NOTE: 1. This Technical Note has been prepared to respond to the Traffic and Geometric Design proposed by Andrew O'Brien in his expert witness statement dated 15 July 2019 (the O'Brien Proposal).

DESCRIPTION
1) Mr O'Brien’s witness statement includes an ‘Alternative Design’. It is referred to here as the ‘O'Brien Proposal’.

2) In broad terms the O'Brien Proposal includes the following features:
   a) on ramp-metering to manage weaving on the freeway;
   b) a simplified M80 interchange to NEL with a reduced number of structures;
   c) a diverging diamond interchange at Grimshaw Street;
   d) an additional connection to Alexandra Parade at the city end of the Eastern Freeway;
   e) the relocation of the express busway to the centre median of the Eastern Freeway from Hoddle Street to Bulleen Road, crossing to the north side of the freeway east of Bulleen Road; and
   f) the removal of the braided ramps between Tram Road and Middleborough Road (as provided in the Reference Project).

3) It is noted that the O'Brien Proposal is premised on preserving the functionality of the Reference Project. To the extent that any further design, including aspects of the O'Brien Proposal, can be demonstrated to preserve functionality while complying with all applicable EPRs and other relevant road design requirements, the design could be considered in the preparation and assessment of the final design.

4) In the time available, and to facilitate discussion, NELP has undertaken an initial review of the O'Brien Proposal and identified a list of items that would require further consideration, design and resolution. These items generally relate to compliance with relevant road design standards and guidelines and impacts on existing and/or future infrastructure and traffic performance.
5) This Technical Note lists the items by reference to the following project areas:
   a) M80 to Eastern Freeway;
   b) Eastern Freeway;
   c) Express Busway Corridor.

6) It considers both the feasibility and functionality of the proposal.

FEASIBILITY

M80 TO EASTERN FREEWAY

7) The O’Brien Proposal does not meet relevant Austroads Guidelines and Standards (*Austroads Guide to Traffic Management: Part 6*) for some key aspects including minimum distances for changes to the speed environment, merge and diverge configurations, and storage. For example:
   
   a) Variations in the speed environment along parts of the M80 (and more specifically within proximity to the Plenty Road exit) do not comply with the minimum distances specified in the Guidelines (changing from 80 km/h – 100 km/h – 80 km/h within 1300 metres as opposed to the minimum distance of 1500 metres);
   
   b) The Grimshaw Street entry ramp does not comply with the minimum length specified in the Guidelines (being 60 metres as opposed to the minimum 120 metres);
   
   c) The Watsonia Road connection is not adequately separated from the adjacent intersection and would not provide sufficient storage to facilitate traffic movements without flow breakdown.

8) Other aspects of this component of the design that would require further mitigation or consideration include the following:
   
   a) The connection of the bus interchange over Watsonia Station:
      
      i) The O’Brien proposal includes a bus interchange over Watsonia Station that cannot connect to Watsonia Road whilst meeting Austroads guidelines and standards.
      
      ii) The interchange has been placed above the existing rail levels for clearance however this would result in the interchange being at least 2m above the existing railway car park level and 3.5m above Watsonia Road at the proposed connection point.
      
      iii) If Watsonia Road is adopted as the level for the bus interchange, then it will have flow-on effects for the levels for the station car park, Greensborough Road and the power line easement east of Greensborough Road.

   b) The spacing of intersections along Watsonia Road:
      
      i) The bus interchange is proposed to connect to Watsonia Road, creating a section of that road containing two intersections within 60m of each other.

   c) Impacts on transmission lines:
      
      i) The bus interchange crosses the rail line to a new road connection in the transmission reservation that will require towers to be relocated closer to residential areas and potentially impact the clearance requirements associated with the transmission lines.

   d) Impacts on pedestrian ramps and Watsonia Station:
      
      i) The bus interchange will require the existing pedestrian ramps connecting to Watsonia Station to be reconstructed and an upgrade to Watsonia Station.

   e) Proximity of intersections:
The new roundabout at Richards Road is placed 60m from a signalized intersection in Greensborough Road.

Consideration of operational difficulties would be necessary if queues at the signalized intersection extend back into the roundabout.

The arrangement at Greensborough Road northbound (north of the Nell Street intersection) would likely cause late lane changes and unsafe operations due to the short distance for commuters to make a decision and select the right lane to match their destination leading up to Grimshaw Street.

No provision has been made for noise walls.

The O’Brien Proposal does not meet relevant Austroads Guidelines and Standards (Austroads Guide to Traffic Management: Part 6) for entry and exit ramps:

a) The entry ramp geometry at Elgar Road, Tram Road and Springvale Road has a merge lane from three lanes to one without achieving the minimum distance of 150m. It is also noted that at this location the storage length is less than the requirements of the Project.

b) The entry ramp geometry at Middleborough Road does not comply with VicRoads Guidelines, which require that a merge from two lanes to one lane has a minimum distance of 80m to the nose of the ramp.

c) The distances between the entry ramps and exit ramps at the following locations do not comply with the Austroads Guidelines which require a distance of 1500m in between entry ramps and exit ramps for carriageway of four or more lanes:

i) the Tram Road Entry Ramp and Middleborough Road Exit Ramp (which are approximately 740m apart).

ii) the Middleborough Road Entry Ramp and Tram Road Exit Ramp (which are approximately 680m apart).

The Proposal also adopts a number of arrangements along the Eastern Freeway corridor that need further consideration to meet Project requirements. These include:

a) The eastbound carriageway:

i) The realigned and regraded eastbound carriageway of the Eastern Freeway from Alexandra Parade under the loop entry ramp to Hoddle Street would impact the main drain to Merri Creek, which is located in the median of Alexandra Parade (and under the loop entry and outside of the Project boundary);

b) The NEL/Eastern Freeway ramp connections:

i) The arrangement of the NEL southbound to Eastern Freeway westbound ramp adopts a radius of 200 – 220m which would not meet the minimum 240m distance specified in the Guidelines and sight distance standards for a design speed of V80kph;

c) Impacts on the golf course overpass:
While the attempt to minimize impact on the sports and recreation facilities is acknowledged, the alignment of the Eastern Freeway eastbound to the NEL northbound ramp would remove the northern abutment of the golf course access overpass and would require earthworks impacting the golf course.

d) The Doncaster Road entry ramp:
   i) The Doncaster Road westbound entry ramp is shown as splitting into separate entries directing commuters to the Eastern Freeway carriageway and NEL carriageways. No details were provided to demonstrate the dual right turns within the Doncaster Road interchange and any impact on overpass width, interchange functional layout and the High Street intersection.
   ii) Due to the number of lanes on the Eastern Freeway under Doncaster Road, this structure would need to be reconstructed and would need to include the additional width shown in the Proposal.

EXPRESS BUSWAY

11) The busway arrangement shown in the O’Brien Proposal requires further consideration, including in respect of:

   a) The busway connection to the Eastern Freeway median:
      i) The busway connection in the median of the Eastern Freeway carriageway under the Hurstbridge rail overpass to the Hoddle Street overpass would require grades exceeding current standards (8-10%).
      ii) To mitigate these grades, the ramps would need to be extended and would potentially impact upon existing infrastructure.

   b) The location of the busway in the Eastern Freeway median:
      i) Locating the busway in the median of two freeway carriageways introduces safety issues that would require mitigation.
      ii) The busway would at the least need to have provision for emergency access and egress points in the event of an incident.

   c) The dimensions of the busway and its capacity to be modified in the future:
      i) The dimensions and arrangement of the proposed busway restricts flexibility for the construction of future infrastructure such as future stations at Chandler Highway and Burke Road.
      ii) The proposed busway also does not have sufficient width to be converted to a rail corridor in the future (unless the overall freeway carriageway is realigned into public open space).

   d) The introduction of an extended underpass:
      i) The O’Brien Proposal features a busway underpass in excess of 80m in length introducing ventilation, flooding and fire and life safety considerations.

   e) The Thompsons Road entry ramps:
      i) The proposed underpass at the Thompsons Road entry ramp conflicts with the existing large Koonung Creek culvert and would require the entire Koonung Creek culvert to be reconstructed over a significant length.
ii) The O’Brien proposal does not provide sufficient length at the Thompsons Road bus station. A minimum of 90m is required and only 45m is provided. A longer length is likely to impact the vertical grade line of the Proposal.

f) The section between Doncaster Road and Springvale Road:
   i) The busway would need further consideration and design to be feasible from Doncaster Road to Springvale Road.
   ii) The Doncaster Park and Ride connection is unlikely to be able to be graded below Doncaster Road to the roundabout, and the freeway carriageway does not provide shoulders wide enough to accommodate bus use from Doncaster Road to Springvale Road.
   iii) It would appear to be possible to design lanes with sufficient width for buses and connection to the busway to the Park and Ride, provided further impacts are accepted for loss of public open space and disruption during construction.

g) Drainage considerations:
   i) The busway is within a floodplain and would require significant drainage pumps.

h) The connection of the busway to Alexandra Parade:
   i) The Department of Transport and Bus Operators have not indicated that the buses will need to travel to Alexandra Parade. Therefore, the connection provided could potentially be redundant infrastructure.

i) Construction considerations:
   i) Construction of a busway under the active Eastern Freeway would take considerable time and would result in significant staging and construction complexity and associated costs. This would arise because of the need to realign the freeway whilst the tunneled underpass is being constructed.

FUNCTIONALITY

12) The layout of the O’Brien Proposal has been tested within the microsimulation model to assess its performance. It should be noted that, because the O’Brien Proposal is two dimensional, this test does not consider issues with grades or compliance with relevant standards. As such, the assessment provides a best-case scenario. This assessment also does not consider safety issues (such as those associated with the extended sections of six lane freeway and the increased risk of crashes).

EASTERN FREEWAY

13) Most freeway sectors performed at an average density Level of Service (Loss) D or better. The following items are noted in this respect:

   a) It should be noted that the microsimulation model cannot model the capacity impacts of tight radius curves such as those located between Bulleen Road and Doncaster Road with specific regard to lane changing and weaving. The O’Brien Proposal proposes this section of freeway to be six lanes wide without addressing the tight radius of this curve. The microsimulation model will be over estimating the performance of this section of the Eastern Freeway.

   b) The westbound diverge to Bulleen Road in the AM Peak period performed at LoS E. This appears to be as a result of the single lane diverge and reduced storage provided on the exit ramp when compared to the Reference Project.

   c) An examination of density results reveals uneven lane utilisation and significant lengths of lanes with density LoS E and F in the eastbound and westbound weaves between NEL and Doncaster.
Road, in both peak periods. In the AM peak period, the kerbside lane of the westbound diverge to Bulleen Road performs at a combination of LoS E and F. In the PM Peak period, the ramp from the Eastern Freeway eastbound to NEL northbound sees significant congestion, as the added lane has been removed from the merge with NEL.

d) Density results also highlight changes in performance between Tram Road and Middleborough Road. In addition to reintroducing the Tram-Middleborough weaving movements to a single carriageway, the O’Brien Proposal removes the direct access ramps between the two arterials. This results in increased design volumes for the Eastern Freeway and the ramp meters in both directions. The relevant ramp meter cycle times were adjusted to account for the additional demand. In the eastbound direction in the PM Peak period, significant lengths of the kerbside lanes in the weave perform at LoS E and F. Heavy demand for the eastbound Middleborough Road exit manifests as density LoS E in the two kerbside lanes preceding the weave, extending west past the Elgar Road bridge. Similar effects are seen in the AM Peak period, to a lesser degree of severity.

e) On the arterial network, the key O’Brien Proposal changes that affect performance are around the Thompsons Road intersection with the eastbound entry ramp. The O’Brien Proposal reduces the number of stop lines at the ramp meter from three to two, and reduces the combined ramp meter storage from approximately 800 metres to 280 metres. The dual lane storage for the right turn from Thompsons Road to the entry ramp is shortened from approximately 180 metres to 70 meters. To partially compensate for the changes to ramp metering arrangement, the cycle time was lowered to the reasonable minimum of 6 seconds, in accordance with VicRoads’ ramp metering guidelines. In the AM Peak period, queueing for the ramp meter exceeds storage and blocks the upstream turning movements from Thompsons Road. The majority of vehicles using the ramp originate from Bulleen Road north, and the single left turn lane from Bulleen Road to Thompsons Road is also severely impeded, resulting in long queues on Bulleen Road north. The delay in this queue is attributed to the north side of Bulleen Road interchange, causing the overall intersection performance to drop from LoS C (Reference Design) to LoS E. Similar effects are seen in the PM Peak period, but are less severe and occur over a shorter time period, meaning the overall interchange performance matches that of the Reference Design (LoS C).

**WATSONIA AND M80**

14) A number of items were identified in respect of the following three specific sites:

a) Grimshaw Street interchange;

b) Watsonia Road/Greensborough Highway;

c) Greensborough Highway/Watsonia Station access.

**Grimshaw Street Interchange**

15) The O’Brien Proposal assumes that the Grimshaw Street interchange would remain as in the case of the Reference Project. However the O’Brien Proposal only allows for two lanes of significant storage on the northern approach rather than the four lanes allowed for in the Reference Project. This significantly reduces the performance of the interchange and causes lengthy queues on the northern approach to the interchange in the AM peak period and even greater queues in the PM peak. Re-allocation of green time to try and reduce these queues also had the impact of causing significant queues on the southern approach to the interchange during the PM peak period. In the AM peak period these issues resulted in a Level of Service (LoS) E for the overall interchange with a LoS F on the northern approach. In the PM peak period the interchange operated at a LoS F with further LoS F performance on the northern approach and Los E performance on the southern approach. Extensive queuing back onto the freeway was noted in the PM peak period affecting both the eastbound M80 and the northbound North East Link carriageways.
Watsonia Road/Greensborough Highway

16) In the O’Brien Proposal the Watsonia Road/Greensborough Highway signalised intersection appears to be slightly over-capacity in the AM peak and more significantly over-capacity in the PM peak. The key issues identified are insufficient storage on the Watsonia Road western approach and the impact of the pedestrian crossings opposing the flow of traffic exiting Watsonia Road. This leads to queues along Watsonia Road regularly extending back through the roundabout located 50m to the west. Bearing in mind the assumptions set out earlier, the microsimulation showed an overall LoS C for the AM peak and LoS F for the Watsonia Road approach due to issues with storage and pedestrian flows. In the PM peak hour the overall site performance was LoS E whilst the Watsonia Road approach was LoS F.

Greensborough Highway/Watsonia Station Access

17) For the O’Brien proposal, bearing in mind the assumptions set out earlier, the microsimulation for the intersection of Greensborough Highway and the Watsonia Station access operated at LoS B in the AM peak and LoS C in the PM peak. However it should be noted that the right turn storage for the south to east movement from Greensborough Highway into the newly included link was significantly exceeded for lengthy periods of the PM peak period and frequently blocked northbound through traffic on the Greensborough Highway.

18) The proposed location of the bus interchange above Watsonia Station will require connection to/from Watsonia Road itself. This intersection would most likely need to be signalised to allow for buses to turn to/from Watsonia Road. This signalised intersection would be in close proximity to the roundabout with Morwell Avenue and as such, it is possible the queues could extend back into the roundabout blocking flow. Bus route 566 currently runs along Watsonia Road and onto Morwell Avenue to connect to La Trobe University. Route 566 will not be able to use the proposed bus interchange above Watsonia Station as there is no opportunity for buses to turn around and continue its route. As a consequence it is likely that the proposed bus interchange would only be serviced by Bus Route 513.

19) Bus route 513 connects to Watsonia Station via Elder Street. In the O’Brien layout, the intersection of Elder Street and Greensborough Road is not signalised. Buses exiting Elder Street will need to find a gap in this traffic, which has free flow connections from the M80 Ring Road and Greensborough Bypass, and then merge across a lane of traffic to turn right into the proposed bus interchange. The design has a limited distance between these two intersections to allow for this to occur (of approximately 70m).

FREEWAY

20) Most freeway sectors performed at an average density LoS D or better.

21) The exceptions to this were in the PM peak period and were located where queues from the Grimshaw Street interchange now blocked back along the ramps and onto the freeway. This was noted on the M80 eastbound between the Plenty Road entry merge and the exit diverge to Greensborough Highway and Grimshaw Street where the lengthy queue from the Grimshaw Street interchange would interfere with the operation of the M80 weave in the latter stages of the PM peak. Additionally, the northbound North East Link carriageway between Lower Plenty Road and Grimshaw Street, would also be impeded at times by the queue from the Grimshaw Street interchange stop-line blocking back to the North East Link carriageway.

22) As an additional check, the reduction in freeway travel speeds caused by peak period congestion was assessed. This analysis showed that, in the northbound direction, the merge of the Grimshaw Street entry ramp with the M80 and also the subsequent merge of the Greensborough Highway entry ramp with the M80 are both subject to notable reductions in travel speed when compared with the Reference Project. This occurs in both the AM and PM peak periods.
23) It should also be noted that a three-lane ramp meter was required for the Grimshaw Street northbound entry ramp whereas the O'Brien Proposal provided only a two-lane ramp meter. The O'Brien Proposal was updated in the model to allow for this and to prevent queues from the meter stop-line interfering with the operation of the upstream arterial network.

OTHER INFORMATION

Nil