

Part B

Tunnels

16

16.0 Tunnels

The chapter provides an assessment of the potential impacts related to tunnel fit-out work during construction and operation of the metro rail tunnels, and identifies mitigation measures to address these impacts. Potential impacts from the proposed tunnel fit-out work and operation of the metro rail tunnels are anticipated to be limited to noise and vibration, non-Aboriginal heritage and soils, groundwater and contamination. No other potential impacts are anticipated and have therefore not been assessed further in this chapter.

A description of the tunnels during operation is included in Section 5.3 (Metro alignment and track) and Section 5.5 (Operational ancillary infrastructure) of this Environmental Impact Statement. A description of the tunnel fit-out and rail systems construction work is provided in Section 6.4.6 (Tunnel fit-out and rail systems work) of this Environmental Impact Statement.

Tunnel excavation would be completed as part of the work carried out under the previous Sydney Metro West planning applications.

16.1 Overview

Sydney Metro West includes about 24 kilometres of twin tunnels between Westmead and the Sydney CBD. The tunnel alignment traverses beneath a highly urbanised area with a mix of land uses, as well as several waterways.

16.1.1 Operation

Operational activities as part of this proposal would be largely confined to the underground operation of metro trains. Appropriate track form would be implemented so that ground-borne noise and vibration from the operation of metro trains in the tunnels would comply with the applicable criteria.

The tunnel alignment would be directly below and in close proximity to a number of heritage items, including some local, State, National, Commonwealth and World heritage items. Ground-borne vibration associated with the operation of this proposal is predicted to be well below cosmetic damage screening levels and human comfort vibration levels at all heritage items. As such, there would be no noise and vibration impacts on heritage items or conservation areas located above the tunnel alignment during operation of this proposal.

There is not anticipated to be any soils, groundwater or contamination impacts during operation of the tunnels. The influence of the tunnel on the overall groundwater levels and regional flow patterns are expected to be negligible as the tunnel would be tanked (to prevent the inflow of groundwater) as part of the work carried out under the previous Sydney Metro West planning applications.

16.1.2 Construction

Impacts of excavation of the tunnels have been assessed under the previous Sydney Metro West planning applications. Tunnel-related construction activities as part of this proposal would be limited to tunnel and rail systems fit-out. Fit-out of the tunnels would occur up to 24 hours per day and seven days per week. As these works would occur underground and are relatively minor in nature, potential impacts such as construction noise and vibration, and potential impacts to heritage items, would be negligible.

16.2 Tunnels description

The metro rail alignment in tunnel would consist of a fixed concrete slab supporting continuously welded rail. The tunnels would also include other equipment and services including rail signalling, controls and communication, overhead traction power, fresh air ventilation, fire and life safety systems, maintenance access, lighting and drainage.

Sydney Metro West would include turnbacks (to allow trains to change to the other set of tracks) at Westmead and in the Sydney CBD. Crossover points (a track crossing point that would enable a train to cross between two parallel tracks for use in degraded operations due to maintenance, breakdowns or other emergencies) would be provided at various points along the alignment.

Stub tunnels would be located at the western and eastern extents of the tunnels to safeguard for potential future extensions. The provision of stub tunnels would allow for minimal disruption of the operating line during the construction of future extensions.

Further details on the operation of the metro rail tunnels and associated systems are provided in Section 5.3 (Metro alignment and track) and Section 5.5 (Operational ancillary infrastructure) of this Environmental Impact Statement.

16.3 Construction description

This section provides a description of the tunnel fit-out and rail systems work required for construction of this proposal.

16.3.1 Overview

Tunnel alignments and excavation were assessed as part of:

- *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a) (approved by the Minister for Planning and Public Places on 11 March 2021)
- *Sydney Metro West Environmental Impact Statement – Major civil construction between the Bays and Sydney CBD* (Sydney Metro, 2021a) (under assessment).

Tunnel fit-out and rail systems work would occur within the same land as the tunnel excavation completed as part of the work carried out under the previous Sydney Metro West planning applications.

16.3.2 Construction work

A description of tunnel fit-out and rail systems work for this proposal, including the proposed access points, is provided in Section 6.4.6 (Tunnel fit-out and rail systems work) of this Environmental Impact Statement. The indicative construction program for tunnel fit-out and rail systems work is shown in Figure 6-1.

Based on current construction planning, tunnel fit-out generally would start at the tunnel access shafts and progress towards other stations sequentially from the following locations:

- Parramatta to Westmead
- Clyde stabling and maintenance facility to Parramatta and North Strathfield
- Burwood North to North Strathfield and Five Dock
- The Bays to Five Dock
- The Bays to Hunter Street.

As identified in Section 6.4.6 (Tunnel fit-out and rail systems work) of this Environmental Impact Statement, other station and ancillary facility shafts and boxes may also be used to support tunnel fit-out and rail systems work.

Based on current construction planning access points for tunnel fit-out and rail systems work would likely be via the Parramatta metro station, Clyde stabling and maintenance facility (including Rosehill services facility), Burwood North Station and The Bays Station construction sites. However, depending on construction staging, other construction sites would be used to access the tunnels to carry out tunnel fit-out and rail systems work.

16.4 Noise and vibration

This section assesses the potential impact of noise and vibration during the operation of the metro tunnels. Impacts during construction are also assessed but limited to tunnel/rail systems fit-out – noting that tunnelling activities were assessed under the previous Sydney Metro West planning applications. Mitigation measures to address the potential impacts are also identified. Technical Paper 3 (Operational noise and vibration) and Technical Paper 4 (Construction noise and vibration) provide further details.

16.4.1 Baseline environment

The noise and vibration impact assessment for the operation of metro tunnels is a criteria-based assessment and therefore there is no relevant specific baseline environment.

16.4.2 Operational impact assessment

Airborne rail noise

The only source of airborne rail noise during operation would be the surface sections of track near the Clyde stabling and maintenance facility. The potential operational noise and vibration impacts at the Clyde stabling and maintenance facility are assessed in Section 17.6.2 (Operational impact assessment) of this Environmental Impact Statement.

Ground-borne rail noise

Ground-borne noise and vibration impacts from operational rail lines in tunnels are generally mitigated by a resilient rubber layer between the rail and the tunnel foundation. This may take the form of resilient rail fasteners, booted sleepers, floating slab track or a combination of measures.

Initial ground-borne noise and vibration modelling was carried out to determine the indicative track form along the tunnel alignment to meet the design objectives at receivers above the tunnels. The modelling assessed the following track types:

- type 1 – standard attenuation
- type 2 – high attenuation
- type 3A – very high attenuation
- type 1A – standard attenuation at crossover locations.

The ground-borne rail noise assessment then considered three scenarios with the above track types:

- scenario 1 – type 1 track form throughout tunnelled alignment
- scenario 2 – type 2 track form throughout, with the exception of type 1A over crossovers, due to track performance requirements at these locations
- scenario 3 – type 3A track form throughout tunnelled alignment.

The number of receivers predicted to exceed the relevant ground-borne noise criteria (from the *Rail Infrastructure Noise Guideline* (EPA, 2003)) for each of the three scenarios is outlined in Table 16-1.

Table 16-1 Number of receivers exceeding ground-borne noise criteria – Tunnels

Source	Criteria, dB(A)	Scenario 1	Scenario 2	Scenario 3
Childcare	35	10	-	-
Commercial	40	143	5	-
Courts	30	11	-	-
Educational facility	40	39	-	-
Library	40	1	1	-
Mixed use	35	12	-	-
Public hall	35	1	-	-
Residential	35	898	74	-
Recording studio	NR15 ¹	7	4	-
Place of worship	40	3	-	-
Total		1125	84	0

Notes:

1. NR (Noise Rating) curves are used for rating noise levels and are a set of octave band curves that provide limiting sound pressure level values. NR15 is equivalent to about 20 dB(A), when considering noise dominated at the middle range frequencies

Given the high number of residential and commercial receivers predicted to exceed the ground-borne noise criteria under scenario 1, type 1 track form is not recommended for use for use along the tunnel lengths where there are exceedances of the criteria.

Scenario 2 shows compliance throughout most of the alignment for residential and commercial receivers, with a total of 84 receivers predicted to exceed ground-borne noise criteria with type 2 track form. The exceptions requiring further mitigation would be:

- receivers in the vicinity of crossovers, where type 1A is not sufficient to mitigate the impacts from crossovers
- a total of four recording studios in the Sydney CBD and Pyrmont, where type 2 track form is not sufficient to meet the NR15 criteria.

Scenario 3 shows compliance with ground-borne noise criteria throughout the alignment.

Further consideration of noise mitigation options would not be required as the three track types would be combined to generate an optimised track form design that would achieve compliance with the applicable criteria for all receivers.

Vibration

Vibration dose value predictions for the three track type scenarios described above (and shown in Section 5.2.2 of Technical Paper 3 (Operational noise and vibration)) indicate that the vibration dose value would be well below the criteria for all track form scenarios and therefore further consideration of mitigation is not required.

As identified in *Assessing Vibration: A Technical Guideline* (NSW Department of Environment and Conservation, 2006), the level of vibration that affects amenity is much lower than that associated with building damage. No cosmetic damage is predicted due to operation of this proposal.

16.4.3 Construction impact assessment

Fit-out of the tunnels would occur up to 24 hours per day and seven days per week. As these works would occur underground and are relatively minor in nature, potential impacts such as construction noise and vibration would be negligible.

16.4.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

The approach to noise and vibration management during the construction phase, including the process for the development of all construction noise and vibration statements is outlined in the Construction Noise and Vibration Standard (CNVS) (refer to Appendix H).

The CNVS provides the overall strategy and approach for construction noise and vibration management for Sydney Metro West, and an outline of the noise and vibration management requirements and processes that would be common to each of the proposed construction sites.

In addition, the Sydney Metro Construction Environmental Management Framework (CEMF) (refer to Appendix F) outlines the construction noise and vibration mitigation measures to minimise impacts as relevant to this proposal as a whole.

The CNVS and CEMF are discussed further in Chapter 20 (Synthesis) of this Environmental Impact Statement.

Mitigation measures that are specific to the operation of the metro tunnels are listed in Table 16-2.

Table 16-2 Noise and vibration mitigation measures – Tunnels

Ref	Impact/issue	Proposed mitigation measure	Timing
Noise and vibration			
EIS-NV3	Potential ground-borne rail noise	Track form would be confirmed as part of design development in order to meet the relevant ground-borne noise and vibration criteria from the Rail Infrastructure Noise Guidelines (EPA, 2013).	Operation

16.5 Non-Aboriginal heritage

This section provides an assessment of the potential impacts on non-Aboriginal heritage items as a result of the operation and construction (including fit-out) of the tunnels as part of this proposal. Further information on non-Aboriginal heritage, including a detailed methodology and assessment, are provided in Technical Paper 5 (Non-Aboriginal heritage).

16.5.1 Baseline environment

The tunnel alignment is located beneath a number of Non-Aboriginal heritage items and conservation areas, including some local, State, World, National or Commonwealth heritage items.

16.5.2 Impact assessment

As discussed in Section 16.4.3, fit-out of the tunnels during construction would occur up to 24 hours per day and seven days per week. As these works would occur underground and are relatively minor in nature, potential noise impacts on heritage items would be negligible. In addition, ground-borne vibration associated with the operation of this proposal is also predicted to be well below the cosmetic damage screening levels and human comfort vibration levels at all heritage items. As such, there would be no noise and vibration impacts on heritage items or conservation areas (including local, State, World, National or Commonwealth heritage) located above the tunnel alignment during construction and operation of this proposal.

Potential ground movement impacts during tunnel excavation were assessed in Chapter 18 of the *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a) and Chapter 14 of the *Sydney Metro West Environmental Impact Statement – Major civil construction between The Bays and Sydney CBD* (Sydney Metro, 2021a). This proposal includes fit-out work within the already constructed tunnels, that would not result in further ground movement impacts compared to those assessed under the previous Sydney Metro West planning applications.

16.5.3 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

Non-Aboriginal heritage during construction of this proposal would be managed in accordance with Sydney Metro's CEMF (refer to Appendix F). The CEMF includes heritage management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.

16.6 Soils, contamination and groundwater

This section describes the potential soils, contamination and groundwater impacts of operation of the tunnels.

The legislative context and methodology for the soils and groundwater assessment is provided in Appendix B (Detailed assessment methodology).

The legislative context and methodology for the contamination assessment is provided in Technical Paper 7 (Contamination).

16.6.1 Baseline environment

The existing groundwater environment along proposed tunnels for this proposal is largely consistent with the environment described in *Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD* (Sydney Metro, 2020a) and *Sydney Metro West Environmental Impact Statement – Major civil construction between The Bays to Sydney CBD* (Sydney Metro, 2021a).

The work carried out under the previous Sydney Metro West planning applications would involve the excavation of the tunnels. The tunnels will be lined with precast segmental linings as tunnelling progresses. The tunnels would also predominantly be located in Ashfield Shale, Mittagong Formation and Hawkesbury Sandstone geology with low hydraulic conductivity and storativity (i.e. a measure of the capacity of the aquifer to release groundwater). As excavation and lining of the tunnels would be completed as part of the work carried out under the previous Sydney Metro West planning applications, soils and contamination impacts are not discussed further in this section.

The tunnels would be lined with precast segmental lining at commencement for this proposal, and as such, would result in groundwater inflows in accordance with design criteria for maximum allowable seepage rates. As a result, localised groundwater drawdown is considered to be negligible.

16.6.2 Operational impact assessment

As the tunnels will be tanked at completion of the work carried out under the previous Sydney Metro West planning applications, there would be no dewatering required during operation of this proposal. As a result, there are not anticipated to be any soils, groundwater or contamination impacts during operation of the tunnels.

The influence of the tunnel on the overall groundwater levels and regional flow patterns are expected to be minimal due to the lining the tunnel to minimise groundwater seepage.

Any long-term groundwater inflows would be collected, treated at the operational water treatment plant at the Clyde stabling and maintenance facility, and discharged in accordance with the water quality requirements outlined in Section 18.9 (Hydrology and water quality) of this Environmental Impact Statement, as well as the relevant operational environmental management plan (post this Environmental Impact Statement).

16.6.3 Construction impact assessment

Prior to commencement of construction of this proposal, the tunnels would be lined as tunnelling progresses. The lining would reduce the groundwater inflows to the design criteria for total allowable seepage rates that would result in minimal impacts to groundwater levels, groundwater quality and regional flow patterns.

Groundwater inflows (considered to be limited to the total allowable seepage rate/s for the lined design) would be collected, treated at construction water treatment plants, and discharged in accordance with the water quality requirements outlined in Section 18.9 (Hydrology and water quality) of this Environmental Impact Statement.

16.6.4 Management and mitigation measures

Environmental management for this proposal would be undertaken through the environmental management approach as detailed in Chapter 20 (Synthesis) of this Environmental Impact Statement. This includes operational mitigation measures (where relevant) and performance outcomes for the operation and construction of this proposal.

Soils, contamination and groundwater during construction of this proposal would be managed in accordance with Sydney Metro's CEMF (refer to Appendix F). The CEMF includes soil, contamination and groundwater management objectives and mitigation measures to minimise impacts as relevant to this proposal as a whole.