VIVA Energy Australia

Attachment F

Construction Noise and Vibration Impact Assessment

Melbourne Jet Pipeline Project

Melbourne Airport Jet Pipeline Project

Construction Noise and Vibration Impact Assessment

Viva Energy Australia

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Document prepared by:

Aurecon Australasia Pty Ltd
ABN 54 005 139 873

Aurecon Centre
Level 8, 850 Collins Street
Docklands, Melbourne VIC 3008

PO Box 23061
Docklands VIC 8012
Australia

T +61 3 9975 3000
F +61 3 9975 3444
E melbourne@aurecongroup.com
W aurecongroup.com

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Author signature	[redacted]	Approver signature	[redacted]
Name	Joshua Loh	Name	Josh Mahon
Title	Senior Acoustic Engineer	Title	Manager – Environment and Planning

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1 Introduction

Viva Energy Australia (Viva Energy) is proposing to construct and operate a new jet fuel pipeline to support the growing fuel needs at Melbourne Airport.

As Australia's second largest airport, annual passenger numbers for Melbourne Airport are expected to almost double by 2042 – increasing from 37 million to more than 76 million per year[1]. In line with this projected increase in passenger numbers, the requirement for jet fuel is expected to increase significantly and is expected to exceed the capacity of the existing fuel supply infrastructure. Notwithstanding future growth, jet fuel supplied via the existing pipeline system is already being supplemented by trucking operations from Geelong and Melbourne's inner-city suburbs. The development of the new pipeline will provide faster replenishment of fuel stocks, provide an alternative to current and escalating dangerous goods vehicle movements and provide a more robust fuel supply chain.

The proposed pipeline aims to:

- help meet the increasing demand for jet fuel and support future growth at Melbourne Airport
- increase the supply security of jet fuel which will contribute to the Victorian state economy
- reduce the reliance on road transport for jet fuel supply with fewer trucks required to deliver fuel to the airport.

The pipeline is proposed to connect from an existing section of the Altona to Somerton pipeline with construction works beginning south of the Western Ring Road (M80) near the Airport Drive exit. The pipeline extends north along the eastern side of Airport Drive and continues on the eastern side of the Tullamarine Freeway (M2) via Mercer Drive.

Based on the locality of the proposed pipeline, construction works are likely to impact some commercial premises (non-sensitive receivers) along Airport Drive and residential properties (sensitive receivers) in Tullamarine between Sharps Road and Melrose Drive as well as Parer Road residents in Airport West. This report addresses potential impacts of construction noise and vibration to sensitive and non-sensitive receivers within the proximity of the pipeline alignment.

2 Project overview

The Melbourne Airport Jet Pipeline Project (the Project) proposes the construction and operation of a 6.7 km new underground pipeline to form a direct connection between the jet fuel storage infrastructure at Melbourne Airport and the existing Altona to Somerton pipeline that follows the southern boundary of Tullamarine (located south of the Western Ring Road (M80)).

The pipeline would commence at a section of the Altona to Somerton pipeline located south of the Western Ring Road (M80) (near the Airport Drive exit) and link into the existing Melbourne Airport JUHI facility (located at Marker Road, Tullamarine). Figure 1 below shows the proposed pipeline alignment.

[1] Melbourne Airport Preliminary Draft Master Plan 2022

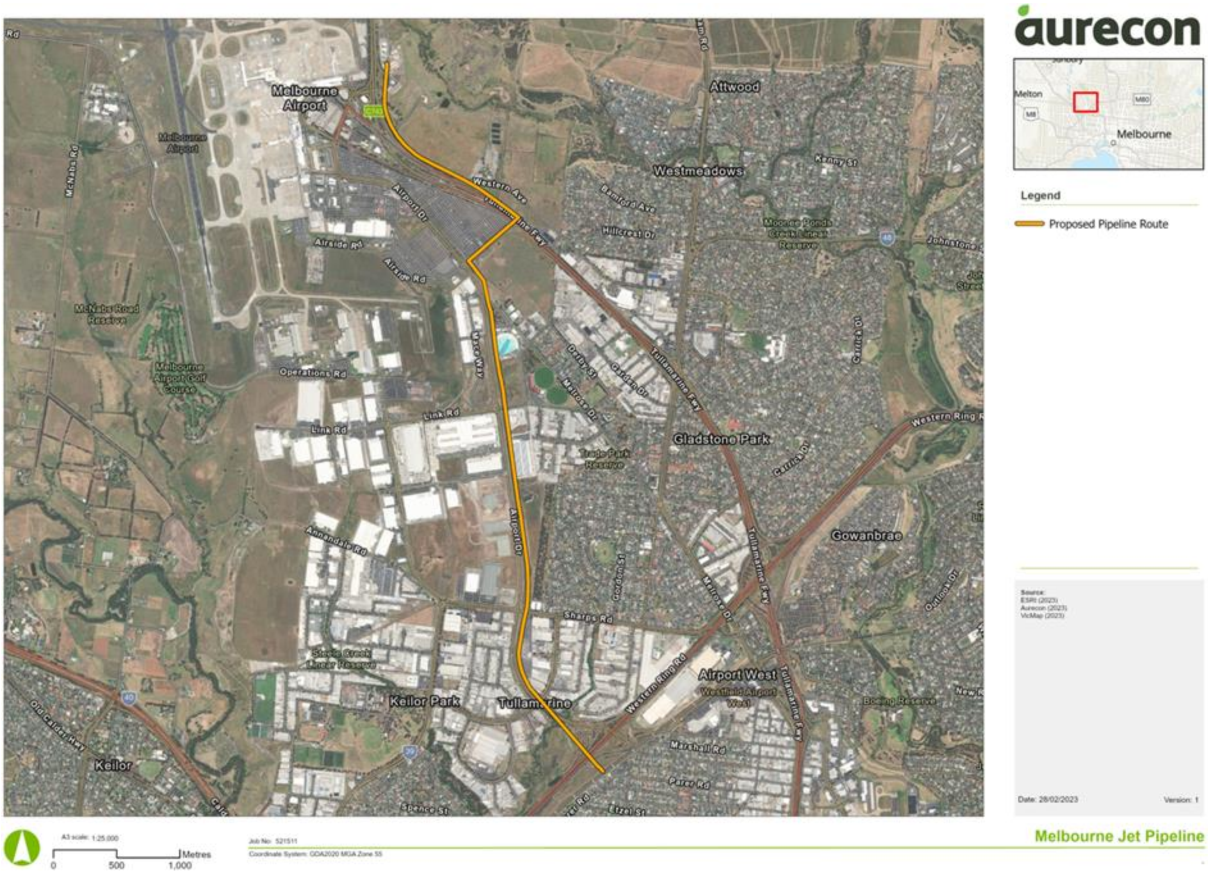

Figure 1: Pipeline alignment location (Source: ESRI)

2.1 Pipeline alignment

The new pipeline will tie in underground to the existing Altona to Somerton pipeline. Aboveground pigging facilities shall be installed near the tie-in. From the tie-in, the pipeline will run north-west towards the Western Ring Road (M80).

A horizontal directional drilling (HDD) crossing is required at the Western Ring Road (M80) and will also go under Steele Creek and Tullamarine Park Road (a total length of approximately 875 m). From this HDD, the pipeline alignment will continue north, first along the western boundary of a privately owned commercial property and then running in the eastern road easement of Airport Drive.

A HDD crossing will be required along Airport Drive for the Sharps Road crossing (a length of approximately 175 m). Further along Airport Drive, another HDD section is required for a length of approximately 1900 m. This HDD section will avoid the congested services in this area and pass underneath Link Road. The pipeline will continue from the HDD exit along Airport Drive up to Mercer Drive.

A HDD crossing will be required at Mercer Drive (a length of approximately 50 m). Following this, the alignment will continue north-east along Mercer Drive where a thrust bored crossing will be required at the southern Value Carpark entrance (a length of approximately 50m), before continuing for approximately 300 m up to the Tullamarine Freeway (M2). A HDD crossing will be required to cross the Tullamarine Freeway (M2) (a length of approximately 125 m).

The alignment will continue north from the Tullamarine Freeway (M2) crossing along Western Avenue with a further HDD section required to avoid an area of stockpiled fill material, under Quarry Road and into the JUHI facility (a length of approximately 600 m).

3 Construction guideline

Construction works associated with the Project qualifies for an assessment under the *Civil construction, building and demolition guide, Publication 1834 (CCBDG).* The CCBDG is applicable under the *Environment*

Protection Act 2017 which also includes the application of the *General Environment Duty* (GED) with regard to noise and vibration impacts.

The CCBDG does not provide any specific criteria for assessing construction vibration. In this case, the assessment of vibration on structures will be evaluated based on the *British Standard BS7385.2 – 1993: Evaluation and measurement for vibration in buildings. Guide to damage from ground-borne vibration.*

3.1 Construction hours

The time periods for the purposes of assessing noise impacts are as follows:

- Day: 7am – 6pm
- Evening: 6pm – 10pm
- Night: 10pm – 7am

In accordance with the CCBDG, normal construction working hours for the Project are defined by the following periods:

- Monday to Friday, 7am – 6pm
- Saturday, 7am – 1pm

Based on the above normal working hours, the periods outside of these designated working hours are:

- Monday to Friday, 6pm – 10pm, 10pm – 7am
- Saturday, 1pm – 10pm, 10pm – 7am
- Sunday and Public Holidays, 7am – 10pm, 10pm – 7am

3.2 Construction criteria

3.2.1 Noise

Outside the normal working hours, noise requirements apply at affected residential premises with reference to the background noise (L_{90}) levels. The following limits apply:

- 10 dB(A) or more for up to 18 months after project commencement during the hours of;
  - Monday to Friday, 6pm – 10pm
  - Saturday, 1pm – 10pm
  - Sunday and Public Holidays, 7am – 10pm
- Noise inaudible[2] within a habitable room[3] of any residential premises during the hours of;
  - Monday to Friday, 10pm – 7am
  - Saturday, Sunday and Public Holidays, 10pm – 7am

In any case, noise and vibration generated by onsite activities shall be minimised as far as reasonably possible.

For the purposes of predicting potential impacts at receivers, the CCBDG states that although inaudibility is considered as not being perceptible by ear, the reference level set at background level +0 dB could be used as a suitable representation for inaudible noise to predict construction noise.

Under the CCBDG, there are no specific noise limits for non-sensitive receivers such as commercial and industrial premises. However, under the GED, consideration is given to all potential receivers that may be

[2] For construction noise prediction purposes, inaud ble noise is a reference level set at background (L_{90}) level +0 dB.
[3] A habitable room is classified as a room other than a kitchen, storage area, bathroom, laundry toilet or pantry.

affected by the proposed works. Therefore, the nearest affected non- sensitive receivers are listed for reference.

Noise survey

For ease of assessment of both non-sensitive and sensitive receivers, attended measurements were conducted within designated zones. For the purposes of this assessment, the zones are highlighted in Figure 2 and are denoted by the following:

- Zone 1: Western Ring Road (M80) to Sharps Road
- Zone 2: Sharps Road to Link Road
- Zone 3: Link Road to Tullamarine Freeway (M2)
- Zone 4: Tullamarine Freeway (M2) to Centre Road (JUHI)

Background noise measurements were conducted between 9th – 10th August 2022 for each time period (day, evening and night). Measurements were conducted in accordance with the *Victoria EPA Noise Protocol* (EPA 1826.4) Australian Standard *AS1055:2018 – Description and measurement of environmental noise*.

Equipment list

The equipment used to conduct the noise measurements are listed in Table 1. Noise measurements were conducted in accordance with Australian Standard AS 1055:2018 *Acoustics – Description and measurement of environmental noise*. All equipment used to conduct the measurements has current and valid NATA certification. The equipment was checked for calibration before and after each set of measurements and no drift was observed.

Table 1: Equipment list

Equipment	Make	Model	Serial No.
Calibrator	Pulsar	Model 105	85217
Sound level meter	Brüel & Kjær	2250	2653913

Measurement results

The results of the attended short-term measurements are summarised in Table 2. These results are used to establish the existing background noise levels in the respective zones to assess against the construction noise criteria presented in Section 3.2.

Table 2: Summary of short-term measurements

Zones	Measurement location	Day, L_{A90}	Evening, L_{A90}	Night, L_{A90}
Zone 1	161 Victory Road, Airport West	58	55	53
Zone 2	78 Allied Drive, Tullamarine	57	51	49
Zone 3	77A Churchill Avenue, Tullamarine	48	42	41
Zone 4	220 Wright Street, Westmeadows	49	49	48

Construction noise limits

Based on the measured background noise levels, the following assessment limits for construction works undertaken in each zone outside of the normal working are presented in Table 3.

Table 3: Construction noise limits outside of normal working hours

Outside normal working hours	Construction noise limits, L_{Aeq} (dB)			
	Zone 1	Zone 2	Zone 3	Zone 4
Monday to Friday, 6pm – 10pm	65	61	52	59
Saturday, 1pm – 10pm	65	61	52	59
Sunday and Public Holidays, 7am – 10pm	65	61	52	59
Monday to Friday, 10pm – 7am	53	49	41	48
Saturday, Sunday and Public Holidays, 10pm – 7am	53	49	41	48

Note: Where outside normal working periods are covered by more than one time period, the lower background levels are used for a conservative assessment

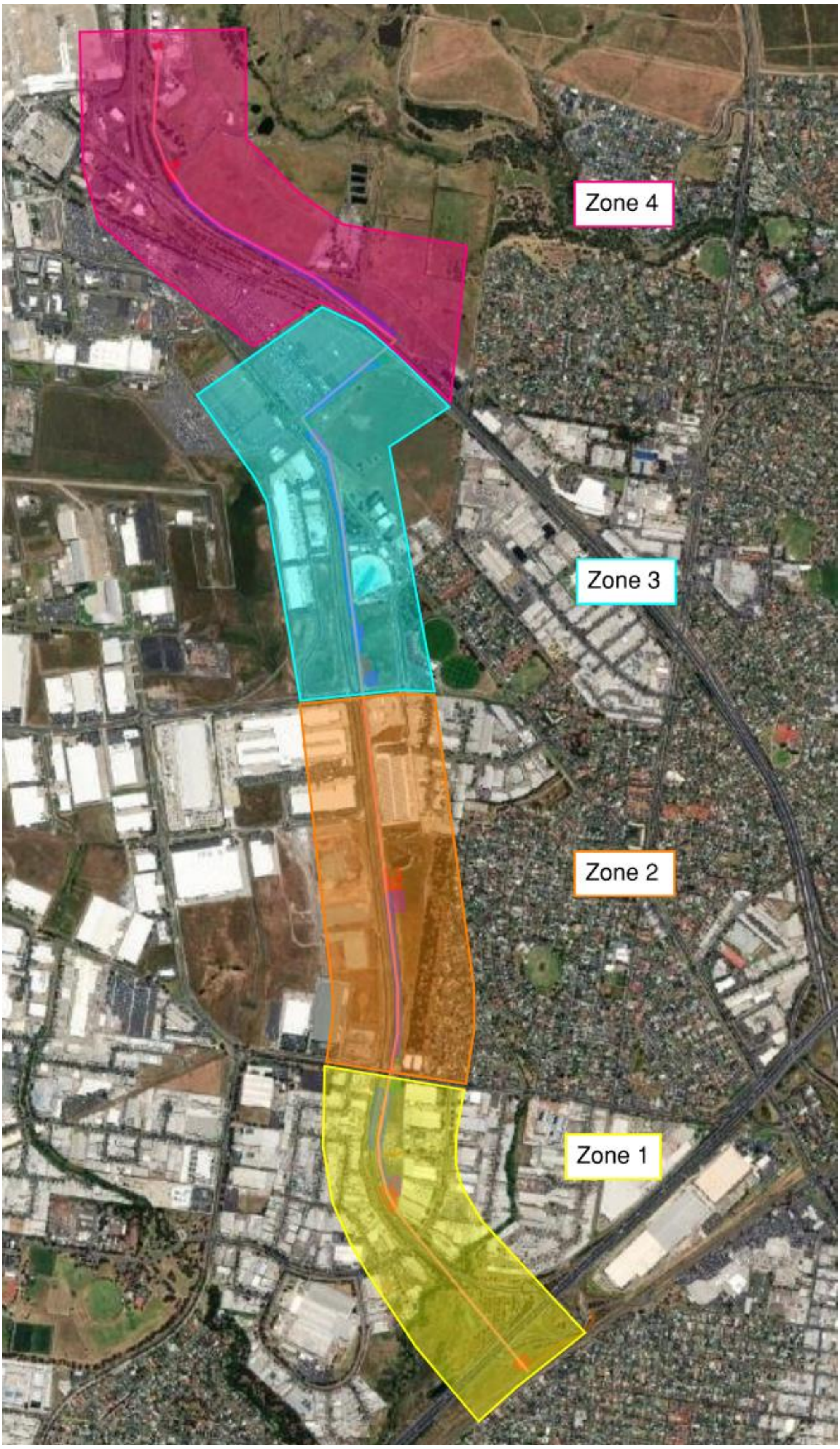

Figure 2: Assessment zones

3.2.2 Vibration

Vibration amenity

The assessment of human comfort which is intermittent vibration in nature is based on the Vibration Dose Values (VDVs). The *British Standard BS6472-1:2008 – Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting* presents VDV as the probability that the predicted vibration dose might result in an adverse response. VDV is assessed for a period of time which in this case accumulates the vibration energy experienced over the daytime and night-time periods. The VDV criteria is based on the likelihood that a person would be annoyed by vibration over an assessment period when assessed within a building. Noting that this is only an indicative assessment, preferred and maximum target values are detailed in Table 4 where impacts shall be maintained below the maximum values as best as possible.

Table 4: Preferred and maximum vibration dose values for intermittent vibration ($m/s^{1.75}$)

Type of space occupancy	Vibration Dose Values ($m/s^{1.75}$)			
	Day (7am to 10pm)		Night (10pm to 7am)	
	Preferred Value	Max Value	Preferred Value	Max Value
Residential	0.2	0.4	0.1	0.2
Offices, schools, educational institutions, places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

Notes:

1. Day is defined as 7:00 am to 10:00 pm. Night is defined as 10:00 pm to 7:00 am.

2. The Guideline Targets are non-mandatory; they are goals that should be sought to be achieved through the application of practicable mitigation measures. If exceeded, then management actions would be required

Vibration of structures

The assessment of vibration on structures is evaluated by the British Standards *BS7385.2 – 1993: Evaluation and measurement for vibration in buildings. Guide to damage from ground-borne vibration.* It is important to note that buildings exposed to higher levels of vibration than those recommended limits do not necessarily result in damage. Similarly, levels that are below the recommended limits does not mean damage would not occur. This guideline vibration management levels are presented in Table 5.

For most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity (PPV), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level.

Based on the *Victorian Heritage Listing Database*, there are no heritage registered buildings or structures within the assessment boundary. Therefore, a lower screening level is not considered for assessed properties.

Table 5: Transient vibration guideline values - minimal risk of cosmetic damage

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 – 15 Hz	15 Hz and above
1	Reinforced or frame structures industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 – 15 Hz	15 Hz and above
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

When evaluating services or buried pipework, the DIN 4150-3 Guideline has been adopted and is presented in Table 6.

Table 6: DIN 4150-3 Guideline values for vibration velocity when evaluating the effects of short-term vibration on buried pipework

Line	Pipe material	Guideline values for vibration velocity measured on the pipe
1	Steel (including welded pipes)	100 mm/s
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80 mm/s
3	Masonry, plastic	50 mm/s

Specific vibration objectives should be determined on a case-by-case basis. A suitably qualified acoustic consultant should be engaged by the contractor to liaise with regarding structures or utility owners to determine acceptable vibration levels.

4 Construction methodology

This section outlines the construction methodology of the pipeline including indicative construction schedule, indicative types of plant equipment and the construction scenarios assessed for noise and vibration impacts.

4.1 Construction activities

Construction is planned to commence as early as mid-2023, subject to Viva Energy Board approvals, regulatory approvals and land access. Construction of the pipeline is anticipated to take 12 to 18 months. Indicative construction activities for the Project are detailed in Table 7.

Table 7: Indicative construction activities and plant

Construction activity	Detail of activity	Plant
Setting up work areas	Before construction can commence, work areas must be set up appropriately. These include lay down areas for equipment, construction material stockpiles and setup areas.	35 Ton Excavator x 2 14G Grader x 1 D7 x Dozer x 1
Clear and grade	Clear and grade involves preparing the pipeline easement and extra work spaces for construction.	

<table>
<tr><th>Construction activity</th><th>Detail of activity</th><th>Plant</th></tr>
<tr><td>Excavation</td><td>A specialised rotary trenching machine or excavator is used to dig the trenches along the pipeline route. Any material removed is placed on the side of the trench (stockpiled), within the construction set up area.
Trenchless construction is used in more complex or environmentally sensitive areas.
Trenchless construction methods used for this Project include:
▪ HDD
▪ Thrust boring.
Further information on these techniques is presented in Section 4.2</td><td><u>Trenching</u>
45 Ton Excavator with Hammer x 2
Rock chain Trencher
<u>HDD</u>
HDD rig x 1
35 Ton Excavator x 1
Mud tanks
Generator (self bunded or within container)
Vacuum Truck x 2
<u>Thrust boring</u>
Rotary auger x 1
35 Ton Excavator x 1
Mud tanks
Generator (self bunded or within container)
Vacuum Truck x 2</td></tr>
<tr><td>Pipe stringing and welding</td><td>Once the pipe lengths have been laid out or ‘strung’ along the construction set up area, qualified welders join the lengths of pipes together. Welds are inspected using x-ray or ultrasonic equipment to ensure their quality and are then coated, to reduce the likelihood of corrosion.</td><td>35 Ton Excavator with vac lift x 1
572 side boom x 1
Bending machine
Prime movers (stringing trucks) x 1
Skid truck x 2
Light Truck with Welding Machines x 2
Tack Rig x 1</td></tr>
<tr><td>Lowering In</td><td>After final quality assurance checks, each completed pipe section is lowered into the trench using specialist side boom tractors and excavators.</td><td rowspan="2">35 Ton Excavator x 2
572 Side Booms x 2
Loader x 2
350 Padding Machine x 1
Trucks to haul in bedding material x 3
Flowcon Truck x 1
Grader x 1
D7 Dozer x 1</td></tr>
<tr><td>Backfill</td><td>When the pipe is in place, it is backfilled with suitable fill material (padding) to protect the pipeline coating from stones or other sharp objects.
The topsoil is then re-instated over the disturbed trench area to the contour of the land so that groundcover can be rehabilitated.</td></tr>
<tr><td>Quality Assurance</td><td>Rigorous quality assurance, inspection and testing occurs during and after installation to confirm that the pipeline integrity meets or exceeds the design criteria.
Using water, the pipe is pressure tested (hydrotested) to ensure it is fit for operational service.</td><td>Fill pump
High pressure squeeze pump
750cfm compressor
1200cfm compressor for drying
Vacuum drying unit</td></tr>
</table>

Construction activity	Detail of activity	Plant
Demobilisation and initial rehabilitation	Disturbed areas will be reinstated and may include re-contouring to match existing landforms. Topsoil conserved during the construction process is re-spread over areas used for construction. Rehabilitation is undertaken in accordance with approval requirements and landowner considerations.	35 Ton Excavator x 2 Graders 16G x 1 Grader 14G x 1 D7 Dozer Tractor - reseeding

4.2 Pipeline construction

The Project will use a combination of HDD, thrust boring and open cut trenching as the primary construction methods used to install the pipeline. Information on these methods is presented in the following sections.

4.2.1 Open cut trenching

Trenching is anticipated to be required for approximately 2.825 km of the alignment. It will be completed using specialised rotary trenching machines and/or excavators to dig a 1 m wide trench to a minimum depth of 1.2 m. If rock is encountered during trenching, a rock breaking process such as the use of rock saws/hammers and/or blasting may be required to excavate the trench.

4.2.2 Horizontal directional drilling

HDD is a trenchless construction method used in more complex or environmentally sensitive areas. Specialist operators drill a hole beneath the surface at a shallow angle, and then pull a welded length of pipe through the hole without disturbing the surface. These operations are carefully planned, are highly engineered and undertaken to minimise disturbance to properties and roads, in environmentally sensitive areas or to address construction issues.

Approximately 3.725 km of HDD is required for the Project. HDD will be undertaken at the following locations:

- Under the Western Ring Road (M80), Steele Creek and Tullamarine Park Road (a total length of approximately 875 m).
- Under Sharps Road (a total length of approximately 175m).
- Section along Airport Drive and underneath Link Road (a total length of approximately 1900 m).
- Under Mercer Drive (a total length of approximately 50 m).
- Under the Tullamarine Freeway (M2) (a total length of approximately 125 m).
- Under an area of stockpiled fill material at the northern section of the pipeline alignment (a total length of approximately 600 m).

HDD requires the excavation of an exit pit, approximately 3m x 3m x 3m, on the opposite side to where the drilling rig is set up to contain drilling fluids used in the drilling process. A smaller entry pit approximately half the size of the exit pit is excavated on the drilling rig side.

4.2.3 Thrust boring

Thrust boring is another trenchless construction method which involves simultaneously jacking a pipe horizontally through the ground while removing the soil by rotating auger. Thrust boring is ideal for developed areas, protected areas, and other crossings where excavations are either undesirable or unfeasible, such as underneath main roads.

Approximately 50 m of thrust boring will be required for the Project. Thrust boring will be undertaken under the southern entrance to the Value Car Park.

4.3 Construction receivers

The construction scenarios are based on the construction schedule proposed for the Project and the pipeline construction methodology proposed throughout sections of the alignment. Different pipeline construction methods (HDD, trenching and thrust boring) will be employed throughout the alignment, while all other associated works (welding, stringing, lowering etc) have been assumed to occur throughout the alignment extent.

Construction noise and vibration predictions are limited to 300m either side of the pipeline alignment. This buffer was adopted as noise and vibration impacts at this distance are likely to be negligible and typically where background levels are higher.

Within the designated zones defined in Section 3, noise and vibration impacts are predicted at the nearest non-sensitive and sensitive receiver based on the pipeline works proposed in the zone. By assessing the closest receivers relative to the pipeline alignment, predictions will be representative of a worst-case scenario assessment. The representative receivers in each zone are detailed in Table 8. Non-sensitive receivers are only provided as a reference as some are closer to the proposed works than sensitive receivers.

Table 8: Summary of nearest receivers in each assessment zone

Zone	Address	Approximate distance, m
Zone 1: non-sensitive	Capital SMART repairs – 28 Tullamarine Park Road	25
Zone 1: sensitive	188 Parer Road, Airport West	65
Zone 2: non-sensitive	National Storage Tullamarine Airport	35
Zone 2: sensitive	5 Fisher Grove, Tullamarine	130
Zone 3: non-sensitive	URBNSURF – 309 Melrose Drive, Melbourne Airport	15
Zone 3: sensitive	386 Melrose Drive, Tullamarine	290
Zone 4: non-sensitive	Cleanaway Depot	100
Zone 4: sensitive	-	> 300

5 Construction noise and vibration assessment

Construction noise and vibration impacts are assessed based on the construction staging outlined in Section 4. The construction scenarios are listed in Table 9. The majority of planned works are proposed to occur during standard working hours where no specific limits apply. However, potential noise and vibration impacts will be assessed to understand the effects of construction at the receivers. This is to inform if any actions shall be taken to manage noise and vibration impacts in the absence of specific limits. As stated within the CCBDG, construction emissions shall be reasonably and practicably managed during all time periods to minimise the impact on receivers.

5.1 Construction scenarios

Table 9: Construction scenarios for the JUHI pipeline

Construction scenario	Specific construction activity	Major plant items	Typical hours of operation
Scenario 1: setting up work areas, clear and grade	Setting up laydown areas and setup areas. Clear and grade preparations for pipeline easement	Excavator, grader, dozer	Standard hours
Scenario 2a: Excavation (trenching)	Excavation of trenches along the pipeline alignment via regular trenching methods. Stockpiling adjacent to pipeline.	Excavator, trencher	Standard hours
Scenario 2b: Excavation (HDD)	Excavation of trenches along the pipeline alignment via HDD methods. Stockpiling adjacent to pipeline.	HDD rig, excavator, vacuum trucks	All time periods
Scenario 2c: Excavation (thrust boring)	Excavation of trenches along the pipeline alignment via Thrust boring methods. Stockpiling adjacent to pipeline.	Rotary auger, excavator, vacuum trucks	All time periods
Scenario 3: Pipe stringing and welding	Pipeline stringing and welding of pipeline sections	Excavator, side boom, skid trucks, welding machinery, tack rig	All time periods
Scenario 4: Lowering in	Completed pipe sections are lowered in the trenches	Excavator, side boom	Standard hours
Scenario 5: Backfill	Suitable fill material is used to backfill trenches and topsoil reinstated	Loader, grader, dozer, trucks	Standard hours
Scenario 6: Quality Assurance	Quality assurance pressure testing after installation	Pump, compressor	Standard hours
Scenario 7: Rehabilitation	Rehabilitation of easement and property landforms. Topsoil is reinstated	Excavator, grader, dozer, tractor	Standard hours

5.2 Propagation model

Construction environmental noise and vibration are predicted externally at sensitive receivers within the designated zones. Emissions are based on the specified plant/equipment to be used for the construction works. The predictions represent the worst-case impacts, with all plant operating simultaneously which is a situation unlikely to occur in practice.

5.2.1 Noise prediction

Noise impacts are calculated using the desktop software Strutt V5.22.05E and adopts the noise propagation prediction methodology within the standard *ISO9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.* The calculations include consideration of atmospheric absorption, distance propagation and ground absorption between source and receiver.

5.2.2 Vibration prediction

Vibration predictions are calculated based on the propagation between the vibration source and the receivers. The propagation characteristic through the ground is represented by a material damping coefficient indicative of the ground material in that area. For this assessment, the ground material will be based on the database of measured vibration levels from similar construction plant.

5.3 Construction source noise levels

The source noise levels for construction plant used in the construction scenarios are detailed in Table 10. Source noise levels have been obtained from a combination of *BS5228.1:2009 – Code of practice for noise and vibration control on construction and open sites – Noise* and Australian Standards *AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites*.

Table 10: Source noise levels of proposed construction plant

Plant	Sound power level (dB) for Octave band centre frequency (Hz) at 10m								Total sound power level
	63	125	250	500	1k	2k	4k	8k	
Excavator	77	85	70	73	70	68	63	57	104
Grader	85	84	80	76	81	75	71	62	112
Dozer	75	79	77	77	74	71	65	57	107
Rock breaker	85	76	74	75	74	75	70	65	108
Rock chain trencher	82	73	71	72	71	72	67	62	105
Generator	80	74	57	54	53	48	45	37	89
Vacuum truck	81	82	67	72	71	74	73	66	107
HDD rig	87	84	86	84	81	80	78	70	115
Rotary auger	44	53	61	64	69	71	76	74	108
Vac lift	77	85	70	73	70	68	63	57	104
Side boom	80	76	71	63	64	63	56	50	98
Prime movers	80	74	57	54	53	48	45	37	89
Bending machine	81	76	79	70	71	68	64	60	104
Skid truck	74	66	64	64	63	60	59	50	96
Welding machine	81	78	76	74	72	69	64	56	105
Tack rig	79	79	78	78	75	71	66	56	108
Loader	74	66	64	64	63	60	59	50	96
Padding machine	77	86	75	75	71	69	64	55	106

Plant	Sound power level (dB) for Octave band centre frequency (Hz) at 10m								Total sound power level
	63	125	250	500	1k	2k	4k	8k	
Flatbed truck	81	79	75	70	70	70	68	65	105
Flowcon truck	78	77	72	72	71	69	62	56	104
Flow pump	73	68	62	62	61	56	53	41	93
High pressure pump	75	70	67	67	69	66	60	53	101
Compressor (750cfm)	84	73	64	59	57	55	58	47	94
Compressor (1200cfm)	75	71	65	70	71	69	62	57	103
Vacuum drying unit	81	82	67	72	71	74	73	66	107
Tractor - reseeding	83	86	76	76	73	72	64	59	107

5.4 Construction source vibration levels

The source vibration levels of plant proposed for construction are detailed in Table 11. Source vibration levels data has been obtained from a combination of *BS5228-2:2009 – Code of practice for noise and vibration control on construction and open sites – vibration*, the *Federal Transit Administration (FTA) – Transit noise and vibration impact assessment* and Aurecon database of onsite measurements.

Table 11: Source vibration levels of proposed construction plant

Equipment	Individual vibration reference level, mm/s		Material damping coefficient, n
	PPV	Ref (m)	
Excavator	3.6	7.6	1.1
Grader	2.9	6	1.2
Dozer	3	7.6	1.2
Rock breaker	9.3	5	1.2
Rock chain trencher	1.8	5	1.2
trucks	0.1	7.6	1.2
Side boom	1.1	15	1.2
Prime movers	1.9	7.6	1.2
Skid trucks	0.1	7.6	1.3
Light trucks with welding	0.5	7.6	1.2
Tack rig	3	7.6	1.2
Padding machine	3	7.6	1.2
Tractor – reseeding	1.8	5	1.2

6 Predicted construction impacts

The predicted noise and vibration levels at sensitive receivers within the designated zones from the proposed construction activities are detailed in the following sections. Predictions are based on the number of plant items designated for each construction scenario listed in Table 9.

6.1 Predicted construction noise

The predicted construction noise impacts at the representative sensitive receivers within the designated zones for each scenario are presented in Table 12.

Table 12: Summary of construction noise impact at nearest sensitive receivers

Construction Scenario	Predicted noise level at nearest residential receiver, dB				Applicable construction noise criteria, $L_{Aeq,}$ dB			
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
Scenario 1: setting up work areas, clear and grade	40	34	26	N/A	65	61	52	59
Scenario 2a: Excavation (trenching)	40	33	24	N/A	65	61	52	59
Scenario 2b: Excavation (HDD)	43	36	28	N/A	53	49	41	48
Scenario 2c: Excavation (thrust boring)	39	32	24	N/A	53	49	41	48
Scenario 3: Pipe stringing and welding	40	33	25	N/A	53	49	41	48
Scenario 4: Lowering in	36	29	20	N/A	65	61	52	59
Scenario 5: backfill	43	36	28	N/A	65	61	52	59
Scenario 6: Quality Assurance	38	30	22	N/A	65	61	52	59
Scenario 7: Rehabilitation	46	39	30	N/A	65	61	52	59

Predicted noise levels at non-sensitive receivers range between 36 – 68 dB(A) depending on the assessed scenario and separation distance. This is provided to inform of likely noise levels experienced at non-sensitive receivers surrounding the proposed works. Although there are no specific criteria for non- sensitive receivers set out within the CCBDG, this satisfies the GED in identifying potential noise impacts towards receivers that may be affected by the proposed works.

6.2 Predicted construction vibration

The predicted construction vibration impacts at the representative sensitive receivers within the designated zones for each scenario are presented in Table 13. The construction vibration limits for human comfort and building structures are as follows:

- Human comfort (amenity): 0.2 $m/s^{1.75}$
- Building structures (residential): 15 mm/s

Table 13: Summary of construction vibration impact at nearest sensitive receivers

Construction Scenario	Predicted vibration level at nearest residential receiver (Amenity) eVDV, $m/s^{1.75}$				Predicted vibration level at nearest residential receiver (structures) PPV, mm/s			
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
Scenario 1: setting up work areas, clear and grade	0.14	0.07	0.09	N/A	0.6	0.3	0.1	N/A
Scenario 2a: Excavation (trenching)	0.17	0.08	0.03	N/A	0.6	0.3	0.1	N/A
Scenario 2b: Excavation (HDD)	0.17	0.08	0.03	N/A	0.6	0.3	0.1	N/A
Scenario 2c: Excavation (thrust boring)	0.12	0.05	0.02	N/A	0.3	0.2	0.1	N/A
Scenario 3: Pipe stringing and welding	0.09	0.04	0.02	N/A	0.4	0.2	0.1	N/A
Scenario 4: Lowering in	0.14	0.07	0.03	N/A	0.5	0.3	0.1	N/A
Scenario 5: backfill	0.11	0.05	0.02	N/A	0.5	0.2	0.1	N/A
Scenario 6: Quality Assurance	-	-	-	-	-	-	-	-
Scenario 7: Rehabilitation	0.15	0.07	0.03	N/A	0.7	0.3	0.1	N/A

Predicted vibration levels at non- sensitive receivers range between 0.06 – 1.01 $m/s^{1.75}$ which is well below the maximum target values for vibration amenity. Predicted PPV values at non- sensitive receivers range between 0.2 – 3.6 mm/s which is also well below the limits for vibration of structures.

7 Assessment outcomes

7.1 Construction noise

Based on the construction scenarios provided, no noise exceedances have been predicted at the nearest sensitive receivers. As a result of reasonably high background noise levels in the area and relatively large separation distance between the proposed pipeline alignment and the sensitive receivers, noise impacts have been predicted to be below the criteria set out in accordance with the CCBDG.

Predicted noise levels at the nearest non- sensitive receivers have also been provided to inform of the likely noise impacts. Given that the existing background levels are generally high in the area, it is unlikely that the proposed works will affect the amenity of non- sensitive premises.

7.2 Construction vibration

Based on the construction scenarios provided, no vibration exceedances have been predicted when assessing damage for building structures and human comfort. As vibration dissipates quickly with distance, the predicted levels at the nearest sensitive receivers are very low and likely not noticeable.

Predicted vibration levels at non- sensitive receivers with regard to vibration amenity and structures are well below the criteria. Attributed to relatively large separation distances, vibration from the proposed works dissipates quickly before reaching the non- sensitive receivers.

7.3 Assessment limitations

Specific construction schedules and plant may change, and works may differ throughout the construction period. This may change the predicted noise and vibration levels at the receivers. Minor changes to the construction programme and plant selections are unlikely to have a significant effect on the predicted levels however, major changes to the construction methodology may require a reassessment to ensure impacts are within the defined criteria.

Although no noise and vibration predictions have resulted in exceedances, it is good practice to maintain suitable amenity for the surrounding community. Works to be undertaken outside of normal working hours must be justified as unavoidable works. The CCBDG recommends that the affected community be engaged prior to works commencing to explain the scheduling and type of works to be undertaken outside the normal work hours.

As there are proposed works that are unavoidable and to occur during the night-time period, it may require approval by the relevant authority and additional requirements or assessment to proceed with unavoidable works. This is to be sought by the contractor prior to commencing construction activities.

8 Managing construction noise and vibration

Although the proposed construction noise and vibration activities have been predicted to comply with the criteria set out within the CCBDG, construction emissions should be managed to reduce impacts as far as possible. While specific mitigation is not required, general good practices shall be adopted by the contractors.

In accordance with the CCBDG, it is expected that noise and vibration is minimised at all times. General construction management measures are applicable for any construction activities to manage noise and vibration impacts. These measures can be implemented to prevent or manage noise and vibration impacts of the project where reasonable and practicable. The following Table 14 lists management controls that can be implemented to minimise noise and vibration emissions.

Table 14: General construction noise and vibration management measures

Control	Applies to	Timing	details
Noise attenuation to be installed in prior to main construction works	Airborne noise	Prior to construction	Where possible, noise attenuation measures such as site barriers and hoardings shall be installed prior to construction commencing
Positioning of trucks and plant to minimise noise and vibration impacts	Airborne noise Vibration	During construction	Trucks and plant shall be orientated away from sensitive receivers to minimise noise and vibration impacts
Ensure delivery truck tailgates are clear and unlocked when unloading and loading	Airborne noise	During construction	Practicably reduce noise impacts when unloading and loading construction equipment and supplies
Avoid transport resonance particularly during night-time works	Airborne noise Vibration	During construction	Manage on site vehicle speeds and avoid using audible reversing alarms. Site paths should be maintained to avoid unnecessary noise sources such as potholes and loose items

Control	Applies to	Timing	details
Undertake construction activities within the nominated hours of work	Airborne noise Vibration	During construction	Where possible, maintain within the nominated construction hours of work. this includes start up and pack up periods.
Limit the hours of work in response to community concerns	Airborne noise Vibration	During construction	Where possible, limit the hours of work when the community have expressed concerns regarding construction impacts
Schedule noisy construction activities during less sensitive periods.	Airborne noise Vibration	During construction	Schedule noisy activities during less sensitive periods noting that community consultation may be required to determine a specific period that is acceptable.
Provide periods of respite from high noise and vibration impact works	Airborne noise Vibration	During construction	Provide respite periods such as extended work breaks, later start times and/or intermittent no-work periods where appropriate
All equipment must be serviced and maintained according to manufacturer's recommendations.	Airborne noise Vibration	During construction	All equipment utilised are expected to be serviced and maintained consistently to ensure they are operating effectively to minimise additional noise and vibration being generated
Implement appropriate project traffic management to minimise noise and vibration impacts	Airborne noise Vibration	During construction	Adjust traffic management plans to minimise travel paths and avoid laydown locations near sensitive receivers
Use only broadband alarms on site for reversing vehicles and plant	Airborne noise	During construction	Use only broadband alarms and/or accommodate forward moving paths
Utilise the lowest noise and vibration work practices and plant that meet the demands of the job	Airborne noise Vibration	During construction	Minimise noise and vibration impacts for works by utilising the lowest noise and vibration emission equipment suitable for the job
Locate site buildings, staff ingress/egress points, laydown yards to minimise disturbance on the community	Airborne noise	During construction	Minimise the use of heavily frequented community areas as locations for site access and buildings. Where possible, dedicated access should be utilised for the project.
Use temporary enclosures around noisy works	Airborne noise	During construction	Where possible, utilise localised temporary enclosures to shield noise generating activities
Ensure noise attenuation of fixed and mobile plant are fitted with appropriate mufflers to minimise noise impacts	Airborne noise	During construction	Ensure noise attenuation measures such as mufflers or silencers are installed to minimise noise emissions. Any implemented noise attenuation measure on equipment shall be consistently maintained.
Turn off plant when not in use	Airborne noise	During construction	Turn off plant when not in use and locate them away from sensitive receivers. Avoid idling when possible.
Avoid heavy handling of materials and equipment	Airborne noise Vibration	During construction	Avoid dropping heavy items or heavy handling of plant to minimise noise and vibration impacts
Register of noise and vibration sensitive receivers	Airborne noise Vibration	Prior to construction	A register of the most affected noise and vibration sensitive receivers shall be made available on site which would include the address, category of receiver and contact details
Site inductions (including 'Tool box talks')	Airborne noise Vibration	Prior to construction	All employees, contractors and subcontractors are to receive an environmental induction which shall contain noise mitigation measures and management actions to be adopted by all. 'Toolbox talks' will also be conducted prior to works to identify noise and vibration risks.
Minimum working distances	Vibration	During construction	Construction methods should be revised when predicted ground borne vibration exceeds vibration objectives. Monitoring and alert systems should be utilised when approaching cosmetic damage objective.

It is also recommended that once a contractor has been engaged, a Construction Noise and Vibration Management Plan be formulated as part of the Environmental Management Plan to develop suitable construction methodologies and implement appropriate measures to manage noise and vibration emissions.

9 Conclusion

Noise and vibration impacts expected during the construction of the proposed new jet fuel pipeline have been assessed. Based on the proposed construction methodology, no noise or vibration exceedances have been predicted at the nearest sensitive and non-sensitive receivers.

Predicted noise and vibration levels from the construction activities comply with the relevant noise and vibration criteria set out in the CCBDG and the applicable standards. Impacts are minor and unlikely to be noticeable at the sensitive and non- sensitive receivers based on the predicted levels.

Document prepared by

Aurecon Australasia Pty Ltd
ABN 54 005 139 873

Aurecon Centre
Level 8, 850 Collins Street
Docklands, Melbourne VIC 3008

PO Box 23061
Docklands VIC 8012
Australia

T +61 3 9975 3000
F +61 3 9975 3444
E melbourne@aurecongroup.com
W aurecongroup.com