

MELBOURNE METRO RAIL PROJECT ENVIRONMENT EFFECTS STATEMENT
INQUIRY AND ADVISORY COMMITTEE

MMRA TECHNICAL NOTE

TECHNICAL NOTE NUMBER: 038
DATE: 19 August 2016
PRECINCT: All Precincts
EES/MAP BOOK REFERENCE: EES Chapter 19; Technical Appendix P – Ground Movement and Land Stability
SUBJECT: Ground movement and land stability
Response to Section 13 of the ‘Preliminary Matters and Further Information’ Request.

NOTE:

1. This Technical Note responds to the matters identified in Section 13 of the ‘Preliminary and Further Information’ request made by the IAC on 25 July 2016 (**Request**).
2. For ease of reference, this Technical Note adopts the topic headings set out in the Request and reproduces the relevant ‘references’ and ‘requests’ prior to setting out MMRA’s response.

13.1 ‘Real time’ monitoring programs

(i) Reference

Section 19.1: Overview, p19.4 notes:

In addition, real time monitoring programs would be implemented from the onset of construction to confirm the impact assessment and manage and document the implementation of any mitigation measures.

(ii) Request

The IAC requests:

71. *more detail on what is proposed with ‘real-time’ monitoring across the Precincts for designated areas warranting such action*
72. *confirmation that the MMRA is proposing to set-up a reliable measure of a ‘baseline’ condition with this monitoring.*

MMRA Response:

3. Real time monitoring refers to systems where the results are available for review almost immediately if needed, and at a frequency of readings that is matched to the anticipated rate of change of the measurement being taken. As an example, systems that are monitoring movements of a sensitive building, whilst construction of Melbourne Metro is underway in its vicinity, could be automated to take readings from survey target prisms and transmit the information to a computer. The computer would be programmed to analyse the data, and automatically issue an alert, for example by SMS to a list of recipients, if a defined threshold value is reached. Real time monitoring can also result in readily available records for review of trends. These systems can be used to measure displacements, tilt, groundwater levels, and even movement across existing cracks.
4. Real time monitoring is not a method expected to be employed to establish the baseline measurements of ground levels across the Melbourne Metro project area, as baseline monitoring is taken at wide intervals of time (up to 3 months) over an extended period, preferably twelve months or more. Baseline monitoring is discussed in Section 11.4.1.1 of Technical Appendix P Ground Movement and Land Stability Impact Assessment of the EES.
5. Settlement arrays, comprising of a line of pins to measure a change of surface profile, and individual settlement monitoring points have both been established along the Melbourne Metro alignment. Settlement monitoring points have also been positioned in the areas potentially affected by groundwater drawdown, which are also areas where the ground surface might currently be moving due to natural occurring or other reasons. Initial level readings have been taken in respect of the Project.
6. A programme of readings at approximately three monthly intervals has been implemented to track the ground movements until PPP contract award. The monitoring results and responsibility for ongoing readings would then be transferred to the Contractor.

13.2 Soft sediments – creep compression and monitoring

(i) Reference

Section 19.4: Background, Section 19.4.2: Ground Movement Mechanisms, p19-7 on 'Secondary compression', notes:

This type of settlement occurs both as a natural process as a result of to (sic) the consolidation which occurs due to the self-weight of the soil, as well as due to historical activities such as fill placement. This settlement is not expected to be exacerbated by Melbourne Metro activities or other environmental effects of Melbourne Metro.

(ii) Request

The IAC requests advice on:

73. *whether there will be any creep (secondary compression) effects in soft soils/sediments associated with dewatering effects that may need to be considered*
74. *with proposed baseline monitoring, whether it would be appropriate or necessary for long lead-in monitoring to be commenced, so that any existing/incumbent creep consolidation effects along the alignment could be differentiated/separated from any induced creep effects from the Project.*

MMRA Response:

7. Secondary consolidation is only expected to be of any significance in the Coode Island Silt, where it is already occurring. Areas of Coode Island Silt that might be affected by drawdown of ground water are in Kensington (mainly under J J Holland Park, and the rail and industrial areas south of the alignment), around the Moonee Ponds Creek, between Lloyd Street and Laurens Street, immediately adjacent to the Yarra River, and offset from the alignment towards Kingsway near Domain Station. These areas are indicated in Figures 19.1 to 19.4 of Chapter 19 of the EES. The geotechnical assessment undertaken by Golder Associates identifies that the long term trends of secondary consolidation are the natural background settlement that is expected to occur regardless of whether the Melbourne Metro is constructed or not (Section 3.4.5 of the Ground Movement Assessment EES Summary Report by Golder Associates (Appendix B to Technical Appendix P of the EES)).
8. The ground movement measurements taken to establish a baseline are ideally conducted over at least a year in order to determine seasonal variations related to the moisture content of the near soils. The monitoring of ground movement has commenced, meaning that there will be a year or more of records before any of the construction that is likely to affect ground water in any significant way is started. This should be a sufficient time to also indicate longer term trends from ongoing secondary consolidation. There is also data already available about typical consolidation rates for Coode Island Silt.

13.3 Design load statement for tunnels

(i) Reference

Section 19.6: Risk Assessment, p19-16.

(ii) Request

The IAC requests:

75. *whether design load statements (i.e. from the surface, near-surface or laterally from substantial basements or footings placed nearby) have been prepared for cut and cover tunnel segments, cavern construction and TBM drilled tunnels, and if so whether they have been relied upon in the preparation of the EES.*

MMRA Response:

9. Building loads have not been used for the derivation of the Level 1 and Level 2 assessments made for the EES. The methods used at these levels do not rely upon surface loading specifically for estimating ground movements. Estimates of surcharge have only been used directly for the Level 3 assessments when applicable, and have been based on the loads from existing buildings. In the absence of detailed information on the adjacent buildings or other structures, these have been based on, for example, typical loadings per floor.

13.4 Minimum pillar width setting for tunnels

(i) Reference

Section 19.6: Risk Assessment, p19-16.

(ii) Request

The IAC requests:

76. *whether a minimum pillar width will be set for the tunnels, with respect to both TBM tunnels and the connecting caverns.*

MMRA Response:

10. It is not intended to specify a minimum pillar width. The stability of the ground between excavations is essentially integrated with the design of the ground support and nature of the ground. There are a number of construction methods for minimising the width of a pillar if required, including strengthening a rock pillar by installing rock bolts (pillar stitching), or replacing weaker ground with concrete before the main excavations are completed.

13.5 Mitigation measures to limit ground movement

(i) Reference

Section 19.8: Impact Assessment, Section 19.8.2: Measures to Limit Ground Movement p19-21 notes:

Ground improvement measures (pre-injection, jet grouting, etc.) may be adopted at some locations to improve ground mass strength and resist local deformation. Additional mitigations for potential ground movement risks may also need to be incorporated in the final design and adopted construction method.

(ii) Request

The IAC requests advice on:

77. *the 'additional mitigation' measures likely to be deployed*

78. *how pressure grouting measures will deal with sensitive surrounding receptors to grout inflows and loss of grout control (i.e., basement tie-back holes, sewers, old existing monitoring wells, other preferred flow pathways).*

MMRA Response:

11. Under pinning or compensation grouting are examples of mitigation techniques that might be used if less intrusive methods are not likely to be sufficiently effective. The options would be determined depending upon the particular circumstances, with consideration of the form of the movement being mitigated and the nature of the structure being protected.
12. Managing the use of pressure grouting would include checking for adjacent voids, and adopting it as a mitigation measure only if the risk was acceptable. Ground improvement using pressure grouting would be expected to be applied at the tunnel or cavern level, and therefore would generally be below the types of potential receptors identified. This would reduce the risk of grout entering the types of assets described. There would also be management measures available, such as checking grout volumes against predictions to minimise risks created by unknown structures.

13.6 Plans for baseline monitoring

(i) Reference

Section 19.8: Impact Assessment, Section 19.8.2: Measures to Limit Ground Movement, p19-21 notes:

The assessment assumes that ground movements and associated potential impacts would be minimised by adopting sound engineering practices which would include engaging contractors with the appropriate levels of skill and experience, using the proposed or equivalent construction methodologies to those in the Concept Design and managing the excavation sequencing and appropriate controls on TBM operation. In addition, comprehensive ground movement and groundwater monitoring programs would be implemented from the onset of construction.

(ii) Request

The IAC requests advice on:

79. *whether there are further plans to conduct comprehensive baseline monitoring (movement and groundwater) leading into construction, and if so, for how long will such baseline monitoring be undertaken.*

MMRA Response:

13. Monitoring systems to measure ground movement and groundwater levels have already been established. Both of these systems will be monitored regularly to establish baseline values until construction commences. This information and the monitoring systems themselves would be provided to

the contractor. After that, measurements at the same points become construction monitoring. It is expected that monitoring of these points (along with additional monitoring systems established by the contractor to monitor specific construction effects) would continue during the construction that would affect the area, and remain until any resulting movements have stabilised.

13.7 Diaphragm wall structures or similar – soft sediments surrounding

(i) Reference

Section 19.8.2 Measures to Limit Ground Movement, pp19-21, notes:

Potential for impacts to existing structures and infrastructure cannot be eliminated and would be managed through the adoption of measures to limit ground movement. Measures would be taken to limit ground movement around an excavation or its propagation to ground surface level. Ground improvement measures (pre-injection, jet grouting, etc) may be adopted at some locations to improve ground mass strength and resist local deformation. Additional mitigations for potential ground movement risks may also need to be incorporated in the final design and adopted construction method”.

(ii) Request

The IAC requests further detail on:

80. the wall support/staging/propping systems to be deployed for those tunnel alignment areas where diaphragm external walls or similar are proposed to be placed through softer sediments for Station Box construction: (i.e., Arden Street, Parkville, Domain) and where normally applied anchor tie-back systems cannot be relied upon for lateral support of these walls (due to the significant presence of the surrounding softer sediments).

MMRA Response:

14. The proposed construction methodologies adopted for the assessments of the cut and cover stations are described in Section 6.6.6 of Chapter 6 of the EES. The methodology shown in the associated diagram (Figure 6-13) shows internal props, struts spanning across the excavation in this case, being used for support of the walls. The particular sequence in this diagram is for the “top down” method, where the roof slab is cast early in the sequence, and then excavation and propping of the walls continues below the roof slab. This is noted as an option for Parkville, and as part of the solution for Domain. It is proposed that Arden would be constructed using the “bottom up” sequence, that is, that the walls are temporarily propped progressively as the station is excavated and then the final station structure is constructed up from the base.
15. The design of the temporary supports of the walls is usually the responsibility of the Contractor because it is preferable that temporary

works are designed in detail to match the construction methodology. For the EES, the deflections of the walls were derived from models using an assumed sequence of propping and excavation, with typical temporary structures (struts) assumed for prediction of wall deflections leading to ground movement. These were assessed to confirm that it is feasible to achieve acceptable performance, but there are other ways that a similar result can be achieved, for example in the lower sections of Parkville where the tie-back ground anchors could be used.

CORRESPONDENCE:

No correspondence.

ATTACHMENTS:

No attachments.