APPENDIX 14

Perth Airport Rail Link – Acid Sulfate Soil Sampling and Analysis Plan (GHD, 2014a)

Included as a separate hard copy report

Public Transport Authority

Perth Airport Rail Link

Acid Sulfate Soil Sampling and Analysis Plan

April 2014

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1. Introduction

1.1 Background Information

GHD Pty Ltd (GHD) was commissioned by the Public Transport Authority (PTA) to prepare an Acid Sulfate Soil (ASS) Sampling and Analysis Plan (SAP) for the three (3) proposed 'Perth Airport Rail Link' alignments herein referred to as 'the alignments' (Figure 1).

GHD understands that the PTA is currently developing a Project Definition Plan for the Perth Airport Rail Link project to connect the city with the airport. The PTA has identified the requirement to commence investigations to assess the likelihood of ASS being present intersecting the alignments.

A Preliminary Site investigation (PSI) and ASS Desktop Assessment has previously been produced within the report referenced below:

- GHD (2013a) *Public Transport Authority, Perth Airport Rail Link, Preliminary Site Investigation.* Report Ref: 61/29667/WP/134062.

The ASS desktop assessment has been reproduced within Section 3 to assist with the preparation and justification of this SAP.

For the purposes of efficiency, it is proposed that this Sampling Analysis Plan (SAP) be submitted to the Department of Environment Regulation (DER) for review and approval prior to any field investigations being undertaken.

The PTA has advised that construction plans are unlikely to be available prior to the implementation of the SAP. This SAP document provides a proposed sampling program for each alignment option. The three (3) station locations were not accurately defined during the preparation of this SAP, however an allowance has been made within the SAP to undertake preliminary ASS investigations.

Once the required construction details have been confirmed, the SAP should be refined as excavations may not be required along certain areas of alignment or additional excavation may be considered necessary as design progresses.

1.2 Proposed Development

Growth of aviation services into and from Perth Airport has created the need to address the transportation demands. This has been recognised by the state and federal governments and Perth Airport Pty Ltd (PAPL). Construction of a rail line connecting Perth city to the airport is an option which the state government is exploring to improve transportation links and cater for the predicted future demand.

The PTA has developed three (3) alignment options for the western half of the Perth Airport Rail Link. All three (3) alignments merge as they enter Perth Airport and then follow a single tunnel alignment to a terminus adjacent to Dundas Road in High Wycombe. A brief description of each option is provided below.

- *Surface option 1:* A combination of elevated structures, at grade and subterranean, sections of rail. Features unique to this alignment option are elevated structures at both the Tonkin Highway/Guildford Road and Tonkin Highway/Great Eastern Highway intersections and a cut and cover tunnel structure along Brearley Avenue;
- *Surface option 2*: A combination of at grade and subterranean sections of rail. Features unique to this alignment option are cut and cover tunnel structures at the

intersections of Tonkin Highway/Guildford Road, Tonkin Highway/Great Eastern Highway and Tonkin Highway/Stanton Road; and

- *Tunnel option:* This option is a bored tunnel for the entire length of the alignment approximately 9km.

In additional to the above options, three (3) locations have been proposed for the construction of stations including:

- Airport West Station, located within the Airport grounds to the west;
- Airport Station, located at the centre of the Airport; and
- High Wycombe Station, located at the eastern extent of the alignment.

The Sampling and Analysis Plan (SAP) is proceeding ahead of finalising the alignment route and work packages would be unlikely to have been prepared for each stage of the construction. A brief description of the construction methodology associated with both bored tunnels and cut and cover tunnel structures is provided below.

1.2.1 Bored Tunnel

Bored tunnels will be constructed using a tunnel boring machine (TBM). TBMs are commonly used to construct road and railway tunnels where access to the surface is not possible, such as dense urban areas, rivers, hills and mountains and airports. The TBM starts and terminates from a concrete box structure that is excavated to the required depth, nominally 15 m below ground level (bgl). The TBM will excavate and line a circular shaped tunnel 6.7 m in diameter. The top of the tunnel is approximately 7 m bgl and the base is approximately 14 m bgl. Limited dewatering is required to facilitate construction of the concrete box structures used for launching and retrieving the TBM.

1.2.2 Cut and Cover Tunnel

Cut and cover tunnels have a rectangular box shape and are constructed from the ground surface using a 'top down' methodology. The 'top down' construction process consists of first digging deep trenches in the ground and filling them with concrete walls. After the walls are constructed, the tunnel roof slab is built from precast concrete planks laid between the walls. The soil is then excavated from below the roof slab down to the base level. This construction method requires dewatering to facilitate construction.

1.3 Purpose of the Report

The aim of the SAP is to develop a sampling rationale in consultation with the DER guidelines which will address ASS issues identified in the ASS desktop assessment within the PSI document.

1.4 Objectives

The objectives of this ASS SAP are to determine:

- Identify potential risks associated with development of the site with respect to ASS; and
- Prepare a SAP for future intrusive works based on the findings of the desktop assessment.

1.5 Scope of Works

The proposed scope of works is outlined below:

- Review of the proposed development in relation to the potential for ASS disturbance during or after construction;
- Review and utilisation of ASS desktop assessment information in terms of topography, geology, hydrology, hydrogeology and sensitive receptors;
- Preparation of a SAP in consultation with the DEC ASS Guideline Series*:* *Identification and investigation of Acid Sulfate Soils and Acidic Landscapes* (2013).

The preparation of this SAP document is considered to be part of an overall staged approach for the proposed alignment. The staged approach is outlined below and this document is considered to complete Phase 2.

Phase 1: Completion of Desktop Assessment (completed as part of the initial Preliminary Site Investigation (PSI)).

Phase 2: Completion of ASS SAP.

Phase 3: Implementation of SAP and completion of ASS investigation.

Note: Additional phases of investigation may be required or recommended following a review of design development and the results of the initial ASS investigation. Additional phases would seek to further characterise and map lithological units that may be disturbed and are considered ASS in accordance with DER criteria.

Phase 4: Preparation of an over-arching project ASSMP.

1.6 Scope and Limitations

This report has been prepared by GHD for Public Transport Authority and may only be used and relied on by Public Transport Authority for the purpose agreed between GHD and the Public Transport Authority as set out in section 1.5 of this report.

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

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

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

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

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

The opinions, conclusions and any recommendations in this report are based on information obtained from the PSI (including the site inspection). Conditions at other parts (non-publicly or not physically accessible) of the alignments may be different from the conditions found at the publicly or physically accessible areas inspected.

Investigations undertaken in respect of this report are constrained by the particular conditions, such as the location of buildings, services and vegetation. As a result, not all relevant features and conditions may have been identified in this report.

Conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the conditions. GHD is also not responsible for updating this report if the conditions change.

2. Introduction to ASS

2.1 Background on Acid Sulfate Soil

The classification of ASS includes both actual acid sulfate soils (AASS) and potential acid sulfate soils (PASS). AASS are soils that generate acidity, whereas PASS are soils that have the potential to generate acidity.

ASS are soils containing naturally-occurring, fine-grained metal sulfides typically pyrite (FeS_2), formed under saturated, anoxic/reducing conditions. They generally occur in Quaternary (1.8 Ma – Present) marine or estuarine sediments, predominantly confined to coastal lowlands (elevations generally below 5 m Australian Height Datum (AHD)). Within these sediments, the majority of soils that present an environmental risk are generally confined to Holocene aged material (<10 000 years). Where these materials have oxidised, they commonly have a mottled appearance (orange and yellow discolouration) due to the presence of oxidised iron minerals.

Although soils described above represent typical conditions where ASS occurs, the presence of ASS materials is not limited to these soil types. In Western Australia, ASS materials have been identified in other soil types such as leached sands and silts. Accordingly, for areas where no data is available and the site conditions (e.g. geology, topography and hydrology) indicate the potential presence of ASS, the extent of ASS materials should be established through field investigations.

2.2 Potential Risks of Acid Sulfate Soil

When PASS are disturbed, either by excavation or lowering of the watertable below natural seasonal levels, sulfides present are exposed to air, allowing oxidisation and consequently, the formation of sulfuric acid (H_2SO_4). AASS are capable of generating acidity in-situ in their natural state; disturbance is not required for acidic discharges to develop.

As a result of the presence of AASS, or the oxidation of PASS, surrounding land (soil) and nearby waterways may become acidic ($pH<6.5$). Under acidic conditions, metals such as aluminium (generally at $pH<4.5$) and iron, as well as trace heavy metals (including arsenic), become more mobile in the environment and can be taken up by infiltrating waters. As a result, surface and/or groundwater concentrations of these metals may reach concentrations which have the potential to cause acute or chronic toxicity to sensitive terrestrial and aquatic plants and animals.

Acidic conditions generated by ASS can also corrode concrete and steel (pipes, bridge abutments, underground services, and other infrastructure) and can result in the rapid deterioration of asphalt surfaces where they overlie AASS or PASS.

Disturbance of ASS impacted areas may release hydrogen sulfide gas which typically settles within confined spaces and excavations such as trenches and/or depressions. Hydrogen sulfide gas has the potential to reach toxic levels and appropriate occupational health and safety measures may require to be implemented within areas of depressions and/ or during excavation of confined spaces.

2.3 Management of Acid Sulfate Soil

Avoiding or minimising disturbance of ASS are the primary methods of management. Where avoiding disturbance is not possible, management techniques available for ASS can include:

- Chemical neutralisation (use of pure fine agricultural lime (AgLime) or a similar neutralising agent);

- Anoxic storage or placement of PASS below the water table and beneath clean non-ASS fill; and
- Hydraulic separation of pyrite from the soil (high maintenance process suitable for coarse grained sediment).

The addition of agricultural lime is the most common amelioration technique applied to acidic soils, where mechanical mixing is completed by plough or excavator to provide adequate homogeneity of the soil/sediment-lime mix.

2.4 Legislative Requirements in Western Australia

The following applies to the site for works involving ASS.

2.4.1 Western Australian Planning Bulletin 64

Planning Bulletin 64/2009 (PB 64/09) published by the Western Australian Planning Commission, aims to provide advice and guidance on matters that should be taken into account in the rezoning, subdivision and development of land containing acid sulfate soils. PB 64/09 requires the identification, assessment and management of soils where:

- The surface elevation is ≤ 5m AHD, and it is proposed to excavate ≥ 100m^3 of soil;
- Where the surface elevation is ≥ 5m AHD, and it is proposed to excavate ≥ 100m^3, and the excavation depth is ≥ 2m; or
- Where any dewatering works are to be undertaken.

2.4.2 Environmental Protection Act 1986

The Environmental Protection Act 1986 (EP Act 1986) provides for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing.

To prevent environmental harm, the act established under Section 50A, states that, A person who –

(a) causes serious environmental harm; or

(b) allows serious environmental harm to be caused, commits an offence.

Accordingly, all parties to a development must show that the environmental risk associated with the development has been assessed and minimised where possible.

2.5 Acid Sulfate Soil Guidance Documents

The following scope of works is proposed to be undertaken in consultation with the DER (formerly Department of Environment and Conservation (DEC)) and in accordance (where applicable) with the following guidelines.

- Department of Water, Water Quality Protection Note 13, *Dewatering of soils at construction sites* (November 2012).
- Swan River Trust, *Policy SRT/DE6, Dewatering* (August 2001).
- Western Australian Planning Commission, Planning Bulletin 64/2009*, Acid Sulfate Soils* (WAPC, 2009).
- DEC Acid Sulfate Soil Guideline Series - *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC, 2013).

- DEC Acid Sulfate Soil Guideline Series - *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes* (DEC, 2011).
- *Dewatering Effluent and Groundwater Monitoring Guidance for Acid Sulfate Soil Areas* (DEC, June 2006).

3. Acid Sulfate Soil Desktop Assessment

The ASS assessment for the proposed alignments has been divided into ASS risk areas based upon the ASS risk mapping classifications, which is considered consistent with geological mapping for the alignments. Accordingly, the alignments have been separated into five (5) ASS assessment areas, taking into account the three (3) design options for the route and accounting for a 100 m Study Area. The ASS areas are identified within Table 1 and depicted on Figure 1.

The desktop assessment below is undertaken from publically available information at the time of writing and the preponderance of information is based upon superficial geological deposits rather than surficial information.

3.1.1 Acid Sulfate Soil Risk Mapping

A review of the DER ASS risk mapping available through the Landgate Shared Information Portal (SLIP) and the Australian Soil Resources Information System (ASRIS) was undertaken in August 2013.

The DER risk mapping indicates that the alignments traverse various areas of ASS risk along the proposed Perth Airport Rail Link alignments. A summary of the ASS risk zones are presented as Table 1 and the ASS risk mapping is depicted on Figure 2.

Table 1 Summary of ASS risk zones in accordance with ASS risk mapping

ASS sub-area	Location	ASS risk mapping	Lithological description
ASS-Area 1	North of Swan River	Class 1: High to moderate and Class 2: Moderate to low	Sm_1 – Alluvium (Qha), SILTY SAND Ms_4 - Alluvium (Qha) SANDY SILT S_8 – Bassendean Sand (Qpb), SAND
ASS-Area 2	Swan River Zone	Class 1: High to moderate	Ms_4 - Alluvium (Qha) SANDY SILT
ASS-Area 3	South of Swan River and PAPL land	Class 2: Moderate to low	S_8 – Bassendean Sand (Qpb), SAND S_{10} – Bassendean Sand over Guildford Formation
ASS-Area 4	East of airport	No known risk classification	Mgs_1 – Guildford Formation (Qpa), PEBBLY SILT
ASS-Area 5	East airport extents	Class 2: Moderate to low	S_{10} – Bassendean Sand over Guildford Formation

ASS = acid sulfate soils, PAPL = Perth Airport Pty Ltd

Acid sulfate soil risk mapping classifications

Class 1: *High to moderate risk of ASS occurring within 3 m of natural soil surface.*

Class 2: *Moderate to low risk of ASS occurring within 3 m of natural soil surface but high to moderate risk of ASS beyond 3 m of natural soil surface.*

The '*no known ASS risk'* area located east of the airport indicates that this risk category has not been assessed due to the absence of suitable geological and geochemical information (i.e. the DER has not collected and validated samples within these locations).

3.1.2 Acid Sulfate Soil and Geological Mapping

The ASS risk mapping designations are considered consistent with the geological information provided in Table 1 and discussed with Section 3.1.1. The geological mapping is depicted on Figure 3.

Typically '*high to moderate'* risk classification is consistent with alluvium deposits associated with the Swan River. Additional '*high to moderate'* risk areas are located within approximately 500 m of the proposed route options and considered to be attributed to the accumulation of peaty wetlands typically associated with low-lying areas.

The '*moderate to low'* classifications are consistent with the Bassendean Dune System (BDS) and the Bassendean Sands underlain by Guildford Formation. Bassendean Sands are typically dominated by quartz sands with clay content typically less than 5% and therefore have a naturally poor buffering capacity. Additionally, variably cemented iron and/or organic rich sands (coffee rock) is likely to be present along the proposed routes. Coffee rock forms by the precipitation of humates and iron from groundwater, mainly within the zone of groundwater fluctuation. Coffee rock is considered to be a source of stored potential acidity.

3.1.3 Acid sulfate soil and historical aerial information

Historical aerial images may provide information on historical wetland areas or swales that may have been historically in-filled and therefore not registered as ASS risk areas. Historical aerial photos for the proposed route were obtained as part of the PSI review. The aerial photographs provided have been utilised to identify further areas of potential ASS risk and assist in defining the future ASS section of the SAP. Table 2 and Figure 2 identifies the historical aerial photograph and any relevant information in regards to ASS.

Table 2 Historical Aerial ASS Assessment

Aerial photo year	ASS sub-area	Location	ASS risk mapping	Additional comments
1953	ASS-area 3	South of Swan River and PAPL land	Class 2: Moderate to low classification	Additional wetland areas are noted within close proximity to the airport runway and are likely to be associated with the superficial formation.

ASS = acid sulfate soils, PAPL = Perth Airport Pty Ltd

3.1.4 Acid Sulfate Soil and Vegetation Communities

A separate environmental investigation including flora and fauna survey has been conducted by GHD (GHD 2013b) of the proposed route. The report outlines that the majority of the study area outside of the Perth Airport boundary has been highly disturbed and includes areas of roadside (alongside Tonkin Highway and Dundas Road), housing and open space'. The proposed route crosses the Swan River (Tonkin Highway) and the '*vegetation within this area has been cleared or modified, with areas of revegetation with native and non-native species, especially along Tonkin Highway. Patches of remnant vegetation were observed at the west boundary with the Perth Airport and in the extreme east of the study area. The over- and midstorey of these areas was mostly intact while the understorey was often dominated by introduced species'*.

In consideration to the environmental investigation report, vegetation communities are considered to be highly disturbed and not considered a key factor to assess ASS. Swamp tolerant species located towards the far eastern portion (ASS-Area 4 and ASS-Area 5) of the route however should be considered as a factor to determine the likelihood of the presence of ASS within this area and included during the SAP design.

3.1.5 Summary of Acid Sulfate Soil Review

The proposed route options transverse various ASS risk mapping classifications including '*high to moderate', 'moderate to low'* and '*no known risk of ASS'*. The majority of the route is located within an area of ‘*moderate to low risk*’ and is associated with the BDS. Typically ASS risk mapping is consistent with geological mapping information. Additionally areas considered to be in-filled historical wetland areas and/or swales were identified in the historically photographs which may require to be included within a future SAP (subject to access).

4. Results of the Desktop Assessment

4.1 Introduction

Given the linear nature of the disturbance, the alignments were assessed in terms of geological conditions to identify locations with potential ASS risks associated along its length. It is noted that construction designs and associated depth of disturbance have not been finalised. It is considered that the majority of disturbance (excavation and/or dewatering) will be undertaken within the superficial deposits. The PTA advises that tunnelling will have a negligible requirement for dewatering and therefore ASS disturbance is limited to the disposal of the excavated muck and the portal. On this basis the risk assessment categories are based upon the superficial deposits at this time.

The GHD ASS risk assessment and proposed sampling regime is presented in Table 3.

4.1.1 Geology

Geology has been used as the primary indicator of potential ASS risk. The alignment is generally characterised by superficial deposits of Bassendean Sands overlying Guildford Formation and alluvial deposits associated with the Swan River overlying surficial formations comprising siltstone, shale, sandstone of the Osborne Formation and localised areas of calcareous sandstone/ limestone of the Ascot Formation. Minor deposits that are noted and may be encountered include peaty material associated with low lying areas and historical geomorphic wetlands.

Much of the published geological information is likely to be based on historical information obtained during drilling programs, topography and interpolated information, a high level of inference is likely to have been employed. As a result care should be taken when interpreting data from these maps as although discrete boundaries are shown between strata, this may not be evident in the field. In addition it would be very difficult even in the field to accurately differentiate boundaries for alluvium and general sandy deposits (eluvial/eolian) from each other.

4.1.2 Topography

Slight undulations of ground level along the alignments can be noted north of the Swan River, with ground levels generally between RL+7 mAHD and RL+13 mAHD. Ground levels in the Swan River have been noted as low as RL-3 mAHD. South of the river, slight undulations likely due to road construction are evident. Thereafter, ground levels gradually increase from RL+9 mAHD to RL+29 mAHD towards the eastern extents.

4.1.3 Hydrogeology

The Department of Water (DoW) Perth Groundwater Atlas (2004) presents an estimate of the maximum groundwater level along the proposed alignments. North of the Swan River, these maximum levels are between RL+5 to +7 mAHD, becoming RL+11 mAHD near Bayswater Station. Groundwater levels tend towards RL+0 mAHD with increasing proximity to the Swan River. Groundwater contours are depicted within Figure 3.

Perched groundwater may occur at higher elevations within the soil profile above interbedded low permeability clayey soil layers or, seasonally, above indurated sand (coffee rock).

4.1.4 Risk Assessment Categories

Superficial Deposits

GHD considers that there are two (2) principal superficial geological units that appear to pose a significant potential ASS risk;

- Alluvium including silty sand (Sm_1), sandy silt (Ms_4) which is classified as moderate/high risk,
- Bassendean Sand including S_8 and S_{10} which is classified as moderate/low risk. These geological units were identified predominately throughout the alignment.

The following risks classifications have been adopted by GHD given the nature of the geology and the accuracy of the mapping:

High to moderate risk: Areas with this classification comprise significant quantities of strata that are known to pose significant potential ASS risks. Examples from the site include large areas of superficial deposits such as alluvium deposits located north of the river and within Swan River floodplain.

Low to moderate risk: Areas with this classification are comprised mostly of moderate risk strata (S_8), along with limited areas of strata that are known to pose a lower potential ASS risk (for example thin veneers of Bassendean Sand overlying Guildford Formation, S_{10}). Strata within these areas may contain AASS. Examples from the site include areas south of the floodplain extents and the PAPL land.

Low-no risk: Areas with this classification comprise strata that are not known to normally pose significant ASS risks. Examples from the site include Guildford Formation located to the east of the airport.

It is anticipated that due to the inter-fingering of superficial geology particularly the Bassendean Sand and Guildford Formation changes may occur with a high frequency across the alignment making it unpractical to assign risk rankings to every change in strata. As a result risk rankings and geology were summarised over areas where similar conditions dominated.

It should be noted that in the sampling and analysis plan, sampling will be targeted with specific reference to these geological units.

Surficial Formations

GHD considers that the superficial geological nature of the Osborne Formation appear to pose a significant potential ASS risk during tunnelling and construction of significant infrastructure such as bridges and stations.

The Osborne Formation is described as a shallow-marine origin and, as redefined, consists of a basal, weakly consolidated, comparatively thick sandstone section, a middle siltstone-shale sequence and an upper sandstone-shale sequence (Davidson, 1995).

Preliminary geotechnical investigations (GHD 2013c) indicate the soils of the Osborne Formation were observed to be dark green-grey mottled pale grey, glauconitic sandy silt to silty sand of low plasticity indicating the sequence is likely to contain pyrite due to the nature and formation of shale and reducing conditions within marine environments.

4.2 Summary

In general, the findings are as follows:

- ASS risk mapping is presented in Figure 2;

- Topography ranging from RL +7m AHD to RL +13m AHD north of the Swan River and south of the Swan River topography ranges from RL+9 m AHD to RL+29 m AHD , the Swan River has been noted as low as RL-3 m AHD.
- Groundwater levels along the proposed alignments range from between RL+5 to +7 m AHD for North of the Swan River increasing to RL+11 mAHD near Bayswater Station. Groundwater levels tend towards RL+0 m AHD with increasing proximity to the Swan River.
- Geological units varied along the alignment, high risk materials identified were mainly associated with alluvium and moderate risk with colluvium.
- Areas of cut and fill are dependent upon the proposed development option; however it is anticipated that soil disturbance is likely to be minimal in areas of fill and so ASS related risks are consequently not considered to be significant. Areas of cut have a high likelihood of soil disturbance and so ASS risks in these areas are considered to be possible.

Based on the proposed works, it is considered that a moderate to low ASS risk is prevalent along the majority of the main alignment. However, high risk areas (predominantly associated with alluvium) were identified at several locations of the alignment.

Table 3 GHD Acid Sulfate Soil Risk Assessment and Sampling Regime

Location	Proposed Construction Scenario	ASS Risk Mapping A review of ASS risk mapping (WAPC, 2009) indicates the following:	Geological/Soil Setting and Topography [1]	Hydrological/ Hydrogeological Setting	Sensitive Environmental Receptors	GHD ASS Risk Category	Sampling Programme
Commencement of alignment to Guildford Road/ Tonkin Highway Intersection	Design Option 1: Disturbance typically less than 1m along alignment. Design Option 2: Disturbance typically less than 1m along alignment. Design Option 3: Typically less than 1m disturbance prior to tunnel.	Class 1: High to moderate and Class 2: Moderate to low	Sm$_1$ – Alluvium (Qha), SILTY SAND Ms$_4$ - Alluvium (Qha) SANDY SILT S$_8$ – Bassendean Sand (Qpb), SAND Topographical mapping indicates that the area is generally undulating with topography ranging from 7 to 13 m AHD.	Depth to water anticipated to range from 1 m bgl to 6 m bgl.	Swan River within 800m at nearest point.	Low	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Sampling location intervals 200m along alignment.
Guildford Road/Tonkin Highway Intersection	Design Option 1: Elevated* structures above ground level. Design Option 2: Subterranean structures below ground level. Design Option 3: Tunnel option discussed within tunnel section below.	Class 1: High to moderate and Class 2: Moderate to low.	Ms4 - Alluvium (Qha) SANDY SILT S8 – Bassendean Sand (Qpb), SAND Topographical mapping indicates that the area is generally undulating with topography ranging from 7 to 13 m AHD.	Depth to water anticipated to range from 1 m bgl to 4 m bgl for Guildford Road/Tonkin Highway Intersection.	Swan River within 800m at nearest point.	Moderate - High	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Option 1: Minimum of four (4) sampling locations; two (2) sampling locations on either side of the support structures required. Depth of foundations and construction type to be discussed prior to investigation. Areas where disturbance >1m bgl for earth working purposes along the alignment investigated at 125m intervals. Option 2: Sampling location Intervals 125m along alignment.
South Tonkin Highway Intersection to South of Swan River.	Design Option 1: Elevated* structures above ground level Design Option 2: Elevated* structures above ground level. Design Option 3: Tunnel option discussed within tunnel section below.	Class 1: High to moderate	Ms4 - Alluvium (Qha) SANDY SILT Sm$_1$ – Alluvium (Qha), SILTY SAND S8 – Bassendean Sand (Qpb), SAND Topographical mapping indicates that the area is generally undulating with topography ranging from 7 to -3 m AHD.	Depth to water anticipated to range from approximately surface (Swan River) to 1 m bgl.	Swan River within immediate vicinity.	Moderate – High	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Option 1 and 2: Minimum of four (4) sampling locations; two (2) sampling locations on either side of the support structures required. Depth of foundations and construction type to be discussed prior to investigation. Areas where disturbance >1m bgl for earth working purposes along the alignment investigated at 100m intervals due to the vicinity of the Swan River.

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[1] Abstracted from the Geological Survey of Western Australia Environmental Geology Series Maps.

* Elevated structure foundations and design information not available at time of writing.

Table 3 GHD Acid Sulfate Soil Risk Assessment and Sampling Regime

Location	Proposed Construction Scenario	ASS Risk Mapping A review of ASS risk mapping (WAPC, 2009) indicates the following:	Geological/Soil Setting and Topography [2]	Hydrological/ Hydrogeological Setting	Sensitive Environmental Receptors	GHD ASS Risk Category	Sampling Programme
Tonkin Highway / Great Eastern Highway Intersection	Design Option 1: Elevated* structures above ground level.	Class 2: Moderate to low	S8 – Bassendean Sand (Qpb), SAND S10 – Bassendean Sand over Guildford Formation Topographical mapping indicates that the area is generally undulating with topography ranging from 9 to 29 m AHD.	Depth to water anticipated to range from approximately 1 m bgl to 4 m bgl. Perched groundwater table is likely to be present within sandy lenses.	Swan River within immediate vicinity at nearest point.	Moderate – High	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Option 1: Minimum of four (4) sampling locations; two (2) sampling locations on either side of the support structures required. Depth of foundations and construction type to be discussed prior to investigation. Areas where disturbance >1m bgl for earth working purposes along the alignment investigated at 125m intervals. Option 2: Sampling location Intervals 125m along alignment
	Design Option 2: Subterranean structures below ground level.						
	Design Option 3: Tunnel option discussed within tunnel section below.						
South of Swan River and PAPL land to Airport tunnel merge point	Design Option 1: Subterranean structures below ground level.	Class 2: Moderate to low	S8 – Bassendean Sand (Qpb), SAND S10 – Bassendean Sand over Guildford Formation Topographical mapping indicates that the area is generally undulating with topography ranging from 9 to 29 m AHD.	Depth to water anticipated to range from approximately 4 m bgl to 10 m bgl. Perched groundwater table is likely to be present within sandy lenses.	Swan River located 700m at nearest point to >1km.	Low – Moderate	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Option 1 and 2: Sampling location Intervals 150m along alignment. Maximum depth of disturbance anticipated 12m bgl (Option 2).
	Design Option 2: Subterranean structures below ground level.						
	Design Option 3: Tunnel option discussed within tunnel section below.						
Airport Tunnel	All Options merge to a tunnel alignment through the Airport to a terminus adjacent to Dundas Road in High Wycombe.	Class 2: Moderate to low and No known risk of ASS occurrence from 3 m of the natural soil surface within far east extents.	S8 – Bassendean Sand (Qpb), SAND S10 – Bassendean Sand over Guildford Formation Mgs1 – Guildford Formation (Qpa), PEBBLY SILT Topographical mapping indicates that the area is generally undulating with topography ranging from 9 to 29 m AHD.	Depth to water anticipated to range from approximately 15 m bgl to 16 m bgl. Perched groundwater table is likely to be present within sandy lenses.	Swamp tolerant, native species. Conservation wetland located immediate vicinity to north. Swan River located approximately 4km to west	Low	Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Sampling location Intervals 250m (subject to access restraints). Maximum depth of disturbance anticipated 30m bgl. Discussions with PTA have indicated that no disturbance from the surface to 7m bgl will be undertaken during construction of the tunnel (exception of portal locations). As a conservative approach, sampling +/- 1m above and below the tunnel should be undertaken. Sampling should also be adjusted to account for the 'muck out' zone. Dewatering is not considered to be required during tunnelling. Dewatering is likely to be required within portal locations.

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[2] Abstracted from the Geological Survey of Western Australia Environmental Geology Series Maps.

* Elevated structure foundations and design information not available at time of writing.

Location	Proposed Construction Scenario	ASS Risk Mapping A review of ASS risk mapping (WAPC, 2009) indicates the following:	Geological/Soil Setting and Topography [3]	Hydrological/ Hydrogeological Setting	Sensitive Environmental Receptors	GHD ASS Risk Category	Sampling Programme
East Airport Extents (High Wycombe Station)	All Options: Terminus adjacent to Dundas Road in High Wycombe.	Class 2: Moderate to low	S_{10} – Bassendean Sand over Guildford Formation Topographical mapping indicates that the area is generally undulating with topography ranging from 9 to 29 m AHD.	Depth to water anticipated to range from approximately 9 m bgl to 15 m bgl. Perched groundwater table is likely to be present within sandy lenses.	Swamp tolerant, native species. Conservation wetland located >1km to north west. Swan River located >5km to west	Low – Moderate	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Option 1: Minimum of four (4) sampling locations; two (2) sampling locations on either side of the support structures required. Depth of foundations and construction type to be discussed prior to investigation. Areas where disturbance >1m bgl for earth working purposes and for station locations to be investigated at 150m intervals.
Airport Stations	Airport West and Airport Terminal Stations.	Class 2: Moderate to low	S8 – Bassendean Sand (Qpb), SAND S10 – Bassendean Sand over Guildford Formation	Depth to water anticipated to range from approximately 15 m bgl to 16 m bgl. Perched groundwater table is likely to be present within sandy lenses.	-	Low -Moderate	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Areas where disturbance >1m bgl for earth working purposes and for station locations to be investigated at 150m intervals.
Design Option 3	Tunnel construction entire alignment. Tunnel proposed between 1.8m bgl (start) and 28.8m bgl (Swan River). Tunnel would combine with proposed tunnel beneath airport.	Class 1: High to moderate and Class 2: Moderate to low.	S8 – Bassendean Sand (Qpb), SAND S10 – Bassendean Sand over Guildford Formation Sm1 – Alluvium (Qha), SILTY SAND Ms4 - Alluvium (Qha) SANDY SILT	Depth to water anticipated to range from approximately surface to 16 m bgl. Perched groundwater table is likely to be present within sandy lenses.	Swan River located within vicinity of tunnel route.	Low	All options: Sampling frequencies at 0.25m intervals through profile to 1m below depth of disturbance. Maximum depth of disturbance anticipated 30m bgl. Discussions with PTA have indicated that no disturbance from the surface to 7m bgl will be undertaken during construction of the tunnel (exception of portal locations). As a conservative approach, sampling +/- 1m above and below the tunnel should be undertaken. Sampling should also be adjusted to account for the 'muck out' zone. Dewatering is not considered to be required during tunnelling. Dewatering is likely to be required within portal locations. Sampling location Intervals 250m (subject to access restraints). Sampling densities for tunnel option may be reduced provided significant geotechnical data in terms of lithological characterisation is obtained.

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[3] Abstracted from the Geological Survey of Western Australia Environmental Geology Series Maps.

* Elevated structure foundations and design information not available at time of writing.

5. Soil Sampling Rationale

Based on the information provided in this report, the presence of ASS materials within the alignments is highly likely. In order to assess the potential presence and distribution of ASS materials at the Site, it is recommended that a targeted intrusive field investigation be undertaken.

At the time of preparation, the construction methodology for the site has not been finalised; however preliminary cut and fill depth estimates have been provided by PTA, which GHD has used as part of this assessment.

It should be noted that the sampling locations are subject to revision once the construction methodology is finalised. If construction of the alignment does not require excavation along various chainages, investigation in these areas may not be required. Accordingly, sampling locations may also be altered once construction methodology has been defined.

Once the detailed field investigations are completed, appropriate management strategies can be prepared as required.

Landowner and Aboriginal heritage issues have not been assessed by GHD. It is assumed that sampling will not be impacted by these issues however this will need to be confirmed once the SAP is further refined. If required, consideration will be given as to how landowner and Aboriginal heritage issues may impact sampling locations.

5.1 Soil Investigation

It is proposed that soil bores will be investigated utilising either a Geoprobe Direct Push Probe where this is possible.

Two (2) environmental scientists will undertake the fieldwork and sampling regime. At least one (1) environmental scientist should be qualified and hold at least 3 years' experience in ASS.

All soil sample locations will be recorded on a hand held GPS unit and drill logs with lithological descriptions in accordance with Australian Standard (AS) 1726 (1993) will be prepared for the sampling locations and will be included in the final report.

The soil investigation will be undertaken with reference to the guidance documents within Section 2.5.

5.1.1 Sampling Densities

As stipulated in the DEC ASS Guideline Series: *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (March, 2013), sampling should be undertaken at 50 m intervals for major linear disturbances (including roads and rail). However, for extensive infrastructure works, the DER may consider a reduced sampling programme.

Additionally comprehensive geological information is currently being collated from additional investigations including geotechnical and contamination assessments. It is considered that this additional information can be utilised to extensively map the subsurface ground conditions and more accurately delineate the lateral and horizontal ASS risk, without extensive sampling location investigations.

GHD have identified moderate to high, low to moderate and low to no risk areas along the alignment. It is proposed that sampling programs will be undertaken as detailed below (where access constraints permit).

The sampling program including sampling intervals and proposed locations are outlined within Table 3 and depicted on the cross sections available for each construction option (Figures 4a to 4d, Figures 5a to 5d and Figures 6a to 6d).

GHD Risk Assessment: Moderate to High Risk Areas

It is proposed that for portions of the alignment in moderate to high risk areas, sampling be undertaken at 100 m intervals for subterranean features and 125m intervals within areas where significant volume of material are proposed to be disturbed (earth worked) within strata identified to be potential high risk with respect to ASS to delineate the extent of ASS risk. Identified high risk materials were mainly associated with alluvium and shallow groundwater.

Bridge and Station Locations

Information provided by PTA (supplemented by this investigation) indicates that bridges and stations will be required for the completion of the alignment. Generally, the construction of bridges and station infrastructure require deep excavations for the installation of footings. As a result, where bridges and stations are proposed the following minimum investigation requirements (dependent on the potential ASS risk) are recommended:

Bridge Infrastructure: Minimum of four (4) sampling locations will be required; two (2) sampling locations on either side of the bridge (at each footing) should be investigated to determine if ASS management measures as required.

Station Infrastructure: Station sampling locations should be determined once designs are finalised, however should concentrate within areas of maximum disturbance such as piling locations.

GHD Risk Assessment: Low to Moderate Risk Areas

It is proposed for portions of the alignment in low to moderate risk areas, sampling should be undertaken at 150 m intervals within strata identified to be potentially moderate risk with respect to ASS to delineate the ASS risk. Identified moderate risk materials were generally associated with colluvium with variable depths to water.

GHD Risk Assessment: Low to No Risk Areas

Based upon the findings of this preliminary investigation, it is considered that portions of the alignment located in low to negligible risk areas of the occurrence of ASS materials will not require intense sampling regime. Sampling within this area should be undertaken at 250m intervals in consideration of the tunnel option presented and limited disturbance of material. Materials associated with low risk areas generally comprised of pebbly silt from the Guildford Formation.

5.1.2 Field Sample Storage and Handling

ASS samples should be collected and stored in accordance with the DER ASS Guideline Series (2013). Samples taken should conform to the following methodology:

- Soil sample to consist of approximately 200g of material, the actual weight of each sample will vary depending upon the specific gravity of the sample medium.
- Visible shell or carbonate nodules to the naked eye are to be removed from the soil sample in the field.
- ASS sample to be placed within a plastic snap-lock bag (laboratory supplied) and the air extruded immediately to prevent oxidation of the soil as much as possible.

- ASS samples to be immediately placed within an esky^{TM} with ice to chill the samples to at least 4ºC until received by the laboratory.
- ASS samples to be couriered/ delivered to the NATA accredited laboratory at the end of each sampling day. Samples should be analysed within holding times (within 24hrs) for the initial pH screening or frozen. Liaison with the laboratory is recommended to ensure they are prepared and ready for sample deliveries to ensure holding times are met.
- Frozen samples are considered to have an indefinite holding time, samples should be held for a minimum of 3 moths (or DER approval) prior to disposal. Samples may be held for longer periods as requested and negotiated with the laboratory.

5.1.3 Laboratory Analysis

ASS site investigations are intended to assess the extent of naturally occurring soil layers containing sulfide bearing minerals. Field and laboratory analyses of soil samples enable the preliminary identification of ASS as either PASS or AASS.

Samples from locations investigating the tunnel option (Option 3) and groundwater well installations should be collected from the surface throughout the profile and stored for potential future analysis (subject to drilling technique).

Initial Field pH Screening

Sampling should be taken at 0.25m intervals to 1m below the proposed depth of disturbance and from +/- 1m of the tunnelling depth (i.e. 6m to 15m) or where there are changes within strata to ascertain the preliminary acid generating capacity across the soil profile.

All samples collected during the field investigation shall be submitted to a NATA accredited laboratory for screening tests of pH_F and oxidised pH_{FOX} analysis.

The initial field screening will be utilised in the assessment for the presence of ASS prior to the scheduling of the confirmatory analysis being undertaken.

Table 4 Initial pH Screening Criteria

Parameter and trigger level	Indication
$4.0 < pH_F \leq 5.5$	Acidic Soil
$pH_F \leq 4.0$	AASS
$pH_{FOX} < 4.0$	PASS likely
$\Delta pH > 2.0$	PASS likely

Table adopted from Table A1 and A2, DEC (2013).

Chromium Reducible Sulfur Suite

Further confirmatory sampling should be undertaken based on initial field screening results from within each lithological unit which present the ASS indicators in Table 4.

Approximately 25% of initial screening samples should be submitted for CRS suite analysis[4], however if samples indicate homogeneous characteristics throughout the profile then confirmatory analysis can be reduced.

CRS analysis provides an estimation of the soils potential sulfidic acidity. This is achieved through measuring the reduced inorganic sulfur content within a soil sample. CRS is not subject to interference from organic matter or sulfate minerals (as is the case with SPOCAS) and

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[4] CRS suite does not include the calculation of bulk density. It is assumed that relevant bulk density information to assist with liming rate calculations will be gained by the geotechnical investigation.

therefore is considered to provide an accurate estimation of the potential sulfidic acidity potential of a material.

Acid Neutralising Capacity

Further confirmatory analysis should include (where appropriate) the analysis and assessment of ANC values within samples collected. Recent research undertake by Southern Cross Geoscience (Sullivan, et al, 2012) indicate that readily available alkalinity and effective carbonaceous materials may be present within the <0.5mm particle size fraction of unground samples.

It is noted that laboratory methods and sample preparation requires to be altered for this assessment, the laboratory should be contacted prior to receipt of samples.

5.1.4 Acid Sulfate Soil Assessment Criteria

Soil for the presence or absence of ASS will be assessed based on net acidity (acidity units) excluding acid neutralising capacity (ANC) greater than 18.7 mol H+/t indicates ASS. The acid based accounting equation, as outlined in the DEC ASS Guideline Series: *Identification and investigation of Acid Sulfate Soils and Acidic Landscapes* (March, 2013) is:

Net Acidity[5] = Potential Acidity + Existing Acidity – Acid Neutralising Capacity[6]

The trigger levels for net acidity based soil texture are outlined in the DEC ASS Guidelines Series: *Treatment and Management of Soils and Water in Acid Sulfate Soils Landscapes* (2011) and are presented in Table 5.

Furthermore, a field pH_{fox} < 3 alone is an indicator of potential ASS in the Bassendean Sands (DEC 2013).

Based on the quantities of material likely to be excavated during the construction phase, it is anticipated that the 0.03%S (equivalent 18.7 mol H^+/tonne) Action Criteria will be applied to the site operations.

Table 5 Action Criteria based on Net Acidity for Three Texture Categories

Soil Texture	Clay Content (%)	< 1,000 Tonnes Disturbed		> 1,000 Tonnes Disturbed	
		% S	mol H^+/tonne	% S	mol H^+/tonne
Coarse (sands – gravels)	< 5	0.03	18.7	0.03	18.7
Medium (sandy loam – light clay)	5 – 40	0.06	37.4	0.03	18.7
Fine (medium to heavy clays, silty clays)	> 40	0.10	64.8	0.03	18.7

Table adopted from Table 10 (DEC, 2013).

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[5] Net Acidity equation has been extracted from the DEC ASS Guideline Series: *Identification and investigation of Acid Sulfate Soils and Acidic Landscapes* (March, 2013)

[6] Due to particular characteristics of the soil and groundwater regime in Western Australia, DEC does not recognise the validity of ANC values without confirmatory kinetic testing or modified laboratory methods to provide a more accurate estimate of the actual amount of neutralising capacity that would be available under real field conditions.

6. Groundwater Investigation

Groundwater assessments and investigations including the strategic locations of groundwater monitoring bores will be undertaken in consultation with contamination assessments of the alignments and PTA. It is recommended that the Swan River Trust, Department of Water and the DER are included and consulted during this process.

It is noted that due to the scope of the prosed groundwater wells, a license to install groundwater wells is not considered to be required from the Department of Water. Liaison with landowners and regulatory authorities is likely to be required for the installation of groundwater wells. Liaison will be undertaken prior to the installation of groundwater wells and relevant permits will be obtained by the PTA.

Preliminary groundwater will be utilised to collate data and assess the groundwater elevation and groundwater geochemistry of the phreatic surface prior to disturbance (including dewatering) commencing.

6.1 Groundwater Monitoring Well Locations

A preliminary network of groundwater monitoring wells is proposed for the alignment. A total of 19 groundwater wells are proposed to be installed typically 500m apart along the alignment. In consideration to the linear nature of the alignment, the groundwater wells will be located (where practically possible) hydraulically up-gradient and down gradient of proposed construction activities within the 100m Study Area. Furthermore it is noted that conversion of soil bores into groundwater monitoring wells where practically possible should be undertaken. The preliminary network of groundwater monitoring wells is presented in Figure 7.

Further groundwater wells will be required to be strategically located and installed prior to dewatering operations once the construction designs are more clearly defined.

6.2 Groundwater Monitoring Well Installation

Groundwater monitoring well construction will comply with the DER *Development of Sampling and Analysis Programs* Guideline (DEP 2001). Groundwater wells installed will be screened depending on the purpose of the monitoring bore (i.e. monitoring drawdown and/or groundwater quality).

Groundwater monitoring wells will be constructed with the following specifications:

- 50 mm polyvinyl chloride (PVC) Class 18 blank and screened casings;
- Screened casing slots will be no greater than 1 mm in width;
- Solid and screened PVC casing attached using flush mounted factory-threaded joints;
- Primary filter pack material will be a chemically inert material and well rounded, with a high coefficient of uniformity and will extent at least 0.5 m above the screened PVC casing;
- Bentonite pellets will be used as annular sealant and will extend at least 0.5 m above the filter pack; and
- Monitoring wells will be finished either at ground level with trafficable steel covers or with lockable steel risers (where possible) and cement.

6.2.1 Disposal of drill cuttings and water

Drill cuttings, development water, purge water and rinse water will be collected and stored until chemical compositions are known. Appropriate disposal requirements for soil cuttings will be determined based on analytical data obtained for assessment.

In consideration of the ASS investigation scope (parameters analysed do not detect contamination) the nearest contamination soil bore to the location will be utilised to assess the disposal requirements.

6.2.2 Groundwater monitoring well development

Groundwater monitoring wells will be developed using a mechanical pump which will remove at least four well volumes and will continue operation until water is relatively clear when pumped from the well. Well development is required to bring the well to its maximum production capacity. Monitoring well development optimises the well efficiency, specific capacity, stabilisation of aquifer material and control of suspended solids.

The newly installed groundwater monitoring wells will be allowed to stabilise for a minimum of seven days prior to purging and sampling.

6.2.3 Groundwater monitoring well surveying

Surveying of each well location will be undertaken following well installation. This will include surveying of the well locations to northings and eastings (accuracy +/- 30mm) and elevation (accuracy +/- 5mm) of ground surface and top of well casing to Australian Height Datum (AHD).

6.3 Groundwater Sampling Regime

The groundwater sampling regime is presented bellow and is considered to provide information and capture seasonal fluctuations and variations within groundwater chemistry and elevation.

- Groundwater will be monitored seven (7) days after settling and all wells to be appropriately gauged in accordance with *AS/NZS 5667.1 – 1998* (Standards Australia 1998); and
- Groundwater wells to be monitored on a quarterly basis for 12 months, with a review by the PTA after the first 12 months.

6.3.1 Measuring groundwater depths

Groundwater levels will be measured from the groundwater wells using an electronic interface water level meter prior to sampling. Measurements will be recorded on groundwater monitoring forms and included within the ASS investigation report.

The electronic interface water level meter will be cleaned in laboratory grade detergent and triple rinsed prior to use at each well.

6.3.2 Groundwater monitoring well purging

Purging of groundwater monitoring wells is essential to evacuate stagnant water in the well casing prior to sampling and to provide a representative sample of *in-situ* groundwater.

Purging of groundwater monitoring wells will be based on AS/NZS 5667.11 – 1998 (Standards Australia 1998). Field groundwater quality measurements for pH, temperature, oxidation-reduction potential (ORP or Eh), dissolved oxygen (DO), and electrical conductivity (EC) will be taken following each purge well volume to assess stabilisation of the well. Groundwater monitoring wells will be purged with a low-flow pumping technique (less than 1 L/minute) until stabilisation of field parameters has occurred, over three consecutive readings. Field measurements for chemical stabilisation parameters will be achieved using a multi-parameter water quality meter. The water quality meter will be calibrated by the supplier, prior to obtaining field measurements, using the appropriate probe and calibration solution. The calibration certificate will be provided in the subsequent investigation report.

The variance associated with the above mentioned parameters required to establish chemical stabilisation are as follows:

- pH: 0.1 unit;
- Temperature: 0.2° C;
- Eh (ORP): 10%;
- DO: 10%; and
- EC: 10%.

Field monitoring forms will be completed at each well, noting the general condition of the well, any visual or olfactory signs of groundwater contamination and purging stabilisation results.

Purging of groundwater monitoring wells will be achieved using low-flow pumping techniques. New tubing and new bladders (where required) will be used for each well to eliminate issues arising from cross-contamination through the repeated use of sampling equipment. The pump will be decontaminated following sampling of each well to prevent cross-contamination between wells.

6.3.3 Groundwater monitoring well sampling

Sampling of groundwater monitoring wells will be based on *AS/NZS 5667.1 – 1998* (Standards Australia 1998).

Groundwater samples will be obtained in accordance with *AS/NZS 5667.1 – 1998 water quality sampling – guidance of sampling groundwaters* (Standards Australia 1998). The purged volume and field parameters, showing stabilisation of parameters prior sample collection, will be recorded on field sheets. Samples will be placed into laboratory prepared containers provided by the primary laboratory. Heavy metals samples will be field filtered using a 0.45 micron filter prior to being placed in sample containers. Each sample will be identified by means of a label showing sample location, date and job number. The samples will then be transferred to a chilled esky for sample preservation prior to and during shipment to the testing laboratory.

Disposable nitrile gloves will be worn during sampling and handling of the laboratory prepared containers to ensure that cross-contamination is not introduced to the groundwater samples. The disposable gloves and various field work waste (e.g. paper towels, scrap paper, plastic wrappers) will be collected and disposed to landfill.

Sample details will be entered on to a CoC form that will accompany the samples to the laboratory. All samples will be transported and handled following CoC procedures. A CoC form will be used for every batch of samples submitted to the laboratory. Delivery of samples to the laboratory will comply with analytical extraction holding times.

All field work will be undertaken by an Environmental Scientist trained in sampling contaminated sites. The Environmental Scientist will undertake all groundwater monitoring and record on a groundwater field forms. Field activities will be conducted in accordance with accepted industry protocols for environmental sampling.

6.3.4 Decontamination of sampling equipment

To ensure groundwater samples are collected without the potential presence of cross-contamination, all sampling equipment will be decontaminated in accordance with the procedure and methods described in *AS 4482.1 – 2005* (Standards Australia 2005). In addition, all samples will be handled by field staff using disposable nitrile gloves, which will be replaced between each sampling event.

Groundwater sampling equipment will be decontaminated as follows:

- Washed and scrubbed in tap water;
- Washed and scrubbed in laboratory grade detergent (e.g. Neutracon); and
- Rinsed in distilled or deionised (Grade 3) water.

6.3.5 Groundwater well monitoring suite

Groundwater well samples to be analysed for the following parameters outlined in Table 6 in accordance with the DER ASS Guideline Series (2011) by a NATA accredited laboratory for the analysis below.

Table 6 Baseline Groundwater Laboratory Suite

Parameter	Analyte
Field Parameters	Static Water Level (SWL), pH, electrical conductivity, dissolved oxygen, redox potential and temperature
Misc Parameters	pH (Lab), Total acidity, total alkalinity and total dissolved solids (TDS)
Major Ions	Cations (Ca, Mg, Na, K) and Anions (Cl, SO_4, HCO_3, Fluorine)
Dissolved metals	Al, As, Cd, Cr (III+VI), Fe, Mn, Ni, Se and Zn
Total metals	Al and Fe
Nutrients	Ammonia as N, Total Nitrogen and Total Phosphorous

7. Health and Safety

7.1 Job Safety and Environmental Assessment

An approved job safety and environmental assessment (JSEA) will be prepared for review prior to beginning field work. A Pre-Work Safety Assessment will be completed prior to commencing work on site, which involves reviewing the JSEA against the condition of the work environment on the day of field work. If there are any changes required to the JSEA these will be noted on the Pre-Work Safety Assessment and the job manager will be notified if field staff believe an unacceptable risk has been identified and cannot be managed on-site.

7.2 Service Location

Dial Before You Dig site plans will be obtained to identify any potential services at the locations of the sampling locations. However, it is recognised that this process does not always identify services on private land. We will request that the PTA provide copies of any available site or services survey plans. In addition, it is proposed a suitably qualified underground utilities clearance contractor be engaged to aid in avoiding underground services during intrusive (drilling) works at the locations of all proposed groundwater monitoring wells.

8. Quality Assurance/Quality Control

The quality assurance/quality control (QA/QC) procedures are based on DER's *Development of Sampling and Analysis Programs* guideline (DEP 2001) and AS/NZS 5667.1 – 1998 (Standards Australia 1998), AS/NZS 5667.11 – 1998 (Standards Australia 1998a) and AS 4482.1 - 2005 (Standards Australia 2005).

QA involves all of the actions, procedures, checks and decisions, undertaken to ensure the representativeness and integrity of samples and accuracy and reliability of analytical results (NEPC 1999). QC involves protocols to monitor and measure the effectiveness of QA procedures.

The organisation implementing this SAP should have a Quality Assurance system accredited to the AS/ISO 9001 standard.

8.1 Field program

8.1.1 Field quality assurance procedures

All fieldwork will be conducted with reference to the DER's *Contaminated Sites Management Series* guidelines which ensure all samples are collected by a set of uniform and systematic methods. Key requirements of these procedures are listed below:

- Decontamination procedures – including washing and rinsing of re-useable equipment, the use of new disposable gloves and sampling tubing between each sampling location and the use of sampling containers provided by the laboratory;
- Sample identification procedures - samples are immediately transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers are clearly labelled with a sample number, job number, and sample date. The sample containers are then transferred to a chilled insulated container for sample preservation prior to and during shipment to the analytical laboratory. Samples unable to be analysed within the 24hr period will be frozen to ensure indefinite storage;
- Chain of custody (CoC) information requirements - a CoC form is completed and forwarded to the testing laboratory with the samples; and
- Blind duplicate sample frequency.

8.1.2 Soil and groundwater sampling and analysis quality control

The DER *Development of Sampling and Analysis Programs* (DEP 2001) outlines soil and groundwater QC sampling protocol. The soil and groundwater QC samples to be collected during the investigation (or for each stage of the investigation) are described below.

- Blind duplicate: Blind replicates are used to identify the variation in the analyte concentration between samples from the same sampling point. Blind duplicates will be collected at a sampling rate of one (1) per 20 samples. The primary and duplicate sample should be analysed for CRS regardless of the pH_F and pH_{FOX}.

No further quality control samples are considered to be required in accordance with the DEC (2013).

8.1.3 Relative percentage difference calculations

Blind duplicate samples will be assessed by calculating the relative percentage difference (RPD) between the primary and blind samples.

A quantitative measure of the accuracy of the analytical results reported is made by calculating the RPDs between the primary, blind and split results in accordance with the procedure described in AS 4482.1 – 2005 (Standards Australia 2005). According to AS 4482.1 - 2005 (Standards Australia 2005) typical RPDs are expected to range between 30% and 50%; however, this may be higher for organics and for low concentrations of analytes. GHD uses 50% as the general assessment criteria.

Where a result is reported below the laboratory limit of reporting (LOR) for one of the duplicate pair samples, the sample will be assigned the concentration of the LOR for RPD calculation purposes.

8.2 Laboratory program

8.2.1 Laboratory analytical programs

Laboratory methods used by the laboratory will be suitable for environmental contaminant analysis and are based on established internationally recognised procedures. The laboratory is NATA accredited for the proposed analysis.

Laboratory duplicate samples

Laboratory duplicate sample analysis is the analysis of a laboratory derived duplicate sample from the process batch, at a rate equivalent to one in twenty samples per analytical batch, or one sample per batch if less than twenty samples are analysed in a batch. A laboratory duplicate provides data on the analytical precision and reproducibility of the analytical results.

The permitted ranges for the RPD of laboratory duplicates are dependent on the magnitude of the results in comparison to the level of reporting as shown in Table 6.

Table 7 Permitted laboratory duplicate relative percentage difference (RPD) ranges

Magnitude of result	Permitted RPD range
< 10 x limit of reporting (LOR)	No limits
10 - 20 x LOR	0% - 50%
> 20 x LOR	0% - 20%

Method blank samples

Method or analysis blank sample analysis are the analysis of a sample that is as free as possible of the analytes of interest, but has been prepared the same as the samples under investigation. The analysis is to ascertain if laboratory reagents, glassware and other laboratory consumables contribute to the observed concentration of analytes in the process batch. If below the maximum acceptable method blank (20% of the practical quantitation limit), the contribution is subtracted from the gross analytical signal for each analysis before calculating the sample analyte concentration. The method blank should return analyte concentrations as ‘not detected’.

Laboratory control samples

Laboratory control spike analysis is the analysis of either a reference material or a control matrix fortified with analytes representative of the analyte class. The purpose of laboratory control spike samples is to monitor method precision and accuracy independent of the sample matrix.

Typically, the percentage recovery of the laboratory control spike sample is compared to the dynamic recovery limits based on the statistical analysis of the processed laboratory control spike sample analysis. Laboratory acceptance criteria indicate recoveries must generally lie between 70% and 130%.

Matrix spike samples

Matrix spike sample analysis is the analysis of one or more replicate portions of samples from the batch, after fortifying the additional portion(s) with known quantities of the analyte(s) of interest. The percentage recovery of target analyte(s) from matrix spike samples is used to determine the bias of the method in the specific sample matrix. Recoveries must generally lie between 70% and 130%.

Internal standards

Internal standards are known additions of known amounts of compounds which are not found in real samples, will not interfere with quantification of analytes of interest and may be separately and independently quantified. The purpose of internal standards in instrumental techniques is to provide independent signals, which serve to check the consistency of the analytical step. Internal standards are often used for organic compounds and some inorganic compounds.

9. Reporting

The Acid Sulfate Soil Investigation (ASSI) report will be prepared in accordance with the DEC ASS Guideline Series: *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (2013). The report will contain:

- DER ASS Summary Form A;
- Executive summary;
- Scope of work;
- Site identification;
- Details of development;
- Site History;
- Site conditions and surrounding environment (including potential receptors);
- Description of geological and hydrogeological conditions;
- Compliance and deviation from the SAP;
- Basis for adoption of assessment criteria;
- Results and risk assessment;

  Discussion of groundwater and soil investigation and laboratory test results with respect to relevant assessment criteria;
- Assessment of QA/QC (field and laboratory) program;
- Conclusions and recommendations.

  Appendices will include: field equipment calibration records, relevant photographs, soil lithological logs and well installation logs; CoC information; laboratory certificates of analysis and relevant figures.

In addition to the ASSI, additional management strategies will be outlined within an Acid Sulfate Soil Management Plan (ASSMP). The ASSMP will be completed once construction options have been defined. The ASSMP will be an over-arching document with potentially further ASSMPs completed for each stage of works (e.g. Station construction).

10. References

Australian Soil Resource Information System (2014) ASRIS online: http://www.asris.csiro.au Last accessed February 2014.

DER Acid Sulfate Soil Guideline Series - Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DEC, 2011).

DER ASS Guideline Series*: Identification and investigation of Acid Sulfate Soils and Acidic Landscapes* (2013).

Dewatering Effluent and Groundwater Monitoring Guidance for Acid Sulfate Soil Areas (DEC, June 2006).

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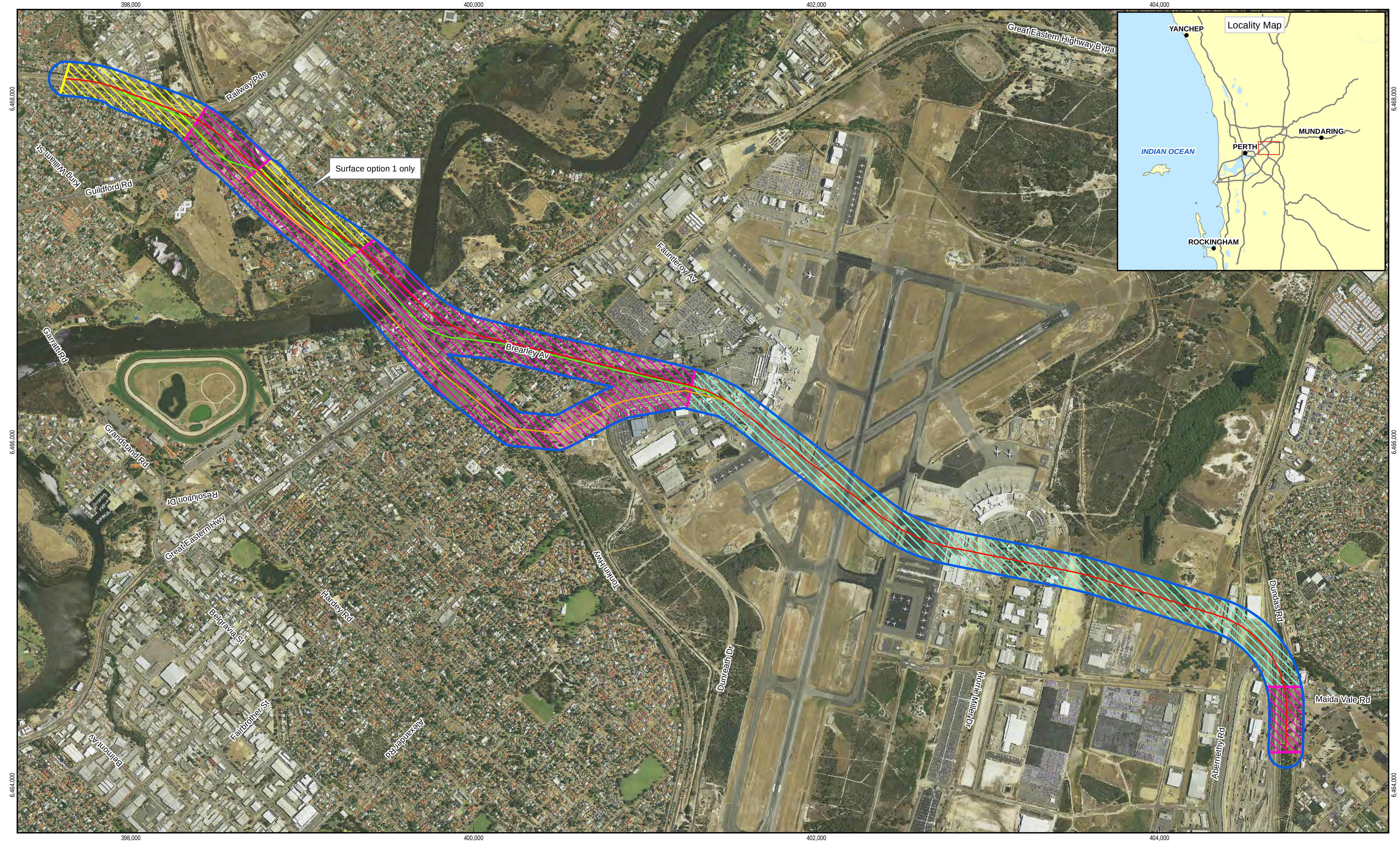
Figures



1:20,000 (at A3)

0 100 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

LEGEND

The Alignment :

Surface Option 1	Study Area
Surface Option 2	Shallow (< 1m disturbance)
Tunnel Option 3	Sub water table disturbance from surface (cut/cover, piling)
	Tunnel: 0 m to 7 m below ground level (bgl) no disturbance; 7 m to 14 m bgl tunnel

Public Transport Authority
Perth Airport Rail Link PSI and SAP

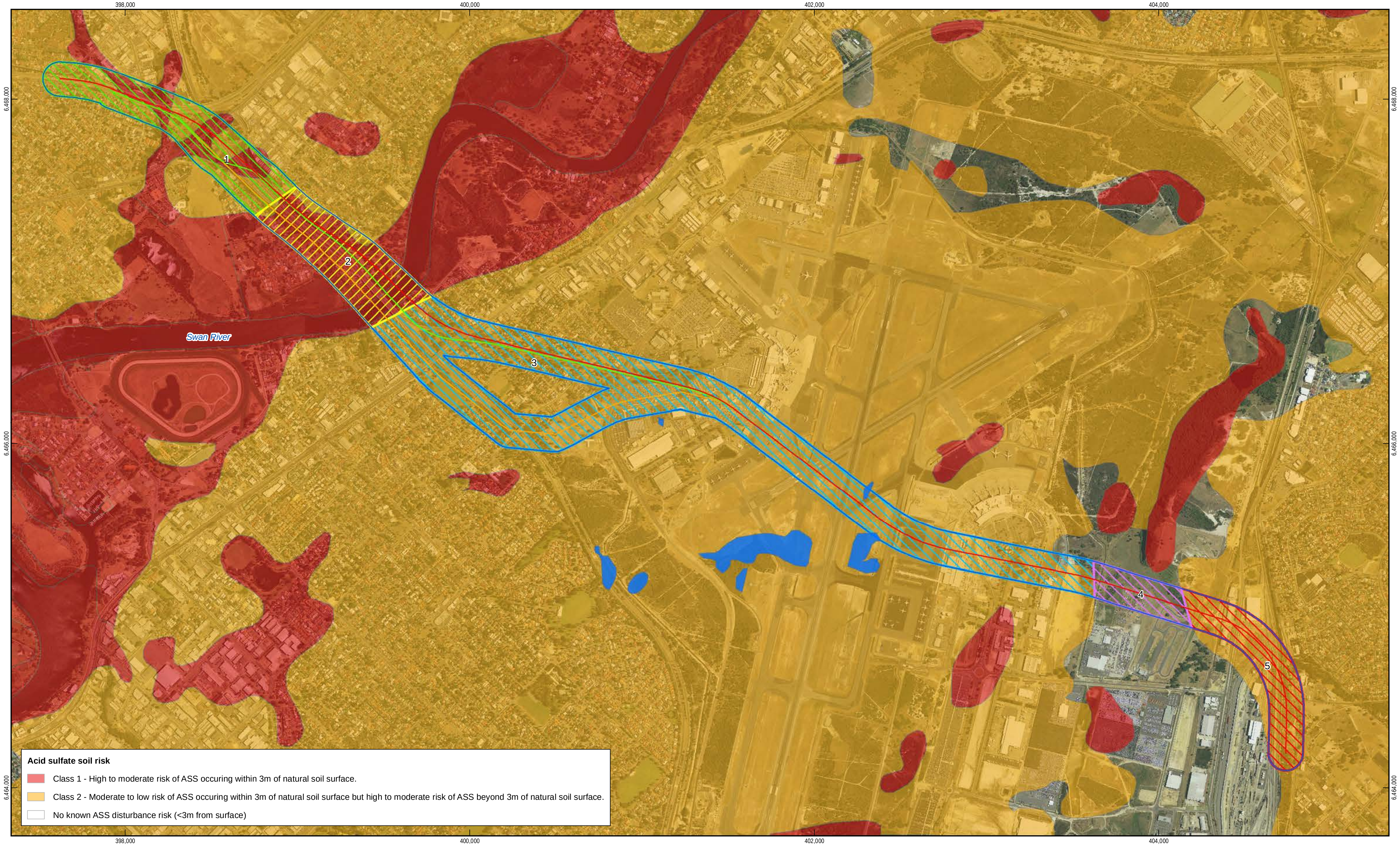
Job Number	61-29667
Revision	0
Date	04 Oct 2013

Site location and definition

Figure 1

G:\61\29667\GIS\Maps\Working\6129667_G001_Fig1_Rev0.mxd

Data source: PTA:The Alignment - 20130807; GHD: Study Area - 20130807, Shallow (<1m disturbance), Sub water table disturbance from surface (cut/cover, piling), Tunnel: 0 m to 7 m below ground level (bgl) no disturbance; 7 m to 14 m bgl tunnel - 20130807; Landgate: Roads - 20130708, Metro Central Mosaic - 2013; GA: 250k Topo Serie 3 - 2006. Created by: vdinh, jrutherford



1:20,000 (at A3)

0 100 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

The Alignment :

- Surface Option 1
- Surface Option 2
- Tunnel Option

- Historical aerial ASS assessment from 1953 historical aerial photograph
- Study Area

Sub-area

- 1
- 2
- 3
- 4
- 5

Public Transport Authority
Perth Airport Rail Link PSI and SAP

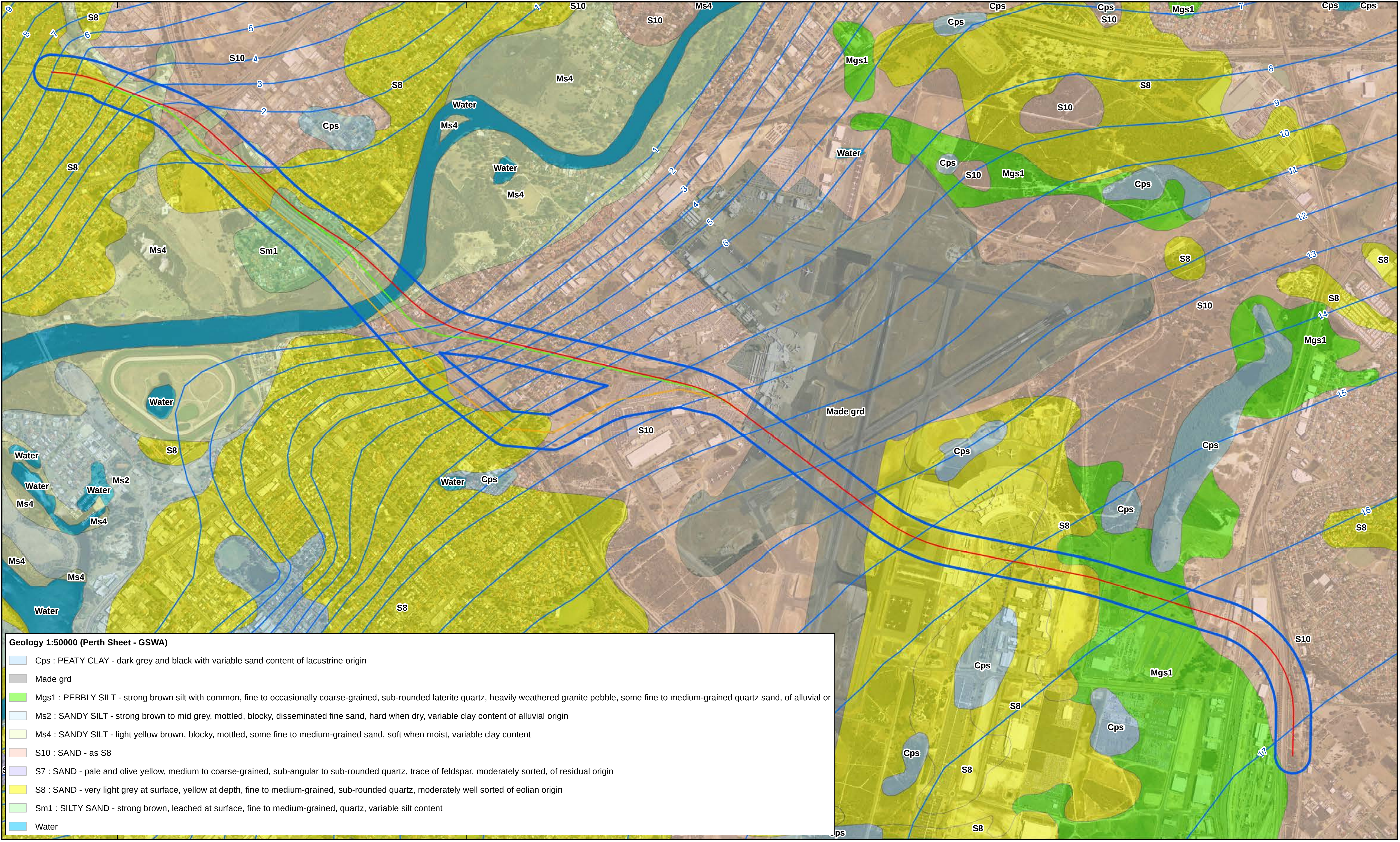
Job Number	61-29667
Revision	2
Date	03 Apr 2014

Acid sulfate soil risk map and sub-areas

Figure 2

G:\61\29667\GIS\Maps\Working\6129667_G004_Fig2_Rev2.mxd

Data source: DEC: Acid sulfate soil risk - 20130807; PTA: The Alignment - 20130807; GHD: Historical aerial ASS assessment from 1953 historical aerial photograph - 20130820, Study Area - 20130807, Sub-area - 20130809; Landgate: Metro Central Mosaic - 2013. Created by: vdinh



Geology 1:50000 (Perth Sheet - GSWA)

- 🟦 Cps : PEATY CLAY - dark grey and black with variable sand content of lacustrine origin
- ⬜ Made grd
- 🟩 Mgs1 : PEBBLY SILT - strong brown silt with common, fine to occasionally coarse-grained, sub-rounded laterite quartz, heavily weathered granite pebble, some fine to medium-grained quartz sand, of alluvial or
- ⬜ Ms2 : SANDY SILT - strong brown to mid grey, mottled, blocky, disseminated fine sand, hard when dry, variable clay content of alluvial origin
- ⬜ Ms4 : SANDY SILT - light yellow brown, blocky, mottled, some fine to medium-grained sand, soft when moist, variable clay content
- ⬜ S10 : SAND - as S8
- ⬜ S7 : SAND - pale and olive yellow, medium to coarse-grained, sub-angular to sub-rounded quartz, trace of feldspar, moderately sorted, of residual origin
- 🟨 S8 : SAND - very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin
- 🟩 Sm1 : SILTY SAND - strong brown, leached at surface, fine to medium-grained, quartz, variable silt content
- 🟦 Water

1:20,000 (at A3)

0 100 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

Legend

Department of Water

— Groundwater contours in meter Australian Height Datum (May 2003)

The Alignment :

— Surface Option 1

— Surface Option 2

— Tunnel Option 3

▭ Study Area

Public Transport Authority
Perth Airport Rail Link PSI and SAP

Job Number	61-29667
Revision	0
Date	01 Nov 2013

Surface geology and groundwater contours

Figure 3

G:\61\29667\GIS\Maps\Working\6129667_G003_Fig4_Rev0.mxd

Data source: DoW: Department of Water - 2013; GSWA: Geology 1:50,000 (Perth Sheet - GSWA) - 2001; PTA: Contaminated sites - 20130807, the Site - 20130807; GHD: Study Area - 20130807; Landgate: Metro Central Mosaic - 2013. Created by: vdinh, jrutherford

Plan

Scale 20,000

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667136884

0 200 400 600m

SCALE 1:20,000 AT ORIGINAL SIZE

N

Legend

Option 1

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
☒ G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations

VERTICAL DATUM
AHD
COORDINATE SYSTEM
PCG94

GHD

Public Transport Authority
Forrestfield - Airport Link
Acid Sulfate Soil Sampling & Analysis Plan
Plan and Longitudinal Section
Option 1 - General Arrangement

Job Number 61-29667
Revision A
Date Nov 2013

Figure 4A

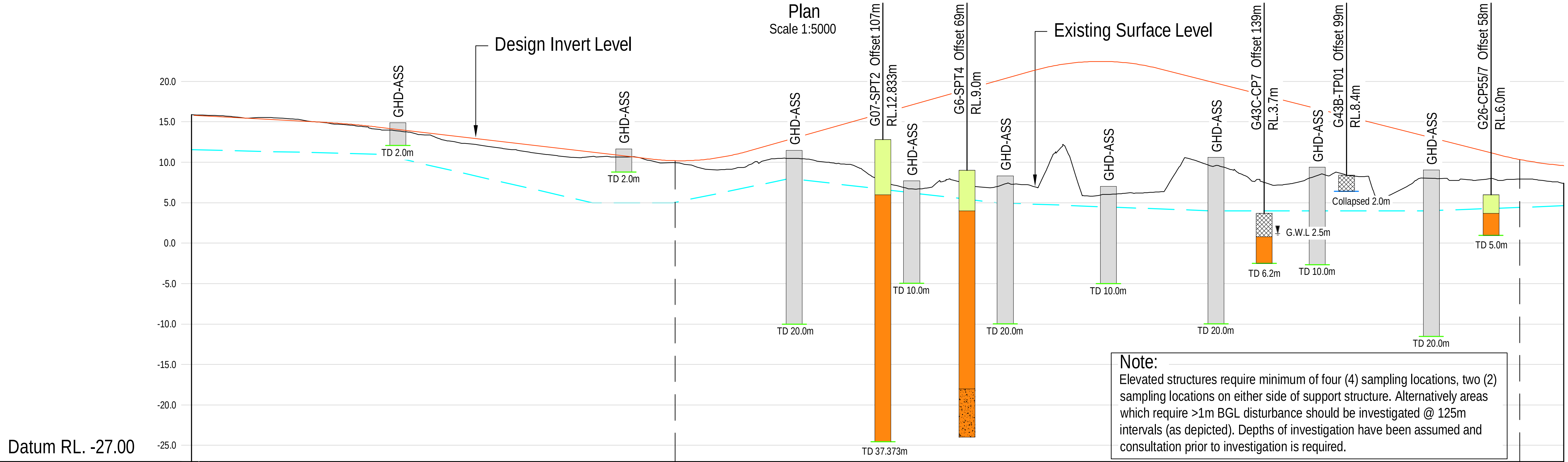
GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 22 November 2013 - 3:39 PM Plotted by: Josh Vale

Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-4A.dwg

Joins Fig-Q4C

Plan
Scale 1:5000



Note:
Elevated structures require minimum of four (4) sampling locations, two (2) sampling locations on either side of support structure. Alternatively areas which require >1m BGL disturbance should be investigated @ 125m intervals (as depicted). Depths of investigation have been assumed and consultation prior to investigation is required.

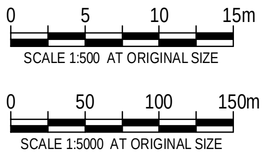
Joins Fig-Q4C

Depth to Invert Level	-0.062	-0.095	-0.234	-0.017	0.107	0.195	0.300	0.750	0.841	0.954	0.488	-0.026	0.264
Existing Surface Level	15.870	15.657	15.524	15.035	14.588	13.962	13.273	12.239	11.565	10.868	10.751	10.681	9.937
Locations (Correspond to Table 3)	Commencement of alignment to Guildford Rd / Tonkin Highway Intersection												

Depth to Invert Level	1.422	1.513	2.534	4.576	7.830	10.564	10.996	13.061	14.617	14.927	16.293	15.257	10.256	10.446	10.597	8.013	7.010	7.367	4.737	3.595	2.341	2.212
Existing Surface Level	9.075	10.103	10.492	9.861	8.017	6.693	7.671	7.016	6.862	7.426	6.098	6.336	10.070	8.612	7.192	8.508	8.243	6.618	7.979	7.853	7.950	7.394
Locations (Correspond to Table 3)	Guildford Rd / Tonkin Highway Intersection																					

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884



Vertical

Horizontal

Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
☒ G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
■	Topsoil
■	Alluvium
■	Bassendean Sand
■	Guilford Formation
▩	Sand & gravel remnant Ascot Formation
■	Ascot formation
■	Osborne formation
■	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
	Option 1
	Approx. Highest Ground Water Level

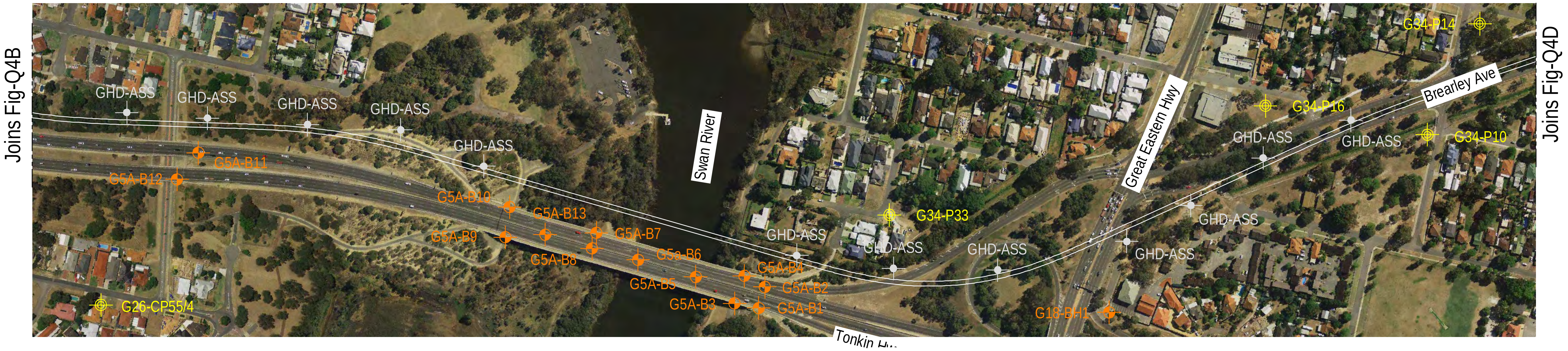
Public Transport Authority
Forrestfield - Airport Link
Acid Sulfate Soils Sampling & Analysis Plan

Plan and Longitudinal Section
Option 1 - Sheet 1 of 3

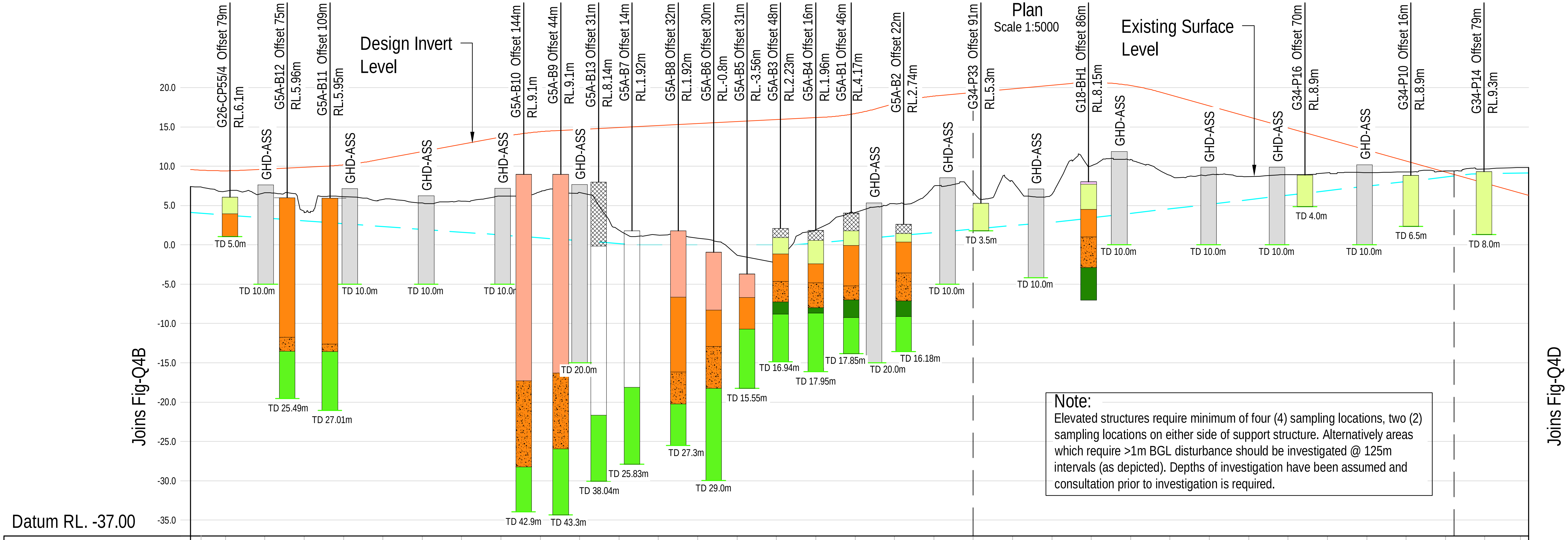
Job Number	61-29667
Revision	A
Date	Nov 2013

Figure 4B

Plot Date: 12 February 2014 - 2:47 PM   Plotted by: Scott Mason   Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-4B.dwg



Plan
Scale 1:5000



Note:
Elevated structures require minimum of four (4) sampling locations, two (2) sampling locations on either side of support structure. Alternatively areas which require >1m BGL disturbance should be investigated @ 125m intervals (as depicted). Depths of investigation have been assumed and consultation prior to investigation is required.

Depth to Invert Level	2.183	2.542	3.018	5.553	4.109	5.134	6.679	7.303	7.584	7.545	8.130	13.339	13.969	14.629	17.017	18.213	14.079	12.515	12.856	11.425	13.198	12.338	13.251	10.428	9.545	10.320	8.603	7.453	5.847	4.295	2.772	1.277	-0.237	-1.899	-3.471
Existing Surface Level	7.300	6.878	6.618	4.333	6.098	5.859	5.239	5.541	6.186	6.878	6.563	1.604	1.224	0.814	-1.325	-2.271	2.114	4.258	5.213	7.534	6.219	7.537	7.082	10.215	10.643	8.635	8.952	8.702	8.908	9.060	9.183	9.278	9.392	9.654	9.827
Location (Corresponds to Table 3)	South of Tonkin Highway Intersection to South of Swan River																				Tonkin Highway / Great Eastern Highway Intersection														

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE
Vertical

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE
Horizontal

N

Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
🟪	Topsoil
🟧	Alluvium
🟨	Bassendean Sand
🟧	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
🟩	Ascot formation
🟩	Osborne formation
⬜	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
	Option 1
	Approx. Highest Ground Water Level

Plot Date: 12 February 2014 - 2:51 PM Plotted by: Scott Mason

Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-4C.dwg

GHD

Public Transport Authority
Forrestfield - Airport Link
Acid Sulfate Soils Sampling & Analysis Plan

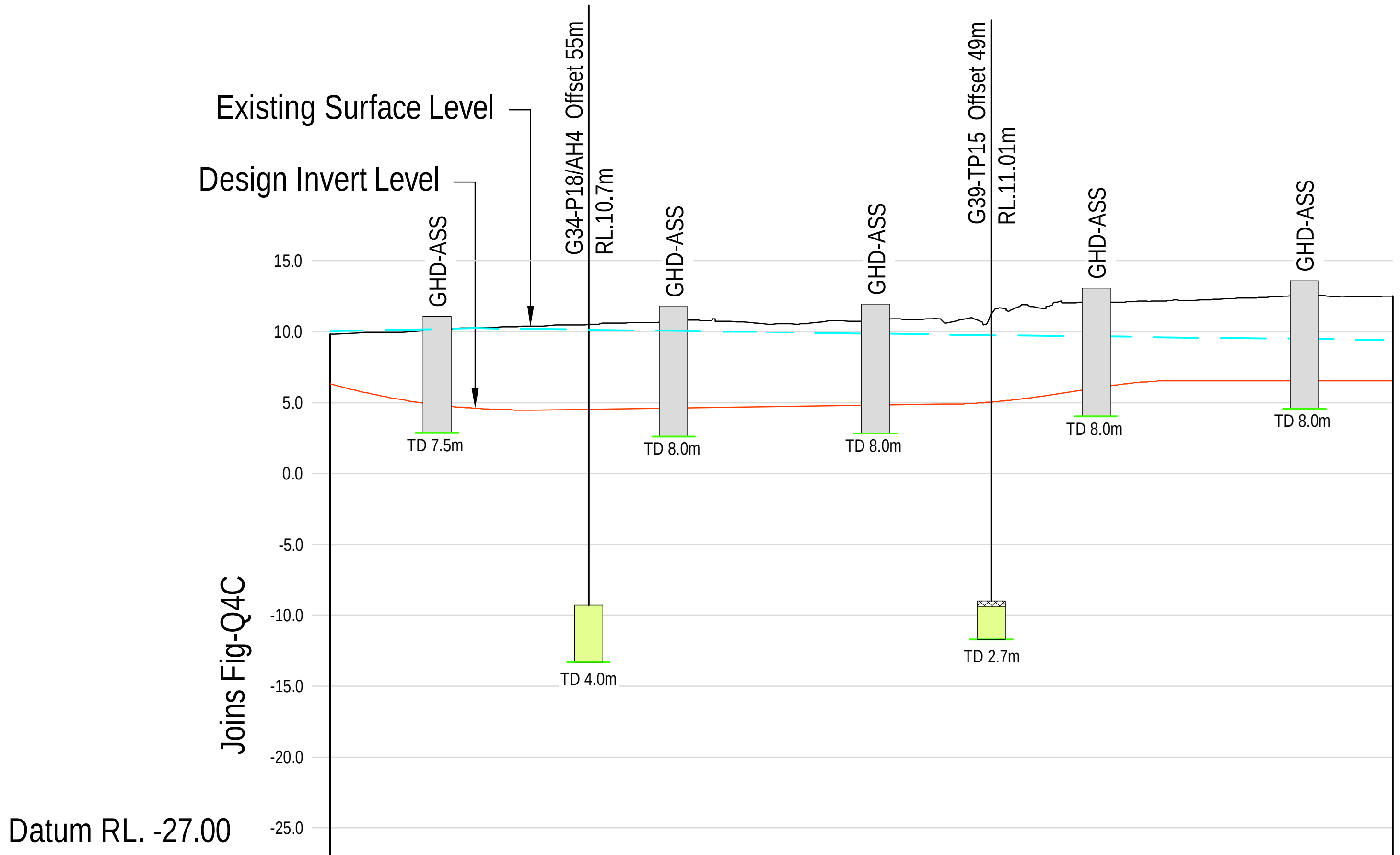
Plan and Longitudinal Section
Option 1 - Sheet 2 of 3

Job Number 61-29667
Revision A
Date Nov 2013

Figure 4C

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

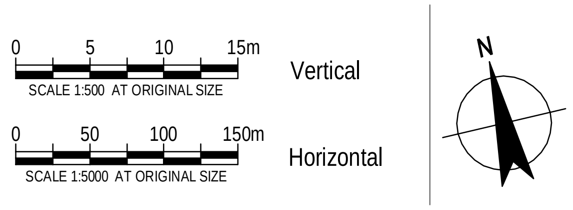
Plan
Scale 1:5000



Depth to Invert Level	-4.736	-5.645	-5.908	-6.039	-6.189	-5.930	-5.961	-6.067	-5.984	-6.291	-5.910	-5.664	-5.839	-6.001	-5.944
Existing Surface Level	9.971	10.259	10.397	10.596	10.814	10.622	10.721	10.895	10.908	11.700	12.065	12.215	12.390	12.552	12.495
Location (Corresponds to Table 3)	South of Swan River and PAPL Land														

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884



Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
☒ G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
🟪	Topsoil
🟧	Alluvium
🟨	Bassendean Sand
🟧	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
🟩	Ascot formation
🟩	Osborne formation
⬜	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
	Option 1

Public Transport Authority
Forrestfield - Airport Link
Acid Sulfate Soils Sampling & Analysis Plan
Plan and Longitudinal Section
Option 1 - Sheet 3 of 3

Job Number 61-29667
Revision A
Date Nov 2013

Figure 4D

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 12 February 2014 - 2:55 PM Plotted by: Scott Mason

Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-4D.dwg

Plan

Scale 20,000

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667136884

0 200 400 600m

SCALE 1:20,000 AT ORIGINAL SIZE

N

Legend

	Option 2 (Surface)
G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations

VERTICAL DATUM
AHD
COORDINATE SYSTEM
PCG94

GHD

Public Transport Authority
Forrestfield - Airport Link
Acid Sulphate Soil Sampling & Analysis Plan

Plan and Longitudinal Section
Option 2 (Surface) - General Arrangement

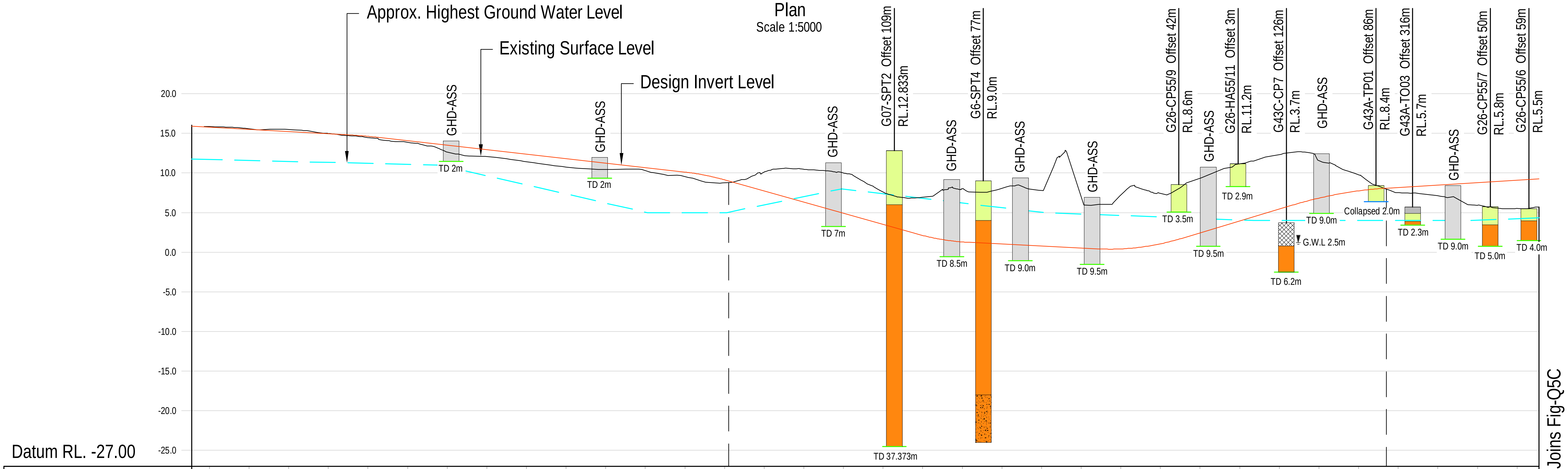
Figure 5A

Job Number	61-29667
Revision	A
Date	Nov 2013

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 22 November 2013 - 3:30 PM Plotted by: Josh Vale Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-5A.dwg

Plan
Scale 1:5000

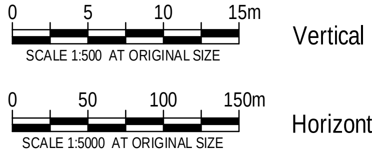


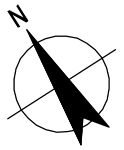
Depth to Invert Level	-0.075	-0.090	-0.246	-0.024	0.139	0.191	0.768	0.890	0.935	1.059	0.847	0.295	0.516	0.494	-2.053	-4.093	-5.073
Existing Surface Level	15.872	15.615	15.499	15.005	14.524	13.930	12.787	12.099	11.488	10.798	10.444	10.430	9.643	8.738	9.881	10.514	10.087
Locations (Correspond to Table 3)	Commencement of Alignment to Guilford Rd / Tonkin Highway Intersection														Guilford Rd / Tonkin Highway Intersection		

Depth to Invert Level	-4.184	-4.673	-6.591	-6.892	-6.998	-7.575	-6.449	-6.473	-6.867	-7.283	-6.919	-5.328	-2.205	0.598	1.284	2.805	3.572
Existing Surface Level	7.790	6.880	7.919	7.943	7.799	8.126	6.853	7.458	9.200	11.116	12.252	12.072	9.900	7.559	7.178	5.961	5.498
Locations (Correspond to Table 3)	Guilford Rd / Tonkin Highway Intersection																

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884





Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-AB401	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
🟪	Topsoil
🟧	Alluvium
🟨	Bassendean Sand
🟧	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
🟩	Ascot formation
🟩	Osborne formation
⬜	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
	Option 2 (Surface)
	Approx. Highest Ground Water Level

Public Transport Authority
Forrestfield - Airport Link
Acid Sulphate Soil Sampling & Analysis Plan

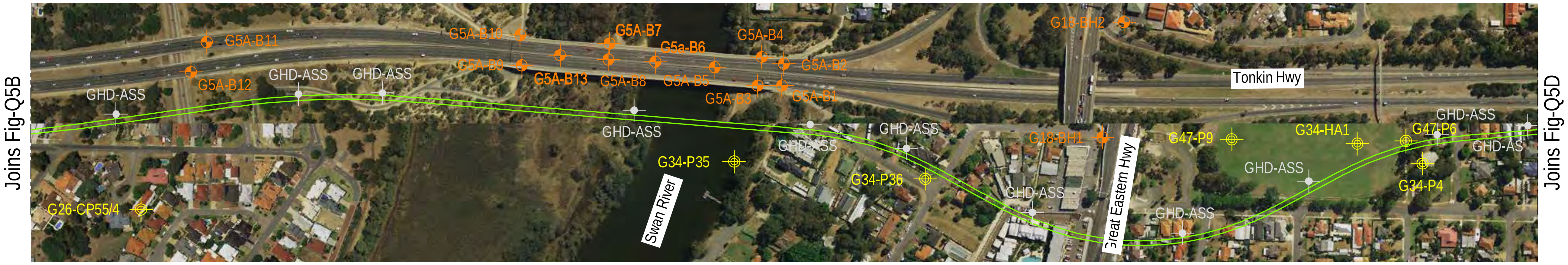
Plan and Longitudinal Section
Option 2 (Surface) - Sheet 1 of 3

Job Number	61-29667
Revision	A
Date	Nov 2013

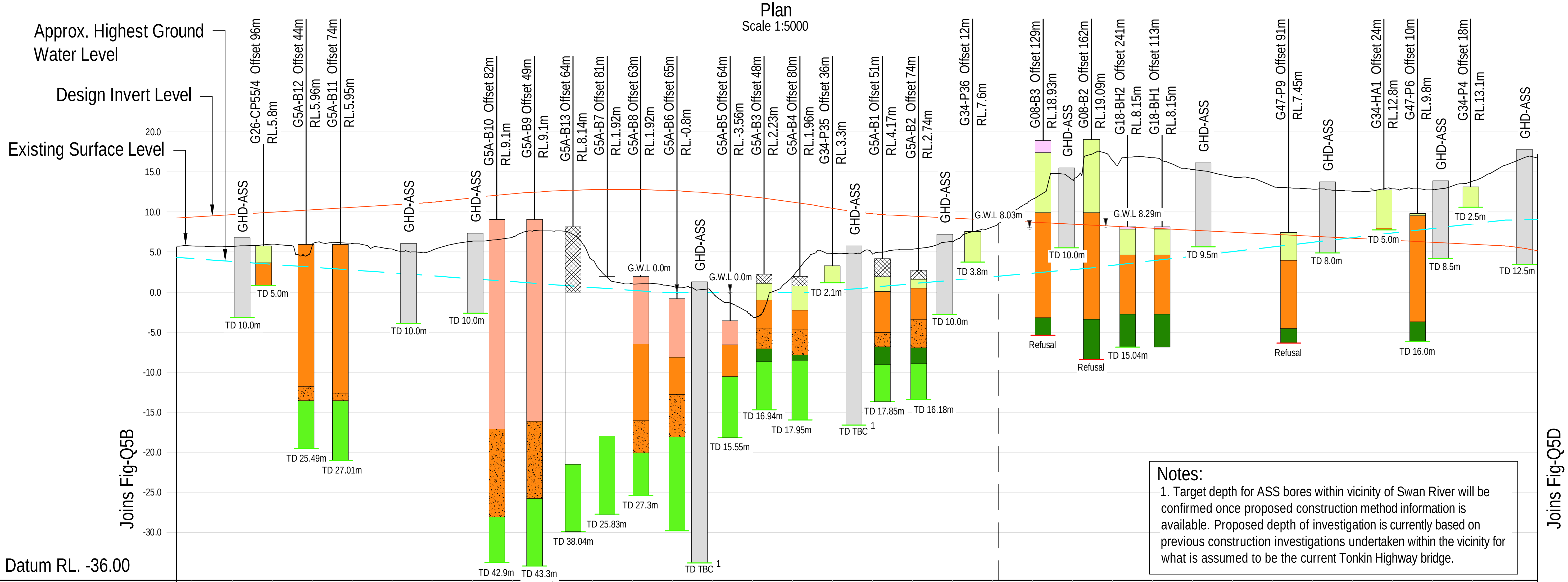
Figure 5B

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 22 November 2013 - 10:51 AM Plotted by: Josh Vale Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-5B.dwg



Plan
Scale 1:5000



Notes:

1. Target depth for ASS bores within vicinity of Swan River will be confirmed once proposed construction method information is available. Proposed depth of investigation is currently based on previous construction investigations undertaken within the vicinity for what is assumed to be the current Tonkin Highway bridge.

Depth to Invert Level	3.601	3.971	4.002	4.728	4.500	5.519	6.017	5.417	5.461	4.987	8.770	11.767	11.939	12.375	14.884	9.389	5.659	4.959	4.139	2.966	0.850
Existing Surface Level	5.774	5.708	5.982	5.560	6.093	5.378	5.201	6.354	6.812	7.626	4.022	1.043	0.727	-0.014	-2.988	1.879	4.828	4.829	5.349	6.272	8.138
Locations (Correspond to Table 3)	South of Tonkin Highway Intersection to South of Swan River																				

Depth to Invert Level	-2.815	-5.561	-8.259	-8.803	-7.578	-6.904	-6.012	-5.872	-5.871	-6.416	-6.544	-7.853	-10.504
Existing Surface Level	11.554	14.050	16.498	16.792	15.317	14.393	13.251	12.862	12.611	12.906	12.784	13.843	16.176
Locations (Correspond to Table 3)	Tonkin Highway / Great Eastern Highway Intersection												

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE
Vertical

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE
Horizontal

N

Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
🟪	Topsoil
🟧	Alluvium
🟨	Bassendean Sand
🟧	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
🟩	Ascot formation
🟩	Osborne formation
⬜	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
—	Option 2 (Surface)
– –	Approx. Highest Ground Water Level

Public Transport Authority
Forrestfield - Airport Link
Acid Sulfate Soil Sampling & Analysis Plan

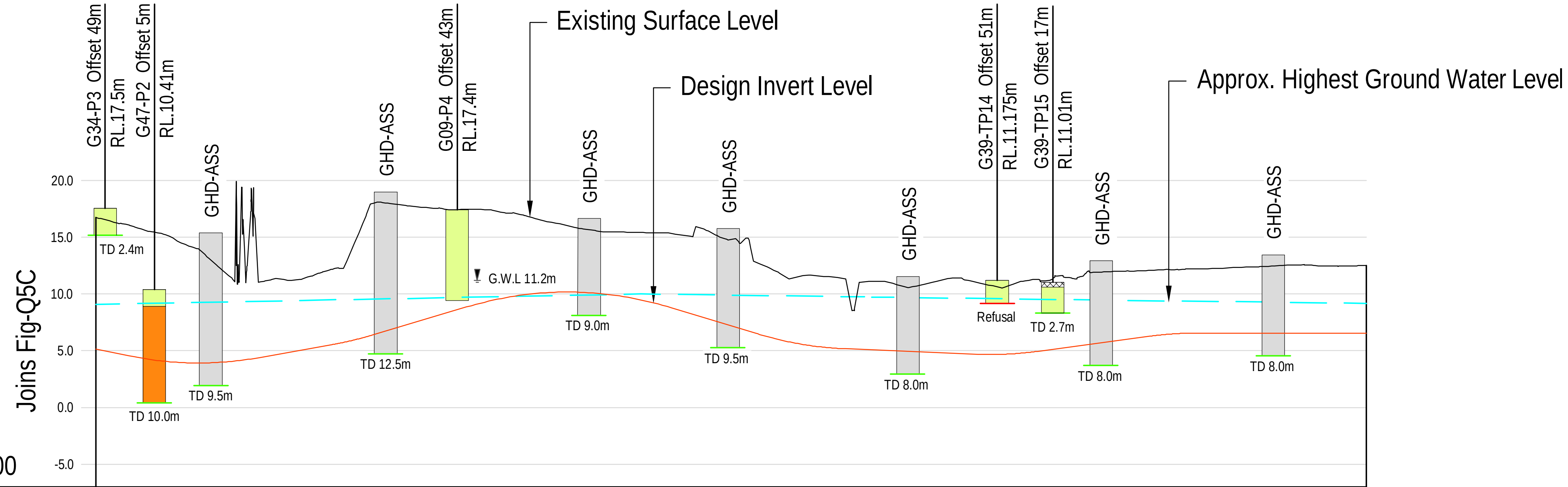
Plan and Longitudinal Section
Option 2 (Surface) - Sheet 2 of 3

Job Number	61-29667
Revision	A
Date	Nov 2013

Figure 5C

Plot Date: 25 November 2013 - 3:42 PM Plotted by: Josh Vale Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-5C.dwg

Plan
Scale 1:5000



Datum RL. -7.00

Depth to Invert Level	-11.487	-10.888	-7.447	-6.380	-6.598	-10.727	-8.809	-7.331	-5.782	-5.740	-6.731	-7.651	-5.892	-3.853	-5.685	-6.439	-6.330	-6.090	-5.898	-5.664	-5.839	-6.001	-5.944
Existing Surface Level	16.250	14.888	11.497	11.213	12.341	17.854	17.420	17.132	15.950	15.442	15.156	14.556	11.512	8.984	10.615	11.167	11.149	11.564	12.047	12.215	12.390	12.552	12.495
Location (Corresponds to Table 3)	South of Swan River and PAPL Land																						

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE
Vertical

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE
Horizontal

N

Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
■	Topsoil
■	Alluvium
■	Bassendean Sand
■	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
■	Ascot formation
■	Osborne formation
■	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
—	Option 2 (Surface)
— —	Approx. Highest Ground Water Level

GHD

Public Transport Authority
Forrestfield - Airport Link
Acid Sulfate Soil Sampling & Analysis Plan
Plan and Longitudinal Section
Option 2 (Surface) - Sheet 3 of 3

Job Number	61-29667
Revision	A
Date	Nov 2013

Figure 5D

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 22 November 2013 - 2:50 PM Plotted by: Josh Vale Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-5D.dwg

Plan
Scale 20,000

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884

0 200 400 600m
SCALE 1:20,000 AT ORIGINAL SIZE

N

Legend

🟧	Option 3 (Tunnel)
⊕ G35-CPT4A	CPT Locations
◩ G39-TP15	TP Locations
◕ G18-BH1	BH Locations
☒ G25-ABH01	Pushtube BH Locations
● G6-SPT4	SPT Locations

VERTICAL DATUM
AHD
COORDINATE SYSTEM
PCG94

GHD

Public Transport Authority
Forrestfield - Airport Link
Acid Sulphate Soil Sampling & Analysis Plan

Plan and Longitudinal Section
Option 3 (Tunnel) General Arrangement

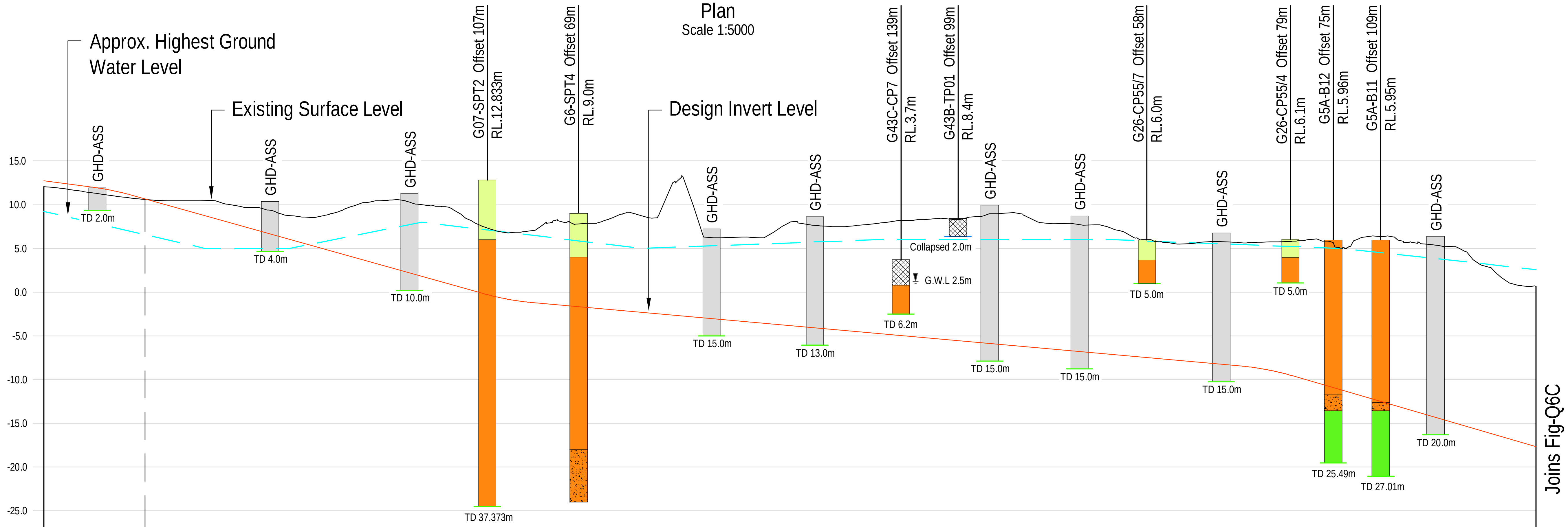
Job Number	61-29667
Revision	A
Date	Nov 2013

Figure 6A

GHD House, 239 Adelaide Tce Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com

Plot Date: 25 November 2013 - 1:12 PM Plotted by: Josh Vale Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-6A_recover.dwg

Plan
Scale 1:5000



Datum RL. -27.00

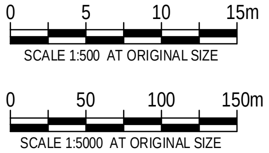
Depth to Invert Level	0.612	0.518	-0.426	-1.850	-2.454	-2.831	-4.784	-7.436	-8.287	-7.950	-7.770	-9.599	-9.981	-10.943	-13.808	-9.494	-10.825
Existing Surface Level	11.623	10.897	10.468	10.492	9.696	8.673	9.226	10.478	9.929	8.192	6.831	8.139	8.073	8.587	11.004	6.242	7.125

Depth to Invert Level	-11.708	-12.312	-13.243	-13.808	-14.889	-14.329	-14.505	-13.930	-13.321	-13.978	-14.393	-15.795	-16.335	-19.182	-19.662	-19.072	-17.929
Existing Surface Level	7.560	7.716	8.199	8.316	8.949	7.941	7.669	6.646	5.589	5.798	5.690	5.892	4.974	6.363	5.385	3.337	0.736

Location (Corresponds to Table 3)	←.→	Commencement of Alignment to Guildford Rd / Tonkin Hwy Intersection	Refer to Design Option 3 Within Table

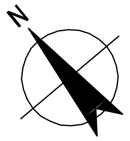
Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884



Vertical

Horizontal



Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
■	Topsoil
■	Alluvium
■	Bassendean Sand
■	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
■	Ascot formation
■	Osborne formation
■	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
—	Option 3 (Tunnel)
— —	Approx. Highest Ground Water Level

Public Transport Authority
Forrestfield - Airport Link
Acid Sulphate Soil Sampling & Analysis Plan

Plan and Longitudinal Section Option 3 (Tunnel) Sheet 1 of 3

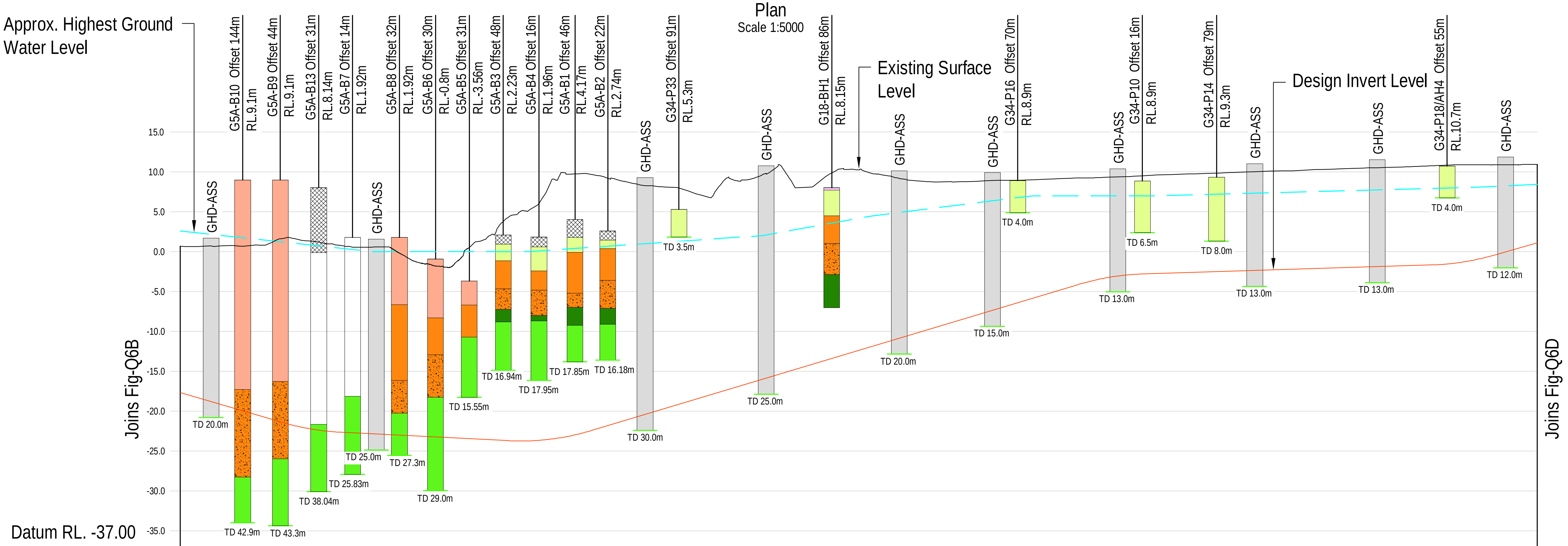
Job Number	61-29667
Revision	A
Date	Nov 2013

Figure 6B

GHD House, 239 Adelaide Tce Perth WA 6004 T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com

Plot Date: 25 November 2013 - 3:44 PM Plotted by: Josh Vale Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29916-FIG-6B.dwg

Plan
Scale 1:5000



Depth to Invert Level	-19.351	-20.833	-23.310	-23.480	-23.355	-22.344	-21.345	-25.252	-28.784	-32.875	-31.116	-28.624	-26.560	-26.536	-25.643	-22.415	-23.148	-20.909	-18.631	-17.129	-15.777	-14.428	-13.098	-12.338	-12.344	-12.343	-12.381	-12.358	-12.393	-12.395	-12.385	-12.398	-11.634	-10.266
Existing Surface Level	0.700	0.724	1.749	0.980	0.558	-0.706	-1.957	1.697	5.060	9.689	9.252	8.260	7.696	9.172	9.779	8.051	10.284	9.545	8.767	8.765	8.913	9.064	9.220	9.389	9.628	9.783	9.977	10.110	10.301	10.460	10.606	10.812	10.869	10.909
Location (Corresponds to table 3)	Refer to Design Option 3 Within Table																																	

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667/136884

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE
Vertical

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE
Horizontal

N

Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
🟪	Topsoil
🟧	Alluvium
🟨	Bassendean Sand
🟧	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
🟩	Ascot formation
🟩	Osborne formation
⬜	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
—	Option 3 (Tunnel)
— —	Approx. Highest Ground Water Level

GHD

Public Transport Authority
Forrestfield - Airport Link
Acid Sulphate Soil Sampling & Analysis Plan
Plan and Longitudinal Section
Option 3 (Tunnel) Sheet 2 of 3

Job Number 61-29667
Revision A
Date Nov 2013

Figure 6C

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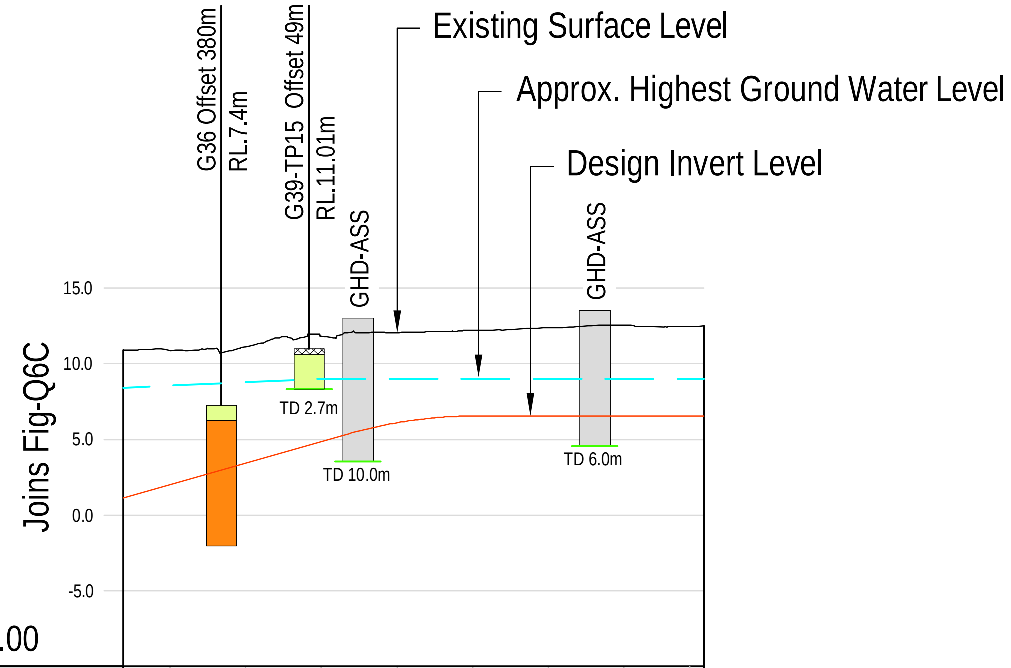
Plan
Scale 1:5000



Datum RL. -10.00								
Depth to Invert Level	-8.822	-7.669	-6.860	-5.924	-5.664	-5.839	-6.001	-5.943
Existing Surface Level	10.896	11.173	11.795	12.068	12.215	12.390	12.552	12.494
Location (Corresponds to Table 3)	Refer to Design Option 3 Within Table							

Longitudinal Section
Scale H 1:5000 V 1:500

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-29667-136884

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE
Vertical

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE
Horizontal

N

Legend

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
GHD-ASS	Proposed Sampling Locations for ASS

▨	Fill
🟪	Topsoil
🟧	Alluvium
🟨	Bassendean Sand
🟧	Guilford Formation
▨	Sand & gravel remnant Ascot Formation
🟩	Ascot formation
🟩	Osborne formation
⬜	Proposed ASS Sample

GWL 25.5m	Ground Water Level Measured
TD 3.45m	Target Depth
Refusal 15.2m	Refusal
Collapsed 5.7m	Collapsed Depth
—	Option 3 (Tunnel)
— —	Approx. Highest Ground Water Level

GHD

Public Transport Authority
Forrestfield - Airport Link
Acid Sulphate Soil Sampling & Analysis Plan
Plan and Longitudinal Section
Option 3 (Tunnel) Sheet 3 of 3

Job Number	61-29667
Revision	A
Date	Nov 2013

Figure 6D

Plot Date: 25 November 2013 - 3:46 PM Plotted by: Josh Vale Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29916-FIG-6D.dwg

Plan

Scale 20,000

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0 200 400 600m

SCALE 1:20,000 AT ORIGINAL SIZE

N

Legend

Option 1

Option 2 (Surface)

Option 3 (Tunnel)

G35-CPT4A	CPT Locations
G39-TP15	TP Locations
G18-BH1	BH Locations
G25-ABH01	Pushtube BH Locations
G6-SPT4	SPT Locations
ASS-MB01	Monitoring BH Locations

VERTICAL DATUM

AHD

COORDINATE SYSTEM

PCG94

Public Transport Authority

Forrestfield - Airport Link

Acid Sulfate Soil Sampling & Analysis Plan

Proposed Groundwater Monitoring Well Locations - All Options

Job Number	61-29667
Revision	A
Date	Nov 2013

Figure 7A

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Plot Date: 12 February 2014 - 2:46 PM Plotted by: Scott Mason

Cad File No: G:\61\29667\CADD\Figures\Report 136884\61-29667-FIG-7A.dwg

GHD

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T: 61 8 6222 8222   F: 61 8 6222 8555   E: permail@ghd.com.au

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	L.Cockerton	D.Todd		D.Todd		12/02/2014
2	L.Cockerton	D.Todd		D.Todd		4/04/2014

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APPENDIX 18

Forrestfield Airport Link – Noise and Vibration Feasibility Assessment and Memo (AECOM, 2014a) and (AECOM, 2014b)

Included as a separate hard copy report

Forrestfield Airport Link

Public Transport Authority of Western
Australia

16-May-2014

Doc No. 60301258-AC-REP-0002

Noise & Vibration Feasibility Assessment

Noise & Vibration Feasibility Assessment

Client: Public Transport Authority of Western Australia
ABN: 61 850 109 576

Prepared by

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ABN 20 093 846 925

16-May-2014

Job No.: 60301258

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

Quality Information

Document	Noise & Vibration Feasibility Assessment
Ref	60301258
Date	16-May-2014
Prepared by	Mike McLoughlin / Imran Khan
Reviewed by	Darren Jurevicius

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	31-Jan-2014	Draft	Barry Moore Associate Director – Rail	
1	05-May-2014	Draft 2 - For Client Review	Jonathan Oliver Associate Director - Rail	
2	07-May-2014	Issued for use	Jonathan Oliver Associate Director - Rail	
3	16-May-2014	Re-issued for Use	Jonathan Oliver Associate Director - Rail	

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  1.2 Rail Alignments 3
  1.3 Feasibility Study Aims 5
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Appendix C
Figures: Vibration - No Mitigation C

Appendix D
Figures: Noise Mitigation Options D

Appendix E
Figures: Vibration - With Mitigation E

Appendix F
Correspondence between DER and PTA F

Appendix G
Tabulated Noise Modelling Results with Mitigation G

Executive Summary

The Public Transport Authority of Western Australia (PTA) is developing a Project Definition Plan (PDP) for the Forrestfield-Airport Link (FAL) project on behalf of the State Government. The FAL project is proposed to link Perth Station to Perth Airport and Forrestfield. The proposed route is approximately 8 km extending from the existing Midland line rail corridor to the Domestic Terminal, continuing through a bored tunnel to the International Terminal and east beyond Perth Airport boundary to a terminus adjacent to Dundas Road in High Wycombe.

The project is currently at the feasibility stage and three route options are being considered between the existing Midland line and the Domestic Terminal covering a distance of approximately 4 km. Two options are a combination of elevated, at grade and subterranean sections; the third option is completely subterranean. The above ground options mainly follow existing road corridors.

AECOM has been engaged by the PTA to carry out a noise and vibration feasibility study of the three proposed alignments between the existing Midland line and the Domestic Terminal to assess if noise and vibration levels will comply with project specific assessment criteria which have been developed in conjunction with the Department of Environment Regulation Noise Branch. Should noise and vibration levels exceed the assessment criteria, noise and vibration mitigation requirements will be determined.

The predicted noise and vibration levels from each of the three route alignments have been predicted and where exceedances of the project specific criteria are identified, mitigation options have been specified.

Noise modelling for mitigation was carried out for compliance to ‘noise target’ and ‘noise limit’ as per *State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP5.4).* Whilst not a requirement of SPP5.4, a criterion for maximum noise levels has also been be adopted for this study to account for the elevated and intermittent nature of rail noise sources.

The predicted vibration levels for tactile vibration were assessed to the criteria as per *AS 2670.2 Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-introduced vibration in buildings (1-80 Hz)*. The regenerated noise (ground borne noise) criteria has been agreed upon with the DER to be no greater than $L_{Amax, slow}$ 35 dB(A) at residential receivers.

The noise mitigation measures in the form of noise barriers were modelled based on the limitations provided by PTA for the maximum height (not exceeding 3m) and minimum distance from the rail tracks (2.5m on elevated structures and 3.2m at grade). The summary of noise and vibration mitigations for each of the route options is presented below.

Route Option 1

- Noise walls of varying lengths and heights at 14 locations will achieve compliance with the SPP5.4 noise target and at 13 locations for compliance with the SPP5.4 noise limit. Practical limitations to wall/ barrier design have however resulted in some residual exceedances for compliance with the noise target. There are no residual exceedances of the noise limit. There were no exceedances predicted for the L_{Amax} noise level criterion after noise mitigation measures are adopted.
- The total area of barrier for this option was calculated to be 8455 m^2 for compliance to noise target and 4225 m^2 for compliance to noise limit.
- The predicted vibration levels with stiff fasteners complied with the criteria for tactile vibration as per AS2670.
- The ground borne noise criterion for this alignment is not applicable as airborne noise is the dominant noise source.

Route Option 2

- Noise walls of varying lengths and heights at 12 locations will achieve compliance with the SPP5.4 noise target and at 9 locations for compliance with the SPP5.4 noise limit. Practical limitations to wall/ barrier design have however resulted in some residual exceedances for compliance with both the noise target and noise limit. There were no exceedances predicted for the L_{Amax} noise level criterion after noise mitigation measures are adopted.
- The total area of barrier for this option was calculated to be 6716 m^2 for compliance to noise target and 2296 m^2 for compliance to noise limit.

- The predicted vibration levels with stiff fasteners complied with the criteria for tactile vibration as per AS2670.
- The ground borne noise predictions show the ground borne noise criterion is exceeded with stiff track fasteners.
- Pandrol Vanguard fasteners were used as mitigation and the resultant vibration impact is significantly reduced with these fasteners; however the ground borne criteria at approximately 12 houses are marginally exceeded with the Pandrol Vanguard. It should be noted the current vibration model is conservative, this will be further refined during the detailed design stage of the project.

Route Option 3

- A noise wall is required at 1 location to achieve compliance with the SPP5.4 noise target and noise limit. Practical limitations to wall/ barrier design have however resulted in some residual exceedances for compliance with the noise target. There are no residual exceedances of the noise limit. There were no exceedances predicted for the L_{Amax} noise level criterion after noise mitigation measures are adopted.
- The total area of barrier for this option was calculated to be 627 m^2 for compliance to noise target and 209 m^2 for compliance to noise limit.
- The predicted vibration levels with stiff fasteners complied with the criteria for tactile vibration as per AS2670.
- The ground borne noise predictions show the ground borne noise criterion is exceeded with stiff track fasteners. Compliance to ground borne noise is predicted with use of Pandrol Vanguard fasteners.

The noise and vibration assessment detailed in this report are suitable for the feasibility study only. A detailed assessment of the final route alignment will be conducted once selected. The assessment criteria used in this feasibility study and the proposed noise and vibration mitigation requirements may therefore change.

1.0 Introduction

1.1 Project Appreciation

Growth of aviation services into and from Perth Airport has exceeded previous projections placing stress on the transportation infrastructure that serves the airport. It is predicted that Perth Airport will continue to experience growth in the coming years. The need to address the transportation demands has been recognised by the State and Federal Governments and Perth Airport Pty Ltd. Construction of a rail line connecting Perth city to the airport is an option which the State government is exploring to improve transportation links and cater for the predicted future demand.

The Public Transport Authority (PTA) is developing a Project Definition Plan (PDP) for the Forrestfield-Airport Link (FAL) project on behalf of the State Government. At this early planning phase, three potential alignment options have been developed. Two options are a combination of elevated, at grade and subterranean sections. The third option is wholly subterranean. Construction and operation of any of these options has the potential to affect the health and amenity of the community through increased levels of noise and vibration within proximity of the proposed rail infrastructure.

Acoustic nomenclature used in this report is presented in Appendix A.

1.2 Rail Alignments

Approximately 4 km of new rail is proposed between the intersection of the Midland Line/Tonkin Highway and the Domestic Terminal at Perth Airport. Currently three route options are being considered for this section of the FAL project and are assessed in this study. Details of these route options are given below and are presented in Figure 1.

- Option 1 - A combination of elevated and at grade rail running to the north of Tonkin Highway entering a subterranean section on Brearley Avenue and then onto the Domestic Terminal (Green line).
- Option 2- A combination of at grade and subterranean rail running to the south of Tonkin Highway, with a crossing under Tonkin Highway onto airport land and then onto the Domestic Terminal (Blue line).
- Option 3 - A wholly subterranean option crossing under the Swan River and residential properties to the Domestic Terminal (Orange line).

All three options merge at the Domestic Terminal and then run in a bored tunnel under the airport. The tunnel surfaces beyond the Perth Airport boundary at a terminus station adjacent to Dundas Road in High Wycombe. This study does not assess noise and vibration levels between the Domestic Terminal and terminus station.

N

AECOM

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DATUM GDA 1994, PROJECTION PCG94

0 255 510 1,020

metres

1:20,000 (when printed at A3)

LEGEND

- Option 1 - at grade
- Option 1 - sub surface
- Option 2 - at grade
- Option 2 - in cut
- Option 2 - sub surface
- Option 3 - at grade
- Option 3 - sub surface
- Airport sub surface link

Forrestfield Airport Rail Link
Route Options

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 2/05/2014

Figure

1

A3 size

1.3 Feasibility Study Aims

The aim of this study is to carry out a noise and vibration assessment of the three route options between the existing Midland line and the Domestic Terminal to assess if noise and vibration levels will comply with project specific assessment criteria which have been developed in conjunction with the Department of Environment Regulation (DER) Noise Branch. Should noise and vibration levels exceed the assessment criteria, mitigation requirements will be determined to reduce noise and vibration to suitable levels.

This report details the proposed FAL project specific noise and vibration assessment criteria, assessment methodology, predicted noise and vibration levels, and where applicable proposes potential noise and vibration mitigation measures.

The assessment criteria and methodology has been agreed with the DER Noise Branch. Correspondence with the DER is included in Appendix F.

1.4 Existing Noise Environment

The majority of the proposed routes between the intersection of the existing Midland line and the Domestic Terminal (approximately 4 km) follow existing road transport corridors. The only exception is where Option 2 (refer to Figure 1) diverts away from existing roads across airport land (north of Tonkin Highway to the Domestic terminal).

The existing noise environment at the closest noise sensitive receptors to the proposed routes is therefore likely to be elevated due to road traffic noise. It should be noted that noise levels at the noise sensitive receptors close to where Option 2 moves away from existing roads across airport land (north of Tonkin Highway to the Domestic terminal) will be lower.

It is proposed that because the existing noise environment along the majority of the FAL alignments between the existing Midland line and the Domestic Terminal are likely to be significantly influenced by road traffic sources, the noise environment will likely be constant in nature during traffic flows, with existing short duration increases in noise level due to occasional loud vehicles (e.g. loud exhaust, trucks).

2.0 Assessment Criteria

2.1 Overview

The PTA has identified the requirement to assess the potential noise and vibration levels associated with constructing and operating the rail line.

The introduction of the FAL has the potential to increase noise levels in existing transport corridors, and alter the existing character of local noise environments around the proposed rail alignments due to adding an additional source of noise in these areas. The noise emitted from the FAL is likely to produce elevated noise levels for short durations, which occur at regular periods dependant on timetabling.

The noise from the FAL would be perceptible at the noise sensitive receivers if the noise levels of the existing environment (e.g. due to road traffic noise 'hum' from the existing transport corridors) are lower than the noise from the FAL. In addition, the FAL has the potential to introduce new tonal events, such as rail squeal.

The noise assessment criteria and methodology for this study has been agreed with the DER Noise Branch. The agreed criteria are presented in the subsequent sections. These criteria are subject to revision during the detailed design of the project. Ongoing consultation with the DER Noise Branch will be undertaken as the project progresses into detailed design and implementation.

The vibration from rail pass by has the potential to generate vibration levels both as tactile vibration and regenerated noise at the sensitive receivers. Tactile vibration typically is used to assess human response to building vibration. Regenerated noise however is mainly for ground borne vibration resulting from the train pass-bys for the alignments in tunnels, deep cuttings, and cut and covers structures. The applicable criterion for tactile vibration and regenerated noise is detailed in the subsequent sections.

2.2 Operational Noise Criteria

The potential noise levels from the FAL for the feasibly study will be assessed based on the rail traffic noise only, and not to be assessed in conjunction with existing road traffic noise.

2.2.1 State Planning Policy 5.4

The Western Australian Planning Commission released *State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP5.4)* in 2009. In terms of road and rail infrastructure, it is applicable for:

- Proposed new noise sensitive development in the vicinity of an existing major road, rail, or freight handling facility.
- Proposed new major road or rail infrastructure projects in the vicinity of existing or future noise sensitive land uses
- Proposed major redevelopment of existing major road or rail infrastructure in the vicinity of existing or future noise sensitive land uses.

In regards to the current proposals of the FAL, the DER have requested that this study be assessed as if it was a new rail corridor, without consideration that it is located in close proximity to existing major roads.

Therefore the operational noise assessment of this study is to be conducted in accordance with SPP 5.4 for new railways and therefore the noise targets and limits that are applicable are given in Table 1.

Table 1 Western Australian outdoor noise criteria for road and rail infrastructure projects

Period	Noise target (façade)	Noise limit (façade)
Day, 6 am to 10 pm	55 dB(A) $L_{eq,16h}$	60 dB(A) $L_{eq,16h}$
Night, 10 pm to 6 am	50 dB(A) $L_{eq,8h}$	55 dB(A) $L_{eq,8h}$

2.2.2 L_{Amax} Noise Criteria

The DER has required that a L_{Amax} noise level criterion be adopted for the FAL development, to account for the elevated and intermittent nature of rail noise sources. The L_{Amax} criterion is as per the NSW Interim guideline for the assessment of noise from rail infrastructure projects of 80 dB (external) during the day and night time.

2.3 Operational Vibration Assessment

2.3.1 Tactile Vibration

Predicted operational vibration levels at vibration sensitive receptors will be assessed against *AS 2670.2 Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-introduced vibration in buildings (1-80 Hz)*. This Standard offers guidance on assessing human response to building vibration. All discussions in this section relate to vibration levels in the *vertical* direction.

AS 2670.2 defines the maximum allowable vibration levels specified in terms of multiples of the “baseline curve”. The baseline curves approximately coincide with the threshold of perception and are historically used to specify maximum allowable vibrations in critical working areas such as hospital operating theatres.

The residential receiver night-time criteria will be used as the assessment criteria. This is considered conservative as this receiver has the most stringent criteria of all the receivers within the assessment area – other receiver types within the area are commercial and industrial receivers.

The criteria have been translated from velocity rms (m/s) to decibel (dB) as shown in Figure 2. Results will be shown in dB scale, with 100 dB being the most stringent value during the night shown on vibration contours for buffer zones

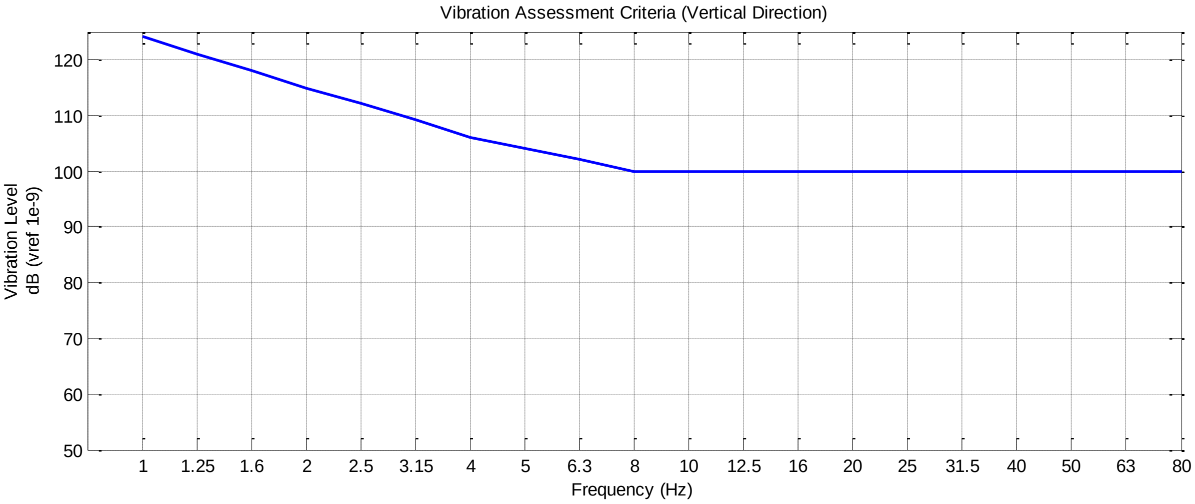


Figure 2 Tactile vibration limit shown in decibel (V ref 1e-9) for the vertical direction

2.3.2 Regenerated Noise

The ground borne noise criteria has been agreed upon with the DER to be no greater than $L_{Amax, slow}$ 35 dB(A) at residential receivers. The ground borne noise criteria is only applicable where receptors are not exposed to airborne noise from the rail alignments, as such the ground borne noise criteria is applicable for alignments in tunnels, deep cuttings, and cut and cover structures.

2.4 Construction Noise

The noise and vibration impacts associated with the construction of the FAL are likely to be temporary in nature at a given location, and are expected to be intermittent dependant on the phase of construction being undertaken.

Potential noise impacts resulting from construction of the FAL will be addressed through the Environmental Protection Act 1986, with the prescribed standards detailed in the Western Australian Environmental Protection (Noise) Regulations 1997.

Construction noise will not be assessed as part of this study, but will be included in later studies once the final route option and construction methodology has been selected. This will include preparation of a Construction Noise and Vibration Management Plan (CNVMP)

3.0 Assessment Methodology

To assess the potential noise and vibration levels, AECOM have used the following methodology for noise and vibration predictions.

3.1 Rail Noise Modelling

To assess the potential noise levels, AECOM have utilised the following methodology for noise prediction based on the SPP 5.4 implementation guidelines.

$L_{Aeq,16hr}$, $L_{Aeq,8hr}$, and L_{Amax} noise predictions have been carried out for each of the proposed alignment options. Noise modelling of rail traffic along the proposed alignments has been carried out using the SoundPLAN 7.1 noise modelling software.

3.1.1 Noise descriptors

SPP 5.4 requires rail noise assessments to be based upon the energy averaged $L_{Aeq,16hr}$ and $L_{Aeq,8hr}$ noise descriptors for the daytime and night time respectively. Daytime is defined as between 6 am and 10 pm, with night time defined as between 10 pm and 6 am.

The assessment methodology also requires the prediction of L_{Amax} noise levels, which are independent on train volumes and therefore time invariant.

3.1.2 Terrain

Existing terrain elevation data was provided in the form of elevation contours and spot heights by Landgate. It is understood that this data was sourced from a Light Detection And Ranging (LIDAR) survey of the region. This data was utilised in building the Digital Ground Model (DGM) used in the *SoundPLAN* model for the noise assessment.

No design information was provided for the Option 1 bridge structures. It has been assumed in the modelling that the rail will be positioned on an un-ballasted bridge structure.

Some CAD data was provided for cut and cut/cover sections of the Option 2 and Option 3 alignments, which has been utilised in conjunction with the Landgate WA data for the existing terrain to create a hybrid *SoundPLAN* DGM of the Option 2 and Option 3 terrain.

All terrain was modelled as acoustically hard (reflective) ground.

3.1.3 Rail alignments

Rail strings in 3D CAD format have been sourced from the project design team for the three proposed alignment options.

Option 1 runs primarily on an elevated structure and has been modelled as a rail source on a concrete bridge structure.

Option 2 utilises a combination of rail on bridges, in cut and open, and in cut and covered structures.

Option 3 utilises a tunnel. We note that noise emissions are considered negligible for tunnels except for the exit and entry points.

3.1.4 Train types

PTA advised that Transperth B-series trains will be used on the FAL. The noise model algorithm inputs were therefore calibrated for both the L_{Aeq} and L_{Amax} noise emissions of B-series Trains.

3.1.5 Train speeds

PTA has advised that the network speed limit for the FAL will be 100 km/h, which has been included as an input to the Kilde algorithm.

3.1.6 Train volumes

Anticipated future train volumes were provided by PTA. These consist of:

- 10-minute running in both directions between 6 am and 10 pm
- 15-minute running in both directions between 5 am and 6 am and between 10 pm and 12pm
- 60-minute running in both directions between 10 pm and 6 am on Friday/Saturday nights

This was calculated to equate to 96 train movements each way during the day time (as defined in SPP5.4), and 14 each way during the night.

3.1.7 Noise sensitive receivers

Building footprints and cadastral data provided by Landgate WA were incorporated into the noise model to identify noise sensitive receptor locations. Building height information was also provided and utilised. Building footprints were cross checked against aerial photography and street level photography to ensure noise sensitive dwellings were correctly identified and modelled.

Noise levels for sensitive receiver locations were modelled at a distance of 1 m from the building façade and at a height of 1.5 m above the ground. Multiple storey receivers were not surveyed for the purpose of this assessment, however will be modelled at detail design stage.

Receiver noise levels predicted at the building façade also include a +2.5 dB(A) façade correction as per the SPP 5.4 requirements.

3.1.8 Calculation area

The calculation area for the noise modelling was developed in consultation with PTA. Noise sensitive receivers located within a 100m setback distance of the proposed rail alignments were included in the noise modelling. The calculation area is limited in western extent to the Clavering Road / Anzac Street meets the rail corridor and in the eastern extent at the Domestic Terminal where the three route options meet.

3.2 Vibration Modelling

3.2.1 Tactile and Ground borne Noise Modelling Methodology

One of the keys to success in this study is the need to employ a vibration model that is able to accurately predict the propagation of vibration through potentially complex geometry and geology and determine the future ground-borne noise and tactile vibration generated by the FAL project.

There are no existing commercially available software packages, so over many projects AECOM has researched and developed methods to calculate vibration from underground railways. AECOM's in-house method uses a combination of the Pipe-in-pipe method to derive the vibratory source level which takes into consideration parameters such as train speed, track form, tunnel geometry and the tunnel material (concrete). Geometric spreading and ground damping are calculated for the assessment area using parameters including:

- Relative location of the receiver to the train (lateral setback from and depth of alignment);
- The foundation type of the receiver building/structure (e.g. spread footings, piles, etc);
- The relative location within the receiver space (i.e. level above ground (i.e. the floor) and lateral setback from track); and
- The type of soil and its frequency dependent damping characteristics.

The vibration assessment utilises identical terrain model, 3D rail alignment and train types as per the noise methodology.

3.2.2 Bored Tunnel and Cut and Cover sections

Cut and cover and bored tunnelled sections are included in the design of route Options 2 and 3 respectively. The reference train vibration source levels were acquired from SLR Consultant's 'Operational Noise and Vibration Assessment' report for 'Perth City Link Rail Project*, Report Number 675.01558-R4.*

The calculation parameters for the vibration assessment are presented in Table 2.

Table 2 Calculation parameters for the vibration assessment

Parameter	Input
Train	
Speed (km/h)	80
Tunnel and track (Option 2 and 3)	
Outside diameter (m) (Bored Tunnel Only)	6.16 m
Wall thickness (m) (Bored Tunnel Only)	0.25 m
Wall material	Concrete
Resilient track form	Stiff rail fasteners
Ground	
Type	Sandy soil
Loss factor	0.0143
Wave speed m/s	1200
Receiver	
Ground Coupling type	Single storey residential

For conservativeness, all receivers have been set to be single storey residential receivers. The train speeds have been modelled for 80km/hr speeds due to the data availability for this train speed. The difference of predicted vibration levels for an 80km/hr train to a 100km/hr train would be very minimal in the range of 1-1.9dB.

Further vibration measurements of trains will be carried out during the detailed design stage of the project. The train speeds based on the final design and selected option will be modelled at this time.

The coupling loss spectrum associated with a single storey residential property is as below. The coupling loss approximates the loss in vibration energy as the vibration travels from the ground into the structure, in this case a residential building.

Table 3 **Coupling loss spectrum associated with single storey residential property**

20	25	31.5	40	50	63	80	100	125	160	200	250	315
-6	-6	-6	-6	-6	-6	-6	-5	-5	-5	-4	-4	-4

3.2.3 At-grade sections

At grade sections are found for the majority of route option 1 and within minor sections of route option 2 and 3. For tracks which are at grade, only tactile vibration needs to be assessed as airborne noise will dominant over ground borne noise.

Vibration measurements for a rail line at grade were taken by AECOM as a part of the study for the new Perth Stadium Transport Infrastructure Project (AECOM report number: *60277837 BH REP 0001 rev2*). The measurements were performed at East Perth and Burswood in direct vicinity of Midland and Armadale/Thornlie lines respectively.

The overall vibration level was 100 dB at a distance of 7 metres from the track. Therefore, the overall vibration level will be less than 100 dB beyond 7 metres from the outer track. Figure 2 shows that the lowest limit for any single frequency band is 100 dB; therefore an overall level which does not exceed 100 dB will comply with the assessment criteria.

3.2.4 Fly-over sections

Fly-over sections have been identified in route options 1 and 2. In AECOM's experience the highest predicted vibration levels from fly-over structures which are made of precast concrete are less than 100 dB. It is therefore considered that such structures do not require vibration assessment. The vibration assessment for route option 2 therefore focuses solely on the cut and cover sections.

4.0 Noise and Vibration Predictions

4.1 Noise

Noise predictions of the three alignment options have been made based on the parameters detailed in the previous sections for the $L_{Aeq, 16hr}$, $L_{Aeq, 8hr}$, and L_{Amax} parameters.

The predicted noise levels and potential impact of the FAL alignments are best presented in terms of noise contours for a visual representation. Noise contours have been predicted for the study area for the three alignments without mitigation for the following parameters and contour values.

Table 4 Noise parameters and contour values

Noise Parameters	Below Noise Target	Exceeds Noise Target	Exceeds Noise Limit
$L_{Aeq, 16 hr}$	<55dB	55-60dB	>60dB
$L_{Aeq, 8 hr}$	<50dB	50-55dB	>55dB
L_{Amax}	<75dB	75-80dB	>80dB

The noise contours for each route option and noise parameter without noise mitigation are shown in the following figures in Appendix B.

- Option 1;
  - $L_{Aeq, 16 hr}$ – Figures B01 – B04
  - $L_{Aeq, 8 hr}$ – Figures B05 – B08
  - L_{Amax} – Figures B09 – B12

- Option 2;
  - $L_{Aeq, 16 hr}$ – Figures B13 – B17
  - $L_{Aeq, 8 hr}$ – Figures B18 – B22
  - L_{Amax} – Figures B23 – B27

- Option 3;
  - $L_{Aeq, 16 hr}$ – Figure B28
  - $L_{Aeq, 8 hr}$ – Figure B29
  - L_{Amax} – Figure B30

The noise predictions indicate that noise levels exceed the assessment criteria (noise limit, noise target and max) and therefore noise mitigation options are required to be considered for all three route options as exceedances of the project specific criteria occurs. In addition, the predictions indicate that the daytime noise levels are the greatest exceedance of the project specific criteria and hence dictate mitigation requirements.

4.2 Vibration

Vibration predictions have been calculated based on the vibration parameters detailed in Section 3.2. Vibration predictions are shown in relation to buffer zones around the proposed alignments.

The tactile vibration Figures (assessment to AS 2670) are shown in dB scale with the 100 dB buffer level being the most stringent criteria for night times.

Ground borne noise buffers are presented in areas where this criterion is applicable (e.g. deep cuttings, tunnels).

4.2.1 Route Option 1

4.2.1.1 Tactile Vibration

Figure C01 in Appendix C shows the 100 dB buffer from the track alignment in accordance with tactile vibration criteria. Only areas at grade have been shown as vibration impacts are unlikely to be an issue for elevated and bridge sections.

Vibration levels due to FAL rail movement's at all residential receivers along this alignment are predicted to be less than 100 dB and would therefore comply with the tactile vibration criterion presented in section 2.3.1.

4.2.1.2 Ground borne Vibration

Ground borne vibration criteria are not applicable to this route option as airborne noise will dominate during train pass-bys.

4.2.2 Route Option 2

4.2.2.1 Tactile Vibration

The vibration levels at surrounding residential buildings of the alignment are shown in Figures C02-C06 of Appendix C. The vibration levels shown indicated that the 100 dB contour does not encroach the footprint of any residential building along the alignment with stiff track coupling, and therefore complies with the tactile vibration criteria.

4.2.2.2 Ground borne Vibration

Ground borne noise contours for option 2 are shown in Figures C07-C11 of Appendix C for scenarios with stiff track coupling. Exceedances above the ground borne noise criteria are predicted for stiff rail fasteners, therefore vibration mitigation should be considered.

4.2.3 Route Option 3

4.2.3.1 Tactile Vibration

Vibration levels at surrounding residential buildings of the alignment are predicted to be less than 100 dB in the study area; therefore no contour maps have been included in Appendix C.

4.2.3.2 Ground borne Vibration

Ground borne noise is expected to exceed the assessment criteria of 35 dB(A) for some residential properties along the alignment with the use of stiff rail fasteners. The ground borne noise contours are shown in Figures C12 – C17 in Appendix C. Therefore vibration mitigation should be considered for this option.

5.0 Mitigation Requirements

5.1 Noise

The provision of noise mitigation of the three FAL route options has been undertaken based upon both L_{Aeq} and L_{Amax} noise levels for preliminary barrier designs to achieve the noise target and noise limit levels of SPP 5.4.

Investigation of the noise levels parameters predicted ($L_{Aeq,16hr}$, $L_{Aeq,8hr}$, and L_{Amax}) indicates that the $L_{Aeq,16hr}$ noise level dictates the requirement for noise mitigation, by having greatest noise exceedance of the criteria. Therefore noise mitigation has been designed based on the $L_{Aeq,16hr}$ noise level, with reference to the L_{Amax} level.

Where noise mitigation is required to be considered, measures will be assessed by the reasonable and practical measures approach as detailed in SPP 5.4.

The following section details the noise barrier requirements for each scenario to achieve the noise target and noise limit levels of SPP 5.4. Tabulated results at all noise-sensitive receivers for the mitigation scenarios of each route option are included in Appendix F.

5.1.1 Noise Mitigation Design Parameters

The specification of noise mitigation options have been based on the following PTA provided limitations of noise barrier design:

- Maximum height of noise walls at grade to be considered is 3 m
- Maximum height of noise walls on elevated sections to be considered is 3 m
- Minimum distance from rail tracks allowable is 2.5 m on elevated sections & 3.2 m at grade.

5.1.2 Route Option 1 - Noise target barrier design

Table 5 provides a summary of the required barrier design for best compliance with the noise targets of SPP 5.4, the locations of these barriers are shown in Figures D01 – D03 in Appendix D.

Table 5 Option 1 Noise Barrier Requirements (Noise Target)

Barrier	Height (m)	Length (m)	Location
A	3	270	On elevated structure
B	1.5	603	On elevated structure
C	2.5	83	On elevated structure
D	3	405	On elevated structure
E	1.0	734	On elevated structure
F	2.5	330	On elevated structure
G	3	110	On elevated structure
H	2.5	110	On elevated structure
I	2.5	134	On elevated structure
J	1.5	374	On elevated structure
K	1.5	590	On elevated structure
L	2.5	357	On elevated structure
M	3	80	At grade
N	3	80	At grade

Practical limitations to wall design have resulted in some residual exceedance predicted with the barrier design in places. A summary of the modelling results for Option 1 with walls design to meet the noise target is provided in Table 6.

Table 6 Predicted noise target exceedances for Option 1

Criteria exceedance level	Number of receivers
1 dB(A)	1
2 dB(A)	1
3 dB(A)	1
4 dB(A)	2
5 dB(A)	0

5.1.3 Route Option 1 - Noise limit barrier design

Table 7 provides a summary of the required barrier design for best compliance with the noise limit of SPP 5.4, the locations of these barriers are shown in Figures D04 – D06 in Appendix D.

Table 7 Option 1 Noise Barrier Requirements (Noise Limit)

Barrier	Height (m)	Length (m)	Location
A	1.5	268	On elevated structure
B	0.5	145	On elevated structure
C	1.5	144	On elevated structure
D	0.5	84	On elevated structure
E	0.5	813	On elevated structure
F	2.5	395	On elevated structure
G	1.5	340	On elevated structure
H	0.5	617	On elevated structure
I	0.5	626	On elevated structure
J	1.5	216	On elevated structure
K	1.5	215	On elevated structure
L	2.5	80	At grade
M	1.5	80	At grade

Note that the barrier design above does not result in any residual exceedances of the noise limit.

5.1.4 Route Option 2 - Noise target barrier design

Table 8 provides a summary of the required barrier design for best compliance with the noise target of SPP 5.4, the locations of these barriers are shown in Figures D07 – D09 in Appendix D.

Table 8 **Option 2 Noise Barrier Requirements (Noise Target)**

Barrier	Height (m)	Length (m)	Location
A	3	219	At grade
B	3	289	At grade
C	3	405	At grade
D	3	297	On elevated structure
E	1.5	306	On elevated structure
F	1.5	304	On elevated structure
G	3	50	At grade
H	2.5	243	On elevated structure
I	3	282	On elevated structure
J	3	44	On elevated structure
K	3	40	At grade
L	3	105	At grade

Practical limitations to wall design have resulted in some residual exceedance predicted with the barrier design in place. A summary of modelling results for the Option 2 scenario with wall design to meet the noise target is provided in Table 9.

Table 9 **Predicted noise target exceedances for Option 2**

Criteria exceedance level	Number of receivers
1 dB(A)	5
2 dB(A)	3
3 dB(A)	2
4 dB(A)	0
5 dB(A)	0
>= 6 dB(A)	3

5.1.5 Route Option 2 - Noise limit barrier design

Table 10 provides a summary of the required barrier design for best compliance with the noise limit of SPP 5.4, the locations of these barriers are shown in Figures D10 – D12 in Appendix D.

Table 10 **Option 2 Noise Barrier Requirements (Noise Limit)**

Barrier	Height (m)	Length (m)	Location
A	3	109	At grade
B	3	143	At grade
C	2.5	144	On elevated structure
D	1	184	On elevated structure
E	0.5	132	On elevated structure

Barrier	Height (m)	Length (m)	Location
F	1.5	282	On elevated structure
G	3	44	On elevated structure
H	1.5	40	At grade
I	3	105	At grade

Practical limitations to wall design have resulted in some residual exceedance predicted with the barrier design in place. A summary of modelling results for the Option 2 scenario with wall design to meet the noise limit is provided in Table 11.

Table 11 Predicted noise target exceedances for Option 2

Criteria exceedance level	Number of receivers
1 dB(A)	3

5.1.6 Route Option 3 - Noise target barrier design

Table 12 provides a summary of the required barrier design for best compliance with the noise target of SPP 5.4, the locations of these barriers are shown in Figure D13 in Appendix D.

Table 12 Option 2 Noise Barrier Requirements (Noise Target)

Barrier	Height (m)	Length (m)	Location
A	3	209	At grade

Practical limitations to wall design have resulted in some residual exceedance predicted with the barrier design in place. A summary of modelling results for the Option 3 scenario with wall design to meet the noise target is provided in Table 13.

Table 13 Predicted noise target exceedances for Option 2

Criteria exceedance level	Number of receivers
1 dB(A)	1
2 dB(A)	0
3 dB(A)	1

5.1.7 Route Option 3 - Noise limit barrier design

Table 14 provides a summary of the required barrier design for best compliance with the noise limit of SPP 5.4, the locations of these barriers are shown in Figures D14 in Appendix D.

Table 14 Option 1 Noise Barrier Requirements (Noise Limit)

Barrier	Height (m)	Length (m)	Location
A	1.0	209	At grade

Note that the barrier design above does not result in any residual exceedances of the noise limit.

5.2 Vibration

Vibration impacts have been predicted assuming the use of stiff rail / sleeper couplings and have been assessed to the criteria of AS 2670 and a ground borne noise criteria of 35 dB ($L_{Amax, slow}$) where applicable.

The assessment has shown that the project specific vibration criteria are predicted to be exceeded for a number of scenarios. This section details the vibration mitigation requirements for each alignment option.

5.2.1 Route Option 1

5.2.1.1 Tactile Vibration

The tactile vibration criteria (AS 2670) is predicted to be achieved for this option with stiff track fasteners.

5.2.1.2 Ground borne vibration

Ground borne noise criteria are not applicable to this alignment option.

5.2.2 Route Option 2

5.2.2.1 Tactile Vibration

The tactile vibration criteria (AS 2670) is predicted to be achieved for this option with stiff track fasteners.

5.2.2.2 Ground borne vibration

Predictions have shown that the ground borne noise criterion is exceeded with stiff track fasteners. The location of exceedances is shown in Figures 3-5 and the mark-up of areas requiring treatment is also shown.

Vibration predictions have therefore been modelled for the option 2 alignment utilising a Pandrol Vanguard fastener, to investigate reducing the impact of ground borne noise. The predicted ground borne noise contours for option 2 with Pandrol Vanguard fasteners are shown in Figures E01-E05 of Appendix E.

The resultant vibration impact is significantly reduced with the Pandrol Vanguard fasteners; however the ground borne criteria at approximately 12 houses on Wyatt Road, Bayswater are marginally exceeded with the Pandrol Vanguard. These marginal exceedances are depicted in Figure E-02.

The current vibration model is conservative and will be further refined during the detailed design stage of the project. Impact measurements to accurately understand the vibration attenuation will be carried out. The current predicted results are conservative and further refining the model based on impact measurements may change the mitigation requirements.

The required locations for the situating of the Pandrol Vanguard for option 2 are detailed in Figure 3 - Figure 5, and associated lengths of tracks requiring mitigation detailed in Table 15

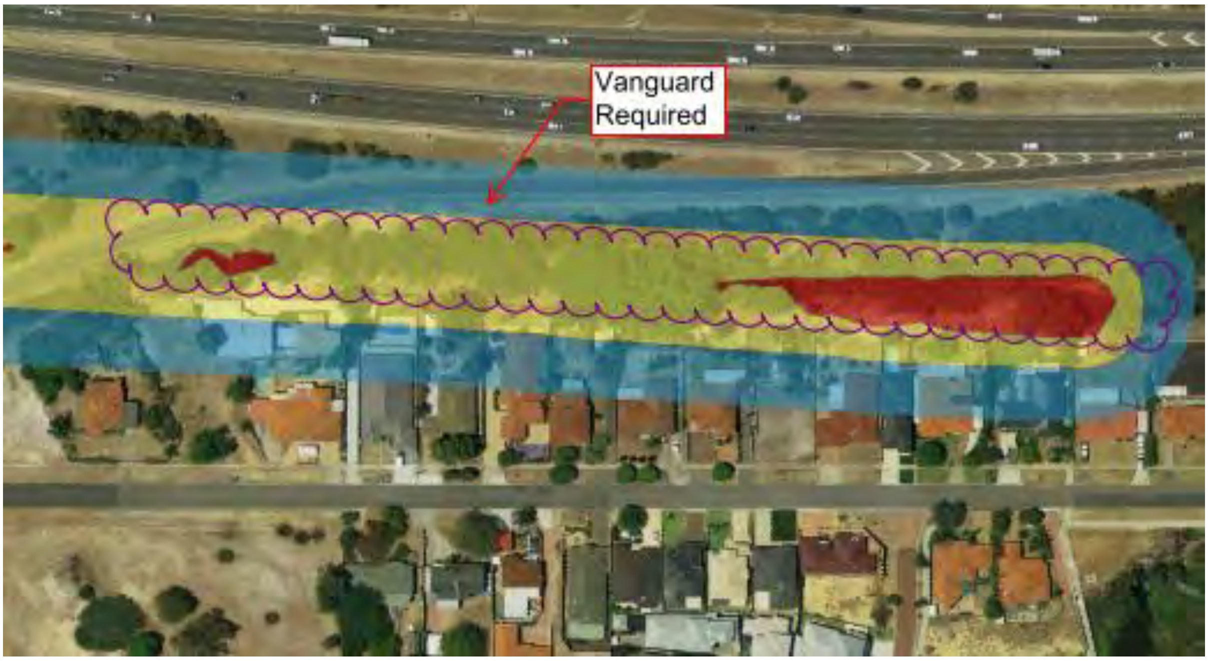


Figure 3 **Proposed Location 1 of Pandrol Vanguard – Option 2**

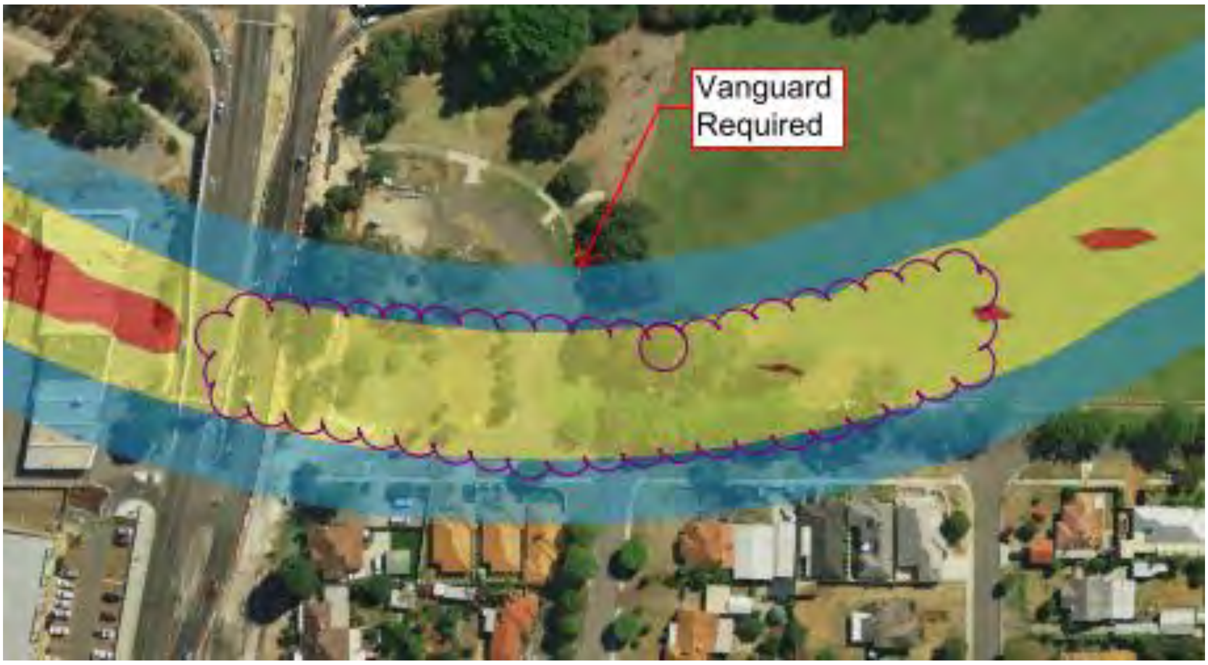


Figure 4 **Proposed Location 2 of Pandrol Vanguard – Option 2**

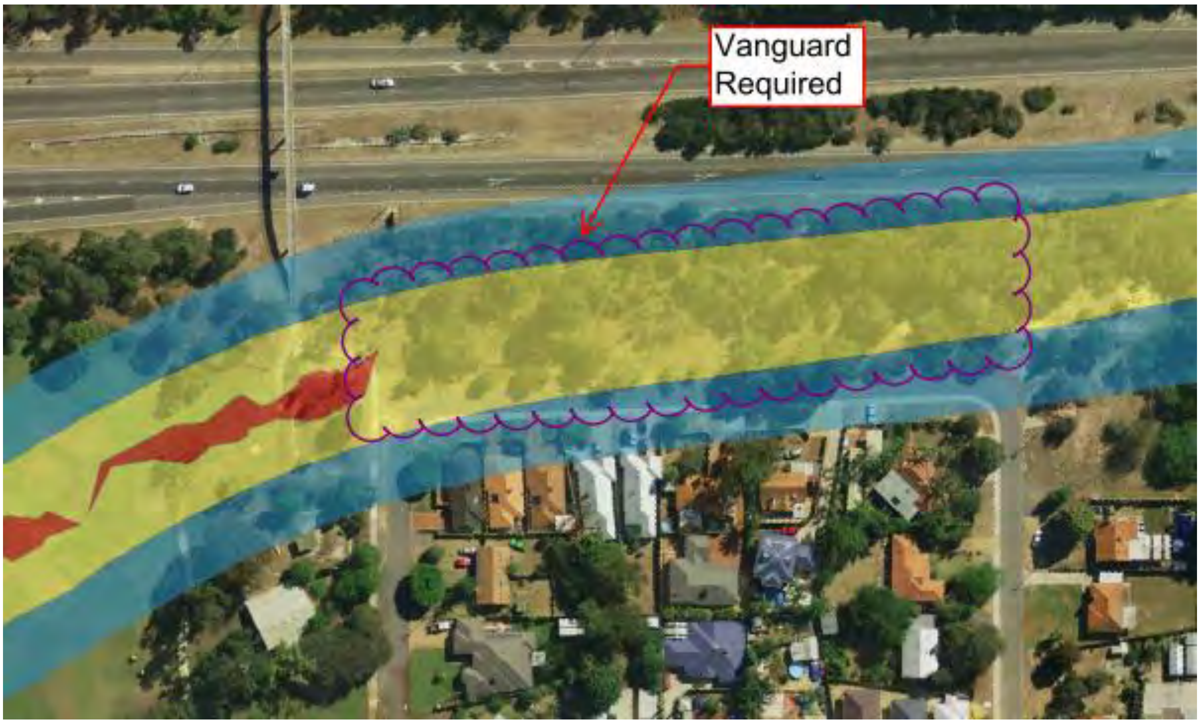


Figure 5 **Proposed Location 3 of Pandrol Vanguard – Option 2**

Table 15 **Option 2 - Pandrol Vanguard Locations and Lengths**

Location	Reference	Length (m)
1	Figure 3	320
2	Figure 4	200

Location	Reference	Length (m)
3	Figure 5	175

5.2.3 Route Option 3

5.2.3.1 Tactile Vibration

The tactile vibration criteria (AS 2670) is predicted to be achieved for this option with stiff track fasteners.

5.2.3.2 Ground borne vibration

Predictions have shown that the ground borne noise criterion is exceeded with stiff track fasteners.

Vibration predictions have therefore been modelled for the option 3 alignment utilising a Pandrol Vanguard fastener, to investigate reducing the impact of ground borne noise. The predicted ground borne noise contours for option 3 with Pandrol Vanguard fasteners are shown in Figures E06-E09 of Appendix E.

The resultant vibration impact is significantly reduced with the Pandrol Vanguard fasteners, and the ground borne noise criteria is predicted not be exceeded with the Pandrol Vanguard fasteners.

The required locations for the situating of the Pandrol Vanguard for option 3 are detailed in Figure 6, and associated lengths of tracks requiring mitigation detailed in Table 16.

Figure 6 **Proposed Location 1 of Pandrol Vanguard – Option 3**

Table 16 **Option 3 - Pandrol Vanguard Locations and Lengths**

Location	Reference	Length (m)
1	Figure 6	750

6.0 Conclusion

AECOM has been engaged by the PTA to carry out a noise and vibration feasibility study of the three proposed alignment to determine noise and vibration mitigation requirements for each of the FAL options. The requirement for mitigation options are based on project specific noise and vibration assessment criteria, which have been developed through consultation with AECOM, PTA, and the DER noise branch.

The predicted noise and vibration levels from each of the three route alignments have been predicted and where exceedances of the project specific criteria are identified, noise mitigation options have been specified.

The noise mitigation measures in the form of noise barriers were modelled based on the limitations provided by PTA for the maximum height (not exceeding 3m) and minimum distance from the rail tracks (2.5m on elevated structures and 3.2m at grade). The summary of noise and vibration mitigations for each of the route options is presented below.

Route Option 1

- Noise walls of varying lengths and heights at 14 locations will achieve compliance with the SPP5.4 noise target and at 13 locations for compliance with the SPP5.4 noise limit. Practical limitations to wall/ barrier design have however resulted in some residual exceedances for compliance with the noise target. There are no residual exceedances of the noise limit. There were no exceedances predicted for the L_{Amax} noise level criterion after noise mitigation measures are adopted.
- The total area of barrier for this option was calculated to be 8455 m^2 for compliance to noise target and 4225 m^2 for compliance to noise limit.
- The predicted vibration levels with stiff fasteners complied with the criteria for tactile vibration as per AS2670.
- The ground borne noise criterion for this alignment is not applicable as airborne noise is the dominant noise source.

Route Option 2

- Noise walls of varying lengths and heights at 12 locations will achieve compliance with the SPP5.4 noise target and at 9 locations for compliance with the SPP5.4 noise limit. Practical limitations to wall/ barrier design have however resulted in some residual exceedances for compliance with both the noise target and noise limit. There were no exceedances predicted for the L_{Amax} noise level criterion after noise mitigation measures are adopted.
- The total area of barrier for this option was calculated to be 6716 m^2 for compliance to noise target and 2296 m^2 for compliance to noise limit.
- The predicted vibration levels with stiff fasteners complied with the criteria for tactile vibration as per AS2670.
- The ground borne noise predictions show the ground borne noise criterion is exceeded with stiff track fasteners.
- Pandrol Vanguard fasteners were used as mitigation and the resultant vibration impact is significantly reduced with these fasteners; however the ground borne criteria at approximately 12 houses are marginally exceeded with the Pandrol Vanguard. It should be noted the current vibration model is conservative, this will be further refined during the detailed design stage of the project.

Route Option 3

- A noise wall is required at 1 location to achieve compliance with the SPP5.4 noise target and noise limit. Practical limitations to wall/ barrier design have however resulted in some residual exceedances for compliance with the noise target. There are no residual exceedances of the noise limit. There were no exceedances predicted for the L_{Amax} noise level criterion after noise mitigation measures are adopted.
- The total area of barrier for this option was calculated to be 627 m^2 for compliance to noise target and 209 m^2 for compliance to noise limit.
- The predicted vibration levels with stiff fasteners complied with the criteria for tactile vibration as per AS2670.

- The ground borne noise predictions show the ground borne noise criterion is exceeded with stiff track fasteners. Compliance to ground borne noise is predicted with use of Pandrol Vanguard fasteners.

The noise and vibration assessment detailed in this report are suitable for the feasibility study only. A detailed assessment of the final route alignment will be conducted once selected. The assessment criteria used in this feasibility study and the proposed noise and vibration mitigation requirements may therefore change.

7.0 References

Western Australian Planning Commission. *State Planning Policy 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning.* 2009.

Implementation Guidelines for State Planning Policy 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning. 2009.

Report Number 675.01558-R4 - SLR 'Operational Noise and Vibration Assessment' report for 'Perth City Link Rail Project

Report Number 60277837 BH REP 0001 rev2 – AECOM ' Preliminary Noise and Vibration Study' report for new Perth Stadium – Transport Infrastructure.

Appendix A

Acoustic Nomenclature

Appendix A Acoustic Nomenclature

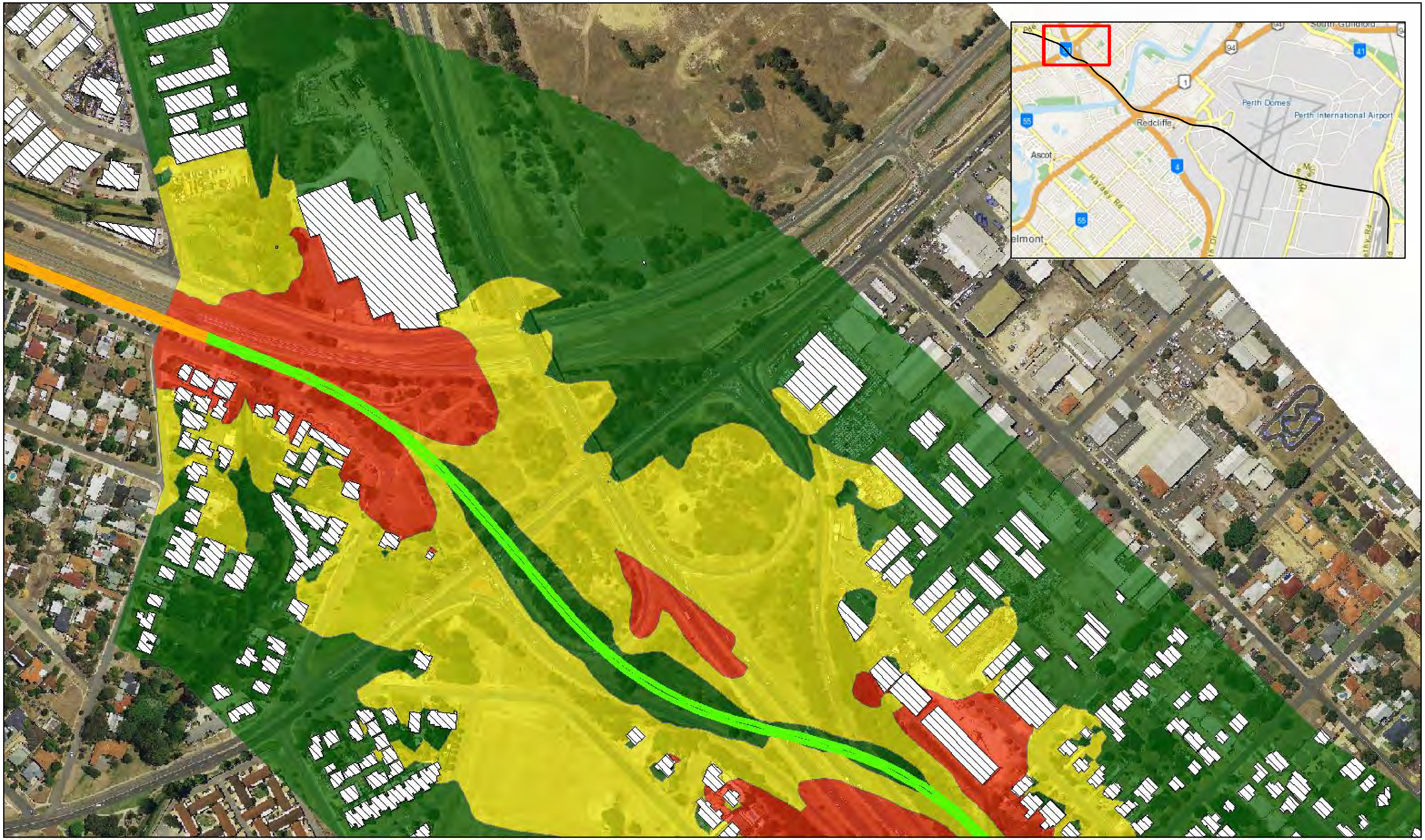
Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Competent Acoustic Consultant	SPP 5.4 defines a competent acoustic consultant as a member of the AAS or the AAAC. AECOM staff in the Perth acoustics team are all members of the AAS, AECOM is a member company of AAAC.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds;

0dB	The faintest sound we can hear
30dB	A quiet library or in a quiet location in the country
45dB	Typical office space. Ambience in the city at night
60dB	Forrest Place at lunch time
70dB	The sound of a car passing on the street
80dB	Loud music played at home
90dB	The sound of a truck passing on the street
100dB	The sound of a rock band
115dB	Limit of sound permitted in industry

dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
L_{Amax}	The maximum sound pressure level measured over a given period.
$L_{Aeq,\ T}$	The logarithmic average sound pressure level over duration period T.
$L_{Aeq.\ 24hrs}$	The logarithmic average sound pressure level over 24 hours.
$L_{Aeq,\ 16hrs}$	The logarithmic average sound pressure level over 24 hours. In the context of SPP 5.4 this refers to the daytime levels (between 06.00 hours and 22 hours).
$L_{Aeq,\ 8hrs}$	The logarithmic average sound pressure level over 8 hours. In the context of SPP 5.4 this refers to the night time levels (between 22.00 hours and 06 hours).
Noise sensitive premises	As defined in the *Environmental Protection (Noise) Regulations 1997*

Appendix B

Figures: Noise – No Mitigation



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N

DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres

1:3,250 (when printed at A3)

LEGEND

Rail alignment - Option 1	**Free field noise contours**	🟫 Building
🟧 At grade	🟩 < 55 dB(A)	
🟩 Fly over structure	🟨 > 55 dB(A) (Noise target)	
🟦 Tunnel	🟥 > 60 dB(A) (Noise limit)	

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
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LAST MODIFIED AC - 24/01/2014

Map
B-01

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1

- 🟧 At grade
- 🟩 Fly over structure
- 🟦 Tunnel

Free field noise contours

- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

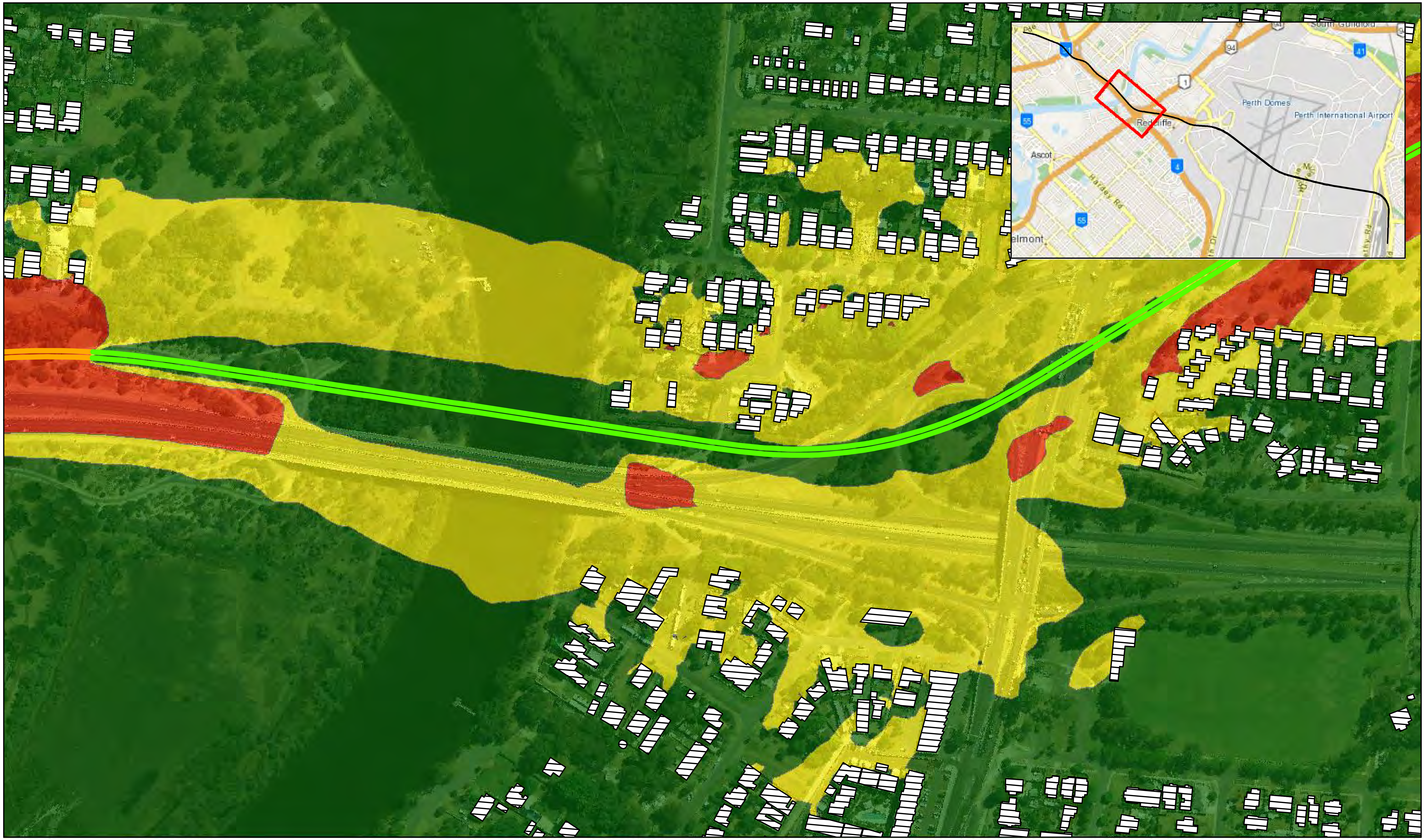
▭ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted daytime L_{Aeq} noise contours

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 25/06/2012

Map
B-02

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1
- 🟧 At grade
- 🟩 Fly over structure
- 🟦 Tunnel

Free field noise contours
- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

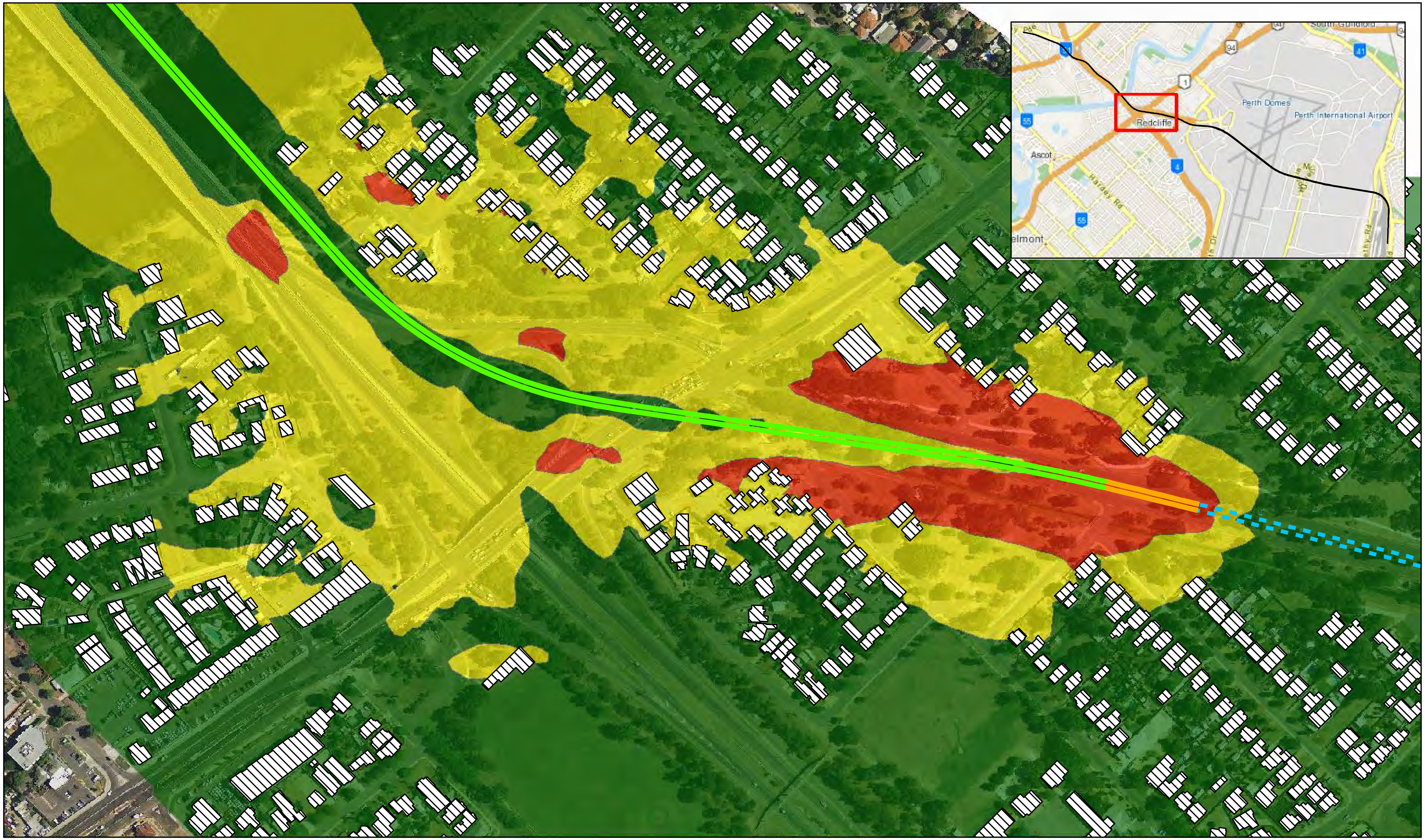
☐ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 25/06/2012

Map
B-03

A3 size



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AECOM
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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1
- 🟧 At grade
- 🟩 Fly over structure
- 🟦 Tunnel

Free field noise contours
- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

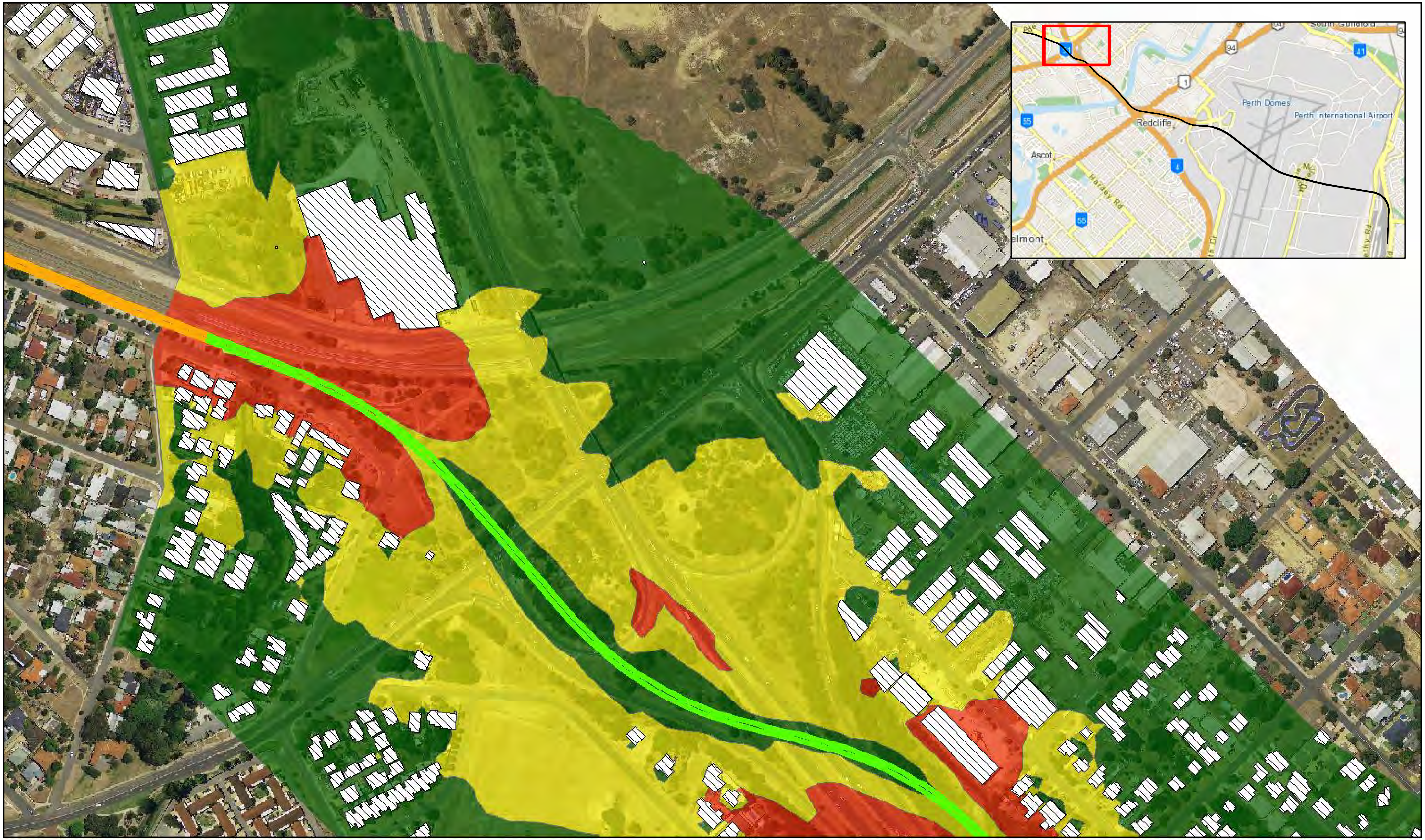
▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 25/06/2012

Map
B-04

A3 size



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N

DATUM GDA 1994, PROJECTION PCG94

0 40 80 160

metres

1:3,250 (when printed at A3)

LEGEND

Rail alignment - Option 1
- 🟧 At grade
- 🟩 Fly over structure
- 🟦 Tunnel

Free field noise contours
- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted night time L_{Aeq} noise contours

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Map
B-05

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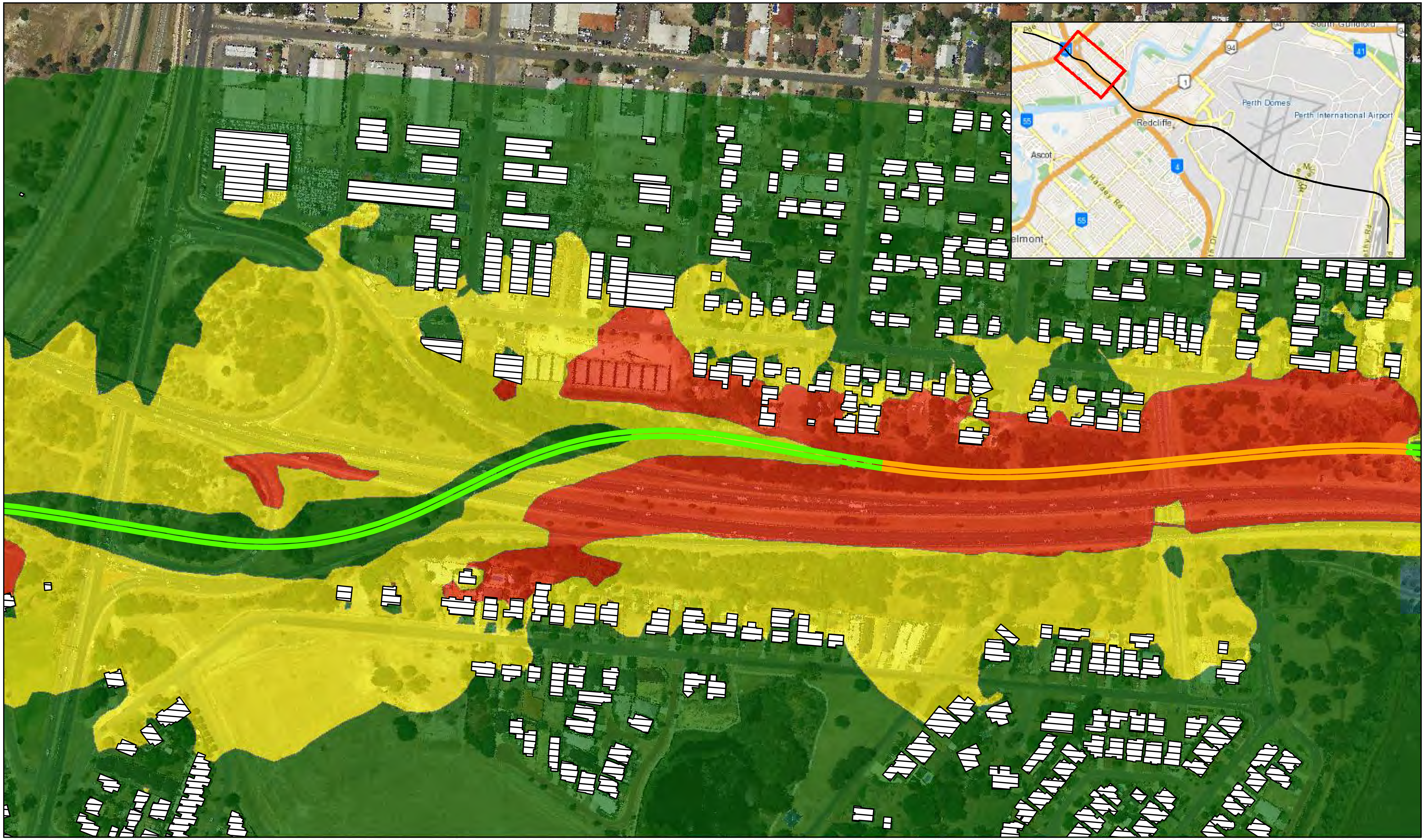

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1
- 🟧 At grade
- 🟩 Fly over structure
- 🟦 Tunnel

Free field noise contours
- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▭ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted night time L_{Aeq} noise contours

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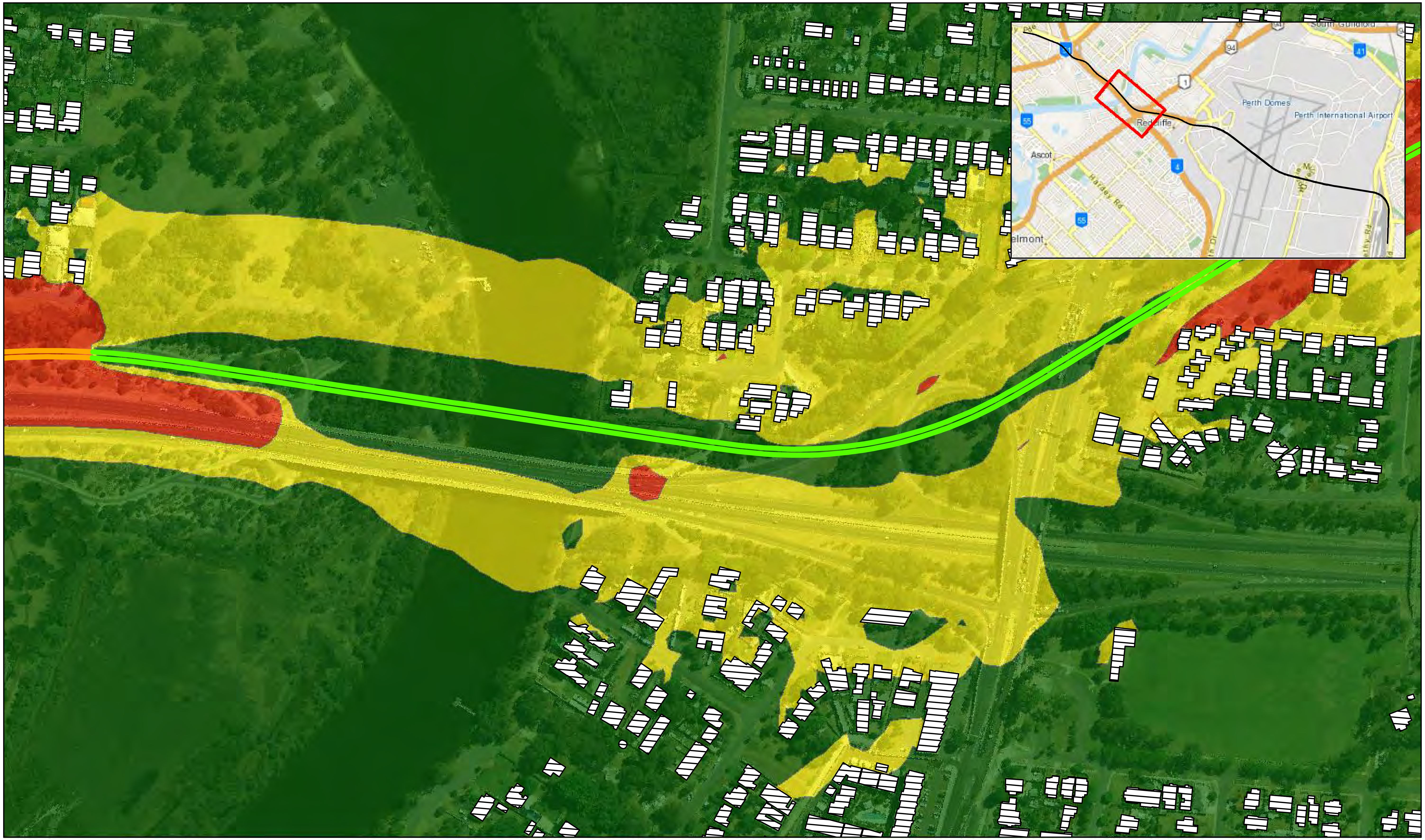
LAST MODIFIED AC - 17/11/2013

Map
B-06

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1
- 🟧 At grade
- 🟩 Fly over structure
- 🟦 Tunnel

Free field noise contours
- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▭ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted night time L_{Aeq} noise contours

PROJECT ID 60301258
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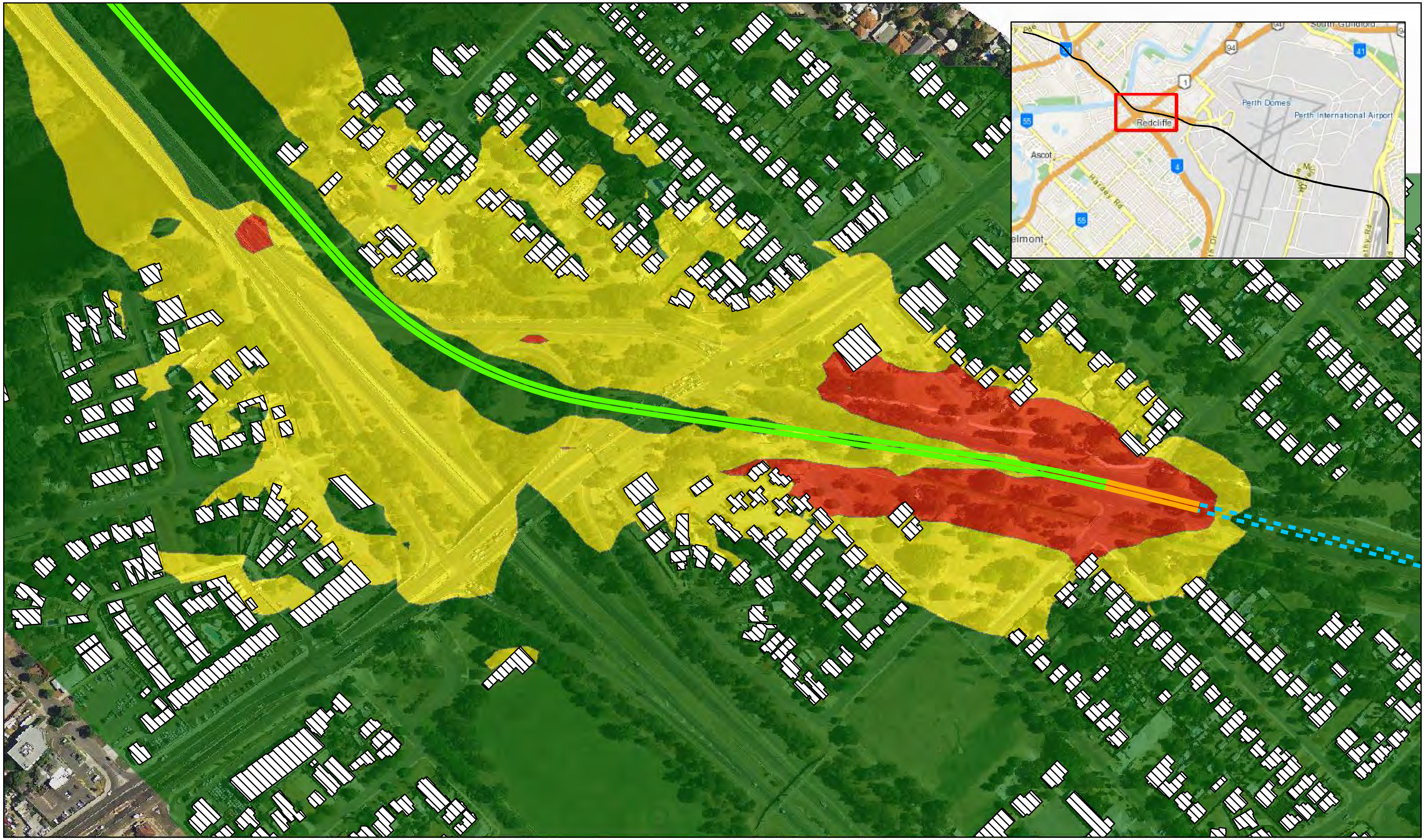
Map
B-07

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

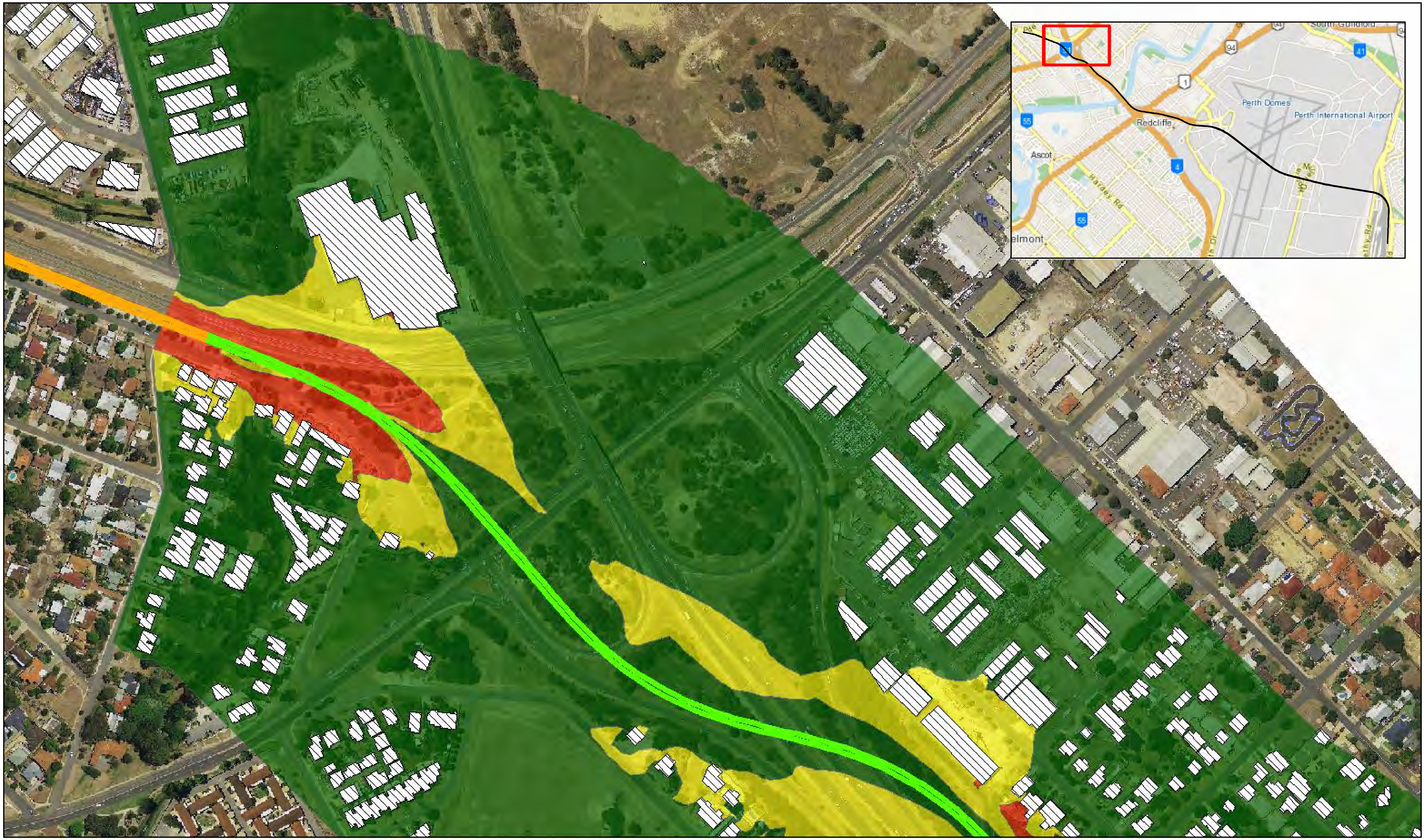
Rail alignment - Option 1	**Free field noise contours**	☐ Building
▬ At grade	🟩 < 50 dB(A)	
▬ Fly over structure	🟨 > 50 dB(A) (Noise target)	
▬ Tunnel	🟥 > 55 dB(A) (Noise limit)	

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted night time L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 17/11/2013

Map
B-08

A3 size



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N

DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres

1:3,250 (when printed at A3)

LEGEND

Rail alignment - Option 1	**Free field noise contours**	▨ Building
🟧 At grade	🟩 < 75 dB(A)	
🟩 Fly over structure	🟨 > 75 dB(A)	
🟦 Tunnel	🟥 > 80 dB(A) (Noise limit)	

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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Map
B-09

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1	**Free field noise contours**	▭ Building
🟧 At grade	🟩 < 75 dB(A)	
🟩 Fly over structure	🟨 > 75 dB(A)	
🟦 Tunnel	🟥 > 80 dB(A) (Noise limit)	

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted L_{Amax} noise contours

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Map
B-10

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1	**Free field noise contours**	
🟧 At grade	🟩 < 75 dB(A)	Building
🟩 Fly over structure	🟨 > 75 dB(A)	
🟦 Tunnel	🟥 > 80 dB(A) (Noise limit)	

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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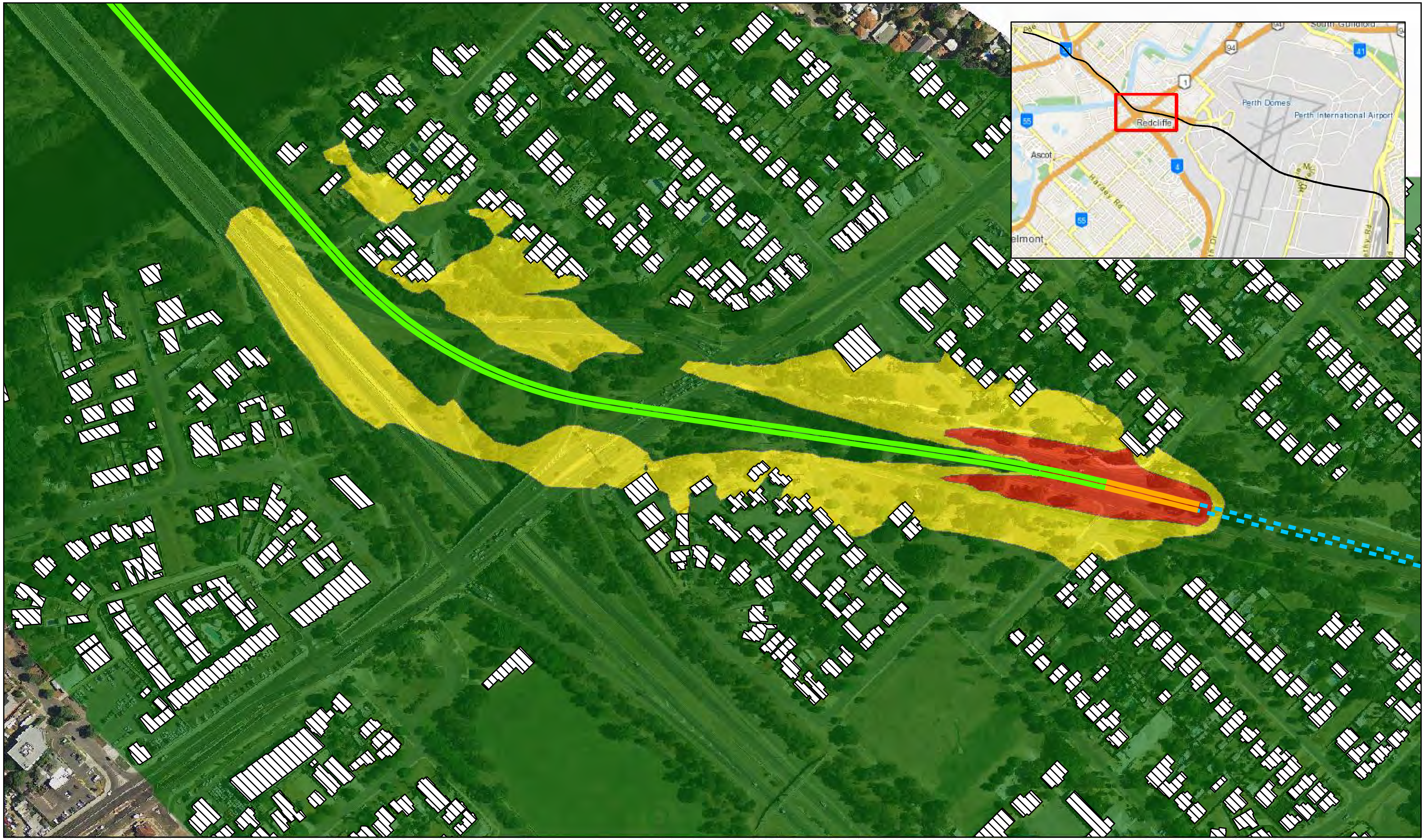
Map
B-11

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1
- 🟧 At grade
- 🟩 Fly over structure
- 🟦 Tunnel

Free field noise contours
- 🟩 < 75 dB(A)
- 🟨 > 75 dB(A)
- 🟥 > 80 dB(A) (Noise limit)

▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Predicted L_{Amax} noise contours

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Map
B-12

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150

metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2

- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut

Free field noise contours

- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

▭ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted daytime L_{Aeq} noise contours

PROJECT ID	60301258
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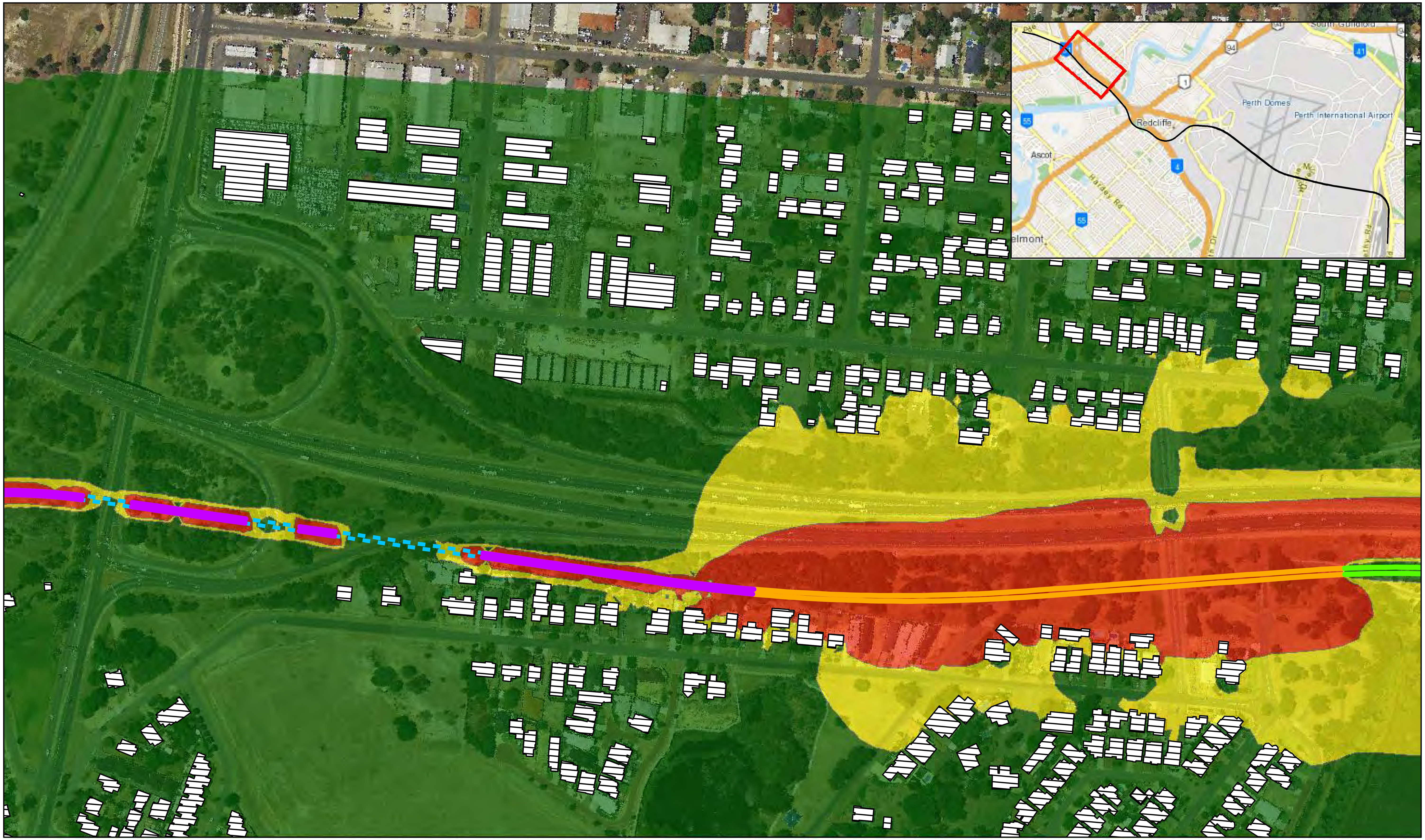
Map
B-13

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- ▬ Tunnel

Free field noise contours
- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
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Map
B-14

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- ▬ Tunnel

Free field noise contours
- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
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Map
B-15

A3 size

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N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- 🟦 Tunnel

Free field noise contours
- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
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Map
B-16

A3 size

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N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- 🟦 Tunnel

Free field noise contours
- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
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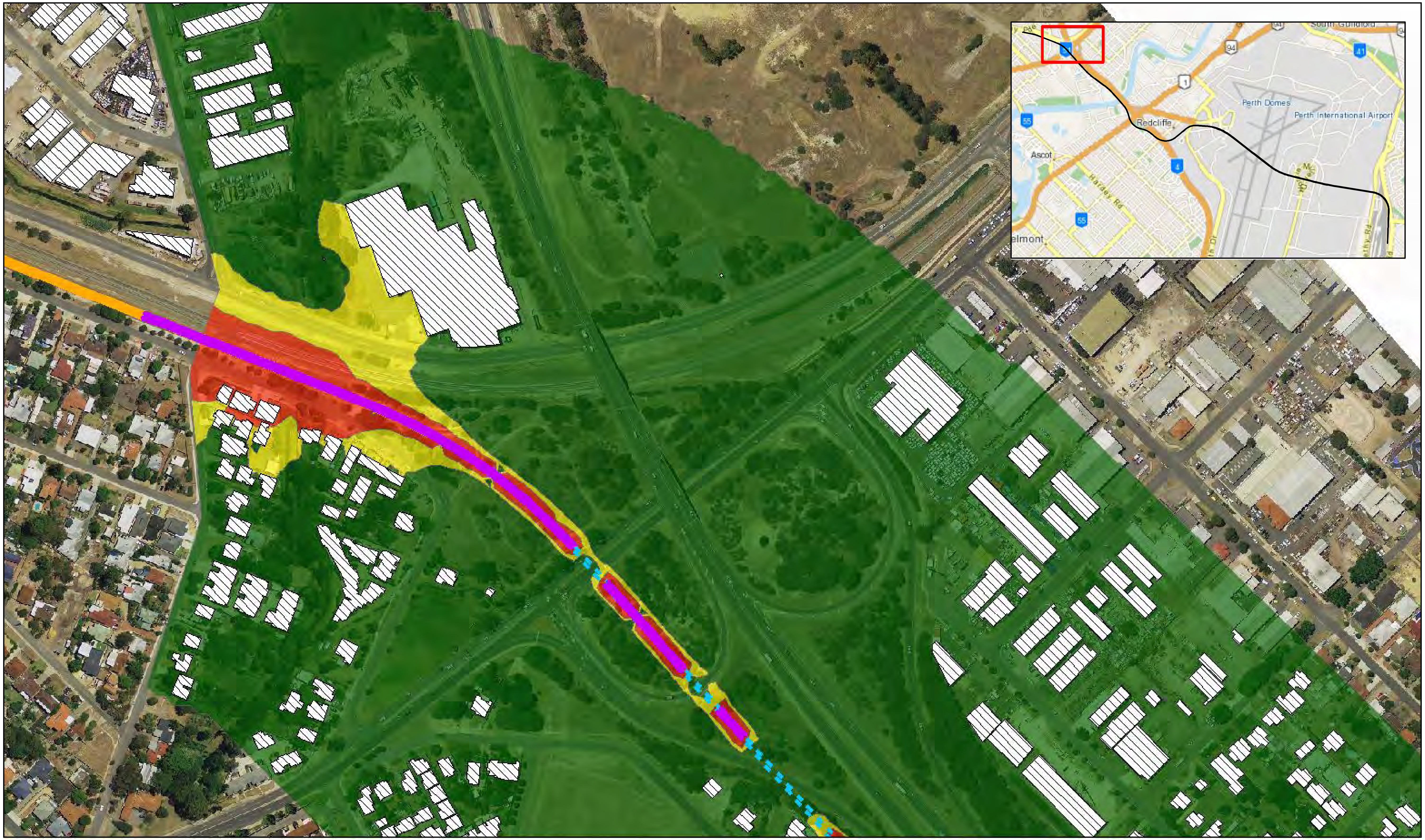
LAST MODIFIED AC - 18/11/2013

Map
B-17

A3 size



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N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut

Free field noise contours
- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▭ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted night time L_{Aeq} noise contours

PROJECT ID 60301258
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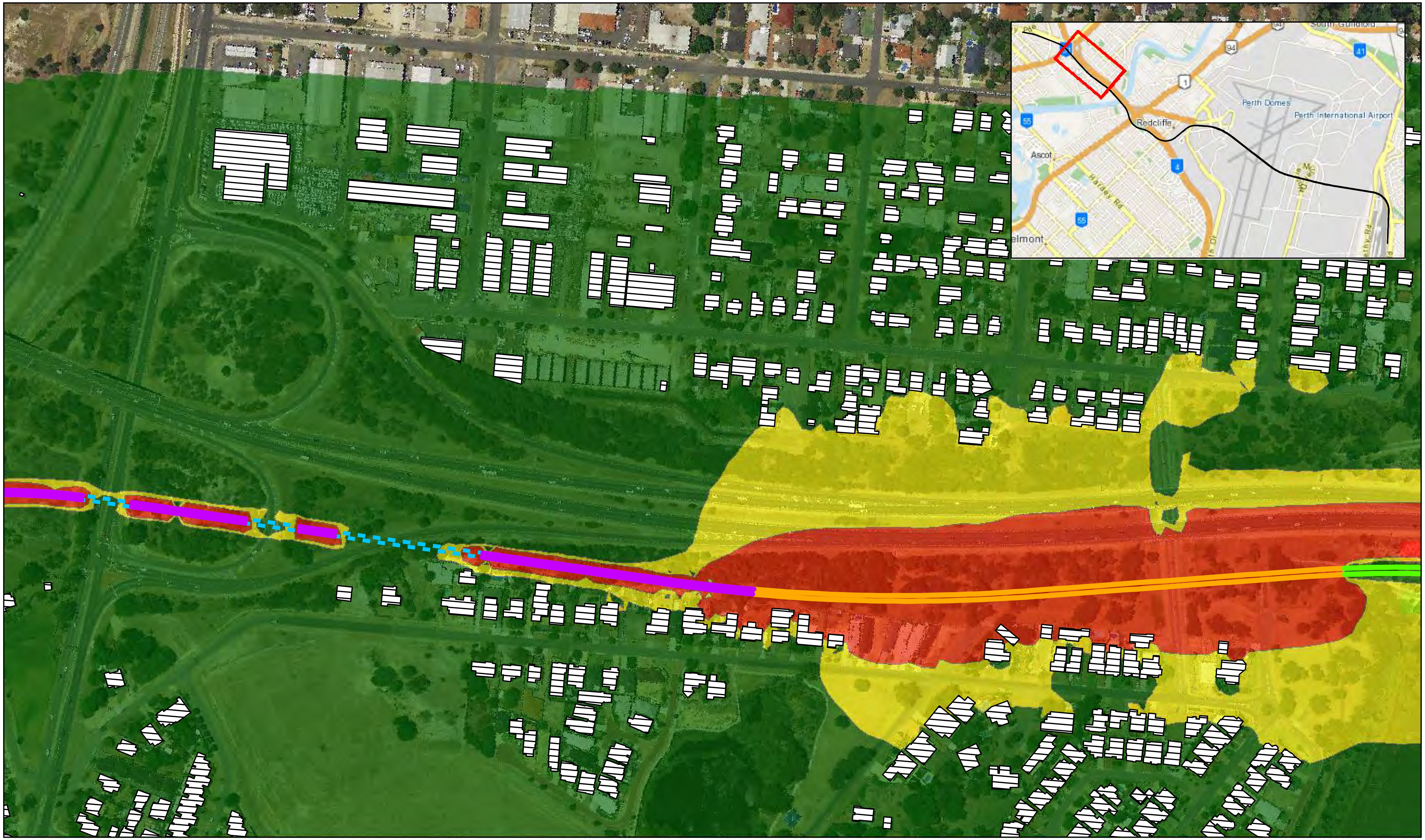
Map
B-18

A3 size



AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- \- Tunnel

Free field noise contours
- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted night time L_{Aeq} noise contours

PROJECT ID	60301258
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Map
B-19

A3 size

AECOM
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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2

- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- ▬ Tunnel

Free field noise contours

- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted night time L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 17/11/2013

Map
B-20

A3 size

N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150

metres

1:3,000 (when printed at A3)

AECOM

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LEGEND

Rail alignment - Option 2

- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- ▬ Tunnel

Free field noise contours

- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted night time L_{Aeq} noise contours

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 17/11/2013

Map

B-21

A3 size

AECOM
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N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- 🟦 Tunnel

Free field noise contours
- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted night time L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 17/11/2013

Map
B-22

A3 size

AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut

Free field noise contours
- 🟩 < 75 dB(A)
- 🟨 > 75 dB(A)
- 🟥 > 80 dB(A) (Noise limit)

▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted L_{Amax} noise contours

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 28/01/2014

Map
B-23

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- ▬ Tunnel

Free field noise contours
- 🟩 < 75 dB(A)
- 🟨 > 75 dB(A)
- 🟥 > 80 dB(A) (Noise limit)

▭ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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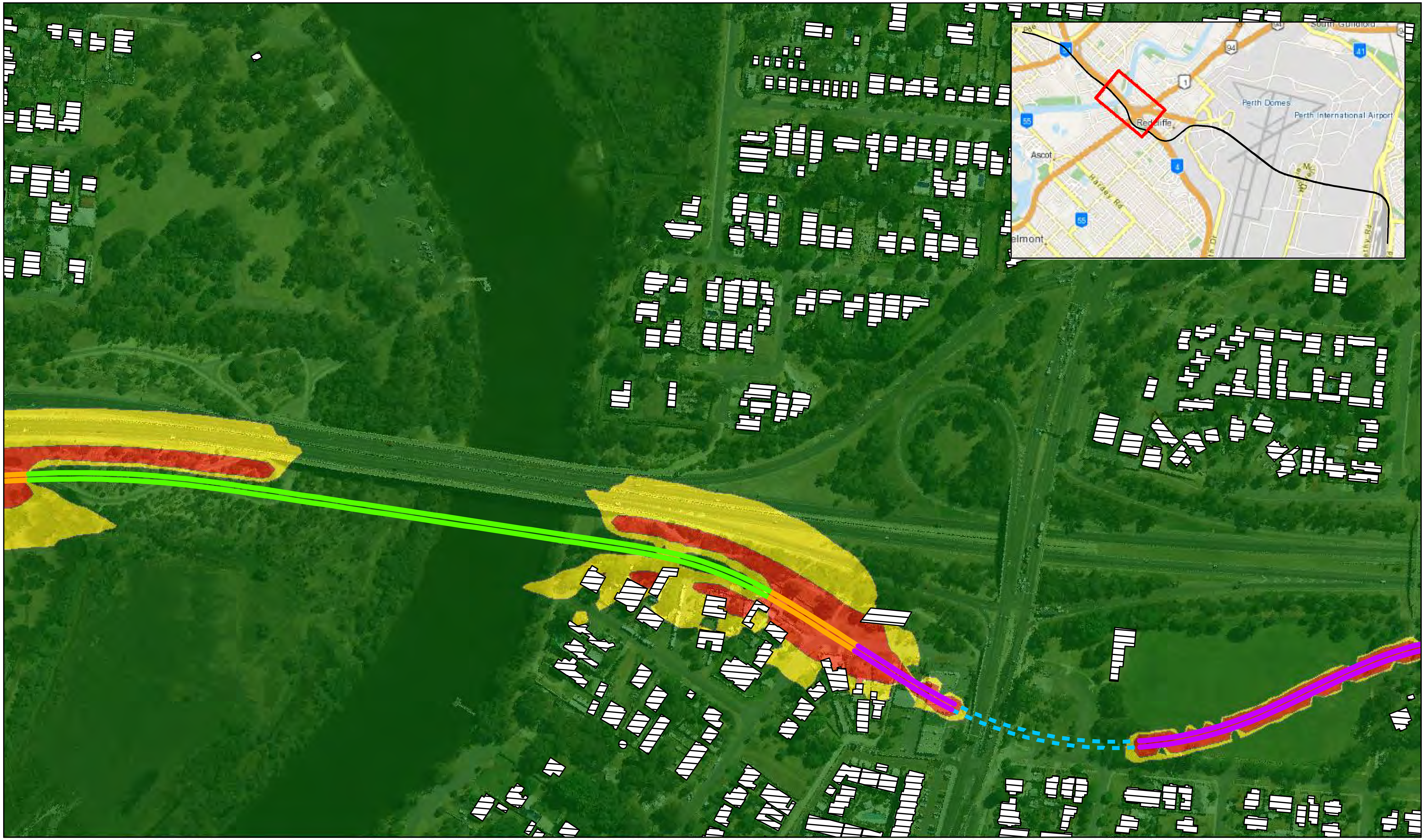
LAST MODIFIED AC - 18/11/2013

Map
B-24

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150

metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2

- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- ▬ Tunnel

Free field noise contours

- 🟩 < 75 dB(A)
- 🟨 > 75 dB(A)
- 🟥 > 80 dB(A) (Noise limit)

▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted L_{Amax} noise contours

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 18/11/2013

Map

B-25

A3 size

N

AECOM
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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2
- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- 🟦 Tunnel

Free field noise contours
- 🟩 < 75 dB(A)
- 🟨 > 75 dB(A)
- 🟥 > 80 dB(A) (Noise limit)

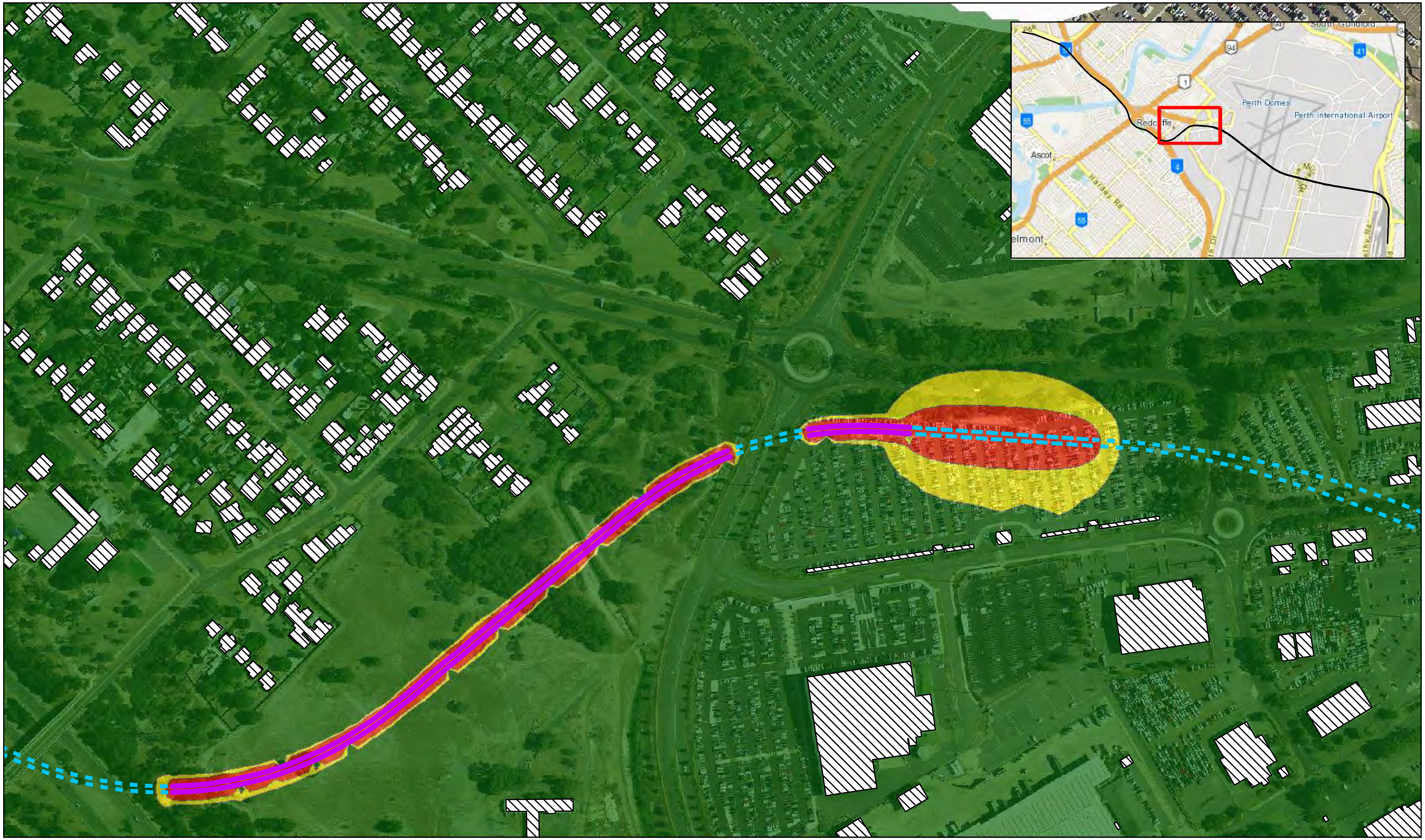
▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted L_{Amax} noise contours

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 18/11/2013

Map
B-26

A3 size



AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 2

- 🟧 At grade
- 🟩 Fly over structure
- 🟪 In cut
- 🟦 Tunnel

Free field noise contours

- 🟩 < 75 dB(A)
- 🟨 > 75 dB(A)
- 🟥 > 80 dB(A) (Noise limit)

▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Predicted L_{Amax} noise contours

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 18/11/2013

Map
B-27

A3 size

AECOM
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N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 3

- ━ At grade
- ╍ Tunnel

Free field noise contours

- 🟩 < 55 dB(A)
- 🟨 > 55 dB(A) (Noise target)
- 🟥 > 60 dB(A) (Noise limit)

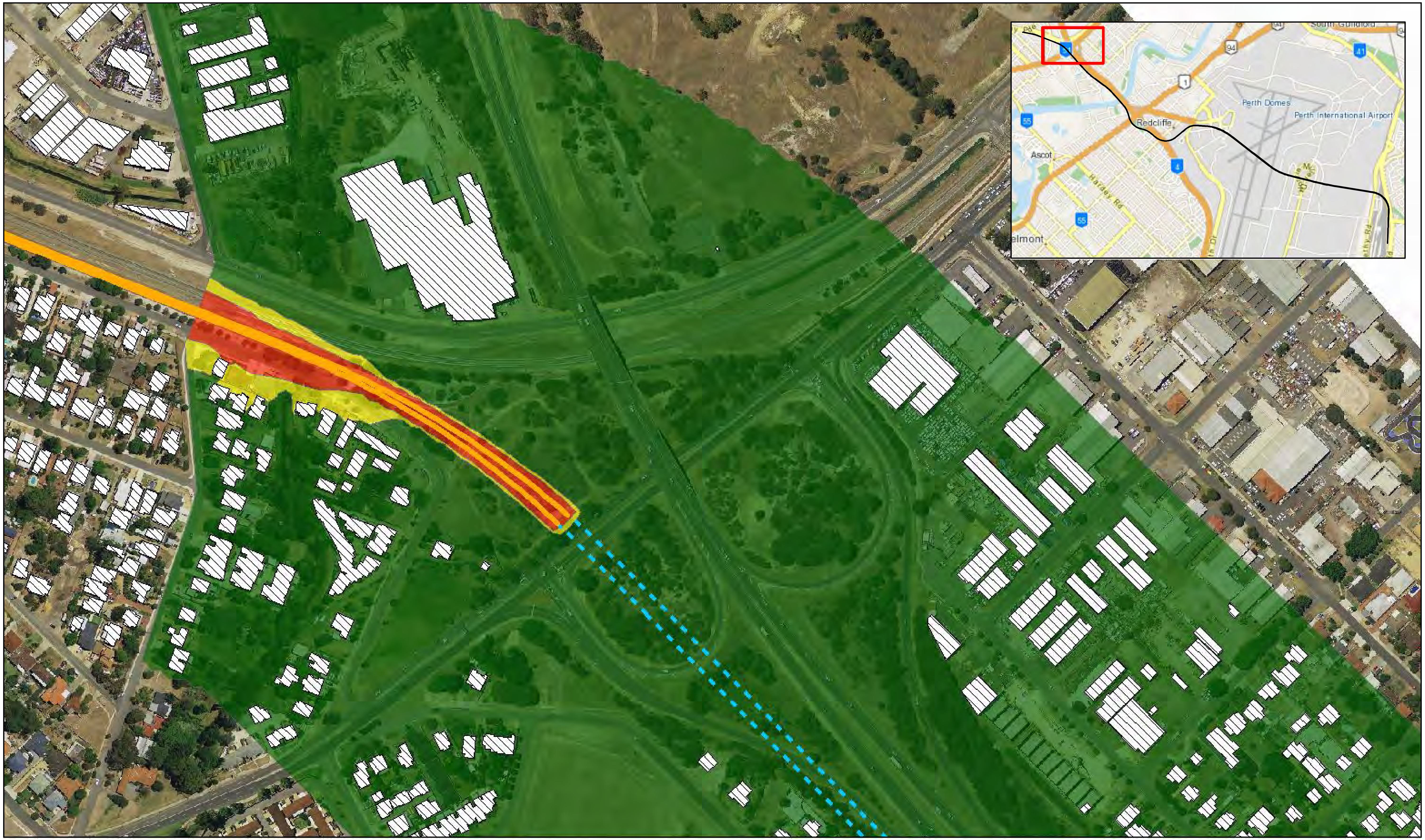
▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 3
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 28/01/2014

Map
B-28

A3 size



AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 3

- At grade
- Tunnel

Free field noise contours

- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

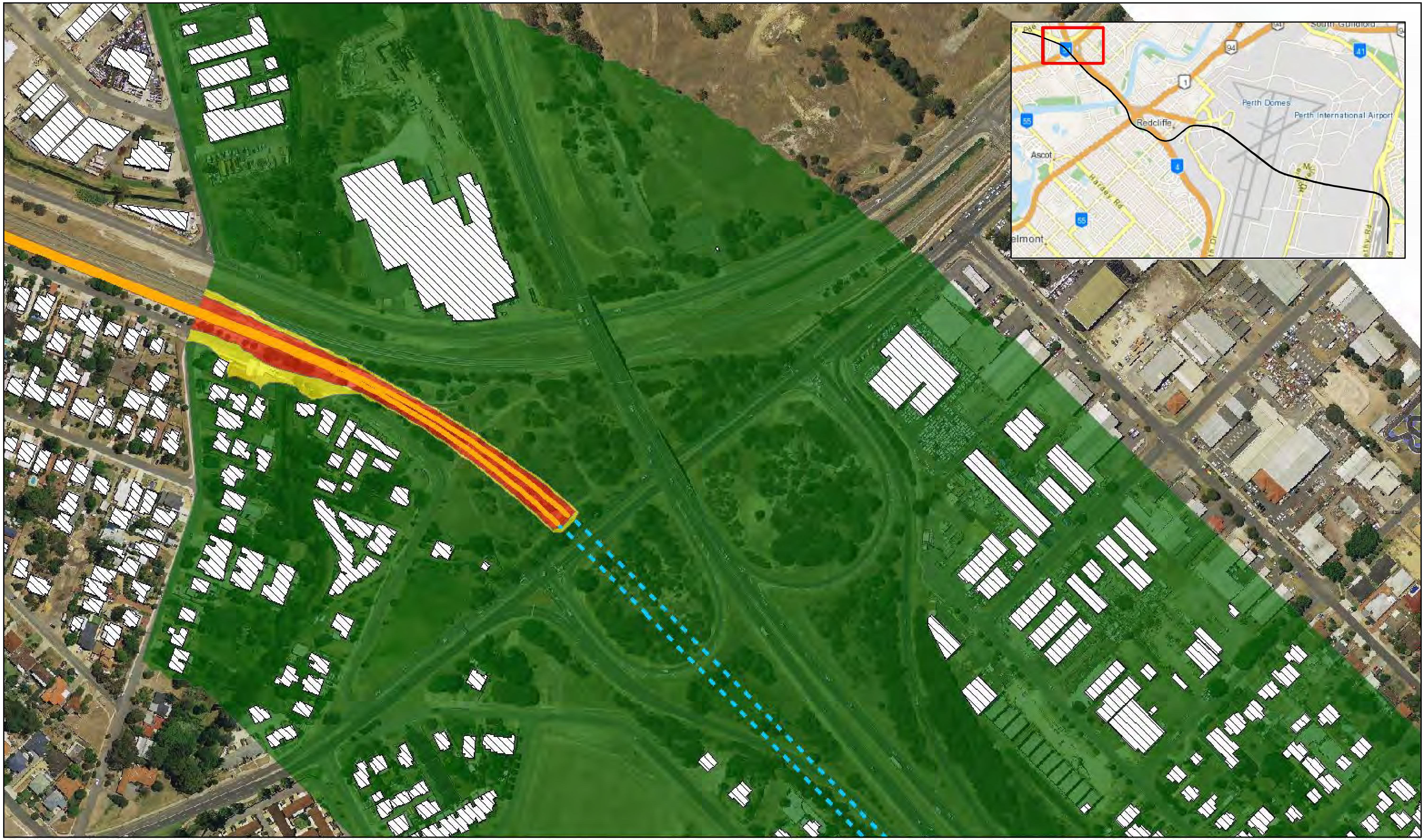
▨ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 3
Predicted night time L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 28/01/2014

Map
B-29

A3 size



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N

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150

metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 3

- ━ At grade
- ╍ Tunnel

Free field noise contours

- 🟩 < 75 dB(A)
- 🟨 > 75 dB(A)
- 🟥 > 80 dB(A) (Noise limit)

▱ Building

Perth Airport Rail Link
Feasibility study noise model
Route option 3
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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LAST MODIFIED AC - 28/01/2014

Map

B-30

A3 size

Appendix C

Figures: Vibration - No Mitigation

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Vibration Level $L_{MAX\ SLOW}$ dB

🟥 100

Perth Airport Rail Link
Feasibility study
Vibration model
Route option 1
With Stiff Rail Fastener
Predicted $L_{max\ slow}$ vibration contours

PROJECT ID	60301258
CREATED BY	GL
LAST MODIFIED	GL - 31/01/2014

Map

C-01

A3 size

Perth Airport Rail Link
Feasibility study
Vibration model
Route option 2
With Stiff Rail Fastener
Predicted $L_{\text{max slow}}$ vibration contours

LEGEND

Vibration Level $L_{\text{MAX SLOW}}$ dB

🟥 100

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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

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LAST MODIFIED GL - 31/01/2014

Map

C-02

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Vibration Level $L_{MAX\ SLOW}$ dB

🟥	100

Perth Airport Rail Link
Feasibility study
Vibration model
Route option 2
With Stiff Rail Fastener
Predicted $L_{max\ slow}$ vibration contours

PROJECT ID 60301258
CREATED BY GL
LAST MODIFIED GL - 31/01/2014

Map
C-03

A3 size

AECOM
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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Vibration Level $L_{MAX\ SLOW}$ dB

🟥 100

Perth Airport Rail Link
Feasibility study
Vibration model
Route option 2
With Stiff Rail Fastener
Predicted $L_{max\ slow}$ vibration contours

PROJECT ID 60301258
CREATED BY GL
LAST MODIFIED GL - 31/01/2014

Map
C-04

A3 size

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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100

metres

1:2,000 (when printed at A3)

LEGEND

Vibration Level $L_{MAX\ SLOW}$ dB

🟥 100

Perth Airport Rail Link
Feasibility study
Vibration model
Route option 2
With Stiff Rail Fastener
Predicted $L_{max\ slow}$ vibration contours

PROJECT ID	60301258
CREATED BY	GL
LAST MODIFIED	GL - 31/01/2014

Map

C-05

A3 size

AECOM
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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Vibration Level $L_{MAX\ SLOW}$ dB

🟥 100

Perth Airport Rail Link
Feasibility study
Vibration model
Route option 2
With Stiff Rail Fastener
Predicted $L_{max\ slow}$ vibration contours

PROJECT ID	60301258
CREATED BY	GL
LAST MODIFIED	GL - 31/01/2014

Map
C-06

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

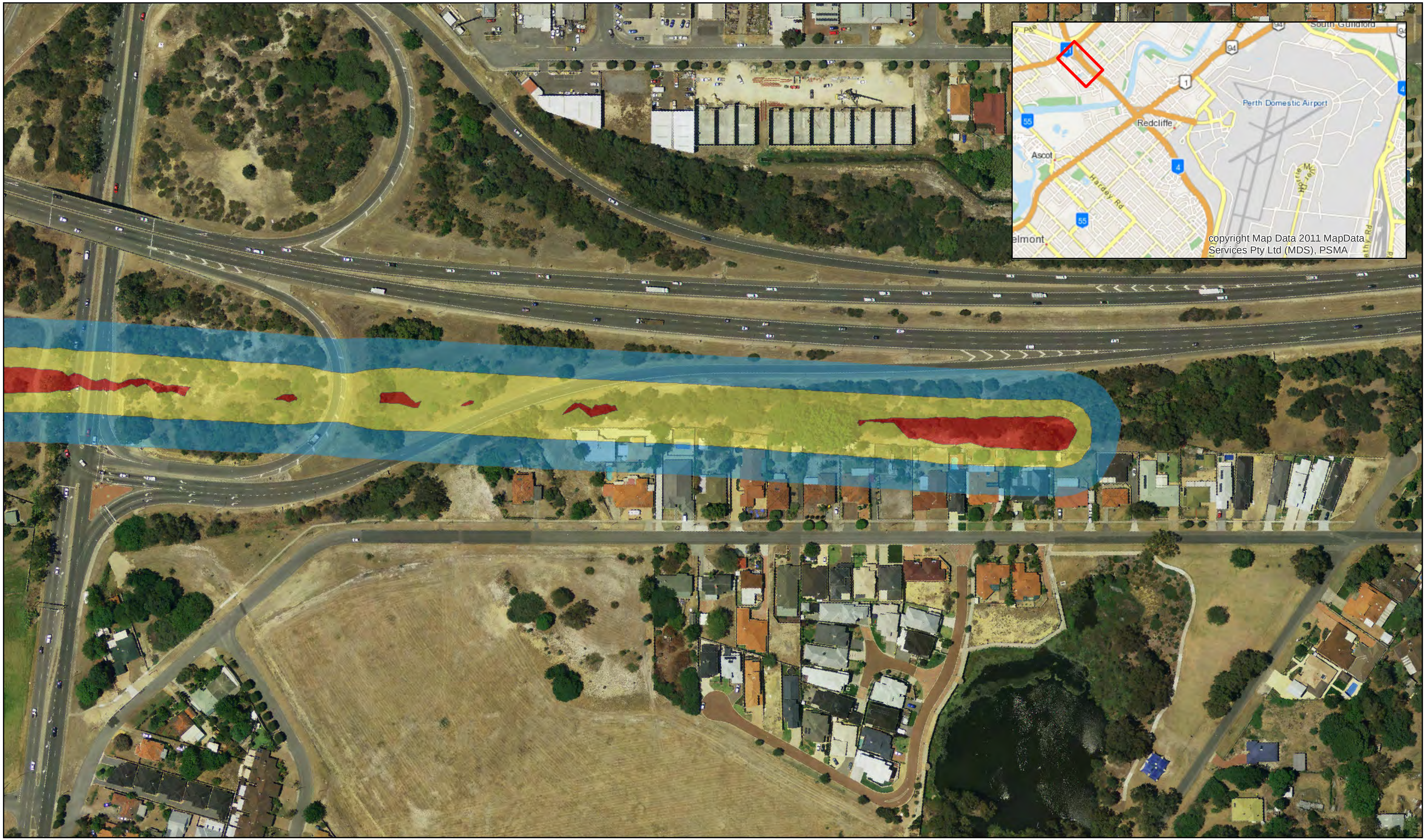
🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Stiff Rail Fastener
Predicted L_{Amax} noise contours

PROJECT ID 60301258
CREATED BY GL
LAST MODIFIED GL - 31/01/2014

Map
C-07

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

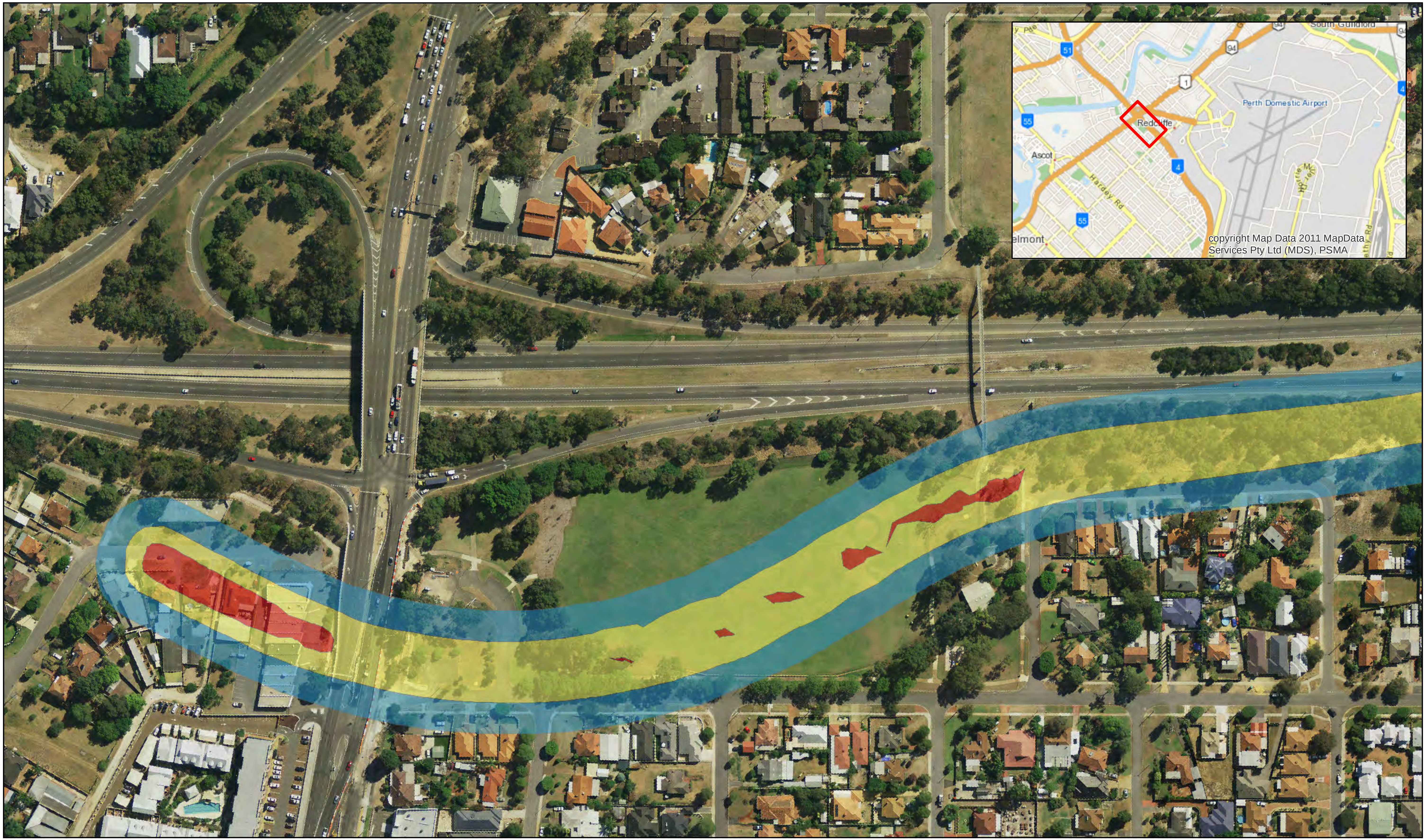
🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Stiff Rail Fastener
Predicted L_{Amax} noise contours

PROJECT ID 60301258
CREATED BY GL
LAST MODIFIED GL - 31/01/2014

Map
C-08

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Stiff Rail Fastener
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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Map
C-09

A3 size

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0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Stiff Rail Fastener
Predicted L_{Amax} noise contours

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Map
C-10

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦 35
🟨 40
🟥 45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Stiff Rail Fastener
Predicted L_{Amax} noise contours

PROJECT ID	60301258
CREATED BY	GL
LAST MODIFIED	GL - 31/01/2014

Map
C-11

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Stiff Rail Fasteners
Predicted L_{Amax} noise contours

PROJECT ID 60301258
CREATED BY GL
LAST MODIFIED GL - 31/01/2014

Map
C-12

A3 size

AECOM
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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Stiff Rail Fasteners
Predicted L_{Amax} noise contours

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Map
C-13

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Stiff Rail Fasteners
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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Map
C-14

A3 size

AECOM
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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦 35
🟨 40
🟥 45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Stiff Rail Fasteners
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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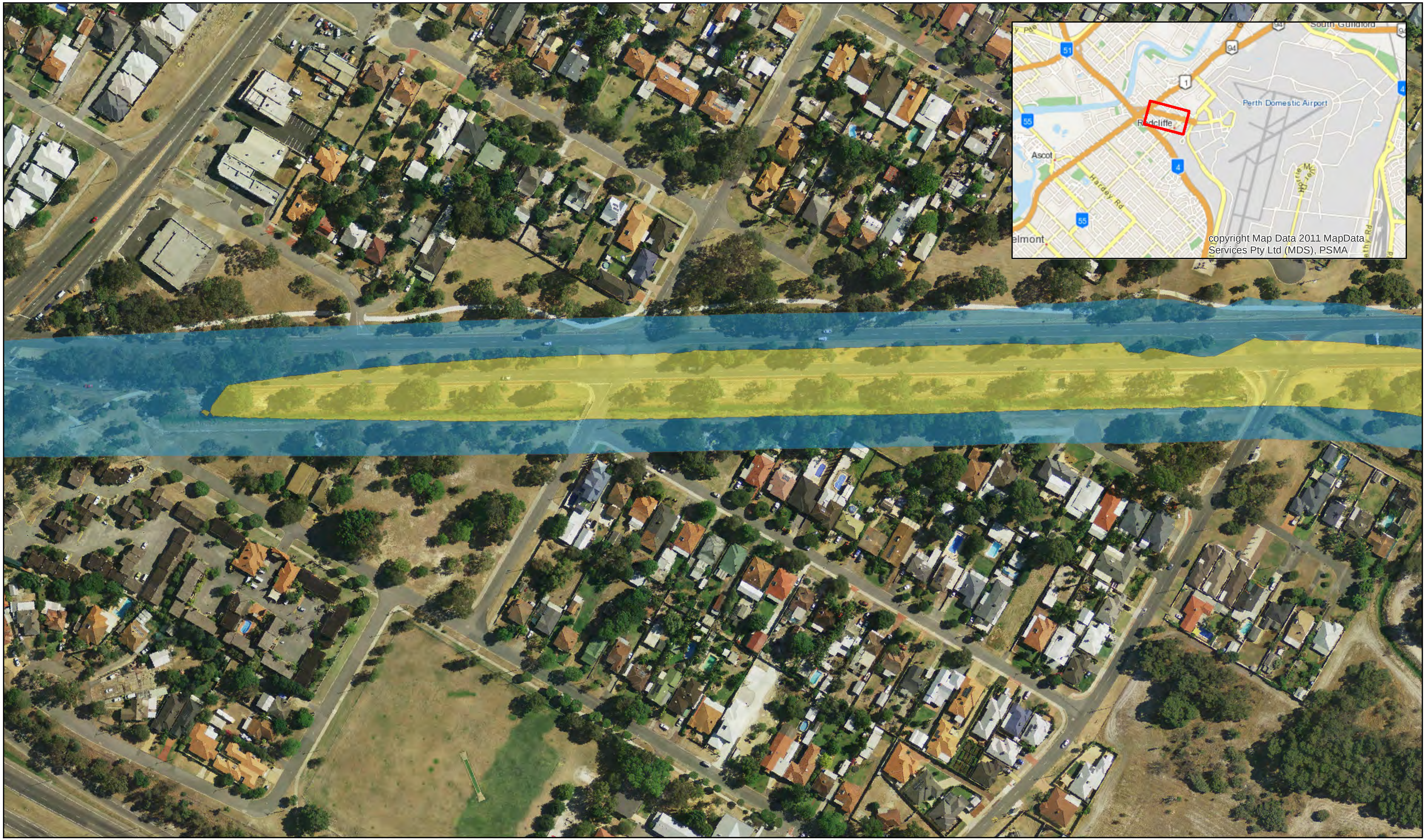
LAST MODIFIED GL - 31/01/2014

Map
C-15

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Stiff Rail Fasteners
Predicted L_{Amax} noise contours

PROJECT ID 60301258
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LAST MODIFIED GL - 31/01/2014

Map
C-16

A3 size

AECOM
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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Stiff Rail Fasteners
Predicted L_{Amax} noise contours

PROJECT ID 60301258
CREATED BY GL
LAST MODIFIED GL - 31/01/2014

Map
C-17

A3 size

Appendix D

Figures: Noise Mitigation Options

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DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres
1:3,250 (when printed at A3)

LEGEND

Buildings - Noise target exceedance
- ▨ > -4 dB(A)
- ▨ > -3 dB(A)
- ▨ > -2 dB(A)
- ▨ > -1 dB(A)
- ▨ > 0 dB(A)
- ▨ > 1 dB(A)
- ▨ > 2 dB(A)
- ▨ > 3 dB(A)

Barriers
- — 0.5 m
- — 1.0 m
- — 1.5 m
- — 1.5 m (at grade)
- — 2.5 m
- — 2.5 m (at grade)
- — 3.0 m
- — 3.0 m (at grade)

— Rail alignment - Option 1

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Noise mitigation design
(Noise target)

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 24/01/2014

Map
D-01

A3 size

AECOM
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DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres

1:3,250 (when printed at A3)

LEGEND

Buildings - Noise target exceedance
- > -4 dB(A)
- > -3 dB(A)
- > -2 dB(A)
- > -1 dB(A)
- > 0 dB(A)
- > 1 dB(A)
- > 2 dB(A)
- > 3 dB(A)

Barriers
- 0.5 m
- 1.0 m
- 1.5 m
- 1.5 m (at grade)
- 2.5 m
- 2.5 m (at grade)
- 3.0 m
- 3.0 m (at grade)

- Rail alignment - Option 1

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Noise mitigation design
(Noise target)

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 24/01/2014

Map
D-02

A3 size

AECOM
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N

DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres

1:3,250 (when printed at A3)

LEGEND

Buildings - Noise target exceedance
- ▨ > -4 dB(A)
- ▨ > -3 dB(A)
- ▨ > -2 dB(A)
- ▨ > -1 dB(A)
- ▨ > 0 dB(A)
- ▨ > 1 dB(A)
- ▨ > 2 dB(A)
- ▨ > 3 dB(A)

Barriers
- 0.5 m
- 1.0 m
- 1.5 m
- 1.5 m (at grade)
- 2.5 m
- 2.5 m (at grade)
- 3.0 m
- 3.0 m (at grade)

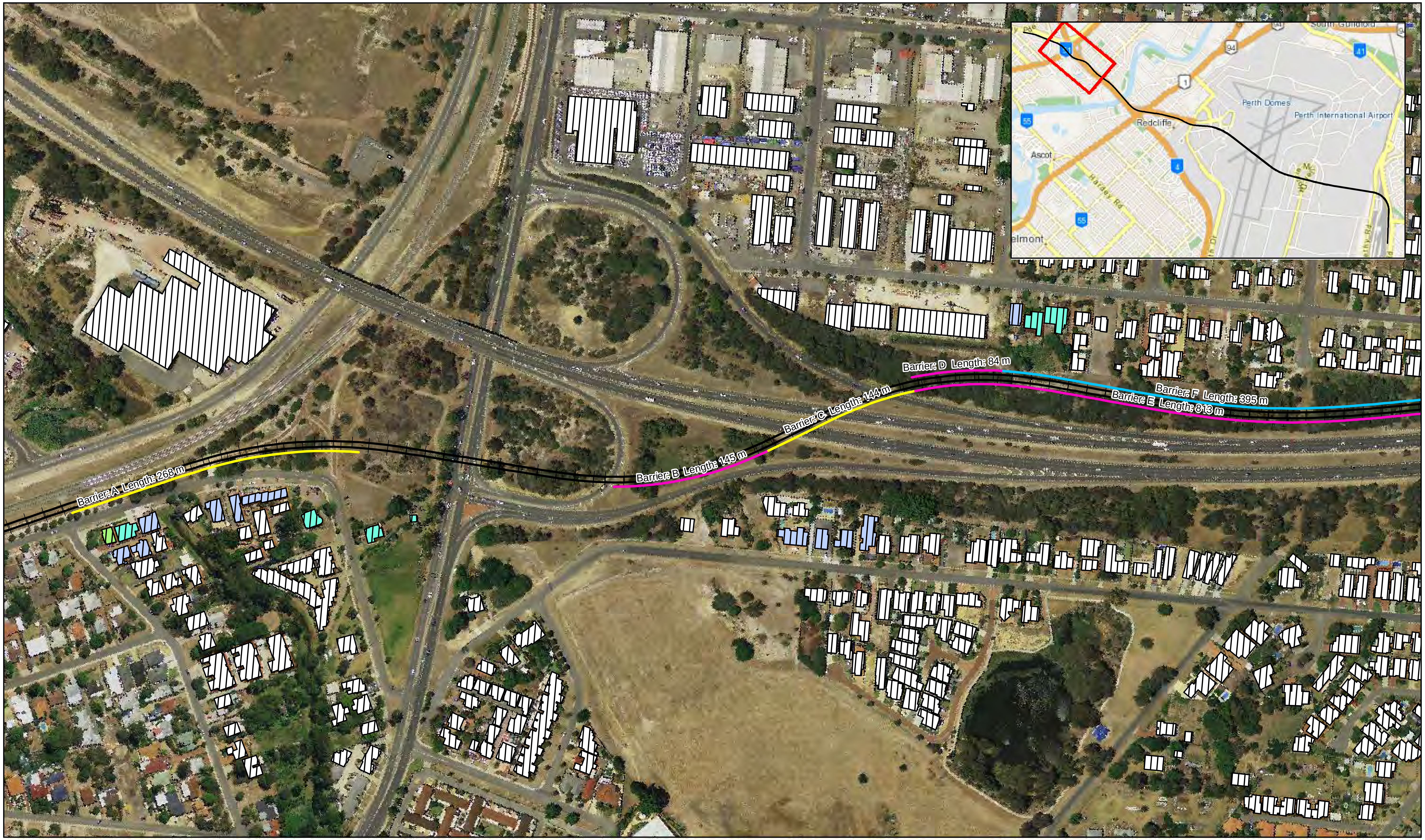
- Rail alignment - Option 1

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Noise mitigation design
(Noise target)

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 24/01/2014

Map
D-03

A3 size



AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres
1:3,250 (when printed at A3)

LEGEND

Buildings - Noise limit exceedance
- > -4 dB(A)
- > -3 dB(A)
- > -2 dB(A)
- > -1 dB(A)
- > 0 dB(A)
- > 1 dB(A)
- > 2 dB(A)
- > 3 dB(A)

Opt1 Limit walls
- 0.5 m
- 1.0 m
- 1.5 m
- 1.5 m (at grade)
- 2.5 m
- 2.5 m (at grade)
- 3.0 m
- 3.0 m (at grade)

- Rail alignment - Option 1

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Noise mitigation design
(Noise limit)

PROJECT ID 60301258
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Map
D-04

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres

1:3,250 (when printed at A3)

LEGEND

Buildings - Noise limit exceedance
- ■ > -4 dB(A)
- ■ > -3 dB(A)
- ■ > -2 dB(A)
- ■ > -1 dB(A)
- ■ > 0 dB(A)
- ■ > 1 dB(A)
- ■ > 2 dB(A)
- ■ > 3 dB(A)

Opt1 Limit walls
- ▬ 0.5 m
- ▬ 1.0 m
- ▬ 1.5 m
- ▬ 1.5 m (at grade)
- ▬ 2.5 m
- ▬ 2.5 m (at grade)
- ▬ 3.0 m
- ▬ 3.0 m (at grade)

- ▬ Rail alignment - Option 1

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Noise mitigation design
(Noise limit)

PROJECT ID 60301258
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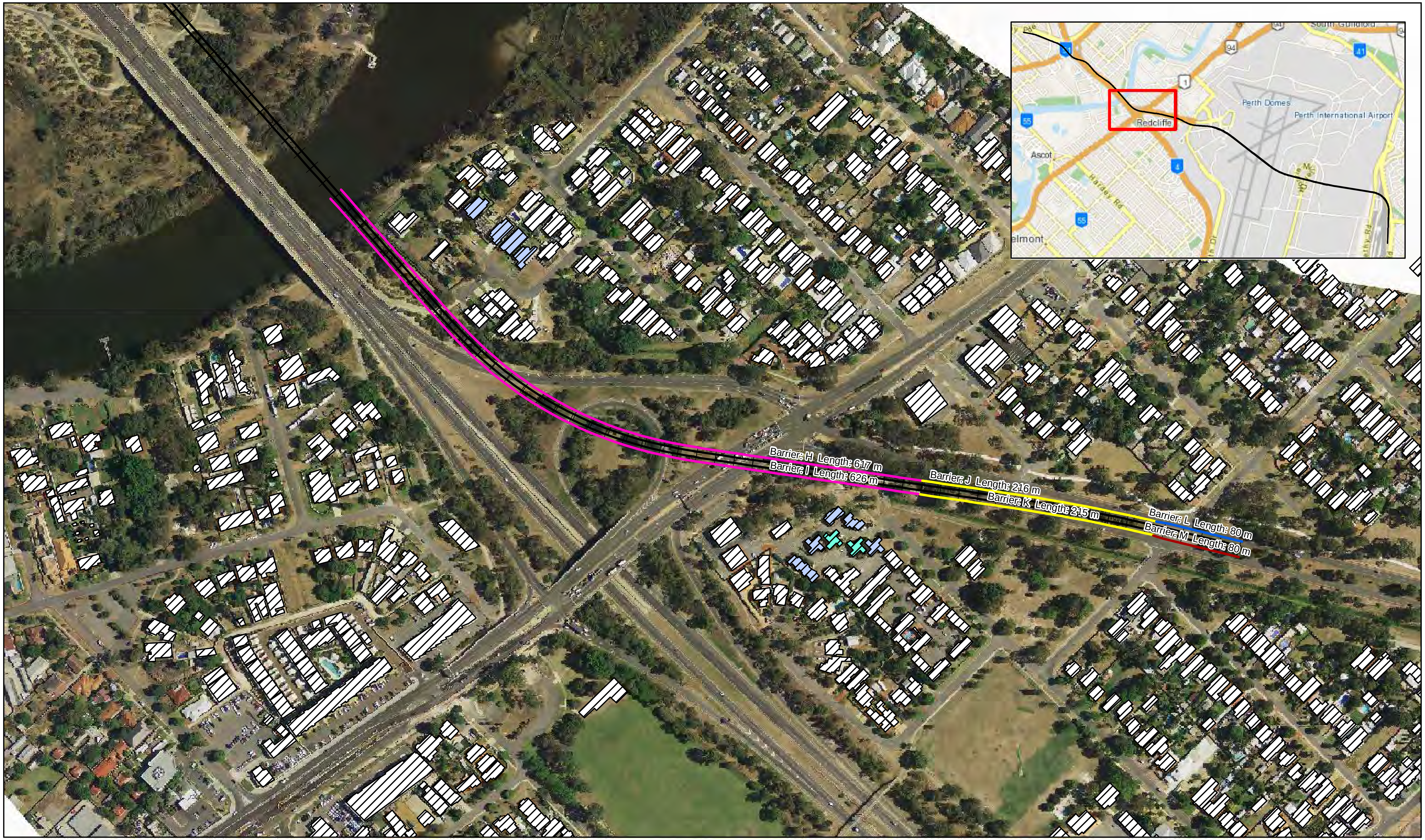
LAST MODIFIED AC - 24/01/2014

Map
D-05

A3 size



AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION PCG94

0 40 80 160
metres

1:3,250 (when printed at A3)

LEGEND

Buildings - Noise limit exceedance		**Opt1 Limit walls**		
▨ > -4 dB(A)	▨ > 0 dB(A)	— 0.5 m	— 2.5 m	— Rail alignment - Option 1
▨ > -3 dB(A)	▨ > 1 dB(A)	— 1.0 m	— 2.5 m (at grade)	
▨ > -2 dB(A)	▨ > 2 dB(A)	— 1.5 m	— 3.0 m	
▨ > -1 dB(A)	▨ > 3 dB(A)	— 1.5 m (at grade)	— 3.0 m (at grade)	

Perth Airport Rail Link
Feasibility study noise model
Route option 1
Noise mitigation design
(Noise limit)

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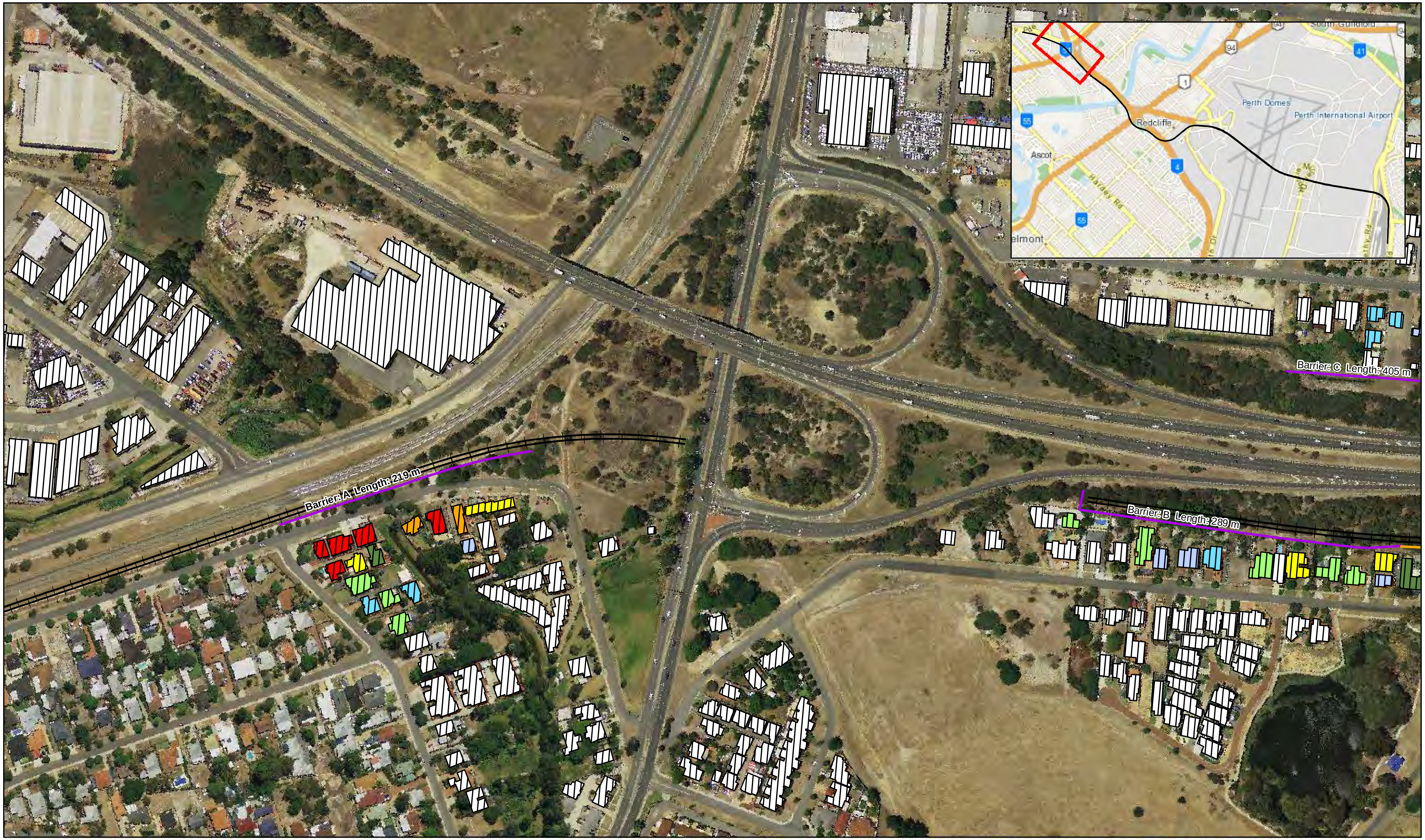
LAST MODIFIED AC - 24/01/2014

Map
D-06

A3 size



AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Buildings - Noise target exceedance
- > -4 dB(A)
- > -3 dB(A)
- > -2 dB(A)
- > -1 dB(A)
- > 0 dB(A)
- > 1 dB(A)
- > 2 dB(A)
- > 3 dB(A)

Barriers
- 0.5 m
- 1.0 m
- 1.5 m
- 1.5 m (at grade)
- 2.5 m
- 2.5 m (at grade)
- 3.0 m
- 3.0 m (at grade)

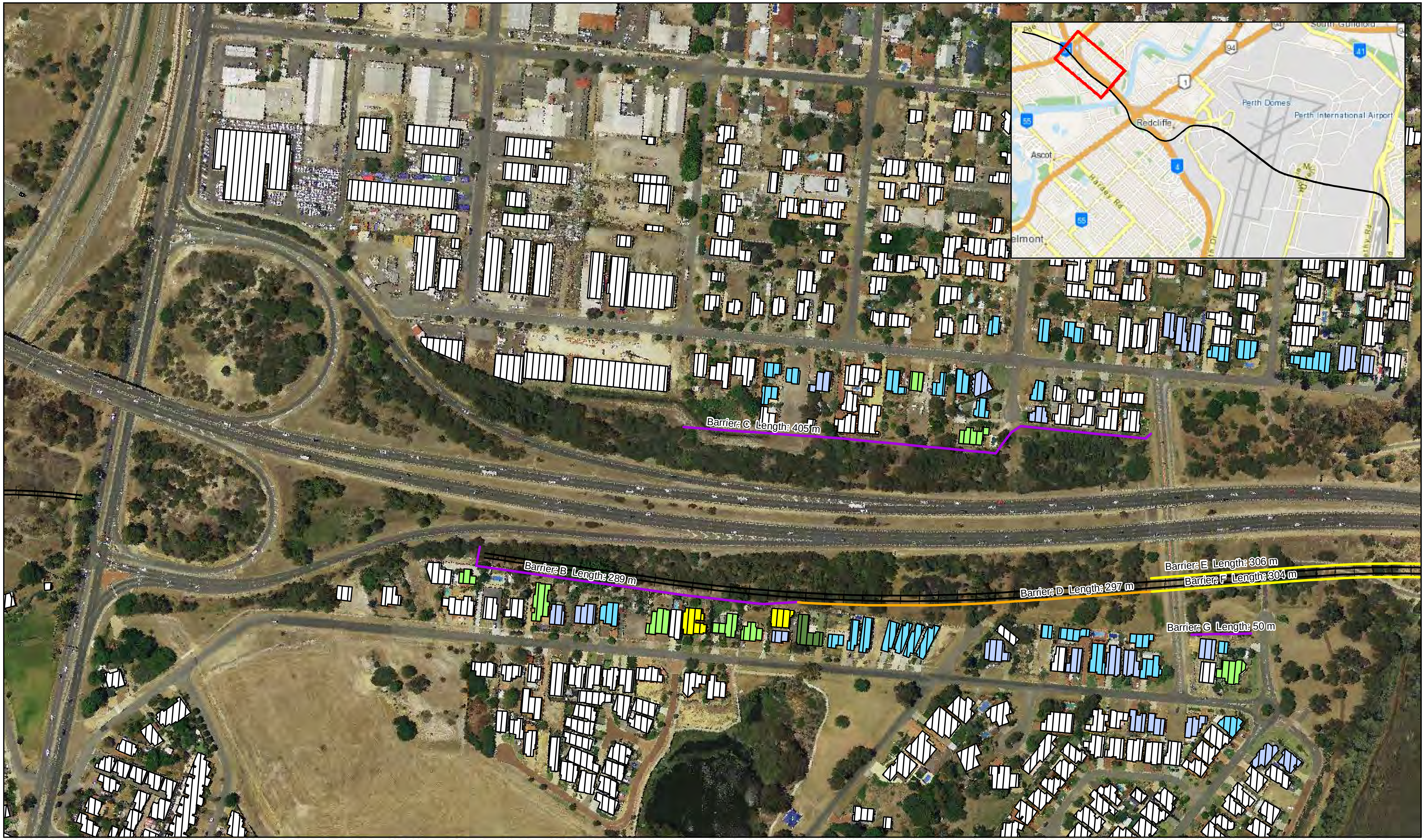
Rail alignment - Option 2

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Noise mitigation design
(Noise target)

PROJECT ID	60301258
CREATED BY	AC
LAST MODIFIED	AC - 28/01/2014

Map
D-07

A3 size



AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Buildings - Noise target exceedance
- ▨ > -4 dB(A)
- ▨ > -3 dB(A)
- ▨ > -2 dB(A)
- ▨ > -1 dB(A)
- ▨ > 0 dB(A)
- ▨ > 1 dB(A)
- ▨ > 2 dB(A)
- ▨ > 3 dB(A)

Barriers
- — 0.5 m
- — 1.0 m
- — 1.5 m
- — 1.5 m (at grade)
- — 2.5 m
- — 2.5 m (at grade)
- — 3.0 m
- — 3.0 m (at grade)

┼ Rail alignment - Option 2

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Noise mitigation design
(Noise target)

PROJECT ID 60301258
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LAST MODIFIED AC - 28/01/2014

Map
D-08

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Buildings - Noise target exceedance
- ⬜ > -4 dB(A)
- 🟦 > -3 dB(A)
- 🟦 > -2 dB(A)
- 🟩 > -1 dB(A)
- 🟩 > 0 dB(A)
- 🟨 > 1 dB(A)
- 🟧 > 2 dB(A)
- 🟥 > 3 dB(A)

Barriers
- 0.5 m
- 1.0 m
- 1.5 m
- 1.5 m (at grade)
- 2.5 m
- 2.5 m (at grade)
- 3.0 m
- 3.0 m (at grade)

Rail alignment - Option 2

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Noise mitigation design
(Noise target)

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 28/01/2014

Map
D-09

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Buildings - Noise limit exceedance

- ▨ > -4 dB(A)
- ▨ > -3 dB(A)
- ▨ > -2 dB(A)
- ▨ > -1 dB(A)
- ▨ > 0 dB(A)
- ▨ > 1 dB(A)
- ▨ > 2 dB(A)
- ▨ > 3 dB(A)

Barriers

- — 0.5 m
- — 1.0 m
- — 1.5 m
- — 1.5 m (at grade)
- — 2.5 m
- — 2.5 m (at grade)
- — 3.0 m
- — 3.0m (at grade)

┼ Rail alignment - Option 2

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Noise mitigation design
(Noise limit)

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Map
D-10

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150

metres

1:3,000 (when printed at A3)

LEGEND

Buildings - Noise limit exceedance

- ▨ > -4 dB(A)
- ▨ > -3 dB(A)
- ▨ > -2 dB(A)
- ▨ > -1 dB(A)
- ▨ > 0 dB(A)
- ▨ > 1 dB(A)
- ▨ > 2 dB(A)
- ▨ > 3 dB(A)

Barriers

- — 0.5 m
- — 1.0 m
- — 1.5 m
- — 1.5 m (at grade)
- — 2.5 m
- — 2.5 m (at grade)
- — 3.0 m
- — 3.0m (at grade)

— Rail alignment - Option 2

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Noise mitigation design
(Noise limit)

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Map

D-11

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Buildings - Noise limit exceedance
- ▨ > -4 dB(A)
- ▨ > -3 dB(A)
- ▨ > -2 dB(A)
- ▨ > -1 dB(A)
- ▨ > 0 dB(A)
- ▨ > 1 dB(A)
- ▨ > 2 dB(A)
- ▨ > 3 dB(A)

Barriers
- — 0.5 m
- — 1.0 m
- — 1.5 m
- — 1.5 m (at grade)
- — 2.5 m
- — 2.5 m (at grade)
- — 3.0 m
- — 3.0m (at grade)

┼ Rail alignment - Option 2

Perth Airport Rail Link
Feasibility study noise model
Route option 2
Noise mitigation design
(Noise limit)

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Map
D-12

A3 size

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DATUM GDA 1994, PROJECTION PCG94
0 37.5 75 150
metres
1:3,000 (when printed at A3)

LEGEND

Buildings - noise target exceedance
- > -4 dB(A)
- > -3 dB(A)
- > -2 dB(A)
- > -1 dB(A)
- > 0 dB(A)
- > 1 dB(A)
- > 2 dB(A)
- > 3 dB(A)

Barriers
- 0.5 m
- 1.0 m
- 1.5 m
- 1.5 m (at grade)
- 2.5 m
- 2.5 m (at grade)
- 3.0 m
- 3.0m (at grade)

Rail alignment - Option 3

Perth Airport Rail Link
Feasibility study noise model
Route option 3
Noise mitigation design
(Noise target)

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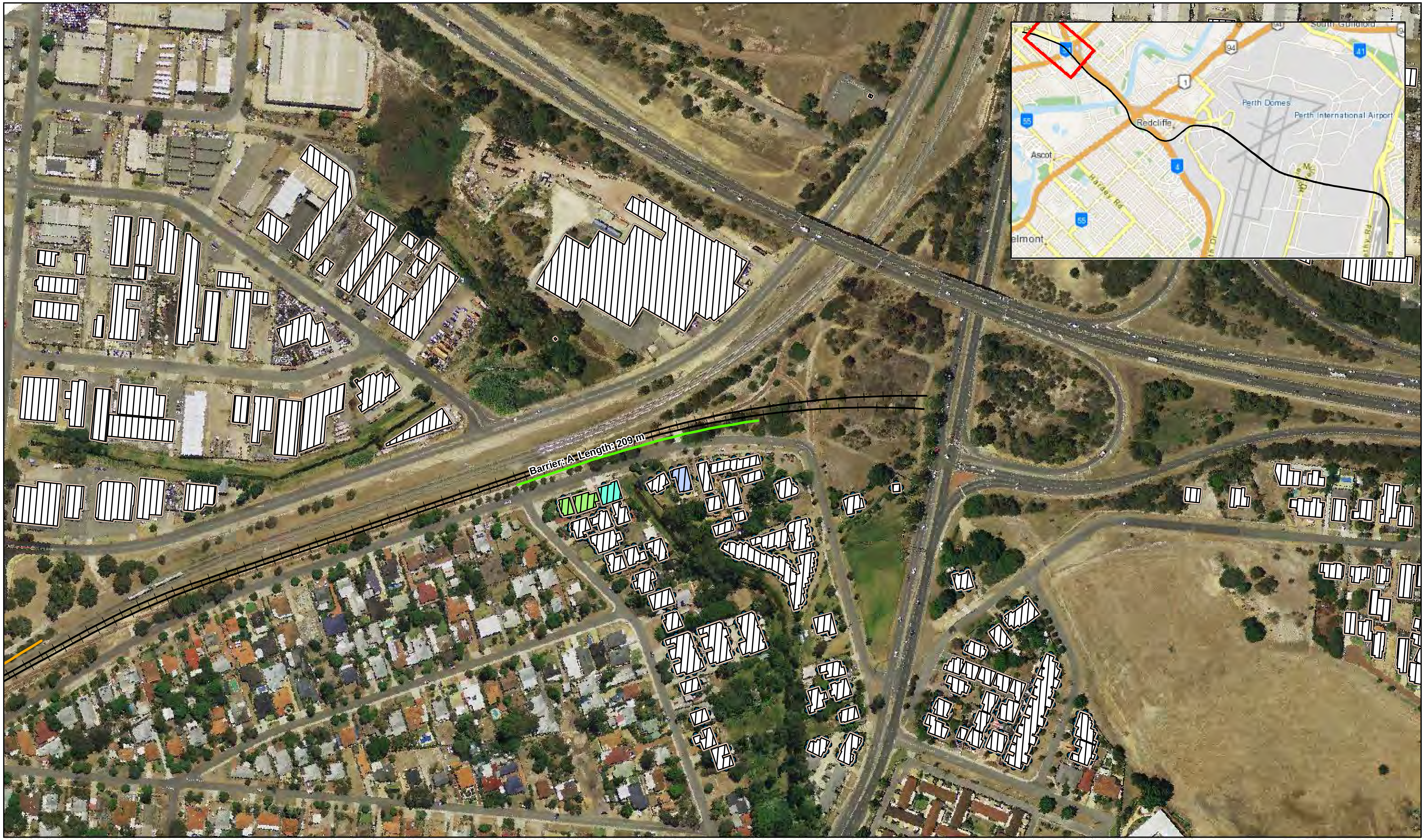
Map
D-13

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150

metres

1:3,000 (when printed at A3)

LEGEND

Buildings - noise limit exceedance

- ▨ > -4 dB(A)
- ▨ > -3 dB(A)
- ▨ > -2 dB(A)
- ▨ > -1 dB(A)
- ▨ > 0 dB(A)
- ▨ > 1 dB(A)
- ▨ > 2 dB(A)
- ▨ > 3 dB(A)

Barriers

- — 0.5 m
- — 1.0 m
- — 1.5 m
- — 1.5 m (at grade)
- — 2.5 m
- — 2.5 m (at grade)
- — 3.0 m
- — 3.0m (at grade)

⊣ Rail alignment - Option 3

Perth Airport Rail Link
Feasibility study noise model
Route option 3
Noise mitigation design
(Noise limit)

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Map

D-14

A3 size

Appendix E

Figures: Vibration - With Mitigation

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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100

metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link

Feasibility study

Regenerated noise model

Route option 2

With Pandrol Vanguard

Predicted L_{Amax} noise contours

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Map

E-01

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
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LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Pandrol Vanguard
Predicted L_{Amax} noise contours

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Map
E-02

A3 size

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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

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LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Pandrol Vanguard
Predicted L_{Amax} noise contours

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Map
E-03

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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Pandrol Vanguard
Predicted L_{Amax} noise contours

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Map
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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

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LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 2
With Pandrol Vanguard
Predicted L_{Amax} noise contours

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Map
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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

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LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Pandrol Vanguard
Predicted L_{Amax} noise contours

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Map
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DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

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LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Pandrol Vanguard
Predicted L_{Amax} noise contours

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Map
E-07

A3 size

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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦	35
🟨	40
🟥	45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Pandrol Vanguard
Predicted L_{Amax} noise contours

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Map
E-08

A3 size

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N

DATUM GDA 1994, PROJECTION PCG94

0 25 50 100
metres

1:2,000 (when printed at A3)

LEGEND

Regenerated Sound Pressure Level L_{AMAX} dBA

🟦 35
🟨 40
🟥 45

Perth Airport Rail Link
Feasibility study
Regenerated noise model
Route option 3
With Pandrol Vanguard
Predicted L_{Amax} noise contours

PROJECT ID	60301258
CREATED BY	GL
LAST MODIFIED	GL - 31/01/2014

Map
E-09

A3 size

Appendix F

Correspondence between DER and PTA

From: Mallie, Olivier
To: Monaghan, Paul
Cc: Ludlow, Miranda; "McLoughlin, Mike"
Subject: RE: Perth Airport Rail link - comments on noise study methodology
Date: Thursday, 17 October 2013 12:24:29 PM

Good afternoon Paul,

I'm happy with the memo from AECOM on our September meeting and have no comments.

Also nothing to add to the proposed scope of work given that AECOM will also be undertaking a regenerated internal noise assessment as part of the feasibility study.

Apologies for the delayed reply,
Regards,
Olivier

Olivier Mallié, *Environmental Noise Officer*

Government of **Western Australia**
Department of **Environment Regulation**

T 08 6467 5362 | F 08 9467 0545 | E olivier.mallie@der.wa.gov.au
Noise Regulation Branch | Department of Environment Regulation
The Atrium, Level 7, 168 St Georges Tce, Perth WA 6000
Locked Bag 33, Cloisters Square WA 6850

From: Monaghan, Paul [mailto:Paul.Monaghan@pta.wa.gov.au]
Sent: Friday, 11 October 2013 16:44
To: Mallie, Olivier
Cc: Ludlow, Miranda; 'McLoughlin, Mike'
Subject: RE: Perth Airport Rail link - comments on noise study methodology

Good afternoon Olivier,

I trust that you are well.

Following the advice which you provided on the proposed assessment criteria and methodology for the Forrestfield Airport Link Noise and Vibration Assessment (refer email below) and our subsequent meeting on 20 September 2013, please find attached a memo prepared by Aecom detailing the outcomes of the meeting and our response to your comments. I trust this provides an accurate description of what was discussed and agreed. Can you please review the memo to ensure that you are happy with its content? And apologies for the delay in getting it to you.

Also attached is the Scope of Works that Aecom will be undertaking on behalf of the PTA as part of the feasibility study (highlighted in yellow on pages 3 & 4). In addition to what is included in the Scope of Works, Aecom will also be undertaking a regenerated internal noise assessment as part of the feasibility study. Can you please review the Scope of Works and if there is anything which you would like to see undertaken which isn't included, please let me know?

In terms of timelines, Aecom have been delayed in commencing the Noise Assessment as PTA is still working on the concept design. We anticipate that Noise Assessment will commence in late October with draft results due late November. I will contact you in a month's time to set up a meeting in which Aecom can provide DER with an update on the Noise modelling.

Please give me a call if you would like to discuss any of the above.

Regards,

Paul Monaghan | Environmental Officer
Infrastructure Planning & Land Services

From: Mallie, Olivier [mailto:Olivier.Mallie@DER.wa.gov.au]
Sent: Monday, September 16, 2013 10:17 AM
To: Monaghan, Paul; Ludlow, Miranda
Subject: FW: Perth Airport Rail link - comments on noise study methodology

Dear Paul, Miranda,

Please find below our initial thoughts and comments in regard to the proposed methodology for the noise study.

Vibration Study
The only criterion mentioned is the vibration criterion of AS2670.2 and there is no mention of regenerated internal noise assessment. We recommend including such assessment in the study and use the regenerated noise criteria from the Perth-Mandurah project (these levels were recommended by the consultant, Heggies at the time).

Noise Study
Our understanding of the proposed methodology involves assessing both the road and rail noise cumulatively and to consider a 'noise change' indicator (section 4.2.3) to ultimately determine whether noise mitigation is required or not. The NRB does not support this type of approach.
This project is a new major rail development within the framework of the SPP 5.4 and therefore the rail noise is to be assessed in isolation with the aim to comply with the Target levels of the SPP. In addition, given the current noise environment along Tonkin Highway, where noise mitigation is required the study should give preference to noise mitigation measures that will also reduce the impact of the road noise as far as is practicable.

We support the use of an outdoor LAmax criterion however, the outdoor LAmax criterion of 80dB should be a limit criterion not to be exceeded at any times, with a target criterion of 75dB where practicable. This is applicable to the rail noise in isolation however, as per above, where practicable, any noise mitigation required should aim at reducing the impact from the road noise.

With the 'elevated' option, we would need further details on the noise modelling methodology i.e. how applicable is the proposed algorithm (Kilde Rep 130)? Could it be done in other ways?

Has the consultant got experience with this kind of elevated rail calculation?

The noise study should also consider the noise impact from the increase in rail traffic between the existing Perth and Bayswater Stations.

Construction Noise
There is mention of a construction noise and vibration management plan (CNVMP) in section 4.4 however we note that a noise management plan is required anyway for all out of hours work and include, as a minimum, all the requirements of reg 13(3). As night time work is very likely to be required, we recommend PTA to prepare a generic NMP to cover both day time and night time works. If required, individual out of hours work NMPs could be prepared based on the generic NMP therefore making the approval process more efficient.
Given the (very) different nature between each options, the PTA will need to identify major differences in construction noise impacts between the different options. For example, the 'elevated' option will require lots of impact piling, making it far less acceptable from the construction noise point of view when compared with the underground option.

Regards,
Olivier

Olivier Mallié, *Environmental Noise Officer*
Government of **Western Australia**
Department of **Environment Regulation**

T 08 6467 5362 | F 08 9467 0545 | E olivier.mallie@der.wa.gov.au
Noise Regulation Branch | Department of Environment Regulation
The Atrium, Level 7, 168 St Georges Tce, Perth WA 6000
Locked Bag 33, Cloisters Square WA 6850

Appendix G

Tabulated Noise Modelling Results with Mitigation

Appendix G

Table 17 **Tabulated noise modelling results**

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
1 Anzac St Bayswater 6053	59	75	59	73	62	77	61	76	N/A	N/A	59	74
1 Colwyn Rd Bayswater 6053	49	63	51	65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1 Gobba Ct Bayswater 6053	51	64	51	64	49	61	53	68	N/A	N/A	N/A	N/A
1 Higgins Way Bayswater 6053	47	60	53	69	44	56	44	56	N/A	N/A	42	55
1 Jacqueline St Bayswater 6053	50	61	51	64	49	61	50	63	N/A	N/A	N/A	N/A
1 Locock St Ascot 6104	53	69	56	71	53	68	54	68	N/A	N/A	N/A	N/A
1 Piercey Ct Redcliffe 6104	N/A	N/A	N/A	N/A	37	49	37	49	N/A	N/A	N/A	N/A
1 Whatley Cr Bayswater 6053	54	66	57	72	57	73	58	74	53	67	56	71
1 Wright Cr Bayswater 6053	50	62	50	63	49	63	51	67	N/A	N/A	N/A	N/A
1 Wyatt Rd Bayswater 6053	N/A	N/A	N/A	N/A	46	59	46	59	43	56	43	56
1 First St Redcliffe 6104	56	71	54	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1/7 Wyatt Rd Bayswater 6053	47	60	55	69	45	58	45	58	N/A	N/A	N/A	N/A
10 Constance St Bayswater 6053	48	60	50	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10 Duchess Ct Bayswater 6053	46	59	47	59	48	60	48	62	N/A	N/A	N/A	N/A
10 Forbes St Ascot 6104	52	66	55	67	52	67	53	67	N/A	N/A	N/A	N/A
10 Kanowna Av W Ascot 6104	50	64	53	66	46	59	49	63	N/A	N/A	N/A	N/A
10 Ryans Ct Redcliffe 6104	N/A	N/A	N/A	N/A	39	53	39	53	N/A	N/A	N/A	N/A
10 Wickham Pl Ascot 6104	53	67	55	70	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100 Boulder Av Redcliffe 6104	47	63	47	60	44	54	44	54	N/A	N/A	N/A	N/A
100 Kanowna Av E Redcliffe 6104	N/A	N/A	N/A	N/A	44	58	44	58	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
101 Central Av Redcliffe 6104	51	65	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
102 Boulder Av Redcliffe 6104	47	62	47	60	44	55	44	55	N/A	N/A	N/A	N/A
102 Kanowna Av E Redcliffe 6104	N/A	N/A	N/A	N/A	44	58	44	58	N/A	N/A	N/A	N/A
103 Boulder Av Redcliffe 6104	44	59	43	58	41	52	41	52	N/A	N/A	N/A	N/A
103 Central Av Redcliffe 6104	49	63	46	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
104 Boulder Av Redcliffe 6104	45	60	44	57	44	55	44	55	N/A	N/A	N/A	N/A
105 Boulder Av Redcliffe 6104	44	59	44	59	43	54	43	54	N/A	N/A	N/A	N/A
105 Central Av Redcliffe 6104	51	65	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
106 Boulder Av Redcliffe 6104	44	59	44	57	42	53	42	53	N/A	N/A	N/A	N/A
107 Central Av Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
107 Central Ave Redcliffe 6104	N/A	N/A	N/A	N/A	47	63	47	63	N/A	N/A	N/A	N/A
108 Second St Redcliffe 6104	N/A	N/A	N/A	N/A	45	59	45	59	N/A	N/A	N/A	N/A
109 Central Av Redcliffe 6104	N/A	N/A	N/A	N/A	48	64	48	64	N/A	N/A	N/A	N/A
11 Anzac St Bayswater 6053	50	64	52	66	51	66	51	66	47	61	49	63
11 Drummond St Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
11 Kanowna Av W Ascot 6104	48	61	55	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11 Lyall St Ascot 6104	N/A	N/A	N/A	N/A	43	57	43	57	N/A	N/A	N/A	N/A
11 The Court Redcliffe 6104	50	64	53	68	42	53	42	54	N/A	N/A	N/A	N/A
11 Wyatt Rd Bayswater 6053	48	59	55	69	44	56	44	56	41	54	41	54
11 Locock St Ascot 6104	53	68	57	72	51	66	55	69	N/A	N/A	N/A	N/A
110 Second St Redcliffe 6104	N/A	N/A	N/A	N/A	44	59	44	59	N/A	N/A	N/A	N/A
111 Central Av Redcliffe 6104	N/A	N/A	N/A	N/A	47	62	47	62	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
111 Matheson Rd Ascot 6104	49	63	50	64	49	63	50	63	N/A	N/A	N/A	N/A
112 Bulong Av Redcliffe 6104	49	63	48	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
112 Matheson Rd Ascot 6104	N/A	N/A	N/A	N/A	49	63	50	63	N/A	N/A	N/A	N/A
113 Central Av Redcliffe 6104	N/A	N/A	N/A	N/A	49	65	49	65	N/A	N/A	N/A	N/A
113 Second St Redcliffe 6104	46	61	46	59	44	55	44	55	N/A	N/A	N/A	N/A
114 Bulong Av Redcliffe 6104	48	61	46	59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
114 Hardy Rd Bayswater 6053	50	61	51	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
114 Matheson Rd Ascot 6104	N/A	N/A	N/A	N/A	49	63	50	63	N/A	N/A	N/A	N/A
115 Second St Redcliffe 6104	47	62	46	59	45	56	45	56	N/A	N/A	N/A	N/A
116 Central Av Redcliffe 6104	47	63	47	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
116 Hardy Rd Bayswater 6053	53	65	54	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
116 Matheson Rd Ascot 6104	51	64	N/A	N/A	51	65	53	65	N/A	N/A	N/A	N/A
116 Bulong Ave Redcliffe 6104	48	62	47	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
116a Central Av Redcliffe 6104	45	63	45	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
116c Hardy Rd Bayswater 6053	52	63	53	65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
117 Second St Redcliffe 6104	42	57	42	56	44	56	44	56	N/A	N/A	N/A	N/A
117a Second St Redcliffe 6104	43	58	42	55	44	56	44	56	N/A	N/A	N/A	N/A
118 Bulong Av Redcliffe 6104	43	59	42	58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
118 Hardy Rd Bayswater 6053	52	63	53	65	50	64	51	65	N/A	N/A	N/A	N/A
118 Matheson Rd Ascot 6104	49	62	53	65	49	63	51	64	N/A	N/A	N/A	N/A
119 Matheson Rd Ascot 6104	49	64	52	65	50	65	51	65	N/A	N/A	N/A	N/A
119 Second St Redcliffe 6104	45	60	45	59	40	53	40	53	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
11a Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	48	63	48	63	N/A	N/A	N/A	N/A
11b Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	49	63	49	63	N/A	N/A	N/A	N/A
12 Constance St Bayswater 6053	49	59	50	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12 Drummond St Redcliffe 6104	N/A	N/A	N/A	N/A	41	53	41	53	N/A	N/A	N/A	N/A
12 Forbes St Ascot 6104	50	63	53	66	50	63	52	65	N/A	N/A	N/A	N/A
12 Kanowna Av W Ascot 6104	49	62	53	68	44	56	47	61	N/A	N/A	N/A	N/A
12 Ryans Ct Redcliffe 6104	N/A	N/A	N/A	N/A	39	52	39	52	N/A	N/A	N/A	N/A
12 Beard Elb Bayswater 6053	45	56	45	58	43	54	43	54	N/A	N/A	N/A	N/A
12 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	51	65	52	65	N/A	N/A	N/A	N/A
1-2/4 Constance St Bayswater 6053	49	61	50	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
120 Bulong Av Redcliffe 6104	47	61	45	57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
121 Matheson Rd Ascot 6104	50	64	54	67	50	65	53	66	N/A	N/A	N/A	N/A
121 Second St Redcliffe 6104	44	59	43	57	41	53	41	53	N/A	N/A	N/A	N/A
122 Bulong Av Redcliffe 6104	46	60	43	56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
122 Central Av Redcliffe 6104	45	60	44	58	41	54	41	54	N/A	N/A	N/A	N/A
122 Hardy Rd Bayswater 6053	53	65	53	67	53	68	56	70	N/A	N/A	N/A	N/A
122 Second St Redcliffe 6104	N/A	N/A	N/A	N/A	41	55	41	55	N/A	N/A	N/A	N/A
124 Bulong Av Redcliffe 6104	42	57	41	56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
124 Central Av Redcliffe 6104	45	60	45	59	43	57	43	57	N/A	N/A	N/A	N/A
124 Hardy Rd Bayswater 6053	54	67	55	69	54	69	59	74	N/A	N/A	N/A	N/A
124 Matheson Rd Ascot 6104	50	62	54	67	51	65	53	66	N/A	N/A	N/A	N/A
124 Second St Redcliffe 6104	N/A	N/A	N/A	N/A	44	57	44	57	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
125 Matheson Rd Ascot 6104	51	64	55	69	51	66	54	69	N/A	N/A	N/A	N/A
126 Bulong Av Redcliffe 6104	45	61	42	58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
126 Central Av Redcliffe 6104	44	58	43	56	42	55	42	55	N/A	N/A	N/A	N/A
126 Matheson Rd Ascot 6104	51	65	54	67	51	64	53	67	N/A	N/A	N/A	N/A
127 Matheson Rd Ascot 6104	50	63	54	70	52	68	55	70	N/A	N/A	N/A	N/A
128 Bulong Av Redcliffe 6104	46	59	44	57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
128 Central Av Redcliffe 6104	45	61	44	58	41	55	41	55	N/A	N/A	N/A	N/A
128 Matheson Rd Ascot 6104	51	65	54	67	51	65	55	69	N/A	N/A	N/A	N/A
129 Matheson Rd Ascot 6104	51	64	56	71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13 Anzac St Bayswater 6053	50	64	52	65	50	65	50	65	47	61	48	62
13 Kanowna Av W Ascot 6104	48	61	55	70	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13 The Court Redcliffe 6104	50	65	53	68	41	52	42	53	N/A	N/A	N/A	N/A
13 The Esplanade Ascot 6104	47	59	50	65	51	66	53	67	N/A	N/A	N/A	N/A
13 The Esplanade Ascot 6104	54	69	53	68	57	73	57	73	N/A	N/A	N/A	N/A
130 Bulong Av Redcliffe 6104	47	62	45	59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13-15 Wyatt Rd Bayswater 6053	48	61	56	70	44	56	44	56	40	55	41	55
132 Bulong Av Redcliffe 6104	48	63	45	59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
132 Central Ave Redcliffe 6104	N/A	N/A	N/A	N/A	44	57	44	57	N/A	N/A	N/A	N/A
134 Central Ave Redcliffe 6104	N/A	N/A	N/A	N/A	44	58	44	58	N/A	N/A	N/A	N/A
136 Central Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	57	45	57	N/A	N/A	N/A	N/A
138 Central Av Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
13a Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	48	64	48	64	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
13b Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	46	61	46	61	N/A	N/A	N/A	N/A
14 Boulder Av Ascot 6104	48	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14 Constance St Bayswater 6053	47	60	49	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14 Duchess Ct Bayswater 6053	48	62	48	62	47	62	50	66	N/A	N/A	N/A	N/A
14 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	49	64	50	64	N/A	N/A	N/A	N/A
14 Newton St Bayswater 6053	46	59	52	65	45	59	44	59	41	53	42	55
14 Kanowna Ave Ascot 6104	48	62	54	70	42	54	43	56	N/A	N/A	N/A	N/A
140 Central Av Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
140 Second St Redcliffe 6104	N/A	N/A	N/A	N/A	43	57	43	57	N/A	N/A	N/A	N/A
147 Bulong Av Redcliffe 6104	N/A	N/A	N/A	N/A	44	60	44	60	N/A	N/A	N/A	N/A
15 Anzac St Bayswater 6053	50	64	53	67	51	66	50	65	46	59	46	60
15 Drummond St Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
15 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	46	62	46	62	N/A	N/A	N/A	N/A
15 Locock St Ascot 6104	49	63	56	72	43	57	47	62	N/A	N/A	N/A	N/A
15 The Court Redcliffe 6104	48	62	50	64	42	54	46	60	N/A	N/A	N/A	N/A
15 The Esplanade Ascot 6104	49	61	52	65	49	63	52	65	N/A	N/A	N/A	N/A
16 Constance St Bayswater 6053	49	60	50	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16 Kanowna Av W Ascot 6104	49	63	56	72	42	56	47	63	N/A	N/A	N/A	N/A
16 Locock St Ascot 6104	51	67	56	72	45	60	53	69	N/A	N/A	N/A	N/A
16 Duchess Ct Bayswater 6053	45	58	45	57	45	58	46	59	N/A	N/A	N/A	N/A
162 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
163 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	61	45	61	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
164 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	47	63	47	63	N/A	N/A	N/A	N/A
165 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	61	45	61	N/A	N/A	N/A	N/A
166 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	46	61	46	61	N/A	N/A	N/A	N/A
167 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	47	63	47	63	N/A	N/A	N/A	N/A
168 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	48	64	48	64	N/A	N/A	N/A	N/A
169 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	61	45	61	N/A	N/A	N/A	N/A
16a Constance St Bayswater 6053	51	62	52	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16a Newton St Bayswater 6053	46	58	51	64	45	60	45	59	40	52	42	55
17 Forbes St Ascot 6104	50	64	55	70	52	67	53	69	N/A	N/A	N/A	N/A
17 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	45	60	45	60	N/A	N/A	N/A	N/A
17 Kanowna Av W Ascot 6104	48	62	55	71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17 The Court Redcliffe 6104	49	62	52	65	44	55	48	62	N/A	N/A	N/A	N/A
17 The Esplanade Ascot 6104	52	67	52	66	55	71	56	71	N/A	N/A	N/A	N/A
170 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	50	66	50	66	N/A	N/A	N/A	N/A
170b Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	50	65	50	65	N/A	N/A	N/A	N/A
171 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	61	45	61	N/A	N/A	N/A	N/A
173 Coolgardie Av Redcliffe 6104	N/A	N/A	N/A	N/A	51	66	51	66	N/A	N/A	N/A	N/A
18 Constance St Bayswater 6053	50	60	51	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	42	57	42	57	N/A	N/A	N/A	N/A
18 Kanowna Av W Ascot 6104	50	63	56	70	46	61	49	64	N/A	N/A	N/A	N/A
18 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
18 Newton St Bayswater 6053	45	56	50	64	42	54	42	54	40	51	40	53

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
18 Locock St Ascot 6104	51	67	56	73	46	61	53	68	N/A	N/A	N/A	N/A
19 Anzac St Bayswater 6053	46	58	50	62	45	60	45	59	42	56	43	57
19 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	45	58	45	58	N/A	N/A	N/A	N/A
19 Kanowna Av W Ascot 6104	49	64	56	71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19 The Court Redcliffe 6104	48	60	49	61	43	55	46	60	N/A	N/A	N/A	N/A
19a The Esplanade Ascot 6104	54	69	54	69	56	72	56	72	N/A	N/A	N/A	N/A
1a Jacqueline St Bayswater 6053	49	61	50	62	47	60	48	62	N/A	N/A	N/A	N/A
2 Boud Av Perth Airport 6105	N/A	N/A	N/A	N/A	46	59	46	59	N/A	N/A	N/A	N/A
2 Constance St Bayswater 6053	49	61	50	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 Gobba Ct Bayswater 6053	51	64	52	65	48	61	53	68	N/A	N/A	N/A	N/A
2 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	49	63	49	63	N/A	N/A	N/A	N/A
2 Jacqueline St Bayswater 6053	48	61	49	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 Ryans Ct Redcliffe 6104	N/A	N/A	N/A	N/A	39	52	39	52	N/A	N/A	N/A	N/A
2 Wickham Pl Ascot 6104	49	63	54	69	52	66	53	68	N/A	N/A	N/A	N/A
2 Beard Elb Bayswater 6053	49	61	51	64	49	63	50	63	N/A	N/A	N/A	N/A
2 Davis St Ascot 6104	50	64	55	71	54	70	56	71	N/A	N/A	N/A	N/A
2 Waterview Parade Ascot 6104	49	63	51	65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2/7 Wyatt Rd Bayswater 6053	47	58	50	65	45	57	45	57	N/A	N/A	N/A	N/A
20 Beard Elb Bayswater 6053	47	60	47	60	45	57	45	57	N/A	N/A	N/A	N/A
20 Constance St Bayswater 6053	49	62	50	62	48	60	50	62	N/A	N/A	N/A	N/A
20 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
20 Kanowna Av W Ascot 6104	50	64	56	72	47	62	50	64	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
20 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	40	52	40	52	N/A	N/A	N/A	N/A
20 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	46	61	46	61	N/A	N/A	N/A	N/A
20 Wyatt Rd Bayswater 6053	50	66	54	71	45	58	45	58	N/A	N/A	N/A	N/A
21 Anzac St Bayswater 6053	46	56	50	63	44	59	44	59	41	54	42	55
21 Kanowna Av W Ascot 6104	50	63	55	70	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21 The Court Redcliffe 6104	47	61	49	62	43	55	46	61	N/A	N/A	N/A	N/A
21a Kanowna Av W Ascot 6104	49	62	53	68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21a Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	41	53	41	53	N/A	N/A	N/A	N/A
22 Beard Elb Bayswater 6053	46	59	48	61	44	56	44	56	N/A	N/A	N/A	N/A
22 Boulder Av Ascot 6104	48	60	53	68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22 Constance St Bayswater 6053	51	65	51	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	42	54	42	54	N/A	N/A	N/A	N/A
22 Kanowna Av W Ascot 6104	50	65	56	72	47	62	50	63	N/A	N/A	N/A	N/A
22 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
22 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	46	61	46	61	N/A	N/A	N/A	N/A
22 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	40	53	40	53	N/A	N/A	N/A	N/A
22b Constance St Bayswater 6053	51	66	51	65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22c Constance St Bayswater 6053	53	68	54	67	51	64	54	66	N/A	N/A	N/A	N/A
23 Anzac St Bayswater 6053	44	56	50	63	44	59	44	58	42	54	42	55
23 Kanowna Av W Ascot 6104	50	63	55	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
23 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	43	55	43	55	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
23a Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	43	56	43	56	N/A	N/A	N/A	N/A
23a O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	42	56	42	56	N/A	N/A	N/A	N/A
24 Boulder Av Ascot 6104	48	59	53	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24 Kanowna Av W Ascot 6104	49	63	55	71	41	54	48	63	N/A	N/A	N/A	N/A
24 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
24 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	44	56	44	56	N/A	N/A	N/A	N/A
24 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	43	54	43	54	N/A	N/A	N/A	N/A
24 Wyatt Rd Bayswater 6053	51	66	55	73	46	58	46	58	N/A	N/A	N/A	N/A
25 Anzac St Bayswater 6053	42	55	49	62	42	56	42	56	39	52	40	53
25 Kanowna Av W Ascot 6104	50	63	55	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	43	56	43	56	N/A	N/A	N/A	N/A
25 Newton St Bayswater 6053	N/A	N/A	N/A	N/A	45	57	45	56	44	57	45	57
25 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	44	57	44	57	N/A	N/A	N/A	N/A
25 The Court Redcliffe 6104	47	60	48	60	44	56	47	62	N/A	N/A	N/A	N/A
25a Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	44	56	44	56	N/A	N/A	N/A	N/A
26 Boulder Av Ascot 6104	49	60	53	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26 Kanowna Av W Ascot 6104	50	64	56	72	45	60	49	64	N/A	N/A	N/A	N/A
26 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
26 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	43	56	44	56	N/A	N/A	N/A	N/A
26 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	44	58	44	58	N/A	N/A	N/A	N/A
27 Lyall St Redcliffe 6104	N/A	N/A	N/A	N/A	39	51	39	52	N/A	N/A	N/A	N/A
27 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	58	45	58	N/A	N/A	N/A	N/A
27 The Court Redcliffe 6104	48	62	48	61	45	56	46	59	N/A	N/A	N/A	N/A
27 Newtown St Bayswater 6053	N/A	N/A	N/A	N/A	43	54	43	54	40	53	41	54
28 Beard Elb Bayswater 6053	47	61	50	64	44	56	45	56	N/A	N/A	N/A	N/A
28 Boulder Av Ascot 6104	48	60	52	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
28 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	57	45	57	N/A	N/A	N/A	N/A
28 Miller Ave Redcliffe 6104	N/A	N/A	N/A	N/A	44	56	44	56	N/A	N/A	N/A	N/A
28a Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	48	61	48	62	N/A	N/A	N/A	N/A
28a O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
29 Kanowna Av W Ascot 6104	52	65	55	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	46	59	46	59	N/A	N/A	N/A	N/A
29a Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	45	60	45	60	N/A	N/A	N/A	N/A
3 Colwyn Rd Bayswater 6053	47	60	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 Dunstone Rd Bayswater 6053	54	66	54	67	53	67	59	73	N/A	N/A	N/A	N/A
3 Forbes St Ascot 6104	55	70	56	70	55	71	56	71	N/A	N/A	N/A	N/A
3 Gobba Ct Bayswater 6053	48	62	49	62	48	61	49	64	N/A	N/A	N/A	N/A
3 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	47	62	47	62	N/A	N/A	N/A	N/A
3 Jacqueline St Bayswater 6053	48	61	48	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 Kanowna Av W Ascot 6104	48	62	53	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 Piercey Ct Redcliffe 6104	N/A	N/A	N/A	N/A	40	53	40	53	N/A	N/A	N/A	N/A
3 Roebourne Pl Ascot 6104	53	67	56	72	52	66	55	68	N/A	N/A	N/A	N/A
3 Waterview Pde Ascot 6104	49	65	49	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 Wright Cr Bayswater 6053	49	63	50	63	45	60	48	64	N/A	N/A	N/A	N/A
3 Wyatt Rd Bayswater 6053	N/A	N/A	N/A	N/A	45	59	45	59	41	55	42	55
3 Locock St Ascot 6104	53	68	57	71	52	66	55	68	N/A	N/A	N/A	N/A
3 Newton St Bayswater 6053	50	63	58	74	45	58	45	58	43	57	43	57
3/27 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	44	58	44	58	N/A	N/A	N/A	N/A
3/4 Constance St Bayswater 6053	48	59	50	63	51	64	54	65	N/A	N/A	N/A	N/A
3/7 Wyatt Rd Bayswater 6053	47	58	50	62	45	57	45	57	N/A	N/A	N/A	N/A
30 Boulder Av Ascot 6104	48	62	51	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	49	63	49	63	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
30 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	44	56	44	56	N/A	N/A	N/A	N/A
30 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	47	61	47	61	N/A	N/A	N/A	N/A
30 Wyatt Rd Bayswater 6053	N/A	N/A	57	73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
302 Great Eastern Hwy Ascot 6104	N/A	N/A	N/A	N/A	42	54	42	54	N/A	N/A	N/A	N/A
308 Great Eastern Hwy Ascot 6104	51	63	N/A	N/A	51	64	52	65	N/A	N/A	N/A	N/A
30a Boulder Av Ascot 6104	48	60	52	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30a Wyatt Rd Bayswater 6053	52	67	56	73	54	69	58	76	N/A	N/A	N/A	N/A
30b Wyatt Rd Bayswater 6053	52	65	54	71	49	64	52	68	N/A	N/A	N/A	N/A
30c Boulder Av Ascot 6104	49	61	54	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
31 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	47	62	47	62	N/A	N/A	N/A	N/A
31 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	45	60	45	60	N/A	N/A	N/A	N/A
32 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	52	67	53	67	N/A	N/A	N/A	N/A
32 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	44	56	44	56	N/A	N/A	N/A	N/A
32 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	48	63	48	63	N/A	N/A	N/A	N/A
32 Wyatt Rd Bayswater 6053	52	65	57	72	48	63	49	65	N/A	N/A	N/A	N/A
33 Miller Av Redcliffe 6104	N/A	N/A	N/A	N/A	51	66	52	66	N/A	N/A	N/A	N/A
33 Newton St Bayswater 6053	N/A	N/A	N/A	N/A	41	50	41	50	36	48	37	50
33 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	47	60	N/A	N/A	N/A	N/A
33 The Esplanade Ascot 6104	52	68	55	70	54	69	56	72	N/A	N/A	N/A	N/A
34 Boulder Av Ascot 6104	49	62	54	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
34 Wyatt Rd Bayswater 6053	53	64	57	71	49	64	49	66	N/A	N/A	N/A	N/A
345 Great Eastern Hwy Redcliffe 6104	N/A	N/A	N/A	N/A	39	50	39	51	N/A	N/A	N/A	N/A
347 Great Eastern Hwy Redcliffe 6104	N/A	N/A	N/A	N/A	43	58	44	59	N/A	N/A	N/A	N/A
35 O'neile Pde Redcliffe 6104	N/A	N/A	N/A	N/A	48	61	48	61	N/A	N/A	N/A	N/A
35 River Rd Bayswater 6053	50	63	52	67	47	60	47	61	N/A	N/A	N/A	N/A
353 Great Eastern Hwy Redcliffe 6104	N/A	N/A	N/A	N/A	50	66	51	66	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
355 Great Eastern Hwy Redcliffe 6104	N/A	N/A	N/A	N/A	50	65	51	66	N/A	N/A	N/A	N/A
36 Boulder Av Ascot 6104	49	61	54	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
36 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	43	57	43	57	N/A	N/A	N/A	N/A
36 River Rd Bayswater 6053	54	68	58	75	51	66	52	68	N/A	N/A	N/A	N/A
36 Wyatt Rd Bayswater 6053	53	67	57	72	54	69	57	74	N/A	N/A	N/A	N/A
366 Great Eastern Hwy Ascot 6104	48	61	52	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
37 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	44	57	44	57	N/A	N/A	N/A	N/A
37 Wyatt Rd Bayswater 6053	50	62	54	70	45	56	46	58	N/A	N/A	N/A	N/A
375 Great Eastern Hwy Redcliffe 6104	54	68	58	73	44	57	47	60	N/A	N/A	N/A	N/A
37a River Rd Bayswater 6053	48	62	52	67	46	60	46	60	N/A	N/A	N/A	N/A
38 Boulder Av Ascot 6104	50	62	54	68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
38 River Rd Bayswater 6053	54	66	58	74	51	66	52	67	N/A	N/A	N/A	N/A
38 Wyatt Rd Bayswater 6053	53	66	56	70	52	64	52	64	N/A	N/A	N/A	N/A
39 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
39 River Rd Bayswater 6053	50	62	53	68	46	59	47	60	N/A	N/A	N/A	N/A
39 The Esplanade Ascot 6104	55	71	56	72	54	69	55	69	N/A	N/A	N/A	N/A
39 Wyatt Rd Bayswater 6053	50	63	54	68	46	57	47	58	N/A	N/A	N/A	N/A
3a Anzac St Bayswater 6053	58	74	57	72	58	74	58	73	54	70	55	70
4 Davis St Ascot 6104	51	64	56	71	54	70	56	71	N/A	N/A	N/A	N/A
4 Duchess Ct Bayswater 6053	49	63	50	64	49	63	53	68	N/A	N/A	N/A	N/A
4 Gobba Ct Bayswater 6053	49	62	49	61	47	59	50	64	N/A	N/A	N/A	N/A
4 Jacqueline St Bayswater 6053	48	60	48	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4 Kanowna Av W Ascot 6104	51	64	54	68	47	62	51	64	N/A	N/A	N/A	N/A
4 Newton St Bayswater 6053	52	65	58	72	47	60	47	60	45	58	45	58
4 Ryans Ct Redcliffe 6104	N/A	N/A	N/A	N/A	40	53	40	53	N/A	N/A	N/A	N/A
4 Wyatt Rd Bayswater 6053	48	60	56	71	44	55	44	55	41	55	41	55

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
4/7 Wyatt Rd Bayswater 6053	47	58	52	66	44	56	44	56	N/A	N/A	N/A	N/A
40 Boulder Av Ascot 6104	51	64	54	68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
40 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	42	54	43	54	N/A	N/A	N/A	N/A
40 Wyatt Rd Bayswater 6053	52	64	55	69	52	63	52	64	N/A	N/A	N/A	N/A
403-407 Great Eastern Hwy Belmont 6104	51	66	52	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
41 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	45	58	45	58	N/A	N/A	N/A	N/A
41 River Rd Bayswater 6053	49	61	52	67	47	60	47	61	N/A	N/A	N/A	N/A
41 The Esplanade Ascot 6104	53	68	53	68	51	66	52	66	N/A	N/A	N/A	N/A
41 Wyatt Rd Bayswater 6053	49	62	52	67	47	58	48	59	N/A	N/A	N/A	N/A
415 Great Eastern Hwy Redcliffe 6104	49	63	50	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
41a Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	46	60	46	60	N/A	N/A	N/A	N/A
42 Boulder Av Ascot 6104	51	65	54	70	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
42 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	41	55	41	55	N/A	N/A	N/A	N/A
42 River Rd Bayswater 6053	52	66	55	71	53	66	56	70	N/A	N/A	N/A	N/A
42 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	39	52	39	52	N/A	N/A	N/A	N/A
42 Wyatt Rd Bayswater 6053	52	66	56	71	53	66	53	66	N/A	N/A	N/A	N/A
42 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
43 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	44	58	44	58	N/A	N/A	N/A	N/A
43 River Rd Bayswater 6053	49	62	50	64	47	62	48	63	N/A	N/A	N/A	N/A
43 The Esplanade Ascot 6104	51	67	53	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
43 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
43 Wyatt Rd Bayswater 6053	49	60	51	64	47	58	48	59	N/A	N/A	N/A	N/A
43a River Rd Bayswater 6053	50	62	50	63	46	60	47	61	N/A	N/A	N/A	N/A
44 River Rd Bayswater 6053	51	62	51	66	53	67	55	69	N/A	N/A	N/A	N/A
44 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
45 Boulder Av Ascot 6104	49	61	52	65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
45 River Rd Bayswater 6053	49	61	50	63	47	61	48	63	N/A	N/A	N/A	N/A
45 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	42	54	42	54	N/A	N/A	N/A	N/A
45 Wyatt Rd Bayswater 6053	49	61	52	65	47	59	48	60	N/A	N/A	N/A	N/A
46 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	43	56	43	56	N/A	N/A	N/A	N/A
46 River Rd Bayswater 6053	54	66	55	68	52	65	57	71	N/A	N/A	N/A	N/A
46 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
46 Wyatt Rd Bayswater 6053	52	66	56	71	54	68	55	68	N/A	N/A	N/A	N/A
46a Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	43	55	43	55	N/A	N/A	N/A	N/A
47 Boulder Av Ascot 6104	50	61	53	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
47 Kanowna Av E Redcliffe 6104	50	65	54	68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
47 River Rd Bayswater 6053	49	63	50	64	47	61	48	63	N/A	N/A	N/A	N/A
47 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
47 Wyatt Rd Bayswater 6053	49	61	51	64	48	58	49	59	N/A	N/A	N/A	N/A
48 River Rd Bayswater 6053	54	67	55	69	50	63	57	71	N/A	N/A	N/A	N/A
48 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	43	55	43	55	N/A	N/A	N/A	N/A
48 Wyatt Rd Bayswater 6053	52	64	56	69	51	67	51	67	N/A	N/A	N/A	N/A
49 Boulder Av Redcliffe 6104	52	65	53	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
49 River Rd Bayswater 6053	49	61	49	61	47	60	49	62	N/A	N/A	N/A	N/A
49 Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	41	53	41	53	N/A	N/A	N/A	N/A
499 Guildford Rd Bayswater 6053	N/A	N/A	N/A	N/A	42	55	42	55	39	51	40	54
4a Wickham Pl Ascot 6104	51	64	55	70	52	67	55	70	N/A	N/A	N/A	N/A
5 Anzac St Bayswater 6053	53	68	54	69	54	70	54	70	51	65	52	67
5 Colwyn Rd Bayswater 6053	46	59	47	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5 Forbes St Ascot 6104	54	69	56	69	54	69	55	70	N/A	N/A	N/A	N/A
5 Gobba Ct Bayswater 6053	49	62	49	62	46	59	50	65	N/A	N/A	N/A	N/A
5 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	50	65	50	65	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
5 Jacqueline St Bayswater 6053	47	59	48	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5 Kanowna Av W Ascot 6104	49	60	53	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5 Piercey Ct Redcliffe 6104	N/A	N/A	N/A	N/A	40	51	40	51	N/A	N/A	N/A	N/A
5 The Court Redcliffe 6104	51	66	55	71	44	55	46	60	N/A	N/A	N/A	N/A
5 Whatley Cr Bayswater 6053	55	68	57	70	58	73	60	75	54	68	57	72
5 Wright Cr Bayswater 6053	48	62	50	62	44	58	47	63	N/A	N/A	N/A	N/A
5 Wyatt Rd Bayswater 6053	46	58	48	62	46	59	46	59	42	56	42	56
5/7 Wyatt Rd Bayswater 6053	46	58	52	67	45	56	45	56	40	54	41	55
50 River Rd Bayswater 6053	53	66	54	67	51	65	57	71	N/A	N/A	N/A	N/A
50 Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	40	53	40	53	N/A	N/A	N/A	N/A
50 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	43	56	43	56	N/A	N/A	N/A	N/A
50 Wyatt Rd Bayswater 6053	53	66	55	71	56	71	56	71	N/A	N/A	N/A	N/A
50a Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	41	53	41	53	N/A	N/A	N/A	N/A
50a Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	45	59	45	59	N/A	N/A	N/A	N/A
51 Boulder Av Redcliffe 6104	52	67	53	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
51 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	42	54	42	54	N/A	N/A	N/A	N/A
51 Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	53	42	53	N/A	N/A	N/A	N/A
51 Wyatt Rd Bayswater 6053	49	61	52	66	47	58	47	58	N/A	N/A	N/A	N/A
51a Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	53	42	53	N/A	N/A	N/A	N/A
52 Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	54	43	54	N/A	N/A	N/A	N/A
52 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	46	59	46	59	N/A	N/A	N/A	N/A
52 Wyatt Rd Bayswater 6053	52	65	55	70	54	69	54	69	N/A	N/A	N/A	N/A
52a Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	43	55	43	55	N/A	N/A	N/A	N/A
53 Boulder Av Redcliffe 6104	52	66	53	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
53 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	42	54	42	54	N/A	N/A	N/A	N/A
53 River Rd Bayswater 6053	51	61	52	62	50	65	53	68	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
53 Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	42	54	42	54	N/A	N/A	N/A	N/A
53 Stanton Rd Redcliffe 6104	N/A	N/A	N/A	N/A	38	51	38	51	N/A	N/A	N/A	N/A
53a River Rd Bayswater 6053	51	63	52	64	49	61	50	63	N/A	N/A	N/A	N/A
54 River Rd Bayswater 6053	53	64	53	66	53	66	57	70	N/A	N/A	N/A	N/A
54 Victoria St Redcliffe 6104	N/A	N/A	N/A	N/A	46	59	47	59	N/A	N/A	N/A	N/A
54 Wyatt Rd Bayswater 6053	52	65	55	70	54	69	54	69	N/A	N/A	N/A	N/A
55 Boulder Av Redcliffe 6104	53	68	53	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
55 Kenmure Av Bayswater 6053	50	62	51	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
55 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	40	53	40	53	N/A	N/A	N/A	N/A
55 River Rd Bayswater 6053	50	62	51	65	51	65	53	67	N/A	N/A	N/A	N/A
55 Smiths Av Redcliffe 6104	N/A	N/A	N/A	N/A	44	56	44	56	N/A	N/A	N/A	N/A
56 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
56 River Rd Bayswater 6053	52	63	53	65	54	66	57	69	N/A	N/A	N/A	N/A
56 Wyatt Rd Bayswater 6053	48	62	51	66	52	65	52	66	N/A	N/A	N/A	N/A
56a Wyatt Rd Bayswater 6053	N/A	N/A	55	69	56	71	N/A	N/A	N/A	N/A	N/A	N/A
56a Wyatt Rd Bayswater 6053	53	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
57 Boulder Av Redcliffe 6104	53	68	53	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
57 River Rd Bayswater 6053	51	60	52	63	53	67	54	67	N/A	N/A	N/A	N/A
57 Wyatt Rd Bayswater 6053	48	62	50	64	49	64	49	64	N/A	N/A	N/A	N/A
58 Kenmure Av Bayswater 6053	51	61	51	63	50	62	52	66	N/A	N/A	N/A	N/A
58 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	40	53	40	53	N/A	N/A	N/A	N/A
58 River Rd Bayswater 6053	52	64	53	66	53	66	56	70	N/A	N/A	N/A	N/A
58 Wyatt Rd Bayswater 6053	53	66	55	68	55	69	56	70	N/A	N/A	N/A	N/A
59 Boulder Av Redcliffe 6104	54	69	53	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
59 Kenmure Av Bayswater 6053	50	63	52	65	50	63	53	66	N/A	N/A	N/A	N/A
59 River Rd Bayswater 6053	50	61	51	63	53	67	55	68	N/A	N/A	N/A	N/A

Receiver address	**Option 1 - Target**		**Option 1 - Limit**		**Option 2 - Target**		**Option 2 - Limit**		**Option 3 - Target**		**Option 3 - Limit**	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
59 Dunstone Rd Bayswater 6053	53	64	54	65	52	66	60	75	N/A	N/A	N/A	N/A
59 Wyatt Rd Bayswater 6053	48	59	49	61	48	62	49	62	N/A	N/A	N/A	N/A
5a Whatley Cr Bayswater 6053	53	67	55	69	57	72	58	73	51	65	54	69
5b Whatley Cr Bayswater 6053	57	71	57	70	62	78	61	77	N/A	N/A	58	74
5c Whatley Cr Bayswater 6053	59	74	58	72	62	77	61	76	56	71	59	74
6 Constance St Bayswater 6053	49	60	51	64	51	63	53	64	N/A	N/A	N/A	N/A
6 Davis St Ascot 6104	51	64	55	69	55	71	56	72	N/A	N/A	N/A	N/A
6 Duchess Ct Bayswater 6053	47	60	48	61	48	61	51	65	N/A	N/A	N/A	N/A
6 Jacqueline St Bayswater 6053	49	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6 Ryans Ct Redcliffe 6104	N/A	N/A	N/A	N/A	40	52	40	52	N/A	N/A	N/A	N/A
60 Central Av Redcliffe 6104	50	63	51	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
60 Kenmure Av Bayswater 6053	51	64	53	65	53	66	56	69	N/A	N/A	N/A	N/A
60 River Rd Bayswater 6053	52	64	53	66	53	66	56	70	N/A	N/A	N/A	N/A
60 Wyatt Rd Bayswater 6053	52	64	55	67	53	67	54	68	N/A	N/A	N/A	N/A
61 Kanowna Av E Redcliffe 6104	48	63	50	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
61 Kenmure Av Bayswater 6053	50	62	50	63	51	65	54	67	N/A	N/A	N/A	N/A
61 Stanton Rd Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
61a River Rd Bayswater 6053	50	61	51	63	53	68	54	68	N/A	N/A	N/A	N/A
62 Kanowna Av E Redcliffe 6104	N/A	N/A	N/A	N/A	43	55	43	55	N/A	N/A	N/A	N/A
62 River Rd Bayswater 6053	52	66	53	67	53	66	58	72	N/A	N/A	N/A	N/A
62 Wyatt Road Bayswater 6053	53	65	55	67	53	68	54	70	N/A	N/A	N/A	N/A
62a Wyatt Rd Bayswater 6053	53	65	55	67	53	68	55	69	N/A	N/A	N/A	N/A
62c Wyatt Rd Bayswater 6053	53	65	55	67	53	68	55	69	N/A	N/A	N/A	N/A
63 Kanowna Av E Redcliffe 6104	48	63	50	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
63 River Rd Bayswater 6053	49	61	50	63	51	64	53	65	N/A	N/A	N/A	N/A
63 Stanton Rd Redcliffe 6104	N/A	N/A	N/A	N/A	40	55	40	55	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
64 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	38	51	38	51	N/A	N/A	N/A	N/A
64 River Rd Bayswater 6053	52	63	52	65	51	65	54	67	N/A	N/A	N/A	N/A
64a River Rd Baywater 6053	51	65	53	66	50	63	58	73	N/A	N/A	N/A	N/A
64a Wyatt Rd Bayswater 6053	53	67	55	69	53	69	56	69	N/A	N/A	N/A	N/A
64b Wyatt Rd Bayswater 6053	53	66	55	68	53	67	56	69	N/A	N/A	N/A	N/A
64c Wyatt Rd Bayswater 6053	54	68	56	69	53	67	57	71	N/A	N/A	N/A	N/A
65 Kanowna Av E Redcliffe 6104	48	63	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
65 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	39	52	39	52	N/A	N/A	N/A	N/A
65 River Rd Bayswater 6053	50	62	52	65	51	62	55	68	N/A	N/A	N/A	N/A
65 Stanton Rd Redcliffe 6104	N/A	N/A	N/A	N/A	41	56	41	56	N/A	N/A	N/A	N/A
65a River Rd Bayswater 6053	51	62	52	63	50	62	54	67	N/A	N/A	N/A	N/A
66 Central Av Redcliffe 6104	51	66	51	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
66 River Rd Bayswater 6053	53	66	54	67	51	65	52	66	N/A	N/A	N/A	N/A
66b River Rd Bayswater 6053	53	65	54	67	51	63	58	71	N/A	N/A	N/A	N/A
67 Kanowna Av E Redcliffe 6104	47	62	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
67 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
67 River Rd Bayswater 6053	51	64	52	65	51	64	56	70	N/A	N/A	N/A	N/A
67 Stanton Rd Redcliffe 6104	N/A	N/A	N/A	N/A	42	58	42	58	N/A	N/A	N/A	N/A
68 Boulder Av Redcliffe 6104	51	67	52	68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
68 Central Av Redcliffe 6104	51	65	49	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
68 River Rd Bayswater 6053	53	66	54	67	51	64	58	71	N/A	N/A	N/A	N/A
68 Wyatt Rd Bayswater 6053	54	67	55	68	53	65	58	73	N/A	N/A	N/A	N/A
68 Wright Crs Bayswater 6053	52	65	52	64	52	66	57	70	N/A	N/A	N/A	N/A
69 Kanowna Av E Redcliffe 6104	48	61	49	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
69 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	37	49	37	49	N/A	N/A	N/A	N/A
69 River Rd Bayswater 6053	51	62	52	65	52	66	55	70	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
69a River Rd Bayswater 6053	50	62	52	65	52	65	56	69	N/A	N/A	N/A	N/A
6a Piercey Ct Redcliffe 6104	N/A	N/A	N/A	N/A	35	47	35	47	N/A	N/A	N/A	N/A
6b Constance St Bayswater 6053	49	59	50	62	40	51	41	52	N/A	N/A	N/A	N/A
7 Anzac St Bayswater 6053	53	68	54	68	54	70	54	70	50	64	51	67
7 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	51	65	51	65	N/A	N/A	N/A	N/A
7 Kanowna Av W Ascot 6104	49	61	53	68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7 Locock St Ascot 6104	53	68	57	71	50	64	54	68	N/A	N/A	N/A	N/A
7 Rotary Pl Bayswater 6053	46	59	47	60	45	56	46	57	N/A	N/A	N/A	N/A
7 Ryans Ct Redcliffe 6104	N/A	N/A	N/A	N/A	40	52	40	52	N/A	N/A	N/A	N/A
7 The Court Redcliffe 6104	51	65	55	70	44	57	44	57	N/A	N/A	N/A	N/A
70 Boulder Av Redcliffe 6104	50	66	50	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
70 Central Av Redcliffe 6104	51	65	50	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
70 River Rd Bayswater 6053	51	65	53	66	51	64	56	70	N/A	N/A	N/A	N/A
70 Stanton Rd Redcliffe 6104	N/A	N/A	N/A	N/A	40	56	40	56	N/A	N/A	N/A	N/A
71 Kanowna Av E Redcliffe 6104	47	62	49	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
71a River Rd Bayswater 6053	51	63	52	66	53	66	56	69	N/A	N/A	N/A	N/A
71b River Rd Bayswater 6053	48	61	50	64	50	64	53	67	N/A	N/A	N/A	N/A
71c River Rd Bayswater 6053	49	61	51	63	50	63	52	66	N/A	N/A	N/A	N/A
72 Boulder Av Redcliffe 6104	50	65	50	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
72 Central Av Redcliffe 6104	51	66	50	65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
72 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	33	47	33	47	N/A	N/A	N/A	N/A
73 Kanowna Av E Redcliffe 6104	46	60	47	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
73 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	39	51	39	51	N/A	N/A	N/A	N/A
73 Second St Redcliffe 6104	42	57	42	55	41	51	41	51	N/A	N/A	N/A	N/A
73 Wyatt Rd Bayswater 6053	52	66	52	67	51	63	55	69	N/A	N/A	N/A	N/A
74 Boulder Av Redcliffe 6104	49	64	50	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
74 Wyatt Rd Bayswater 6053	54	66	55	67	53	66	59	72	N/A	N/A	N/A	N/A
75 Kanowna Av E Redcliffe 6104	46	59	46	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	38	50	38	50	N/A	N/A	N/A	N/A
75 River Rd Bayswater 6053	52	66	54	67	53	67	56	69	N/A	N/A	N/A	N/A
75 Second St Redcliffe 6104	42	57	41	55	44	55	44	55	N/A	N/A	N/A	N/A
75a Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	39	51	39	51	N/A	N/A	N/A	N/A
77 Central Av Redcliffe 6104	48	62	48	59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
77 Kanowna Av E Redcliffe 6104	44	60	47	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
77 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	39	51	39	51	N/A	N/A	N/A	N/A
77 River Rd Bayswater 6053	52	66	53	65	52	63	55	67	N/A	N/A	N/A	N/A
77 Second St Redcliffe 6104	43	58	43	56	43	54	43	54	N/A	N/A	N/A	N/A
77a Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	40	52	40	52	N/A	N/A	N/A	N/A
78 Boulder Av Redcliffe 6104	48	64	48	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
78 Victoria St N Redcliffe 6104	48	62	49	62	45	56	45	56	N/A	N/A	N/A	N/A
79 Boulder Av Redcliffe 6104	49	65	51	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
79 Central Av Redcliffe 6104	48	61	47	59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
79 Morrison St Redcliffe 6104	N/A	N/A	N/A	N/A	39	52	39	52	N/A	N/A	N/A	N/A
79 Second St Redcliffe 6104	44	59	46	57	41	51	41	51	N/A	N/A	N/A	N/A
79 Wyatt Rd Bayswater 6053	51	63	51	63	51	64	53	68	N/A	N/A	N/A	N/A
79 River Rd Bayswater 6053	52	65	53	65	52	64	55	68	N/A	N/A	N/A	N/A
79a River Rd Bayswater 6053	53	68	53	67	51	65	53	68	N/A	N/A	N/A	N/A
8 Beard Elb Bayswater 6053	46	58	46	60	46	58	46	59	N/A	N/A	N/A	N/A
8 Constance St Bayswater 6053	49	60	50	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8 Davis St Ascot 6104	50	62	55	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8 Duchess Ct Bayswater 6053	47	57	47	58	48	60	49	61	N/A	N/A	N/A	N/A
8 Kanowna Av W Ascot 6104	51	65	54	67	46	61	50	65	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
8 Newton St Bayswater 6053	50	62	55	70	51	66	51	66	47	58	47	58
80 Boulder Av Redcliffe 6104	47	62	47	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
80 Central Av Redcliffe 6104	53	67	52	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
80 Victoria St N Redcliffe 6104	47	60	49	62	42	54	42	54	N/A	N/A	N/A	N/A
81 Boulder Av Redcliffe 6104	47	63	47	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
81 River Rd Bayswater 6053	52	66	53	65	50	63	53	66	N/A	N/A	N/A	N/A
82 Boulder Av Redcliffe 6104	46	61	46	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
82 Victoria St N Redcliffe 6104	48	62	50	64	42	54	42	54	N/A	N/A	N/A	N/A
82 Wyatt Rd Bayswater 6053	53	66	54	67	52	65	57	72	N/A	N/A	N/A	N/A
83 Boulder Av Redcliffe 6104	48	64	49	64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
83 Central Av Redcliffe 6104	49	63	47	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
83 Kanowna Av E Redcliffe 6104	45	60	47	60	41	51	41	51	N/A	N/A	N/A	N/A
83 Wright Cr Bayswater 6053	50	63	50	62	51	64	54	68	N/A	N/A	N/A	N/A
83 Wyatt Rd Bayswater 6053	50	62	51	62	52	64	54	68	N/A	N/A	N/A	N/A
84 Boulder Av Redcliffe 6104	46	61	48	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
84 Central Av Redcliffe 6104	53	67	52	65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
85 Boulder Av Redcliffe 6104	47	62	47	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
85 Kanowna Av E Redcliffe 6104	44	59	44	58	41	52	41	52	N/A	N/A	N/A	N/A
85 Wright Cr Bayswater 6053	51	63	51	63	53	66	56	71	N/A	N/A	N/A	N/A
85 Wyatt Rd Bayswater 6053	51	64	51	64	52	64	55	69	N/A	N/A	N/A	N/A
85-87 Central Ave Redcliffe 6104	50	64	49	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
86 Boulder Av Redcliffe 6104	45	59	47	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
86 Wyatt Rd Bayswater 6053	52	66	53	67	53	67	58	73	N/A	N/A	N/A	N/A
87 Boulder Av Redcliffe 6104	47	63	47	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
87 Kanowna Av E Redcliffe 6104	42	57	43	57	40	51	40	51	N/A	N/A	N/A	N/A
87a Boulder Av Redcliffe 6104	46	63	45	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
88 Boulder Av Redcliffe 6104	46	59	48	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
88 Wyatt Rd Bayswater 6053	50	64	51	65	50	63	54	69	N/A	N/A	N/A	N/A
89 Boulder Av Redcliffe 6104	45	60	45	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
89 Kanowna Av E Redcliffe 6104	46	59	47	58	40	50	40	50	N/A	N/A	N/A	N/A
89 Wyatt Rd Bayswater 6053	51	63	51	64	52	65	55	69	N/A	N/A	N/A	N/A
89-91 Central Ave Redcliffe 6104	47	62	46	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8a Constance St Bayswater 6053	50	62	52	65	51	62	52	63	N/A	N/A	N/A	N/A
9 Drummond St Redcliffe 6104	N/A	N/A	N/A	N/A	41	54	41	54	N/A	N/A	N/A	N/A
9 Dunstone Rd Bayswater 6053	52	65	54	68	50	64	58	71	N/A	N/A	N/A	N/A
9 Forbes St Ascot 6104	49	62	53	67	53	68	54	68	N/A	N/A	N/A	N/A
9 Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	50	64	50	64	N/A	N/A	N/A	N/A
9 Kanowna Av W Ascot 6104	48	61	55	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9 Locock St Ascot 6104	53	67	57	71	49	63	54	68	N/A	N/A	N/A	N/A
9 The Court Redcliffe 6104	50	64	54	69	42	52	42	53	N/A	N/A	N/A	N/A
9 The Esplanade Ascot 6104	50	64	51	63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9 Wyatt Rd Bayswater 6053	47	60	54	69	44	56	44	56	41	55	41	55
90 Boulder Av Redcliffe 6104	45	60	46	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
90 Wyatt Rd Bayswater 6053	53	65	54	66	54	67	60	75	N/A	N/A	N/A	N/A
91 Boulder Av Redcliffe 6104	46	62	45	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
92 Boulder Av Redcliffe 6104	45	60	45	60	40	52	40	52	N/A	N/A	N/A	N/A
93 Central Av Redcliffe 6104	49	63	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
94 Kanowna Av E Redcliffe 6104	N/A	N/A	N/A	N/A	42	55	42	55	N/A	N/A	N/A	N/A
95 Boulder Av Redcliffe 6104	44	60	44	59	40	51	40	51	N/A	N/A	N/A	N/A
95 Central Av Redcliffe 6104	49	64	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
95 Kanowna Av E Redcliffe 6104	N/A	N/A	N/A	N/A	44	58	44	58	N/A	N/A	N/A	N/A
96 Boulder Av Redcliffe 6104	47	64	46	61	42	55	42	55	N/A	N/A	N/A	N/A

Receiver address	Option 1 - Target		Option 1 - Limit		Option 2 - Target		Option 2 - Limit		Option 3 - Target		Option 3 - Limit	
	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade	$L_{Aeq,16hr}$ - Façade	L_{Amax} - Façade
96 Kanowna Av E Redcliffe 6104	N/A	N/A	N/A	N/A	44	57	44	57	N/A	N/A	N/A	N/A
97 Boulder Av Redcliffe 6104	47	62	46	61	41	53	41	53	N/A	N/A	N/A	N/A
97 Central Av Redcliffe 6104	49	63	47	61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
98 Boulder Av Redcliffe 6104	46	61	46	60	43	55	43	55	N/A	N/A	N/A	N/A
98 Kanowna Av E Redcliffe 6104	N/A	N/A	N/A	N/A	44	57	44	57	N/A	N/A	N/A	N/A
99 Boulder Av Redcliffe 6104	46	61	45	60	41	53	41	53	N/A	N/A	N/A	N/A
99 Central Av Redcliffe 6104	50	64	48	62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9a Anzac St Bayswater 6053	51	62	54	68	54	71	54	70	49	63	50	66
9b Greenshields Way Redcliffe 6104	N/A	N/A	N/A	N/A	50	64	50	64	N/A	N/A	N/A	N/A

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Memorandum

To	Paul Monaghan - PTA	Page	4
CC			
Subject	Forrestfield Airport Link - Noise assessment, Eastern end alignment		
From	Adam Cook		
File/Ref No.	60301258-AC-MEM-0001	Date	20-May-2014

Paul,

We report on the results of noise and vibration modelling for the eastern end of the Forrestfield Airport Link (FAL) alignment. This memorandum forms an addendum to AECOM's Feasibility Study Report (AECOM Ref: 60301258-AC-REP-0002)

1.0 Project noise and vibration criteria

Noise

Noise and vibration criteria for the FAL project were provided in the Feasibility Study Report. We have summarised these below.

Operational noise has been assessed in accordance with *State Planning Policy 5.4* (SPP 5.4) for new railways. The Department of Environmental Regulation (DER) have also set an additional maximum noise level (L_{Amax}) criterion for FAL. The applicable noise targets and limits for FAL are provided in Table 1.

Table 1 Project noise criteria adopted from SPP 5.4

Time period	Façade noise target	Façade noise limit	Maximum noise level criteiron
Day (6 am – 10 pm)	55 dB(A) $L_{eq,16hr}$	60 dB(A) $L_{eq,16hr}$	80 dB(A) L_{Amax}
Night (10 pm – 6 am)	50 dB(A) $L_{eq,8hr}$	55 dB(A) $L_{eq,8hr}$	

Tactile vibration

Predicted operational vibration levels at vibration sensitive receptors are assessed against *AS 2670.2: Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-introduced vibration in buildings (1-80 Hz)* (AS 2670.2). The AS 2670.2 criteria curve for residential receivers is the most stringent curve applicable to the receiver types in the vicinity of the rail corridor, and was therefore adopted as a project-wide tactile vibration criterion. The curve, converted into dB re $1x10^{-9}$ m/s is shown in Figure 1.

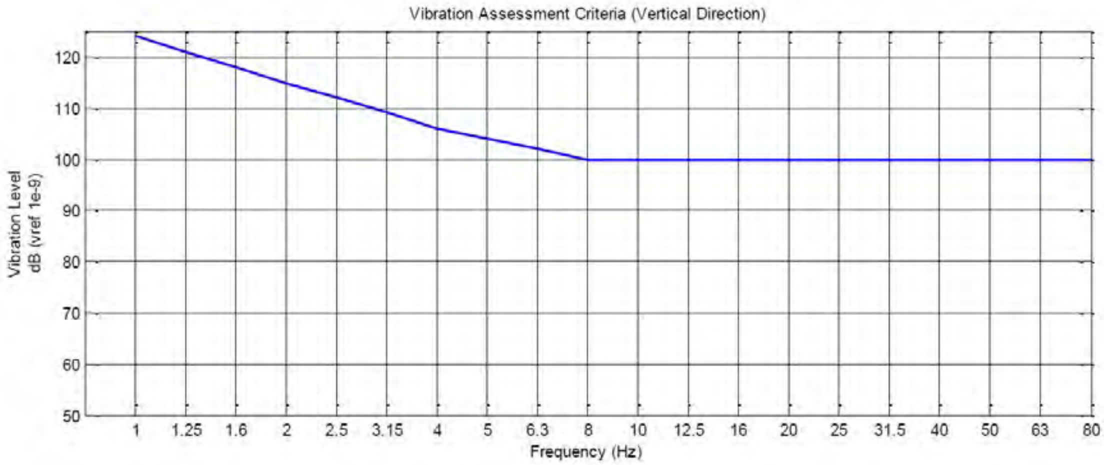

Figure 1 **Tactile vibration criteria curve from AS 2670.2**

For simplicity, the lowest applicable criterion of 100 dB re 10^{-9} m/s was adopted as the tactile vibration criteria for FAL.

Regenerated noise

The ground borne noise criteria was agreed upon with the DER to be 35 dB(A) $L_{Amax,slow}$ at residential receivers. This criterion is only applicable where receptors are not exposed to airborne noise from the rail alignments; for example, where the rail alignment is in tunnels, deep cuttings, or cut and cover structures.

2.0 Noise and vibration receivers

Sensitive receiver locations for noise and vibration near the Eastern end alignment of FAL were incorporated into the Feasibility Study noise model; however noise levels were not reported in the Feasibility Report due to the truncation of the assessment area. The assessment area has been expanded to the East and to the South to provide additional results for receivers near the Eastern end of the FAL alignment.

Sensitive receivers were identified by cross referencing Landgate data with aerial photography and street level photography.

Noise levels for identified sensitive receiver locations were modelled at a distance of 1 m from the building façade and at a height of 1.5 m above the ground. Upper levels of multiple storey receivers were not surveyed for the purpose of this assessment, however will be modelled at detail design stage.

Receiver noise levels predicted at the building façade also include a +2.5 dB(A) façade correction as per the SPP 5.4 requirements.

3.0 Noise model inputs

Noise modelling of rail traffic along the proposed alignments has been carried out using SoundPLAN 7.1 noise modelling software.

The noise model has utilised the following inputs:

- elevation contours and spot heights for existing terrain by Landgate
- future terrain and rail head geometry for the three alignment options from Preliminary CAD designs
- train types, train volumes and network speeds as advised by PTA
- building footprints, building heights and cadastral data by Landgate

The noise model has been calibrated for L_{Aeq} and L_{Amax} emissions for Transperth B-series trains

4.0 Noise modelling results

Noise modelling results for the additional locations modelled at the Eastern end of the alignment are shown in Table 2. Exceedances of noise target levels are shown in **bold** text, exceedances of noise limit levels are shown in **<u>bold underline</u>** text.

Table 2 Noise modelling results

Receiver address	East airport receiver levels [dB(A)]		
	Day **$L_{Aeq,16hr}$ - Façade**	**Night** **$L_{Aeq,8hr}$ - Façade**	**Maximum** **L_{Amax} - Façade**
1 Jabiru Ct High Wycombe 6057	33	27	49
1 Sorensen Rd High Wycombe 6057	39	29	54
3 Jabiru Ct High Wycombe 6057	33	28	49
3 Orchid Ct High Wycombe 6057	24	18	42
3 Sorensen Rd High Wycombe 6057	42	30	56
4 Orchid Ct High Wycombe 6057	35	27	53
5 Orchid Ct High Wycombe 6057	40	24	55
5 Sorensen Rd High Wycombe 6057	34	22	49
6 Orchid Ct High Wycombe 6057	39	32	54
6 Sultana Rd W High Wycombe 6057	**57**	49	72
8 Sorensen Rd High Wycombe 6057	38	31	53
9 Sorensen Rd High Wycombe 6057	33	28	48
10 Everitt Pl High Wycombe 6057	46	41	60
10 Ibis Pl High Wycombe 6057	51	43	67
10 Sorensen Rd High Wycombe 6057	37	28	53
10 Sultana Rd W High Wycombe 6057	51	37	67
11 Sorensen Rd High Wycombe 6057	33	28	49
11 Sultana Rd W High Wycombe 6057	**56**	40	71
12 Sorensen Rd High Wycombe 6057	35	29	49
13 Palmer Cr High Wycombe 6057	40	24	53
15 Palmer Cr High Wycombe 6057	37	28	50
16 Lorikeet Loop High Wycombe 6057	40	35	54
16 Palmer Cr High Wycombe 6057	37	31	50
17 Palmer Cr High Wycombe 6057	37	30	50
18 Lorikeet Loop High Wycombe 6057	38	33	51
18 Palmer Cr High Wycombe 6057	38	31	51
19 Palmer Cr High Wycombe 6057	37	30	50
20 Lorikeet Loop High Wycombe 6057	38	32	50
20 Palmer Cr High Wycombe 6057	40	30	54
21 Palmer Cr High Wycombe 6057	38	29	51
22 Lorikeet Loop High Wycombe 6057	38	33	51
22 Palmer Cr High Wycombe 6057	38	28	52
23 Palmer Cr High Wycombe 6057	38	30	51
24 Palmer Cr High Wycombe 6057	38	30	51

Receiver address	East airport receiver levels [dB(A)]		
	Day $L_{Aeq,16hr}$ - Façade	Night $L_{Aeq,8hr}$ - Façade	Maximum L_{Amax} - Façade
25 Palmer Cr High Wycombe 6057	37	32	50
26 Palmer Cr High Wycombe 6057	39	30	51
27 Palmer Cr High Wycombe 6057	38	32	50
28 Palmer Cr High Wycombe 6057	39	31	52
29 Palmer Cr High Wycombe 6057	37	27	50
30 Palmer Cr High Wycombe 6057	42	22	57
31 Palmer Cr High Wycombe 6057	40	29	55
32 Palmer Cr High Wycombe 6057	41	23	57
34 Palmer Cr High Wycombe 6057	38	30	54
36 Palmer Cr High Wycombe 6057	38	30	52

Maps showing noise contours for $L_{Aeq,16hr}$, $L_{Aeq,8hr}$, and L_{Amax} noise levels are included as an attachment to this memorandum.

5.0 Vibration modelling results

Generally speaking, tactile vibration levels will satisfy the criterion at setback distances greater than 10 m from the nearest rail line. Regenerated noise levels are predicted to be less than 35 dB(A) at horizontal distances greater than 20 m from the nearest rail line.

6.0 Discussion of compliance with noise and vibration criteria

Noise

Two noise-sensitive locations are predicted to have exceedances of the noise criteria. Properties located at 6 Sultana Rd West, High Wycombe and 11 Sultana Rd West, High Wycombe are predicted to exceed the daytime noise target criterion by 2 dB(A) and 1 dB(A) respectively. Levels are not predicted to exceed the daytime noise limit. No exceedances of the night time noise target or noise limit, or of the L_{Amax} criterion are predicted at these or any of the other noise sensitive locations at the Eastern end of the alignment.

Vibration

The closest building footprints for sensitive receivers are approximately 70 m from the nearest rail line. Tactile vibration levels will therefore satisfy the 100 dB re $1x10^{-9}$ m/s throughout the Eastern end of the alignment without vibration mitigation. Regenerated noise levels are also likely to satisfy the 35 dB(A) regenerated noise criterion without the use of vibration mitigation.

Adam Cook

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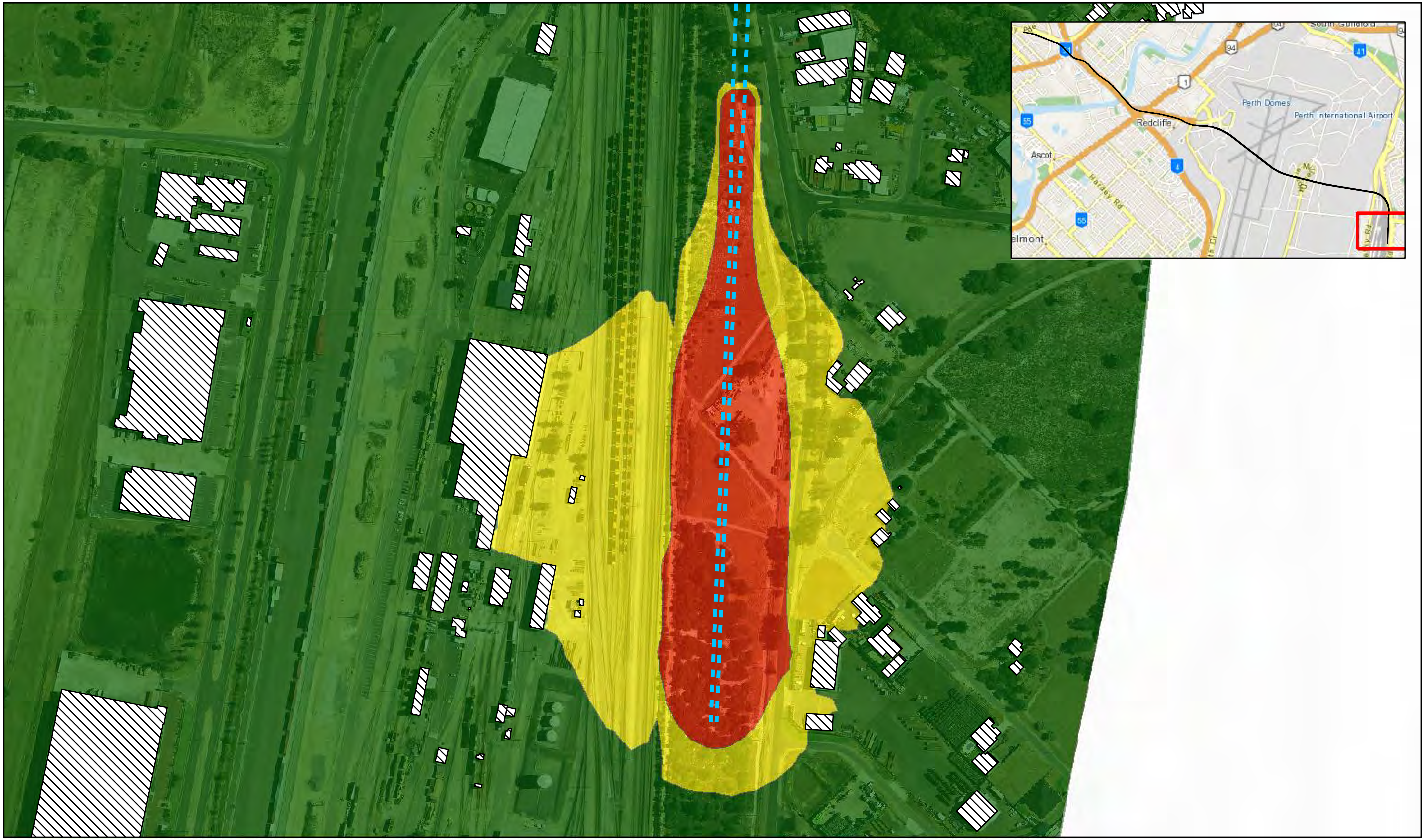

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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1

- - Tunnel

Free field noise contours

🟩 < 55 dB(A)

🟨 > 55 dB(A) (Noise target)

🟥 > 60 dB(A) (Noise limit)

▨ Building

Forrestfield Airport Link
Feasibility study noise model
All route options (East Airport)
Predicted daytime L_{Aeq} noise contours

PROJECT ID 60301258
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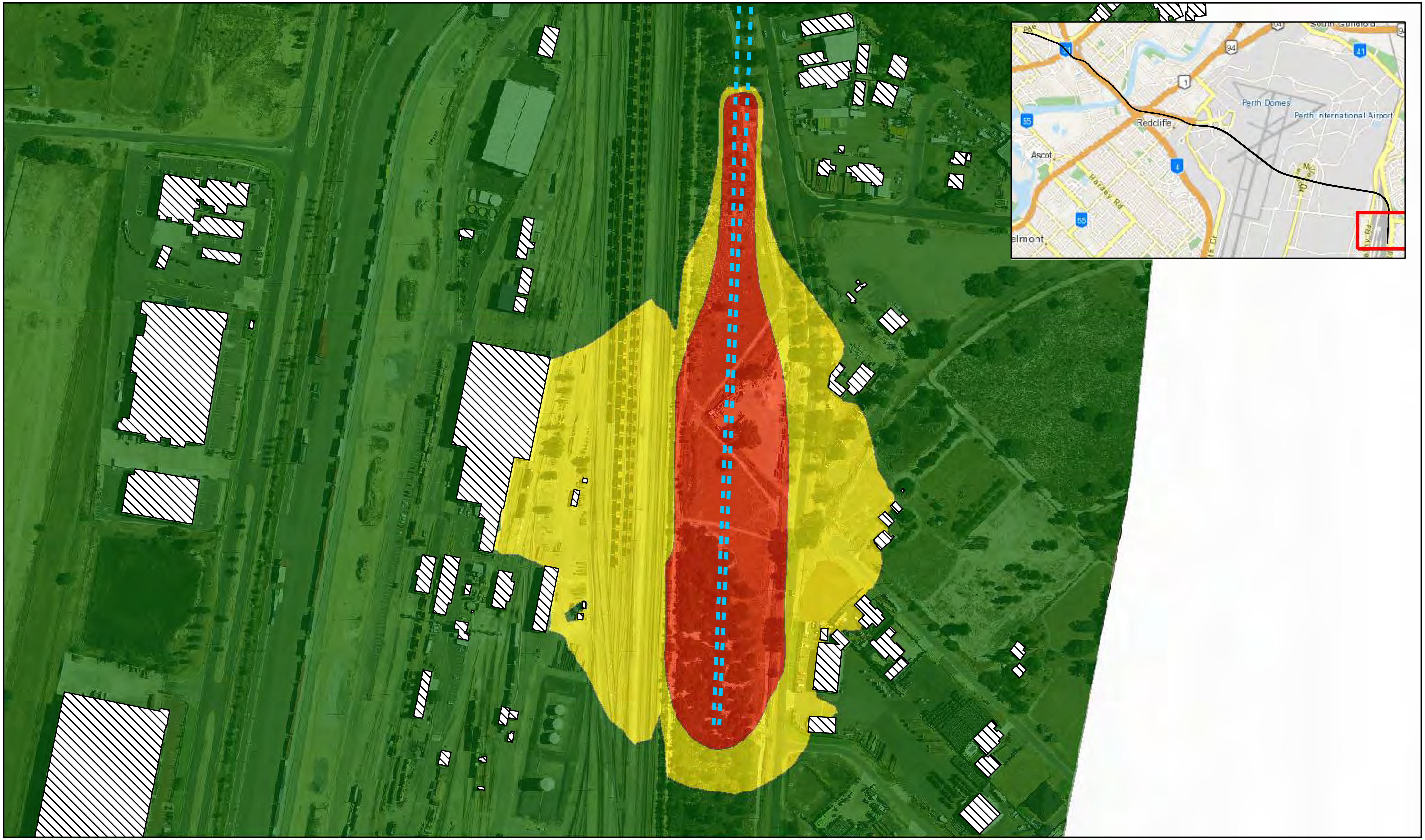
LAST MODIFIED AC - 20/05/2014

Map
1

A3 size



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0 37.5 75 150
metres

1:3,000 (when printed at A3)

LEGEND

Rail alignment - Option 1

- ▬ Tunnel

Free field noise contours

- 🟩 < 50 dB(A)
- 🟨 > 50 dB(A) (Noise target)
- 🟥 > 55 dB(A) (Noise limit)

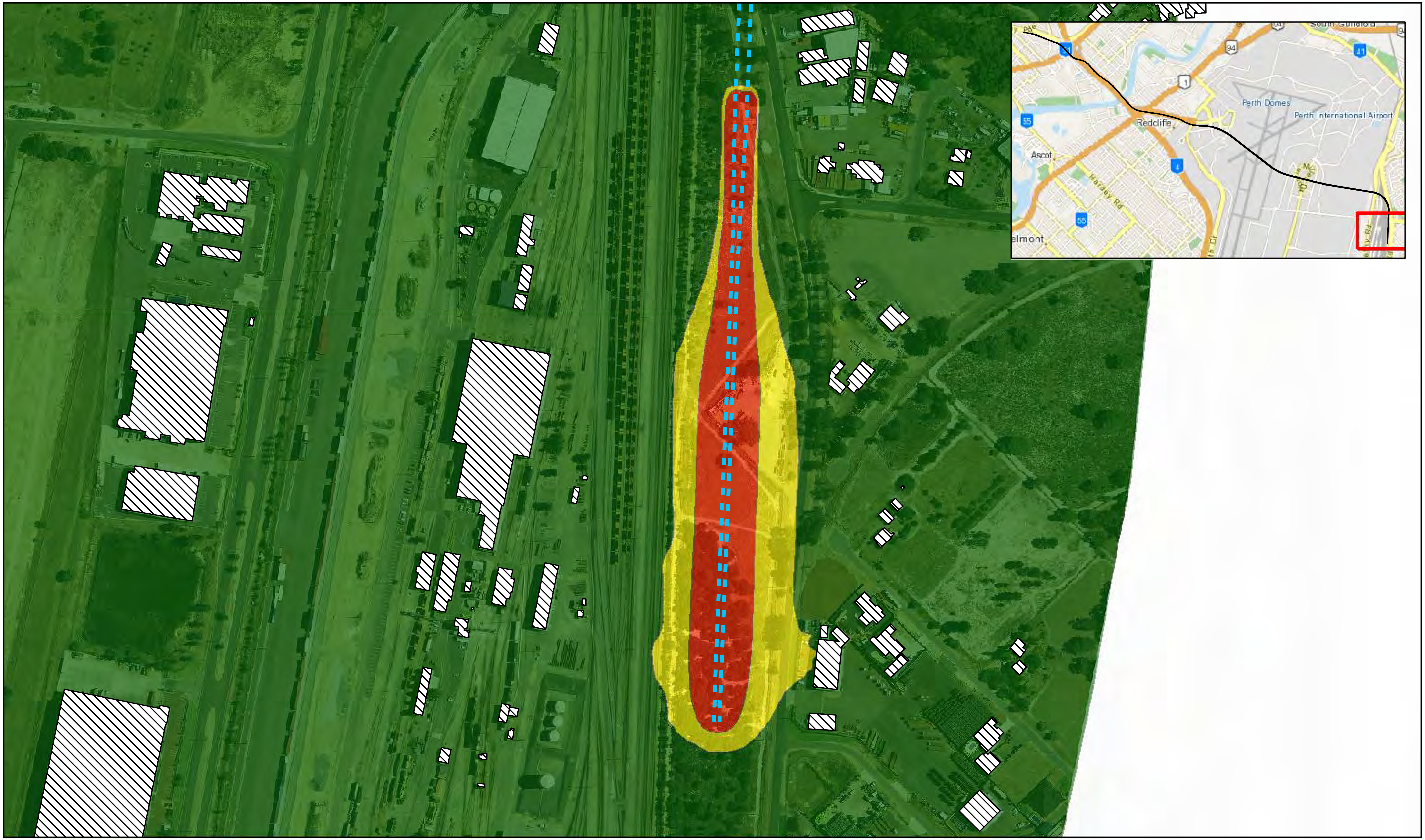
▨ Building

Forrestfield Airport Link
Feasibility study noise model
All route options (East Airport)
Predicted night time L_{Aeq} noise contours

PROJECT ID 60301258
CREATED BY AC
LAST MODIFIED AC - 20/05/2014

Map
2

A3 size



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DATUM GDA 1994, PROJECTION PCG94

0 37.5 75 150

metres

1:3,000 (when printed at A3)

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LEGEND

Rail alignment - Option 1

- Tunnel

Free field noise contours

🟩 < 75 dB(A)

🟨 > 75 dB(A)

🟥 > 80 dB(A) (Noise limit)

▨ Building

Forrestfield Airport Link
Feasibility study noise model
All route options (East Airport)
Predicted L_{Amax} noise contours

PROJECT ID	60301258
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Map

3

A3 size