Victorian Planning Authority

Sunbury South and Lancefield Road Precinct Structure Plans (PSPs) – Infrastructure Design Study

Design report

15 December 2016

PARSONS BRINCKERHOFF

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Prepared by:	Ryan McCormack, Tim Page, Guy Wilkinson	Date: 02/12/2016	Signature:
Reviewed by:	Guy Wilkinson	Date: 15/12/2016	Signature:
Approved by:	David Rotton	Date: 15/12/2016	Signature:

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Parsons Brinckerhoff Australia Pty Limited *ABN 80 078 004 798* Level 15 28 Freshwater Place Southbank VIC 3006 Tel: +61 3 9861 1111 Fax: +61 3 9861 1144 www.pbworld.com *Certified to ISO 9001, ISO 14001, OHSAS 18001*

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1. Introduction

1.1 Background

The Victorian Planning Authority (VPA) is currently preparing Precinct Structure Plans (PSPs) for the expansion of the Sunbury Township. The Sunbury South and Lancefield Road PSPs, in the City of Hume, represent large scale development areas in the Sunbury-Diggers Rest Growth Corridor.

To inform the infrastructure contributions plans and the land use budgets, the VPA required concept designs to be prepared for proposed road, intersection, bridge and culvert projects within these PSPs.

1.2 Scope

Parsons Brinckerhoff was engaged by the VPA to undertake an infrastructure design study in the Sunbury South and Lancefield Road Precinct Structure Plans (PSPs). The original scope of this study was to:

- Prepare 2D concept designs for the:
  - Interim and ultimate arrangement of 11 intersections (SS-IT1 to SS-IT6, LR-IT1 to LR-IT5)
  - Ultimate arrangement of the arterial roads Lancefield Road (LR-RD1, SS-RD2), Sunbury Road (SS-RD1) and Vineyard Road (SS-RD3)
  - Ultimate arrangement of connector roads designated as SS-RD4, SS-RD5, SS-RD6, SS-RD7, SS-RD8, LR-RD2, LR-RD3 and a connector road known as Jacksons Hill Link Road (SS-RD9).
- Review existing concept design for each bridge and culvert project: LR-BD1, LR-BD2, LR-BD3, SS-BD2, SS-BD3 and SS-BD4.
- Develop a concept design for bridge projects LR-BD4 and SS-BD1.

During the study the following scope was added:

- Prepare concept designs for:
  - Interim and ultimate arrangement of SS-IT7 and SS-IT8
  - Ultimate intersection arrangement of SS-IT9 and SS-IT10.

Table 1.1 Sunbury South PSP infrastructure projects

Infrastructure project name	Project type	Scope	Comment
SS-RD1	Road	Ultimate concept design	
SS-RD2	Road	Ultimate concept design	
SS-RD3	Road	Ultimate concept design	
SS-RD4	Road	Ultimate concept design	
SS-RD5	Road	Ultimate concept design	
SS-RD6	Road	Ultimate concept design	
SS-RD7	Road	Ultimate concept design	

Infrastructure project name	Project type	Scope	Comment
SS-RD8	Road	Ultimate concept design	Ultimate concept design involves resurfacing works only (2 x 3.5 m lanes with a sprayed sealed shoulder)
SS-RD9	Road	Ultimate concept design	
SS-IT1	Intersection	Interim and ultimate concept design	
SS-IT2	Intersection	Interim and ultimate concept design	
SS-IT3	Intersection	Interim and ultimate concept design	
SS-IT4	Intersection	Interim and ultimate concept design	
SS-IT5	Intersection	Interim and ultimate concept design	
SS-IT6	Intersection	Interim and ultimate concept design	Intersection no longer required
SS-IT7	Intersection	Interim and ultimate concept design	
SS-IT9	Intersection	Ultimate concept design	
SS-IT8	Intersection	Interim and ultimate concept design	
SS-IT10	Intersection	Ultimate concept design	
SS-BD1	Bridge	Review design by others and prepare concept design	
SS-BD2	Culvert	Review design by others	
SS-BD3	Culvert	Review design by others	
SS-BD4	Bridge (road underpass)	Review design by others	

Table 1.2 Lancefield Road PSP infrastructure projects

Infrastructure project name	Project type	Scope	Comment
LR-RD1	Road	Ultimate concept design	
LR-RD2	Road	Ultimate concept design	
LR-RD3	Road	Ultimate concept design	
LR-IT1	Intersection	Interim and ultimate concept design	
LR-IT2	Intersection	Interim and ultimate concept design	
LR-IT3	Intersection	Interim and ultimate concept design	
LR-IT4	Intersection	Interim and ultimate concept design	
LR-IT5	Intersection	Interim and ultimate concept design	
LR-BD1	Bridge	Ultimate concept design	
LR-BD2	Bridge	Review design by others	
LR-BD3	Bridge (road underpass)	Review design by others	
LR-BD4	Culvert	Ultimate concept design	

Refer to drawings CIV-501 and CIV-502 in Appendix B for infrastructure project locations and extents.

2. Reference information

2.1 Externally supplied information

The following information was made available to Parsons Brinckerhoff by the VPA for use in this study:

Table 2.1 Externally supplied information and data

Document name	Author	Version/ date
Jacksons Creek Road Crossing PSP 1075 – Lancefield Road, Options Assessment and Development	GTA Consultants	A-Dr
Sunbury South and Lancefield Road PSP – Infrastructure Design and Costings (Grade Separations and Harpers Creek Crossing) draft report	Aurecon	0
Jacksons Creek Road Crossing PSP 1074 – Sunbury South, Options Assessment and Development	GTA Consultants	A-Dr
Jackson Hill Factsheet	Hume City Council	-
Future urban structure	Supplied by VPA	
Design Base Yirrangan way Option 2 sketches	Hume City Council	22/05/2012
Sketch CG130479SK05 – P2 Interim functional layout plan	Cardno	26/06/2014
Aerial imagery	Supplied by VPA	-
LIDAR data	Supplied by VPA	-
Development Services Schemes (Confidential)	Supplied by VPA	-
Creek and Grade Separation Crossing	Hume City Council	-
Cadastral boundaries	data.vic.gov.au	4/08/2015
PAO boundaries	data.vic.gov.au	12/08/2015
Growth Area Road Network Planning – Guidance and Policy Principles	VicRoads & VPA	-
VicRoads Tree Planting Policy	-	Feb-15
Tree data and cross sections of Vineyard Road	Hume City Council	-

A significant amount of investigative work had already been completed in the study area by others, as noted in Table 2.1, and this study relies on the outcomes of this previously completed work.

2.2 Design standards

The following design standards were used for the intersection and road design projects:

- Austroads Guide to Road Design (AGRD) – Part 3: Geometric Design
- Austroads Guide to Road Design (AGRD) – Part 4: Intersections and Crossings - General
- Austroads Guide to Road Design (AGRD) – Part 4A: Unsignalised and Signalised Intersections
- Austroads Guide to Road Design (AGRD) – Part 6A: Pedestrian and Cyclist Paths

- Austroads Guide to Road Design (AGRD) – Part 5B: Drainage – Open Channels, Culverts and Floodways
- VicRoads Supplement to the Austroads Guide to Road Design: Part 3 – Geometric Design
- VicRoads Supplement to the Austroads Guide to Road Design: Part 3 – Geometric Design
- VicRoads Supplement to the Austroads Guide to Road Design: Part 4 – Intersections & Crossings – General
- VicRoads Supplement to the Austroads Guide to Road Design: Part 6A – Pedestrian and Cyclist Paths
- VicRoads Traffic Engineering Manual Volume 2 – Chapter 16: Longitudinal Lines
- VicRoads Traffic Engineering Manual Volume 2 – Chapter 17: Transverse Lines
- Transport and Main Roads (QLD) Road Drainage Manual

3. Basis of design

The following sections identify the basis of design adopted for the concept design of the infrastructure projects.

3.1 Road and intersection projects

3.1.1 Design speed

Table 3.1 Design speed adopted for each road type

Road Type	Road Environment	Posted Speed Limit	Design Speed	Reference
Connector Street - Boulevard	Urban (when developed)	60 km/h	60 km/h	Growth Area Road Network Planning – Guidance and Policy Principles
Connector Street	Urban (when developed)	60 km/h	60 km/h	Growth Area Road Network Planning – Guidance and Policy Principles
Arterial (primary)	Urban (when developed)	80 km/hr	80 km/hr	Growth Area Road Network Planning – Guidance and Policy Principles

3.1.2 Horizontal geometry

Table 3.2 Horizontal geometry design limits

Criteria	Value	Comment	Reference
Minimum radius for adverse cross fall	60 km/h = 200 m 80 km/h = 500 m	Urban Side friction factor = 0.17 Urban Side friction factor = 0.13	VicRoads Supplement to AGRD, Part 3, Table V7.2
Minimum radius for horizontal curves with superelevation	60 km/h = 98 m 80 km/h = 240 m	Desirable min. friction factor	AGRD, Part 3, Table 7.5
Minimum horizontal curve length	60 km/h = 100 m 80 km/h = 180 m		AGRD, Part 3, Table 7.6
Merge Taper Length	100 m (60 km/h) 130 m (80 km/h)		AGRD Part 3 Table 9.8

3.1.3 Intersection turn lane lengths

The VPA provided sketches of the desired intersection arrangements required at each of the intersection locations. The turn lane lengths are based on the values nominated in *Table 4-1* from the *Growth Area Road Network Planning – Guidelines & Policy Principles* document, and as shown below:

Table 3.3 Typical turn lane lengths adopted for ultimate arrangement

Road Type	Turn Lane	Assumed turn volume	Total turn lane length (inc. taper)
Primary Arterial	Left	400 veh/hr	100 m (inc. 25 m taper)
	Single Right	200 veh/hr	200 m (inc. 25 m taper)
	Double Right	400 veh/hr	170 m (inc. 55 m taper)
Secondary Arterial	Left	400 veh/hr	100 m (inc. 20 m taper)
	Single Right	200 veh/hr	200 m (inc. 20 m taper)
Connector Street	Left	500 veh/hr	100 m (inc. 15 m taper)
	Right	500 veh/hr	100 m (inc. 30 m taper)

3.1.4 Typical cross sections

The cross sections shown in the figures below were used for the various road projects as summarised in Table 3.4.

Table 3.4 Road projects and the corresponding cross section adopted

Road project number	Road name (if applicable)	Cross section
LR-RD1	Lancefield Road (north)	Primary arterial
LR-RD2	Jacksons Creek Crossing – North	Boulevard connector
LR-RD3	Balbethan Drive	Connector
SS-RD1	Sunbury Road	Primary arterial
SS-RD2	Lancefield Road (south)	Primary arterial
SS-RD3	Vineyard Road	Primary arterial
SS-RD4	Jacksons Creek Crossing – South	Boulevard connector
SS-RD5	Buckland Way	Connector
SS-RD6	Fox Hollow Drive	Connector
SS-RD7	Watsons Road	Connector
SS-RD8	Crinnion Road	N/A
SS-RD9	Jackson Hill Link Road	Connector

The arterial road cross sections were workshopped with VicRoads, Hume City Council and the VPA.

SS-RD8 only requires upgrade works to the existing pavement to allow for 2 x 3.5 m lanes with sprayed sealed shoulders.

The adopted cross sections are shown on drawings CIV-0201, CIV-0202, CIV-0203 and CIV-0204 in Appendix B.

3.1.5 Design vehicles and swept paths

The design vehicles adopted for the intersection configurations are as per *Austroads Design Vehicles and Turning Path Templates Guid*e. The design vehicles were used to establish the intersection size and configuration. The FLPs shown in the drawings do not consider the swept path of a check vehicle (a larger vehicle than the design vehicle which may need to operate with reduced clearances or encroach into adjacent lanes) as the location of signs and traffic signals have not yet been established and therefore would provide limited benefit.

The left turn movements have been assessed at a 5 km/h design speed and the right turn movements at 15 km/h. Clearances provided for opposing right turn movements are 1 m for single opposing vehicles and 2 m for two opposing vehicles as per Section 7.2 of *Austroads Guide to Road Design Part 4A*.

Table 3.5 Design Vehicles

Intersection Type	Intersections	Design Vehicle
Arterial/Arterial	SS-IT3*	Prime mover and semi-trailer (19 m)
Arterial/Collector (Connector)	SS-IT1, SS-IT2, SS-IT4, SS-IT5, SS-IT7 LR-IT1, LR-IT2, LR-IT3, LR-IT4	Single unit truck/bus (12.5 m)
Collector/Collector (Connector/Connector)	LR-IT5 SS-IT9, SS-IT10	Single unit truck/bus (12.5 m)

*The turning movements into and out of SS-RD4 (Collector/Connector Road) have been designed for the Single unit truck/bus (12.5 m).

3.1.6 Vertical geometry

Table 3.6 Vertical geometry limits

Vertical Geometry Limits	Value	Comments	Reference
Minimum k value for a Crest Curve	60 km/h = 11.8 80 km/h = 29.3	Desirable minimum value for a 2.0s reaction time (2.5s is not available for these speeds)	AGRD, Part 3, Table 8.7
Minimum k value for a Sag Curve	60 km/h = 10 80 km/h = 17	Other Urban and Rural Roads without street lighting	AGRD, Part 3, Figure 8.7
Minimum Longitudinal Grade	1.0%	Desirable minimum value for drainage purposes	AGRD, Part 3, Table 8.5
Maximum Longitudinal Grade	60 km/h = 7–9 % 80 km/h = 5–7%	Rolling Terrain	AGRD, Part 3, Table 8.3

Preliminary vertical design was completed for SS-RD4, SS-RD5 and SS-RD9 only using the previous designs completed by GTA, Aurecon and Hume City Council as a base. Indicative earthworks batters and retaining wall extents have been shown on the drawings for these road projects only using the following criteria:

- Fill batter – 6:1
- Cut batter – 3:1

- Fill retaining wall when fil height >5 m
- Cut retaining wall when cut height >3 m.

3.2 Bridge and culvert projects

3.2.1 Bridge design criteria

The standards, procedures and codes relevant to the bridge concept design include those listed as follows:

- Austroads Guide to Road Design
- AS 3845.1 – 2015 – Road safety barrier systems and devices
- AS 4678 – 2002 – Earth retaining structures
- AS5100 Parts 1 to 7 – 2004 – Bridge design (SM1600 vehicle loading)
- VicRoads Bridge Technical Notes
- VicRoads Standard Specification for Roadworks and Bridgeworks.

3.2.2 Culvert design criteria

The culvert design process outlined in AGRD Part 5B was used to size the culvert for project LR-BD4. The following information was provided by the VPA in order to size the culvert:

- The existing 100yr Annual Recurrence Interval (ARI) flood level at the proposed culvert location is RL 248.81 AHD
- The flow width at this location is approximately 15 m.

The standards, procedures and codes relevant to the culvert bridge concept design include those listed for the bridge design criteria in section 3.2.1 above, in addition to the following:

- AS 1597.2 – 2013 – Precast reinforced concrete box culverts – large culverts
- AS 1657 – 2015 – Fixed platforms, walkways, stairways and ladders – design, construction and installation.

4. Road and intersection projects

High level, 2-dimensional concept designs were developed for the nominated road and intersection projects. The desired lane arrangement for each intersection was provided by the VPA. As no feature survey information was made available, concept design were developed using base aerial imagery and cadastral information.

The road alignments used were drawn from those established by GTA, Aurecon, Hume City Council and from those identified in the future urban structure as supplied by the VPA. Refer to the respective documents outlined in section 2. In some cases the alignment was adjusted slightly to conform to the basis of design as described in section 3. In addition, the designs were subject to a number of iterations in response to comments received following review by the VPA.

4.1.1 Interim on ultimate

To minimise redundant work, the interim design of intersections was completed after the ultimate configuration was established. The outside kerbs are established for the ultimate arrangement and used in the interim. When the road is upgraded to the ultimate arrangement in the future, construction occurs from the outside in and thus the outside kerb should not need to be altered.

On the concept design drawings for the interim intersection arrangement, as the outside kerb line is set for the ultimate arrangement, a nominal transition has been shown to tie back into the existing road cross section.

4.1.2 Land take calculations

Using the cadastral information, the land take required for the ultimate arrangement of the intersections and roads was calculated. It should be noted that, as advised by the VPA, the proposed right of way (ROW) boundary was taken from the back of path rather than at the extent of the batters. The area of land take was calculated and shown on the drawings in Appendix B.

To minimise small pieces of land take in certain situations the cross section applied along a road was locally narrowed as requested by the VPA. This was done by reducing the verge/nature strip width locally and by narrowing foot or cycle path. Verge reduction has been applied locally along LR-RD3 (refer to drawing 2113308A-CIV-1033) and a reduction in the path and verge/nature strip width has been applied along SS-RD1 (refer to drawing 2113308A-CIV-1102).

4.1.3 Cross sections at structures

To minimise the span of structures required, the connector road cross sections were reduced to a 13.5 m cross section at the structure as agreed with the VPA. This cross section removes parking bays and allows for one shared path and one pedestrian path to be carried on or under the structure. On either side of the structure, the cross section transitions back to the relevant connector street cross section. These cross sections are shown on drawing 2113308A-CIV-0204.

4.1.4 LR-BD1 and LR-RD2

The VPA is currently undertaking a review of the alignment for road LR-RD2 and bridge LR-BD1. Thus the alignment of both of these projects is subject to change based on the outcome of this review.

5. Bridge projects and culvert projects

5.1 Review of structures

A number of structures exist within the Sunbury South and Lancefield Road PSP area which have had varying levels of design completed by others. A review of these designs was undertaken in particular with respect to how they integrate with the design work undertaken in this study. The cross sections for the roads in the previous studies differ from those adopted by the concept design shown of the drawing in Appendix B. These differences are noted below.

5.1.1 LR-BD1

LR-BD1 is the structure carrying LR-RD2 over Jacksons Creek in the Lancefield Road PSP area. A previous high level concept design of this structure was completed by GTA Consultants (Option B). In undertaking a review of this work, the following has been noted:

- The GTA report nominated an 11m cross section for the structure however, the cross section adopted for LR-RD2 on the structure is 13.5 m.
- While some of the details are provided in the report section, the concept design drawing is generally lacking detail. Concept design drawings should include a plan and elevation as well as typical section(s). Span lengths, bridge articulation, substructure details (piles, piers, crossheads, abutments etc.), number and size of girders, barrier type have not been included in this design.
- No 100 year ARI flood water level is noted on elevation, indicating level of freeboard to bridge soffit (pending availability of flood/flow data from Melbourne Water):
  - Without flood data, the bridge and approach heights cannot be established and appropriate scour treatment cannot be specified and as such, a contingency amount should be built into any cost estimates to allow for this.
- Wing walls and scour protection treatment should be shown on the plan and elevation.
- An end port to guard rail termination should be shown.

The VPA is currently undertaking a review of the alignment for road LR-RD2 and bridge LR-BD1. The alignment of LR-BD1 is subject to change based on the outcome of this review.

5.1.2 LR-BD2

LR-BD2 is a road bridge (for LR-BD2) crossing over the Bendigo rail line in the southern part of the Lancefield Road PSP area. Aurecon completed a concept design of this structure and the following comments have been made on this design:

- The 14.5 m cross section adopted by Aurecon differs to the 13.5 m cross section adopted for LR-BD2 over the structure.
- The span and skew of the bridge is suitable for integral or semi-integral abutments. It is preferable to use integral or semi-integral abutments to remove expansion joints and/or bearings which will reduce the future maintenance requirements and provide improved serviceability, ride quality and structural

redundancy. Given the shallow depth foundations and potential requirement for quick construction time over the railway, semi-integral abutments may be more appropriate.

- There is a risk of slope failure/stability issues with a shallow foundation adjacent to the cutting. We suggest using a pile socketed into the rock at this stage, until more geotechnical information is available to prove the suitability of a shallow foundation option.
- We note that the flange width is fairly large which may require a thicker deck slab to span the longer distance.

5.1.3 LR-BD3

LR-BD3 is a rail bridge over the connector street LR-RD2 in the northern part of the Lancefield Road PSP area. Aurecon completed a concept design of this structure and the following comments have been made on this design:

- Aurecon have adopted a 19.4m span, however the cross section width adopted for LR-RD2 through the underpass is 13.5m. Aurecon's design appears to allow for future widening however, LR-RD2 has been designed for a connector street ultimate cross section.
- The span and skew of the bridge is suitable for integral or semi-integral abutments. It is preferable to use integral or semi-integral abutments to remove expansion joints and/or bearings which will reduce the future maintenance requirements and provide improved serviceability, ride quality and structural redundancy.
- Reinforcement couplers could be cast-in to enable a continuous connection over the intermediate pier for the future proofing for a future train station.
- Offset to the edge of the walkway is insufficient per VRIOGS 011.1, Appendix B. A minimum of 2400 mm offset from the centreline of the track to the nearest bridge element is required.
- Note that Accredited Rail Operator (ARO) approval is required for a reduction of the walkway width to 600mm on the rural network. A minimum 1700 mm wide walkway is required otherwise under VRIOGS 011.1
- The geogrid for the retaining wall should be shown to illustrate the extent of the reinforced earth.

5.1.4 SS-BD2

SS-BD2 is a bridge carrying SS-RD4 over Harpers Creek in the Sunbury South PSP area. Aurecon completed a concept design of this structure and the following comments have been made on this design:

- Aurecon have adopted an 11 m cross section over the structure, however the cross section width adopted for SS-RD4 over the bridge is 13.5 m.
- 100 year ARI flood water level should be shown on the elevation, indicating level of freeboard to bridge soffit (pending availability of flood/flow data from Melbourne Water):
  - We note without flood data, the bridge and approach heights cannot be established and appropriate scour treatment cannot be specified and as such, a contingency amount should be built into any cost estimates to allow for this.
- Wing walls and scour protection treatment should be shown on plan and elevation.
- An end port to guard rail termination should be shown.
- Due to nature of span and low skew angle, we suggest an integral bridge be considered as the preferred structural form, hence minimising bridge maintenance over the structures life.

5.1.5 SS-BD3

SS-BD3 is a culvert carrying SS-RD4 over Harpers Creek in the Sunbury South PSP area. Aurecon completed a concept design of this structure and the following comments have been made on this design:

- Adequate allowance/capacity for blockage due to debris in the single cell culvert should be provided to minimise afflux
- The debris size/flow velocity/ARI assumed for sizing of the culvert had not been documented (it is understood this is pending availability of flood/flow data from Melbourne Water)
- The 100 year ARI flood water level should be shown on elevation, indicating level of freeboard to crown unit (pending availability of flood/flow data from Melbourne Water)
- Wire rope barrier/guard rail treatment over culvert extents should be considered as required
- Scour protection on GA's should be shown
- 2.1 m wide shoulders were indicated in GTA's initial options assessment report
- Culvert crossing extents on long section should be shown
- We note without flood data, the culvert sizes and extents (single or multi cell) and scour treatment cannot be established with relative accuracy and as such, a contingency amount should be built into the any cost estimates to allow for this.

5.1.6 SS-BD4

SS-BD4 is a rail bridge over the connector street SS-RD4 in the Sunbury South PSP area. Aurecon completed a concept design of this structure and the following comments have been made on this design:

- Aurecon have adopted a 19.4 m span, however the cross section width adopted for LR-RD2 through the underpass is 13.5 m. Aurecon's design appears to allow for future widening however, LR-RD2 has been designed for a connector street ultimate cross section
- Draft of AS 5100.2 requires hold down system for 'floating' bridges. This should be considered for costing purposes
- Wing Wall extents should be shown on the drawings
- Transition barrier/end post extents should be shown
- Derailment kerb height above rail should be shown
- Consider anti-throw screens on shared user path to prevent unauthorised access onto tracks and objects falling onto road way.

5.2 Concept designs

Concept designs were prepared for the below mentioned structures. No geotechnical information was made available regarding the local ground conditions and as such the design work completed should be reviewed once information on the existing ground conditions is known.

5.2.1 LR-BD4 – Culvert

The VPA advised that LR-DB4 was to be a standard culvert crossing. A preliminary culvert sizing was completed for the 1 in 100 year ARI event following the method outlined in AGRD part 5B and using the inlet and outlet control nomographs. The VPA advised that the 100 year flood level at the culvert location was RL 248.81.

Manning's formula was used to calculate the velocity (V) in the existing channel from the 100 year ARI flood level provided. From inspection of the aerial photo, a Manning's Roughness 'n' value of 0.5 was deemed appropriate for the existing channel as it appears to be grassed with some shrubs and weeds. A cross section was cut from the LIDAR contours provided to calculate the waterway area (A) of the channel flow and the wetted perimeter (P). The discharge (Q) was then calculated for the 100yr ARI event.

The tailwater level was calculated by developing a stage discharge curve for the downstream channel by assuming that it can be approximated by a trapezoidal shape. Using the discharge (Q) calculated for the existing channel the tailwater depth was established from the staged discharge curve.

Results of the calculations showed that 4No. 2100 mm(W) x 900 mm(H) box culverts are required and calculations are provided in Appendix C.

The box culverts were designed to minimise afflux upstream and to maintain the existing flow paths. Rock protection is required at the outlet as the outlet velocity is approximately 4 m/s and the flow at the outlet is supercritical (Fr=1.08). A rock apron 21 m long with minimum rock size of 500 mm has been specified to reduce the effects of scour on the downstream channel. The headwater level was calculated as being 1.35 m and a 100 mm freeboard is required to this level. Thus, the minimum shoulder level should be RL249.75 at the culvert location.

It should be noted that this design is a high level concept only and the culvert design should be reviewed and modelled during detailed design to further investigate the hydraulic performance, backwater effects and, in particular, the scour impact on the downstream channel.

The proposed structural arrangement is as follows:

- Length of the culvert crossing will be approximately 25 m
- Main elements of the culvert crossing include: a cast-in-situ reinforced concrete slab, precast reinforced concrete crown units, precast reinforced concrete end walls, precast reinforced concrete wing walls, and cast-in-situ reinforced concrete apron slabs
- The precast reinforced concrete crown units shall be designed and supplied by a reputable proprietary supplier/manufacturer such as Humes and Rocla.

Nominal heights and extents of wing walls have been provided. These shall be confirmed and designed accordingly once flood levels and flow speeds are more accurately known/established.

5.2.2 SS-BD1 – Bridge

5.2.2.1 Short option

A new bridge structure (SS-BD1) has been designed to carry Lancefield Road over Jacksons Creek.

The proposed bridge will be supported on intermediate piers and abutments at the northern and southern ends.

The proposed structural arrangement is as follows:

- The bridge will have equal spans of approximately 35 m.
- Deck width between barriers will be 13.5 m (to provide two traffic lanes, a shared use path and pedestrian walkway).
- The superstructure will consist of 1800 mm deep precast prestressed Super-T girders with a composite in-situ deck slab.
- The girders will be simply supported on elastomeric bearings with link slabs over the intermediate piers and expansion joints at each abutment.
- The substructure will consist of reinforced concrete columns supported on a reinforced concrete pile cap and driven piles.
- For construction within the creek, it is proposed to use a precast pile cap infilled with in-situ concrete.
- The reinforced concrete abutment crossheads will be supported on bored piles.
- A 4 m long reinforced concrete approach slab will be provided at each abutment.
- Medium performance level barriers have been proposed for this bridge.
- Deck drainage will be required as the bridge is at the low-point of the vertical alignment.

Drainage has been assumed to be captured via scupper drains set into the shared path and collected at the abutment before being discharged.

Flood levels, flow speed and scour depths are not known accurately at this stage. Further design development will be required as more information becomes available to confirm pile, pile cap, pier design as well as any scour protection requirements such as rock beaching.

Driven pile construction with a precast pile cap was considered for ease of construction within the creek. There is potential to use bored piles with a column extension to simplify construction (eliminating pile caps) depending on the creek depths and ground profile. A mix of driven and bored piles may also be considered (i.e. driven piles within the creek, and bored piles outside of the creek).

5.2.2.2 Long option alternative

A second alternative option was developed for SS-BD1 to reduce the likely earthworks required. The structural arrangement is per the short option described in section 5.2.2.1 with nine spans and up to 43 m high piers required. In addition, an alternative road alignment has also been proposed to further reduce the likely earthworks required. However, whilst the earthworks cost may be reduced by adopting the long option bridge solution, further costs will be incurred from the additional structural works required for the longer and taller structure.

Whilst super-T beams are likely to provide the most cost effective solution, an alternative structural system may be desired as it could provide more favourable aesthetic outcomes. Using an alternative system, such as box girders, would reduce the number of spans required (thus reducing the number of piers) however the construction costs would likely to be significantly more expensive as the construction may require the girders to be incrementally launched due to the height of the structure. This would also increase the construction time frame.

Appendix A

Minutes of meetings

PARSONS BRINCKERHOFF

Parsons Brinckerhoff Australia Pty Limited

ABN 80 078 004 798

Level 15 28 Freshwater Place
Southbank VIC 3006
Tel: +61 3 9861 1111
Fax: +61 3 9861 1144

www.pbworld.com

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Minutes

Client	Metropolitan Planning Authority	**Meeting No.**	01
Project	Sunbury South and Lancefield Rd PSP Infrastructure costing study	**Date**	14 July 2015
Subject	Inception Meeting	**Time**	9:30 pm
Venue	Level 25, 35 Collins St, Melbourne	**Ref**	201505459-CIV-MIN-001 RevA
Chair	Mat Garner (MPA)		
Attendees	Guy Wilkinson (Parsons Brinckerhoff), Ryan McCormack (Parsons Brinckerhoff), Chris Bright (MPA), John Petrakos (MPA), Gareth Edgley (Hume City Council)		

Item	Status
General	
Future roads don't need to be where they are shown, they can be moved. However, existing roads are constraints. Intersection locations are fixed. PB needs to design road geometry appropriate to fit with intersection locations. Connector Roads are to be designed as self-enforcing low speed roads	Noted
Second workshop – Lancefield Road, Vineyard Road and Sunbury Road is included in PB scope.	Noted
Interim on Ultimate design principle: - MPA has agreed this approach with VicRoads - Important to get outside kerb line in place in the ultimate arrangement. As road is upgraded to the ultimate, widening occurs in the median - Curves to transition back to interim based on 60km'hr to minimise the tie in section.	Noted
Cost estimates to be undertaken as the final task, once all concept designs have been finalised to avoid rework.	Noted
MPA to provide input information prior to the commencement of any work including: ▪ LIDAR data ▪ Georeferenced aerial image ▪ Relevant reports and designs (GTA, Aurecon and others) ▪ Intersection configurations, lane arrangements and SIDRA outputs ▪ Geotechnical reports ▪ Future urban strucutre ▪ Other advices, strategies or documents that are to be considered	Noted

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Item	Status
Cadastral information to be obtained from data.vic.gov.au	
MPA can use PB's large file transfer site if required: https://ftp.pbworld.com/	Noted
PB will not commence work on an infrastructure project until all input information is received. PB to provide a breakdown of each infrastructure project listing the required input information for comment by MPA. Work will not commence until all information has been received for that project. An indicative program will be developed once a common understanding of the inputs required for each infrastructure project has been developed.	PB to provide break down of inputs required per projects
Lancefield Road PSP	
Aurecon report on grade separation will be provided by MPA which includes CAD information - PB to review how this connects into the road network and whether it satisfies road requirements	Noted
Intersection 5 – intersection connects to Australand development. Further information is to be provided before PB commences work on this intersection. All other intersections are existing with additional legs being added.	MPA to provide advice prior to commencement of work
Lancefield Rd: - Tight cross section - PAO switches sides - Ultimate design to show where relocations might occur "Boulevard" treatment consideration to be provided to PB prior to work commencing (to be provided by Hume City Council).	MPA/Hume to provide advice on Boulevard treatment prior to commencement of work
Sunbury South	
Roads 6-8 – not enough road reserve width (<25m). MPA to provide advice on how to proceed.	MPA to provide advice prior to commencement of work
Jacksons Hill Link (connection with Buckland Rd). Aurecon report did not focus on how the grade separation (road under rail) connects with Jacksons Hill and this will need to be considered by PB. Significant cut and fill issues here. The road alignment can be moved to accommodate an appropriate solution. It is important to lock down the road alignment due to the topographical constraints. Cut material is not suitable for fill material in the location and hence, earthworks will be the most significant cost item.	MPA to provide input information prior to commencement of work.
PB to review all input information (to be provided by MPA) prior to the workshop to discuss Jacksons Hill link. It is envisioned that PB will assist in developing a solution at the workshop.	PB to review all input information ahead of the workshop.
Contract Admin	
MPA to provide purchase order before works can commence	MPA provide purchase order

Item	Status
Invoicing to be monthly. Invoices to note the following: - Purchase order - Itemise tasks and percentage complete/claimed	Noted
Notices served by email are acceptable	Noted
MPA approves Aquenta to be engaged by PB to undertake the cost estimates	Noted
Deliverable due dates to be confirmed as the project progresses.	Noted
Regular progress reporting will be in the form of a brief email report	Noted

Appendix B

Concept design drawings