

Typical Noise Levels



Appendix C
Correspondence with the Department of Aboriginal Affairs

Elkington, Amy

From: Sally McGann [Heritage] [Sally.McGann@daa.wa.gov.au]
Sent: Thursday, 8 May 2014 3:56 PM
To: Elkington, Amy
Cc: Christine Lewis [Heritage]
Subject: RE: Roe/Berkshire

Hello,

I can confirm that the intersection works depicted in the map attached to your email are not within the boundary of any sites as currently mapped on the Register of Aboriginal Sites.

It may appear that *DAA 25023 Poison Gully Creek* is within the area but it is not. This site has 'closed' site status as it is a culturally sensitive site. This means that the boundary of the site as it is mapped on the Register is masked by a larger boundary so that the location of the place is protected. The following is a link to the DAA Information Access Policy:

<http://www.daa.wa.gov.au/en/Heritage-and-Culture/Resources/Policies-and-procedures/Information-Access-Policy/>

Please let me know if you require any further information.

Regards,

Sally.

Sally McGann
Senior Advice & Approvals Officer



Government of **Western Australia**
Department of **Aboriginal Affairs**

Ground Floor, 151 Royal Street, East Perth WA 6004
Ph: (08) 6551 8075 Fax: (08) 6551 8088
Sally.McGann@daa.wa.gov.au www.daa.wa.gov.au
[DAA Strategic Framework 2012 – 2014](#)

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From: Elkington, Amy [<mailto:Amy.Elkington@gatewaywa.com.au>]
Sent: Thursday, 8 May 2014 3:31 PM
To: Sally McGann [Heritage]
Subject: Roe/Berkshire

Hi Sally,

Thank you again for your time today.

In 2012 Main Roads sought advice from your department as to whether formal approval would be required for the upgrade of the current Roe Highway and Berkshire Road intersection. At this time the project was proposing to only upgrade the intersection and realign some of the roads. Since this time it has been determined that a traffic light intersection will not be sufficient with both current and predicted traffic volumes. Hence an interchange is currently proposed. This does also increase the project footprint. A copy of the preliminary design and project boundary is attached for your reference. Also on this plan is the registered Aboriginal Heritage Site Poison Gully Creek. I am writing to seek you advice as to whether the original advice still stands or if a formal approval is now required. I have also attached the original application and DIA advice for your reference.

If you need any further information please do not hesitate to contact me. Thank you for your assistance.

Amy

Amy Elkington
Environmental Scientist



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E amy.elkington@gatewaywa.com.au



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Appendix D

Gateway WA Construction Environmental Management Plan (Appendix B – Management, Monitoring and Contingency Tables)

Vegetation and Flora

Background	<p>Vegetation and flora within the project area varies from cleared areas to remnant vegetation of excellent quality. Two threatened flora species (<i>Conospermum undulatum</i> and <i>Macarthuria keigheryi</i>) exist within the broad project area, within areas of native bushland. Whilst construction of the project will directly impact the vegetation and flora, it can be reduced through re-design and actions undertaken in the field.</p>				
Activity	<ul style="list-style-type: none"> • Clearing vegetation • Moving around site 	Location	Entire Site		
Overall Objective	<ul style="list-style-type: none"> • Minimise vegetation clearing • Ensure impacts on Declared Rare and Priority Flora (as listed at the time of construction) are adequately identified and minimised during construction. 				
Associated Documents	<ul style="list-style-type: none"> • Specification 301 Clearing • Rehabilitation and Landscape Management Plan • Environment Monitoring Plan • Rehabilitation Plan – Pioneer Park Offset • Gateway WA Permit to Take Rare Flora (State land only) 				
Management and Mitigation					
Timing	Management and Mitigation Actions			Responsibility	
Design/Pre-construction	A pre-clearing tree survey will be undertaken to identify any trees with a trunk diameter at breast height of 150mm or greater, close to the clearing boundaries. Locations of these trees will be recorded by a surveyor.			Approvals Manager	
Design/Pre-construction	<p>The design will be modified where practicable to minimise the number of trees as well as bandicoot and cockatoo habitat required to be cleared. This may include:</p> <ul style="list-style-type: none"> • Retaining walls in lieu of batters • Fences and/or noises on batter edges rather than cadastre boundaries • Reducing median widths • Avoiding locating drainage infrastructure such as basins in areas of remnant vegetation. <p>Results of the survey as detailed in the row above as well as previous fauna surveys will be used to assist with these possible modifications.</p>			Design Manager	

Induction	The induction program will include relevant vegetation and flora information.	Safety and Support Services Manager
Prior to Clearing	'No-go' maps are provided for each construction zone – attached at Appendix A. These indicate sensitive environmental and heritage areas, in particular the locations of threatened plant species and threatened fauna habitat and conservation zones on Perth Airport.	Environment Manager
Prior to Clearing	The clearing line will be clearly marked onsite by a surveyor in accordance with the design. This line will be checked by a member of the Environment Team (with appropriate experience) prior to the commencement of clearing works to ensure it represents the least, practicable, disturbance.	Project Engineer Environment Manager
Prior to Clearing	An internal Clearing Permit will be approved for each clearing zone by the Environment Manager (or their representative) to ensure the applicable environmental and social aspects of the clearing are considered and managed. The Clearing Permits will ensure that the applicable external approval conditions are complied with.	Site Engineer
Prior to Clearing	Cuttings and seed of <i>Conospermum undulatum</i> will be collected prior to the plants being cleared, as per the requirements of the DPaW Permit to Take Rare Flora and the Rehabilitation Plan – Pioneer Park Offset.	Environment Manager
Construction	Clearing will not be undertaken any further than 4 m from the boundary of earthworks unless required for safety reasons, or no other practical means of access to the site is available.	Project Manager
Construction	Mature trees, trees of significance, remnant vegetation and threatened flora and communities will be retained as far as practicable within the approved Project Site boundary and will be clearly marked on site and on clearing plans. No more than 103 ha of native vegetation can be cleared within State land on the Project area.	Project Manager Environment Manager
Construction	Fencing (temporary or otherwise) and/or flagging shall be placed to delineate the project area from retained significant mature trees, populations of threatened flora and fauna habitats, Precinct 5, the Infrastructure Only Conservation Zone and threatened ecological communities. Signage will also be in place on the ground to further notify the workforce that moving beyond the fence line is not allowed. This fence shall be fauna proof, where necessary, and installed prior to, or immediately after, the completion of clearing works in the vicinity and is to be approved by the Environment Manager prior to works continuing.	Supervisor Project Engineer Environment Manager
Construction	Existing or proposed, cleared areas shall be utilised for temporary construction purposes, such as tracks, offices, stockpiling and laydown areas. The indicative locations of temporary facilities are provided at Appendix A.	Construction Manager Project Manager Supervisor
Construction	Vegetation which can be retained will be pruned with a chainsaw in preference to clearing where practicable.	Site Engineer
Construction	Plant/machinery used for pushing and heaping operations shall be fitted with root rakes or similar equipment and operated in a manner such that as little soil as possible is removed and heaped with the cleared vegetative material.	Project Engineer
Construction	Trees to be removed shall be felled in a manner that they fall within the approved clearing area.	All personnel
Construction	Cleared vegetation will not be burned on site.	All personnel
Construction	Cleared vegetation suitable for reuse will generally be reduced in size (chipping) and reused within the soft landscaping works.	Construction Manager
Construction	Cleared vegetation not suitable for reuse will be disposed of at an appropriate landfill facility, or buried at least 1 m beneath the eventual surface of the road (in accordance with Main Roads specifications).	Construction Manager
Construction	Vehicles and equipment shall not be driven over, or parked on, tree root zones as far as is practicable.	All personnel
Construction	Construction works will be undertaken in accordance with the detailed design plans.	Project and Construction Managers Project and Site Engineers Superintendents and

		Supervisors
Construction	In the event that previously unrecorded Threatened or Priority plants are identified in the construction zone the following will occur: <ul style="list-style-type: none"> The Environment Manager will be notified immediately; Work in the immediate area (within 20m of the location of the plants) will be suspended subject to further investigation; A detailed assessment of the area, and suitable habitat in the vicinity of the impact area, will be undertaken by a qualified and experienced botanist in order to quantify the potential loss of plants; Design and construction will be re-considered to avoid or minimise loss of plants; If avoidance is not possible, Gateway WA will apply for a Ministerial 'permit to take' under the Wildlife Conservation Act, WA (where plants occur on State land only) and will implement the requirements of the permit; Opportunities to preserve, re-use and re-establish plants will be examined, in consultation with the DER. 	All personnel Environment Manager
Construction	Machinery or vehicles are not to move outside the clearing line, except on existing tracks or designated side tracks.	All personnel
Rehabilitation	Batters and other areas not required for permanent road infrastructure purposes shall be covered with topsoil and/or mulched and revegetated unless otherwise determined. Refer to the Rehabilitation and Landscape Management Plan.	Environmental Works Manager
Rehabilitation	At least 15 plants of <i>Conospermum undulatum</i> will be established in pots and re-planted in sites with suitable conditions within the project rehabilitation areas. This will occur at the Roe Highway/Tonkin Highway interchange or on Roe Highway. Other plants will be re-established in the Pioneer Park offset area. All plants will be monitored and maintained as per the Rehabilitation and Landscape Management Plan.	Environment Manager Environmental Works Manager

Monitoring Program

Parameter	Location	Frequency	Responsibility
Flagging/temporary fencing surrounding significant trees, TECs and threatened flora populations	Construction area	Weekly during construction	Environmental Manger
Placement of compounds, stockpiles and laydown areas are in suitable locations	Construction area	Weekly during construction	Environment Manager
Clearing lines and temporary fences utilised	Construction area, particularly where clearing is required and areas have been fenced	Weekly during construction	Environment Manager
Minimise clearing footprint where possible	All areas prior to clearing	All areas prior to clearing	Environment Manager
Areas of unauthorised clearing	Construction area	Weekly during construction	Environment Manager
Vegetation condition, assessing: <ul style="list-style-type: none"> Tree/plant health by species Vegetation cover Weediness index Vegetation condition will be assessed in accordance with the requirements in the Environment Monitoring Plan.	As per the Environment Monitoring Plan	As per the Environment Monitoring Plan	Environment Manager

Contingencies

Trigger	Action
Clearing or disturbance to vegetation outside approved	<ol style="list-style-type: none"> Investigate cause Review management procedures

areas	<ol style="list-style-type: none"> 3. Increase education amongst all personnel 4. Review use of temporary flagging/fencing to delineate boundaries of project area 5. Rehabilitate areas with native species under the direction of a suitably qualified environmental consultant and as soon as possible after incident in accordance with the Rehabilitation and Landscape Management Plan 6. Monitor success of rehabilitation
<p>Unauthorised clearing of, or impacts to, <i>Conospermum undulatum</i> or <i>Macarthuria keigheryi</i></p>	<ol style="list-style-type: none"> 1. Investigate cause 2. Review management procedures 3. Notify DER and DoE 4. Agree contingency actions with DER and DoE 7. Rehabilitate areas with native species under the direction of a suitably qualified environmental consultant and as soon as possible after incident 5. Monitor effectiveness of contingency actions
<p>Non-compliance with management and mitigation measures</p>	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions.

Fauna

Background

Construction activities may cause accidental death or injury to animals within the project area, particularly during clearing works. Construction activities may also result in loss or segregation of fauna habitat. Fauna likely to be found in the project area include mammals, reptiles and birds. The pictured animals are threatened or otherwise significant and are known to occur within the project area.



Rainbow Bee-eater



Bandicoot / Quenda



Red-tailed Black Cockatoo



Carnaby's Black Cockatoo



Western Swamp Tortoise

Activity	All works, particularly clearing vegetation	Location	Entire Site
Overall Objective	<ul style="list-style-type: none"> • Ensure potential impacts on protected fauna (as listed at the time of construction) are adequately identified and minimised during construction. • Minimise impact to terrestrial fauna. 		
Associated Documents	<ul style="list-style-type: none"> • DPaW Permit to Relocate Fauna 		
Management and Mitigation			
Timing	Management and Mitigation Actions	Responsibility	
Pre-construction	<p>The implementation of fauna underpasses within the design should be considered in relation to fauna movements. If undertaken, strategies to deter inappropriate access (e.g. by motorcyclists) shall be investigated and implemented where feasible. The design will considered strategies to encourage fauna use and discourage predation from feral animals (such as sky lights).</p> <p>A map of the proposed fauna underpass is provided at Appendix A.</p>	Design Manager Environment Manager	
Pre-construction	<p>The detailed design shall include fauna exclusion fencing at appropriate locations along the road verge to minimise the risk of fauna entering the road alignment. A map of proposed fauna fencing is attached at Appendix A.</p>	Design Manager Environment Manager	

Pre-construction	A 'no-go' map is provided for each construction zone – attached at Appendix A. These indicate sensitive environmental areas.	Environment Manager
Pre-construction	A permit to take fauna shall be acquired from DPaW, outlining the trapping and translocation program to be undertaken prior to clearing works.	Environment Manager
Induction	The induction program will include relevant fauna information.	Safety and Support Services Manager
Prior to Clearing	<p>The clearing area will be searched for fauna, this will include:</p> <ul style="list-style-type: none"> • Trapping. • Ground searches for fauna. • Tree hollow inspections, including the use of a cherry picker if required, with the purpose to remove any mammals or birds (including eggs) from the trees prior to clearing. <p>The method of fauna searches will be determined based on previous fauna studies within the area and any observable evidence on site (i.e. tracks, scat, etc.)</p> <p>Captured fauna (including eggs) will either be relocated into the neighbouring vegetation, unless injured or sick, or if neighbouring vegetation is not suitable, at a location agreed with DER, or the relevant Local Government Authority.</p>	Environment Manager
Clearing	A suitably qualified Fauna Spotter shall be onsite during all major clearing works to identify fauna within the clearing area and relocate if necessary.	Environment Manager
Clearing	Clearing should be timed, where practicable, to prevent coinciding with the main nesting/breeding seasons of fauna species which occur within the project area – usually Spring – September to December.	Environment Manager Project Manager
Clearing	Clearing should be undertaken from degraded areas towards better quality bushland areas on one front, to provide an opportunity for fauna to move out of the clearing area.	Project Manager Supervisor
Clearing	Machinery should start up at least 10 minutes prior to clearing to potentially 'scare' fauna away from the area.	Project Manager Supervisor
Construction	If injured/sick animals are encountered, or eggs are removed from trees, a nominated licenced fauna carer shall be called to care for the animal. The carer may only enter site if escorted by the Site Supervisor. This action is restricted to mammal and avian species, and medium to large reptiles. Alternatively animals may be taken to the local veterinary centre or wildlife centre.	Environment Team Supervisor
Construction	Fauna encountered in the construction area shall be given the chance to move on if there is no threat to the person's safety in doing so.	All personnel
Construction	Native fauna encounters will be recorded and reported to DPaW.	Environment Manager
Construction	Trenches will not be left open between shifts unless unavoidable. If this is to occur, a ramp should be made within the trench to allow fauna to escape.	Construction Manager Supervisor
Construction	Temporary fencing shall be placed around high use fauna areas, such as cockatoo feeding areas, once clearing has concluded.	Construction Manager Supervisor
Construction	Speed restrictions shall be implemented for all access tracks on site.	Superintendent
Construction	Lighting shall be directed toward the intended target to prevent excessive light spill.	Supervisor
Construction	Lighting that is not required and will not impair operations and/or personnel health and safety shall be switched off.	All personnel
Construction	Control of feral/pest animals shall be undertaken if deemed necessary.	Environment Manager
Construction	Firearms, traps and pets are not to be brought to site, except where pre-clearing fauna trapping is authorised.	All personnel

Monitoring Program			
Parameter	Location	Frequency	Responsibility
Direct impacts to Black Cockatoos and Quenda.	Construction area	Opportunistically during construction	Environment Manager
Presence of trapped fauna in pits, trenches, compounds or any other work area which has the real potential to entrap fauna, and ensure all are checked and cleared.	Construction area	Daily during construction (reported at least weekly)	Superintendent
Flagging and/or fences protecting nesting trees, fauna habitat, and feeding areas are in place.	Construction area	Daily during construction (reported at least weekly) Weekly during construction	Superintendent Environment Manager
Encounters with native fauna are recorded and made available to DPaW.	Construction area	Opportunistically during construction Reported as required through Permit to Take Fauna	Environment Manager
Encounters with pest/feral animals to determine if control is necessary	Construction area	Opportunistically during construction	Environment Manager
Contingencies			
Trigger	Action		
Fauna deaths or injuries	<ol style="list-style-type: none"> 1. Investigate cause 2. Contact DoE and/or DPaW if there are impacts on listed threatened species 3. Review management procedures 4. Increase education amongst all personnel 5. Erect fencing to prevent fauna access to active construction areas (if required) 		
Previously undetected cockatoo nesting trees discovered (actual nesting of a Black Cockatoo)	<ol style="list-style-type: none"> 1. Personnel shall cease work near nesting trees and report to Environment Manager and/or Supervisor 2. Environmental, Project and Design Managers shall investigate and review potential methods to avoid damaging nesting trees where practicable whilst inhabited. 3. Implement method, which may include limiting impact on the tree whilst breeding, or removal of eggs to a registered carer. 4. Monitor success of management. 5. Report location and actions to DPaW. 		
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. - Improve methods for marking clearing lines. - Install additional temporary fencing or signs. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions. 		

Bushfire Prevention and Response

Background	<p>Bushfires can occur as a result of construction works, specifically:</p> <ul style="list-style-type: none"> • Vehicle and machinery use near dry vegetation • Undertaking hot works • Smoking and/or disposing of cigarette butts inappropriately. <p>Bushfires become both a safety and environmental concern, and can severely impact vegetation and fauna.</p>		
Activity	All works, particularly those undertaken near dry vegetation, on hot, dry days and/or those involving a source of ignition	Location	Entire site, particularly near vegetation
Overall Objective	<ul style="list-style-type: none"> • Comply with the <i>Bush Fires Act 1954</i> 		
Associated Documents	<ul style="list-style-type: none"> • Total Fire Bans (http://www.dfes.wa.gov.au/totalfirebans/Pages/default.aspx) • Harvest Bans (http://www.kalamunda.wa.gov.au) 		

Management and Mitigation

Timing	Management and Mitigation Actions	Responsibility
Induction	All personnel will be educated on bushfire prevention, including the risk of disposing of cigarette butts on the ground.	Safety and Support Services Manager
Construction	Hot works shall not be undertaken on total fire ban days unless an exemption has been approved by Department of Fire and Emergency Services.	Project Manager
Construction	Clearing operations within the Shire of Kalamunda shall not be undertaken on total harvest ban days unless an exemption has been approved.	Construction Manager
Construction	All activities involving hot works shall have a valid Hot Works permit.	All personnel
Construction	Cigarette bins are to be located frequently throughout site.	Supervisor Site Engineer
Construction	No fires are to be lit at any time.	All personnel
Construction	Fire extinguishers and fire fighting equipment to be available in all site offices.	Construction Manager
Construction	All construction vehicles to have portable fire extinguishers.	Plant Manager All personnel
Construction	Earth moving machinery and water trucks to be on standby during extreme fire danger periods.	Construction Manager
Construction	Procedures shall be developed for dealing with small fires and fires that require external assistance. These procedures shall make up part of the Emergency Response Management Plan and shall be communicated to all working in the project work area.	Safety and Support Services Manager

Monitoring Program

Parameter	Location	Frequency	Responsibility
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Integrity of machinery and vehicles during pre-starts.	Entire Site	Daily for plant / Weekly for vehicles	Alliance Director
Contingencies			
Trigger	Action		
Bushfire occurs onsite	<ol style="list-style-type: none"> 1. Investigate cause (undertaken by the Alliance or the authorities). 2. If fire was found to have started onsite, review management measures practicality or relevance. 3. Improve training and education for all personnel. 4. Improve and implement increased protective measures as necessary. 5. Monitor the success of these actions. 6. Additionally, investigate possible methods of rehabilitation for the impacted areas. 		
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions. 		

Dieback and Weed Control

Background	<p><i>Phytophthora cinnamomi</i> (Dieback) is a soil-borne pathogen that survives and reproduces on a wide range of native plant species. Dieback infestations spread through bushland either:</p> <ul style="list-style-type: none"> naturally through the movement of contaminated soil and possibly water, artificially through the movement of contaminated soil on vehicles and the importation of contaminated soil, mulch or fill, and occasionally via foot traffic. <p>Vegetation in the project area is deemed to be mostly infected or unprotectable from infestation.</p> <p>Weeds may have a negative impact on the environment, including impacting the success of the soft landscaping and degradation of adjacent remnant vegetation. With the movement of soil through various methods, weed seeds can easily spread throughout the project area or be introduced from other areas if transported to site. Weed control is therefore necessary to prevent the introduction of new species and the spread of those existing.</p> <p>The Project area is highly altered in most locations, being considered uninterpretable, or unprotectable for dieback in many locations. Significant bushland or habitat areas adjacent to, or likely to remain within, the Project area will be protected through dieback hygiene requirements.</p>		
Activity	All works	Location	Entire site
Overall Objective	<ul style="list-style-type: none"> Minimise the risk of introduction and spread of dieback as a result of construction works. Minimise the risk of introduction and spread of weeds as a result of construction works. 		
Associated Documents	<ul style="list-style-type: none"> Managing Phytophthora Dieback for Local Governments (Dieback Working Group, 2000) 		

Management and Mitigation

Timing	Management and Mitigation Actions	Responsibility
Induction	The induction shall include information regarding dieback and weed impacts and management actions outlined in this table.	Safety and Support Services Manager
Pre-clearing	The weed status of the project will be assessed prior to clearing commencing. This aims to determine areas of topsoil which can be salvaged for rehabilitation and landscape works.	Environment Manager
Pre-clearing	Weed control should be undertaken in accordance with Condition 11 of Clearing Permit CPS 5242/2.	Construction Manager
Construction	All machinery entering the Site must be free of soil and plant debris.	Supervisor Plant Manager
Construction	The number of access points to the project shall be reduced as far as practicable.	Construction Manager
Construction	<p>A Weed and Seed Inspection (see Attachment A) will be in place and apply to all vehicles arriving on site. When on site clean down of all vehicles, machinery, equipment and tools will occur at designated hygiene stations, where relevant. This shall occur in specific areas where it necessary to minimise the risk of dieback and weed spread into areas of adjacent significant vegetation or other significant habitat or species locations.</p> <p>Clean down shall include brushing, gouging, scraping and/or water blasting to remove any compacted soil or plant matter. Once the natural surface is covered, no further dieback and weed wash down will be required, provided vehicles and plant remain within the resurfaced area.</p>	Project Manager Plant Manager Environment Manager
Construction	Hygiene stations shall be provided and utilised at specific locations when working on the natural ground surface. Hygiene stations will be dry where possible. Indicative locations are provided in Appendix A.	Project Manager
Construction	Soils will only be moved in dry conditions, that being when soils (not dust) do not freely adhere to rubber tyres, tracks, vehicle chassis or wheel arches.	Project Manager

Construction	Imported soils will be absent of weed or dieback. Certification of this will be provided internally by Gateway based on supplier information and/or product testing. Examples of supplier information include management of weed and dieback during the sourcing and stockpiling processes, such as criteria for selection of quarries where soils are sourced. the inclusion of a robust weed control program during stockpiling, and/or whether the material is pasteurised, hence weed seeds and dieback are 'cooked' out. Examples of product testing include analysing samples of the product for any presence of dieback or weed.	Construction Manager Environmental Works Manager
Construction	Topsoil and woodchips taken from site will be re-used as close to the original source as practicable.	Project Manager
Construction	Cleared vegetation or topsoil not suitable for reuse (i.e. weed infested) will be disposed of at an appropriate facility, or buried at least 1 m beneath the eventual surface of the road (in accordance with Main Roads specifications).	Project Manager Supervisor
Construction	Weed control shall be undertaken within the project site every three months or as agreed with the Environment Manager. This shall include, but not limited to: <ul style="list-style-type: none"> • Laydown areas • Stockpiles • Batters • Unsealed construction areas • Additional areas of weed infestation. Weeds control will not be delayed until immediately prior to soft landscaping works being undertaken.	Environmental Works Manager
Construction	Records of the use of herbicides shall be maintained.	Project Manager

Monitoring Program

Parameter	Location	Frequency	Responsibility
Vegetation condition and presence of Dieback	Vegetated areas within project area	Prior to clearing and two years post construction	Main Roads WA
Presence and extent of declared weeds	Areas of remnant vegetation and soft landscaping within the project area	Post construction	Environment Manager
Complaints from the public of weed introduction and spread along the road reserve.	Entire site	Construction	Relationships Manager

Contingencies

Trigger	Action
Recurrence of complaints from public and observations from site or weed introduction and spread within the project site.	<ol style="list-style-type: none"> 1. From complaints, identify areas of significant weeds and possible source of infestation. 2. Review and revise weed controls. 3. Implement new controls and monitor area for further weed infestations.
Declared plant identified	<ol style="list-style-type: none"> 1. Review treatment program and ensure plant is eradicated during any following weed control event. 2. Continue monitoring.
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions.

Hydrology and Wetlands			
Background	<p>There are a number of major constructed drains, as well as mapped wetlands within and surrounding the project area. A significant portion of the area to the east of the existing Tonkin Highway alignment comprises palusplain wetlands which are damplands with a seasonally high water table. Many of these are protected. One wetland of particular importance is Runway Swamp, located directly adjacent to the north of the new Perth Airport access road near the Tonkin/Leach Highway interchange. This is the only wetland which has seasonal, surface water. Wetlands in this area rely primarily on groundwater to remain viable. Many of the existing constructed drains and basins in the area intersect natural groundwater levels, and since their construction (mostly in the 1960's and 1970's have had the effect of lowering natural groundwater levels to facilitate development of the airport, as well as low lying roads and industrial land. This drained water forms much of the "base flow" or "summer flow" seen in major drains such as the Southern Main drain.</p> <p>Additionally many sensitive, vegetated areas in the vicinity of the Project may be affected by impacts to the surface and groundwater. Sensitive areas include Conservation Category Wetlands, the Infrastructure Only Conservation Zone (IOCZ), Precinct 5, registered Threatened Ecological Communities (TECs) and threatened flora and fauna habitats. Other sensitive areas on the project, such as threatened flora communities can also be affected by changed surface flows and groundwater levels.</p> <p>Majority of surface water on the western portion of the project has been significantly altered with the urbanisation of the area over time. Little existing remnant wetlands remain, with stormwater either infiltrated at source or piped into local basins within the Kewdale and Belmont areas.</p> <p>Surface water and groundwater levels and quality may potentially be affected by the construction of the project, which may lead to contamination of the neighbouring environment, reduction in groundwater for neighbouring stakeholders to use and a reduction in wetland levels. Despite being lowered by the existing drainage network, groundwater experienced in the project area is typically shallow (1-6 m below ground level), with dewatering works required for some construction activities in low lying areas, or those requiring deeper excavation, including the construction of the Tonkin/Leach Highway interchange.</p> <p>Drainage design has been agreed with the Department of Water and incorporates the principles for management incorporated in the Stormwater Management Manual for Western Australia (Department of Water, 2004-2007). These include the requirement for detention and infiltration of surface water from road runoff for the large majority of rainfall events (1 yr, 1 hour event, up to 16mm of rain) (ref http://www.water.wa.gov.au/PublicationStore/first/84981.pdf - Chapter 9 see Section 3.1).</p>		
Activity	All works	Location	Entire site
Overall Objective	<ul style="list-style-type: none"> • Maintain existing surface and groundwater hydrology within the project area and adjacent areas. • Prevent deleterious impacts on surface and groundwater quality. • Prevent spillage of hazardous goods to the adjacent environment, particularly wetlands, during operation. 		
Associated Documents	<ul style="list-style-type: none"> • Main Roads Western Australia (2005), Handbook of Environmental Practice for Road Construction and Maintenance Works • Gateway WA Environmental Monitoring Plan • Gateway WA Surface and Groundwater Management Plan 		
Management and Mitigation			
Timing	Management and Mitigation Actions		Responsibility
Prior to commencement of major construction works	<p>Baseline groundwater information will be collected for the groundwater at nominated wetlands adjacent to the works, and including surface water at Runway Swamp. Baseline information may also be collected at reference sites situated further away from the works. Baseline information will include both water quality and groundwater levels. Basic parameters for monitoring will be:</p> <ul style="list-style-type: none"> • Major ions • Nutrients (Nitrogen, Phosphorus) • conductivity and dissolved oxygen <p>Further details of baseline groundwater water quality and levels are provided in the Surface and Groundwater Management Plan (see below).</p>		Environment Manager
Planning	The highway design will be adjusted within the road reserve to avoid as much area of Conservation and Resource Enhancement Category Wetlands, as well as Runway Swamp, as far as is practicable.		Design Manager

Planning	A Drainage Strategy shall be developed for the Project and approved by the Department of Water prior to construction commencement. This shall be consistent with best practice management as described in the Stormwater Management Manual for Western Australia (Department of Water, 2004-2007). Figures from the approved Drainage Strategy showing the proposed drainage plan are provided at Attachment B.	Design Manager
Planning	Road run-off shall be infiltrated at source wherever possible. Where it cannot be infiltrated at source it will be conveyed to an alternate location within the road reserve where it can be infiltrated by means of landscaped detention/infiltration basins or swales. Provision for storage for 1 year ARI (Annual Recurrence Interval), 1 hour storm runoff will be made within these structures where practicable to recharge the superficial aquifer and to protect the surrounding environment in case of a major spill through the incorporation of a baffled outlet. In extremely constrained developed area, where existing road run-off discharges into adjacent Local Government Authority and/or Water Corporation drainage assets, stormwater retention may also be achieved at source through adoption of leaky pits, whilst existing outfall points will be retained and discharge limited to pre-development flow rates or to values agreed with the asset owner. Generally, detailed drainage includes the capacity of retaining 20,000 L in areas adjacent to wetlands in order to prevent contamination of wetlands during a traffic incident involving large volumes of hazardous goods. Pollution treatment devices will be provided upstream of existing direct discharge into the Swan River.	Design Manager
Planning	In cases other than minor road widening works and intersection upgrades where existing conditions are not significantly modified, there shall be no direct discharge of road run-off into permanently protected wetlands (those outside the Project Impact footprint) unless otherwise endorsed by Department of Water. This will be achieved by: <ul style="list-style-type: none"> • Kerbing or constructing swales • Draining road run-off to median and roadside swales or detention/infiltration basins • Installing terminal drainage blocks at end of swales to ensure retention/infiltration prior to overland sheet flow • Ensuring no direct drainage connection between the median and adjacent wetland areas Vegetating roadside swales (will slow water flow and provide for biological infiltration).	Design Manager
Planning	No more than 16 ha of wetlands will be permanently impacted on Perth Airport land. No more than 34 ha of wetlands will be permanently impacted on State land.	Design Manager Project Manager
Planning	A Surface and Groundwater Management Plan will be developed and implemented. This will include the management and monitoring (quality and groundwater levels) requirements for all dewatering and construction drainage works onsite and shall be approved by the Department of Water. Monitoring requirements will also be provided in the Environmental Monitoring Plan.	Environment Manager
Planning	Erosion controls shall be applied upstream of all permanent discharge points.	Design Manager
Planning	Investigation of the project area will be undertaken to determine where Acid Sulfate Soil management will be needed. Any management plans which are developed shall be approved by DER and implemented during construction.	Environment Manager
Induction	The induction program shall include information regarding the conservation of wetlands, potential impacts to surface and groundwater quality as well as the management actions outlined in this table.	Safety and Support Services Manager
Pre-construction	A 'no-go' map is provided for each construction zone. These indicate all sensitive environmental areas and are attached at Appendix A.	Environment Manager
Construction	Dewatering (taking groundwater), including bore abstraction, will be undertaken in accordance with a Licence to Take water as approved by the Department of Water as required under the <i>Rights in Water and Irrigation Act 1914</i> .	Environment Manager
Construction	The taking of other water, such as that from nearby evaporation ponds, will only be undertaken on the advice of the Environment Manager.	Construction Manager

Construction	<p>Construction shall be undertaken in accordance with detailed design plans, including:</p> <ul style="list-style-type: none"> installing of fences to minimise risk of accidental impact on all permanently protected (adjacent) wetlands installing erosion/scour control measures minimising native vegetation clearing. <p>Such controls should be installed in conjunction with surrounding drainage works, and should not be installed at a later date, potentially leading to impacts during this period.</p>	Project Manager
Construction	Diversion of any open drains will be avoided during construction wherever possible.	Construction Manager
Construction	<p>Stormwater management shall be designed and implemented wherever relevant on road construction areas, within laydown areas and at offices with the aim to prevent direct run-off into nearby permanently protected wetlands as well as other sensitive areas (Precinct 5, IOCZ, and threatened flora, communities and fauna habitats).</p> <p>Stormwater management will include the use of low bunds, silt fencing, bales or other erosion and siltation prevention equipment where necessary. Major areas of silt traps are shown on the Environmental Constraints and Management figures at Appendix A.</p>	Construction Manager
Construction	<p>Stockpiles which will remain on site for more than a day during May – September and more than five days during October – April, will be bunded where necessary to minimise the amount of run-off entering environmentally sensitive areas.</p> <p>Stockpiles will not be placed on a sealed surface within 15 m of a drainage pit, unless pit protection is in place.</p>	Project Manager
Construction	Wash down bay water will be discharged at least 50 m from Conservation Category or Resource Enhancement wetlands, Precinct 5, IOCZ, areas of threatened flora or communities.	Project Manager Plant Manager
Construction	Wash down of vehicles and plant will not occur except in designated areas such as the wash down bays.	Construction Director All personnel
Construction	Wash down of concrete trucks, apart from the truck chute, will not be washed down on site. Concrete water from the chute wash down will be confined onsite and removed once hardened. It will not be released into vegetated areas.	Construction Manager Supervisor
Construction	Existing natural drainage paths and drainage channels will not be unnecessarily blocked or restricted. Any material that is found to block drainage will be removed immediately.	Construction Manager Supervisor
Rehabilitation	Soft landscaping works shall occur as soon as practicable in the sequence of works.	Project Manager Environmental Works Manager

Monitoring Program

Parameter	Location	Frequency	Responsibility
<p>Wetland monitoring</p> <p>Water quality information will be collected from the groundwater at nominated wetlands adjacent to the works, and including surface water at Runway Swamp. Information may also be collected at reference sites situated further away from the works. Information will include both water quality and wetland levels. Parameters for monitoring will be:</p> <ul style="list-style-type: none"> Major ions Nutrients (Nitrogen, Phosphorus) pH, conductivity and dissolved oxygen 	Adjacent and possible reference wetlands – see Surface and Groundwater Management Plan and Environmental Monitoring Plan for further information	<p>Prior to construction</p> <p>At least quarterly during construction as defined by the Environmental Monitoring Plan</p> <p>At least once at the completion of construction works.</p> <p>Quarterly for three years following practical completion (see Operational Environment Management Plan)</p>	<p>Environment Manager</p> <p>Main Roads WA</p>

Evidence of water pooling	Entire site	Opportunistic during construction	Environment Manager
Evidence of physical disturbance of permanently protected wetlands	Interface area between wetlands and construction site	Monthly during construction	Environment Manager
Monitoring as per the ASS Management Plan and Surface and Groundwater Management Plans	As per the ASS and Surface and Groundwater Management Plans	As per the ASS and Surface and Groundwater Management Plans	As per the ASS and Surface and Groundwater Management Plans
Significant run-off from construction areas	Entire site	Weekly during construction Daily (reported at least weekly)	Environment Manager Supervisor

Contingencies

Trigger	Action
Change in wetland water levels compared to baseline levels, not attributed to weather conditions	<ol style="list-style-type: none"> 1. Investigate potential cause of change in water levels. 2. If change is likely a result of project activities, identify possible control measures to remedy (e.g. installation of additional balancing culverts). 3. Monitor effectiveness of additional control measure.
Change to water quality levels compared to baseline levels	<ol style="list-style-type: none"> 1. Investigate potential cause of change in water quality. 2. If change is likely a result of project activities, identify possible control measures to remedy (e.g. erosion and scour control). 3. Monitor effectiveness of additional control measures.
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions.

Rehabilitation			
Background	<p>Disturbed areas within the road reserve which are not stabilised as part of the final design will be rehabilitated with native vegetation (known as 'soft landscaping'). These areas can include, but not limited to, embankments, bunds, medians, verges, adjacent land and intersections. A soft landscaping design will be incorporated within the urban landscaping design, and with further details included within the Revegetation and Landscaping Specification 304 as well as the Rehabilitation and Landscape Management Plan.</p> <p>Soft landscaping provides the benefit of stabilising loose soils which otherwise may erode causing scour issues on embankments, and improving the visual amenity of the overall project.</p>		
Activity	Clearing, rehabilitation	Location	Entire site
Overall Objective	<ul style="list-style-type: none"> To re-establish suitable native vegetation across the Project area Minimise wind and water erosion. 		
Associated Documents	<ul style="list-style-type: none"> Main Roads Western Australia (2005), Handbook of Environmental Practice for Road Construction and Maintenance Works Specification 304 Revegetation and Landscaping Rehabilitation and Landscape Management Plan Rehabilitation Plan – Pioneer Park Offset 		
Management and Mitigation			
Timing	Management and Mitigation Actions		Responsibility
Pre-construction	Develop a Rehabilitation and Landscape Management Plan		Environment Manager
Pre-construction	The soft landscaping design shall include the rehabilitation of interchanges, median and road verges with native species, including Black Cockatoo and bandicoot foraging species.		Landscape Design Manager
Pre-construction	Avoid establishment of black cockatoo foraging habitat immediately adjacent to the road alignment to minimise the risk of vehicle strike.		Landscape Design Manager
Pre-construction	The design shall consider the use of vegetation as screening along road verges adjacent to residential areas.		Landscape Design Manager
Pre-construction	Undertake soft landscaping in consultation with the community, with special consideration of visual amenity.		Relationships Manager
Construction			Landscape Design Manager
Construction	Suitable topsoil must be stripped and stockpiled for reuse in revegetation of disturbed areas as soon as practically possible. This topsoil will be signed where necessary whilst stockpiled to avoid contamination.		Project Manager Environmental Works Manager
Construction	Salvaged topsoil must be respread as close as possible to the areas from which it was sourced.		Project Manager Environmental Works Manager
Construction	All suitable native vegetation chipped must be stockpiled for later use in soft landscaping works.		Project Manager
Construction	The Alliance shall consider the salvage of vegetation, including the transplantation of <i>Macrozamia riedlei</i> , <i>Xanthorrhoea preissii</i> and <i>Kingia australis</i> , during project development (Rehabilitation and Landscape Management Plan).		Environmental Works Manager Environment Manager

Construction	Material from plants of <i>Conospermum undulatum</i> that are to be removed during the project will be collected and used for propagation of new plants, as per the requirements of the Rehabilitation Plan – Pioneer Park Offset.		Environment Manager Environmental Works Manager
Construction	Rehabilitation works will be undertaken as soon as practicable, however will be dependent on timing with the winter rain months (May to September).		Environmental Works Manager
Monitoring Program			
Parameter	Location	Frequency	Responsibility
Soil erosion as detailed with the SWTC	Entire site – unsealed areas	Autumn and Spring of each year after practical completion of the Landscaping Works until the end of the Defects Correction Period for the Landscaping Works	Environmental Works Manager Alliance Director
Plant survival	Areas of soft landscaping	As per the Rehabilitation and Landscape Management Plan	Environmental Works Manager Alliance Director
Contingencies			
Trigger	Action		
Significant erosion found on site	<ol style="list-style-type: none"> 1. Areas of significant erosion (as defined in the SWTC) will be remediated within three months of assessment. 2. Method of remediation to be determined by the Landscape Manager in accordance with the requirements of the SWTC. 		
Unsuccessful plant survival	<ol style="list-style-type: none"> 1. Undertake actions as per the Rehabilitation and Landscape Management Plan. 		
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions. 		

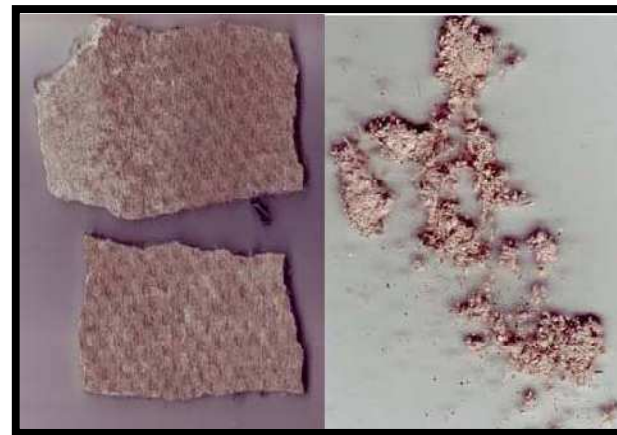
Contaminated Soils, Acid Sulphate Soils and use of Hazardous Substances

Background

As a result of historical use, the possibility exists for contaminated soils to occur within the project site. Given the previous use of the area, the most probable forms of contamination are likely to be as a result of large fuel/oil spills, old underground fuel storage tanks, leach drains or disused asbestos. The disturbance of a contaminated site can pose environmental and human health risks if not managed correctly.

Additionally, the project lies within areas of Acid Sulphate Soils (ASS). ASS are naturally occurring soils, sediments and peats generally found near estuaries and coastal lakes. ASS are benign in their natural state, however when these soils are exposed to air through dewatering or excavation, oxygen reacts with the iron sulphides in the soil. This leads to the production of sulphuric acid which can contaminate soils and water, potentially impacting the surrounding environment, human health and built infrastructure.

Furthermore, during construction works, the potential exists for further contamination to occur through the accidental release of hazardous substances.



Examples of contamination – asbestos, soil contaminated with oil

Example of ASS

Activity

All works, particularly initial earthworks

Location

Entire Site

Overall Objective

- Comply with the *Contaminated Site Act 2003*.
- Minimise impacts on the environment, community and personnel upon discovery and remediation of contaminated land.
- Comply with the Treatment and management of soils and water in acid sulfate soil landscapes (DEC, 2011).
- Prevent deleterious impacts on the surface and groundwater quality.
- Prevent contamination of surface and groundwater through spills of hydrocarbons and chemicals.

Associated Documents

- Main Roads Western Australia (2005), Handbook of Environmental Practice for Road Construction and Maintenance Works
- Treatment and management of soils and water in acid sulfate soil landscapes (DEC, 2011).

Management and Mitigation

Timing	Management and Mitigation Actions	Responsibility
Pre-construction	Desktop and site investigations will be undertaken prior to construction commencement to determine any potential and actual contaminated sites within the project boundaries.	Environment Manager
Pre-construction	Undertake an ASS investigation to determine if construction works will impact ASS.	Environment Manager

Pre-construction	If the presence of ASS is identified within the project area, and ASS Management Plan will be developed and implemented during construction. This plan will cover both excavation of ASS and dewatering within ASS areas, and will be approved by DER.	Environment Manager
Pre-construction	If soil or groundwater contamination that may be impacted by the construction works is identified during the investigations, a management strategy will be developed. This shall include an assessment of the risks to the environment and human health, removal of contaminated soils with validation to DER guidelines and appropriate treatment of excavated soils.	Construction Manager Environment Manager
Induction	The induction shall include information of the potential ASS and contamination risks based on the outcomes of these investigations, as well as the management actions presented in this table.	Safety and Support Services Manager
Construction	During intrusive works such as excavations, if visual and or olfactory evidence suggests potential for contamination (e.g. fill material, building rubble, odours, soil staining), works will cease, the site supervisor will be notified, and the material sampled and analysed. Works will commence once the status of the material has been confirmed and corrective actions implemented (if required).	All personnel
Construction	Determination of contamination and requirements for remediation will be undertaken on advice from the Environment Manager. The site of potential contamination will be contained (i.e. bunded) to prevent any spread of contaminants, and will be fenced to prevent any unauthorised access.	Environment Manager Site Engineer
Construction	Asbestos waste from existing structures, and (if encountered) from previously unidentified sources, shall be removed and disposed of by a suitably qualified asbestos removalist contractor.	Construction Manager
Construction	All hydrocarbons, chemicals, pesticides and herbicides on site shall be stored in purpose built containers or tanks in a bunded storage area with adequate capacity to contain spills. They will not be stored within 50 m of a wetland or open drainage line or within 15 m of a drainage pit.	Supervisor All personnel
Construction	Bunds shall be regularly inspected and cleaned.	Supervisor
Construction	Refuelling on site shall be undertaken on a sealed or bunded surface or if practicable, using a catch tray.	All personnel
Construction	No refuelling shall occur within 50 m of any water body (except stationary plant required to be located in proximity to work site). These include the wetlands to the east of the project and open drainage lines.	All personnel
Construction	Vehicles shall not be left unattended when refuelling.	All personnel
Construction	A spill response plan for hydrocarbons and chemicals, including pesticides and herbicides, shall be developed to ensure the spill is contained effectively, cleaned up appropriately and efficiently with approved materials. This shall include the provision and use of spill kits.	Safety and Support Services Manager
Construction	Any contaminated soil shall be disposed of to an appropriate licenced landfill facility. Records of disposal shall be maintained.	Construction Manager Commercial Manager
Construction	Site security shall be implemented to prevent unauthorised access to storage areas.	Project Manager
Construction	Temporary site toilets will not be placed within 50 m of a wetland or open drain, or within 15 m of a drainage pit.	Supervisor

Monitoring Program

Parameter	Location	Frequency	Responsibility
Storage of hazardous goods.	Entire site	Daily Weekly	Supervisor Environment Manager
Surface water, groundwater and soil quality	To be determined within Environmental Monitoring Plan	To be determined within Environmental Monitoring Plan	Environment Manager

Contingencies	
Trigger	Action
Discovery of previously unidentified contaminated area.	<ol style="list-style-type: none"> 1. Cease works and notify Environment Manager. 2. Material sampled and analysed. 3. Implement corrective actions as advised by the Environment Manager. 4. Works are not to recommence until approval is given by the Environment Manager. 5. Notify DER/PAPL of the discovery and the outcome within one month of discovery.
Spill or leak of hazardous materials during construction	<ol style="list-style-type: none"> 1. If spill enters the environment (including drainage basins off-site) DER Pollution Response will be notified. 2. The cause of a level 1 or 2 spill shall be investigated. 3. An appropriate remedy shall be implemented, possibly including: <ul style="list-style-type: none"> – repairing defective equipment. – upgrading fuel storage and handling procedures. – remediation of impacted area.
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions.

Construction Noise and Vibration			
Background	Noise and vibration emissions are primarily a nuisance for nearby residents surrounding the construction. Noise and vibration emissions can also disturb nearby fauna, impacting their ability to forage near the project site. Vibrations from site can also result in damage to nearby infrastructure. The level of annoyance from noise and vibration is dependent upon the duration, intensity and timing of the construction activities.		
Activity	All works, particularly those which create a lot of noise and those occurring outside regular hours	Location	Entire site, particularly near sensitive receptors (residential, bush etc.)
Overall Objective	<ul style="list-style-type: none"> Comply with the Environmental Protection (Noise) Regulations 1997 Manage vibration so that it complies with industry best practice 		
Associated Documents	<ul style="list-style-type: none"> Construction Noise and Vibration Management Plan 		
Management and Mitigation			
Timing	Management and Mitigation Actions		Responsibility
Induction	Workforce inductions will include education in relation to the minimisation of noise and vibration.		Safety and Support Services Manager
Construction	Select machinery and adopting operational practices that will produce the lowest practical level of noise and vibration. All machinery will be fitted with mufflers.		Project and Construction Managers Project and Site Engineers
Construction	Drum rollers to be oscillating mode by default (i.e. unless it can be shown that vibratory roller will limit vibration at closest building to comply with limits prescribed in DIN 4150).		Construction Manager Superintendent
Construction	Ground vibration in adjoining properties will be managed to minimise nuisance impact and will not exceed limits as prescribed in DIN4150.		Project Manager
Construction	Conduct field trials of vibration propagation using proposed plant and suitably accurate vibration monitoring instruments.		Project Manager
Construction	Construction activities (including materials transport) shall be limited between 0700 and 1900 Monday to Saturday, excluding public holidays (standard work hours) unless an out of hours Construction Noise Approval is obtained.		Project Manager
Construction	Where construction activities are required outside of approved operating hours: <ol style="list-style-type: none"> Prepare Construction Noise Management Plan (CNMP) Obtain approval of NMP from the City of Belmont and/or Shire of Kalamunda. Ensure all nearby residents are notified prior to works, with details of time period of activity and summary of why the activity is required outside of usual hours. Reduce noise emissions as much as practicable, e.g. croakers in place of reverse beepers. 		Project Manager
Construction	Property condition surveys will be conducted and reports prepared by an independent qualified assessor for all properties and existing bridges within 50 m of works and with owner consent.		Alliance Director
Construction	A complaints register shall be established and maintained.		Relationships Manager
Construction	Appropriate access routes, staff parking and work area conditions will be determined prior to activity commencing which will minimise noise and vibration impacts on the neighbouring community. These will be specified within Vehicle Movement Plans.		Construction Manager

Construction	Reversing beepers or croakers will be used during the hours of 7am to 7pm, Monday to Saturday, excluding public holidays. Alternative, less intrusive, alarms such as croakers will be used during out of hours works (7pm to 7am, Sundays and Public Holidays).	Alliance Director
Construction	Idling of all vehicles and plant is to be kept to a minimum.	All personnel
Construction	Conventional radios are to be kept at a reasonable volume and will need to be turned off immediately if nearby stakeholders complain.	All personnel
Construction	Residents and businesses in proximity to the project area will be advised of the proposed construction work schedule.	Project Manager Relationships Manager
Construction	Acoustic screens (e.g. fences, site offices) shall be used where practicable for equipment that may run on a 24 hour basis near sensitive areas.	Project Manager
Construction	Generators, compressors and other semi-fixed equipment that generates noise shall be located as far as practicable from nearby residences.	Project Manager
Construction	Maintenance schedules shall be followed and pre-start inspections shall be undertaken to ensure that all equipment is in good condition.	Project Manager

Monitoring Program

Parameter	Location	Frequency	Responsibility
Integrity of machinery and vehicles during pre-starts.	Entire Site	Daily for plant / Weekly for vehicles	Alliance Director
Noise levels – if warranted through numerous complaints	Dependent on complaints	Dependent on complaints	Project Manager
Vibration impacts – as required to monitor compliance with limits under DIN4150	Dependent on location of impacted area	No less than monthly and following specific complaints	Environment Manager
Impacts due to excessive vibration on surrounding infrastructure (i.e. pre- and post-construction property condition surveys).	Properties and bridges within 50 m of the construction site	Prior to construction and if warranted post construction	Relationships Manager

Contingencies

Trigger	Action
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> Investigate cause. Implement contingency actions which may include: <ul style="list-style-type: none"> Review management measures practicality or relevance. Improve training and education for all personnel. Improve and implement increased protective measures as necessary. Monitor the success of these actions.
Target vibration level exceeded at monitoring location	<ol style="list-style-type: none"> Investigate cause Alter conditions if possible Consider replacing machinery where practicable
Complaints received concerning noise or vibration	<ol style="list-style-type: none"> Manage complaints and ensure a rapid response occurs. Undertake noise monitoring if necessary. Rectify impacts due to vibrations as per the SWTC.

Construction Dust			
Background	The primary air quality concern during construction is the potential level of dust generated during the road construction, particularly in very dry conditions. Dust is a nuisance to the environment and has the potential to decrease amenity values. Dust can impact the health of nearby flora, by blocking and damaging stomata therefore rendering the plant unable to perform photosynthesis. Dust can also be a health hazard, causing respiratory problems and dangerously reducing visibility for nearby traffic. The long-term effects from dust are expected to be insignificant, due to the temporary nature of the construction program.		
Activity	All works, particularly those on unsealed surfaces during dry periods	Location	Entire site
Overall Objective	<ul style="list-style-type: none"> Manage dust so that it does not create adverse social impacts 		
Associated Documents	<ul style="list-style-type: none"> A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities (DEC 2011) 		
Management and Mitigation			
Timing	Management and Mitigation Actions		Responsibility
Induction	Workforce inductions will include education in relation to the minimisation of dust.		Safety and Support Services Manager
Construction	Dust generation shall be controlled / mitigated through appropriate measures where practicable including, but not limited to, hydro mulch, water application through water carts, and chemical dust suppressants. This applies to the entire construction site and includes, but is not limited to haul roads, cleared areas, batters and stockpiles. Particularly in the instance of stockpiles, the use of walls and covers shall be investigated and implemented where deemed necessary.		Supervisor Site Engineer
Construction	Appropriate licences from the Department of Water will be obtained if required to supply water for dust suppression and other construction purposes.		Project Manager
Construction	Existing sealed roads utilised by the Alliance will be cleaned regularly if they become littered with loose material as a result of construction works. This cleaning will be undertaken with a wet vacuum broom truck where necessary to reduce dust emissions.		Supervisor Superintendent
Construction	A complaints register for any issues of concern shall be established.		Relationships Manager
Construction	The extent of cleared and other disturbed areas will be minimised as far as is practicable for construction requirements.		Construction Manager
Construction	When within 5 m of a residential boundary, stockpiles shall be kept to below fence height.		Supervisor
Construction	Generally stockpiles will be kept below 7 m in height.		Supervisor
Construction	If stockpiles are left untouched for greater than 28 days long-term stabilisation methods such as mulch or other stabilisers should be implemented.		Project Engineer Supervisor
Construction	All vehicles carrying dusty loads will be covered through the use of tarpaulins etc. when travelling in areas with sensitive receptors both inside and outside the project area. The only exception to this is Moxy trucks which cannot practicably be covered.		All personnel
Construction	The construction site will be kept clean to minimise dust accumulation within and surrounding the site.		Supervisor
Construction	Soil surfaces will be rehabilitated and/or stabilised to minimise dust lift.		Construction Manager Supervisor

Construction	Maintenance schedules shall be followed and pre-start inspections shall be undertaken to ensure that all equipment is in good condition.	Project Manager All personnel
Construction	If required and practicable, construction material shall be dampened by sprinkling water prior to transportation, especially during dry and windy weather conditions.	Supervisor All personnel

Monitoring Program

Parameter	Location	Frequency	Responsibility
Evidence of excessive dust lift (visual assessment)	Entire Site	Opportunistically	Supervisor All personnel
Airborne dust concentration (e.g. a 'dust box' to measure dust concentration)	At least 2 locations observed to be sensitive to nuisance dust e.g. runway approach, residential areas, showrooms etc.	Continuous	Environment Manager
Dust on vegetation	Entire Site with particular emphasis on areas of neighbouring vegetation	Weekly	Environment Manager





Contingencies

Trigger	Action
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> Investigate cause. Implement contingency actions which may include: <ul style="list-style-type: none"> Review management measures practicality or relevance. Improve training and education for all personnel. Improve and implement increased protective measures as necessary. Monitor the success of these actions.
Pre-determined/specified dust concentration exceeded	<ol style="list-style-type: none"> Investigate cause. Implement contingency actions which may include: <ul style="list-style-type: none"> Review management measures practicality or relevance. Improve training and education for all personnel. Improve and implement increased protective measures as necessary. Monitor the success of these actions.
Complaints received concerning dust	<ol style="list-style-type: none"> Manage complaints and ensure a rapid response occurs. Undertake dust monitoring if necessary.

Construction Waste			
Background	The construction of the project will inevitably produce waste products including domestic wastes, unsuitable spoil and materials from demolition. Appropriate reuse, recycle or disposal of these products will be undertaken to minimise the impact on the environment.		
Activity	All works, particularly those involving demolition works and earthworks.	Location	Entire site
Overall Objective	<ul style="list-style-type: none"> All construction activities are to be carried out with the principles of cleaner production and waste minimisation. 		
Associated Documents	<ul style="list-style-type: none"> Landfill Waste and Classification Definitions 1996 (DEC 2009) 		
Management and Mitigation			
Timing	Management and Mitigation Actions	Responsibility	
Induction	The workforce induction shall outline the requirements for waste minimisation and management practices. All workers will be encouraged to minimise waste production and to make sure that any wastes produced are disposed of appropriately.	Safety and Support Services Manager	
Construction	Education will be provided to all personnel on the impacts litter has on the environment.	Environment Manager	
Construction	Waste management shall be managed under the strategy of reduce, reuse, recycle. Sending waste to landfill will be avoided as a last-resort option.	Alliance Director	
Construction	Suppliers will be requested to minimise packaging of materials delivered to site.	Commercial Manager Project Director	
Construction	Waste, such as asphalt profiling, concretes and soils will be re-used where possible on the project or sent to a recycling depot.	Construction Director	
Construction	The project site will be kept clean and tidy with litter and waste placed in appropriate disposal / recycle bins.	All personnel	
Construction	Litter and recycle bins shall be placed (and regularly emptied) in appropriate areas.	Supervisor	
Construction	Waste chemicals shall be disposed of as per the corresponding MSDS sheet.	All personnel	
Construction	All waste which cannot be re-used or recycled will be disposed of at an appropriate licenced facility.	Construction Manager	
Monitoring Program			
Parameter	Location	Frequency	Responsibility
Presence of litter within and adjacent to the project site which is attributed to construction activities.	Entire Site	Opportunistically and reported weekly Opportunistically and reported weekly	Supervisor Environment Manager
% of waste in each stream (re-use, recycle, landfill)	Entire site as well as project offices	Quarterly	Sustainability Manager
Correct usage of recycle and refuse bins	Entire Site	Opportunistically and reported weekly	Environment Manager
Contingencies			

Trigger	Action
Non-compliance with management and mitigation measures	<ol style="list-style-type: none"> 1. Investigate cause. 2. Implement contingency actions which may include: <ul style="list-style-type: none"> - Review management measures practicality or relevance. - Improve training and education for all personnel. 3. Improve and implement increased protective measures as necessary. 4. Monitor the success of these actions.
Complaints received concerning waste	<ol style="list-style-type: none"> 1. Manage complaints and ensure a rapid response occurs.

Aboriginal and European Heritage

<p>Background</p>	<p>All Aboriginal and European Heritage are protected by law; as such it cannot be impacted without approval. It is important that where works are undertaken within heritage sites that only the area designed to be impacted is actually impacted. There are two known Aboriginal Heritage Sites near the project area, both occurring east of the Tonkin/Leach Highway interchange. During construction works, the potential exists for previously undiscovered sites to be found.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p style="text-align: center;">Examples of Aboriginal Heritage – rock, rock painting, quartz</p> <p style="text-align: right;">Example of European Heritage – convict road</p>		
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<p>Activity</p>	<p>All works, particularly initial earthworks</p>	<p>Location</p>	<p>Entire Site, particularly east of the Tonkin/Leach Highway interchange</p>
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<p>Overall Objective</p>	<ul style="list-style-type: none"> • Comply with the requirements of the <i>Aboriginal Heritage Act 1972</i> including those within the Section 18 approval. • Minimise impacts on Aboriginal Heritage, both known and unknown. • Liaise with relevant Aboriginal groups when required • Comply with the requirements of the <i>Heritage of Western Australia Act 1972</i> and the Government Heritage Property Disposal Process.
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<p>Associated Documents</p>	<ul style="list-style-type: none"> • Main Roads Western Australia (2005), Handbook of Environmental Practice for Road Construction and Maintenance Works • Section 18 approval to disturb an Aboriginal Heritage Site
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Management and Mitigation

<p>Timing</p>	<p>Management and Mitigation Actions</p>	<p>Responsibility</p>
<p>Induction</p>	<p>The induction shall address heritage issues, including location of known sites and staff obligations with regards to the protection of known and unknown Aboriginal Heritage sites and values pursuant to the <i>Aboriginal Heritage Act 1972</i>.</p>	<p>Safety and Support Services Manager</p>
<p>Pre-construction</p>	<p>The local Aboriginal community along with the project archaeologist shall be given the opportunity to salvage artefacts from the registered Aboriginal Heritage Site (ID 3993) prior to the commencement of construction in that area.</p>	<p>Environment Manager</p>
<p>Pre-construction Construction</p>	<p>Provide information to the local Aboriginal community outlining the intended design, general construction methods and timing of the road construction. Due consideration will be given to requests made by the Aboriginal people regarding the protection of Aboriginal heritage and the recognition of Aboriginal culture and history.</p>	<p>Relationships Manager Environment Manager</p>
<p>Construction</p>	<p>GWA will endeavour to provide employment and/or work experience to the local Noongar community.</p>	<p>Alliance Director</p>
<p>Construction</p>	<p>Known Aboriginal Heritage sites situated outside or partly outside of the construction footprint shall be clearly identified on clearing permits as 'no-go' areas.</p>	<p>Environment Manager</p>

Construction	Aboriginal heritage site boundaries adjacent to the works shall be protected by fencing or flagging signalling no-go, if they occur within the construction works to prevent any unauthorised access.	Project Manager Environment Manager
Construction	Compounds, stockpiles, access tracks, vehicle parking and other project infrastructure will be located away from known Aboriginal Heritage sites.	Supervisor
Construction	A suitably qualified heritage consultant shall be engaged to assist with advice, consultation and investigations of Aboriginal and/or European heritage matters as required.	Environment Manager
Construction	Noongar representatives will be engaged to monitor initial ground disturbing activities in close proximity to, and within, known Aboriginal Heritage sites.	Environment Manager Project Manager
Construction	If objects of potential significance to the Aboriginal community are found during construction in existing Aboriginal Heritage sites, those works will cease immediately within 20 m of the object and action will be undertaken on the advice of the project archaeologist and the Aboriginal community.	All personnel Supervisor
Construction	Should any Aboriginal Heritage objects be identified they shall be salvaged and managed according to advice from the Noongar representatives monitoring the works.	Project Manager
Construction	If suspected skeletal remains are found, works shall cease and the incident reported immediately to the WA Police and DIA. Works will not resume until the Police, DIA and the project archaeologist are satisfied with the management of the remains.	All personnel
Construction	If skeletal remains are an Aboriginal Heritage matter and not a police matter, they will be managed by the community and DIA with advice from the project archaeologist.	Project Manager
Construction	If potential European heritage objects are found during construction works, they shall be salvaged and managed according to advice from a suitably qualified archaeologist and the Environment Manager.	All personnel Environment Manager

Monitoring Program

Parameter	Location	Frequency	Responsibility
Locations of compounds, stockpiles and associated construction materials are outside known Aboriginal Heritage Sites	Entire project	Weekly	Environment Manager
Temporary fencing is erect and in place at adjacent Aboriginal Heritage Sites	Adjacent Aboriginal Heritage Sites	Weekly	Environment Manager
Monitor any unauthorised disturbance of known sites	Adjacent Aboriginal Heritage Sites	Weekly	Environment Manager
Check disturbance is within allowed limits at any new sites found during construction	Dependent upon discovery	As required – dependent upon timing of discovering and agreed management	Environment Manager
Monitor initial ground disturbance in areas of known sites	Aboriginal Heritage Sites	Daily during initial ground disturbance	Environment Manager/Project Heritage Consultant

Contingencies

Trigger	Action
Unauthorised disturbance of Aboriginal or European Heritage Site	<ol style="list-style-type: none"> 1. Investigate cause 2. Notify DAA or State Heritage Office 3. Review management measures 4. Increase education amongst all personnel

Non-compliance with management and mitigation measures	<ol style="list-style-type: none">1. Investigate cause.2. Implement contingency actions which may include:<ul style="list-style-type: none">- Review management measures practicality or relevance.- Improve training and education for all personnel.3. Improve and implement increased protective measures as necessary.4. Monitor the success of these actions.
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Elkington, Amy

From: VISKOVICH Adam [Adam.Viskovich@water.wa.gov.au]
Sent: Thursday, 29 May 2014 12:50 PM
To: Elkington, Amy
Subject: RE: Gateway WA

Hi Amy

Regarding the road construction application referred to below, what you have said is correct. Following up on the conversation regarding the application to increase the allocation for areas 2 and 6. We have to wait until the 15 day comment period is over starting from the date of advertising. This will mean that Tuesday 10 June would be earliest we would be able to finalise your application.

Kind Regards

Adam Viskovich
Natural Resource Management Officer
Swan Avon Region
DEPARTMENT OF WATER
Ph: 6250 8086 Fax: 6250 8050

From: Elkington, Amy [<mailto:Amy.Elkington@gatewaywa.com.au>]
Sent: Thursday, 29 May 2014 10:13 AM
To: VISKOVICH Adam
Subject: Gateway WA

Hi Adam,

Thank you for your time this morning. As discussed Gateway is currently undertaking the environmental assessment and approvals for a new road construction project, namely at the Roe Highway/Berkshire Road interchange. In the next few months Gateway will be applying for a licence to take water for construction purposes. It is understood that the application process will need to be followed but initial thoughts from DoW is that obtaining a licence will likely be achievable. Please let me know is I have this incorrect.

Thank you

Amy

Amy Elkington
Environmental Scientist



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