MELBOURNE METRO RAIL PROJECT ENVIRONMENT EFFECTS STATEMENT INQUIRY AND ADVISORY COMMITTEE

MMRA TECHNICAL NOTE

TECHNICAL NOTE NUMBER:	074
DATE:	6 October 2016
PRECINCT:	All Precincts
EES/MAP BOOK REFERENCE:	N/A
SUBJECT:	Response to the 'Matters for further consideration and/or clarification' request dated 12 September 2016 (viii) Station boxes and shafts – consideration for buoyancy uplift on tanked structures

NOTE:

1. This Technical Note has been prepared to respond to issues raised by the Inquiry and Advisory Committee (**"IAC"**) in the 'Matters for further consideration and/or clarification' request dated 12 September 2016.

2. For ease of reference, this Technical Note sets out each relevant request made by the IAC followed by a response from MMRA.

Request:

3. The IAC has requested:

   Anthony Bennett identified that work had been done on the issue of buoyancy (due to surrounding groundwater across the longer-term) and potential mitigation measures, as part of the structural integrity of the Project. Can that work be provided to the IAC (global buoyancy implications of Station Boxes and specific uplift implications on the base slab of the Station Boxes).

Response:

4. In developing the Concept Design for Melbourne Metro, a structural analysis was undertaken in relation to each MMRP station, shaft and portal. Among other issues, the analysis considered the load implications of groundwater on the temporary and permanent structures.

5. With regard to the issue of buoyancy loads (water pressure upon the underside of structures), Melbourne Metro structures were assessed against global buoyancy in accordance with BS EN1997-1:2004, with the brief to:

    a. Be able to resist buoyancy at all stages of construction and throughout the design life of the structure;

    b. Consider groundwater levels that are based upon the highest credible extreme event water table during both construction and operation;

    c. Determine buoyancy resistance with consideration of only the minimum structural weight of the part of the underground structure that is in place at the time of the assessed load (i.e. only a 'shell' structure, without full fit out); and

    d. Determine overall stability by comparing the net result of the addition of factored down stabilising forces (structural self-weight, surcharge, and frictional resistance) with factored up destabilizing forces (buoyant uplift).

6. This assessment was completed as part of the broader structural design process for Melbourne Metro. As a result, the assessment is not in a form which can readily be extracted and provided to the IAC.

7. In certain cases (particularly for the Station Boxes), the results of the buoyancy assessment indicated that the self-weight of the walls, slabs and roofs of the structure were insufficient to alone resist buoyant uplift.

8. To address these issues, the design of each Station Box has included the provision of tension piles. These piles are heavily reinforced concrete elements that extend down from the base slabs into the ground. These tension piles provide further downward resistance for the Station Boxes by:

    a. Contributing additional structural surface area in contact with the ground that can mobilise frictional resistance; and

    b. Providing additional self-weight.

9. The determination of frictional resistance between structural elements and the surrounding soil has only been taken into account where evidence, based on in situ tests, is available to justify the friction coefficient being

adopted. This coefficient may differ from structure to structure, due to local geotechnical characteristics.

10. The inclusion of tension piles within each Station Box provided sufficient mobilised resistance to stabilise the Station boxes against global buoyant uplift. With these inclusions, Melbourne Metro structures developed within the *Concept Design* are compliant to BS EN1997-1:2004. Accordingly, there are no global stability implications for the Station Boxes under the highest credible extreme water table events.

11. In addition to the consideration of global buoyancy, Melbourne Metro structures have been designed to have sufficient capacity to resist local buoyancy loads between the restraining elements (such as the retaining piles and tension piles).

CORRESPONDENCE:

No correspondence.

ATTACHMENTS:

No attachments.