



METRONET Stage 1: Morley-Ellenbrook Line

Morley Station Acoustic Design Report

MEL-MLCX-AR-RPT-00031

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1. Executive Summary

This document discusses noise and vibration levels predicted with operation of the proposed Morley Station and the extent to which those levels comply with applicable statutory and project requirements.

On the basis of the assessment undertaken it is concluded that:

- Overall environmental rail noise levels, when assessed at nearby potential noise sensitive premises are predicted to comply with applicable state noise regulations and planning policy. Rail vibration levels are predicted to be compliant with recommended levels.
- Road transport noise from car parking areas and local vehicle traffic will increase significantly in the area from current conditions, but are predicted to remain compliant with relevant state policies.
- Station access laneways and Car parking areas will need to avoid the use of speed humps, loose laid road coverings or large smooth painted concrete surfaces to minimise vehicle noise emissions.
- Design of the station plant and facilities such as mechanical services, public address and crowding areas to meet applicable environmental noise regulations may be achieved through conventional / industry standard design approaches and therefore is not anticipated to require specialist design input.
- Noise ingress from Tonkin Highway is estimated to be significant and likely to result in noise levels within station habitable rooms above SWTC targets assuming a standard façade construction. Discussion of options for noise management along with existing station examples have been provided to MELConnx via an RFI (CRF1407 – CRFI-SLR-285-00001) seeking direction, and the project team is currently investigating further options.

Acknowledgement of Country

MELconnx acknowledges the Whadjuk People of the Noongar Nation as the Traditional Custodians of the land and waters on which the Morley-Ellenbrook Line Project is located. We pay our respect to their Elders, both past and present and thank them for their continuing connection to the country, culture and community.

2. Project overview

2.1 METRONET Vision and Objectives

As Perth's single largest investment in public transport, METRONET will transform the way people commute and connect. It will create jobs and business opportunities and stimulate local communities and economic development to assist communities to thrive. The METRONET vision is for a well-connected Perth with more transport, housing and employment choices.



In delivering METRONET, the WA Government has considered peoples' requirements for work, living and recreation within future urban centres with a train station at the heart.

The objectives are to:

- Support economic growth with better connected businesses and greater access to jobs
- Deliver infrastructure that promotes easy and accessible travel and lifestyle options
- Create communities that have a sense of belonging and support Perth's growth and prosperity
- Plan for Perth's future growth by making the best use of our resources and funding
- Lead a cultural shift in the way government, private sector and industry work together to achieve integrated land use and transport solutions for the future of Perth.

2.2 Morley-Ellenbrook Line overview

As Perth grows, so does the need for rail infrastructure and METRONET is a critical element of the State Government's infrastructure agenda. The Morley-Ellenbrook Line (MEL) Project will improve connectivity between the north east metropolitan area and the rest of the city and unlock economic development in these local community areas.

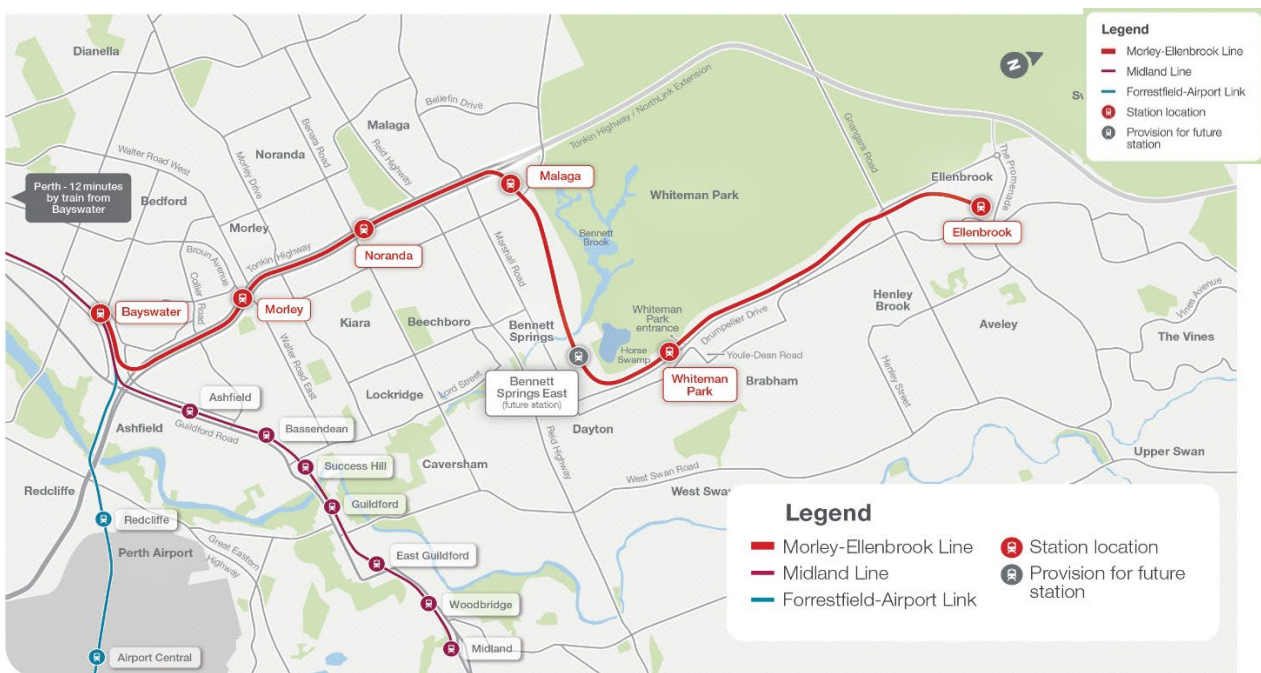


Figure 1: Morley-Ellenbrook Line © METRONET

The Public Transport Authority (PTA) is the lead agency delivering the MEL Project, with Main Roads WA (MRWA) undertaking some enabling works.

2.2.1 Project features

Transport infrastructure works for the Project include:

- A 21km rail line spurring from the Midland Line east of Bayswater Station, travelling north in the Tonkin Highway median, east through land north of Marshall Road and north on the western side of New Lord Street into Ellenbrook
- Stations at Morley, Noranda, Malaga, Whiteman Park and Ellenbrook with future-proofing for a station at Bennett Springs East
- Parking and bus interchanges/facilities at stations
- Significant grade separations at key road crossings
- Underpasses to allow the rail line to enter and exit the Tonkin Highway median
- Principal shared paths for walking and cycling access along the rail line
- Track and associated infrastructure to connect to the existing Midland Line
- Road and bridge reconfiguration works
- Integration across the packages of works and other nearby projects.

2.2.2 General scope of works

The Project's general scope of works includes the design and delivery of rail infrastructure and ancillary works to support operational passenger rail between Bayswater and Ellenbrook, including stations with inter-modal bus and rail with parking and associated road works at Bayswater, Morley, Noranda, Malaga, Whiteman Park and Ellenbrook stations.

The Project activities include all investigation, design, approvals, construction, testing and commissioning, Entry Into Service (EIS), training and operational readiness required to incorporate the new railway to Ellenbrook, and tie into the existing network including the associated road, utilities and other required works to interface with adjacent works and contracts. This will include bulk earthworks and retaining structures, grade separations, roads and drainage.

The design and delivery of the main works package for the Project is broken into three distinct stages:

- Alliance Development Stage
- Project Alliance Reference Design Stage
- Project Alliance Delivery Stage (Detailed Design through to Project close-out).



Figure 2: Architect's Impression of Morley Station concept © MELConnx

2.2.3 Key Project Objectives, Key Compliance Objectives and Critical Success Factors

The PTA and MELconnx’s single Non-Owner Participant (NOP) Laing O’Rourke Construction Australia Pty Ltd, have formed an integrated, collaborative Project Alliance to successfully deliver rail infrastructure that reflects our absolute commitment to achieving the Project Objectives and delivering positive outcomes for the State.

The following image demonstrates how we have mapped each Key Project Objective in the Project Alliance Agreement (PAA) against the Critical Success Factors to achieve best-for-project outcomes, underpinned by the Key Compliance Objectives.

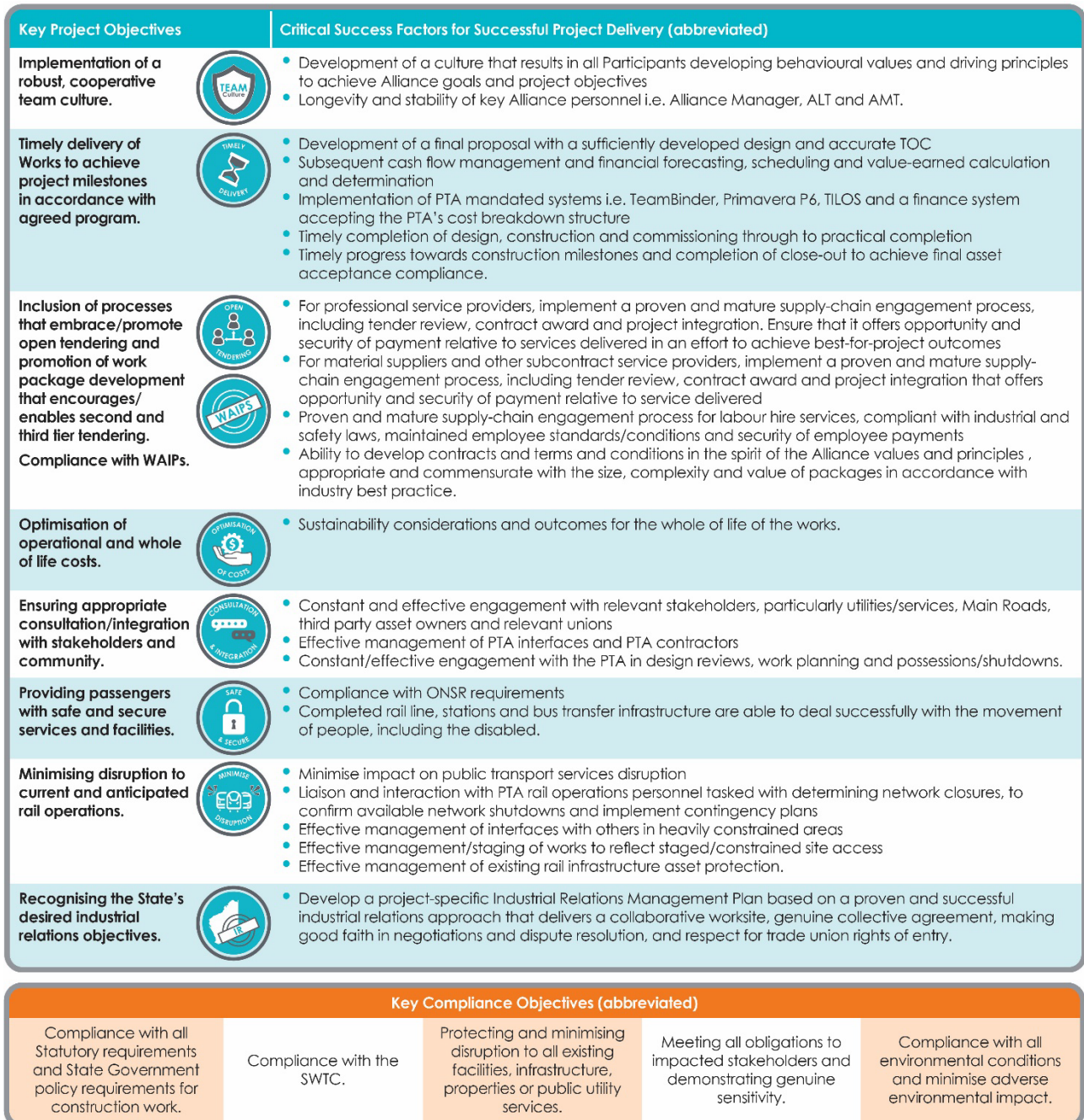


Figure 3: Key Project Objectives, Critical Success Factors and Key Compliance Objectives

2.3 Alliance vision and delivery approach

The MEL Project will be delivered under an alliance contract to support the management of project and stakeholder interfaces and to mitigate project risks. A collaborative alliance approach will see the Works carried out in a cooperative, coordinated and efficient manner in compliance with the Alliance Principles.

MELconnx understands that the successful delivery of the Project is critically linked to meeting the PTA's Key Project Objectives. These objectives have shaped our vision for the Project that is around delivering a high-quality product and creating exceptional value-for-money. We are committed to a no-blame culture and to the prompt and mutual resolution of any issues that may arise.

During the AD Stage, representatives from both the PTA and MELconnx participated in an interactive workshop to begin the process of developing a suitable Alliance Vision for the Project (refer Figure 4 below for workshop outcomes).



Figure 4: AD Stage Alliance Vision Development Outcomes (developed with the PTA)

The Alliance Foundation workshop was held on 11/11/2020 and the results of this workshop generated the basis for the Vision, Purpose, Values and Behaviours Commitment Statements represented here.

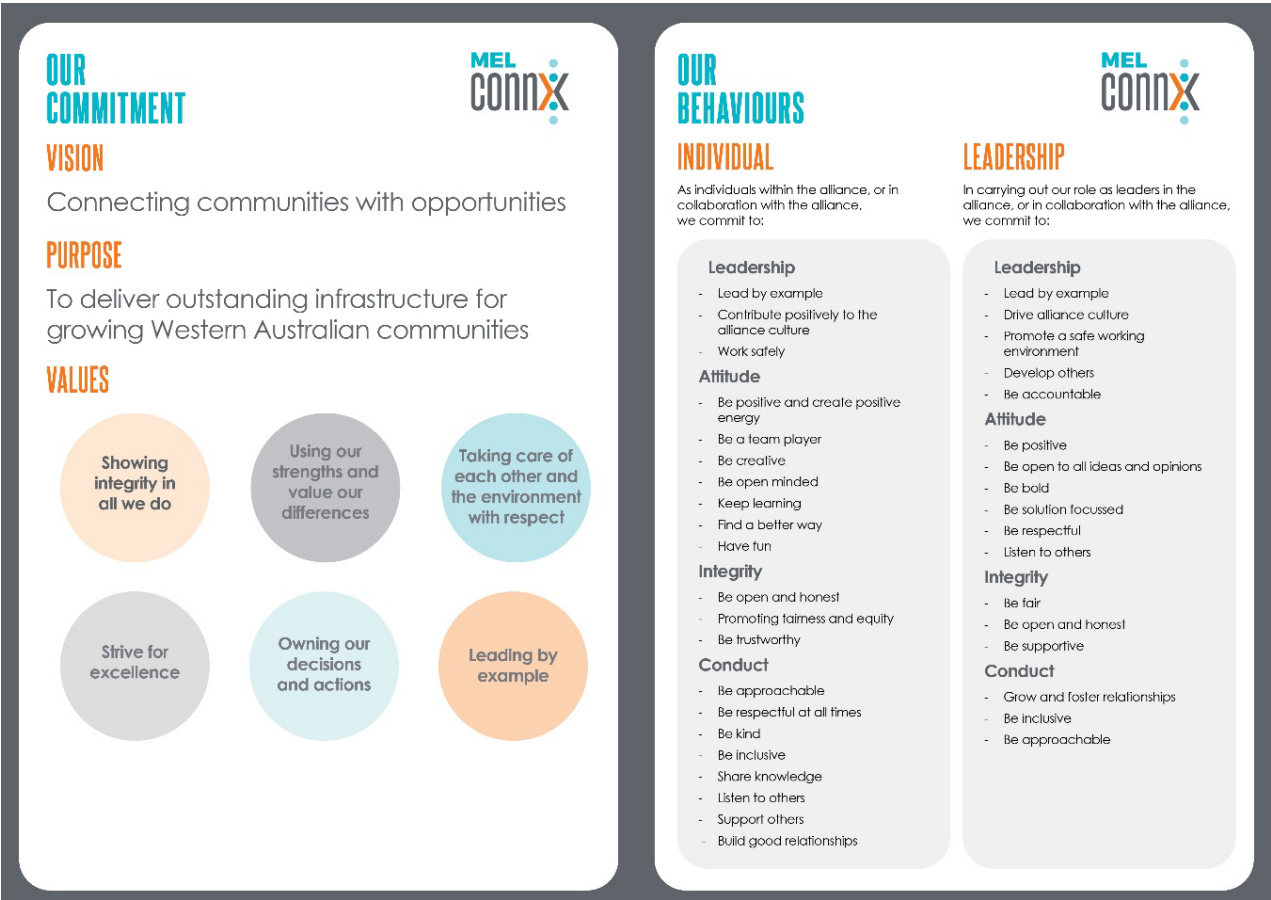


Figure 5: MELconnx Alliance Vision, Purpose and Values

2.4 Purpose of the Report

Morley Station is proposed as a key station where all trains will slow down and stop at the station (no non-stop 'through' traffic as part of normal services).

The project will also involve the construction of a new multi-storey car park, car drop off points and bus interchanges, the operation of which may involve a change in noise levels at nearby residential and other sensitive locations.

This document discusses predicted noise and vibration emissions with operation of the proposed Morley Train Station and the extent to which those levels comply with applicable statutory and project requirements.

This Design Report identifies any interdependencies between each Design Package and how those dependencies have been accommodated within the document. The Design Report describes the relationship between each of the Package(s) engineering lifecycle and the assurance gates throughout the Project.

2.5 Changes Since Previous Design Submission

2.5.1 Alliance Development Stage to Reference Design Stage

Not applicable at this Design Stage.

2.5.2 Reference Design to Interim Detailed Design

Not applicable at this Design Stage.

2.5.3 Interim Detailed Design to Final Detailed Design

Not applicable at this Design Stage.

2.5.4 IFC Design Finalisation

Not applicable at this Design Stage.

3. Design Description

3.1 Scope of this Design Package

The scope of this Design Package is outlined as follows.

- A schedule of recommended controls where required to be considered and reviewed for design optimisation and design/statutory planning approval within the packages is described in Section 3.3.

3.2 Design Description

The following subsections discuss the key project noise and vibration issues assessed in further detail.

3.2.1 Rail operations

Treatments to the railway sections involved at Morley Station are considered in detail within the Operational Noise and Vibration Design Report (ONVDR), refer MEL-MLCX-EN-RPT-00032 for more information. The ONVDR notes that speeds in the immediate vicinity of the station are low for rolling noise levels to be above State Planning Policy 5.4 Road and Rail Noise (SPP5.4) targets that may be assessable at nearby development.

Note that compliance with SPP5.4 does not prevent community complaint. Subjectively, residents in the area may notice noise from low speed rail movements and the braking system air release as trains depart. Train air conditioning systems may also be noticeable on unusually hot days. These noise emissions are modelled to be within SPP5.4 targets.

Given the expected speeds in the immediate vicinity of the station, vibration levels are predicted to be within recommended criteria applicable at adjacent receivers and anticipated future development sites nearby.

3.2.2 Station and associated infrastructure

Asphaltic, bitumen-based road and bare concrete vehicle parking surfaces should be used instead of smooth concrete or heavily painted surfaces which can result in strong sound reflections and/or tyre squeal under cornering.

Speed bumps or sudden changes in road level (e.g. loose gutters, expansion control joints) should be avoided.

Traffic calming where required should be managed via gradual gradient pedestrian crossings (such as wombat crossings).

On the basis of a screening assessment of proposed public address systems (Section 4.8.1) and likely crowd noise (Section 4.8.3), compliance with relevant assigned noise levels is predicted.

The station is predicted to comply with SWTC requirements with regards to internal reverberation levels provided on the basis of absorptive finishes recommended in Section 4.8.1. Refer to Appendix A for recommended treatments to specific building elements in order to meet SWTC requirements around acoustic separation and reverberation.

Whilst the semi-open platforms at the north and south end provide significant access to open air, the platform sections under Broun Avenue will experience higher reverberation times. The increased environmental noise and reverberation is recommended to be accounted for in the design of the public address (PA) and emergency warning and information systems.

3.2.3 Electrical transformer noise

The transformer located just south of the proposed multi-storey carpark is approximately 150 metres from the existing residential uses to the east of station precinct. Based on expected loading and sound power levels for transformers, along with the existing noise walls, it is predicted that noise emissions will be compliant with applicable noise regulations.

3.2.4 Mechanical noise

A basic screening assessment has been undertaken considering the minimum distance to potential noise sensitive development and the proposed mechanical plant and equipment. Given the equipment comprises small enclosed fan coil units and domestic level air conditioning outdoor condensers, compliance with applicable noise regulations is predicted.

3.2.5 Local road traffic and new roundabouts

Local road vehicle traffic noise may vary due to the introduction of the proposed train station but is not assessable within the criteria outlined.

3.3 Relationship with other Design Packages

The relationship and/or reliance of this design package on other MEL design packages is derived from the N2 Matrix and is outlined in the Table below.

Relationship with other Design Packages	Description/Title	Interface Elements	Integration Strategy
E018	Line wide - Permanent Way and Stabling & Track – Transit Space & Structure /Ballast Interface	Trackform Rail web dampers Under ballast matting	Confirm trackform Review rail web damper options
E016	LW Urban Design - Urban Design - Architecture	Noise walls	Confirm spatial inputs and coordinate implementation of recommended treatments
E017	Linewide Urban Design - Landscape	Noise walls	Confirm spatial inputs and coordinate implementation of recommended treatments
E001	Morley Precinct – Urban Design – Architecture	Noise walls	Confirm spatial inputs and coordinate implementation of recommended treatments
E065	Morley Precinct Civil - Fencing and Gates, Retaining Walls & Minor Structures, Noise Walls	Noise walls	Confirm spatial inputs and coordinate implementation of recommended treatments
E069	Morley Station – Electrical - Lighting & LV & Comms & Security	Electrical plant noise emissions	Confirm inputs and coordinate implementation of any recommended treatments

E072	Morley Station – Mechanical and BMSC	Mechanical plant noise emissions	Confirm inputs and coordinate implementation of any recommended treatments
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3.4 External Interfaces

The relationship and/or reliance of this design package on external interfaces and details of integration strategies are outlined in the Table below.

Item	External Party	Interface Elements	Integration Strategy
	N/A		

4. Design Inputs

4.1 Project Design Requirements

The following design inputs, loads combinations, standards and other key design inputs have been used in preparation of this report;

4.1.1 Environmental noise regulations

Refer to Section 4.5.1 below.

4.1.2 SWTC Requirements

Refer to Section 4.5.

4.1.3 Operational Scenarios

Normal operations are expected to result in 74 train movements per day (6am to 10pm) and 16 movements per night (10pm to 6am) at the Morley Station.

The “PTA Concept Train Operating Plan” described as being within Book 5 of the SWTC could not be accessed and has been requested in CFRI063. In lieu of this information, these volumes are used from the Reference Design.

4.1.4 Stations and Infrastructure

Stations and infrastructure have been assessed on the basis of supplied drawings to date. We note that the design of Morley Station utilises natural ventilation strategies, with significant openings at sides and/or roof level throughout the platforms.

Reference	Supplier	Usage
MS Office 2013	Microsoft Inc. (with proprietary SLR code)	Calculation of in-car noise levels Calculation of 3D receiver distances Calculation of 1D vibration propagation Consolidation and presentation of results 1D propagation / noise analyses
SoundPLAN v8.1	SoundPLAN GmbH	Calculation of site wide airborne noise emissions according to prescribed standards

4.3 Applicable Codes and Standards

Applicable standards, codes and guidelines to this design package (at time of project commencement) including identification of specific provisions, criteria and classifications are provided in the Table below.

Reference	Description/Title	Compliance (Specific Provisions, Criteria and Classifications)
Australian and Other Standards and Guidelines		
CR NOI TSI	Technical specification for interoperability relating to the subsystem 'rolling stock – noise' of the trans-European conventional rail system, adopted by the Commission Decision 2011/229/EU, April 2011	Referenced for typical wheel-rail roughness assumptions
SPP5.4	State Planning Policy No. 5.4 Road and Rail Noise 2019	Compliance criteria
EPNR	Western Australia Environmental Protection (Noise) Regulations 1997	Compliance criteria
AS 2670.1	Evaluation of human exposure to whole-body vibration - General requirements	Reference for assessment method
AS 2670.2	Evaluation of human exposure to whole-body vibration - Continuous and shock-induced vibration in buildings (1 to 80 Hz)	Referenced for criteria comparison
ISO GUIDE 98-3	Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)	Referenced for uncertainty estimation
ISO 2631-1:1997	Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 1: General requirements.	Reference for assessment method
AS ISO 2631.2:2014	Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Vibration in buildings (1 Hz to 80 Hz).	Compliant
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc, 2011 ASHRAE Handbook - Heating, Ventilating, and Air-Conditioning APPLICATIONS - SI Edition, Atlanta GA http://www.ashrae.org	Referenced for typical HVAC installation and operations
FTA	C.E. Hanson, D.A. Towers, and L.D. Meister 2006, Transit Noise and Vibration Impact Assessment, Office of Planning and Environment, Federal Transit Administration, Report FTA-VA-90-1003-06, Washington DC	Referenced for vibration assessment method
Nord2000	Jonasson HG, Storeheier S. Nord 2000. New Nordic prediction method for rail traffic noise [Internet]. 2001. (SP Rapport).	Rail noise modelling algorithm adopted
Green Star	Green Star Design and As-built Requirements for Railway Stations (v1.1)	Partially compliant (within the scope of this report)
ISCA	Infrastructure Sustainability Council of Australia (ISv2.0) Design and As Built	General reference
PTA Standards and Specifications		

4.4 Reference Information

The project specific reference information and reports that have been used as inputs into the development of the detailed design are included in the table below.

Document Ref.	Description/Title	Revision
25-A-285-EC0151	MEL - MLCX – MORLEY STATION - COMMUNICATIONS - EASE ACOUSTIC MODEL - SHEET 01	TBC
25-A-285-EC0152	MEL - MLCX - MORLEY STATION - COMMUNICATIONS - EASE ACOUSTIC MODEL - SHEET 02	TBC
GCOR-LOR-LW-00096	Track Inputs for Noise Modelling	02-Jun-2021 13:10 AWST
GCOR-LOR-PW-00193	Design data for SLR noise modelling	07-May-2021 19:02 AWST
GCOR-LOR-PW-00166	MELconnx CAD issue to SLR	30-Apr-2021 09:42 AWST
GCOR-LOR-LW-00047	Latest WIP rail strings	19-Apr-2021 11:51 AWST
GCOR-LOR-PW-00128	Update to Health Safety Environmental Management System	06-Apr-2021 15:56 AWST
GCOR-LOR-PW-00071	Aerial Imagry (sic)	01-Apr-2021 15:48 AWST
GCOR-LOR-PW-00067	Project AD Design Information On ASite	23-Feb-2021 11:16 AWST
MEL-MLCX-EN-RPT-00031	Baseline Noise and Vibration Monitoring Report	A01
25-A-285-AR0083	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - SHORT ELEVATION	A01
25-A-285-AR0097	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - ENLARGED PLANS - PTA DECKED CARPARK	A01
25-A-285-AR0072	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - PLATFORM LEVEL - SHEET 3	A01
25-A-285-AR0085	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - SECTION - SHEET 2	A01
25-A-285-AR0088	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - ENLARGED PLANS - MSCP SECTIONS	A01
25-A-285-AR0071	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - PLATFORM LEVEL - SHEET 2	A01
25-A-285-AR0044	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - CONCOURSE LEVEL - SHEET 2	A01
25-A-285-AR0043	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - CONCOURSE LEVEL - SHEET 1	A01
25-A-285-AR0098	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - ENLARGED PLANS - PTA DECKED CARPARK	A01
25-A-285-AR0015	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - STATION OVERALL PLAN - PLATFORM LEVEL	A01
25-A-285-AR0045	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - CONCOURSE LEVEL - SHEET 3	A01
25-A-285-AR0073	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - CONCOURSE LEVEL - SHEET 1	A01
25-A-285-AR0095	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - ENLARGED PLANS - PTA DECKED CARPARK	A01
25-A-285-AR0016	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - STATION OVERALL PLAN - CONCOURSE LEVEL	A01
25-A-285-AR0086	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - SECTION - SHEET 3	A01
25-A-285-AR0074	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - CONCOURSE LEVEL - SHEET 2	A01
25-A-285-AR0017	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - STATION OVERALL PLAN - ROOF LEVEL	A01
25-A-285-AR0096	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - ENLARGED PLANS - PTA DECKED CARPARK	A01
25-A-285-AR0075	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - CONCOURSE LEVEL - SHEET 3	A01
25-A-285-AR0010	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - OVERALL PLANS - LOCATION PLAN	A01

Document Ref.	Description/Title	Revision
25-A-285-AR0082	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG ELEVATION - SHEET 3	A01
25-A-285-AR0026	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - OVERALL SECTIONS	A01
25-A-285-AR0042	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - PLATFORM LEVEL - SHEET 3	A01
25-A-285-AR0084	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - SECTION - SHEET 1	A01
25-A-285-AR0001	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - COVER PAGE	A01
25-A-285-AR0002	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - DRAWING LIST	A01
25-A-285-AR0081	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG ELEVATION - SHEET 2	A01
25-A-285-AR0024	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - OVERALL ELEVATIONS - STATION OVERALL ELEVATIONS	A01
25-A-285-AR0041	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - PLATFORM LEVEL - SHEET 2	A01
25-A-285-AR0018	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - BUS INTERCHANGE PLAN	A01
25-A-285-AR0070	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - PLATFORM LEVEL - SHEET 1	A01
25-A-285-AR0080	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG ELEVATION - SHEET 1	A01
25-A-285-AR0019	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - BUS INTERCHANGE ROOF PLAN	A01
25-A-285-AR0087	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - OVERALL ELEVATIONS - MSCP ELEVATIONS	A01
25-A-285-AR0040	MEL - MLCX - MORLEY STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - PLATFORM LEVEL - SHEET 1	A01
25-A-285-LA0065	MEL - MLCX - MORLEY STATION - LANDSCAPING - GENERAL ARRANGEMENT & FINISHES PLAN	A02
25-A-285-LA0067	MEL - MLCX - MORLEY STATION - LANDSCAPING - GENERAL ARRANGEMENT & FINISHES PLAN	A02
25-A-285-LA0066	MEL - MLCX - MORLEY STATION - LANDSCAPING - GENERAL ARRANGEMENT & FINISHES PLAN	A02
25-A-285-LA0006	MEL - MLCX - MORLEY STATION - LANDSCAPING - SCHEDULES	A02
25-A-285-LA0069	MEL - MLCX - MORLEY STATION - LANDSCAPING - GENERAL ARRANGEMENT & FINISHES PLAN	A02
25-A-285-LA0002	MEL - MLCX - MORLEY STATION - LANDSCAPING - LEGEND & NOTES	A02
25-A-285-LA0068	MEL - MLCX - MORLEY STATION - LANDSCAPING - GENERAL ARRANGEMENT & FINISHES PLAN	A02
25-A-285-LA0010	MEL - MLCX - MORLEY STATION - LANDSCAPING - LANDSCAPE SITE PLAN	A02
25-A-285-LA0001	MEL - MLCX - MORLEY STATION - LANDSCAPING - COVER SHEET	A02
25-A-285-CI0001	MEL - MLCX - MORLEY STATION - CIVIL - COVER SHEET AND DRAWING INDEX	A01
25-A-285-CI0111	MEL - MLCX - MORLEY STATION - CIVIL - PAVEMENT AND KERBING - DETAIL - SHEET 1	A01
25-A-285-CI0112	MEL - MLCX - MORLEY STATION - CIVIL - PAVEMENT AND KERBING - DETAIL - SHEET 2	A01
25-A-285-CI0060	MEL - MLCX - MORLEY STATION - CIVIL - GENERAL ARRANGEMENT - OVERALL PLAN	A01
25-A-285-CI0020	MEL - MLCX - MORLEY STATION - CIVIL - DRAINAGE AND FINISHED SURFACE - OVERALL PLAN	A01

Document Ref.	Description/Title	Revision
25-A-285-CI0070	MEL - MLCX - MORLEY STATION - CIVIL - COMBINED PROPOSED UTILITIES - OVERALL PLAN	A01
25-A-285-CI0130	MEL - MLCX - MORLEY STATION - CIVIL - MINOR STRUCTURES - OVERALL PLAN	A01
25-A-285-CI0002	MEL - MLCX - MORLEY STATION - CIVIL - BULK EARTHWORKS - OVERALL PLAN	A01
25-A-285-CI0100	MEL - MLCX - MORLEY STATION - CIVIL - PAVEMENT AND KERBING - OVERALL PLAN	A01
25-A-285-CI0150	MEL - MLCX - MORLEY STATION - CIVIL - VEHICLE TRACKING - OVERALL PLAN	A01
25-A-285-ST0016	MEL - MLCX - MORLEY STATION - STRUCTURAL - PLATFORM LEVEL PLAN - SHEET 1 OF 3	A01
25-A-285-ST0037	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 11 OF 13	A01
25-A-285-ST0019	MEL - MLCX - MORLEY STATION - STRUCTURAL - CONCOURSE LEVEL PLAN - SHEET 1 OF 3	A01
25-A-285-ST0032	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 6 OF 13	A01
25-A-285-ST0001	MEL - MLCX - MORLEY STATION - STRUCTURAL - COVER SHEET & DRAWING INDEX	A01
25-A-285-ST0024	MEL - MLCX - MORLEY STATION - STRUCTURAL - ROOF PLAN - SHEET 3 OF 5	A01
25-A-285-ST0033	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 7 OF 13	A01
25-A-285-ST0002	MEL - MLCX - MORLEY STATION - STRUCTURAL - 3D VIEW	A01
25-A-285-ST0003	MEL - MLCX - MORLEY STATION - STRUCTURAL - SITE PLAN	A01
25-A-285-ST0008	MEL - MLCX - MORLEY STATION - STRUCTURAL - FOUNDATION PLAN - SHEET 1 OF 3	A01
25-A-285-ST0030	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 4 OF 13	A01
25-A-285-ST0020	MEL - MLCX - MORLEY STATION - STRUCTURAL - CONCOURSE LEVEL PLAN - SHEET 2 OF 3	A01
25-A-285-ST0025	MEL - MLCX - MORLEY STATION - STRUCTURAL - ROOF PLAN - SHEET 4 OF 5	A01
25-A-285-ST0026	MEL - MLCX - MORLEY STATION - STRUCTURAL - ROOF PLAN - SHEET 5 OF 5	A01
25-A-285-ST0039	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 13 OF 13	A01
25-A-285-ST0038	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 12 OF 13	A01
25-A-285-ST0017	MEL - MLCX - MORLEY STATION - STRUCTURAL - PLATFORM LEVEL PLAN - SHEET 2 OF 3	A01
25-A-285-ST0031	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 5 OF 13	A01
25-A-285-ST0018	MEL - MLCX - MORLEY STATION - STRUCTURAL - PLATFORM LEVEL PLAN - SHEET 3 OF 3	A01
25-A-285-ST0023	MEL - MLCX - MORLEY STATION - STRUCTURAL - ROOF PLAN - SHEET 2 OF 5	A01
25-A-285-ST0021	MEL - MLCX - MORLEY STATION - STRUCTURAL - CONCOURSE LEVEL PLAN - SHEET 3 OF 3	A01
25-A-285-ST0010	MEL - MLCX - MORLEY STATION - STRUCTURAL - FOUNDATION PLAN - SHEET 3 OF 3	A01
25-A-285-ST0009	MEL - MLCX - MORLEY STATION - STRUCTURAL - FOUNDATION PLAN - SHEET 2 OF 3	A01
25-A-285-ST0034	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 8 OF 13	A01

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25-A-285-ST0027	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 1 OF 13	A01
25-A-285-ST0028	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 2 OF 13	A01
25-A-285-ST0022	MEL - MLCX - MORLEY STATION - STRUCTURAL - ROOF PLAN - SHEET 1 OF 5	A01
25-A-285-ST0035	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 9 OF 13	A01
25-A-285-ST0029	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 3 OF 13	A01
25-A-285-ST0036	MEL - MLCX - MORLEY STATION - STRUCTURAL - SECTIONS - SHEET 10 OF 13	A01
25-A-285-EG0101	MEL - MLCX - MORLEY STATION - ELECTRICAL - COVER SHEET	A02
25-A-285-EG0154	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - LEVEL 1 - LIGHTING LAYOUT	A01
25-A-285-EG0150	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 1 - LIGHTING LAYOUT	A01
25-A-285-EG0153	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - GROUND LEVEL - LIGHTING LAYOUT	A01
25-A-285-EG0175	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - LEVEL 2 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0111	MEL - MLCX - MORLEY STATION - ELECTRICAL - SITE PLAN - LIGHTING	A01
25-A-285-EG0126	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 2 - POWER LAYOUT	A01
25-A-285-EG0167	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 3 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0146	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 2 - LIGHTING LAYOUT	A01
25-A-285-EG0156	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - LEVEL 3 - LIGHTING LAYOUT	A01
25-A-285-EG0168	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 1 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0127	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 3 - POWER LAYOUT	A01
25-A-285-EG0139	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 2 - CONTAINMENT LAYOUT	A01
25-A-285-EG0105	MEL - MLCX - MORLEY STATION - ELECTRICAL - LUMINAIRE SCHEDULE PART 2	A01
25-A-285-EG0103	MEL - MLCX - MORLEY STATION - ELECTRICAL - LEGEND	A01
25-A-285-EG0172	MEL - MLCX - MORLEY STATION - CAR PARK EXTERNAL - ELECTRICAL - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0187	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 3 - COMMUNICATIONS CONTAINMENT LAYOUT	A01
25-A-285-EG0138	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 1 - CONTAINMENT LAYOUT	A01

Document Ref.	Description/Title	Revision
25-A-285-EG0169	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 2 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0147	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 3 - LIGHTING LAYOUT	A01
25-A-285-EG0176	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - LEVEL 3 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0170	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 1 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0152	MEL - MLCX - MORLEY STATION - CAR PARK EXTERNAL - ELECTRICAL - LIGHTING LAYOUT	A01
25-A-285-EG0198	MEL - MLCX - MORLEY STATION - ELECTRICAL - SINGLE LINE DIAGRAM - EARTHING & BONDING	A01
25-A-285-EG0185	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 1 - COMMUNICATIONS CONTAINMENT LAYOUT	A01
25-A-285-EG0189	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 2 - COMMUNICATIONS CONTAINMENT LAYOUT	A01
25-A-285-EG0110	MEL - MLCX - MORLEY STATION - ELECTRICAL - SITE PLAN - POWER	A01
25-A-285-EG0186	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 2 - COMMUNICATIONS CONTAINMENT LAYOUT	A01
25-A-285-EG0190	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 1 - COMMUNICATIONS CONTAINMENT LAYOUT	A01
25-A-285-EG0131	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 2 - POWER LAYOUT	A01
25-A-285-EG0130	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 1 - POWER LAYOUT	A01
25-A-285-EG0141	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 2 - CONTAINMENT LAYOUT	A01
25-A-285-EG0165	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 1 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0112	MEL - MLCX - MORLEY STATION - ELECTRICAL - SITE PLAN - POWER DISTRIBUTION - DEMARCATION	A01
25-A-285-EG0151	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 2 - LIGHTING LAYOUT	A01
25-A-285-EG0148	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 1 - LIGHTING LAYOUT	A01
25-A-285-EG0104	MEL - MLCX - MORLEY STATION - ELECTRICAL - LUMINAIRE SCHEDULE PART 1	A01
25-A-285-EG0188	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 1 - COMMUNICATIONS CONTAINMENT LAYOUT	A01
25-A-285-EG0173	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - GROUND LEVEL - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0191	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 2 - COMMUNICATIONS CONTAINMENT LAYOUT	A01

Document Ref.	Description/Title	Revision
25-A-285-EG0174	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - LEVEL 1 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0155	MEL - MLCX - MORLEY STATION - CAR PARK INTERNAL - ELECTRICAL - LEVEL 2 - LIGHTING LAYOUT	A01
25-A-285-EG0145	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 1 - LIGHTING LAYOUT	A01
25-A-285-EG0135	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 1 - CONTAINMENT LAYOUT	A01
25-A-285-EG0128	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 1 - POWER LAYOUT	A01
25-A-285-EG0129	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 2 - POWER LAYOUT	A01
25-A-285-EG0136	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 2 - CONTAINMENT LAYOUT	A01
25-A-285-EG0140	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 1 - CONTAINMENT LAYOUT	A01
25-A-285-EG0137	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 3 - CONTAINMENT LAYOUT	A01
25-A-285-EG0166	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 2 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0171	MEL - MLCX - MORLEY STATION - BUS INTERCHANGE - ELECTRICAL - ZONE 2 - EMERGENCY LIGHTING LAYOUT	A01
25-A-285-EG0149	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - ELECTRICAL - ZONE 2 - LIGHTING LAYOUT	A01
25-A-285-EG0125	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - ELECTRICAL - ZONE 1 - POWER LAYOUT	A01
25-A-285-ME0020	MEL - MLCX - MORLEY STATION - MECHANICAL - SCHEMATIC DIAGRAM	A01
25-A-285-ME0011	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - MECHANICAL - ZONE 3 - MECHANICAL LAYOUT	A01
25-A-285-ME0021	MEL - MLCX - MORLEY STATION - MECHANICAL - SECTIONS	A01
25-A-285-ME0013	MEL - MLCX - MORLEY STATION - CONCOURSE LEVEL - MECHANICAL - ZONE 2 - MECHANICAL LAYOUT	A01
25-A-285-ME0010	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - MECHANICAL - ZONE 2 - MECHANICAL LAYOUT	A01
25-A-285-ME0002	MEL - MLCX - MORLEY STATION - MECHANICAL - LEGEND	A01
25-A-285-ME0017	MEL - MLCX - MORLEY STATION - MULTI-STORY CAR PARK - MECHANICAL - LEVEL 3 - MECHANICAL LAYOUT	A01
25-A-285-ME0016	MEL - MLCX - MORLEY STATION - MULTI-STORY CAR PARK - MECHANICAL - GROUND FLOOR - MECHANICAL LAYOUT	A01
25-A-285-ME0001	MEL - MLCX - MORLEY STATION - MECHANICAL - COVER SHEET	A02
25-A-285-ME0005	MEL - MLCX - MORLEY STATION - MECHANICAL - SITE PLAN	A01

Document Ref.	Description/Title	Revision
25-A-285-ME0009	MEL - MLCX - MORLEY STATION - PLATFORM LEVEL - MECHANICAL - ZONE 1 - MECHANICAL LAYOUT	A01

4.5 Design Criteria

The design criteria utilised in the development of this report are outlined below.

4.5.1 Permanent Way

SWTC 13.6.1-3 states that

The Alliance must design and construct the operating passenger railway and any associated noise mitigation controls to meet the requirements of "State Planning Policy No. 5.4 Road and Rail Noise (SPP 5.4)" (WAPC, 2019).

The Alliance must design and construct the operating passenger railway to ensure that the L_{Amax} applicable to the 95th percentile train passby event is 80 dB or less at buildings with a noise sensitive use located on noise sensitive premises.

The table below outlines the adopted noise objective levels in regard to airborne noise during road and rail operations. Noise mitigation must be provided where the noise level is above these targets

Table 1 Adopted rail noise criteria

Metric	Application	Value(s)	Notes
Period average noise levels	Major upgrade of existing railway <i>Applied where emissions from MID and FAL lines are considered significant (Bayswater area)</i>	$L_{Aeq,day}$ 60 dB	SPP5.4
		$L_{Aeq,night}$ 55 dB	
	New railway <i>(All other locations)</i>	$L_{Aeq,day}$ 55 dB	
		$L_{Aeq,night}$ 50 dB	
Maximum noise levels	Line wide	L_{Amax} 80 dB	95 th percentile. SWTC

These objectives are assessed outdoors, 1 metre from the main building on a lot associated with a noise sensitive usage. Consistent with SPP5.4, the criteria are assessed

- Only at premises that are occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan parks, camping grounds, educational establishments, child care premises, hospital, nursing home, corrective institution; or place of worship (Note that this excludes recreational parks, commercial and industrial premises along the alignment – results will be determined for these locations, but mitigation would not be recommended); and
- at all floor levels where identified from surveys, noting that sufficient mitigation (in the context of the targets) may not reasonable or practicable at higher floors.

4.5.2 Stations and Associated Infrastructure

Section 13.7 of Book 4 of the SWTC details the noise and vibration Technical Criteria requirements for the design and operation of the station and associated infrastructure, and includes the following statements:

The Alliance must address noise and vibration impacts associated with station noise impacts, inclusive of any new road infrastructure to service the stations, to surrounding sensitive receivers, occupational health and amenity for PTA staff and patrons.

[.] Noise and Vibration Criteria for Impacts to Surrounding Sensitive Premises at Stations and associated infrastructure (eg. car parks, plant rooms etc.) must be designed to comply with the requirements of the Environmental Protection (Noise) Regulations 1997 (WA).

[.] The Alliance shall determine the noise criteria for impacts from Station entry roads and grade separations and design roads and any associated noise mitigation controls to meet the requirements of Western Australia State Planning Policy No 5.4, Road and Rail Noise 2019.

4.5.2.1 Environmental Noise Regulations

Environmental noise emissions (excluding trains and some emissions from road vehicles) from various premises to nearby noise receiving premises are covered by legislation in the form of the *Western Australia Environmental Protection (Noise) Regulations 1997*, which operate under the *Environmental Protection Act 1986*. For this project, these regulations apply to stations and ancillary operational equipment, and specifically do not apply to narrow gauge trains.

To achieve compliance, received noise levels at nearby premises including noise sensitive premises (for example, residential, commercial and industrial premises) are not to exceed specified noise limits in the form of assigned noise levels. The Act gives state authorities powers to order financial penalties and closure of plant that are in excess of assigned noise levels through a formal investigation process. There are methods within the Regulations by which assets found to be producing excessive noise be managed on an ongoing basis in consultation with the Department of Water and Environment Regulation (DWER), say through noise management plans and/or alternative criteria, however at its core of any such agreement is that the proponent will exercise all reasonable and practicable measures to minimise noise.

The assigned noise levels, as shown in Table 2, vary for each noise sensitive receiver, as they are determined from consideration of Influencing Factors (IF) which takes into account the amount of commercial, industrial and road transport infrastructure within specific distances to the receiving noise sensitive premises.

Table 2 Table of Assigned Noise Levels, dB

Part of premises receiving noise	Time of day	L _{A10}	L _{A1}	L _{Amax}
Noise Sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + IF	55 + IF	65 + IF
	0900 to 1900 hours Sunday and public holidays	40 + IF	50 + IF	65 + IF
	1900 to 2200 hours all days	40 + IF	50 + IF	55 + IF
	2200 hours on any day to 0700 Monday to Saturday and 0900 hours Sunday and public holidays	35 + IF	45 + IF	55 + IF
Noise Sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use.	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

For Morley station, the closest sensitive receivers are located approximately 150 m from the station platforms, bus stations or car park. An IF of 10 dB is applied in accordance with the Regulations based on:

- Presence of major road within 100 m of the receiver (transport factor of 6 dB); and
- Presence of industrial and commercial in the surrounding including the proposed Morley station precinct (factor of 4 dB).

Regulation 7 of the *Environmental Protection (Noise) Regulations 1997* requires that, if noise emitted from any premises when received at any other premises cannot reasonably be free of intrusive characteristics of tonality, modulation and impulsiveness, then a series of adjustments must be added to the emitted levels (measured or calculated) and the adjusted level must comply with the assigned level. The adjustments are detailed in Table 3 and are further defined in Regulation 9(1) of the *Environmental Protection (Noise) Regulations 1997*.

Note that the following adjustments (Table 3) generally apply to fixed plant and infrastructure only.

Table 3 Table of adjustments for intrusive characteristics

Application	Where tone(s) are present	Where modulation is present	Where impulsiveness is present
Adjustment where noise emission is not music (These adjustments are cumulative to a maximum of 15 dB)	+5dB	+5dB	+10dB

Tones are defined in Regulation 9(1) as being present where the difference between the A weighted sound pressure level in any one third octave band and the arithmetic average of the A-weighted sound pressure levels in the two adjacent one third octave bands is greater than 3dB in terms of $L_{Aeq,T}$ where the time period T is greater than 10% of the representative assessment period, or greater than 8dB at any time when the sound pressure levels are determined as LAS levels.

Modulation is defined as a variation in the emission of noise that —

- is more than 3 dB L_{AF} or is more than 3 dB L_{AF} in any one third octave band;
- is present for at least 10% of the representative assessment period; and
- is regular, cyclic and audible.

Impulsiveness is defined as present where the difference between L_{Apeak} and L_{ASmax} is more than 15dB when determined for a single representative event.

During the assessment process the above adjustments have been applied to relevant noise sources, taking into account specific intrusive characteristics of these noise sources based on SLR’s in-house noise database. It is unlikely that modulation or impulsiveness characteristics would apply to PTA fixed assets being typically electrical power transformers or air handling plant

4.5.2.2 Ambient Noise Levels within Passenger Station Areas

Section 13.7.1 of the SWTC defines acceptable noise levels via the following table, as defined in AS 1055.1:1997 and assessed according to AS/NZS 2107:2000. In order to be consistent with the SWTC, the 2000 version of AS/NZS 2107 is followed in this assessment and not the more recent 2016 version. However, the internal noise and reverberation requirements in the 2016 version are similar with no significant changes to recommended values that are relevant to this project. As such, no compromise to acoustic amenity is anticipated in using the SWTC requirements (which references the 2000 version).

Table 4 Ambient noise level criteria

Area	Scenario	Minimum acceptable noise level (dB)	Maximum acceptable noise level (dB)
Ticket sales area	Building services and plant	-	L_{Aeq} 45
General office areas	Building services and plant	-	L_{Aeq} 45
Staff crib rooms	Building services and plant	-	L_{Aeq} 45
Public waiting areas, kiosks	Building services and plant	-	L_{Aeq} 45
Toilets and amenities	Building services and plant	L_{Aeq} 45	L_{Aeq} 55
Parking and waste storage areas	Building services and plant	-	L_{Aeq} 65
Platforms, at any position within 1.5m of platform edge or centreline (whichever is closer to track), and more than 8 metres from Portals	Stationary trains, auxiliary equipment operating as normal	-	L_{Aeq} 70
	Moving trains	-	L_{ASmax} 80
	Building services and plant (ventilation, escalators, etc.)	-	L_{Aeq} 55
	Emergency smoke fan systems	-	L_{Aeq} 85
Plantrooms	Building services and plant	-	L_{Aeq} 85
All other areas	All	-	Table 1, AS/NZS 2107:2000 ‘Satisfactory’ values plus 5dB

Section 13.7.1 of the SWTC also states that

For enclosed rooms containing plant, equipment and electrical power Assets, noise levels must be assessed at no less than 1 metre from any item of equipment; and noise levels from mechanical ventilation systems serving the room must not exceed L_{Aeq} 65dB.

The criteria listed above in this section do not apply to systems or components operating in emergency mode. In this situation, noise generated by the systems or their components must comply with AS 1670.4 and AS 1668.1, and not exceed levels that affect speech intelligibility in egress paths, evacuation assembly areas, or operational or emergency control rooms or areas.

4.5.2.3 Noise and Vibration Ingress into Passenger Station Areas

Generally, from SWTC Book 4:

- 13.2-1 The Alliance must design station entry roads, grade separations and roads works and any associated noise mitigation controls to meet the requirements of "State Planning Policy No. 5.4 Road and Rail Noise (SPP 5.4)" (WAPC, 2019).
- [.] 13.5-3 The Alliance must consider the cumulative noise impact from road traffic and the operating passenger railway when designing and constructing any noise mitigation measures along Tonkin Highway.
- [.] 13.7-2 The Alliance must address noise and vibration impacts associated with station noise impacts, inclusive of any new road infrastructure to service the stations, to surrounding sensitive receivers, occupational health and amenity for PTA staff and patrons.

These all point to the same thing, ambient noise on the platform and occupiable spaces. SWTC 13.7.1 is most specific, stating the Alliance "shall design station areas to comply with" an internal target of L_{Aeq} 45 dB, inline with the reference standards.

Section 13.7.2 of the SWTC states that the Alliance shall also comply with the following requirements:

Floor vibration levels within publicly accessible areas from plant, equipment or external sources not exceed L_v , $RMS, 1s$ 112dB.

4.5.2.4 Reverberation within Passenger Station Areas

Section 13.7.3 of the SWTC states that the Alliance shall comply with the following requirements:

Within platform areas, the spatial average reverberation time (RT60) values for the full octave bands with centre frequencies 500Hz and 1kHz not exceed 1.3 seconds for the scenario where 100 patrons are present, or 1.6 seconds when empty.

At all other areas, spatial average reverberation time (RT60) values for the full octave bands with centre frequencies 500Hz and 1 kHz be in accordance with AS/NZS 2107:2000 given the usage of each space.

4.5.2.5 Public Address Systems within Passenger Station Areas

Section 13.7.4 of the SWTC states that:

The Alliance must ensure that the PA systems achieve the minimum sound level and speech intelligibility requirements of clause 4.3.4 and 4.3.6 of AS 1670.4 for all representative locations, environmental conditions and passenger levels

External noise ingress from adjacent road traffic sources must be assessed and considered when designing and constructing all stations to ensure that the public address systems within passenger station Areas achieve the minimum sound level and speech intelligibility requirements of clause 4.3.4 and 4.3.6 of AS 1670.4 for all representative locations, environmental conditions and passenger levels.

4.5.2.6 Acoustic Sound Insulation within Passenger Station Areas

Section 13.7.5 of the SWTC states that:

Airborne sound insulation targets are given in terms of the weighted level difference, D_w between two spaces. The Alliance must ensure that design complies with the following general in-situ airborne sound insulation targets:

- $D_w \geq 35dB$ between normally occupied enclosed spaces.
- $D_w \geq 28dB$ between normally occupied spaces where the common partition includes a door.

The following table presents criteria that supersede these general requirements for specific occupied spaces.

Where two different space types are adjacent to one another, the Alliance must ensure that the more onerous target applies.

Table 5 Vibration criteria (SWTC Book 5 Table 31: Airborne Sound Insulation Requirements)

	Space Type / Occupancy	Minimum Weighted Sound Level Difference, Dw, dB
Between normally occupied back of house offices and crib rooms	Generally	40
	Where the common partition at the interface includes a door	30
Toilets and amenities to nearby public areas	Generally	42
	Where the common partition at the interface includes a door	25
	Where the common partition at the interface has no door	16

SWTC 13.7.5 also states that

Where receiving spaces are not fully enclosed, the closest point of assessment must be at least 4 metres from the nearest door or window or the nearest scheduled seating position, whichever is closest.

Noise from hydraulic services associated with toilet amenities (e.g. flushing) must not be audible in any other publicly accessible area.

Noise from hand dryers within toilets and amenities should not be audible at any position more than 2 metres from the entrance, and must not be audible at any commercial retail or patron seating areas.

4.6 Design Life

Not applicable.

4.7 Durability Requirements

Not applicable.

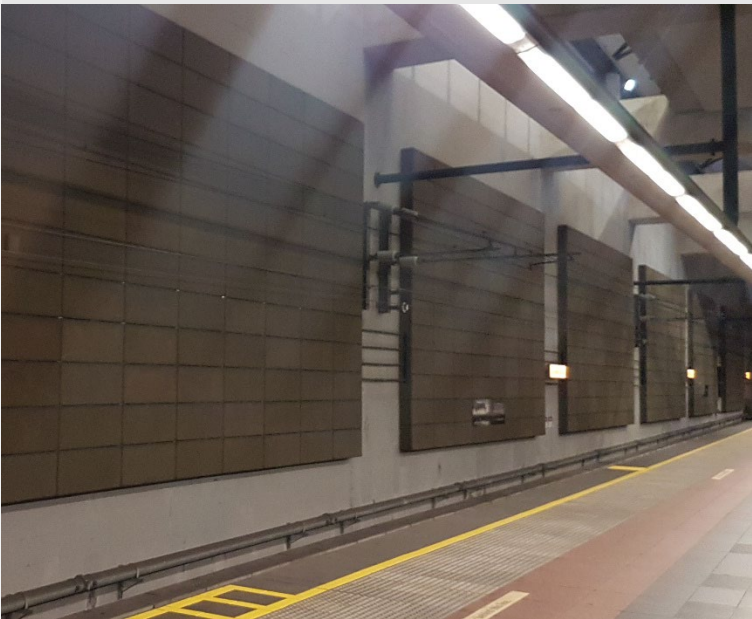

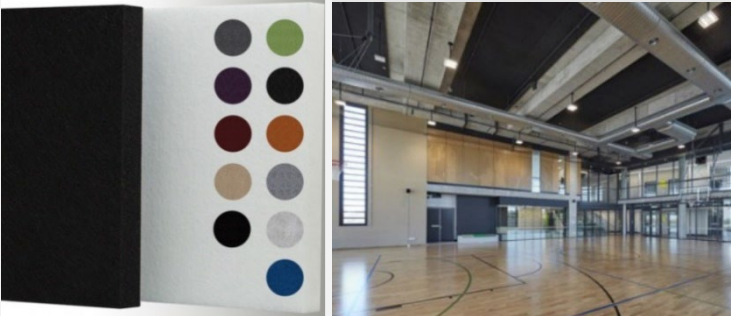
4.8 Specialist Technical Inputs

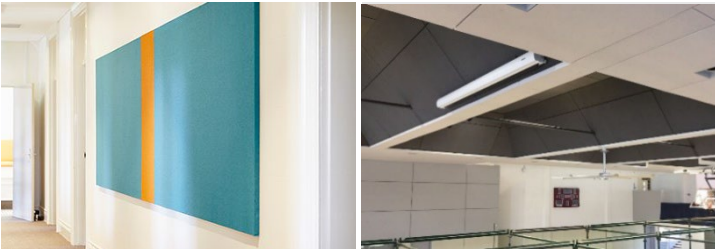




4.8.1 Reverberation


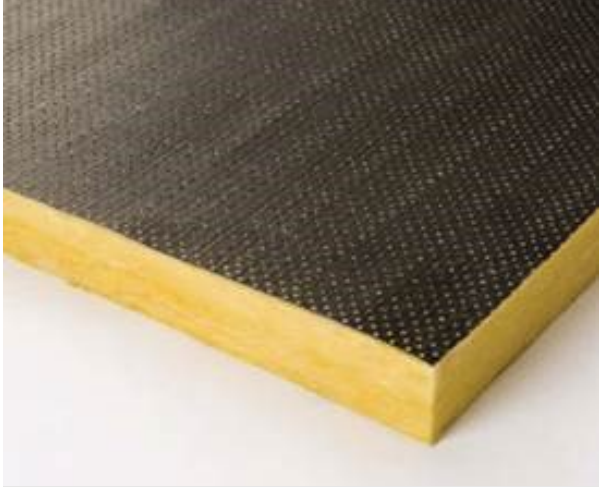
Reverberation times must be controlled within occupiable spaces in accordance with Section 4.5.2.4. Based on criteria from this section, reverberation times within the concourse area are recommended to be reduced as far as is practicable. It is anticipated that these recommendations can be achieved through the suitable installation of 150 m² of absorptive finishes achieving Class A or B according to EN ISO 11654, or minimum a_w 0.80 (Noise Reduction Coefficient NRC 0.80).

The platform section under Broun Avenue is acknowledged to experience significantly higher reverberation times (> 1.6 s) than typical open platform sections. However, options for absorptive treatments within platform areas are limited considering that majority of the surfaces are bridge structures and retaining walls under Broun Avenue. As such reverberation times are recommended to be minimised as far as feasible via architectural treatments where possible. The PA system design shall carefully consider reverberations within platform areas to ensure relevant STI targets are achieved.

The markups in Appendix A refer to absorptive finishes within identified primary spaces. The following table provides various examples of such products. The selected product should be of Class A or B according to EN ISO 11654, or minimum a_w 0.80 (Noise Reduction Coefficient NRC 0.80).

Name	Image (Source), link	Description
<p>Quietstone Standard or Pyrotek Reapor</p>		<p>Porous recycled glass material designed primarily for direct fixing to walls and ceilings. Non-toxic, non-flammable and not affected by moisture. Non fibrous material. Can be cleaned with a high pressure hose.</p> <p>Classified Class A according to EN ISO 11654 (50 mm+)</p> <p>Used in various Perth train stations already (Elizabeth Quay, Joondalup etc.)</p> <p>Main downside is risk of friable silica dust when broken / handled.</p>
<p>Acoufelt</p>	 <p>https://acoufelt.com/products/panels/</p>	<p>Can be self-adhesive backed (Direct fix) or mechanically fixed</p> <p>Can be ordered with hi resolution image print</p> <p>Low resistance to damage</p> <p>EN ISO 11654 Class C (α_w 0.70-0.75) or better</p> <p>25 to 100 mm thick polyester with fabric facing</p> <p>Non-toxic, Non-allergenic, Non-irritant</p>
<p>Pyrotek Echohush</p>	 <p>https://www.pyroteknc.com/products/echohush/echohush-board/</p>	<p>EN ISO 11654 Class C (α_w 0.70-0.75) or better</p> <p>25 to 100 mm thick polyester with fabric facing</p> <p>Direct fix installation</p> <p>Recyclable, various colour options</p> <p>Can be used to pin / Velcro items on</p> <p>Non-toxic, Non-allergenic, Non-irritant</p>

Name	Image (Source), link	Description
CSR Martini DECO Quiet Panel	 http://www.csrmartini.com.au/products/decorative-acoustic-products	Effectively equivalent to Pyrotek Echohush
Stratocell Whisper FR	 http://www.soundblock.com.au/sound-absorbers/stratocell-whisper	EN ISO 11654 Class C (α_w 0.70-0.75) or better 25 to 100 mm thick Polyethylene foam (unpainted) Lightweight and easily cut into shapes, affix to walls or hang
Asona Triton	 http://www.asona.co.nz/	EN ISO 11654 Class B (α_w 0.80-0.85) 25 to 100 mm thick glass fibre with fabric facing Direct fix installation Recyclable, various colour options
Renhurst RenAcoustic Baffles	 http://renhurst.com/renacoustic-baffles/	EN ISO 11654 Class C (α_w 0.70-0.75) or better Rigid fibreglass core and a fine textured fleece Lightweight with various suspension options
Himmel Ecophon Solo Panels	 https://www.himmel.com.au/product-listing/2016/07/13/ecophon-solo-panels	Suspended colour panels Likely limited extent due to ceiling fan / air movement needs Glass fibre reinforced for rigidity

Name	Image (Source), link	Description
Stratocell Whisper	 <p data-bbox="357 656 906 678">www.soundblock.com.au/sound-absorbers/stratocell-whisper</p>	<p data-bbox="1155 257 1410 313">Claimed to be resilient to water and humidity</p> <p data-bbox="1155 322 1449 456">Flame retardant and/or Group 1 fire rating. Claimed self-extinguishing material (Class B2) to DIN 4101 series</p> <p data-bbox="1155 465 1378 521">Light weight and non-corrosive.</p> <p data-bbox="1155 530 1461 586">Easy to fix and fasten, pinned or glued</p> <p data-bbox="1155 595 1442 651">Sheet size is 2400 x 1200 x 50mm thick</p> <p data-bbox="1155 660 1458 712">Classified Class A according to EN ISO 11654</p>
32-48 kg/m³ glasswool or mineral fibre faced with glass fabric	 <p data-bbox="357 1227 651 1249">www.bradfordinsulation.com.au/</p>	<p data-bbox="1155 730 1461 1003">Manufactured by spinning molten glass, containing up to 80% recycled material, into fine fibres which are then bonded together using a thermosetting resin. Typical density of 48 to 60 kg/m³. Non-flammable, non-toxic material which is not affected by moisture.</p> <p data-bbox="1155 1012 1453 1227">Typically installed in perforated sheet metal enclosures with an additional spun bonded cloth film to protect from dust and moisture. Industrial product with relatively long product life.</p>

With the control of reverberation, it is anticipated that the PA intelligibility requirements can be achieved through careful speaker system design within the concourse, as discussed in the subsection 4.8.3.

4.8.2 Noise ingress from Tonkin Highway to Platform areas

Baseline monitoring report MEL-MLCX-EN-RPT-00031 documents monitoring at Stirling Station to be LAeq 78 dB on the open ends of the platform. Accounting for substantially more trucks on Tonkin in the future, the same report estimates Morley and Noranda station platform levels to be around LAeq 80 dB.

A noise reducing wall between the Station and the Tonkin Hwy should be considered for the following reasons:

- The internal noise levels into the platform offices may exceed the targets under SWTC with a standard façade construction
- The ambient levels on platform are predicted to be sufficiently high, thereby requiring passengers to have a raised voice (or shout) to be audible
- There may be challenges in the PA system being sufficiently intelligible under the SWTC and AS 1670.4.

A detailed discussion along with possible mitigation options are provided to MELConnx (via RFI CRFI407 CRFI-SLR-285-00001) and the project team is currently investigating feasible options.

4.8.3 Public Address (PA) Systems

The public address system will need to be designed to be sufficiently audible (involving both sound level and speech intelligibility) to meet relevant provisions of Australia Standard 1670.4, Fire Detection, Warning, Control and Intercom Systems - System Design, Installation and Commissioning - Sound Systems and Intercom Systems for Emergency Purposes (AS 1670.4) such that patrons can be advised in case of emergencies.

By inspection of each station arrangement and distancing to the nearest residential receivers (screening assessment), it can be seen that there is a range of sound levels which can meet both the minimum sound level limit requirements of AS 1670.4 and the maximum noise level limits listed.

An active PA system which regulates speaker volume depending on actual ambient sound level conditions to maintain intelligibility is recommended for the Morley Station.

The PA system is currently designed by the communications designer, and the detailed results of compliance will be published as the project progresses. The following items are being considered in the PA design process:

- Ambient/background noise levels typically experienced on platforms as estimated in the Baseline Monitoring Report (MEL-MLCX-EN-RPT-00031).
- Investigation on the requirement of external noise screening to platforms to achieve STI targets (as discussed in RFI CRFI407 CRFI-SLR-285-00001).
- Reverberation times within concourses and platforms (as discussed in Section 4.8.1).

4.8.4 Crowd / Patron Noise

Average crowd and patron noise levels in the context of the design criteria and other environmental noise sources are considered insignificant.

The arrangement of the station has passenger waiting areas on the platform and entry areas at distances over 100 metres from potential sensitive premises and/or generously spaced open environments.

Providing this level of distance separation and low crowd densities is predicted to result in sustained crowd / patron noise levels (conversations, walking) as individually $L_{Aeq} 60 \text{ dB @ 1 metre}$ or less, and therefore below $L_{Aeq} 30 \text{ dB @ 40 metres}$ will be at a cumulative level that is inaudible at nearby residential locations against other background environmental noise.

4.8.5 Vehicle Car Parking

EU Parking Area Noise 2007¹ guidelines have been used to provide an indicative level of noise emissions on surrounding areas.

- Vehicle movement rate for P&R facilities over under 20 km from CBD. A vehicle entering or exiting a parking bay is one movement, so the same vehicle arriving and departing on the same day completes two movements.
 - 0.30 per hour per parking bay (6 am to 10 pm).
 - 0.06 per hour per parking bay (10 pm to 6 am).
- Random fill across all parking lots.²
- Impulse correction K_1 4 dB.
- L_{w0} 63 dB (standardised vehicle sound power level).

4.8.6 Car Parking Laneway and Kiss and Ride

Car movements have been modelled using Nord2000 methodologies with the following parameters:

¹ Bayer, Landesamt für Umwelt 2007, Parking Area Noise - Recommendations for the Calculation of Sound Emissions of Parking Areas, Motorcar Centers and Bus Stations as well as of Multi-Storey Car Parks and Underground Car Parks, Bayerisches Landesamt für Umwelt, Parkplatzlärmstudie 6, Aufl., August 2007.

² Random fill assumed in the absence of a specific car parking traffic analysis. Fill patterns in practice may vary due to proximity to train station, and presence of ticketed parking and/or reserved parking.

- Movements of up to 40 vehicles per hour during the day, and up to 10 vehicles per hour during the night has been assumed for the assessment.
- Changes in level from arriving / idling / departure at stations (as assessed at nearest noise sensitive location) have been determined insignificant and not modelled. Publicly accessible road sections beyond the loop or its intersections are not included.
- Ground class F (compacted dense ground).
- Category 1 vehicles approximately L_{AE} 78 dB at 7.5m and 40 km/hr.
- Traffic case F (40 km/hr max).
- Asphalt concrete surface, any increases in noise level due to gradients was included on the basis of the ground topography provided.

4.8.7 Bus movements

Bus vehicles have been modelled using Nord2000 methodologies with the following parameters:

- Bus movements of up to 4 buses per stand per hour during the day (up to 48 buses/hour in total), and 0.5 bus per stand per hour during the night (up to 6 buses/hour in total) has been assumed for the assessment.
- Changes in level from arriving / idling / departure at stations (as assessed at nearest noise sensitive location) have been determined insignificant and not modelled. Publicly accessible road sections beyond the loop or its intersections are not included.
- Ground class F (compacted dense ground).
- Category 2a vehicles (up to 12.5m length and 2 axles, e.g. Volgren OC500LE), approximately L_{Amax} 75dB, L_{AE} 78dB at 7.5m and 35km/hr.
- Traffic case F (35km/hr max).
- Asphalt concrete surface, any increases in noise level due to gradients was included on the basis of the ground topography provided.

4.8.8 Mechanical outdoor plant

The supplied drawings indicate that the outdoor mechanical plant comprise condenser units. Based on rooms served, each would have capacities the order of 6 kW or less (similar to domestic residential air conditioning systems). These units, assessed in cumulative terms, are considered compliant with internal noise criteria and the assigned noise levels defined in Section 4.5.1 at the nearest noise sensitive premises.

4.8.9 Electrical transformers

From the supplied drawings, it can be seen that the transformers associated with the station are approximately 25 metres from nearest residential property to the east of the site. By inspection of the likely transformer sound power level / loading and the proposed screening elements, compliance with the relevant assigned noise levels is predicted.

4.8.10 Vibration source levels

Vibration emissions from the site will be mainly controlled by rail traffic. Road vehicles will also contribute where speed humps, loose panels (e.g. gutter or pit covers) or sudden variations in road surface are introduced.

This assessment acknowledges that typical rail vibration levels in the immediate area will decrease from corresponding decreases in rail speeds when all trains pass through Morley Station (rather than pass through the area at or near the track section limit).

On a number of previous projects in Perth, ground vibration measurements have been carried out by SLR adjacent to surface rail track carrying passenger trains at a variety of distances from the rail centreline at each site. As each marker indicates levels which were not exceeded by 95% of trains, typical (median) measured levels are lower.

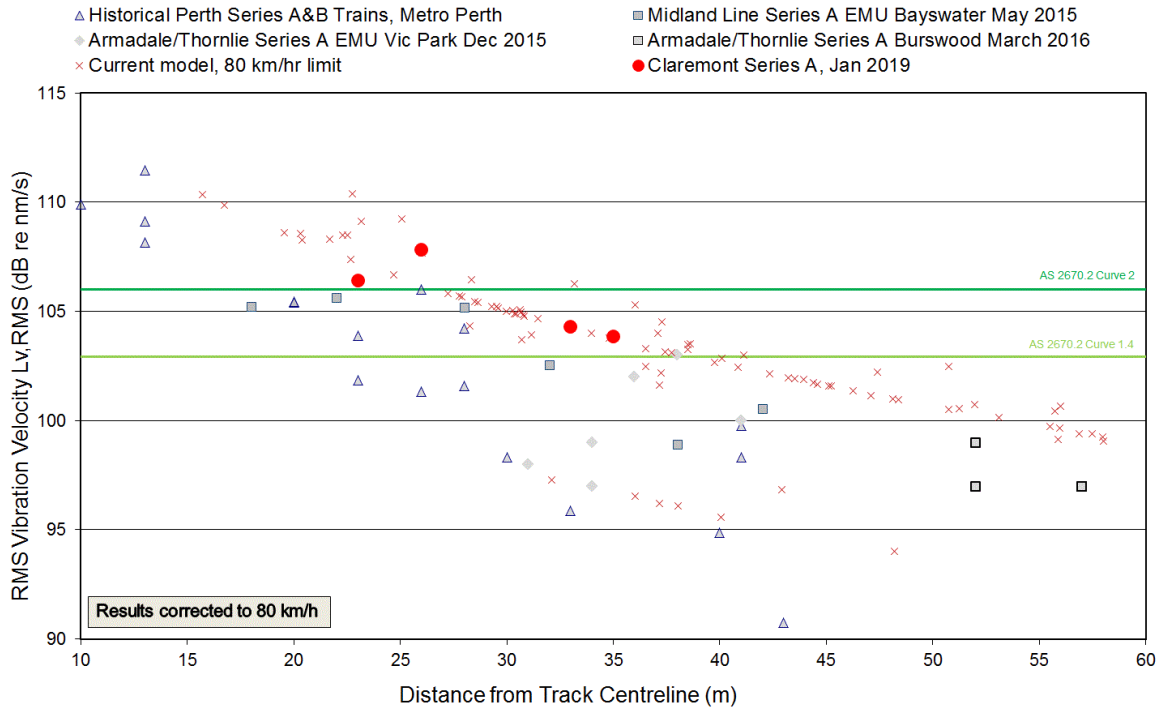


Figure 7: Comparison of measured and predicted railway vertical vibration levels over plan distance

Adjusting for speeds around 40 km/hr, which would be the highest speed that could be expected in the vicinity of the station, typical vibration levels will comply with Curve 1.4 (Residential) at approximately 30m from the nearest track centreline. Curve 2 will be complied with at approximately 20m from the nearest track centreline. For reduced speeds associated with stopping trains, rail vibration levels applicable to station areas are also considered to meet the $L_{v,RMS,1s}$ 112dB requirement referenced in Section 4.5.2.3.

Actual results will vary from these estimates according to rail condition, in situ soil and terrain profiles; however even after allowing for such variation, vibration levels are predicted to be compliant.

On the basis of the above, the project provisions for vibration mitigation may be limited to avoiding road speed humps and loose coverings for buses and heavy vehicle traffic if applicable. Where traffic speed control is required, gradual gradient pedestrian crossings (such as wombat crossings) are proposed to be implemented which is not predicted to introduce noticeable noise and/or vibration increase.

4.9 Constructability Requirements

Not applicable.

4.10 Environmental & Sustainability Design Criteria

Should this station be considered in regards to Credit 14 under Green Star Design and As-built Requirements for Railway Stations (v1.1), there are four (4) points available under Acoustic Comfort. These relate to:

- 14.1 Internal Noise Levels
- 14.2 Reverberation
- 14.3 Audibility
- 14.4 Hearing Loop Coverage

The SWTC requirements for Station internal noise levels (Section 4.5.3.1) and reverberation (Section 4.5.3.3) is predicted to achieve the design credits under 14.1 and 14.2 of the Green Star requirements. As-built credits are achievable via compliant post-construction measurements.

The credits for Audibility and Hearing Loop Coverage (14.3 and 14.4) are not within the scope of this Report.

The noise and vibration design requirements under ISCA are applicable line wide and are covered within the Operational Noise and Vibration Design Report (MEL-MLCX-EN-RPT-00032).

4.11 Future Proofing

Not applicable.

4.12 Value Engineering

Not applicable.

4.13 Third Party Operational Stakeholders

Not applicable.

4.14 Design Input from Stakeholders and Community Involvement Process

Not applicable.

4.15 Design Risks, Assumptions, Issues, Dependencies, Opportunities, and Constraints (RAIDOC)

Detailed of design risks, assumptions, issues, dependencies, opportunities and constraints are outlined below.

4.15.1 Design Risk Register

Design risks related to this design package are detailed in the Table below;

ID	Description	Status	Evidence of Validation
	Noise and reverberation on platform areas. The platform section under Broun Avenue is acknowledged to experience significantly higher reverberation times (> 1.6 s) than typical open platform sections. However, options for absorptive treatments within platform areas are limited considering that majority of the surfaces are bridge structures and retaining walls under Broun Avenue. As such reverberation times are recommended to be minimised as far as feasible via architectural treatments where possible. The PA system design shall carefully consider reverberations within platform areas to ensure relevant STI targets are achieved.	Open	
	Transport noise ingress into enclosed staff areas being excessive on SWTC targets. Increasing the airborne sound insulation of customer service and staff areas may not be sufficient or appropriate. Reference is made to CRF1407 for further discussion.	Open	

4.15.2 Design Assumptions

Design assumptions related to this design package are detailed in the Table below;

ID	Description	Status	Evidence of Validation
	Rough / diffusive wall finishes. If walls are hard reflective, then wall extents may need to be revised.		
	Existing residential walls and noise walls relevant to the report outcomes are acoustically sound, continuous / without gaps.		
	Car parking and vehicle trafficable areas avoid the use of loose laid road coverings, e.g. openable drains and grates are positively secured with mechanical fasteners.		
	Car parking and vehicle trafficable areas avoid the use of smooth concrete surfaces, e.g. concrete surfaces are brush		

	finished or otherwise rough such that tyres do not squeak under heavy steering.		
	Cumulative mechanical external plant noise emissions do not exceed L_{WA} 92 dB during the day and L_{WA} 83 dB at night, which is considered to be a conservative estimate of commercial split systems servicing existing outdoor train stations in Perth (up to the order of 60 kW installed capacity outdoors). This includes the effects of screening panels and station buildings.		

4.15.3 Design Issues

Design issues related to this design package are detailed in the Table below;

ID	Description	Status	Evidence of Validation
	Not applicable at this design stage		

4.15.4 Design Dependencies

Design dependencies related to this design package are detailed in the Table below;

ID	Description	Status	Evidence of Validation
	Noting Rail Systems Australia appears to have already constructed EASE models for Morley Station (25-A-285-EC0151 and 25-A-285-EC0153), responsibility for production of Speech Transmissibility Index (STI) contours and design of loudspeaker arrangements to be submitted as part of the various Station packages will rest with Rail Systems Australia.		

4.15.5 Design Opportunities

Design opportunities related to this design package are detailed in the Table below;

ID	Description	Status	Evidence of Validation
	Not applicable at this design stage		

4.15.6 Design Constraints

Design constraints related to this design package are detailed in the Table below;

ID	Description	Status	Evidence of Validation
	Not applicable at this design stage		

4.16 **Requests for Information (RFI)**

Requests for information submitted in relation to this design package are outlined in the Table below.

Copies of the RFIs are provided in Appendix W of this report.

RFI	Description/Title	Response
062	Noise and Vibration - Baseline Measurements	Closed

CRFI-SLR-PW-00001		
063 CRFI-SLR-PW-00002	Noise and Vibration Assessments - Data Input Log / Requests	Closed
068 CRFI-SLR-PW-00003	Conversion of federated model 25-B-00-0001.4.0.IFI to AutoCAD	Closed
CRFI407	Morley Station - Highway Noise Walls	Open

5. Design Outputs

5.1 Deliverables List

Not applicable.

5.2 Drawings and Models

5.2.1 Mechanical plant noise levels

Forecast internal noise levels on the basis of nominated mechanical arrangements and specifications are provided for selected spaces as follows:

Description of Area / Room	Space Type Definition	Target sound level, L _{Aeq} , dB	Estimated range, L _{Aeq} , dB
25-A-285-AR0015 DRIVER WC	Toilets and amenities	45 to 55	40 to 50
25-A-285-AR0015 CSO OFFICE	General office areas	45	<40
25-A-285-AR0015 TEA PREP	Staff crib rooms	45	<40
25-A-285-AR0016 CONCOURSE CSO	General office areas	45	<40
25-A-285-AR0016 MALE and FEMALE AMENITIES	Toilets and amenities	45 to 55	40 to 50
25-A-285-AR0016 STAFF CRIB	Staff crib rooms	45	<40
25-A-285-AR0015 PLATFORM	Platforms	70	60 to 65
25-A-285-AR0016 CONCOURSE	Public waiting areas	45	40 to 50

5.2.2 Rail movements

Figure 8 and Figure 9 present forecast noise levels from rail operations in the vicinity of the station.



Figure 8: Forecast distribution in airborne noise from rail operations for comparison with L_{Aeq} night criteria



Figure 9: Forecast distribution in airborne noise from rail operations for comparison with L_{Amax} criteria

5.2.3 Bus and car parking activities

Figure 10 presents forecast noise levels in the vicinity of the station as a result of modelled bus and car parking / drop off facilities according to Section 4. It can be seen that noise impacts at adjacent development areas from road vehicles can be managed to levels compliant with applicable criteria.

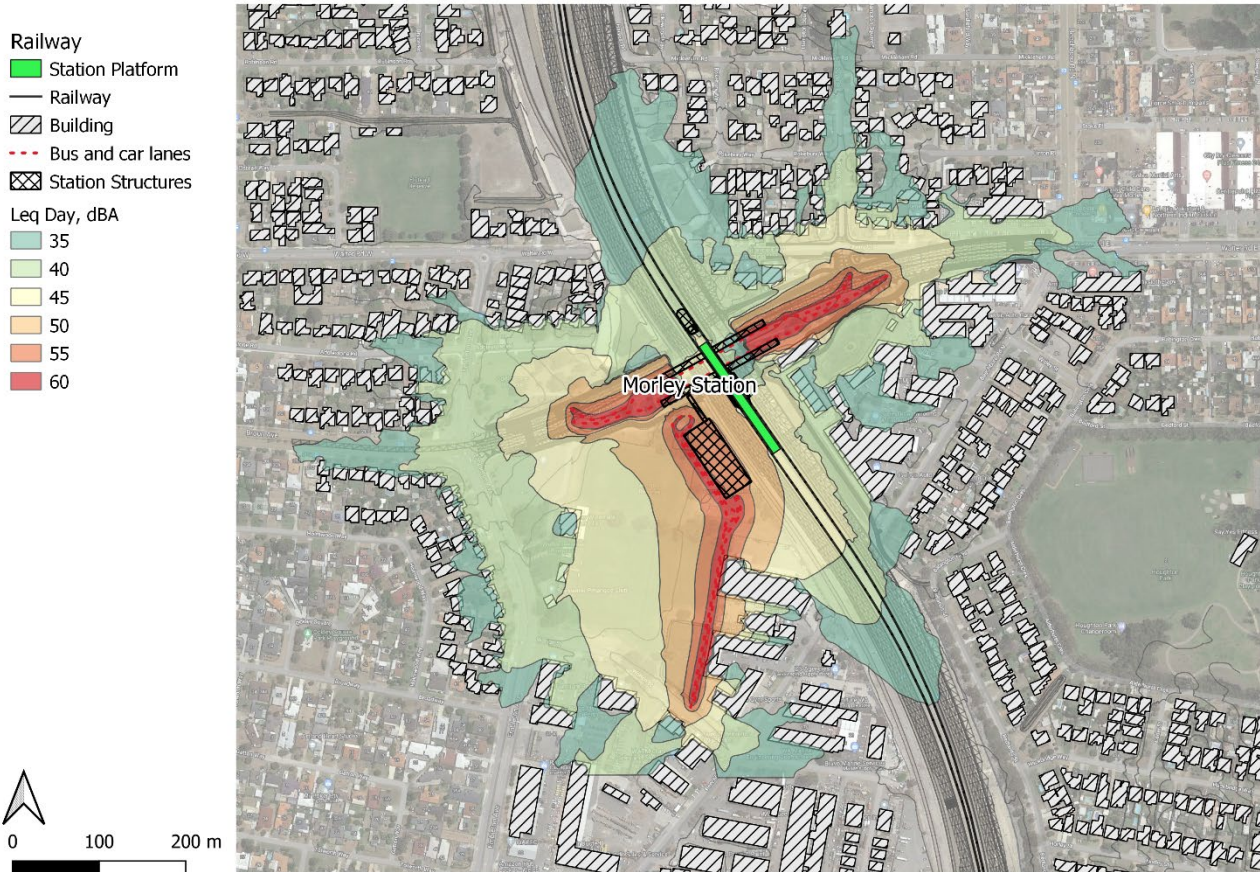


Figure 10: Forecast distribution in airborne noise from station car parking areas for comparison with L_{Aeq} day criteria

It can be seen that the predicted levels from bus and car parking activities at the station are within the targets outlined in Section 4.5.2 to the nearest receivers.

5.3 Specifications

Not applicable at this design stage.

5.4 Standard Reference Drawings

Not applicable.

5.5 System Coordination Drawings and Models

Not applicable.

5.6 Type Approvals

Not applicable.

5.7 Calculations

5.7.1 Noise Propagation Effects

5.7.1.1 Path Attenuation Factors

Outside the rail reserve, the environmental factors relevant to noise propagation were modelled as follows:

- Topography dataset of existing conditions for the assessment area was sourced from Landgate and adapted to the provided alignment in 3D dwg format.
- Given the relatively short propagation distances, weather conditions for each time period were considered neutral, with 20°C ambient temperature and no prevailing wind or temperature gradient effects.

- Existing noise barrier and fence heights and locations were reviewed with necessary corrections being made to reflect their realistic existing conditions. The modelling was then carried out on the basis that these fences and barriers are acoustically solid, i.e. they perform as effective noise barriers, being of suitable construction to sufficiently reduce noise transmission.

5.7.1.2 *Air Attenuation and Diffraction*

The propagation of railway noise from source to nearby sensitive areas has been estimated using industry standard numerical code that has been validated through field measurements.

- 'N2k': The Nord2000 Rail prediction method is an update to the Kilde formulation based on advancements in the late 1990s. The main benefit comes from the fact that the N2k methodology calculates in terms of one-third octave bands, rather than a single number to represent all frequencies. This is critical in regards to the design of noise walls, because their effectiveness is strongly frequency dependent – the difference in noise reduction at higher frequencies is vastly different compared to low frequencies.
- The ISO 9613 Industrial Prediction Model has been used for predicting noise from stationary assets with noise sources including sirens and bells. Various weather conditions can be taken into account in this modelling algorithm.

Stationary noise sources are modelled according to the parameters outlined in the following Table.

Parameter	Day period	Night period
Wind speed	Nil (ISO 9613, $C_{met} = 0\text{dB}$)	Nil (ISO 9613, $C_{met} = 0\text{dB}$)
Temperature inversion lapse rate	Nil (ISO 9613)	Nil (ISO 9613)
Temperature	20°C	15°C
Relative humidity	50%	50%
Mean barometric pressure	1013hPa	1013hPa

These sources are generally those assessed under the Regulations, such as crowd noise, public address systems, fixed mechanical plant and idling buses not on public roads.

5.7.1.3 *Ground absorption*

The table below summarises the ground absorption rates modelled.

Parameter	Value	Comments
Default	0	Hard ground
Rail reserve generally	0	Hard ground
Undeveloped sites, loose soil	0	Conservatively assuming future development / sealed surfaces
Significant road and sealed concrete surfaces	0	Conservatively 100% hard reflective
Established parks and reserves	0.6	60% sound absorptive

5.8 Schedules

Not applicable.

6. Competence for Design

Not applicable at this Design Stage.

7. Design Reviews and Certification

7.1 Interdisciplinary Design Check (IDC) Review

Not applicable at this Design Stage.

7.2 IDC Certificate

Not applicable at this Design Stage.

7.3 Design Verification

Not applicable at this Design Stage.

7.4 Independent Verification

Not applicable at this Design Stage.

7.5 BCA

Not applicable at this Design Stage.

7.6 DDA

Not applicable at this Design Stage.

7.7 PTA Design Submission Reviews.

Not applicable at this Design Stage.

8. Design Compliance

The demonstration of compliance with the requirements of the Project Definition Documents, including any non-conformances of concessions is summarised on the following sections.

8.1 Standards & Guidelines

See Section 4.3.

8.2 SWTC

Not applicable at this Design Stage.

8.3 Planning & Environmental Approvals

Not applicable at this Design Stage.

8.4 Third Party Requirements

Not applicable at this Design Stage.

8.5 Deviation Register

Not applicable at this Design Stage.

8.6 Non-Compliances Register

Not applicable at this Design Stage.

9. External Interface Work Packages

9.1 Project Interface Control Plan

Not applicable at this Design Stage.

10. Effects of the Works

Not applicable.

11. Safety in Design

11.1 Overview

Not applicable.

11.2 Systems Safety Assurance Plan.

Not applicable.

11.3 Compliance with Safety Assurance Plan

Not applicable.

11.4 Safety Analysis

Not applicable.

11.5 Safety Argument

Not applicable.

11.6 Hazard Analysis

Not applicable.

11.7 Satisfaction of Safety Integrity Level Targets

11.8 Satisfaction of GSN Requirements

Not applicable.

11.9 Management of Safety Requirements

Not applicable.

11.10 Transfer of Residual Risks and Safety Related Operational Conditions

Not applicable.

11.11 Safety Assurance Statement

Not applicable.

12. Systems Engineering

12.1 Sub-system Allocation

Not applicable.

12.2 Requirements Management

Not applicable.

12.3 Engineering Assurance Summary

Not applicable.

13. Sustainability in Design

Not applicable.

14. Testing & Commissioning Requirements

Not applicable.

14.1 ITP's

Not applicable.

14.2 Hold Points

Not applicable.

14.3 Witness Points

Not applicable.

15. Human Factors

Not applicable.

16. Reliability, Availability and Maintainability (RAM)

16.1 General RAM Provisions

Not applicable.

16.2 RAM Targets

Not applicable.

17. Construction Methodology

17.1 Construction Methods

Not applicable.

17.2 Operational Staging

Not applicable.

17.3 Works in Track Occupancies

Not applicable.

18. Asset Maintenance Strategy

Not applicable.

18.1 RTO Assets

18.2 Other Assets

Not applicable.

19. Asset Operations Strategy

The following operational strategy has been assumed in this design package:

19.1 Normal Modes of Operations

19.2 Degraded Modes of Operations

20. Decommissioning Strategy

Not applicable.

20.1 Capability to Modify

20.2 Decommissioning Strategy

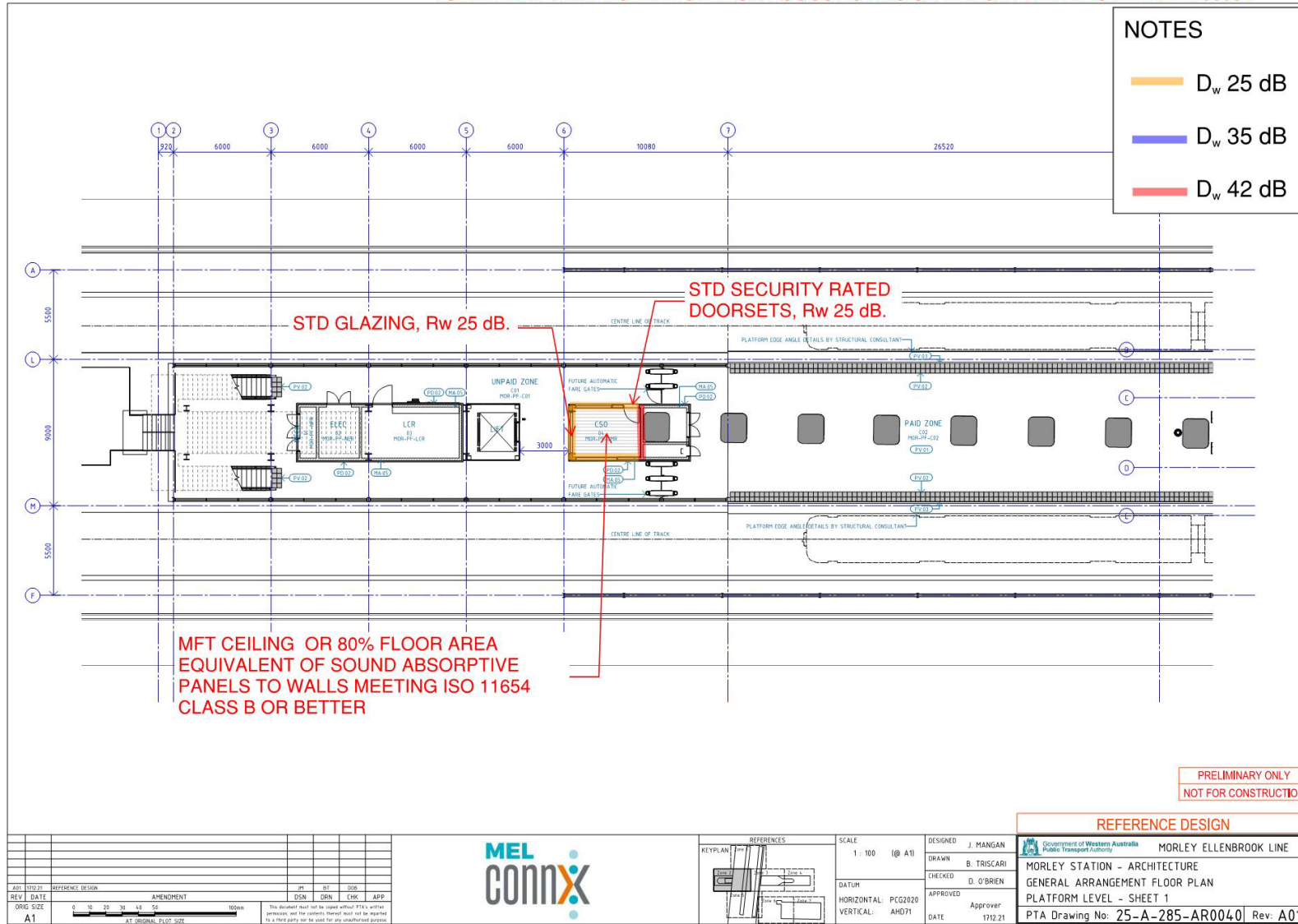
21. Project Actions Register

A list of outstanding issues and assumptions that may affect the design are outlined in the Table below.

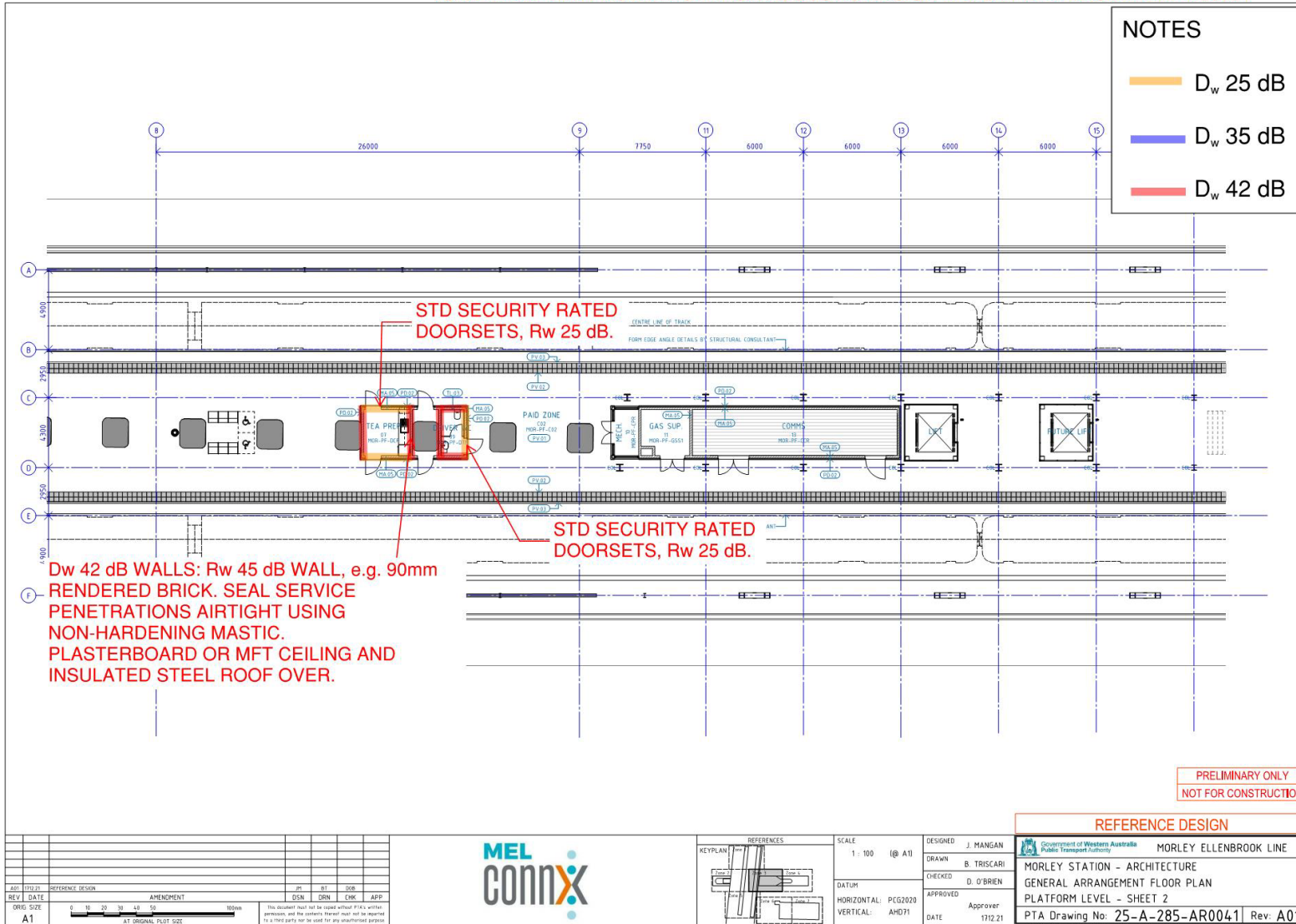
ID	Outstanding Issues	Potential Effect	Status
	Final arrangement of loudspeakers / PA systems	Increased noise emissions	

Appendix A: Drawing and Model List

TO BE READ WITH MORLEY STATION ACOUSTIC DESIGN REPORT MEL-MLCX-AR-RPT-00031



TO BE READ WITH MORLEY STATION ACOUSTIC DESIGN REPORT MEL-MLCX-AR-RPT-00031

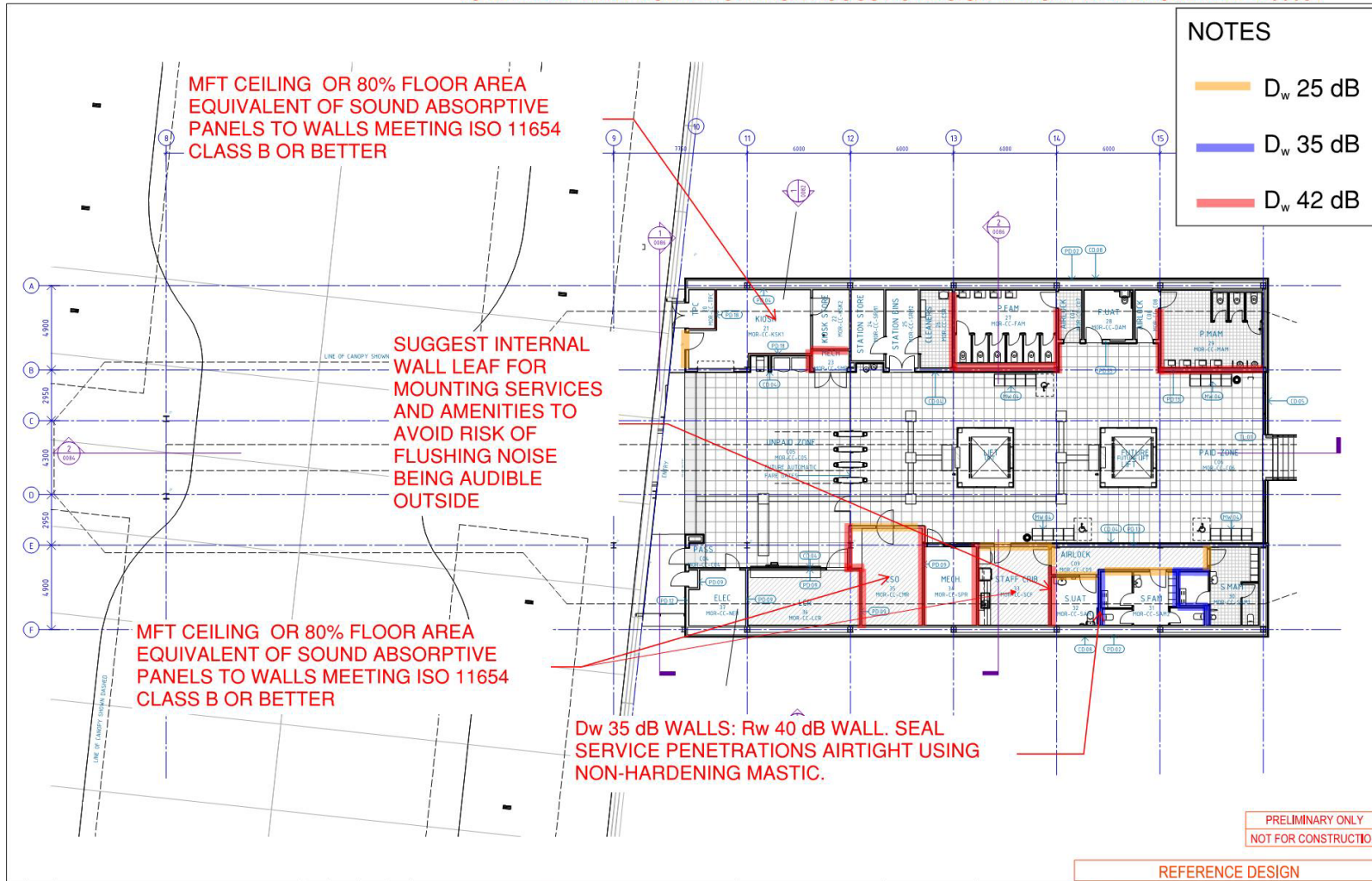


PRELIMINARY ONLY
 NOT FOR CONSTRUCTION

REFERENCE DESIGN

		SCALE: 1:100 (@ A1)		DESIGNED: J. MANGAN		MORLEY ELLENBROOK LINE	
KEY PLAN		DATUM:		CHECKED: B. TRISCARI		MORLEY STATION - ARCHITECTURE	
REFERENCES		HORIZONTAL: PCG2020		APPROVED: D. O'BRIEN		GENERAL ARRANGEMENT FLOOR PLAN	
DATE:		VERTICAL: AHD71		DATE: 1712 21		PLATFORM LEVEL - SHEET 2	
REV. DATE		APPROVED:		DATE:		PTA Drawing No: 25-A-285-AR0041 Rev: A01	

TO BE READ WITH MORLEY STATION ACOUSTIC DESIGN REPORT MEL-MLCX-AR-RPT-00031



REV	DATE	DESCRIPTION	BY	CHK	APP
01	17/12/21	REFERENCE DESIGN	JM	BT	DOB
02		AMENDMENT	OSN	ORN	CHK
03			OSN	ORN	CHK
04			OSN	ORN	CHK
05			OSN	ORN	CHK



SCALE	DESIGNED
1 : 100 @ A1	J. MANGAN
DRAWN	B. TRISCARI
CHECKED	D. O'BRIEN
APPROVED	
DATE	17/12/21

DATE	APPROVED
17/12/21	Approver

REFERENCE DESIGN
MORLEY ELLENBROOK LINE
MORLEY STATION - ARCHITECTURE
GENERAL ARRANGEMENT FLOOR PLAN
CONCOURSE LEVEL - SHEET 2
PTA Drawing No: 25-A-285-AR0044 Rev: A01



Appendix B: Specifications

Not applicable at this design stage

Appendix C: Standard Drawings

Not applicable at this design stage

Appendix D: Engineering Change Approvals

Not applicable at this design stage

Appendix E: Calculations



Job No.	Job Title				
675.30045	MEL D				
Date Created	By	Date Revised	Rev	Sheet	
31 Jan 2022	AD	31 Jan 2022	0	3	
Date Reviewed	By	Review Type	Review Status		

Morley Mechanical Noise Emissions - Screening Calc (ISO9613)

Item / Description	Rating/Broadband/Input			Octave Band Centre Frequency, Hz								
	Rating	dB	dB(A)	31.5	63	125	250	500	1k	2k	4k	8k
Source levels / inputs												
Empirical Air-Cooled Condenser Lw	Conservative power level	60.0 kW	92.0 (A)		96	96	93	90	86	83	80	72
Day reduced duty			0.0									
Emission level, total			92.0 (A)		96	96	93	90	86	83	80	72
Separation distance from station centre	180.0 m											
Air temp	20.0											
Environmental losses For distances r >> source dimension ds												
Point Source Propagation Loss	180.0 m	3.0 dB		-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0
Atmospheric Attenuation - Theory: ISO	180 m	20 °C	RH 70%		0.0	-0.1	-0.2	-0.5	-0.9	-1.6	-4.1	-13.8
Ground Attenuation, Theory: ISO 9613.2, Source Zone Ground 50% Soft Ground, M	180.0 m	1.0 m	1.5 m		4.8	1.4	-4.9	-4.3	1.1	2.4	2.4	2.4
Assume no barriers, wall reflection or screening effects												
Received level outdoors, night	L _{Aeq}		38 (A)		47.6	44.2	34.7	32.0	33.0	30.6	25.1	7.4
Residential day time target (EPNR)	10 dB influencing factor		55 (A)									
Excess on target (level of compliance)			(17.3)									
Forecast level of compliance is more than design uncertainty												

Figure E11: Mechanical plant noise emissions screening calc, Morley, day period



Job No.	Job Title		
Date Created	By	Date Revised	Rev Sheet
30 Sep 2021	AD	30 Sep 2021	0 3
Date Reviewed	By	Review Type	Review Status

Morley Station staff crib

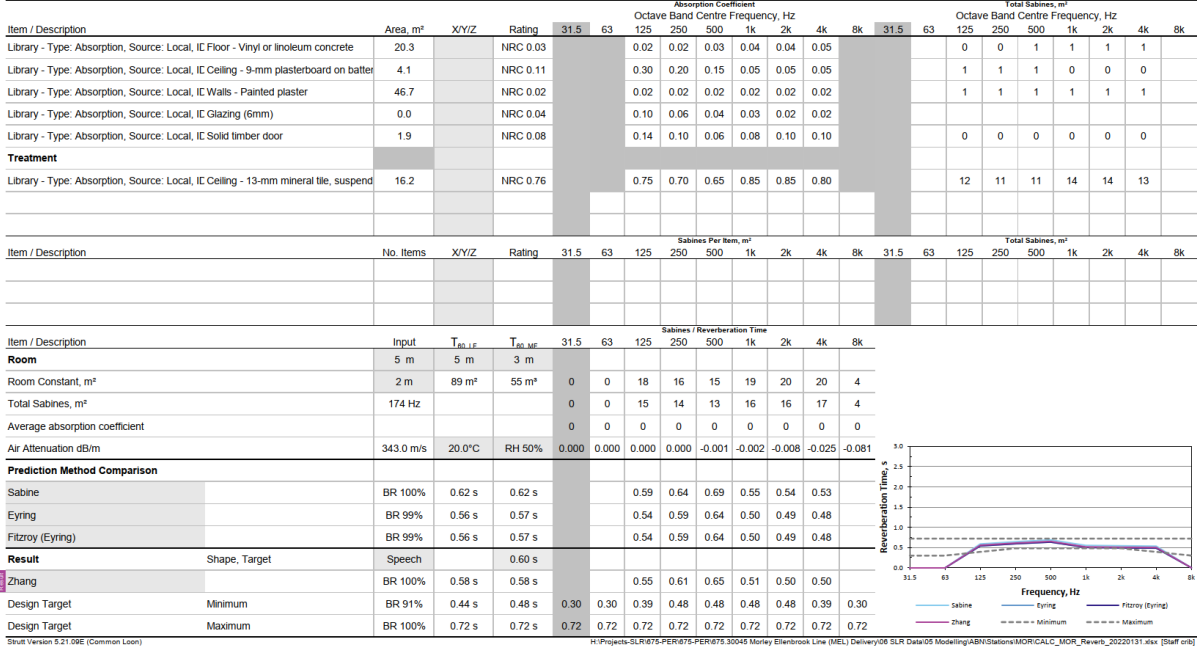


Figure E14: Estimated reverberation times for Morley Staff Crib



Job No.	Job Title		
Date Created	By	Date Revised	Rev Sheet
31 Jan 2022	AD	31 Jan 2022	4 1
Date Reviewed	By	Review Type	Review Status

Morley Concourse Reverberation (RT60)

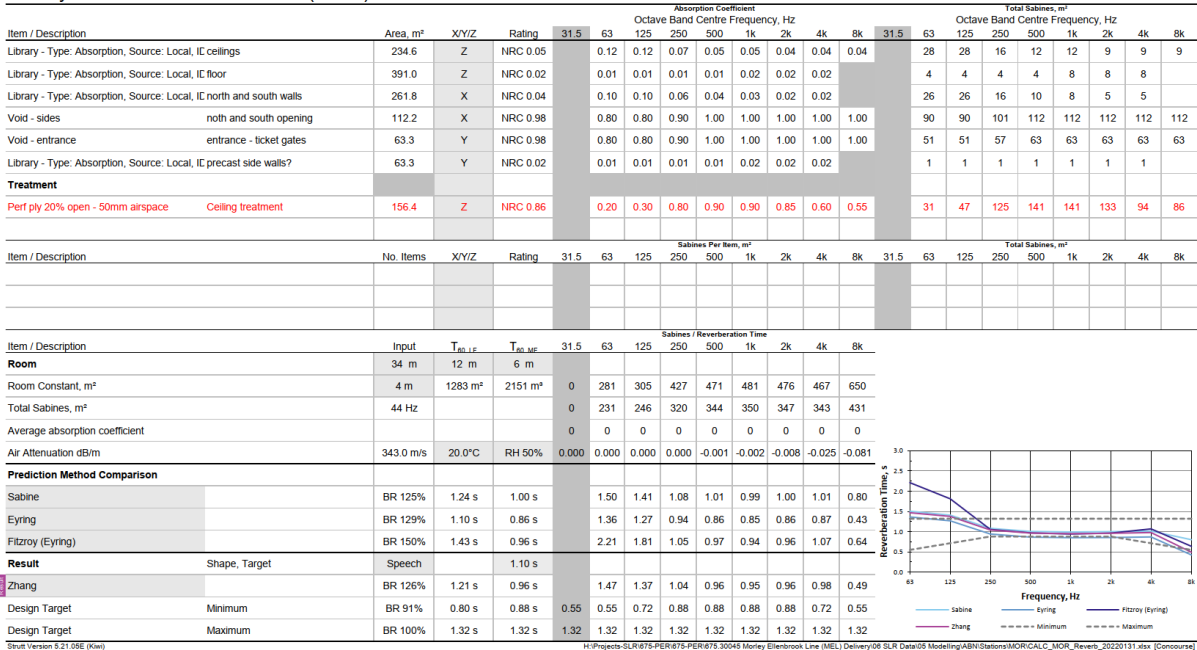


Figure E15: Estimated reverberation times of Morley Concourse



Job No.		Job Title	
Date Created	By	Date Revised	Rev
31 Jan 2022	AD	09 Feb 2022	2
Date Reviewed	By	Review Type	Review Status
			1

Morley Platform (under Bourn Av) Reverberation (RT60)

Item / Description	Area, m²	X/Y/Z	Rating	Absorption Coefficient								Total Sabines, m²										
				Octave Band Centre Frequency, Hz								Octave Band Centre Frequency, Hz										
				31.5	63	125	250	500	1k	2k	4k	8k	31.5	63	125	250	500	1k	2k	4k	8k	
Library - Type: Absorption, Source: Local, IC Rough concrete roof	4662.0	Z	NRC 0.03			0.02	0.03	0.03	0.03	0.04	0.07				93	140	140	140	186	186	326	
Library - Type: Absorption, Source: Local, IC Parquet in asphalt - floor	4662.0	Z	NRC 0.06			0.04	0.04	0.07	0.06	0.06	0.07				186	186	326	280	280	326		
Library - Type: Absorption, Source: Local, IC Rough concrete east west walls	945.0	Y	NRC 0.03			0.02	0.03	0.03	0.03	0.04	0.07				19	28	28	28	38	66		
Void noth and south opening	1110.0	X	NRC 0.98	0.80	0.80	0.90	1.00	1.00	1.00	1.00	1.00		888	888	999	1110	1110	1110	1110	1110	1110	1110

Item / Description	No. Items	X/Y/Z	Rating	Sabines Per Item, m²								Total Sabines, m²											
				31.5	63	125	250	500	1k	2k	4k	8k	31.5	63	125	250	500	1k	2k	4k	8k		

Item / Description	Input	T ₆₀ (s)		Sabines / Reverberation Time																		
		T _{60, LF}	T _{60, HF}	31.5	63	125	250	500	1k	2k	4k	8k										
Room	63 m	74 m	8 m																			
Room Constant, m²	4 m	11379 m²	34965 m³	0	964	1328	1546	1900	1909	2228	3428	5519										
Total Sabines, m²	18 Hz			0	889	1189	1361	1628	1635	1863	2634	3716										
Average absorption coefficient				0	0	0	0	0	0	0	0	0										
Air Attenuation dB/m	343.0 m/s	20.0°C	RH 50%	0.000	0.000	0.000	0.000	-0.001	-0.002	-0.008	-0.025	-0.061										
Prediction Method Comparison																						
Sabine	BR 129%	4.44 s	3.45 s	6.34	4.74	4.14	3.46	3.45	3.02	2.14	1.52											
Eyring	BR 131%	4.19 s	3.20 s	3.15	4.49	3.89	3.21	3.19	2.77	1.88	0.15											
Arau-Puchades	BR 195%	10.31 s	5.29 s	5.07	11.36	9.25	5.21	5.37	4.15	2.28	0.15											
Result	Shape, Target	Speech	1.80 s																			
Zhang	BR 129%	4.29 s	3.32 s	3.14	4.59	3.99	3.33	3.31	2.91	2.05	0.04											
Design Target	Minimum	BR 91%	1.31 s	1.44 s	0.90	0.90	1.17	1.44	1.44	1.44	1.17	0.90										
Design Target	Maximum	BR 100%	2.16 s	2.16 s	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16										

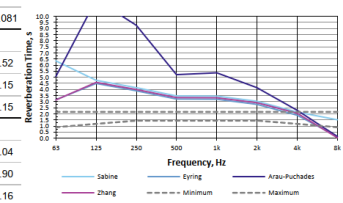


Figure E16: Estimated reverberation times of Morley Platform (under Broun Av)

Appendix F: Schedules

Not applicable at this design stage

Appendix G: ITP Strategy

Not applicable at this design stage

Appendix H: IDC Review Schedule

Not applicable at this design stage

Appendix I: IDC Certificates

Not applicable at this design stage

Appendix J: Design Verification Certificates

Not applicable at this design stage

Appendix K: Independent Verification Certificates

Not applicable at this design stage

Appendix L: BCA Certification

Not applicable at this design stage

Appendix M: DDA Certification

Not applicable at this design stage

Appendix N: PTA Comments Review Register

Not applicable at this design stage

Appendix O: RATM Extract

Not applicable at this design stage

Appendix P: Third Party Approvals

Not applicable at this design stage

Appendix Q: Concessions

Not applicable at this design stage

Appendix R: Non-Compliance/Deviation Report

Not applicable at this design stage

Appendix S: Designers Certificate of Compliance

Not applicable at this design stage

Appendix T: Contractors Certificate of Compliance

Not applicable at this design stage

Appendix U: Durability Assessment

Not applicable at this design stage

Appendix V: Sustainability

Not applicable at this design stage

Appendix W: RFIs

Not applicable at this design stage

Appendix X: Project Interface Control Plan

Not applicable at this design stage

Appendix Y: Project Hazard Log

Not applicable at this design stage

Appendix Z: Safety in Design

Not applicable at this design stage

Appendix AA: Human Factors

Not applicable at this design stage

Appendix BB: Reliability, Availability, Maintainability

Not applicable at this design stage

Appendix CC: Competency Assessment Confirmation Letter

Not applicable at this design stage