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Sunbury Culvert Modification Temporary Support and Staging

Joe Abraham, Temporary Works Coordinator, CPB Contractors
Jawad Zeerak, Associate Principal Geotechnics, EIC Activities
Max Un, Principal Structural Engineer, AECOM
Megan Ward, Graduate Engineer Geotechnics, EIC Activities

ABSTRACT

To take full advantage of the extra capacity on the rail network created by the Metro Tunnel, a range of enhancements are needed on the Sunbury Line to allow larger, more modern trains to run. The Sunbury Line Upgrade (SLU) will see various upgrades within the rail corridor extending from Footscray to Sunbury. As part of this project, Rail Infrastructure Alliance (RIA) is upgrading power, train stabling, station platforms and other associated infrastructure along the Sunbury Line. To accommodate the installation of additional rail track near Sunbury station, an extension to an existing bluestone culvert at Sunbury, constructed in 1859, was proposed. This culvert structure features steel deck, and substructure of bluestone masonry abutments, wing walls and invert slab. Part of the existing invert slab which provides propping support, was required to be demolished for the construction of the extension. Due to an operational rail environment, this scope had to be delivered during limited rail occupations. A temporary works design and staging solution was developed to ensure safe demolition of the culvert invert slab and construction of the permanent structure during live train operation, while maintaining the stability and limiting movement of the existing bluestone wingwall. The solution consisted of temporary propping and a comprehensive staging plan. This paper discusses the various options considered, design development, challenges, methodology and monitoring of culvert and tracks during construction including performance of the temporary propping from a design and construction perspective.

1 INTRODUCTION

The Sunbury Line Upgrade (SLU) is being delivered in part by the Rail Infrastructure Alliance (RIA) to provide rail infrastructure upgrades to support the Metro Tunnel Project and deliver major improvements in capacity, reliability, and frequency of services on the Sunbury Line. RIA is an alliance between Rail Projects Victoria (RPV), CPB Contractors, John Holland, Metro Trains Melbourne (MTM) and AECOM. A combination of power upgrades and platform modifications is needed to enable future High Capacity Metro Trains (HCMTs) to operate along the existing Sunbury Line. CIMIC's engineering and technical services business EIC Activities (EIC) provides design and technical support to the project.

SLU will see various upgrades within the rail corridor extending from Footscray to Sunbury. To enable the addition of a new track at Sunbury, widening of the existing heritage listed, masonry bluestone culvert (Sunbury culvert) was required. This paper discusses the design, staging and construction of the temporary works to enable the bridge modification works. The temporary support scheme and staging plan, in addition to ensuring stability and integrity of the structure, also allowed the Sunbury train line to remain operational throughout the construction period.

1.1 Existing Sunbury culvert

The Sunbury culvert was constructed in 1859 on the Sunbury train line with bluestone masonry. It is of regional significance as one of the original structures on the Melbourne to Bendigo railway (Figure 1 below). Over time, the Sunbury culvert has undergone some modifications to adapt to the changing rail environment. The most recent modification was undertaken in 2003 as part of the regional fast rail project which replaced the deck to steel troughs supported on steel beams.

The initial site investigations undertaken by RIA, ascertained the existing invert slab provided support to the wingwalls. Initial stability checks further confirmed that removal of invert slab or parts of it would have an inverse effect on the stability of the existing structure. In addition, the masonry structure was considered to be sensitive to excessive movements which could result in development of tensile

forces within the structure in particular at the joints. Therefore, a temporary support scheme was required to ensure stability of the wing walls and existing structure during construction and limit any movements on the structure.

1.2 Proposed Deck Widening

RIA is undertaking widening of the existing Sunbury masonry culvert as part of the SLU scope of works. The widening works involve a new concrete structure on new pile foundations. This requires partial demolition of the existing invert slab of the culvert to facilitate the construction of the new substructure. The demolition works comprises partial removal of the existing bluestone invert slab for an area of 2.5m x 4.75m to 400mm below the existing invert at the lowest point below the curved slab. An extract from design of the proposed modification and widening works is shown in Figure 2 below.

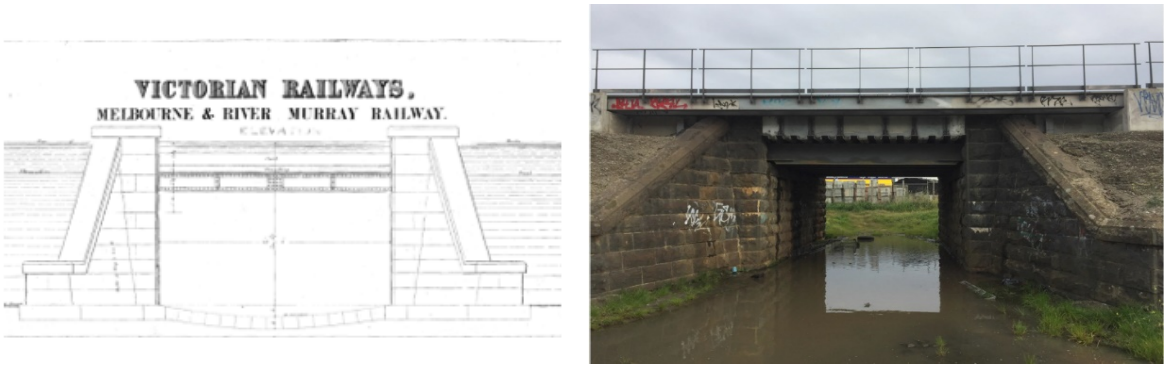

Figure 1 – Historical drawings of Sunbury culvert (L), Existing culvert before widening works (R)

2 GEOTECHNICAL CONDITIONS

Despite a relatively consistent geology area across the larger site, the local geology and subsurface ground conditions at the location of the culvert structure was relatively complex and variable. As can be seen in an extract from Geological Survey of Victoria (GSV) Sunbury Map sheet, Quaternary aged Newer Volcanics basalt (Qvn) covers most of the site to great extents, with colluvium deposits (Qrt) locally found within the Sunbury culvert area as shown in Figure 2.

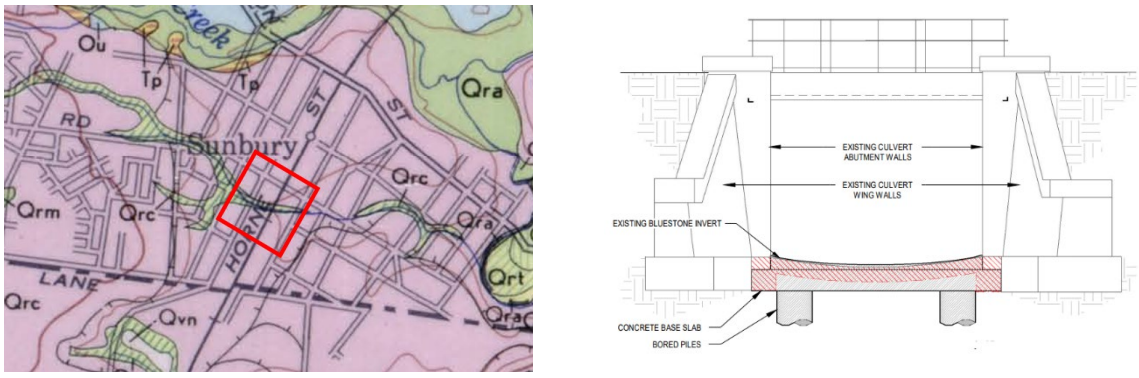

Figure 2 – Sunbury Mapsheet, GSV (L), Proposed modification of culvert (R)

Additional boreholes and piling works for the structure foundation, revealed high strength conglomerates at restively shallow depths below the existing surface.

A design subsurface ground profile and associated geotechnical parameters were assessed based on the available site investigation data and used in the geotechnical analysis which are generally in line with the parameters used in the design of the bridge widening works.