



METRONET Stage 1: Morley-Ellenbrook Line

Noranda Station Acoustic Design Report

MEL-MLCX-AR-RPT-00032

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Table of contents

Noranda Station Acoustic Design Report	2
1. Executive Summary	8
2. Project overview.....	9
2.1 METRONET Vision and Objectives	9
2.2 Morley-Ellenbrook Line overview.....	9
2.2.1 Project features	10
2.2.2 General scope of works.....	10
2.2.3 Key Project Objectives, Key Compliance Objectives and Critical Success Factors	11
2.3 Alliance vision and delivery approach	12
2.4 Purpose of the Report	13
2.5 Changes Since Previous Design Submission	13
2.5.1 Alliance Development Stage to Reference Design Stage	13
2.5.2 Reference Design to Interim Detailed Design.....	13
2.5.3 Interim Detailed Design to Final Detailed Design	13
2.5.4 IFC Design Finalisation	13
3. Design Description	13
3.1 Scope of this Design Package.....	13
3.2 Design Description.....	13
3.2.1 Rail operations	13
3.2.2 Station and associated infrastructure	13
3.2.3 Noise from Tonkin Highway	14
3.2.4 Electrical transformer noise.....	14
3.2.5 Mechanical noise	14
3.2.6 Local road traffic and new roundabouts	15
3.3 Relationship with other Design Packages.....	15
3.4 External Interfaces	15
4. Design Inputs.....	15
4.1 Project Design Requirements	15
4.1.1 Environmental noise regulations.....	15
4.1.2 SWTC Requirements.....	15
4.1.3 Operational Scenarios	16
4.1.4 Stations and Infrastructure	16
4.1.5 Electrical transformers	16
4.1.6 Fire pumps.....	17
4.1.7 Mechanical outdoor plant	17
4.2 Design Software Used for this Package	17
4.3 Applicable Codes and Standards	18
4.4 Reference Information	18
4.5 Design Criteria.....	22
4.5.1 Permanent Way	23
4.5.2 Stations and Associated Infrastructure.....	23
4.6 Design Life.....	27
4.7 Durability Requirements	27
4.8 Specialist Technical Inputs.....	27
4.8.1 Reverberation.....	27

4.8.2	Noise ingress from Tonkin Highway to Platform areas	30
4.8.3	Fire pumps.....	30
4.8.4	Public Address (PA) Systems	31
4.8.5	Crowd / Patron Noise.....	31
4.8.6	Vehicle Car Parking.....	32
4.8.7	Kiss and Ride	32
4.8.8	Mechanical outdoor plant	32
4.8.9	Electrical transformers	32
4.8.10	Vibration source levels.....	33
4.9	Constructability Requirements.....	33
4.10	Environmental & Sustainability Design Criteria	33
4.11	Future Proofing	34
4.12	Value Engineering	34
4.13	Third Party Operational Stakeholders	34
4.14	Design Input from Stakeholders and Community Involvement Process	34
4.15	Design Risks, Assumptions, Issues, Dependencies, Opportunities, and Constraints (RAIDOC)	34
4.15.1	Design Risk Register	34
4.15.2	Design Assumptions	34
4.15.3	Design Issues.....	35
4.15.4	Design Dependencies	35
4.15.5	Design Opportunities	35
4.15.6	Design Constraints.....	35
4.16	Requests for Information (RFI)	35
5.	Design Outputs	36
5.1	Deliverables List.....	36
5.2	Drawings and Models.....	36
5.2.1	Mechanical plant noise levels	36
5.2.2	Rail movements	36
5.2.3	Car parking activities.....	39
5.3	Specifications	39
5.4	Standard Reference Drawings.....	39
5.5	System Coordination Drawings and Models.....	39
5.6	Type Approvals	39
5.7	Calculations	39
5.7.1	Noise Propagation Effects.....	39
5.8	Schedules.....	40
6.	Competence for Design	40
7.	Design Reviews and Certification.....	41
7.1	Interdisciplinary Design Check (IDC) Review	41
7.2	IDC Certificate	41
7.3	Design Verification	41
7.4	Independent Verification.....	41
7.5	BCA.....	41
7.6	DDA	41
7.7	PTA Design Submission Reviews.....	41
8.	Design Compliance	41
8.1	Standards & Guidelines.....	41

8.2	SWTC	41
8.3	Planning & Environmental Approvals	41
8.4	Third Party Requirements	41
8.5	Deviation Register.....	41
8.6	Non-Compliances Register	41
9.	External Interface Work Packages.....	41
9.1	Project Interface Control Plan	41
10.	Effects of the Works	42
11.	Safety in Design	42
11.1	Overview.....	42
11.2	Systems Safety Assurance Plan.	42
11.3	Compliance with Safety Assurance Plan	42
11.4	Safety Analysis.....	42
11.5	Safety Argument	42
11.6	Hazard Analysis	42
11.7	Satisfaction of Safety Integrity Level Targets.....	42
11.8	Satisfaction of GSN Requirements.....	42
11.9	Management of Safety Requirements	42
11.10	Transfer of Residual Risks and Safety Related Operational Conditions	42
11.11	Safety Assurance Statement	42
12.	Systems Engineering	42
12.1	Sub-system Allocation	42
12.2	Requirements Management	42
12.3	Engineering Assurance Summary	42
13.	Sustainability in Design	42
14.	Testing & Commissioning Requirements	43
14.1	ITP's	43
14.2	Hold Points	43
14.3	Witness Points	43
15.	Human Factors	43
16.	Reliability, Availability and Maintainability (RAM)	43
16.1	General RAM Provisions	43
16.2	RAM Targets	43
17.	Construction Methodology	43
17.1	Construction Methods.....	43
17.2	Operational Staging	43
17.3	Works in Track Occupancies	43
18.	Asset Maintenance Strategy	43
18.1	RTO Assets	43
18.2	Other Assets.....	43
19.	Asset Operations Strategy	43
19.1	Normal Modes of Operations	44
19.2	Degraded Modes of Operations	44
20.	Decommissioning Strategy.....	44
20.1	Capability to Modify.....	44
20.2	Decommissioning Strategy	44
21.	Project Actions Register.....	44

Appendix A: Drawing and Model List.....	45
Appendix B: Specifications.....	48
Appendix C: Standard Drawings.....	49
Appendix D: Engineering Change Approvals.....	50
Appendix E: Calculations	51
Appendix F: Schedules.....	54
Appendix G: ITP Strategy	55
Appendix H: IDC Review Schedule.....	56
Appendix I: IDC Certificates	57
Appendix J: Design Verification Certificates	58
Appendix K: Independent Verification Certificates	59
Appendix L: BCA Certification	60
Appendix M: DDA Certification.....	61
Appendix N: PTA Comments Review Register	62
Appendix O: RATM Extract	63
Appendix P: Third Party Approvals	64
Appendix Q: Concessions	65
Appendix R: Non-Compliance/Deviation Report.....	66
Appendix S: Designers Certificate of Compliance	67
Appendix T: Contractors Certificate of Compliance	68
Appendix U: Durability Assessment	69
Appendix V: Sustainability	70
Appendix W: RFIs	71
Appendix X: Project Interface Control Plan	72
Appendix Y: Project Hazard Log	73
Appendix Z: Safety in Design	74
Appendix AA: Human Factors.....	75
Appendix BB: Reliability, Availability, Maintainability	76
Appendix CC: Competency Assessment Confirmation Letter	77

Tables

Table 3	Adopted rail noise criteria.....	23
Table 1	Table of Assigned Noise Levels, dB	24
Table 2	Table of adjustments for intrusive characteristics.....	24
Table 4	Ambient noise level criteria	25
Table 5	Vibration criteria (SWTC Book 5 Table 31: Airborne Sound Insulation Requirements)	26

Figures

Figure 1: Morley-Ellenbrook Line © METRONET	9
Figure 2: Architect's Impression of Noranda Station concept © MELConnx	10
Figure 3: Key Project Objectives, Critical Success Factors and Key Compliance Objectives	11
Figure 4: AD Stage Alliance Vision Development Outcomes (developed with the PTA)	12
Figure 5: MELconnx Alliance Vision, Purpose and Values.....	12
Figure 6 Example of screen installed at Sterling Station platform sections (Source: Google Earth).....	14
Figure 7: Extract of architectural overview plan 25-A-286-AR0010_A02 indicating site locality.	16
Figure 8: Extract of architectural plan 25-A-286-AR0010_A02	17
Figure 9: Proposed plantroom enclosure for fire pump with solid north and east partitions	31
Figure 10: Forecast distribution in airborne noise from rail operations for comparison with L_{Aeq} night criteria	38
Figure 11: Forecast distribution in airborne noise from rail operations for comparison with L_{Amax} criteria	38
Figure 12: Forecast distribution in airborne noise from station car parking areas for comparison with L_{Aeq} day criteria	39
Figure E13: Mechanical plant noise emissions screening calc, Noranda, day period	51
Figure E14: Mechanical plant noise emissions screening calc, Noranda, night period	52
Figure 15: Reverberation estimation, Noranda Vertical Transport Building Staff Crib.....	52
Figure E16: Reverberation times for Noranda Platform Staff Office	53

1. Executive Summary

This document discusses noise and vibration levels expected with operation of the proposed Noranda 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 expected to comply with applicable state noise regulations and planning policy. Rail vibration levels are expected 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 expected to remain compliant with relevant state policies.
- 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 with a potential to have high internal noise levels to station habitable rooms assuming a standard façade construction. As such, screening elements/walls are recommended to be adopted along the platform to sufficiently shield platform buildings from highway noise.

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.

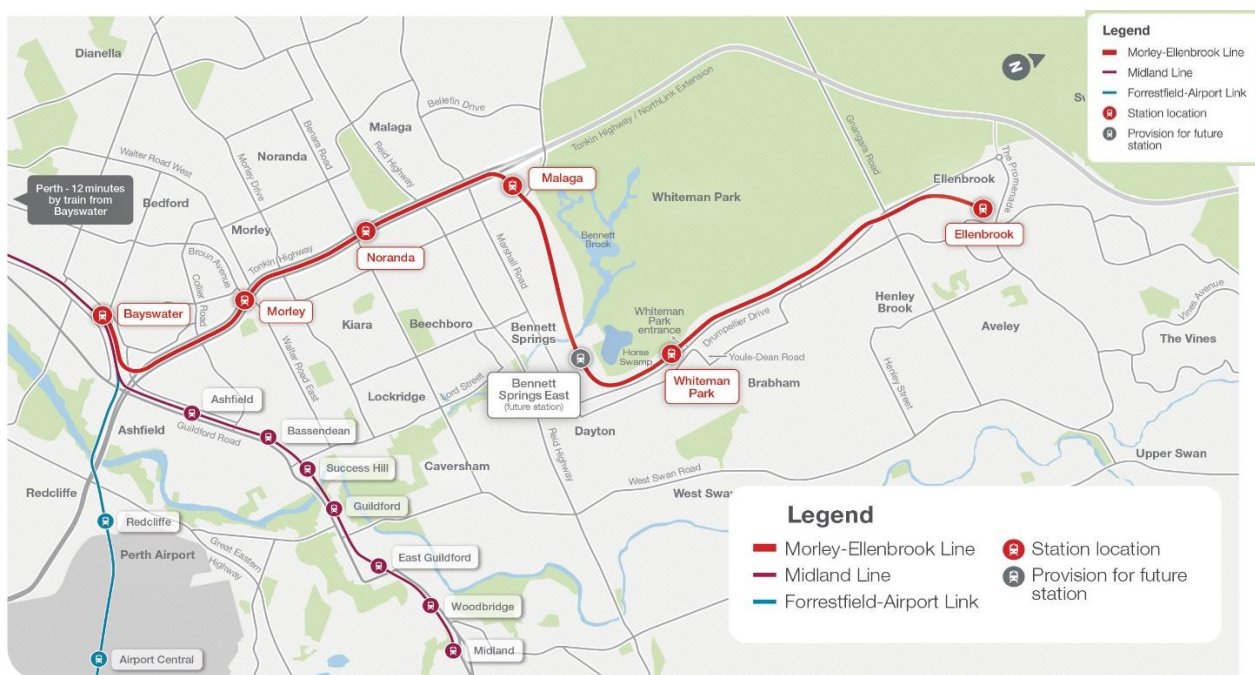


Figure 1: Morley-Ellenbrook Line © METRONET

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 Noranda 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.



Key Project Objectives		Critical Success Factors for Successful Project Delivery (abbreviated)			
Implementation of a robust, cooperative team culture.		<ul style="list-style-type: none">Development of a culture that results in all Participants developing behavioural values and driving principles to achieve Alliance goals and project objectivesLongevity and stability of key Alliance personnel i.e. Alliance Manager, ALT and AMT.			
Timely delivery of Works to achieve project milestones in accordance with agreed program.		<ul style="list-style-type: none">Development of a final proposal with a sufficiently developed design and accurate TOCSubsequent cash flow management and financial forecasting, scheduling and value-earned calculation and determinationImplementation of PTA mandated systems i.e. TeamBinder, Primavera P6, TILOS and a finance system accepting the PTA's cost breakdown structureTimely completion of design, construction and commissioning through to practical completionTimely progress towards construction milestones and completion of close-out to achieve final asset acceptance compliance.			
Inclusion of processes that embrace/promote open tendering and promotion of work package development that encourages/enables second and third tier tendering.		<ul style="list-style-type: none">For professional service providers, implement a proven and mature supply-chain engagement process, including tender review, contract award and project integration. Ensure that it offers opportunity and security of payment relative to services delivered in an effort to achieve best-for-project outcomesFor material suppliers and other subcontract service providers, implement a proven and mature supply-chain engagement process, including tender review, contract award and project integration that offers opportunity and security of payment relative to service deliveredProven and mature supply-chain engagement process for labour hire services, compliant with industrial and safety laws, maintained employee standards/conditions and security of employee paymentsAbility to develop contracts and terms and conditions in the spirit of the Alliance values and principles , appropriate and commensurate with the size, complexity and value of packages in accordance with industry best practice.			
Compliance with WAIPs.					
Optimisation of operational and whole of life costs.		<ul style="list-style-type: none">Sustainability considerations and outcomes for the whole of life of the works.			
Ensuring appropriate consultation/integration with stakeholders and community.		<ul style="list-style-type: none">Constant and effective engagement with relevant stakeholders, particularly utilities/services, Main Roads, third party asset owners and relevant unionsEffective management of PTA interfaces and PTA contractorsConstant/effective engagement with the PTA in design reviews, work planning and possessions/shutdowns.			
Providing passengers with safe and secure services and facilities.		<ul style="list-style-type: none">Compliance with ONSR requirementsCompleted rail line, stations and bus transfer infrastructure are able to deal successfully with the movement of people, including the disabled.			
Minimising disruption to current and anticipated rail operations.		<ul style="list-style-type: none">Minimise impact on public transport services disruptionLiaison and interaction with PTA rail operations personnel tasked with determining network closures, to confirm available network shutdowns and implement contingency plansEffective management of interfaces with others in heavily constrained areasEffective management/staging of works to reflect staged/constrained site accessEffective management of existing rail infrastructure asset protection.			
Recognising the State's desired industrial relations objectives.		<ul style="list-style-type: none">Develop a project-specific Industrial Relations Management Plan based on a proven and successful industrial relations approach that delivers a collaborative worksite, genuine collective agreement, making good faith in negotiations and dispute resolution, and respect for trade union rights of entry.			
Key Compliance Objectives (abbreviated)					
Compliance with all Statutory requirements and State Government policy requirements for construction work.	Compliance with the SWTC.	Protecting and minimising disruption to all existing facilities, infrastructure, properties or public utility services.	Meeting all obligations to impacted stakeholders and demonstrating genuine sensitivity.	Compliance with all environmental conditions and minimise adverse environmental impact.	

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

2.4 Purpose of the Report

Noranda 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 car parks, car drop off points and pedestrian facilities, the operation of which may involve a change in noise levels at nearby residential and other sensitive locations.

This document discusses expected noise and vibration emissions with operation of the proposed Noranda 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 Noranda Station are considered not required. 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 anticipated future development sites nearby.

3.2.2 Station and associated infrastructure

Asphaltic or bitumen-based road and 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 can however be managed via gradual gradient pedestrian crossings (such as wombat crossings) if required.

The project results in inclusion of new bus bays along Benara Road, which is strictly not assessable under the State Planning Policy 5.4. Nevertheless, considering the traffic flow Benara Road, it is anticipated that new bus bays would not have significant noise contributions to the overall noise levels.

From Section 5.2 it can be seen that noise impacts at adjacent development areas from road vehicles can be managed to levels compliant with applicable criteria.

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 expected.

The station is expected to comply with SWTC requirements with regards to internal reverberation levels provided on the basis of hard diffusive internal walls and the open 'sawtooth' style ceiling and roof system which provides significant access to open air.

Refer to Appendix A for recommended treatments to specific building elements in order to meet SWTC requirements around acoustic separation and reverberation.

3.2.3 Noise from Tonkin Highway

A full height screen is expected on each side of the platform, similar to Stirling and Glendalough stations. The length of the screen would not be the same length of the platform, but in proportion of the platform staff building. The main reason it is considered needed is due to staff offices or crib rooms / amenities located at platform level. This screen may also assist towards improving comfort / safety for passengers requiring assistance.

Tempered glass or off-the-shelf acrylic / PLEXIGLAS SoundStop or equivalent would suit from an acoustic perspective, formed in near air-tight continuous sections. Deep framing sections should be on the inside / towards the platform.



Figure 6 Example of screen installed at Stirling Station platform sections (Source: Google Earth)

3.2.4 Electrical transformer noise

The transformer located just south of the proposed kiss and ride is approximately 25 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 expected that noise emissions will be compliant with applicable noise regulations.

3.2.5 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 expected.

3.2.6 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
E004	Noranda Precinct – Urban Design – Architecture	Noise walls	Confirm spatial inputs and coordinate implementation of recommended treatments
E077	Noranda Precinct Civil - Fencing and Gates, Retaining Walls & Minor Structures, Noise Walls	Noise walls	Confirm spatial inputs and coordinate implementation of recommended treatments
E080	Noranda Station – Electrical - Lighting & LV & Comms & Security	Electrical plant noise emissions	Confirm inputs and coordinate implementation of any recommended treatments
E083	Noranda Station – Mechanical and BMSC	Mechanical plant noise emissions	Confirm inputs and coordinate implementation of any recommended treatments

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 Noranda 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 each station utilises natural ventilation strategies, with significant openings at roof level throughout the station.

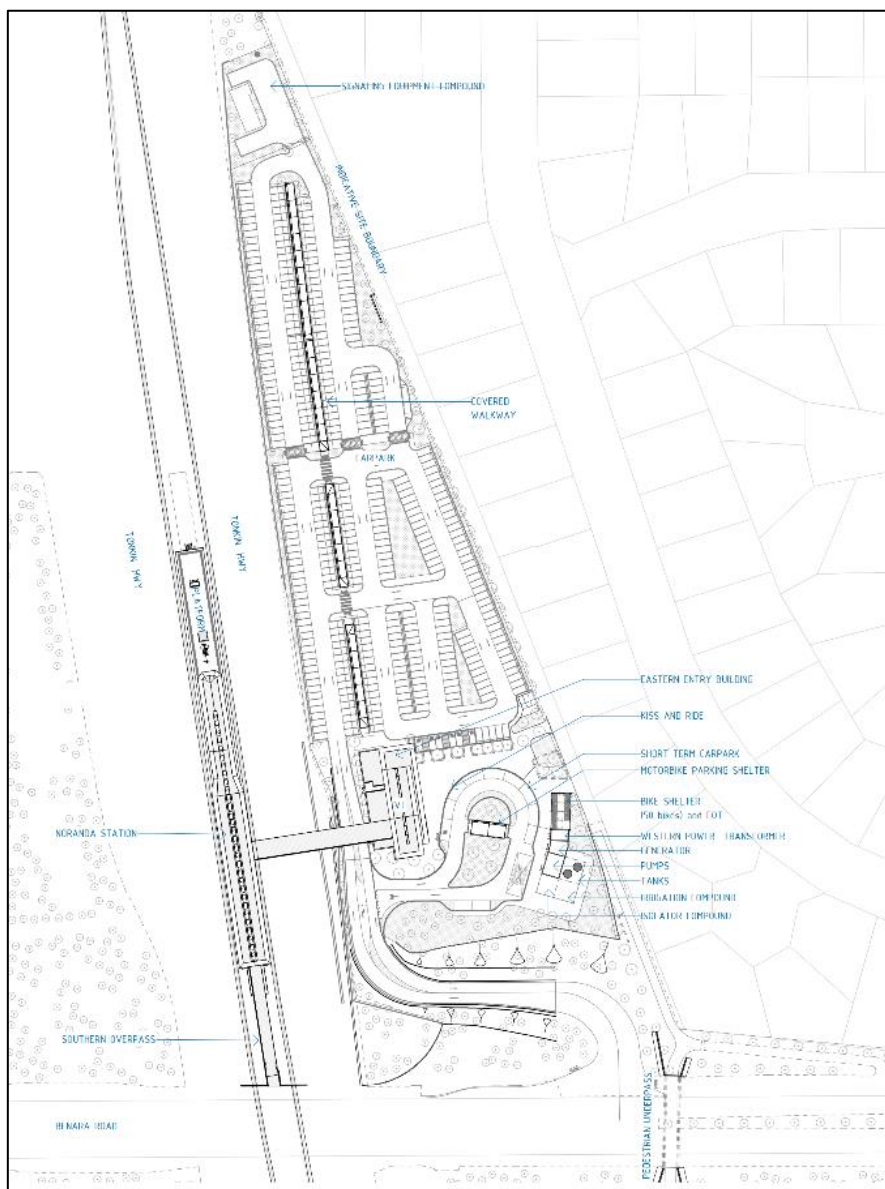


Figure 7: Extract of architectural overview plan 25-A-286-AR0010_A02 indicating site locality.

4.1.5 Electrical transformers

From the supplied drawings, it can be seen that the transformers associated with the station are approximately 40 metres from existing residential development (East of the precinct). By inspection of the likely transformer sound

power level / loading and the proposed screening elements, along with the existing noise walls, compliance with the relevant assigned noise levels is expected.

4.1.6 Fire pumps

From the supplied drawings, it can be seen that the fire pump within the station precinct is approximately 20 metres from the existing development (East of the precinct). By inspection of the likely pump sound power level / loading and the proposed screening elements, compliance with the relevant assigned noise levels is expected during regular maintenance with the installation of appropriate pump room / enclosure.

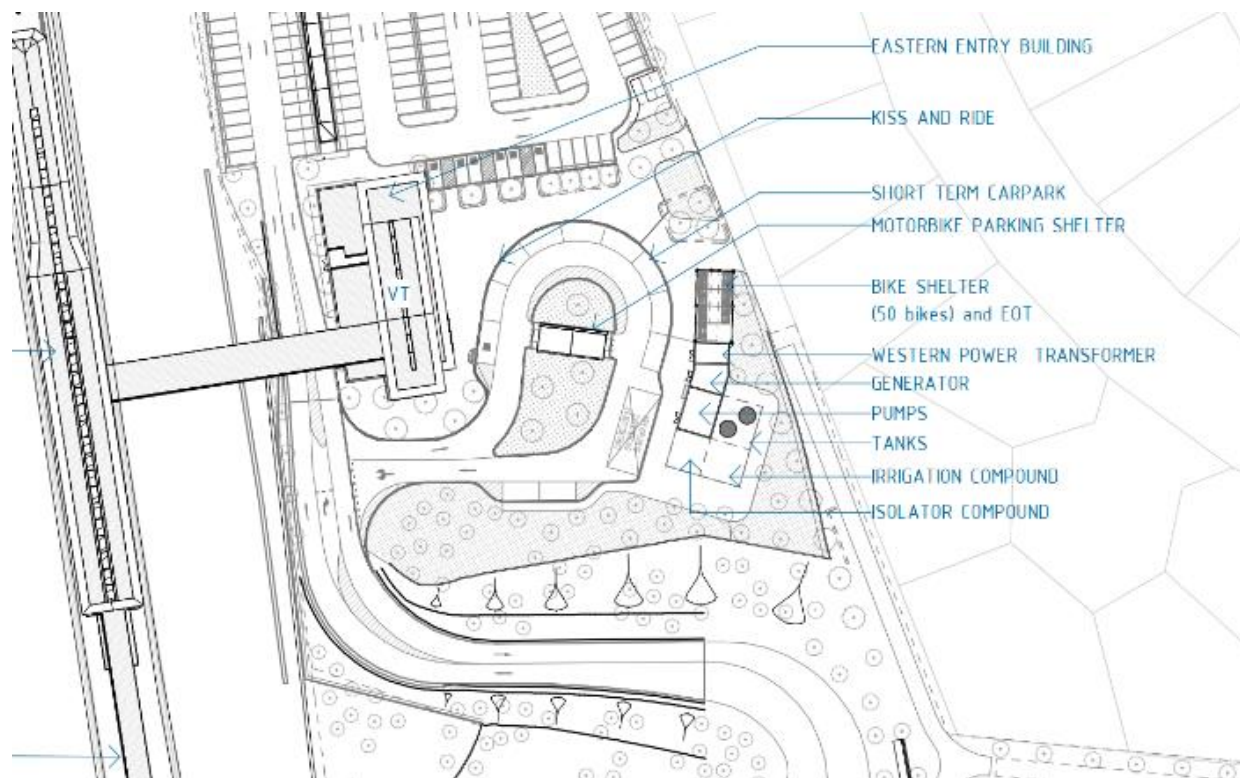


Figure 8: Extract of architectural plan 25-A-286-AR0010_A02

4.1.7 Mechanical outdoor plant

Drawings 25-A-286-ME0008 to -ME0013 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 the assigned noise levels defined in Section 4.5.1 at the nearest noise sensitive premises.

4.2 Design Software Used for this Package

Computer software used to develop this package is outlined in the Table below.

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-286-EC0151	MEL - MLCX – NORANDA STATION - COMMUNICATIONS - EASE ACOUSTIC MODEL - SHEET 01	A
25-A-286-EC0152	MEL - MLCX - NORANDA STATION - COMMUNICATIONS - EASE ACOUSTIC MODEL - SHEET 02	A

Document Ref.	Description/Title	Revision
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
(TBA)	<Architectural and Civil Drawing packages>	
	Baseline Noise and Vibration Measurements (SLR Consulting)	(in preparation)
25-A-286-AR0051	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - VERTICAL TRANSPORT BUILDING - ROOF	A01
25-A-286-AR0086	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - VERTICAL TRANSPORT BUILDING ELEVATION - SHEET 1	A01
25-A-286-AR0082	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG ELEVATION - SHEET 3	A02
25-A-286-AR0070	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - PLATFORM LEVEL - SHEET 1	A02
25-A-286-AR0048	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - ROOF LEVEL - SHEET 3	A02
25-A-286-AR0047	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - ROOF LEVEL - SHEET 2	A02
25-A-286-AR0044	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - CONCOURSE LEVEL - SHEET 2	A02
25-A-286-AR0043	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - CONCOURSE LEVEL - SHEET 1	A02
25-A-286-AR0025	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - OVERALL ELEVATIONS - STATION ELEVATIONS - SHEET 2	A01
25-A-286-AR0071	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - PLATFORM LEVEL - SHEET 2	A01
25-A-286-AR0072	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - PLATFORM LEVEL - SHEET 3	A01
25-A-286-AR0074	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - CONCOURSE LEVEL - SHEET 2	A01
25-A-286-AR0075	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - VERTICAL TRANSPORT BUILDING - GROUND FLOOR	A01
25-A-286-AR0085	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - SHORT ELEVATION - SHEET 2	A01
25-A-286-AR0087	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG SECTION - SHEET 1	A01

Document Ref.	Description/Title	Revision
25-A-286-AR0088	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG SECTION - SHEET 2	A01
25-A-286-AR0040	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - PLATFORM LEVEL - SHEET 1	A02
25-A-286-AR0045	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - CONCOURSE LEVEL - SHEET 3	A02
25-A-286-AR0049	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - VERTICAL TRANSPORT BUILDING - GROUND FLOOR	A01
25-A-286-AR0050	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - VERTICAL TRANSPORT BUILDING - CONCOURSE	A01
25-A-286-AR0076	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - VERTICAL TRANSPORT BUILDING - CONCOURSE	A01
25-A-286-AR0084	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - SHORT ELEVATION - SHEET 1	A01
25-A-286-AR0080	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG ELEVATION - SHEET 1	A02
25-A-286-AR0073	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - REFLECTED CEILING PLAN - CONCOURSE LEVEL - SHEET 1	A02
25-A-286-AR0046	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - ROOF LEVEL - SHEET 1	A02
25-A-286-AR0017	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - STATION OVERALL PLAN - ROOF	A02
25-A-286-AR0041	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - PLATFORM LEVEL - SHEET 2	A02
25-A-286-AR0042	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT FLOOR PLAN - PLATFORM LEVEL - SHEET 3	A02
25-A-286-AR0016	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - STATION OVERALL PLAN - CONCOURSE LEVEL	A02
25-A-286-AR0015	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - STATION OVERALL PLAN - PLATFORM LEVEL	A02
25-A-286-AR0002	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - DRAWING LIST - SHEET 01	A02
25-A-286-AR0001	MEL - MLCX - ARCHITECTURAL - NORANDA STATION - COVER PAGE	A01
25-A-286-AR0120	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - DETAILS - VT BUILDING DETAILS - SHEET 1	A01
25-A-286-AR0089	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - SHORT SECTION - SHEET 1	A01
25-A-286-AR0010	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - OVERALL PLANS - LOCATION PLAN	A02
25-A-286-AR0090	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - SHORT SECTION - SHEET 2	A01
25-A-286-AR0026	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - OVERALL SECTIONS - SHEET 1	A02
25-A-286-AR0081	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - GENERAL ARRANGEMENT - LONG ELEVATION - SHEET 2	A01

Document Ref.	Description/Title	Revision
25-A-286-AR0012	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - OVERALL PLANS - LIMIT OF WORKS PLAN	A01
25-A-286-AR0024	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - OVERALL ELEVATIONS - STATION ELEVATIONS - SHEET 1	A01
25-A-286-AR0027	MEL - MLCX - NORANDA STATION - ARCHITECTURAL - OVERALL SECTIONS	A01
25-A-286-CI0078	MEL - MLCX - NORANDA STATION - CIVIL - PAVEMENT AND KERBING - DETAIL - SHEET 1	A01
25-A-286-CI0086	MEL - MLCX - NORANDA STATION - STRUCTURAL - MINOR STRUCTURES - PLAN	A01
25-A-286-CI0093	MEL - MLCX - NORANDA STATION - STRUCTURAL - VEHICLE TRACKING PLAN	A01
25-A-286-CI0011	MEL - MLCX - NORANDA STATION - CIVIL - DRAINAGE AND FINISHED SURFACE - PLAN	A01
25-A-286-CI0012	MEL - MLCX - NORANDA STATION - CIVIL - DRAINAGE AND FINISHED SURFACE - PLAN - SHEET 1	A01
25-A-286-CI0039	MEL - MLCX - NORANDA STATION - CIVIL - GENERAL ARRANGEMENT - PLAN	A01
25-A-286-CI0001	MEL - MLCX - NORANDA STATION - CIVIL - COVER SHEET AND DRAWING INDEX	A01
25-A-286-CI0073	MEL - MLCX - NORANDA STATION - CIVIL - PAVEMENT AND KERBING - PLAN	A01
25-A-286-CI0002	MEL - MLCX - NORANDA STATION - CIVIL - BULK EARTHWORKS - PLAN	A01
25-A-286-CI0013	MEL - MLCX - NORANDA STATION - CIVIL - DRAINAGE AND FINISHED SURFACE - PLAN - SHEET 2	A01
25-A-286-CI0046	MEL - MLCX - NORANDA STATION - CIVIL - COMBINED PROPOSED UTILITIES - PLAN	A01
25-A-286-ME0009	MEL - MLCX - NORANDA STATION - PLATFORM - MECHANICAL - ZONE 1 - LAYOUT	A01
25-A-286-ME0011	MEL - MLCX - NORANDA STATION - PLATFORM - MECHANICAL - ZONE 3 - LAYOUT	A01
25-A-286-ME0017	MEL - MLCX - NORANDA STATION - MECHANICAL - SECTIONS	A01
25-A-286-ME0002	MEL - MLCX - NORANDA STATION - MECHANICAL - LEGEND	A01
25-A-286-ME0013	MEL - MLCX - NORANDA STATION - VT BUILDING & KISS AND RIDE - MECHANICAL - LAYOUT	A01
25-A-286-ME0001	MEL - MLCX - NORANDA STATION - MECHANICAL - COVER SHEET	A01
25-A-286-ME0014	MEL - MLCX - NORANDA STATION - MECHANICAL - SCHEMATIC DIAGRAM	A01
25-A-286-ME0010	MEL - MLCX - NORANDA STATION - PLATFORM - MECHANICAL - ZONE 2 - LAYOUT	A01
25-A-286-ME0005	MEL - MLCX - NORANDA STATION - MECHANICAL - SITE PLAN	A01
25-A-286-PL0025	MEL - MLCX - NORANDA STATION - HYDRAULICS - DETAILS	A01
25-A-286-PL0012	MEL - MLCX - NORANDA STATION - PLATFORM - HYDRAULICS - DRAINAGE - PLAN - ZONE 2	A01
25-A-286-PL0013	MEL - MLCX - NORANDA STATION - PLATFORM - HYDRAULICS - DRAINAGE - PLAN - ZONE 3	A01

Document Ref.	Description/Title	Revision
25-A-286-PL0014	MEL - MLCX - NORANDA STATION - CONCOURSE - HYDRAULICS - DRAINAGE - PLAN - ZONE 1	A01
25-A-286-PL0001	MEL - MLCX - NORANDA STATION - HYDRAULICS - COVER SHEET AND DRAWING INDEX	A01
25-A-286-PL0002	MEL - MLCX - NORANDA STATION - HYDRAULICS - LEGEND	A01
25-A-286-PL0003	MEL - MLCX - NORANDA STATION - HYDRAULICS - SITE PLAN	A01
25-A-286-PL0004	MEL - MLCX - NORANDA STATION - PLATFORM - HYDRAULICS - WATER AND WET FIRE - PLAN - ZONE 1	A01
25-A-286-PL0005	MEL - MLCX - NORANDA STATION - PLATFORM - HYDRAULICS - WATER AND WET FIRE - PLAN - ZONE 2	A01
25-A-286-PL0006	MEL - MLCX - NORANDA STATION - PLATFORM - HYDRAULICS - WATER AND WET FIRE - PLAN - ZONE 3	A01
25-A-286-PL0007	MEL - MLCX - NORANDA STATION - CONCOURSE - HYDRAULICS - WATER AND WET FIRE - PLAN - ZONE 1	A01
25-A-286-PL0008	MEL - MLCX - NORANDA STATION - VT BUILDING & KISS AND RIDE - HYDRAULICS - WATER AND WET FIRE - PLAN - GROUND	A01
25-A-286-PL0009	MEL - MLCX - NORANDA STATION - VT BUILDING & KISS AND RIDE - HYDRAULICS - WATER AND WET FIRE - PLAN - FIRST FLOOR	A01
25-A-286-PL0010	MEL - MLCX - NORANDA STATION - WALKWAY - HYDRAULICS - WATER AND WET FIRE - PLAN - FIRST FLOOR	A01
25-A-286-PL0011	MEL - MLCX - NORANDA STATION - PLATFORM - HYDRAULICS - DRAINAGE - PLAN - ZONE 1	A01
25-A-286-PL0015	MEL - MLCX - NORANDA STATION - CONCOURSE - HYDRAULICS - DRAINAGE - PLAN - ZONE 2	A01
25-A-286-PL0016	MEL - MLCX - NORANDA STATION - STATION ROOF - HYDRAULICS - DRAINAGE - PLAN - ZONE 1	A01
25-A-286-PL0017	MEL - MLCX - NORANDA STATION - STATION ROOF - HYDRAULICS - DRAINAGE - PLAN - ZONE 2	A01
25-A-286-PL0018	MEL - MLCX - NORANDA STATION - VT BUILDING & KISS AND RIDE - HYDRAULICS - DRAINAGE - PLAN - GROUND	A01
25-A-286-PL0019	MEL - MLCX - NORANDA STATION - VT BUILDING & KISS AND RIDE - HYDRAULICS - DRAINAGE - PLAN - FIRST FLOOR	A01
25-A-286-PL0020	MEL - MLCX - NORANDA STATION - VT BUILDING & KISS AND RIDE - HYDRAULICS - DRAINAGE - PLAN - ROOF	A01
25-A-286-PL0021	MEL - MLCX - NORANDA STATION - CANOPIES - HYDRAULICS - DRAINAGE - PLAN - ZONE 1	A01
25-A-286-PL0022	MEL - MLCX - NORANDA STATION - CANOPIES - HYDRAULICS - DRAINAGE - PLAN - ZONE 2	A01
25-A-286-PL0023	MEL - MLCX - NORANDA STATION - CANOPIES - HYDRAULICS - DRAINAGE - PLAN - ZONE 3	A01
25-A-286-PL0024	MEL - MLCX - NORANDA STATION - WALKWAY - HYDRAULICS - PLAN - ROOF	A01
25-A-286-PL0026	MEL - MLCX - NORANDA STATION - HYDRAULICS - FIRE HYDRANT PLANT DETAIL	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 be reasonable or practicable at higher floors.

4.5.2 Stations and Associated Infrastructure

Section 13.7 of Book 5 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 Noranda station, the closest sensitive receivers are located immediately east of the station. An IF of 10 dB is applied in accordance with the Regulations based on:

- Presence of major road within 100m of the receiver (transport factor of 6 dB); and
- Presence of industrial use due to the proposed Noranda station precinct (industrial 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 accordance with the SWTC it is proposed to follow this the 2000 version of AS/NZS 2107 and not the more recent 2016 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 (RT_{60}) 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 (RT_{60}) 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:

- *$D_w \geq 35$ dB between normally occupied enclosed spaces.*
- *$D_w \geq 28$ dB 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, D_w , dB
Between normally occupied back of house offices and crib rooms	Generally	40
	Where the common partition at the interface includes a door	30
	Generally	42

	Space Type / Occupancy	Minimum Weighted Sound Level Difference, Dw, dB
Toilets and amenities to nearby public areas	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

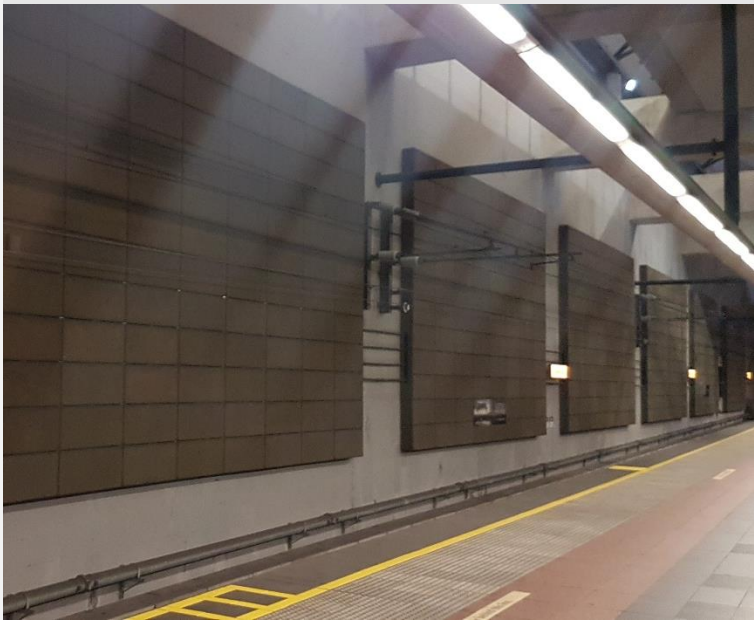
Not applicable.










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.

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 α_w 0.80 (Noise Reduction Coefficient NRC 0.80).

Name	Image (Source), link	Description
Quietstone Standard or Pyrotek Reapor		<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>

Name	Image (Source), link	Description
Acoufelt	    <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>
Pyrotek Echohush	  <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>
CSR Martini DECO Quiet Panel	  <p>http://www.csrmartini.com.au/products/decorative-acoustic-products</p>	<p>Effectively equivalent to Pyrotek Echohush</p>
Stratocell Whisper FR	 <p>http://www.soundblock.com.au/sound-absorbers/stratocell-whisper</p>	<p>EN ISO 11654 Class C (α_w 0.70-0.75) or better</p> <p>25 to 100 mm thick Polyethylene foam (unpainted)</p> <p>Lightweight and easily cut into shapes, affix to walls or hang</p>

Name	Image (Source), link	Description
Asona Triton	 http://www.asona.co.nz/	<p>EN ISO 11654 Class B (α_w 0.80-0.85)</p> <p>25 to 100 mm thick glass fibre with fabric facing</p> <p>Direct fix installation</p> <p>Recyclable, various colour options</p>
Renhurst RenAcoustic Baffles	 http://renhurst.com/renacoustic-baffles/	<p>EN ISO 11654 Class C (α_w 0.70-0.75) or better</p> <p>Rigid fibreglass core and a fine textured fleece</p> <p>Lightweight with various suspension options</p>
Himmel Ecophon Solo Panels	 https://www.himmel.com.au/product-listing/2016/07/13/ecophon-solo-panels	<p>Suspended colour panels</p> <p>Likely limited extent due to ceiling fan / air movement needs</p> <p>Glass fibre reinforced for rigidity</p>
Stratocell Whisper	 www.soundblock.com.au/sound-absorbers/stratocell-whisper	<p>Claimed to be resilient to water and humidity</p> <p>Flame retardant and/or Group 1 fire rating. Claimed self-extinguishing material (Class B2) to DIN 4101 series</p> <p>Light weight and non-corrosive.</p> <p>Easy to fix and fasten, pinned or glued</p> <p>Sheet size is 2400 x 1200 x 50mm thick</p> <p>Classified Class A according to EN ISO 11654</p>

Name	Image (Source), link	Description
32-48 kg/m ³ glasswool or mineral fibre faced with glass fabric	 www.bradfordinsulation.com.au/	<p>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>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 following subsection.

4.8.2 Noise ingress from Tonkin Highway to Platform areas

A standard façade detail for occupied spaces within station buildings may achieve approximately a 20 dB difference between outdoor highway noise and internal noise levels. There are various options to further improve this performance but it will reduce the ability for those inside to hear what may occur outside the office or interact with the public.

As for outdoor noise levels, the 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.

With that reduction of 20 dB from the building, it is anticipated that internal noise levels would be 15 dB above the 45 dB target.

To achieve a 15 dB reduction in heavy vehicle noise, a large freestanding wall will not suffice or be efficient, particularly where there are reflections from roof elements above or walls nearby considering the elevation of truck engine exhausts. Like the station examples given in Section 3.2.3, the screens would need to extend to any roof elements nearby, and be of sufficient extent on each side of the staff building on the platform.

4.8.3 Fire pumps

The electric fire pump within the station precinct is located approximately 20 m from the nearest residential use. A nominal electric pump size of 1000 kW rating at 900 rpm is assumed for the assessment (L_{WA} 100 dB). It is assumed that pump would operate in an emergency, or during regular maintenance. Such maintenance would occur typically once a month during the day periods.

Based on this size and location, it is anticipated that compliance can be achieved by enclosing the pump within a semi-enclosed plant room, as indicated in the figure below. The north and east side of the room, along with the roof/lid is recommended to be completely solid (i.e. no holes or gaps). The south and west walls can remain open if required for ventilation purposes.

If a redundant diesel pump is required, it should also be placed within the same enclosure along with suitable mufflers to exhausts.

The solid partitions (walls and roof) are modelled as airtight with a minimum surface density of 12 kg/m².

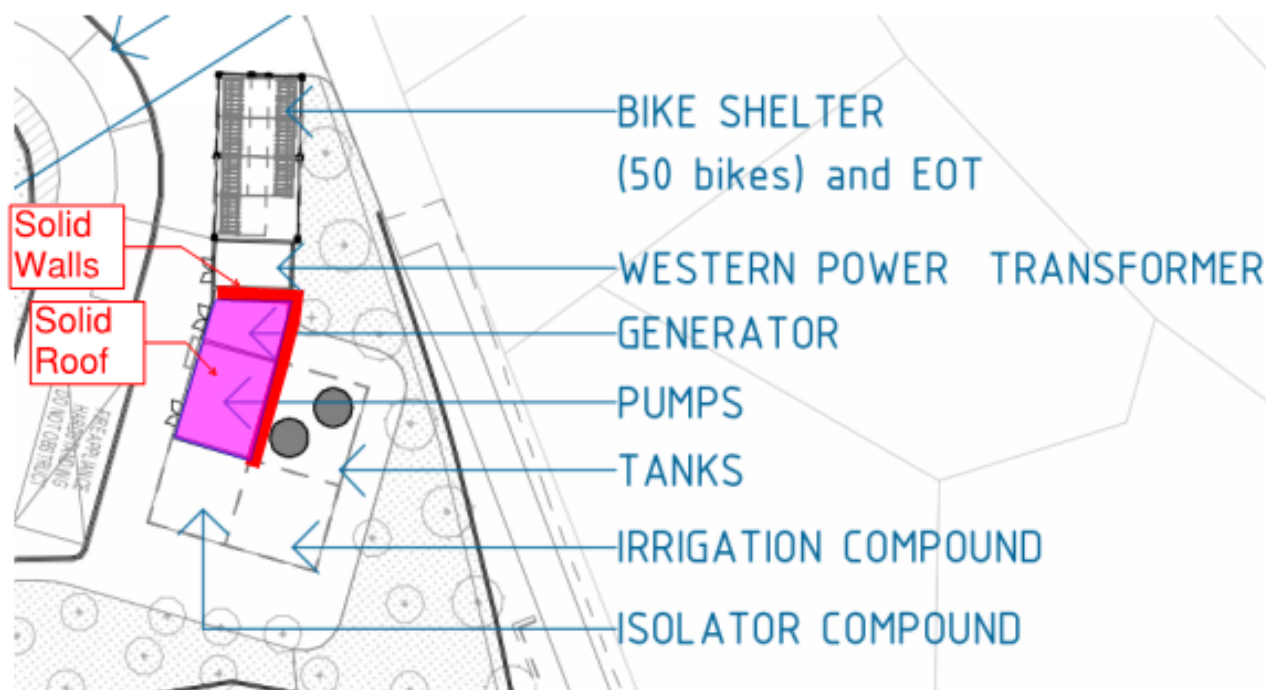


Figure 9: Proposed plantroom enclosure for fire pump with solid north and east partitions

4.8.4 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 Noranda Station.

The PA system is currently designed by the communications designer, and the detailed results of compliance will be published as the project progresses.

4.8.5 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 50 metres from potential sensitive premises and/or generously spaced open environments.

Providing this level of distance separation and low crowd densities is expected to ensure that any sustained crowd / patron noise levels (conversations, walking) as individually $L_{Aeq} 60 \text{ dB @ 1 metre}$ 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.

4.8.6 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 10 km (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).

4.8.7 Kiss and Ride

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

- 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.

4.8.8 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 expected.

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.

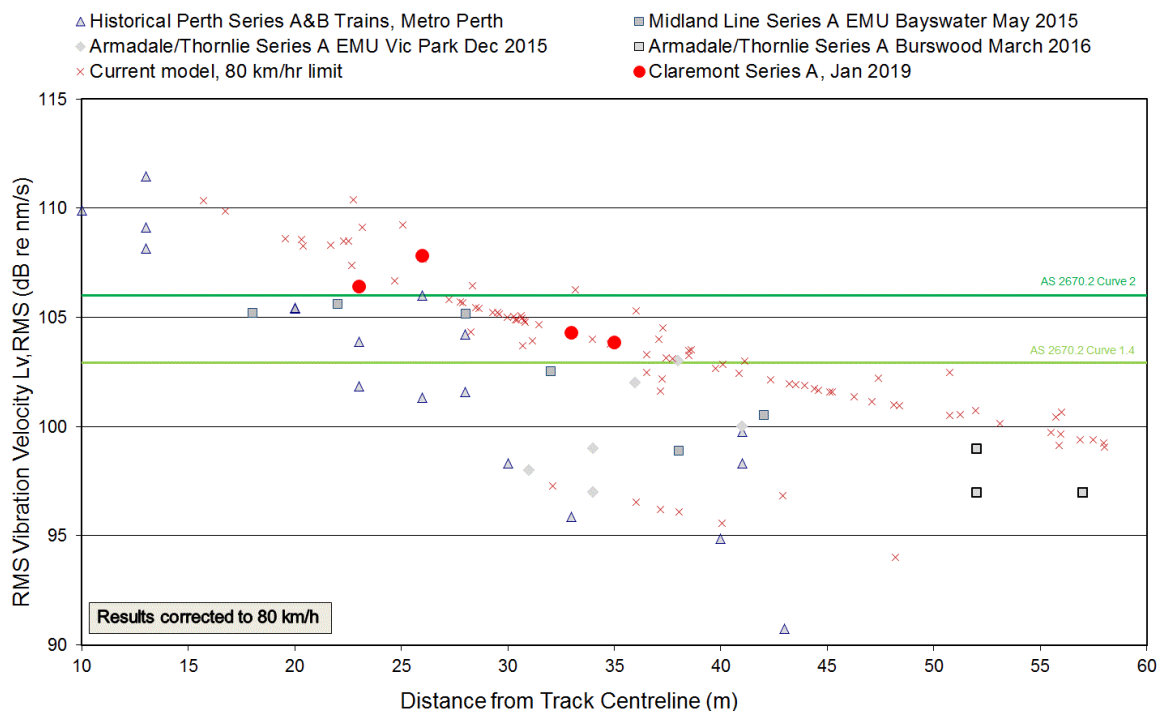
² Random fill assumed in the absence of a specific car parking traffic analysis. Fill patterns in practice may vary due to proximity to train station, and presence of ticketed parking and/or reserved parking.

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 Noranda 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.



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 expected 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) can be implemented which is not expected to introduce noticeable noise and/or vibration increase.

4.9 Constructability Requirements

Not applicable.

4.10 Environmental and 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 expected 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
	Not applicable at this design stage		

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.		
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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 Noranda Station (25-A-286-EC0151 and 25-A-286-EC0152), 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 CRFI-SLR-PW-00001	Noise and Vibration - Baseline Measurements	Closed
063	Noise and Vibration Assessments - Data Input Log / Requests	Closed

CRFI-SLR-PW-00002		
068 CRFI-SLR-PW-00003	Conversion of federated model 25-B-00-0001.4.0.IFI to AutoCAD	Closed

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-286-AR0040 DRIVER WC	Toilets and amenities	45 to 55	40 to 50
25-A-286-AR0040 STAFF OFFICE	General office areas	45	<40
25-A-286-AR0040 DRIVER CRIB	Staff crib rooms	45	<40
25-A-286-AR0049 VERTICAL TRANSPORT STAFF CRIB	Staff crib rooms	45	<40
25-A-286-AR00459VERTICAL TRANSPORT WC	Toilets and amenities	45 to 55	40 to 50
PLATFORM	Platforms	70	60 to 65
25-A-286-AR0040/49 VERTICAL TRANSPORT / CONCOURSE	Public waiting areas	45	40 to 50

Figure 10 presents the forecast noise levels in the vicinity of the station as a result of mechanical noise.

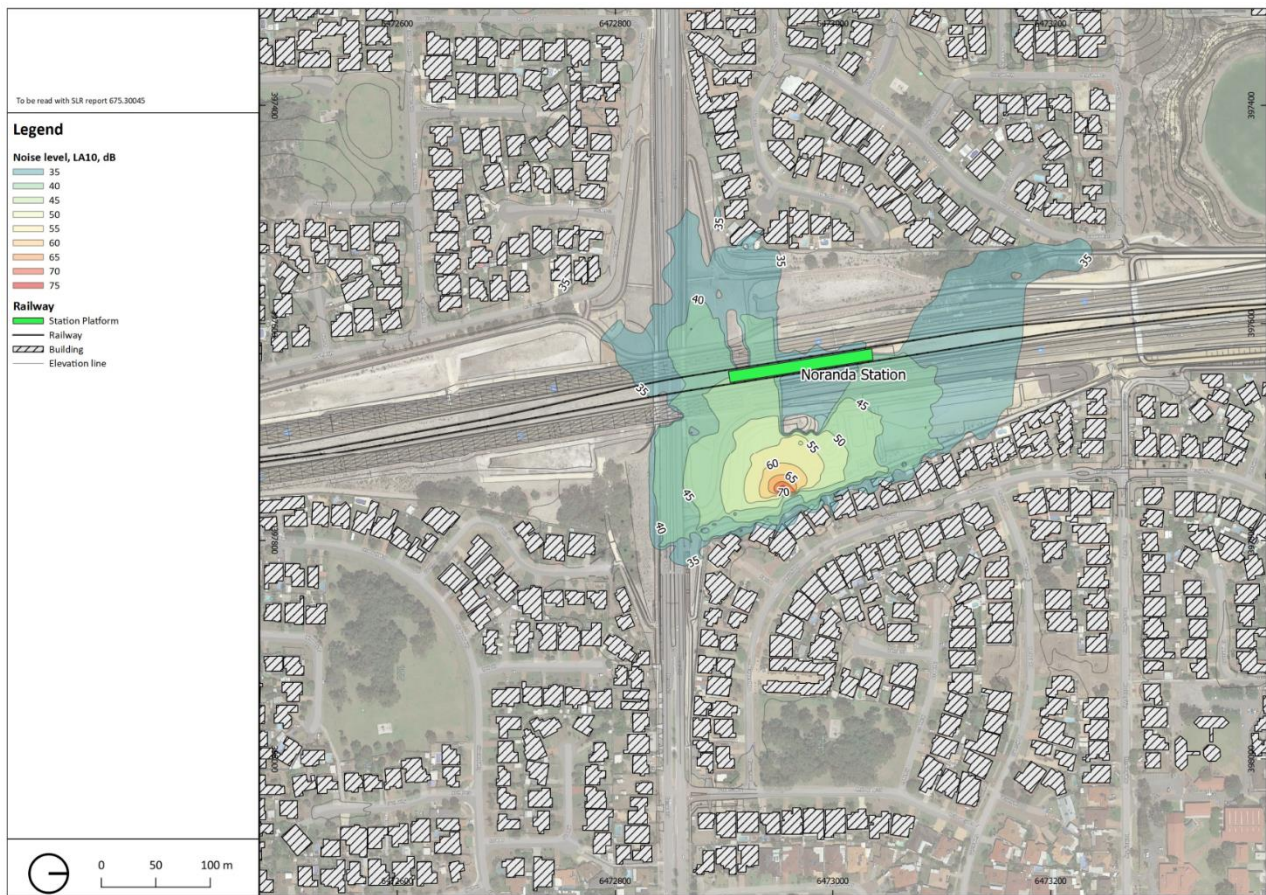


Figure 10: Forecast distribution in airborne noise from mechanical noise for comparison with L_{A10} criteria

5.2.2 Rail movements

Figure 11 and Figure 12 present forecast noise levels from rail operations in the vicinity of the station.

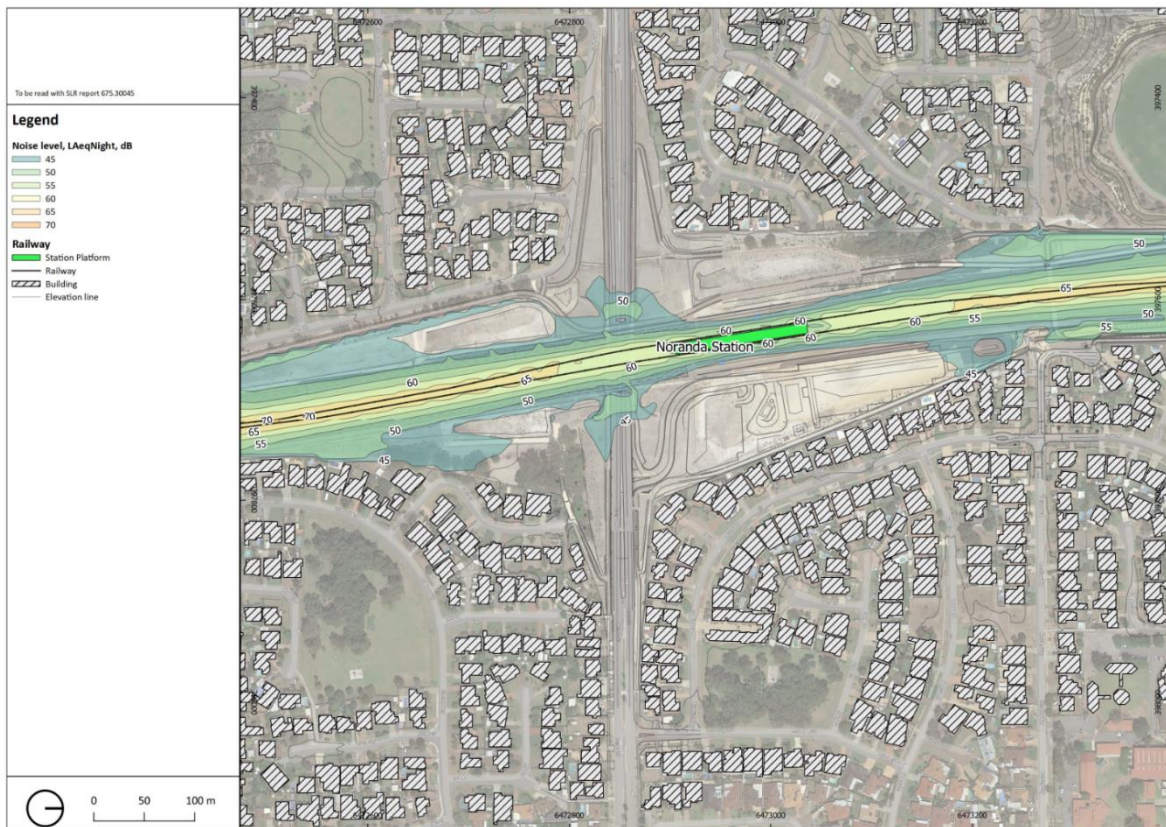


Figure 11: Forecast distribution in airborne noise from rail operations for comparison with L_{Aeq} night criteria

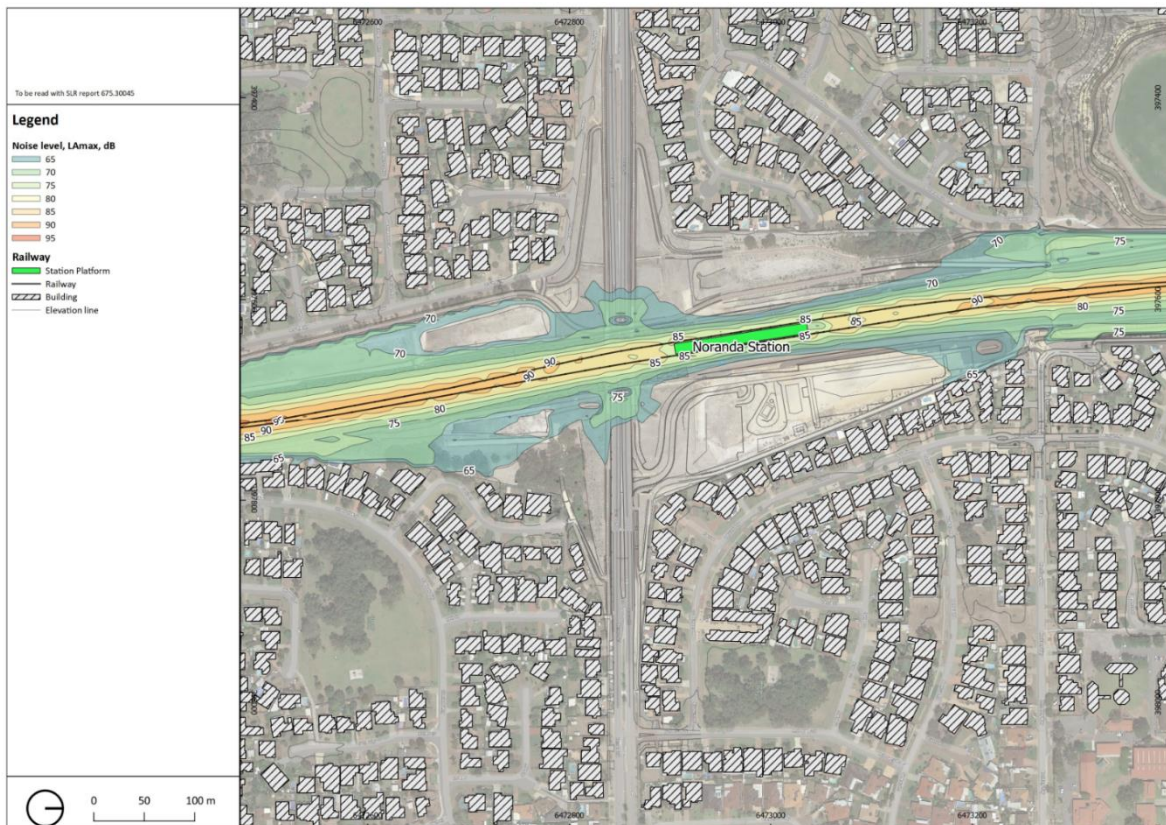


Figure 12: Forecast distribution in airborne noise from rail operations for comparison with L_{Amax} criteria

5.2.3 Car parking activities

Figure 13 presents forecast noise levels in the vicinity of the station as a result of modelled car parking / drop off facilities according to Section 4.

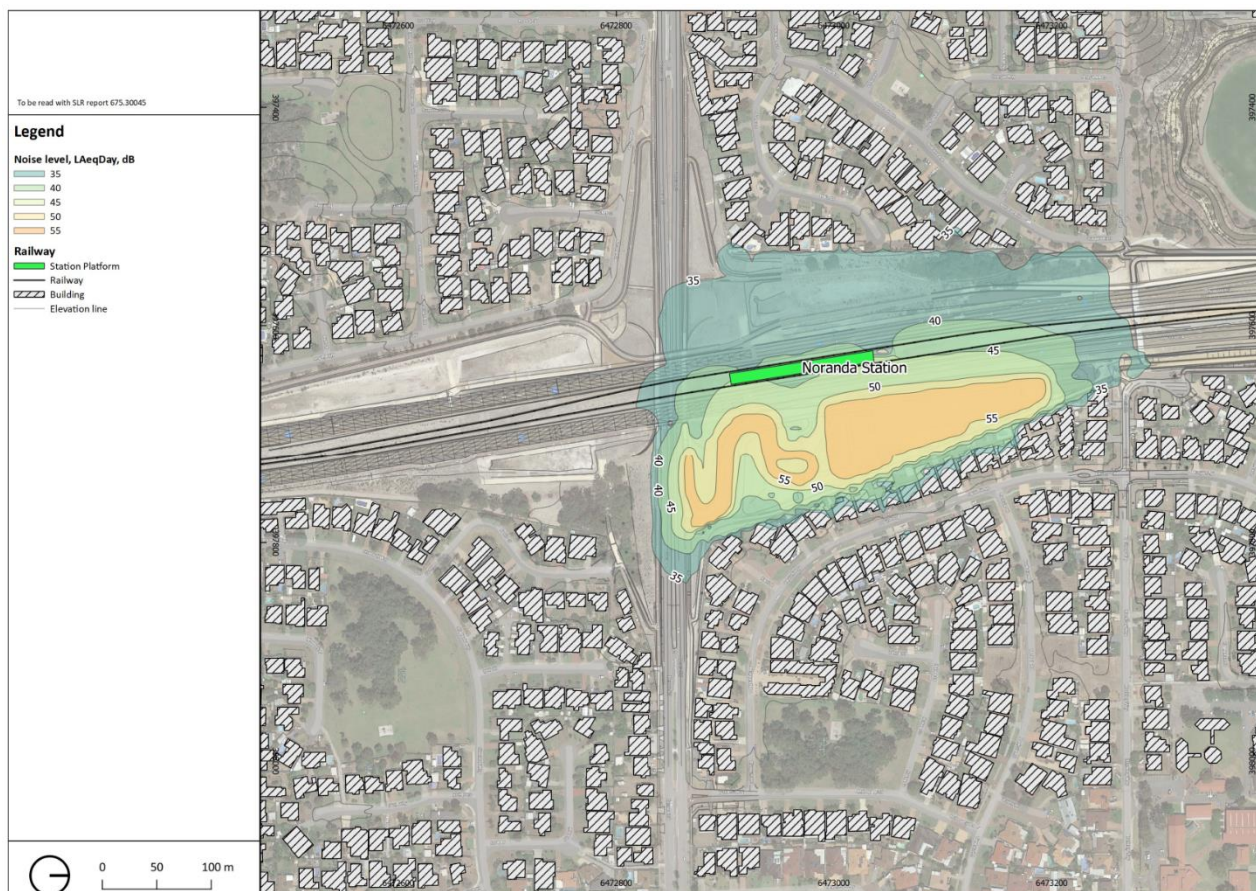


Figure 13: Forecast distribution in airborne noise from station car parking areas for comparison with L_{Aeq} day criteria

It can be seen that the predicted levels from 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

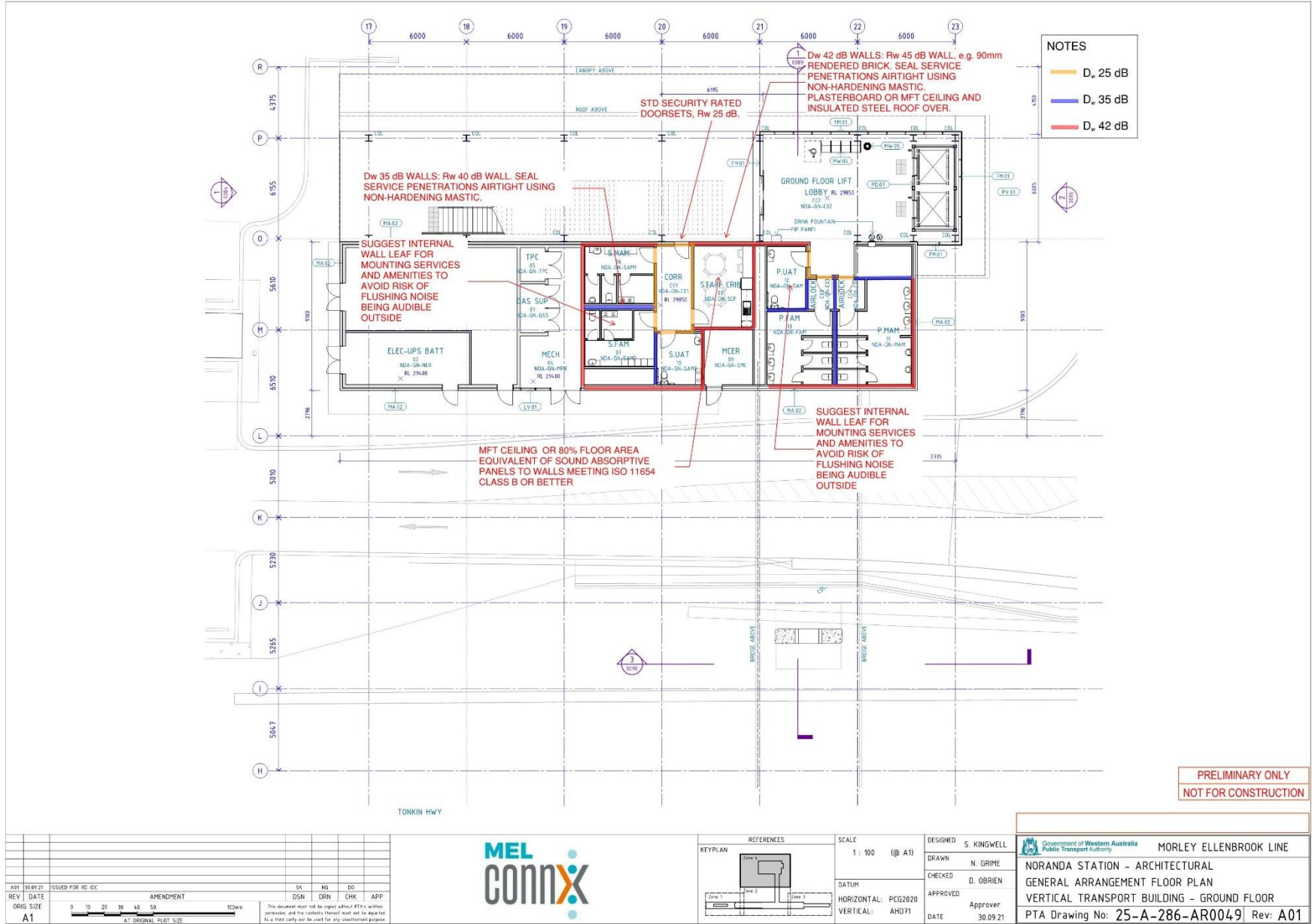
21. Project Actions Register

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 NORANDA STATION ACOUSTIC DESIGN REPORT MEL-MLCX-AR-RPT-00032



NOTES

- D_s 25 dB
- D_s 35 dB
- D_s 42 dB

RED ANNOTATIONS:

- Dw 35 dB WALLS: Rw 40 dB WALL. SEAL SERVICE PENETRATIONS AIRTIGHT USING NON-HARDENING MASTIC.
- MFT CEILING OR 80% FLOOR AREA EQUIVALENT OF SOUND ABSORPTIVE PANELS TO WALLS MEETING ISO 11654 CLASS B OR BETTER
- Dw 42 dB WALLS: Rw 45 dB WALL, e.g. 90mm RENDERED BRICK. SEAL SERVICE PENETRATIONS AIRTIGHT USING NON-HARDENING MASTIC. PLASTERBOARD OR MFT CEILING AND INSULATED STEEL ROOF OVER.
- STD SECURITY RATED DOORSETS, Rw 25 dB.
- SUGGEST INTERNAL WALL LEAF FOR MOUNTING SERVICES AND AMENITIES TO AVOID RISK OF FLUSHING NOISE BEING AUDIBLE OUTSIDE

LEGEND:

REV	DATE	DESCRIPTION	BY	CHECKED	APP'D
A07	10.09.21	ISSUED FOR RC-402	SK	NB	ID
A01	06.08.21	ISSUED FOR INFORMATION	SK	NB	ID

AMENDMENT

REV	DATE	DESCRIPTION	BY	CHECKED	APP'D
A1	06.08.21	ISSUED FOR INFORMATION	SK	NB	ID

SCALE: 1 : 100 (@ A1)

DATUM: HORIZONTAL: PCG2020 VERTICAL: AH071

DESIGNED: S.KINGWELL
DRAWN: N.GRIME
CHECKED: D.O'BRIEN
APPROVED: [Signature]
DATE: 30.09.21

REFERENCES:

KEYPLAN:

GOVERNMENT OF WESTERN AUSTRALIA Public Transport Authority MORLEY ELLENBROOK LINE

NORANDA STATION - ARCHITECTURAL GENERAL ARRANGEMENT FLOOR PLAN PLATFORM LEVEL - SHEET 1

PTA Drawing No: 25-A-286-AR0040 Rev: A02

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	
15 Sep 2021	LZ	15 Sep 2021	0	3	
Date Reviewed	By	Review Type	Review Status		

Noranda Station 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)									
Day reduced duty				0.0									
Evening emission level, total				92.0 (A)									
Separation distance from station centre		70.0 m											
Air temp		20.0											
Environmental losses For distances $r \gg$ source dimension ds													
Point Source Propagation Loss		70.0 m	3.0 dB		-44.8	-44.8	-44.8	-44.8	-44.8	-44.8	-44.8	-44.8	-44.8
Atmospheric Attenuation - Theory: ISO		70 m	20 °C	RH 70%	0.0	0.0	-0.1	-0.2	-0.4	-0.6	-1.6	-5.4	
Ground Attenuation, Theory: ISO 9613.2, Source Zone Ground 50% Soft Ground, M		70.0 m	1.0 m	1.5 m	3.0	1.0	-4.1	-3.7	0.5	1.5	1.5	1.5	
Assume no barriers, wall reflection or screening effects													
Received level outdoors, night	L _{Aeq}			46 (A)	54.0	52.0	43.9	41.1	41.2	38.9	34.9	23.2	
Residential night time target (EPNR)	6 dB transport factor			51 (A)									
Excess on target (level of compliance)				(4.8)									
Forecast level of compliance is more than design uncertainty													

Figure E14: Mechanical plant noise emissions screening calc, Noranda, day period



Job No.	Job Title			
675.30045	MEL D			
Date Created	By	Date Revised	Rev	Sheet
06 Oct 2021	AD	06 Oct 2021	2	1
Date Reviewed	By	Review Type	Review Status	

Noranda Station 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	
Evening reduced duty				-9.0										
Evening emission level, total				83.0 (A)		87	87	84	81	77	74	71	63	
Separation distance from station centre	70.0 m													
Air temp	20.0													
Environmental losses														
For distances r >> source dimension ds														
Point Source Propagation Loss	70.0 m	3.0 dB		-44.8		-44.8	-44.8	-44.8	-44.8	-44.8	-44.8	-44.8	-44.8	
Atmospheric Attenuation - Theory: ISO	70 m	20 °C	RH 70%	0.0		0.0	-0.1	-0.2	-0.4	-0.6	-1.6	-5.4		
Ground Attenuation, Theory: ISO 9613.2, Source Zone Ground 50% Soft Ground, M	70.0 m	1.0 m	1.5 m	3.0		1.0	-4.1	-3.7	0.5	1.5	1.5	1.5		
Assume no barriers, wall reflection or screening effects														
Received level outdoors, night	L _{Aeq}			37 (A)	45.0	43.0	34.9	32.1	32.2	29.9	25.9	14.2		
Residential night time target (EPNR)	6 dB transport factor			41 (A)										
Excess on target (level of compliance)				(3.8)										
Forecast level of compliance is more than design uncertainty														

Figure E15: Mechanical plant noise emissions screening calc, Noranda, night period



Job No.	Job Title			
Date Created	By	Date Revised	Rev	Sheet
30 Sep 2021	AD	06 Oct 2021	1	3
Date Reviewed	By	Review Type	Review Status	

Noranda Station staff crib

Item / Description	Area, m²	X/Y/Z	Rating	31.5	63	Absorption Coefficient								Total Sabines, m²							
						125	250	500	1k	2k	4k	8k	31.5	63	125	250	500	1k	2k	4k	8k
Library - Type: Absorption, Source: Local, IC Floor - Vinyl or linoleum concrete	28.2		NRC 0.03			0.02	0.02	0.03	0.04	0.04	0.05				1	1	1	1	1	1	1
Library - Type: Absorption, Source: Local, IC Ceiling - 9-mm plasterboard on batts	5.6		NRC 0.11			0.30	0.20	0.15	0.05	0.05	0.05				2	1	1	0	0	0	0
Library - Type: Absorption, Source: Local, IC Walls - Painted plaster	51.9		NRC 0.02			0.02	0.02	0.02	0.02	0.02	0.02				1	1	1	1	1	1	1
Library - Type: Absorption, Source: Local, IC Glazing (6mm)	4.0		NRC 0.04			0.10	0.06	0.04	0.03	0.02	0.02				0	0	0	0	0	0	0
Library - Type: Absorption, Source: Local, IC Solid timber door	1.9		NRC 0.08			0.14	0.10	0.06	0.08	0.10	0.10				0	0	0	0	0	0	0
Treatment																					
Library - Type: Absorption, Source: Local, IC Ceiling - 13-mm mineral tile, suspend	22.6		NRC 0.76			0.75	0.70	0.65	0.85	0.85	0.80				17	16	15	19	19	18	
Sabines Per Item, m²														Total Sabines, m²							
Item / Description	No. Items	X/Y/Z	Rating	31.5	63	125	250	500	1k	2k	4k	8k	31.5	63	125	250	500	1k	2k	4k	8k
Room	5 m	6 m																			
Room Constant, m³	2 m	114 m³	76 m³	0	0	26	23	21	27	28	28	6									
Total Sabines, m²	148 Hz			0	0	21	19	18	22	22	23	6									
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														Reverberation Time, s							
Sabine	BR 99%	0.62 s	0.62 s			0.59	0.65	0.69	0.56	0.55	0.54										
Eyring	BR 99%	0.56 s	0.57 s			0.53	0.59	0.64	0.50	0.49	0.48										
Fitzroy (Eyring)	BR 99%	0.56 s	0.57 s			0.53	0.59	0.64	0.50	0.49	0.48										
Result	Shape, Target	Speech	0.60 s																		
Zhang		BR 99%	0.58 s			0.55	0.61	0.65	0.51	0.51	0.50										
Design Target	Minimum	BR 91%	0.44 s	0.48 s	0.30	0.30	0.39	0.48	0.48	0.48	0.39	0.30									
Design Target	Maximum	BR 100%	0.72 s	0.72 s	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72									

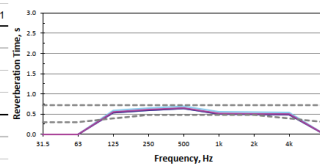


Figure 16: Reverberation estimation, Noranda Vertical Transport Building Staff Crib



Job No.	Job Title
Date Created 30 Sep 2021	By AD
Date Reviewed 06 Oct 2021	Rev 1
Date Reviewed	Review Type
	Review Status

Noranda Station Office

Absorption Coefficient												Total Sabines, m²										
Item / Description	Area, m²	X/Y/Z	Rating	31.5	63	Octave Band Centre Frequency, Hz								Octave Band Centre Frequency, Hz								
						125	250	500	1k	2k	4k	8k	31.5	63	125	250	500	1k	2k	4k	8k	
Library - Type: Absorption, Source: Local, IC Floor - Vinyl or linoleum concrete	20.4		NRC 0.03			0.02	0.02	0.03	0.04	0.04	0.05				0	0	1	1	1	1		
Library - Type: Absorption, Source: Local, IC Ceiling - 9-mm plasterboard on batt	4.1		NRC 0.11			0.30	0.20	0.15	0.05	0.05	0.05				1	1	1	0	0	0		
Library - Type: Absorption, Source: Local, IC Walls - Painted plaster	47.8		NRC 0.02			0.02	0.02	0.02	0.02	0.02	0.02				1	1	1	1	1	1		
Library - Type: Absorption, Source: Local, IC Solid timber door	1.9		NRC 0.08			0.14	0.10	0.06	0.08	0.10	0.10				0	0	0	0	0	0		
Treatment																						
Library - Type: Absorption, Source: Local, IC Ceiling - 13-mm mineral tile, suspend	16.3		NRC 0.76			0.75	0.70	0.65	0.85	0.85	0.80				12	11	11	14	14	13		
Sabines Per Item, m²												Total Sabines, m²										
Item / Description	No. Items	X/Y/Z	Rating	31.5	63	125	250	500	1k	2k	4k	8k	31.5	63	125	250	500	1k	2k	4k	8k	
Sabines / Reverberation Time																						
Item / Description	Input	T _{60, LF}	T _{60, MF}	31.5	63	125	250	500	1k	2k	4k	8k										
Room	6 m	4 m	3 m																			
Room Constant, m²	2 m	90 m²	55 m²	0	0	18	16	15	20	20	20	4										
Total Sabines, m²	174 Hz			0	0	15	14	13	16	16	17	4										
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	-0.081										
Prediction Method Comparison																						
Sabine		BR 100%	0.62 s	0.62 s			0.59	0.64	0.69	0.55	0.54	0.53										
Eyring		BR 100%	0.56 s	0.57 s			0.54	0.59	0.64	0.50	0.49	0.48										
Fitzroy (Eyring)		BR 100%	0.56 s	0.57 s			0.54	0.59	0.64	0.50	0.49	0.48										
Result	Shape, Target	Speech		0.60 s																		
Zhang		BR 100%	0.58 s	0.58 s			0.55	0.61	0.65	0.51	0.50	0.50										
Design Target	Minimum	BR 91%	0.44 s	0.48 s	0.30	0.30	0.39	0.48	0.48	0.48	0.39	0.30										
Design Target	Maximum	BR 100%	0.72 s	0.72 s	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72										

Strut Version 5.21.08E (Common Loan)

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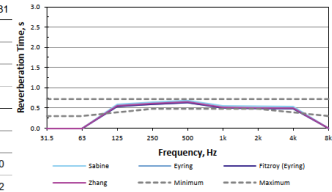


Figure E17: Reverberation times for Noranda Platform Staff Office

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