5.2.2 Development traffic

The PnR and KnR facility access at Malaga Station is understood to be shared with access to future development proposed around Malaga Station.

The traffic associated with future development has been assumed to occur post-opening year of Malaga Station. Based on the STEM plots provided, it is apparent there is growth link volume along PnR access off Beechboro Road North.

For this assessment, it has been assumed that this growth in link volume on an all-day level is directly attributed to future development surrounding the station. From this analysis, the difference in STEM 2031 and 2041 link volume from 2026 has been accounted for. This all-day STEM link volume growth has been shown within Table 4.

Based on the all-day traffic shown within Table 4, a peak hour factor for the morning and evening peak of 9% and 8% respectively has been applied. The distribution of future development inbound and outbound traffic movements has been altered from the PnR and KnR traffic distributions. This has been informed from the STEM TVDs provided by METRONET on 3rd August 2020. The assumed traffic distributions for future development traffic is within Table 5.

5.2.3 Public transport traffic

The bus forecasts provided have been updated from past assumptions outlined within the PDP planning stage for MEL, however, the final routes, services, and frequencies are still yet to be confirmed. The anticipated bus routes within the Malaga Station road network as used in this analysis have been shown previously in Figure 11 on Page 10. The accompanying services and headways noted within Figure 11 have been summarised in Table 6.

5.2.4 Traffic flows

The distribution of vehicle classifications for the intersection is shown within Table 7 and Table 8.

These vehicle class percentages, along with the respective vehicle class passenger car equivalent (PCU) conversion factors outlined within the Main Roads WA Operational Modelling Guidelines have been used within the SIDRA modelling for each peak period scenario.

Peak period turning movement volumes within the road network for all future modelled scenarios have been summarised within **Appendix B.**

Table 6: Forecasted public transport – peak AM/ PM headway (mins)

Route number	Route	AM Peak Headway (minutes)		PM Peak Headway (minutes)	
		Inbound	Outbound	Inbound	Outbound
M3	*Malaga Station to Perth Busport (via Alexander Drive)*	*5*	*5*	*5*	*5*
M4	*Malaga Station to Mirrabooka Bus Station (via Australis Avenue)*	*20*	*20*	*20*	*20*
M5	*Malaga Station to Warwick Station (via Beach Road)*	*10*	*10*	*10*	*10*
M6	*Malaga Station to Mirrabooka Bus Station (via Alexander Heights)*	*20*	*20*	*20*	*20*
M7	*Malaga Station to Warwick Station (via Kingsway)*	*10*	*10*	*10*	*10*
M8	*Malaga Station to Warwick Station (via Alexander Heights Shopping Centre)*	*10*	*10*	*10*	*10*
A1	*Malaga Station to Morley Bus Station*	*60*	*60*	*30*	*30*
A3	*Malaga Station to Morley Bus Station (via Beechboro Road)*	*10*	*10*	*10*	*10*
A4	*Malaga Station to Morley Bus Station (via Bottlebrush Drive and Danube Avenue)*	*20*	*20*	*20*	*20*
A5	*Malaga Station to Malaga Station (via Walter Road and Bassendean Station)*	*10*	*10*	*10*	*10*

Table 4: All-day traffic generated for future development surrounding Malaga Station

Associated forecast year	Growth of inbound all-day trips	Growth of outbound all-day trips
2031	200	300
2041	1,700	1,700

Table 5: Future development traffic distribution

	Distribution of Inbound traffic		Distribution of Outbound traffic	
Associated forecast year	From North	From South	To the North	To the South
2031	50%	50%	67%	33%
2041	41%	59%	65%	35%

Table 7: Vehicle classification proportions – AM peak

	Vehicle classification (%) w/o buses											
Class	1	2	3	4	5	6	7	8	9	10	11	12
Class %	92.1%	4.4%	2.4%	0.4%	0.0%	0.0%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%
Group %	92.1%	7.3%				0.6%				0%	0%	0%

Table 8: Vehicle classification proportions – PM peak

	Vehicle classification (%) w/o buses											
Class	1	2	3	4	5	6	7	8	9	10	11	12
Class %	96.1%	1.5%	1.5%	0.2%	0.0%	0.1%	0.1%	0.0%	0.3%	0.1%	0.0%	0.0%
Group %	96.1%	3.2%				0.5%				0.1%	0%	0%

5.3 Key modelling findings

Based on the traffic generation and distribution exercise summarised in the section so far, static traffic modelling through the use of SIDRA Intersections (version 8.0) has been used to analyse the operational performance at the Beechboro Road/ Marshall Road intersection and the two Malaga Station access intersections.

A detailed summary of the project case scenario results has been provided within **Appendix C** with the SIDRA movement summaries output provided within **Appendix D**.

5.3.1 Baseline traffic performance

In order to evaluate the traffic impacts that the development will have on the surrounding network, an initial assessment of the baseline performance has been undertaken.

For the baseline modelling exercise, the Malaga Station precinct comprises only a single intersection at Marshall Road/ Beechboro Road North, while the project-case model is anticipated to expand this network, including two additional intersections as described previously. Modelling has been undertaken using traffic count surveys provided by METRONET and undertaken by Austraffic over a 24-hour period on the 3rd and 5th December 2019.

The existing performance of the intersection has been summarised below within Table 9.

Table 9: Baseline traffic performance

Intersection	Approach	Lane	LOS AM	LOS PM	Average Delay (s) AM	Average Delay (s) PM	DoS AM	DoS PM	Queue Results AM	Queue Results PM
Beechboro Road North/ Marshall Road	North	Left/ Through	LOS C	LOS C	29.7	33.1	49.3%	43.8%	6.7	6
		Through/ Right	LOS C	LOS C	32	34.3	49.3%	43.8%	5.2	5.7
	East	Left/ Through	LOS C	LOS D	32	37.5	66.6%	66.1%	10	8.8
		Through/ Right	LOS C	LOS D	32.1	37.5	66.6%	66.1%	9.8	8.8
	South	Left	LOS B	LOS B	14.9	12.5	28.1%	16.8%	5.1	3
		Through	LOS C	LOS C	23.5	28	27.6%	41.3%	3.8	6
		Through/ Right	LOS C	LOS D	33.4	38.1	27.6%	41.3%	2.2	3.3
	West	Left/ Through	LOS C	LOS D	34.3	36.1	57.3%	78.8%	6.3	16.5
		Through/ Right	LOS D	LOS C	35.7	33.6	67.5%	73.0%	8	14.4

As indicated, the west approach of the intersection is most critical in both the AM and PM peak periods. This approach demonstrated the highest LOS and DoS within both peak periods (LOS D and DoS of 67.5% and 78.8% respectively).

The weekday evening peak has also shown increased delay in comparison to the morning peak. However, no approach delay is shown to exceed the LOS D operation.

5.3.2 Opening year (2024)

The network performs within capacity during the opening year of the station (2024) as shown below in Table 10. It should be noted to inform the upgrades required the future modelling at the Beechboro Road N/ Marshall Road intersection has been completed based on the existing configuration.

The worst performing approach is the west approach and north approach at the Beechboro Road N/ Marshall Road intersection during the AM and PM peaks; respectively. Both approaches reported LOS E but were below 90% degree of saturation.

The PnR and bus interchange accesses reported good operation (LOS B or below).

The right turn movement entering the bus interchange from the north approach is not forecast to carry any demand however was modelled to operate on a filter across two through lanes within the signal program. This movement reported LOS A due to the minimal demand (1 vehicle) assigned to this movement in all future scenarios.

Table 10: Future modelling results – Malaga Station road network (2024 opening year)

	Intersection	Beechboro Road North/ Marshall Road		Beechboro Road North/ PnR Access		Beechboro Road North/ Bus Interchange Access	
	Peak	AM	PM	AM	PM	AM	PM
	Worst approach (DoS)	North	North	South	West	North	North
Criteria	Overall LOS	LOS D	LOS D	LOS A	LOS A	LOS A	LOS A
	Worst LOS	LOS E	LOS E	LOS B	LOS B	LOS B	LOS B
	Overall average delay (s)	45.1	42.6	7	7.8	8.5	9
	Worst delay (s)	71.1	58	6.3	2.6	7.2	9.3
	Worst DoS	86.6	85.0	47.4	78.3	63.4	68.0
	Worst queue results (vehs)	17.3	17.3	10.2	25.2	28.1	31.8

5.3.3 Opening +5 years (2029)

Despite the implementation of the dual carriageway upgrade along Marshall Road, the Beechboro Road North/ Marshall Road intersection will begin to operate above capacity by 2029 (during the 2029 AM peak hour), with failure in both the AM and PM peak hours by 2034 as indicated by Table 11 on the following page.

The east and west Marshall Road approaches fail during the 2029 AM peak, 2034 AM peak and 2034 PM peak, with queues in excess of 200 metres during these periods (with a worst queue of approximately 510 metres originating from the eastern approach during the 2034 AM peak).

The northern Beechboro Road North approach also fails during the 2029 AM peak and 2034 AM peak, with queue lengths of 113 metres and 138 metres respectively. As a result of these overcapacity issues, mitigation measures at the Beechboro Road/ Marshall Road intersection were tested and reported on within Section 4.3.4.

The PnR and bus interchange accesses still reported good operation during the morning peak and satisfactory operation during the evening peak of 2029 and 2034 (LOS C or below).

Table 11: Future modelling results – Malaga Station road network (2029)

	Intersection	Beechboro Road North/ Marshall Road		Beechboro Road North/ PnR Access		Beechboro Road North/ Bus Interchange Access	
	Peak	AM	PM	AM	PM	AM	PM
	Worst approach (DoS)	North	East	South	West	North	North
Criteria	Overall LOS	LOS E	LOS E	LOS A	LOS A	LOS A	LOS B
	Worst LOS	LOS F	LOS F	LOS B	LOS C	LOS B	LOS B
	Overall average delay (s)	71.5	57.9	7.1	9.1	8.6	10.2
	Worst delay (s)	119.7	85.5	6.6	2.6	7.4	10.9
	Worst DoS	96.6%	89.3%	48.9%	85.9%	64.5%	75.3%
	Worst queue results (vehs)	33.4	26.9	11.1	35.2	29.1	39.1

5.3.4 Opening +10 years (2034)

Without any interventions, the performance of the Beechboro Road North/ Marshall Road intersection is exacerbated by year 2034 as shown in Table 12 below. There is no change expected to

the level of service for the other two intersections although the degree of saturation for the Beechboro Road North/ Park N Ride access during the PM peak is forecast to exceed 90%.

5.3.5 Proposed Upgrades: Beechboro Road North/ Marshall Road signalised option (Proposed Detailed Design Layout)

It should be noted, the City of Swan are planning and designing for the conversion of the Beechboro Road North/ Marshall Road intersection to be to a dual-lane roundabout.

In a scenario where this conversion to a roundabout is not realised and on the basis of the results detailed in the previous section; the project case option has been tested to identify measures that would ensure that the intersection operates within capacity to at least 2034 if this intersection were to remain signalised. The upgrades comprise east and west auxiliary right turn lanes on Marshall Road (150m and 130m in length respectively) and north and south auxiliary right turn lanes on Beechboro Road (60 metres each). These upgrades are proposed in combination with the station upgrades along Beechboro Road for opening year.

This layout with the additional measures has been progressed as the proposed layout in the Detailed Design phase of the project.

Opening year (2024)

The proposed project case for the Beechboro Road North/ Marshall Road intersection was not required to be tested for the opening year of the station as the existing intersection was indicated to perform within capacity, operating with a degree of saturation below 90% during both peak periods.

Modelling the project case for the opening +5 years and opening +10 years scenarios as discussed in the following sections indicated improved performance at this intersection. Conceivable, applying these same measures to the opening year scenario would also show greater capacity at this intersection.

Opening +5 years and +10 years

The resulting changes to the operational performance have been demonstrated within Table 13 for both the 2029 and 2034 peak periods. The implementation of these upgrades reported the following findings:

- The Beechboro Road N/ Marshall Road intersection performs near practical capacity by 2029, with all scenarios operating with a degree of saturation below 90%. The PM Peak performs within capacity to at least 2034 during the PM peak, reporting a degree of saturation below 80%.
- All scenarios reported a significant reduction in the average intersection delay and maximum queue results, operating with an average intersection delay below 50 seconds and reporting a maximum queue of below 20 vehicles.

Table 12: Future modelling results – Malaga Station road network (2034)

	Intersection	Beechboro Road North/ Marshall Road		Beechboro Road North/ PnR Access		Beechboro Road North/ Bus Interchange Access	
	Peak	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
	Worst approach (DoS)	East	East	South	West	North	North
Criteria	*Overall LOS*	**LOS F**	**LOS F**	**LOS A**	**LOS A**	**LOS A**	**LOS B**
	Worst LOS	**LOS F**	**LOS F**	**LOS B**	**LOS C**	**LOS B**	**LOS B**
	Overall average delay (s)	116.8	84.9	7.6	10.7	9	11.8
	Worst delay (s)	186.8	129.3	7.7	2.6	7.6	13.1
	Worst DoS	111.0%	101.7%	54.8%	91.2%	68.4%	81.4%
	Worst queue results (vehs)	51.5	43.5	15.4	46.8	32.3	47.3

Table 13: Future modelling results – Beechboro Road North/ Marshall Road upgrade

	Intersection	Beechboro Road North/ Marshall Road (WITHOUT project case upgrades)				Beechboro Road North/ Marshall Road (WITH project case upgrades)			
	Peak	**2029 AM**	**2029 PM**	**2034 AM**	**2034 PM**	**2029 AM**	**2029 PM**	**2034 AM**	**2034 PM**
	Worst approach (DoS)	North	East	East	East	East	West	South	West
Criteria	*Overall LOS*	**LOS E**	**LOS E**	**LOS F**	**LOS F**	**LOS D**	**LOS C**	**LOS D**	**LOS C**
	Worst LOS	**LOS F**	**LOS F**	**LOS F**	**LOS F**	**LOS D**	**LOS D**	**LOS E**	**LOS E**
	Overall average delay (s)	71.5	57.9	116.8	84.9	35.6	27	44.6	33.1
	Worst delay (s)	119.7	85.5	186.8	129.3	42.5	37.5	52	47.4
	Worst DoS	96.6%	89.3%	111.0%	101.7%	85.7%	68.7%	88.7%	77.1%
	Worst queue results (vehs)	33.4	26.9	51.5	43.5	11.4	9.9	16.1	14.2

5.3.6 Summary of findings

Based on the analysis completed, both the Beechboro Road North/ Bus Interchange Access signalised intersection and the Beechboro Road North/ Park n Ride/ Kiss n Ride Access roundabout will operate well within capacity during the project-case scenario years. Some queuing is expected within the PnR-KnR, however these queues are expected to clear reasonably quickly due to the proposed intersection control.

The existing Beechboro Road North/ Marshall Road intersection is forecast to reach capacity during the 2029 AM peak, with a LOS E and DOS of 96.6%.

It is noted that the City of Swan have a planned conversion of the Marshall Road/ Beechboro Road intersection to a two-lane roundabout. For a scenario where this does not occur, an upgraded geometry to the existing signalised intersection with auxiliary right turn lanes on both the Marshall Road and Beechboro Road North approaches has also been tested to resolve the initial capacity issues within the project case assessment. This layout with the additional project case measures has been progressed as the proposed layout in the Detailed Design phase of the project and result in the intersection performing within capacity up to and including 10 years post station opening.

It is also to important to note that there is residual capacity identified for the existing Marshall Road/ Beechboro Road North intersection during the opening year scenario and for the proposed layout with the additional project case upgraded measures up to and including 10-years post opening of the station. The identified residual capacity for all assessed scenarios ensures that if there are any adjustments to the demands observed at this intersection, it will continue to operate within capacity if it was to remain as a signalised intersection.

6 Recommendations and summary

The Malaga Station precinct is currently being planned as part of the overall delivery of the MEL passenger rail service proposed to operate between Bayswater and Ellenbrook, with an expected opening year of 2024. This TIA has detailed the associated impacts that the development will have on the surrounding transport network and the expected land uses within and surrounding the vicinity of the site.

The proposed site is planned to comprise a new underground rail station accompanied by a 2,000-bay PnR facility and KnR, a 20-stand bus interchange and large cycling facility for both station and non-station users. Access to the station will be facilitated by modifications to Beechboro Road North, allowing two access points. One access point will service vehicles entering the PnR and KnR facilities via a dual-carriageway roundabout south of the station. The other access point will facilitate access to the bus interchange for numerous new bus services.

Despite planning for the immediate surrounding land uses and development arrangement is largely undetermined, it is anticipated that the precinct will be classed a 'Neighbourhood Centre', likely comprising a mix of high to medium density mixed-uses within walking catchment of the station entry building. Surrounding the station, land use will comprise of primarily medium to low density residential, with the station likely to serve as a major transit hub connecting the community to employment, commercial, retail and recreational areas along the MEL alignment and beyond.

According to STEM plots, the station is estimated to generate a total of 1,300 trips during the AM peak hour, while the surrounding development is estimated to generate a total of 1,700 daily inbound and outbound trips when it reaches full build-out in 2041.

Both the Beechboro Road North/ Bus Interchange Access signalised intersection and the Beechboro Road North/ Park n Ride/ Kiss n Ride Access roundabout will operate well within capacity during the project-case scenario years. However, the existing Beechboro Road North/ Marshall Road intersection is forecast to reach capacity during the 2029 AM peak, with a LOS E and DOS of 96.6%.

It is noted that the City of Swan have a planned conversion of the Marshall Road/ Beechboro Road intersection to a two-lane roundabout. For a scenario where this does not occur, an upgraded geometry to the existing signalised intersection with auxiliary right turn lanes on both the Marshall Road and Beechboro Road North approaches has also been tested to resolve the initial capacity issues within the project case assessment. This layout with the additional mitigation measures has been progressed as the proposed layout in the Detailed Design phase of the project and result in the intersection performing within capacity up to and including 10 years post station opening.

Based on the operational analysis and assessment of the access and supporting network, the following recommendations have been developed.

Pedestrian and cyclist access:

- To support access for northbound patrons accessing from Beechboro Road North south of Marshall Road, it is recommended that the Marshall Road/ Beechboro Road North signalised intersection is modified to allow a signal phase for pedestrians. This would allow pedestrians and cyclists to cross safely at the intersection connecting them with the PSP running along the western edge of Beechboro Road North.
- The futureproofed PSP along the rail alignment to the east should be constructed as a priority. It is understood that the development of this route is tied to the planned residential developments of Bennett Springs East.
- Provision of shared path connection to Ballajura by flyover across Tonkin Highway should be delivered as a priority project, to provide direct active transport access to the existing residents.

Public transport access:

- While planning for the surrounding area is limited and future road layouts are unconfirmed, it is recommended that proposed services are reviewed to enable new developments to the north and east of the station are well serviced by public transport, with bus stops within 400m of dwellings.
- It would be prudent for bus priority measures to be considered at the proposed conversion of Marshall Road/ Beechboro Road North intersection into a dual-lane roundabout. This should form part of City of Swan's future study on this proposed conversion and the impact of the planned land development surrounding Malaga Station. This is to be conducted as a separate study to the TIA detailed in this report.

Vehicle access and parking:

- The northeast service road access egressing the proposed bus interchange is posed to conflict with the futureproofed PSP running parallel to Whiteman Drive. Although this service road will have minimal utilisation, it is recommended that this access is managed through clear signage when required to avoid conflict with active transport modes and service vehicles.
- Future mixed-use development has been proposed around Malaga Station west of the KnR and PnR facilities. Whilst planning is yet to be undertaken and the access arrangement for the development is yet to be determined, it is understood that the station car park is to be shared with the proposed future development. It is recommended that the PTA engage developers early in the process to understand the requirements of the car park in meeting demand. This should be conducted in a future study where parking for the Malaga Station development should be considered holistically, rather than just focusing on the station parking in isolation. This includes providing adequate access for vehicles and the safe movement of pedestrians to/ from their vehicles.
- Some queuing is expected for the exit from the KnR/PnR facility on to Beechboro Road North by 2034. Further traffic modelling should be carried out in tandem with planning for the future development of the precinct, to assess whether an upgrade to the roundabout may be required to accommodate both the station and development traffic.
- It is recommended that the Stage 2 Traffic Signals Approvals Process is progressed to Main Roads WA to confirm the Detailed Design intersection control treatment and geometry with the inclusion of Malaga Station and the anticipated parking and bus interchange arrangements.

Summary

Based on these findings it is recommended that the site requirements and supporting infrastructure within the surrounding road network be implemented prior to opening of the station.

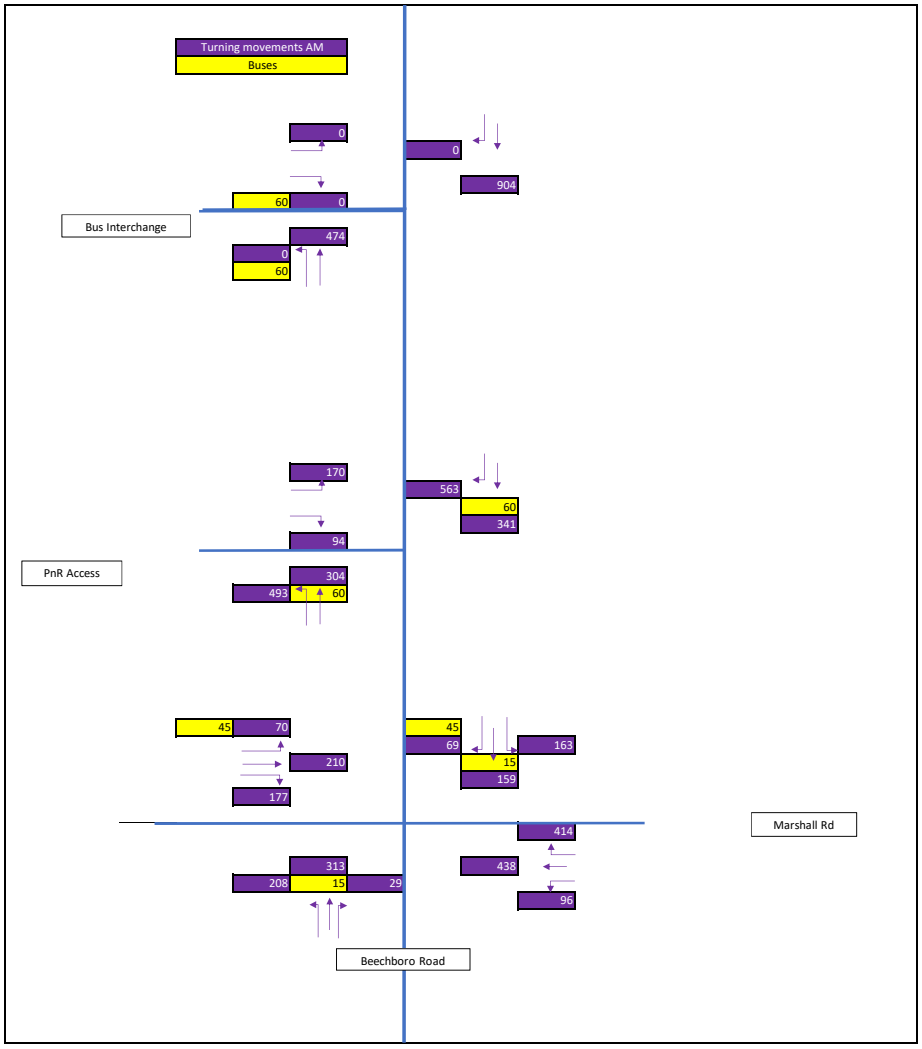
It is shown however, that the station is fit for purpose and serviced by both the existing and proposed surrounding transport network, facilitating safe and adequate access for pedestrians, cyclists, buses and general vehicles.

Appendix A – Malaga Station precinct traffic forecasts

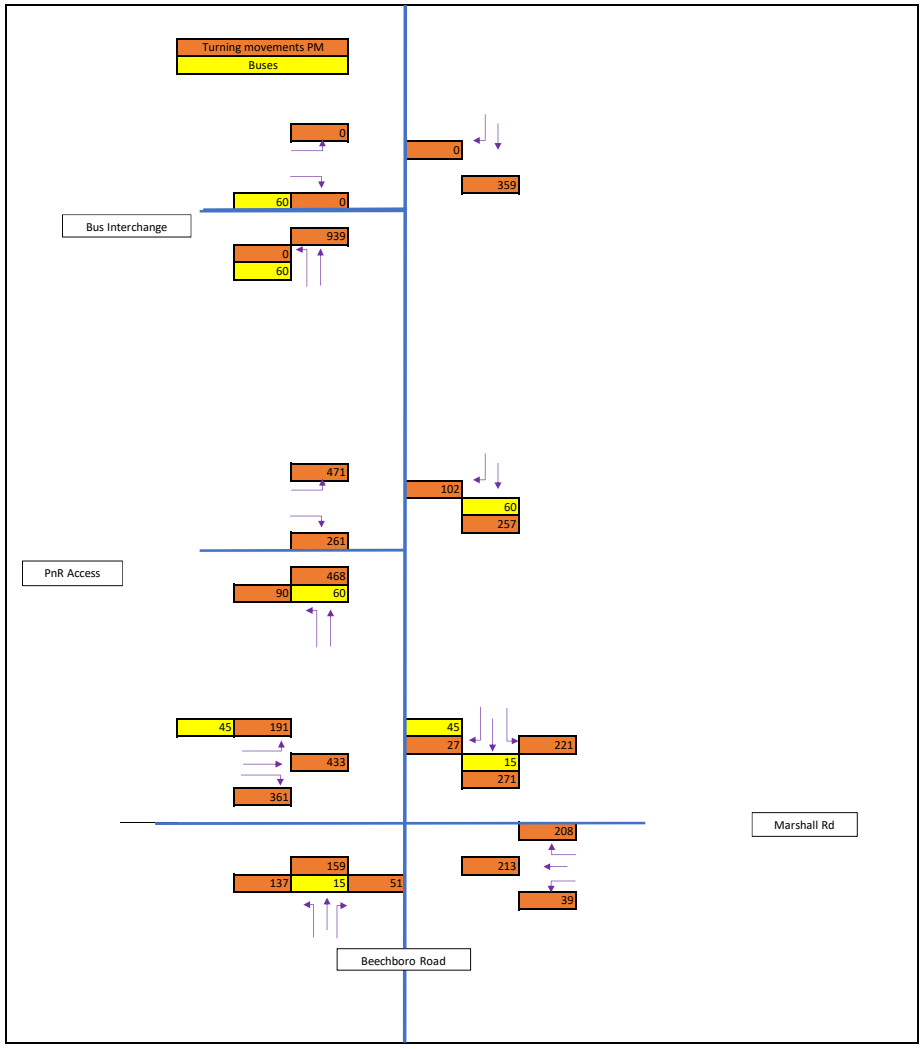
2024 AM/ PM total volume with bus forecasts

2024 Peak hour forecasts for Station Trips and Background Traffic - Combined volume + Buses

AM PEAK



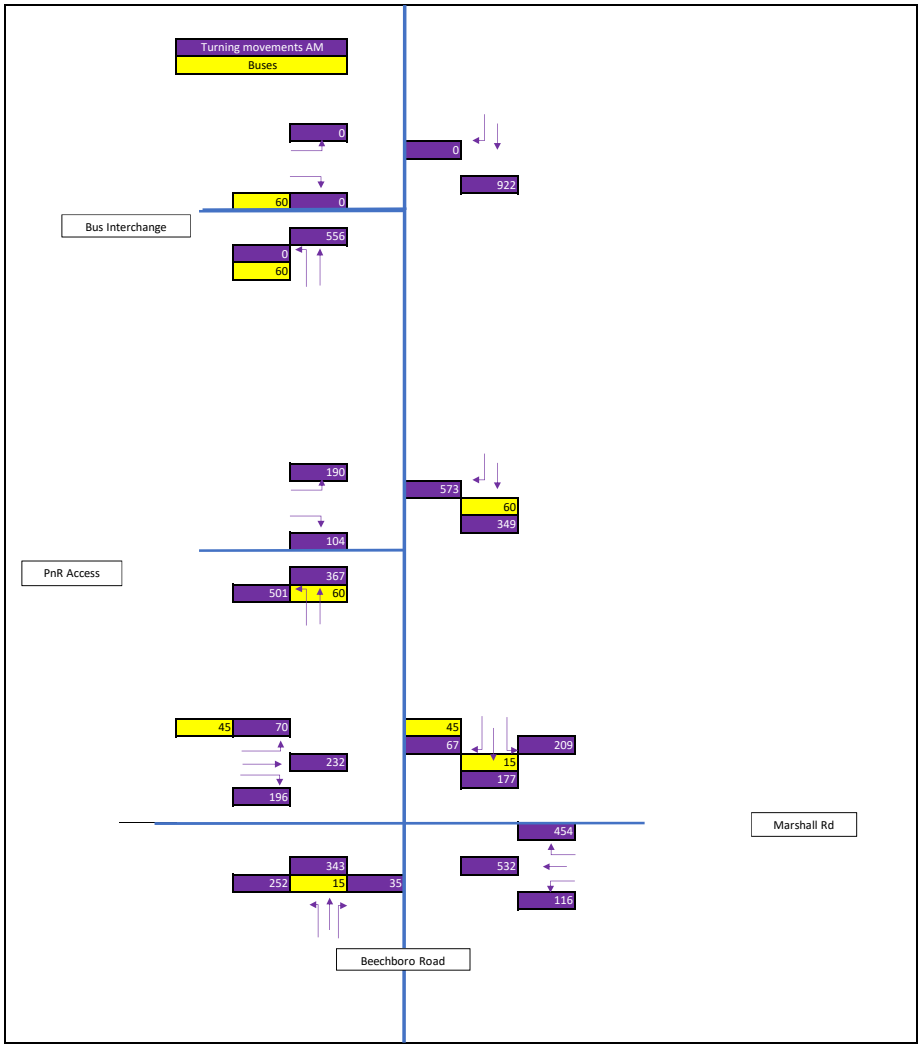
PM PEAK



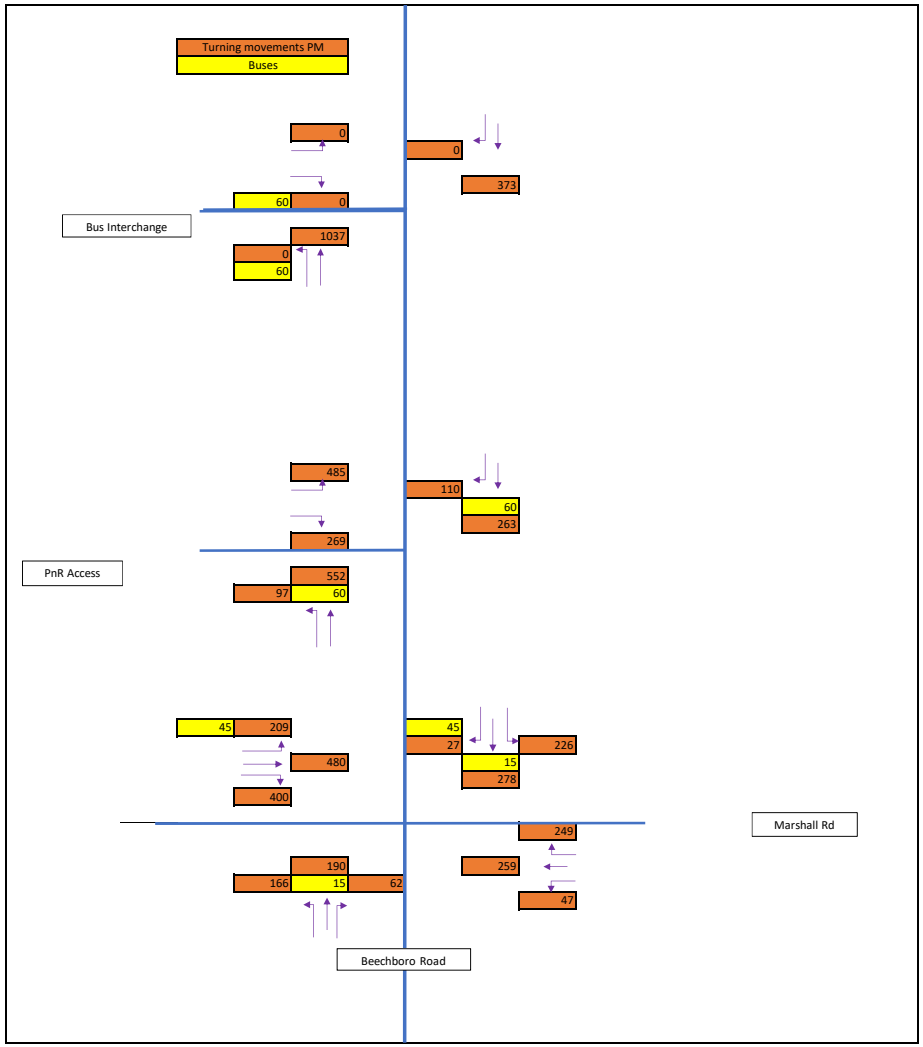
2029 AM/ PM total volume with bus forecasts

2029 Peak hour forecasts for Station Trips and Background Traffic - Combined volume + Buses

AM PEAK



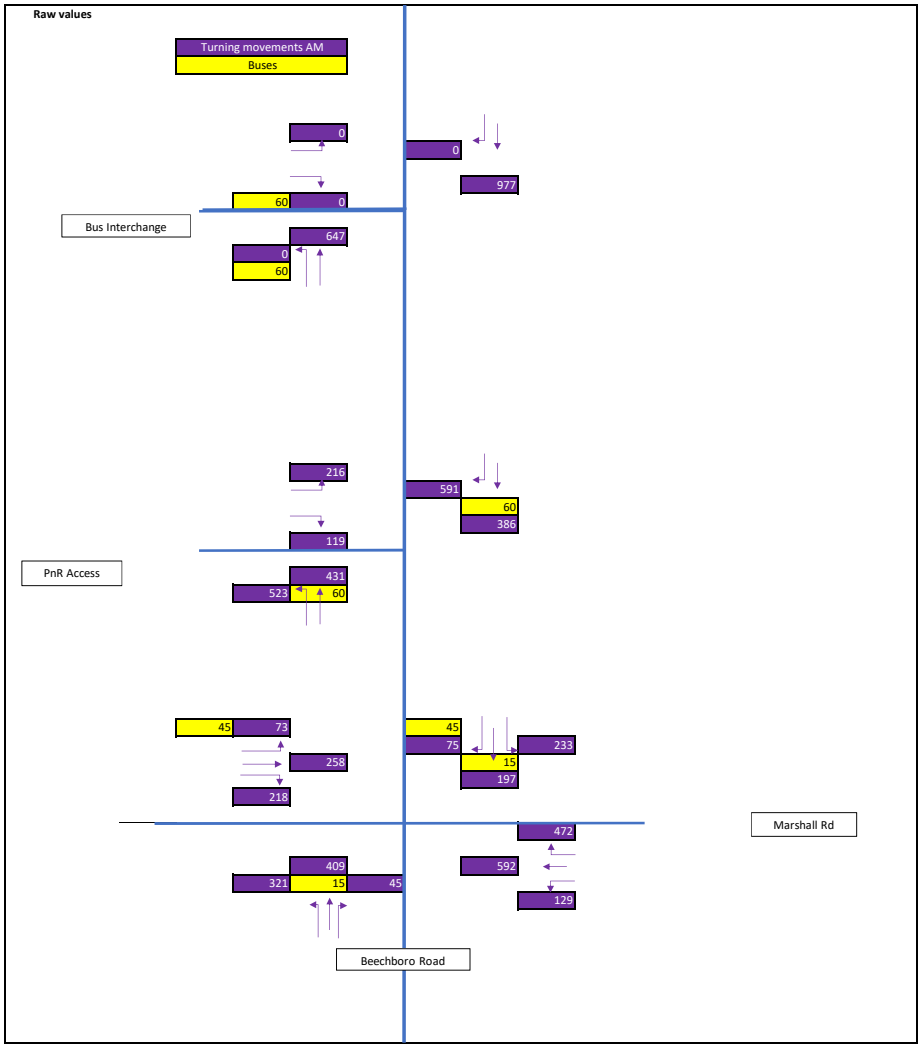
PM PEAK



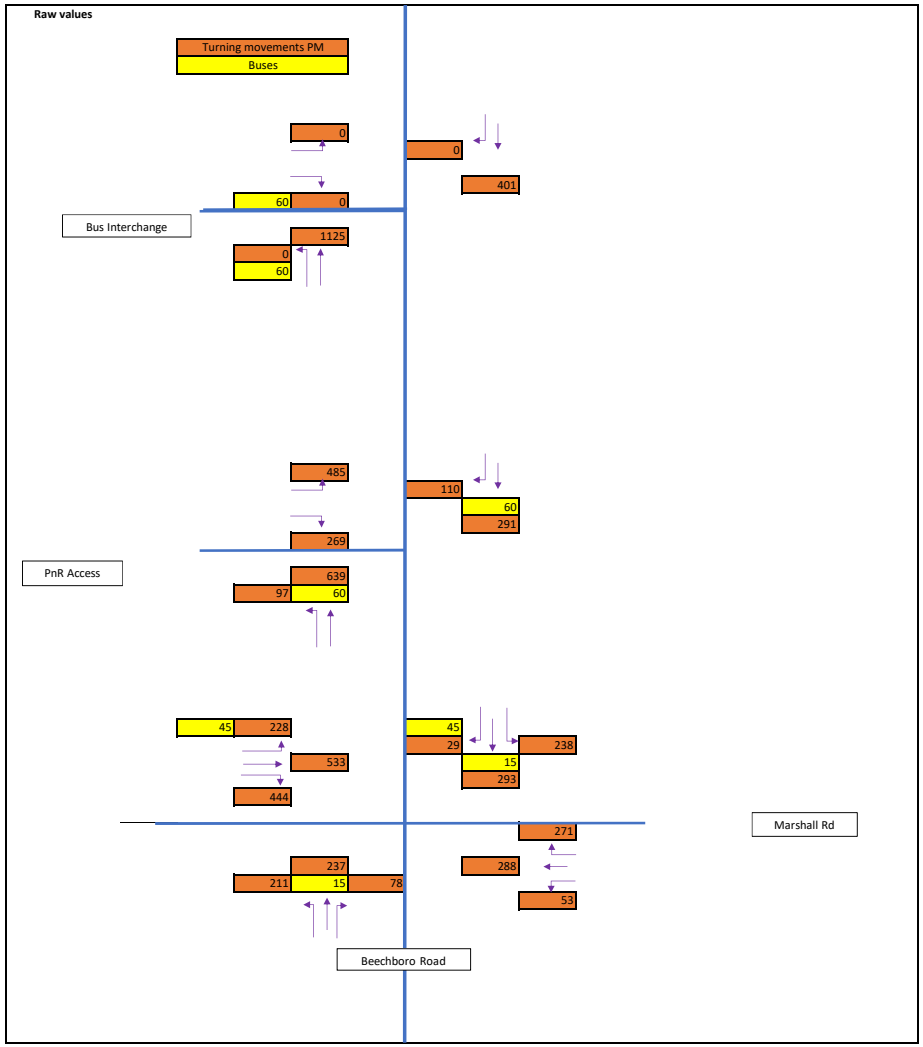
2034 AM/ PM total volume with bus forecasts

2034 Peak hour forecasts for Station Trips and Background Traffic - Combined volume + Buses

AM PEAK

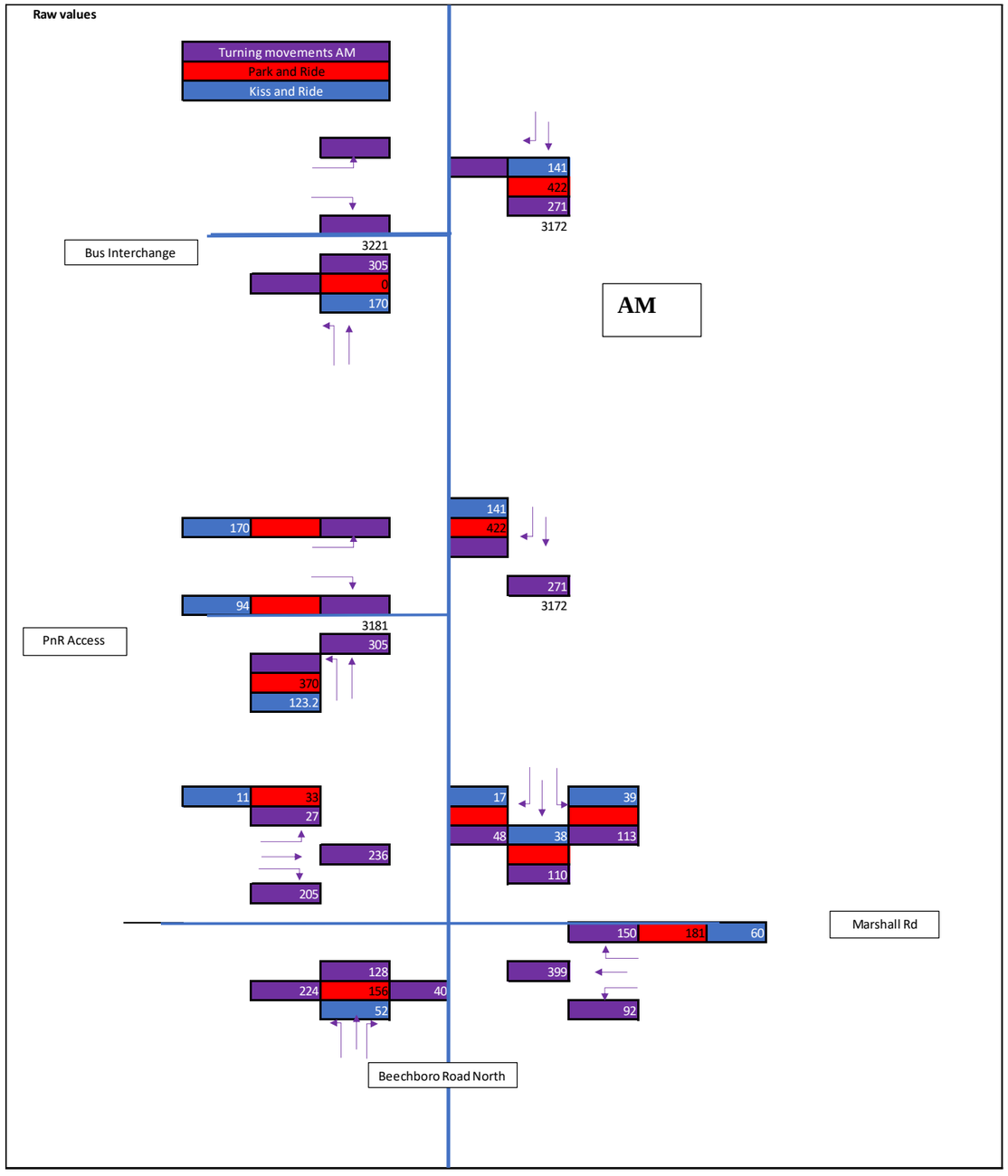


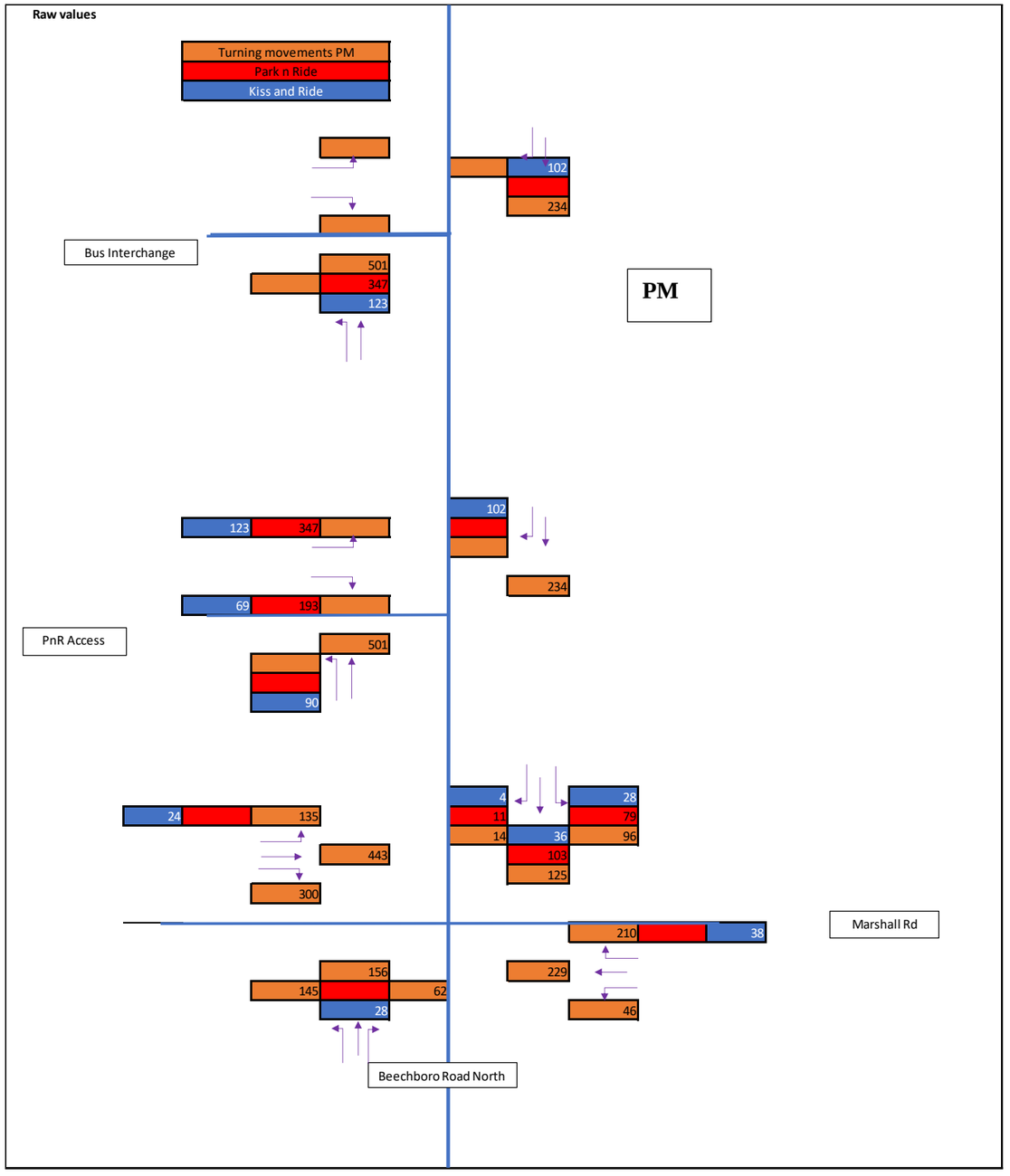
PM PEAK



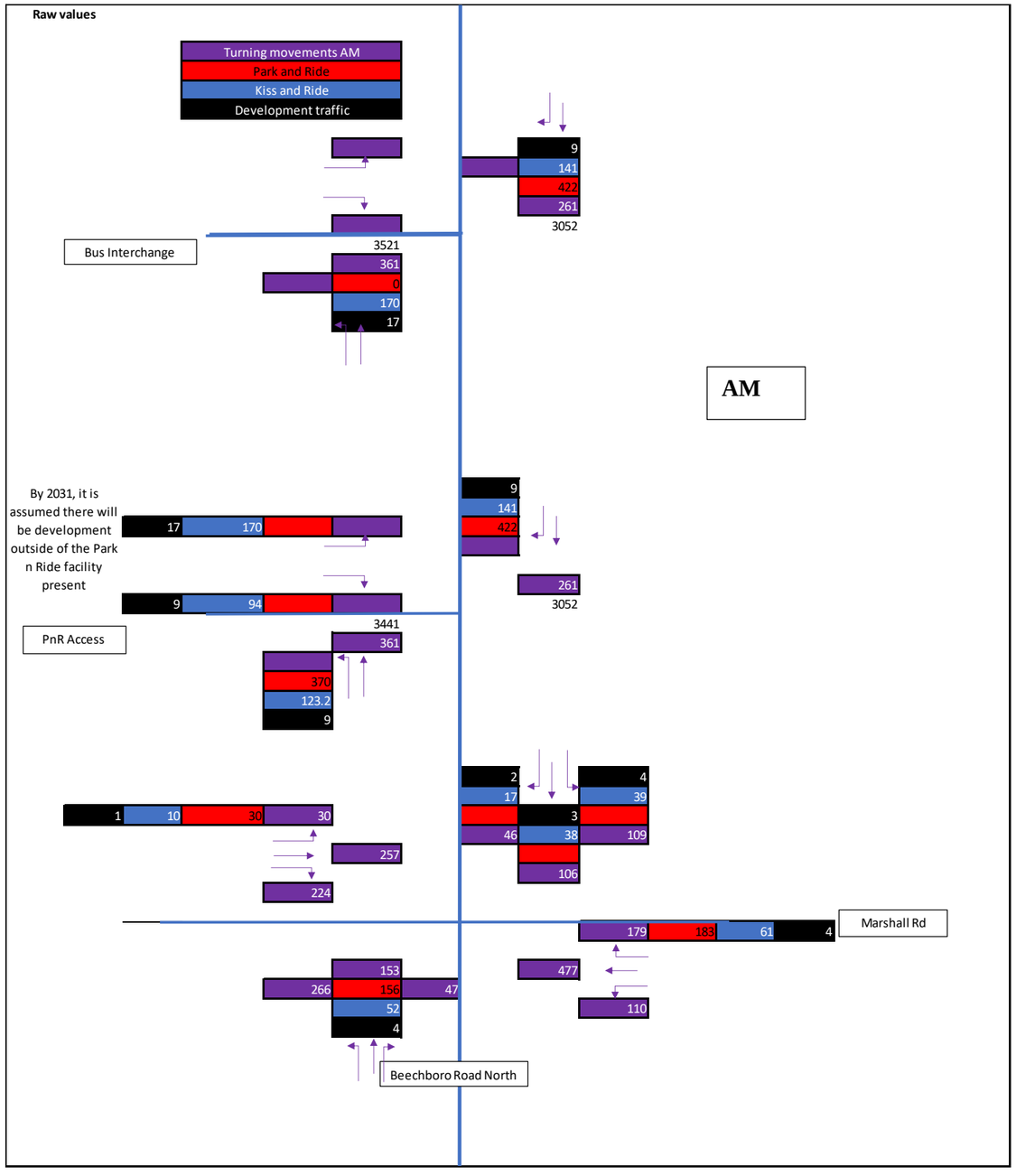
Appendix B – Future peak period turning movement volumes

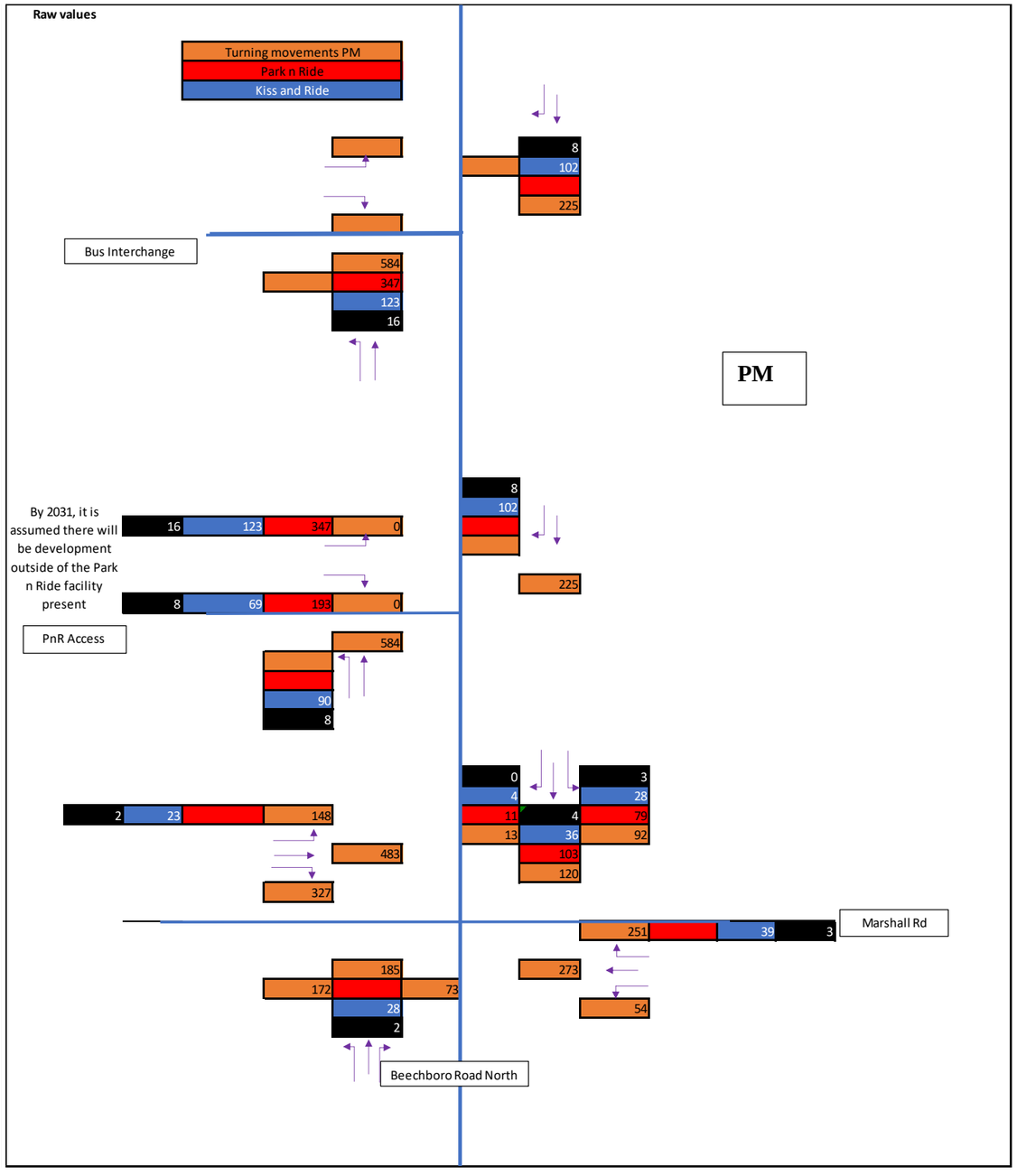
Opening year



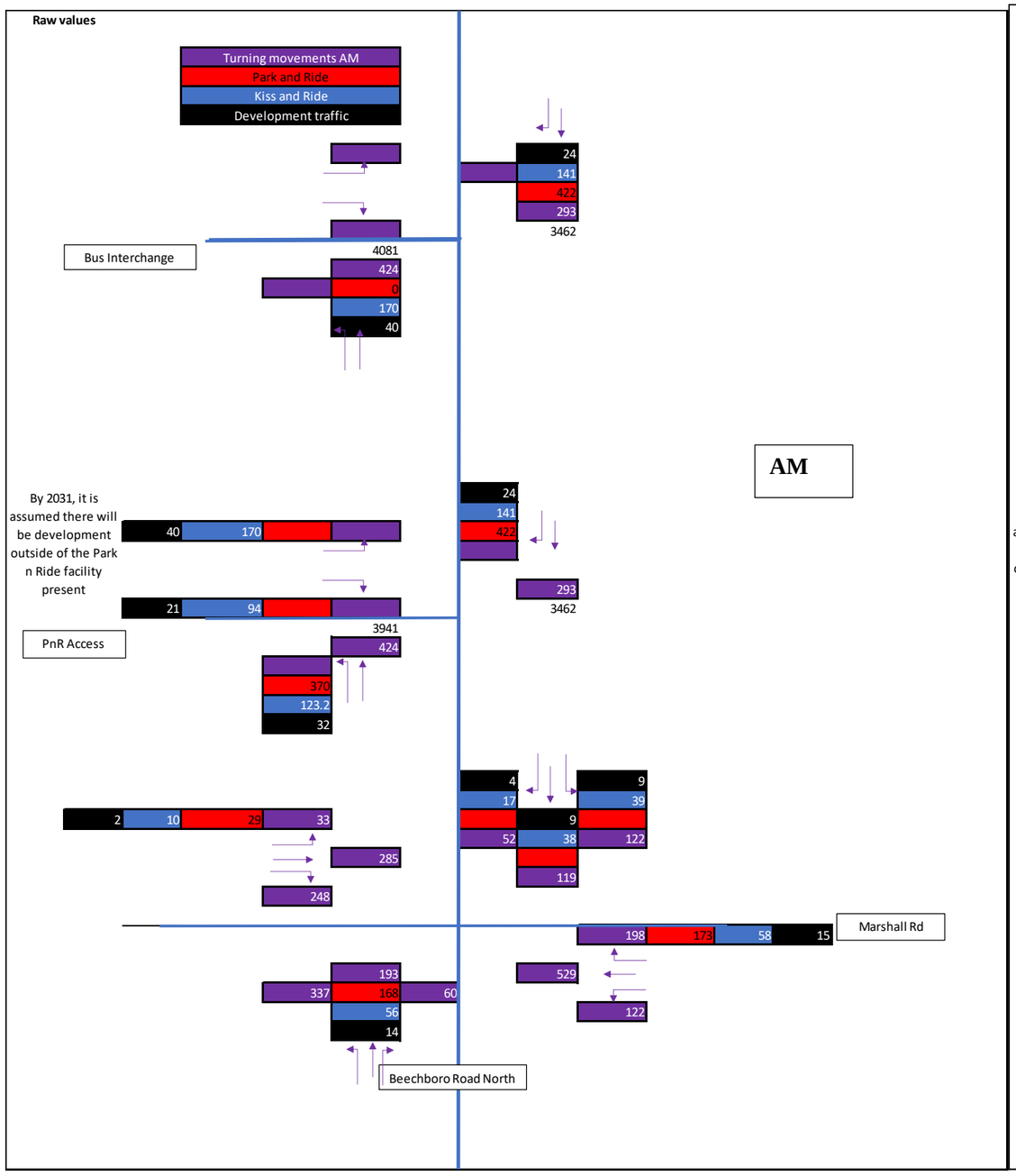


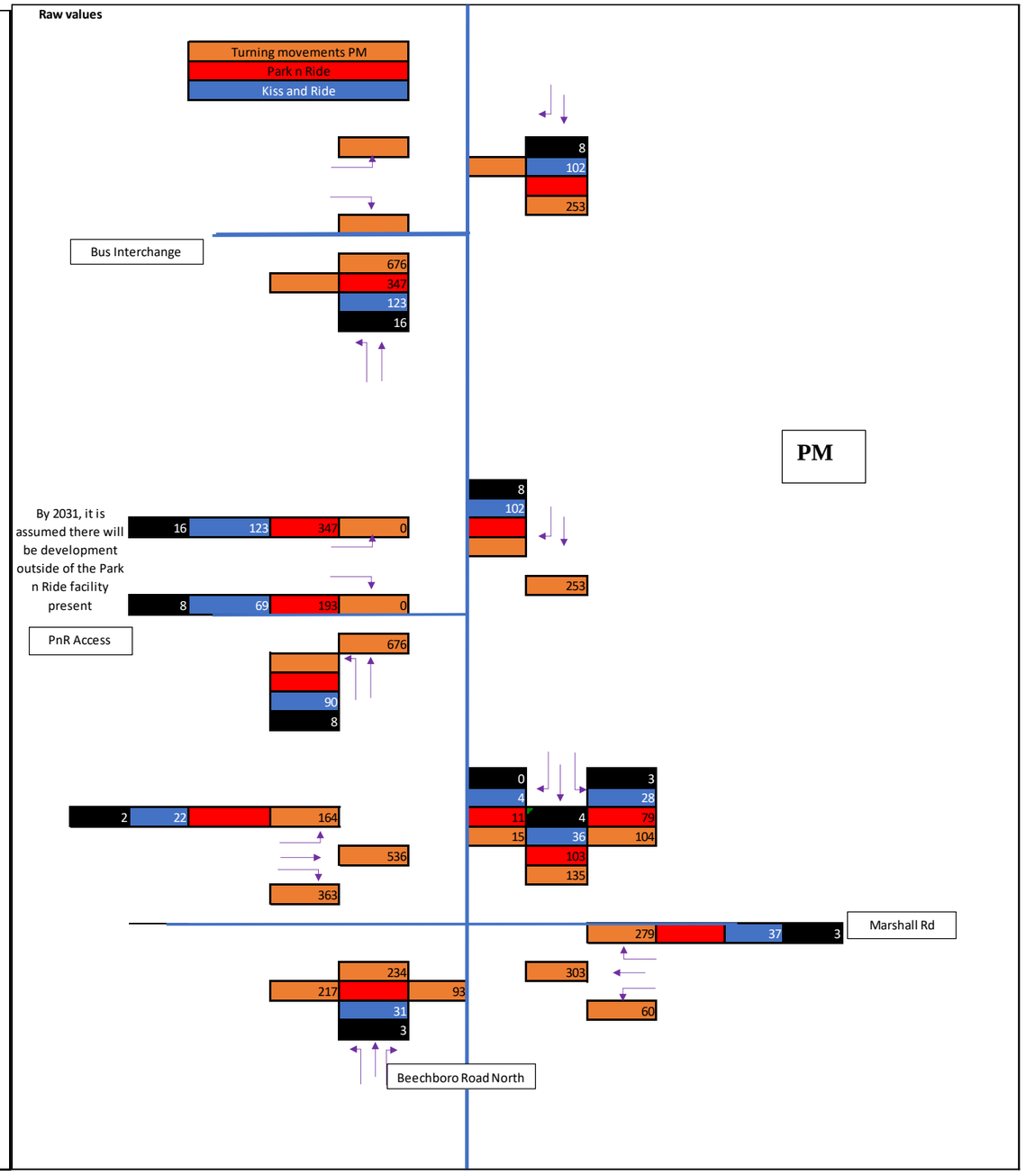
+5 Years


Raw values
Turning movements AM
Park and Ride
Kiss and Ride
Development traffic
9
141
422
261
3052
Bus Interchange
3521
361
0
170
17
AM
By 2031, it is assumed there will be development outside of the Park n Ride facility present
9
141
422
261
3052
17
170
9
94
PnR Access
3441
361
370
123.2
9
2
17
3
46
4
39
38
109
106
1
10
30
30
257
224
Marshall Rd
179
183
61
4
153
266
156
47
52
4
477
110
Beechboro Road North


Raw values
Turning movements PM
Park n Ride
Kiss and Ride
8
102
225
Bus Interchange
584
347
123
16
PM
By 2031, it is assumed there will be development outside of the Park n Ride facility present
8
102
225
16
123
347
0
8
69
193
0
PnR Access
584
90
8
0
4
11
13
3
28
4
79
36
92
103
120
2
23
148
483
327
Marshall Rd
251
39
3
185
172
73
28
2
273
54
Beechboro Road North

+10 Years


Raw values
Turning movements AM
Park and Ride
Kiss and Ride
Development traffic
Bus Interchange
4081
424
0
170
40
24
141
422
293
3462
AM
By 2031, it is assumed there will be development outside of the Park n Ride facility present
40
170
21
94
PnR Access
3941
424
370
123.2
32
24
141
422
293
3462
2
10
29
33
285
248
4
17
9
52
38
119
9
39
122
Marshall Rd
198
173
58
15
193
337
168
60
56
14
529
122
Beechboro Road North


Raw values
Turning movements PM
Park n Ride
Kiss and Ride
Bus Interchange
676
347
123
16
8
102
253
PM
By 2031, it is assumed there will be development outside of the Park n Ride facility present
16
123
347
0
8
69
193
0
PnR Access
676
90
8
8
102
253
2
22
164
536
363
0
4
11
15
3
28
79
104
4
36
103
135
Marshall Rd
279
37
3
234
217
93
31
3
303
60
Beechboro Road North

Appendix C – Project case scenario results

2024 Results

Intersection	Approach	Lane	LOS		Average Delay (s)		Degree of Saturation		Queue Results (pcu's)	
			AM	PM	AM	PM	AM	PM	AM	PM
Beechboro Rd/ Marshall Rd	North	Left/ Through	LOS D	LOS D	43.4	51.2	70.6%	85.0%	10.3	12.1
		Through/ Right	LOS E	LOS E	71.1	57.6	86.6%	85.0%	4.6	8.3
	East	Left/ Through	LOS D	LOS E	49.8	56.1	84.9%	83.2%	17.3	8.1
		Through/ Right	LOS D	LOS E	50.4	56.1	84.9%	83.2%	16.6	8.1
	South	Left	LOS B	LOS B	19.2	11.1	21.9%	11.9%	3.6	1.5
		Through	LOS D	LOS C	37.9	34.2	44.6%	41.7%	6.4	4.8
		Through/ Right	LOS D	LOS E	49.8	58	44.6%	51.5%	4.1	1.7
	West	Left/ Through	LOS D	LOS D	52.4	43.6	70.9%	84.7%	7	17.3
		Through/ Right	LOS E	LOS D	57.9	37.3	83.6%	78.5%	10.8	15.4
Beechboro Rd/ Park and Ride	North	Through	LOS A	LOS A	2.6	3.4	35.8%	22.2%	0.6	0.4
		Right	LOS A	LOS B	9.8	10.3	40.2%	22.2%	0.8	0.4
	South	Left	LOS A	LOS A	6.2	3	47.4%	26.2%	1.3	0.4
		Through	LOS A	LOS A	6.5	2.5	45.4%	26.2%	1.1	0.4
	West	Left	LOS A	LOS B	6.6	10.9	28.1%	78.3%	0.6	3.4
		Right	LOS B	LOS B	14.6	18.9	28.1%	78.3%	0.6	3.4
Beechboro Rd/ Bus Interchange	North	Through	LOS A	LOS A	8.7	6.8	63.4%	25.9%	3.7	1.2
		Right	LOS B	LOS B	12.9	16.3	0.2%	0.4%	0	0
	South	Left	LOS A	LOS A	7.6	7.6	8.3%	8.6%	0.1	0.1
		Through	LOS A	LOS A	7.1	9.4	35.2%	68.0%	1.6	4.2
	West	Left	LOS B	LOS B	16.2	16.2	0.3%	0.3%	0	0
		Right	LOS B	LOS B	18	18	28.9%	29.9%	0.5	0.6

2029 Results

Intersection	Approach	Lane	LOS		Average Delay (s)		Degree of Saturation		Queue Results (pcu's)	
			AM	PM	AM	PM	AM	PM	AM	PM
Beechboro Rd/ Marshall Rd	North	Left/ Through	LOS D	LOS E	51.7	67.8	72.0%	87.7%	15.9	18.9
		Through/ Right	LOS F	LOS F	119.7	80.7	96.6%	87.7%	7.1	10.1
	East	Left/ Through	LOS F	LOS E	91.2	78.6	96.5%	89.3%	33.4	14.1
		Through/ Right	LOS F	LOS E	92.3	78.6	96.5%	89.3%	32.1	14.1
	South	Left	LOS C	LOS B	22.3	12.6	25.3%	14.1%	5.7	2.4
		Through	LOS D	LOS D	47	46.4	48.8%	46.3%	9.6	7.8
		Through/ Right	LOS E	LOS F	65.3	85.5	48.8%	80.7%	5.5	3.1
	West	Left/ Through	LOS E	LOS E	72.9	57.9	79.5%	88.4%	10.6	26.9
		Through/ Right	LOS F	LOS D	92.4	47.7	93.7%	81.9%	18.1	23.3
Beechboro Rd/ Park and Ride	North	Through	LOS A	LOS A	2.6	3.4	36.8%	22.7%	0.6	0.4
		Right	LOS A	LOS B	9.9	10.3	41.3%	22.7%	0.8	0.4
	South	Left	LOS A	LOS A	6.4	3.1	48.9%	30.5%	1.4	0.5
		Through	LOS A	LOS A	6.9	2.6	47.0%	30.5%	1.2	0.5
	West	Left	LOS A	LOS B	6.7	14.6	31.7%	85.9%	0.7	4.8
		Right	LOS B	LOS C	14.7	22.5	31.7%	85.9%	0.7	4.8
Beechboro Rd/ Bus Interchange	North	Through	LOS A	LOS A	8.8	6.8	64.5%	26.9%	3.8	1.3
		Right	LOS B	LOS B	13.7	17.3	0.3%	0.4%	0	0
	South	Left	LOS A	LOS A	7.6	7.6	8.3%	8.5%	0.1	0.1
		Through	LOS A	LOS B	7.4	11.1	41.2%	75.3%	2	5.2
	West	Left	LOS B	LOS B	16.2	16.2	0.3%	0.3%	0	0
		Right	LOS B	LOS B	18	18	28.9%	29.9%	0.5	0.6

2029 UPGRADE Results

Intersection	Approach	Lane	LOS		Average Delay (s)		Degree of Saturation		Queue Results (pcu's)	
			AM	PM	AM	PM	AM	PM	AM	PM
Beechboro Rd/ Marshall Rd	North	Left/ Through	LOS A	LOS B	7.6	10.6	16.7%	23.0%	1.3	2.2
		Through/ Right	LOS D	LOS D	42.5	37.5	64.1%	44.4%	3.1	1.9
	East	Left/ Through	LOS D	LOS C	54.4	28.7	85.7%	28.1%	11.4	3.3
		Through/ Right	LOS C	LOS C	20.3	21.5	67.9%	62.1%	7.9	3.8
	South	Left	LOS C	LOS C	21.2	27.2	29.0%	27.2%	4.6	3.4
		Through	LOS D	LOS D	53.1	40.4	82.5%	45.9%	6.1	2.9
		Through/ Right	LOS D	LOS D	37.7	35.4	14.7%	29.8%	0.9	1.5
	West	Left/ Through	LOS D	LOS C	39.2	28.6	45.5%	56.9%	3.9	7.8
		Through/ Right	LOS B	LOS B	19.7	19	32.8%	68.7%	2.8	6.7
Beechboro Rd/ Park and Ride	North	Through	LOS A	LOS A	2.6	3.4	36.8%	22.7%	0.6	0.4
		Right	LOS A	LOS B	9.9	10.3	41.3%	22.7%	0.8	0.4
	South	Left	LOS A	LOS A	6.4	3.1	48.9%	30.5%	1.4	0.5
		Through	LOS A	LOS A	6.9	2.6	47.0%	30.5%	1.2	0.5
	West	Left	LOS A	LOS B	6.7	14.6	31.7%	85.9%	0.7	4.8
		Right	LOS B	LOS C	14.7	22.5	31.7%	85.9%	0.7	4.8
Beechboro Rd/ Bus Interchange	North	Through	LOS A	LOS A	8.8	6.8	64.5%	26.9%	3.8	1.3
		Right	LOS B	LOS B	13.7	17.3	0.3%	0.4%	0	0
	South	Left	LOS A	LOS A	7.6	7.6	8.3%	8.5%	0.1	0.1
		Through	LOS A	LOS B	7.4	11.1	41.2%	75.3%	2	5.2
	West	Left	LOS B	LOS B	16.2	16.2	0.3%	0.3%	0	0
		Right	LOS B	LOS B	18	18	28.9%	29.9%	0.5	0.6

2034 Results

Intersection	Approach	Lane	LOS		Average Delay (s)		Degree of Saturation		Queue Results (pcu's)	
			AM	PM	AM	PM	AM	PM	AM	PM
Beechboro Rd/ Marshall Rd	North	Left/ Through	LOS D	LOS E	48.5	68	72.2%	87.6%	17.3	21.9
		Through/ Right	LOS F	LOS F	174.5	85.8	106.6%	87.6%	9.5	10
	East	Left/ Through	LOS F	LOS F	185.9	129.3	111.0%	101.7%	51.5	21.3
		Through/ Right	LOS F	LOS F	186.8	129.3	111.0%	101.7%	49.4	21.3
	South	Left	LOS C	LOS B	21.6	12.6	31.2%	17.6%	7.3	3.2
		Through	LOS D	LOS D	44.8	47.1	58.7%	62.3%	10.6	10.1
		Through/ Right	LOS E	LOS F	64.3	122.3	58.7%	98.7%	7.3	5
	West	Left/ Through	LOS F	LOS F	89.4	110.2	91.1%	100.5%	13.6	43.5
		Through/ Right	LOS F	LOS E	165.4	72.5	107.3%	93.2%	26.5	34.4
Beechboro Rd/ Park and Ride	North	Through	LOS A	LOS A	2.7	3.4	40.5%	24.8%	0.8	0.5
		Right	LOS A	LOS B	9.9	10.3	43.1%	24.8%	0.9	0.5
	South	Left	LOS A	LOS A	7.3	3.1	54.8%	34.0%	1.8	0.6
		Through	LOS A	LOS A	8.2	2.6	54.8%	34.0%	1.8	0.6
	West	Left	LOS A	LOS B	7	19.8	38.5%	91.2%	0.9	6.4
		Right	LOS B	LOS C	15	27.7	38.5%	91.2%	0.9	6.4
Beechboro Rd/ Bus Interchange	North	Through	LOS A	LOS A	9.4	6.9	68.4%	29.0%	4.3	1.4
		Right	LOS B	LOS B	14.5	18.2	0.3%	0.4%	0	0
	South	Left	LOS A	LOS A	7.6	7.6	8.3%	8.5%	0.1	0.1
		Through	LOS A	LOS B	7.6	13.4	46.3%	81.4%	2.3	6.3
	West	Left	LOS B	LOS B	16.2	16.2	0.3%	0.3%	0	0
		Right	LOS B	LOS B	18	18	28.9%	29.9%	0.5	0.6

2034 UPGRADE Results

Intersection	Approach	Lane	LOS		Average Delay (s)		Degree of Saturation		Queue Results (pcu's)	
			AM	PM	AM	PM	AM	PM	AM	PM
Beechboro Rd/ Marshall Rd	North	Left/ Through	LOS A	LOS B	8.3	12.9	18.8%	24.3%	1.9	3.2
		Through/ Right	LOS D	LOS D	52	47.4	70.3%	53.2%	4.2	2.3
	East	Left/ Through	LOS E	LOS C	66.8	34.8	87.4%	31.9%	16.1	4.6
		Through/ Right	LOS C	LOS C	23.5	24	68.6%	54.7%	10.3	4.6
	South	Left	LOS C	LOS C	24.8	28.4	35.4%	30.3%	7.5	5
		Through	LOS E	LOS D	70.6	52.1	88.7%	63.2%	10.6	4.5
		Through/ Right	LOS D	LOS D	45.1	45.2	17.4%	44.8%	1.4	2.4
	West	Left/ Through	LOS D	LOS D	47.8	35.8	46.1%	64.2%	5.6	10.8
		Through/ Right	LOS C	LOS B	24.8	18.4	36.1%	64.9%	4.1	7.9
Beechboro Rd/ Park and Ride	North	Through	LOS A	LOS A	2.7	3.4	40.5%	24.8%	0.8	0.5
		Right	LOS A	LOS B	9.9	10.3	43.1%	24.8%	0.9	0.5
	South	Left	LOS A	LOS A	7.3	3.1	54.8%	34.0%	1.8	0.6
		Through	LOS A	LOS A	8.2	2.6	54.8%	34.0%	1.8	0.6
	West	Left	LOS A	LOS B	7	19.8	38.5%	91.2%	0.9	6.4
		Right	LOS B	LOS C	15	27.7	38.5%	91.2%	0.9	6.4
Beechboro Rd/ Bus Interchange	North	Through	LOS A	LOS A	9.4	6.9	68.4%	29.0%	4.3	1.4
		Right	LOS B	LOS B	14.5	18.2	0.3%	0.4%	0	0
	South	Left	LOS A	LOS A	7.6	7.6	8.3%	8.5%	0.1	0.1
		Through	LOS A	LOS B	7.6	13.4	46.3%	81.4%	2.3	6.3
	West	Left	LOS B	LOS B	16.2	16.2	0.3%	0.3%	0	0
		Right	LOS B	LOS B	18	18	28.9%	29.9%	0.5	0.6

Appendix D – SIDRA movement summaries

Marshall Rd/ Beechboro Rd Intersection - AM Peak 2024

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	217	1.9	217	1.9	0.219	19.2	LOS B	3.6	27	0.55	0.73	0.55	44.6
2	T1	342	5.2	342	5.2	0.446	37.9	LOS D	6.4	49.1	0.89	0.74	0.89	26.9
3	R2	30	8.5	30	8.5	0.446	49.8	LOS D	4.1	31.2	0.94	0.77	0.94	33.8
Approach		589	4.2	589	4.2	0.446	31.6	LOS C	6.4	49.1	0.77	0.74	0.77	34.4
East: Marshall Rd														
4	L2	100	3.5	100	3.5	0.849	49.8	LOS D	17.3	132.2	1	0.98	1.14	33.8
5	T1	457	5.7	457	5.7	0.849	44.3	LOS D	17.3	132.2	1	0.98	1.14	34.3
6	R2	432	6.5	432	6.5	0.849	50.4	LOS D	16.6	127.6	1	0.95	1.15	23
Approach		989	5.8	989	5.8	0.849	47.5	LOS D	17.3	132.2	1	0.97	1.14	30.1
North: Beechboro Rd														
7	L2	170	3.2	170	3.2	0.706	43.4	LOS D	10.3	80.2	0.93	0.83	0.95	32.4
8	T1	181	14	181	14	0.706	37.8	LOS D	10.3	80.2	0.93	0.83	0.95	33.1
9	R2	119	42.2	119	42.2	0.866	71.1	LOS E	4.6	45.1	1	1	1.46	24.4
Approach		470	17.2	470	17.2	0.866	48.2	LOS D	10.3	80.2	0.95	0.87	1.08	30.1
West: Marshall Rd														
10	L2	120	54.3	120	54.3	0.709	52.4	LOS D	7	64.4	0.98	0.87	1.05	23.5
11	T1	219	8.1	219	8.1	0.836	49.6	LOS D	10.8	83.1	0.99	0.92	1.13	32.3
12	R2	185	6	185	6	0.836	57.9	LOS E	10.8	83.1	1	0.96	1.2	30.9
Approach		523	18	523	18	0.836	53.1	LOS D	10.8	83.1	0.99	0.93	1.14	30.3
All Vehicles		2571	10	2571	10	0.866	45.1	LOS D	17.3	132.2	0.94	0.89	1.04	30.9

Beechboro Rd/ Park and Ride Intersection - AM Peak 2024

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	514	0	514	0	0.474	6.2	LOS A	1.3	9.8	0.61	0.63	0.61	60.2
2	T1	380	25.4	380	25.4	0.454	6.5	LOS A	1.1	10.2	0.61	0.61	0.61	46.6
Approach		894	10.8	894	10.8	0.474	6.3	LOS A	1.3	10.2	0.61	0.62	0.61	56.1
North: Beechboro Rd														
8	T1	418	18.1	418	18.1	0.358	2.6	LOS A	0.6	5.2	0.21	0.27	0.21	51.3
9	R2	587	0	587	0	0.402	9.8	LOS A	0.8	5.7	0.21	0.61	0.21	58.4
Approach		1005	7.5	1005	7.5	0.402	6.8	LOS A	0.8	5.7	0.21	0.47	0.21	56.7
West: Park & Ride Access														
10	L2	177	0	177	0	0.281	6.6	LOS A	0.6	4.7	0.54	0.7	0.54	57
12	R2	98	0	98	0	0.281	14.6	LOS B	0.6	4.7	0.54	0.7	0.54	57
Approach		275	0	275	0	0.281	9.4	LOS A	0.6	4.7	0.54	0.7	0.54	57
All Vehicles		2174	7.9	2174	7.9	0.474	7	LOS A	1.3	10.2	0.42	0.56	0.42	56.5

Beechboro Rd/ Bus Interchange Intersection - AM Peak 2024

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	63	100	63	100	0.083	7.6	LOS A	0.1	1.8	0.44	0.64	0.44	42.4
2	T1	494	10.7	494	10.7	0.352	7.1	LOS A	1.6	12.9	0.74	0.61	0.74	52.3
Approach		557	20.8	557	20.8	0.352	7.2	LOS A	1.6	12.9	0.7	0.61	0.7	51.6
North: Beechboro Rd														
8	T1	943	4.5	943	4.5	0.634	8.7	LOS A	3.7	28.1	0.86	0.76	0.91	46.8
9	R2	1	0	1	0	0.002	12.9	LOS B	0	0	0.68	0.59	0.68	42
Approach		944	4.5	944	4.5	0.634	8.7	LOS A	3.7	28.1	0.85	0.76	0.91	46.8
West: Bus Interchange Access														
10	L2	1	0	1	0	0.003	16.2	LOS B	0	0.1	0.81	0.59	0.81	40.2
12	R2	63	100	63	100	0.289	18	LOS B	0.5	7	0.88	0.74	0.88	15.7
Approach		64	98.4	64	98.4	0.289	17.9	LOS B	0.5	7	0.88	0.74	0.88	16.6
All Vehicles		1564	14.1	1564	14.1	0.634	8.5	LOS A	3.7	28.1	0.8	0.71	0.84	48.2

Marshall Rd/ Beechboro Rd Intersection - PM Peak 2024

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	148	2.9	148	2.9	0.119	11.1	LOS B	1.5	11	0.36	0.67	0.36	49.4
2	T1	188	11.1	188	11.1	0.417	34.2	LOS C	4.8	37.9	0.89	0.73	0.89	28.5
3	R2	55	2.7	55	2.7	0.515	58	LOS E	1.7	12.9	1	0.76	1.01	30.2
Approach		391	6.8	391	6.8	0.515	28.8	LOS C	4.8	37.9	0.7	0.71	0.7	36.6
East: Marshall Rd														
4	L2	42	2.4	42	2.4	0.832	56.1	LOS E	8.1	62.3	1	0.98	1.24	32
5	T1	230	8.1	230	8.1	0.832	50.5	LOS D	8.1	61	1	0.97	1.24	32.4
6	R2	225	3.1	225	3.1	0.832	56.1	LOS E	8.1	61	1	0.94	1.24	21.5
Approach		497	5.3	497	5.3	0.832	53.5	LOS D	8.1	62.3	1	0.96	1.24	28.2
North: Beechboro Rd														
7	L2	239	3.7	239	3.7	0.85	51.2	LOS D	12.1	92.4	0.99	0.98	1.2	29.7
8	T1	309	8.5	309	8.5	0.85	48.7	LOS D	12.1	92.4	1	1	1.25	29.7
9	R2	78	64.5	78	64.5	0.85	57.6	LOS E	8.3	72.8	1	1.03	1.3	28.5
Approach		625	13.6	625	13.6	0.85	50.8	LOS D	12.1	92.4	1	1	1.24	29.5
West: Marshall Rd														
10	L2	255	23.1	255	23.1	0.847	43.6	LOS D	17.3	138.3	0.98	0.97	1.12	26.3
11	T1	468	2.3	468	2.3	0.847	35.6	LOS D	17.3	138.3	0.97	0.94	1.08	36.8
12	R2	390	0.8	390	0.8	0.785	37.3	LOS D	15.4	113.9	0.95	0.89	1	37.3
Approach		1112	6.5	1112	6.5	0.847	38	LOS D	17.3	138.3	0.97	0.93	1.06	35.2
All Vehicles		2625	8	2625	8	0.85	42.6	LOS D	17.3	138.3	0.94	0.92	1.08	32.5

Beechboro Rd/ Park and Ride Intersection - PM Peak 2024

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	97	0	97	0	0.262	3	LOS A	0.4	3.5	0.19	0.29	0.19	63.5
2	T1	559	15.6	559	15.6	0.262	2.5	LOS A	0.4	3.5	0.2	0.27	0.2	51.8
Approach		657	13.3	657	13.3	0.262	2.6	LOS A	0.4	3.6	0.2	0.28	0.2	54.7
North: Beechboro Rd														
8	T1	342	23.1	342	23.1	0.222	3.4	LOS A	0.4	3.1	0.36	0.42	0.36	47.4
9	R2	110	0	110	0	0.222	10.3	LOS B	0.4	3.1	0.35	0.52	0.35	61.7
Approach		452	17.4	452	17.4	0.222	5	LOS A	0.4	3.2	0.36	0.44	0.36	52.7
West: Park & Ride Access														
10	L2	509	0	509	0	0.783	10.9	LOS B	3.4	25.2	0.81	0.99	1.12	51.6
12	R2	282	0	282	0	0.783	18.9	LOS B	3.4	25.2	0.81	0.99	1.12	51.6
Approach		790	0	790	0	0.783	13.8	LOS B	3.4	25.2	0.81	0.99	1.12	51.6
All Vehicles		1900	8.7	1900	8.7	0.783	7.8	LOS A	3.4	25.2	0.49	0.61	0.62	52.8

Beechboro Rd/ Bus Interchange Intersection - PM Peak 2024

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	65	100	65	100	0.086	7.6	LOS A	0.1	1.8	0.44	0.64	0.44	42.4
2	T1	1014	3.6	1014	3.6	0.68	9.4	LOS A	4.2	31.8	0.88	0.81	0.98	50.3
Approach		1079	9.4	1079	9.4	0.68	9.3	LOS A	4.2	31.8	0.85	0.8	0.95	50
North: Beechboro Rd														
8	T1	388	4.2	388	4.2	0.259	6.8	LOS A	1.2	9.2	0.71	0.57	0.71	49.2
9	R2	1	0	1	0	0.004	16.3	LOS B	0	0.1	0.82	0.59	0.82	39.4
Approach		389	4.1	389	4.1	0.259	6.8	LOS A	1.2	9.2	0.71	0.57	0.71	49.1
West: Bus Interchange Access														
10	L2	1	0	1	0	0.003	16.2	LOS B	0	0.1	0.81	0.59	0.81	40.2
12	R2	65	100	65	100	0.299	18	LOS B	0.6	7.3	0.89	0.75	0.89	15.7
Approach		66	98.4	66	98.4	0.299	18	LOS B	0.6	7.3	0.89	0.74	0.89	16.5
All Vehicles		1533	11.9	1533	11.9	0.68	9	LOS A	4.2	31.8	0.82	0.74	0.89	49.2

Marshall Rd/ Beechboro Rd Intersection - AM Peak 2029

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	263	2.1	263	2.1	0.253	22.3	LOS C	5.7	42.8	0.53	0.73	0.53	42.9
2	T1	373	4.9	373	4.9	0.488	47	LOS D	9.6	73.1	0.87	0.73	0.87	23.7
3	R2	36	11.9	36	11.9	0.488	65.3	LOS E	5.5	42.6	0.94	0.78	0.94	29.4
Approach		673	4.2	673	4.2	0.488	38.3	LOS D	9.6	73.1	0.74	0.74	0.74	31.8
East: Marshall Rd														
4	L2	121	3.4	121	3.4	0.965	91.2	LOS F	33.4	254.1	1	1.12	1.32	24.5
5	T1	555	5.3	555	5.3	0.965	85.7	LOS F	33.4	254.1	1	1.11	1.32	24.7
6	R2	473	6.3	473	6.3	0.965	92.3	LOS F	32.1	246	1	1.05	1.33	15.2
Approach		1149	5.5	1149	5.5	0.965	89	LOS F	33.4	254.1	1	1.09	1.32	21.2
North: Beechboro Rd														
7	L2	218	2.5	218	2.5	0.72	51.7	LOS D	15.9	123.6	0.92	0.83	0.92	29.7
8	T1	200	13.2	200	13.2	0.72	46.2	LOS D	15.9	123.6	0.92	0.83	0.92	30.2
9	R2	117	44.8	117	44.8	0.966	119.7	LOS F	7.1	70.4	1	1.09	1.65	17.4
Approach		535	15.7	535	15.7	0.966	64.5	LOS E	15.9	123.6	0.94	0.89	1.08	25.9
West: Marshall Rd														
10	L2	120	64.8	120	64.8	0.795	72.9	LOS E	10.6	99.5	1	0.92	1.12	18.8
11	T1	242	9.3	242	9.3	0.937	77.5	LOS E	18.1	140.1	1	0.99	1.24	26
12	R2	204	7.2	204	7.2	0.937	92.4	LOS F	18.1	140.1	1	1.06	1.34	23.9
Approach		566	20.3	566	20.3	0.937	81.9	LOS F	18.1	140.1	1	1	1.25	24
All Vehicles		2923	9.9	2923	9.9	0.966	71.5	LOS E	33.4	254.1	0.93	0.95	1.13	24.3

Marshall Rd/ Beechboro Rd Intersection - AM Peak 2029 UPGRADE

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	263	2.1	263	2.1	0.29	21.2	LOS C	4.6	33.9	0.62	0.75	0.62	43.6
2	T1	373	4.9	373	4.9	0.825	53.1	LOS D	6.1	46.5	1	0.95	1.27	22.2
3	R2	36	11.9	36	11.9	0.147	37.7	LOS D	0.9	6.9	0.89	0.72	0.89	36.2
Approach		673	4.2	673	4.2	0.825	39.8	LOS D	6.1	46.5	0.85	0.86	1	31.3
East: Marshall Rd														
4	L2	121	3.4	121	3.4	0.857	54.4	LOS D	11.4	86.4	1	1.02	1.24	32.2
5	T1	555	5.3	555	5.3	0.857	49.3	LOS D	11.4	86.4	1	1.01	1.25	33
6	R2	473	6.3	473	6.3	0.679	20.3	LOS C	7.9	60.6	0.87	0.84	0.87	36.4
Approach		1149	5.5	1149	5.5	0.857	37.9	LOS D	11.4	86.4	0.95	0.94	1.09	33.7
North: Beechboro Rd														
7	L2	218	2.5	218	2.5	0.167	7.6	LOS A	1.3	9.4	0.28	0.63	0.28	51.1
8	T1	200	13.2	200	13.2	0.473	46.1	LOS D	2.9	23.5	0.98	0.77	0.98	31.2
9	R2	117	44.8	117	44.8	0.641	42.5	LOS D	3.1	30.5	1	0.82	1.07	31.9
Approach		535	15.7	535	15.7	0.641	29.7	LOS C	3.1	30.5	0.7	0.72	0.71	37.3
West: Marshall Rd														
10	L2	109	71	109	71	0.455	39.2	LOS D	3.9	40.2	0.87	0.78	0.87	28.2
11	T1	242	9.3	242	9.3	0.537	37.6	LOS D	5.3	41.8	0.93	0.78	0.93	37
12	R2	204	7.2	204	7.2	0.328	19.7	LOS B	2.8	21.5	0.77	0.76	0.77	44.5
Approach		556	20.7	556	20.7	0.537	31.3	LOS C	5.3	41.8	0.86	0.77	0.86	38.3
All Vehicles		2912	10	2912	10	0.857	35.6	LOS D	11.4	86.4	0.86	0.85	0.96	34.7

Beechboro Rd/ Park and Ride Intersection - AM Peak 2029

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	522	0	522	0	0.489	6.4	LOS A	1.4	10.3	0.62	0.64	0.62	60.1
2	T1	383	27.2	383	27.2	0.47	6.9	LOS A	1.2	11.1	0.63	0.63	0.65	46.2
Approach		905	11.5	905	11.5	0.489	6.6	LOS A	1.4	11.1	0.62	0.63	0.63	55.9
North: Beechboro Rd														
8	T1	426	17.9	426	17.9	0.368	2.6	LOS A	0.6	5.4	0.23	0.28	0.23	51.1
9	R2	597	0	597	0	0.413	9.9	LOS A	0.8	6	0.23	0.61	0.23	58.3
Approach		1024	7.5	1024	7.5	0.413	6.9	LOS A	0.8	6	0.23	0.47	0.23	56.6
West: Park & Ride Access														
10	L2	198	0	198	0	0.317	6.7	LOS A	0.7	5.4	0.56	0.71	0.56	56.8
12	R2	108	0	108	0	0.317	14.7	LOS B	0.7	5.4	0.56	0.71	0.56	56.8
Approach		307	0	307	0	0.317	9.5	LOS A	0.7	5.4	0.56	0.71	0.56	56.8
All Vehicles		2236	8.1	2236	8.1	0.489	7.1	LOS A	1.4	11.1	0.43	0.57	0.44	56.3

Beechboro Rd/ Bus Interchange Intersection - AM Peak 2029

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	63	100	63	100	0.083	7.6	LOS A	0.1	1.8	0.44	0.64	0.44	42.4
2	T1	580	10.5	580	10.5	0.412	7.4	LOS A	2	15.6	0.76	0.64	0.76	52.1
Approach		642	19.2	642	19.2	0.412	7.4	LOS A	2	15.6	0.73	0.64	0.73	51.5
North: Beechboro Rd														
8	T1	961	4.3	961	4.3	0.645	8.8	LOS A	3.8	29.1	0.86	0.77	0.93	46.6
9	R2	1	0	1	0	0.003	13.7	LOS B	0	0	0.71	0.59	0.71	41.4
Approach		962	4.3	962	4.3	0.645	8.8	LOS A	3.8	29.1	0.86	0.77	0.93	46.6
West: Bus Interchange Access														
10	L2	1	0	1	0	0.003	16.2	LOS B	0	0.1	0.81	0.59	0.81	40.2
12	R2	63	100	63	100	0.289	18	LOS B	0.5	7	0.88	0.74	0.88	15.7
Approach		64	98.4	64	98.4	0.289	17.9	LOS B	0.5	7	0.88	0.74	0.88	16.6
All Vehicles		1668	13.6	1668	13.6	0.645	8.6	LOS A	3.8	29.1	0.81	0.72	0.85	48.3

Marshall Rd/ Beechboro Rd Intersection - PM Peak 2029

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	179	3.1	179	3.1	0.141	12.6	LOS B	2.4	17.8	0.35	0.67	0.35	48.4
2	T1	221	10.4	221	10.4	0.463	46.4	LOS D	7.8	61.5	0.89	0.75	0.89	24
3	R2	67	3.4	67	3.4	0.807	85.5	LOS F	3.1	23.5	1	0.9	1.33	24.6
Approach		468	6.6	468	6.6	0.807	39	LOS D	7.8	61.5	0.7	0.74	0.74	32.3
East: Marshall Rd														
4	L2	51	2.8	51	2.8	0.893	78.6	LOS E	14.1	109.2	1	1.04	1.26	26.8
5	T1	280	8.7	280	8.7	0.893	73	LOS E	14.1	106.7	1	1.03	1.26	27
6	R2	269	3.7	269	3.7	0.893	78.6	LOS E	14.1	106.7	1	0.97	1.26	17
Approach		599	6	599	6	0.893	76	LOS E	14.1	109.2	1	1	1.26	23.1
North: Beechboro Rd														
7	L2	244	0	244	0	0.877	67.8	LOS E	18.9	142.5	1	0.97	1.17	25.6
8	T1	316	8.7	316	8.7	0.877	67.4	LOS E	18.9	142.5	1	1	1.22	25
9	R2	78	68.1	78	68.1	0.877	80.7	LOS F	10.1	91.2	1	1.04	1.3	23.3
Approach		638	12.6	638	12.6	0.877	69.1	LOS E	18.9	142.5	1	1	1.21	25
West: Marshall Rd														
10	L2	274	22.1	274	22.1	0.884	57.9	LOS E	26.9	214	1	0.98	1.12	21.9
11	T1	518	2.4	518	2.4	0.884	48.6	LOS D	26.9	214	0.99	0.95	1.08	32.6
12	R2	432	0.6	432	0.6	0.819	47.7	LOS D	23.3	172.5	0.96	0.9	0.99	33.8
Approach		1225	6.2	1225	6.2	0.884	50.4	LOS D	26.9	214	0.98	0.94	1.06	31.1
All Vehicles		2930	7.6	2930	7.6	0.893	57.9	LOS E	26.9	214	0.94	0.93	1.08	27.9

Marshall Rd/ Beechboro Rd Intersection - PM Peak 2029 UPGRADE

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	179	3.1	179	3.1	0.272	27.2	LOS C	3.4	25.5	0.74	0.76	0.74	40.6
2	T1	221	10.4	221	10.4	0.459	40.4	LOS D	2.9	22.7	0.97	0.76	0.97	26.1
3	R2	67	3.4	67	3.4	0.298	35.4	LOS D	1.5	11.1	0.94	0.75	0.94	37.3
Approach		468	6.6	468	6.6	0.459	34.6	LOS C	3.4	25.5	0.88	0.76	0.88	34.1
East: Marshall Rd														
4	L2	51	2.8	51	2.8	0.281	28.7	LOS C	3.3	25.5	0.77	0.68	0.77	41.7
5	T1	280	8.7	280	8.7	0.281	23.6	LOS C	3.3	25.5	0.77	0.66	0.77	43
6	R2	269	3.7	269	3.7	0.621	21.5	LOS C	3.8	28.4	0.92	0.82	0.92	35.6
Approach		599	6	599	6	0.621	23.1	LOS C	3.8	28.4	0.84	0.73	0.84	40.4
North: Beechboro Rd														
7	L2	244	0	244	0	0.23	10.6	LOS B	2.2	16.5	0.44	0.68	0.44	48.8
8	T1	316	8.7	316	8.7	0.651	42.3	LOS D	4.3	33.5	1	0.83	1.06	32.5
9	R2	83	63.7	83	63.7	0.444	37.5	LOS D	1.9	21.2	0.96	0.77	0.96	33.7
Approach		644	12.5	644	12.5	0.651	29.7	LOS C	4.3	33.5	0.78	0.77	0.81	37.4
West: Marshall Rd														
10	L2	274	22.1	274	22.1	0.569	28.6	LOS C	7.8	64.3	0.83	0.8	0.83	32.3
11	T1	518	2.4	518	2.4	0.671	27.1	LOS C	9.9	74.1	0.9	0.8	0.9	41.3
12	R2	432	0.6	432	0.6	0.687	19	LOS B	6.7	49.4	0.83	0.81	0.83	45.1
Approach		1225	6.2	1225	6.2	0.687	24.6	LOS C	9.9	74.1	0.86	0.8	0.86	41.2
All Vehicles		2935	7.6	2935	7.6	0.687	27	LOS C	9.9	74.1	0.84	0.77	0.85	39

Beechboro Rd/ Park and Ride Intersection - PM Peak 2029

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	105	0	105	0	0.305	3.1	LOS A	0.5	4.2	0.21	0.3	0.21	63.4
2	T1	661	13.4	661	13.4	0.305	2.6	LOS A	0.5	4.2	0.22	0.28	0.22	51.6
Approach		766	11.5	766	11.5	0.305	2.6	LOS A	0.5	4.3	0.22	0.28	0.22	54.3
North: Beechboro Rd														
8	T1	338	23.9	338	23.9	0.227	3.4	LOS A	0.4	3.3	0.38	0.42	0.38	47.2
9	R2	119	0	119	0	0.227	10.3	LOS B	0.4	3.3	0.37	0.53	0.37	61.3
Approach		457	17.7	457	17.7	0.227	5.2	LOS A	0.4	3.4	0.37	0.45	0.37	52.8
West: Park & Ride Access														
10	L2	524	0	524	0	0.859	14.6	LOS B	4.8	35.2	0.92	1.16	1.51	47.2
12	R2	290	0	290	0	0.859	22.5	LOS C	4.8	35.2	0.92	1.16	1.51	47.2
Approach		814	0	814	0	0.859	17.4	LOS B	4.8	35.2	0.92	1.16	1.51	47.2
All Vehicles		2037	8.3	2037	8.3	0.859	9.1	LOS A	4.8	35.2	0.53	0.67	0.77	50.6

Beechboro Rd/ Bus Interchange Intersection - PM Peak 2029

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	65	100	65	100	0.085	7.6	LOS A	0.1	1.8	0.44	0.64	0.44	42.4
2	T1	1120	3.9	1120	3.9	0.753	11.1	LOS B	5.2	39.1	0.92	0.9	1.13	48.9
Approach		1185	9.1	1185	9.1	0.753	10.9	LOS B	5.2	39.1	0.89	0.89	1.09	48.7
North: Beechboro Rd														
8	T1	403	4.1	403	4.1	0.269	6.8	LOS A	1.3	9.6	0.71	0.58	0.71	49.1
9	R2	1	0	1	0	0.004	17.3	LOS B	0	0.1	0.85	0.59	0.85	38.7
Approach		404	4.1	404	4.1	0.269	6.9	LOS A	1.3	9.6	0.71	0.58	0.71	49.1
West: Malaga Stn Access														
10	L2	1	0	1	0	0.003	16.2	LOS B	0	0.1	0.81	0.59	0.81	40.2
12	R2	65	100	65	100	0.299	18	LOS B	0.6	7.3	0.89	0.75	0.89	15.7
Approach		66	98.4	66	98.4	0.299	18	LOS B	0.6	7.3	0.89	0.74	0.89	16.5
All Vehicles		1654	11.5	1654	11.5	0.753	10.2	LOS B	5.2	39.1	0.85	0.81	0.99	48.1

Marshall Rd/ Beechboro Rd Intersection - AM Peak 2034

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	335	2	335	2	0.312	21.6	LOS C	7.3	54.5	0.54	0.74	0.54	43.3
2	T1	442	4.2	442	4.2	0.587	44.8	LOS D	10.6	80.2	0.86	0.73	0.86	24.4
3	R2	47	11.5	47	11.5	0.587	64.3	LOS E	7.3	55.9	0.96	0.8	0.96	29.7
Approach		824	3.7	824	3.7	0.587	36.5	LOS D	10.6	80.2	0.73	0.74	0.73	32.7
East: Marshall Rd														
4	L2	135	3.4	135	3.4	1.11	185.9	LOS F	51.5	391.3	1	1.52	1.87	14.7
5	T1	617	5.2	617	5.2	1.11	180.4	LOS F	51.5	391.3	1	1.48	1.87	14.7
6	R2	492	6.3	492	6.3	1.11	186.8	LOS F	49.4	378.4	1	1.32	1.87	8.4
Approach		1244	5.4	1244	5.4	1.11	183.5	LOS F	51.5	391.3	1	1.42	1.87	12.4
North: Beechboro Rd														
7	L2	243	2.5	243	2.5	0.722	48.5	LOS D	17.3	133.6	0.9	0.83	0.9	30.6
8	T1	221	12	221	12	0.722	42.9	LOS D	17.3	133.6	0.9	0.83	0.9	31.2
9	R2	125	40.8	125	40.8	1.066	174.5	LOS F	9.5	91.4	1	1.23	1.98	13
Approach		589	14.2	589	14.2	1.066	73.1	LOS E	17.3	133.6	0.92	0.91	1.13	23.9
West: Marshall Rd														
10	L2	123	56.5	123	56.5	0.911	89.4	LOS F	13.6	123.4	1	1.05	1.32	16.1
11	T1	269	9.3	269	9.3	1.073	120.7	LOS F	26.5	205.3	1	1.18	1.56	19.6
12	R2	227	7.1	227	7.1	1.073	165.4	LOS F	26.5	205.3	1	1.32	1.8	15.9
Approach		619	17.9	619	17.9	1.073	130.9	LOS F	26.5	205.3	1	1.21	1.6	17.5
All Vehicles		3276	8.9	3276	8.9	1.11	116.8	LOS F	51.5	391.3	0.92	1.12	1.4	17.5

Marshall Rd/ Beechboro Rd Intersection - AM Peak 2034 UPGRADE

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	335	2	335	2	0.354	24.8	LOS C	7.5	55.8	0.63	0.76	0.63	41.8
2	T1	473	3.9	473	3.9	0.887	70.6	LOS E	10.6	80.3	1	1.02	1.31	18.4
3	R2	47	11.5	47	11.5	0.174	45.1	LOS D	1.4	11.2	0.88	0.73	0.88	33.8
Approach		855	3.6	855	3.6	0.887	51.2	LOS D	10.6	80.3	0.85	0.9	1.02	27.6
East: Marshall Rd														
4	L2	135	3.4	135	3.4	0.874	66.8	LOS E	16.1	122.4	1	1	1.2	29
5	T1	617	5.2	617	5.2	0.874	61.8	LOS E	16.1	122.4	1	1.01	1.2	29.7
6	R2	492	6.3	492	6.3	0.686	23.5	LOS C	10.3	79	0.87	0.84	0.87	34.3
Approach		1244	5.4	1244	5.4	0.874	47.2	LOS D	16.1	122.4	0.95	0.94	1.07	30.6
North: Beechboro Rd														
7	L2	243	2.5	243	2.5	0.188	8.3	LOS A	1.9	14.4	0.28	0.63	0.28	50.5
8	T1	221	12	221	12	0.425	55.5	LOS E	4	32	0.96	0.76	0.96	28.5
9	R2	125	40.8	125	40.8	0.703	52	LOS D	4.2	40.4	1	0.84	1.1	29
Approach		589	14.2	589	14.2	0.703	35.3	LOS D	4.2	40.4	0.69	0.73	0.71	34.9
West: Marshall Rd														
10	L2	123	56.5	123	56.5	0.461	47.8	LOS D	5.6	54.5	0.87	0.78	0.87	24.7
11	T1	269	9.3	269	9.3	0.543	46.6	LOS D	7.5	58.9	0.92	0.78	0.92	33.9
12	R2	227	7.1	227	7.1	0.361	24.8	LOS C	4.1	31.9	0.77	0.78	0.8	41.9
Approach		619	17.9	619	17.9	0.543	38.8	LOS D	7.5	58.9	0.86	0.78	0.87	35.2
All Vehicles		3308	8.9	3308	8.9	0.887	44.6	LOS D	16.1	122.4	0.86	0.86	0.95	31.4

Beechboro Rd/ Park and Ride Intersection - AM Peak 2034

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	545	0	519	0	0.548	7.3	LOS A	1.8	13.7	0.67	0.69	0.72	58.9
2	T1	512	23.1	490	23.5	0.548	8.2	LOS A	1.8	13.7	0.68	0.71	0.77	44.2
Approach		1057	11.2	1009 N1	11.4	0.548	7.7	LOS A	1.8	15.4	0.67	0.7	0.75	53.6
North: Beechboro Rd														
8	T1	465	16.8	465	16.8	0.405	2.7	LOS A	0.8	6.3	0.26	0.29	0.26	50.6
9	R2	616	0	616	0	0.431	9.9	LOS A	0.9	6.5	0.25	0.61	0.25	58.2
Approach		1081	7.2	1081	7.2	0.431	6.8	LOS A	0.9	6.5	0.26	0.47	0.26	56.3
West: Park & Ride Access														
10	L2	225	0	225	0	0.385	7	LOS A	0.9	6.3	0.61	0.75	0.61	56.4
12	R2	124	0	124	0	0.385	15	LOS B	0.9	6.3	0.61	0.75	0.61	56.4
Approach		349	0	349	0	0.385	9.8	LOS A	0.9	6.3	0.61	0.75	0.61	56.4
All Vehicles		2488	7.9	2440 N1	8	0.548	7.6	LOS A	1.8	15.4	0.48	0.61	0.51	55.2

Beechboro Rd/ Bus Interchange Intersection - AM Peak 2034

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	63	100	63	100	0.083	7.6	LOS A	0.1	1.8	0.44	0.64	0.44	42.4
2	T1	675	10.4	653	10.4	0.463	7.6	LOS A	2.3	18	0.78	0.66	0.78	52
Approach		737	18	716 N1	18.2	0.463	7.6	LOS A	2.3	18	0.75	0.66	0.75	51.4
North: Beechboro Rd														
8	T1	1019	4.3	1019	4.3	0.684	9.4	LOS A	4.3	32.3	0.88	0.82	0.99	45.9
9	R2	1	0	1	0	0.003	14.5	LOS B	0	0.1	0.75	0.59	0.75	40.8
Approach		1020	4.3	1020	4.3	0.684	9.5	LOS A	4.3	32.3	0.88	0.82	0.99	45.9
West: Bus Interchange Access														
10	L2	1	0	1	0	0.003	16.2	LOS B	0	0.1	0.81	0.59	0.81	40.2
12	R2	63	100	63	100	0.289	18	LOS B	0.5	7	0.88	0.74	0.88	15.7
Approach		64	98.4	64	98.4	0.289	17.9	LOS B	0.5	7	0.88	0.74	0.88	16.6
All Vehicles		1821	13.2	1799 N1	13.3	0.684	9	LOS A	4.3	32.3	0.83	0.75	0.89	48

Marshall Rd/ Beechboro Rd Intersection - PM Peak 2034

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	228	3.1	228	3.1	0.176	12.6	LOS B	3.2	23.9	0.34	0.67	0.34	48.4
2	T1	272	9	272	9	0.623	47.1	LOS D	10.1	79.1	0.88	0.75	0.88	23.8
3	R2	84	3.3	84	3.3	0.987	122.3	LOS F	5	37.7	1	1.09	1.74	19.7
Approach		584	5.9	584	5.9	0.987	44.5	LOS D	10.1	79.1	0.69	0.77	0.8	30.5
East: Marshall Rd														
4	L2	57	2.8	57	2.8	1.017	129.3	LOS F	21.3	164.7	1	1.29	1.6	19.4
5	T1	311	8.7	311	8.7	1.017	123.7	LOS F	21.3	160.9	1	1.27	1.6	19.6
6	R2	293	3.7	293	3.7	1.017	129.3	LOS F	21.3	160.9	1	1.13	1.6	11.6
Approach		661	6	661	6	1.017	126.7	LOS F	21.3	164.7	1	1.21	1.6	16.3
North: Beechboro Rd														
7	L2	257	0	257	0	0.876	68	LOS E	21.9	165.6	1	0.96	1.14	25.5
8	T1	333	8.5	333	8.5	0.876	68.4	LOS E	21.9	165.6	1	0.99	1.19	24.8
9	R2	80	66.4	80	66.4	0.876	85.8	LOS F	10	91.4	1	1.04	1.3	22.4
Approach		670	12.1	670	12.1	0.876	70.3	LOS E	21.9	165.6	1	0.99	1.18	24.8
West: Marshall Rd														
10	L2	295	20.8	295	20.8	1.005	110.2	LOS F	43.5	344.8	1	1.18	1.43	13.5
11	T1	576	2.4	576	2.4	1.005	92	LOS F	43.5	344.8	1	1.13	1.35	23.5
12	R2	479	0.6	479	0.6	0.932	72.5	LOS E	34.4	255.2	1	1.01	1.19	27.5
Approach		1350	5.8	1350	5.8	1.005	89	LOS F	43.5	344.8	1	1.1	1.31	22.7
All Vehicles		3265	7.1	3265	7.1	1.017	84.9	LOS F	43.5	344.8	0.94	1.04	1.25	22.4

Marshall Rd/ Beechboro Rd Intersection - PM Peak 2034 UPGRADE

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	228	3.1	228	3.1	0.303	28.4	LOS C	5	37.2	0.71	0.77	0.71	40.1
2	T1	272	9	272	9	0.632	52.1	LOS D	4.5	35.1	1	0.82	1.03	22.5
3	R2	84	3.3	84	3.3	0.448	45.2	LOS D	2.4	17.9	0.98	0.77	0.98	33.9
Approach		584	5.9	584	5.9	0.632	41.9	LOS D	5	37.2	0.88	0.79	0.9	31.4
East: Marshall Rd														
4	L2	57	2.8	57	2.8	0.319	34.8	LOS C	4.6	35.3	0.79	0.7	0.79	39
5	T1	311	8.7	311	8.7	0.319	29.6	LOS C	4.6	35.3	0.79	0.68	0.79	40.1
6	R2	293	3.7	293	3.7	0.547	24	LOS C	4.6	34.5	0.89	0.83	0.91	34
Approach		661	6	661	6	0.547	27.6	LOS C	4.6	35.3	0.83	0.75	0.84	38
North: Beechboro Rd														
7	L2	257	0	257	0	0.243	12.9	LOS B	3.2	23.2	0.47	0.69	0.47	47.1
8	T1	333	8.5	333	8.5	0.771	55.6	LOS E	5.8	44.9	1	0.9	1.17	28.4
9	R2	80	66.4	80	66.4	0.532	47.4	LOS D	2.3	26	0.99	0.78	0.99	30.3
Approach		670	12.1	670	12.1	0.771	38.2	LOS D	5.8	44.9	0.8	0.81	0.88	33.8
West: Marshall Rd														
10	L2	295	20.8	295	20.8	0.642	35.8	LOS D	10.8	88.9	0.88	0.82	0.88	28.7
11	T1	576	2.4	576	2.4	0.757	35.6	LOS D	14.2	106	0.94	0.86	0.97	37.7
12	R2	479	0.6	479	0.6	0.649	18.4	LOS B	7.9	58.1	0.78	0.81	0.78	45.5
Approach		1350	5.8	1350	5.8	0.757	29.5	LOS C	14.2	106	0.87	0.83	0.88	38.8
All Vehicles		3265	7.1	3265	7.1	0.771	33.1	LOS C	14.2	106	0.85	0.8	0.88	36.2

Beechboro Rd/ Park and Ride Intersection - PM Peak 2034

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	105	0	104	0	0.34	3.1	LOS A	0.6	4.9	0.22	0.29	0.22	63.3
2	T1	755	12.5	749	12.5	0.34	2.6	LOS A	0.6	4.9	0.22	0.28	0.22	51.5
Approach		860	11	853 N1	11	0.34	2.6	LOS A	0.6	5	0.22	0.28	0.22	53.9
North: Beechboro Rd														
8	T1	379	21.2	379	21.2	0.248	3.4	LOS A	0.5	3.7	0.39	0.42	0.39	47.2
9	R2	119	0	119	0	0.248	10.3	LOS B	0.5	3.7	0.38	0.52	0.38	61.6
Approach		498	16.2	498	16.2	0.248	5.1	LOS A	0.5	3.8	0.39	0.45	0.39	52.4
West: Malaga Stn Access														
10	L2	524	0	524	0	0.912	19.8	LOS B	6.4	46.8	0.98	1.32	2.01	42.1
12	R2	290	0	290	0	0.912	27.7	LOS C	6.4	46.8	0.98	1.32	2.01	42.1
Approach		814	0	814	0	0.912	22.6	LOS C	6.4	46.8	0.98	1.32	2.01	42.1
All Vehicles		2172	8	2165 N1	8.1	0.912	10.7	LOS B	6.4	46.8	0.55	0.71	0.93	47.9

Beechboro Rd/ Bus Interchange Intersection - PM Peak 2034

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Beechboro Rd														
1	L2	65	100	65	100	0.085	7.6	LOS A	0.1	1.8	0.44	0.64	0.44	42.4
2	T1	1215	3.9	1210	3.9	0.814	13.4	LOS B	6.3	47.3	0.95	1.01	1.29	47.1
Approach		1280	8.7	1274 N1	8.7	0.814	13.1	LOS B	6.3	47.3	0.92	0.99	1.25	46.9
North: Beechboro Rd														
8	T1	433	4.1	433	4.1	0.29	6.9	LOS A	1.4	10.5	0.72	0.59	0.72	49
9	R2	1	0	1	0	0.004	18.2	LOS B	0	0.1	0.88	0.58	0.88	38.1
Approach		434	4.1	434	4.1	0.29	6.9	LOS A	1.4	10.5	0.72	0.59	0.72	49
West: Malaga Stn Access														
10	L2	1	0	1	0	0.003	16.2	LOS B	0	0.1	0.81	0.59	0.81	40.2
12	R2	65	100	65	100	0.299	18	LOS B	0.6	7.3	0.89	0.75	0.89	15.7
Approach		66	98.4	66	98.4	0.299	18	LOS B	0.6	7.3	0.89	0.74	0.89	16.5
All Vehicles		1780	10.9	1774 N1	11	0.814	11.8	LOS B	6.3	47.3	0.87	0.88	1.11	46.8

Appendix E – Swept path analysis drawing

MALAGA STATION PLATFORM

LINE A

JOINS DRG No. 25-A-287-CI0140

MATCH

NATIVE VEGETATION RETENTION AREA

BEECHBORO ROAD NORTH

MATCH

JOINS DRG No. 25-A-287-CI0140

LINE B

NOTES

1. THIS DRAWING SET IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING DRAWING SETS
   - PRECINCT ARCHITECTURAL (25-A-287-AR)
   - PRECINCT STRUCTURAL (25-A-287-ST)
   - PRECINCT LANDSCAPING (25-A-287-LA)
   - PRECINCT HYDRAULICS (25-A-287-PL)
   - LINEWIDE RAIL (25-C)
   - LINEWIDE HIGHWAYS (25-C)
2. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE NOTED.
3. VEHICLE MOVEMENTS HAVE BEEN TRACKED USING AUSTROADS 2013 VEHICLE SPECIFICATIONS. TRACKING SPEED FOR TURNING MOVEMENTS FOR ALL VEHICLES - 5km/h FORWARD, 2.5km/h REVERSE.

LEGEND

645 EXISTING CADASTRE BOUNDARY

MODIFIED BEECHBORO ROAD NORTH

LINEWIDE RAIL EARTHWORKS

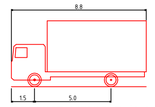
DEVELOPMENT ENVELOPE

INDICATIVE PROJECT FOOTPRINT

RAIL ALIGNMENT

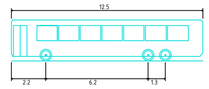
B99 VEHICLE (REALISTIC MIN RADIUS) (2004)

OVERALL LENGTH	5.200m
OVERALL WIDTH	1.940m
OVERALL BODY HEIGHT	1.878m
MIN BODY GROUND CLEARANCE	0.272m
TRACK WIDTH	1.840m
LOCK-TO-LOCK TIME	4.00s
CURB TO CURB TURNING RADIUS	6.250m



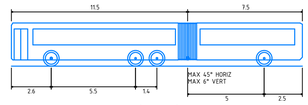
SERVICE VEHICLE (8.8m)

OVERALL LENGTH	8.800m
OVERALL WIDTH	2.500m
OVERALL BODY HEIGHT	3.632m
MIN BODY GROUND CLEARANCE	0.427m
TRACK WIDTH	2.500m
LOCK-TO-LOCK TIME	4.00s
CURB TO CURB TURNING RADIUS	9.000m



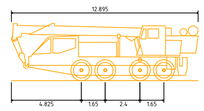
RIGID BUS (12.5m) - COVERS REFUSE VEHICLE

OVERALL LENGTH	12.500m
OVERALL WIDTH	2.500m
OVERALL BODY HEIGHT	4.300m
MIN BODY GROUND CLEARANCE	0.490m
TRACK WIDTH	2.500m
LOCK-TO-LOCK TIME	6.00s
CURB TO CURB TURNING RADIUS	12.500m



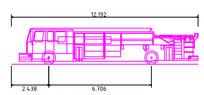
ARTICULATED BUS (19.0m) - COVERS SINGLE UNIT TRUCK AND REFUSE VEHICLE

OVERALL LENGTH	19.000m
OVERALL WIDTH	2.500m
OVERALL BODY HEIGHT	2.823m
MIN BODY GROUND CLEARANCE	0.410m
TRACK WIDTH	2.500m
LOCK-TO-LOCK TIME	6.00s
CURB TO CURB TURNING RADIUS	15.000m



LIEBHERR LTM 1090-4.1 MOBILE CRANE

OVERALL LENGTH	12.895m
OVERALL WIDTH	2.980m
OVERALL BODY HEIGHT	3.955m
MIN BODY GROUND CLEARANCE	0.370m
TRACK WIDTH	2.980m
LOCK-TO-LOCK TIME	4.00s
WALL TO WALL TURNING RADIUS	10.230m



PUMPER FIRE TRUCK

OVERALL LENGTH	12.192m
OVERALL WIDTH	2.489m
OVERALL BODY HEIGHT	2.361m
MIN BODY GROUND CLEARANCE	0.2m
TRACK WIDTH	2.489m
LOCK-TO-LOCK TIME	5.00s
MAX WHEEL ANGLE	45.00°

NOT FOR CONSTRUCTION

REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
A	10.06.21	REFERENCE DESIGN	ST	AA	MM	MA

ORIG SIZE A1

0 10 20 30 40 50 100mm

AT ORIGINAL PLOT SIZE

CAD DRAWING PATHNAME

MEL connx

REFERENCES

XR25C_09_VEHICLE_TRACKING
XR25C_09_PRECINCT_PLAN_DES
XR25C_03_HIGHWAYS_PLAN
XR25C_01_FENCELINE_PLAN

SCALE 1:1000m

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD

DESIGNED S.TOMIZZI
DRAWN A.ANTONYO
CHECKED M.MONTEIRO
APPROVED M.ARAVIND
DATE 10.06.21

Government of Western Australia Public Transport Authority

MORLEY ELLENBROOK LINE

MALAGA STATION
CIVIL - VEHICLE TRACKING
PLAN SHEET 1

PTA Drawing No: 25-A-287-CI0139 Rev: A

Appendix F – Stormwater

Technical Note

To:	MELConnx	**Date:**	**9/08/2021**
Copies:	-	**Doc No.:**	MELMEL-MLCX-CI-NTE-81002
Sender:	JAJV	**Revision:**	A
Discipline:	CI - Civil and Drainage		
Subject:	Malaga Station Precinct – Stormwater Drainage Strategy		

1. Purpose

This document forms part of the Design Documentation for the Morley-Ellenbrook Line (MEL) in relation to the Malaga Station Precinct Civil Engineering Design. The precinct stormwater strategy design is intended for space planning purposes to allocate space for the different drainage systems and Water Sensitive Urban Design (WSUD) initiatives, as per the requirements stated on *SWTC Book 3: Part A- Scope of Works* and ensure there are no fatal flaws in precinct geometry design and associated drainage strategy. Furthermore, it highlights constraints, risks and opportunities which will inform the detailed design phase of design.

The purpose of this document is to provide a description on the design development of the stormwater drainage elements in response to the proposed station precinct masterplan. This includes precinct geometry and associated stormwater drainage for the following:

- Precinct overall layout, including vehicular access and circulation areas
- Bus interchange
- Pick-up and Drop-off
- Parking

The intent is that this Technical Note is to support the Development Application for Malaga Station.

2. Background

The Morley-Ellenbrook Line (MEL) Project will improve connectivity between the Perth north east metropolitan area and the rest of the city and unlock economic development in these local community areas.

The Public Transport Authority (PTA) is the lead agency delivering the MEL Project, with Main Roads WA (MRWA) undertaking some enabling works.

2.1. General scope of works

The Project's general scope of works includes the design and delivery of rail infrastructure and ancillary works to support operational passenger rail between Bayswater and Ellenbrook, including stations with inter-modal bus and rail with parking and associated road works at Bayswater, Morley, Noranda, **Malaga**, Whiteman Park and Ellenbrook stations.

The design and delivery of the main works package for the Project is broken into three distinct stages:

- Alliance Development Stage
- Project Alliance Reference Design Stage
- Project Alliance Delivery Stage (Detailed Design through to Project close).

Technical Note

Figure 1 Architect's Impression of Malaga Station © MELconnx

3. Technical

3.1. General

In accordance with the SWTC, Book 3: Part A – Scope of Works, Section 3.4 Malaga Station Surrounds, the scope of this technical note outlines the development of a stormwater management strategy for managing stormwater/surface water and groundwater across the entire Station Surrounds for retention and/or detention to maximise the absorption of rainfall and surface runoff within the site, and treatment (where required) and conveyance of stormwater.

The basis of the design and the specific design methodologies adopted for the stormwater drainage design are described below. This section outlines the design considerations associated with the stormwater strategy development of the Malaga Station including carpark, bus interchange and associated precinct.

The design is documented on the following sketch MEL-MLCX-CI-SKT-81000.

3.2. Existing Drainage

Malaga Precinct development is located in an area that is generally graded in a south easterly direction towards Beechboro Road North. Stormwater runoff spreads over the land, ponds in low spots and dissipates through infiltration.

3.3. General Design Strategy

The impermeability of the area will be increased as a result of the proposed development, therefore the post development stormwater runoff will exceed the pre-development runoff. The general drainage strategy for the precinct is as follows:

- Capture and treat the 1EY 1hour runoff.
- Minor Storm: 10% AEP. The drainage system shall be capable of carrying and controlling flow from the minor storm event. The flood level to be kept below the pavement level.
- Major Storm: 1% AEP. Safe, well-defined overland flow paths will be incorporated in the surface design. Above ground storage will be kept away from critical infrastructure (i.e., buildings, major roads) with a minimum of 300mm freeboard. All drainage infrastructure will be approved by the relevant local council. A maximum flood depth on the pavement to be kept to maximum of 200mm.
- Major Storm: 1% AEP. Station building and platform runoff to be captured and dissipated on site.

Furthermore, where management of superficial groundwater is required as part of the project work, groundwater to be managed consistent with the DWER's publication "Water resource considerations when controlling groundwater levels in urban development, DoW, April 2013", and the requirements specified in the SWTC Book 3: Part A: Scope of Works.

3.4. General Design Input

The key drainage design inputs for the station precincts are noted as:

- Design Intensity-Frequency-Duration (IFD) Rainfall – BOM 2016 IFD
- 2% AEP Ground Water Levels
- Geotechnical investigation and report
- Climate change factor applied to the IFD
- Infiltration rate for the site has been adopted as 1m/day for the minor and major analysis.

3.5. Drainage Design

The stormwater drainage strategy for the site is documented on sketch MEL-MLCX-CI-SKT-81000 and is separated into six components as follows:

- Bus interchange
- SER, carpark north, and kiss and ride north (pick up and drop off)
- Carpark south
- Pick up and drop off south, access roads and roundabout
- Station platform and building

The design was completed using DRAINS and 12D. In the detailed design stage, the swales will be modelled as "basin with infiltration" in DRIANS and the pipe network size will be checked using ILSAX method in 12D. The basins are sized for the respective major catchment, modelled in DRIANS. The effect of the attenuation in the swales within the carpark has been neglected for this exercise.

Refer Table 1 (below) for the catchment areas and discharge points for each major catchment.

3.5.1. Bus Interchange

The bus interchange arrangement includes the active bays at the inner edge and the lay over bays along the outer edge. The area is sloped towards the outer kerb line. The proposed drainage system for the bus interchange comprises a pit and pipe network that drains into an infiltration basin on the south eastern side of the area, Basin 1. The basin is formed by a surround bund with a 3m wide access track on top of the bund for maintenance purposes.

The basin includes an overflow weir connecting to a downstream basin, Basin 2. The latter is described further in the “carpark” section.

3.5.2. SER and Carpark North, Pick Up and Drop Off North

The pick-up and drop-off road comprises a central median swale with runoff draining to this central feature. Noting the space available for the proposed swale, this drainage feature is too narrow to accommodate and infiltrate the resulting design flow. Catchpits are proposed within the swale to direct flow to the carpark area, continuing along the central access road in the carpark towards Basin 2 on the eastern side of the Precinct.

The runoff resulting on the development lots have not been included in the design and have been assumed to be managed on site when developed.

The carpark is graded north west to south east. The area is generally crowned in the center of each vehicular aisle to direct the runoff to the swales proposed between each parking lane. There is a raised catchpit at the lower end of the swales. The runoff will be attenuated and infiltrated within the swales then overflow through the raised catchpits into the pipe network. The pipe network is located along the central access road in the carpark and graded towards Basin 2 on the eastern side of the Precinct

The SER is located on the eastern side of the carpark. A grated gully is proposed for the SER area that will discharge to Basin 2.

Basin 2 receives runoff from the SER, pick-up and drop-off north and carpark north catchments, as well as overflow from Basin 1. Basin 2 is equipped with an overflow weir to Basin 3.

According to the DRAINS model, Basin 1 and Basin 2 will overflow for the design event (10% AEP). However, as the design progresses through detailed design this will be reviewed and confirmed. Basin 3 does not receive any direct inflow from the Precinct catchments and is only sized to contain the design event (10% AEP) overflow from Basin 2. Basin 3 is anticipated to have 350mm freeboard to the top bund level for the design event (10% AEP).

3.5.3. Carpark South

Carpark south is also graded north west to south east with the lowest point at the south eastern corner. The area is generally crowned in the center of each vehicular aisle to direct the runoff to the swales proposed between each parking lane. There is a raised catchpit at the lower end of the swales. The runoff will be attenuated and infiltrated within the swales. Overflow is proposed to be captured through the raised catchpits and into the pipe network. The pipe network is located in the southern access road and graded toward Basin 4. Basin 4 also receives runoff from the pick-up and drop-off south, access road and roundabout which is discussed further in the following section.

3.5.4. Pick up and Drop Off South, Access Road and Roundabout

The pick-up and drop-off south of the central access road to the carpark has been designed with a high point located approximately halfway along the central median. The northern portion drains towards catchpits connecting via a pit and pipe system to the drainage infrastructure proposed for the central car park access road. The southern portion, consistent to the above slopes towards the median island, but in this case the runoff will be collected in a proposed swale and overflows into a raised catchpit in the swale. The pit is proposed to be connected to the piped network along the eastbound carriageway of the access road that will gravitate towards Basin 4.

The roundabout and westbound carriage are drained via pit and pipe to Basin 4. Basin 4 is sized to cater for the design event. An overflow weir is designed for the major runoff release from Basin 4.

3.5.5. Station Platform and building

The train station roof and platform drainage systems include 4 separate catchments as follows:

Technical Note

- Northern roof drainage: 590 m^2
- Platform and eastern roof drainage: 1230 m^2
- Southern roof drainage: 760 m^2
- Access to the station building: 400 m^2

The roof drainage on the northern section is directed to the ground level via downpipes. The downpipes will discharge to the open drain (toe drain) that is proposed along the northern boundary of the site. The downpipe discharge locations are highlighted in the Hydraulic design package.

The platform and eastern roof catchment are piped towards the allocated drainage storage cells in the platform. Proposed drainage cells must be located between the canopy piers with a suitable clearance to the pier structure. The proposed solution is the Stormbrixx chamber system for its highest void ratio and suitability for use in these conditions due to spatial constraints. The unit is sized for 1% AEP with infiltration through the base. The base is kept as 200mm above the 2% AEP groundwater level.

The southern roof drainage will be directed to the proposed Stormbrixx unit in the landscape area at the southern side of the building.

Downpipes for the roof on the access ramp to the building are designed to be discharged into individual soakwells, proposed close to the southern edge of the access ramp.

Table 1 Catchment Areas and Discharge Points

Area	Catchment Area (ha)	Discharge Point	1% AEP Flow Management
Bus Interchange	Impervious: 1.44 ha Pervious: 0.36 ha	Basin 1	Overflow via top weir to Basin 2
SER and Carpark North	Impervious: 2.9 ha Pervious: 0.72 ha	Basin 2	Overflow via top weir to Basin 3 *
Carpark South and Access Road and Roundabout	Impervious: 2.3 ha Pervious: negligible	Basin 4	Overflow via top weir towards the major flow path to culvert under Beechboro Road North *
Station Building	Impervious: 0.31 ha	Underground storage Soakwells Downpipes to the northern swale	Underground storages are sized for major events.

**Basin 3 accommodates overflow from Basin 2 and does not receive direct flow from the Precinct area. There is no overflow for 10% AEP from Basin 3. The 1% AEP overflow will be conveyed through an overflow weir to downstream open drain and directed via a culvert across Beechboro Road North. The proposed culvert will be designed as part of Beechboro Road North package. The location of the culvert and the discharge area across the road will be presented in this design once the design for Beechboro Road North is developed further.*

3.5.6. Design groundwater level

The design groundwater adopted for this strategy is the 2% AEP groundwater that has been modelled as a tin across the area.

3.6. Reference Documents

List any supporting documents that relate to this report, or are referenced within it, including document reference numbers.

The following documents support this report:

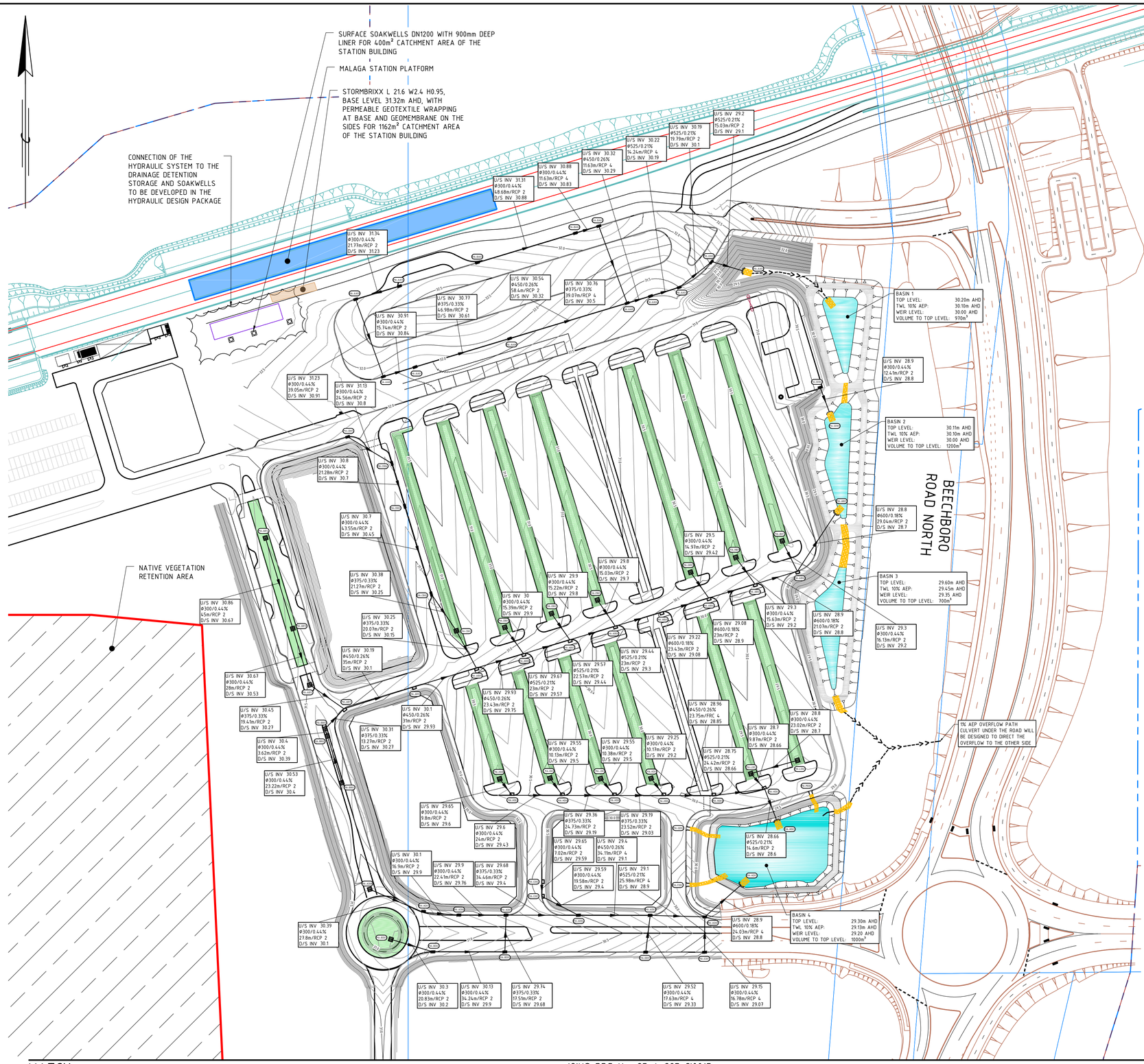
Table 2: Reference document

Reference Number	Name
25-B-00-CI001	Rail Model
25-B-287-AR0001	Architectural Model
MEL-ADV-GE-RPT-00008	Geotechnical Report
TIN_Grndwater_Full_Align_AEP002	Groundwater Model
MEL-MLCX-SV-MDL-00001	Topographical Survey

DOCUMENT CHECKING

	Prepared by	Checked by	Approved by
Name	Maryam Khamesi (Senior Drainage Engineer)	Miguel Monteiro (Civil Engineering SRE) Alistair Avern-Taplin (Stations Package Manager)	Sunil Bhogal (Design Manager)

Appendix A – Stormwater Strategy Plan



MATCH

JOINS DRG No. 25-A-287-CI0015

LINE A

NOTES

1. THIS DRAWING SET IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING DRAWING SETS
   - PRECINCT ARCHITECTURAL (25-A-287-AR)
   - PRECINCT STRUCTURAL (25-A-287-ST)
   - PRECINCT LANDSCAPING (25-A-287-LA)
   - PRECINCT HYDRAULICS (25-A-287-PL)
   - LINEWIDE RAIL (25-C)
   - LINEWIDE HIGHWAYS (25-C)
2. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE NOTED.
3. THE PROPOSED SURFACE HAS BEEN DESIGNED TO ENSURE THAT SURFACE WATER RUNOFF RESULTING FROM THE MAJOR STORM EVENT (1% AEP) WILL NOT IMPACT CRITICAL INFRASTRUCTURE.
4. THE DESIGN GROUNDWATER LEVEL FOR THIS SITE VARIES FROM +29.00mAHD TO +31.2mAHD (GENERALLY INCREASING EAST TO WEST). REFER TO MALAGA GROUNDWATER MODEL TIN_GRNDWATER_MALAGA_AEP002_20210316.
5. A DESIGN PERMEABILITY VALUE OF 1.16 X 10^{-5} m/s (1 m/DAY) HAS BEEN ASSUMED BASED ON A REVIEW OF THE ADVISIAN GEOTECHNICAL INVESTIGATION INTERPRETIVE REPORT MEL_ADV-GE-RPT-00008 (15/12/2020).
6. FOR STATION ROOF DRAINAGE REFER TO MALAGA STATION HYDRAULICS DRAWINGS.
7. FOR FURTHER DETAILS, REFER TO CITY OF SWAN STANDARD DRAWINGS
   - STD-43-2-10 CULVERT DETAILS
   - STD-43-2-0 HEADWALL FOR PIPE CULVERTS
   - STD-125-1S-0 STONE PITCHING ON OPEN DRAINS (DRAIN BLOCK)
   - STD-125-2S-0 STONE PITCHING OPEN DRAINS (FOR HEADWALL OUTLET INTO OPEN DRAIN)
   - STD-108-1S-0 INTERCONNECTED SOAKWELLS WITH OVERFLOW INTO THE CITY DRAINAGE SYSTEM
   - STD-68-1S DRAINAGE PIT DETAILS
   - STD-69-1S GULLY GRATE
   - STD-56-2S STANDARD MANHOLE
   - STD-56-4 TYPICAL MANHOLE

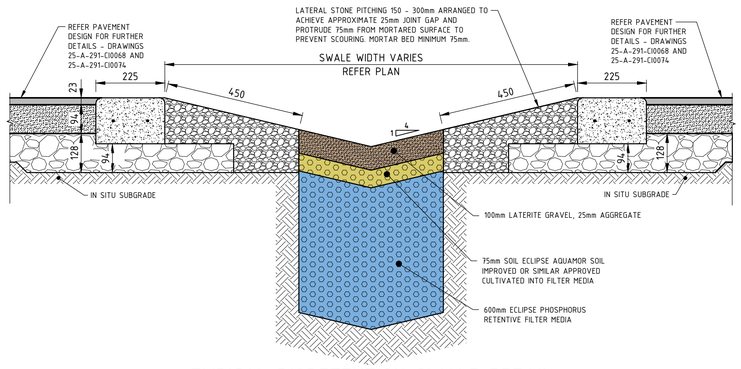
LEGEND

- RAIL ALIGNMENT
- DEVELOPMENT ENVELOPE
- INDICATIVE PROJECT FOOTPRINT
- 645 — EXISTING CADASTRAL BOUNDARY
- DRAINAGE DETENTION BASIN
- DRAINAGE SWALE / BIO-RETENTION / TREATMENT AREA
- BURIED DRAINAGE DETENTION STORAGE. STORMTECH OR APPROVED EQUIVALENT
- 18.0 — PROPOSED MAJOR CONTOURS
- PROPOSED MINOR CONTOURS
- PROPOSED DRAINAGE PIPE, FLOW DIRECTION
- PROPOSED OPEN DRAIN
- PROPOSED CATCHPIT/BUBBLE-UP PIT
- PROPOSED STREET GULLY
- PROPOSED HEADWALL
- PROPOSED SIDE ENTRY PIT
- PROPOSED KERB OPENING WITH ROCK PITCHING
- PROPOSED 150mm STONE PITCHING
- ML-BA02 — PROPOSED DRAINAGE PIT CALL-OUT

PIPE INFO

U/S INV 29.71m
Ø450 / 0.26%
4.27m / RCP 4
D/S INV 29.70m

UPSTREAM I.L.
SIZE / GRADE
LENGTH / PIPE CLASS
DOWNSTREAM I.L.



TYPICAL BIORETENTION SWALE DETAIL

NTS

REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
A	09/08/21	DA SUBMISSION	MK	PP	MM	MA

ORIG SIZE A1

0 10 20 30 40 50 100mm

AT ORIGINAL PLOT SIZE

MEL connx

REFERENCES

XR25C_09_DRAINAGE_DES
XR25C_09_PR_CONTOURS_DES
XR25C_09_PRECINCT_PLAN_DES
XR25C_01_FENCELINE_PLAN

SCALE 1:1000m

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD

DESIGNED	M.KHAMESI
DRAWN	P.POURHAMZEH
CHECKED	M.MONTEIRO
APPROVED	M.ARAVIND
DATE	09.08.21

Government of Western Australia
Public Transport Authority

MORLEY ELLENBROOK LINE

MALAGA STATION
CIVIL - DRAINAGE AND FINISHED SURFACE
PLAN SHEET 1

PTA Drawing No: MEL-MLCX-CI-SKT-81000 | Rev: A

CAD DRAWING PATHNAME

Appendix G – EPA Ministerial Statement

Published on: 15 December 2020 Statement No. 1156

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED
(Environmental Protection Act 1986)

MALAGA TO ELLENBROOK RAIL WORKS

Proposal: The proposal is to construct and operate a new 13 kilometre railway line between Malaga and Ellenbrook in the City of Swan. The proposal includes the construction of new train stations and associated facilities at Malaga, Whiteman Park and Ellenbrook and a potential future station at Bennett Springs.

Proponent: Public Transport Authority of Western Australia
Australian Business Number 61 850 109 576

Proponent Address: Public Transport Centre, West Parade
PERTH WA 6000

Assessment Number: 2238

Report of the Environmental Protection Authority: 1690

Pursuant to section 45 of the *Environmental Protection Act 1986,* it has been agreed that the proposal described and documented in Table 1 of Schedule 1 may be implemented and that the implementation of the proposal is subject to the following implementation conditions and procedures:

1 Proposal Implementation

1-1 When implementing the proposal, the proponent shall not exceed the authorised extent of the proposal as defined in Table 2 of Schedule 1, unless amendments to the proposal and the authorised extent of the proposal have been approved under the *Environmental Protection Act 1986*.

2 Contact Details

2-1 The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty-eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.

3 Time Limit for Proposal Implementation

3-1 The proponent shall not commence implementation of the proposal after five (5) years from the date of this Statement, and any commencement, prior to this date, must be substantial.

3-2 Any commencement of implementation of the proposal, on or before five (5) years from the date of this Statement, must be demonstrated as substantial by providing the CEO with written evidence, on or before the expiration of five (5) years from the date of this Statement.

4 Compliance Reporting

4-1 The proponent shall prepare, and maintain a Compliance Assessment Plan which is submitted to the CEO at least six (6) months prior to the first Compliance Assessment Report required by condition 4-6, or prior to implementation of the proposal, whichever is sooner.

4-2 The Compliance Assessment Plan shall indicate:

(1) the frequency of compliance reporting;

(2) the approach and timing of compliance assessments;

(3) the retention of compliance assessments;

(4) the method of reporting of potential non-compliances and corrective actions taken;

(5) the table of contents of Compliance Assessment Reports; and

(6) public availability of Compliance Assessment Reports.

4-3 After receiving notice in writing from the CEO that the Compliance Assessment Plan satisfies the requirements of condition 4-2 the proponent shall assess compliance with conditions in accordance with the Compliance Assessment Plan required by condition 4-1.

4-4 The proponent shall retain reports of all compliance assessments described in the Compliance Assessment Plan required by condition 4-1 and shall make those reports available when requested by the CEO.

4-5 The proponent shall advise the CEO of any potential non-compliance within seven (7) days of that non-compliance being known.

4-6 The proponent shall submit to the CEO the first Compliance Assessment Report fifteen (15) months from the date of issue of this Statement addressing the twelve (12) month period from the date of issue of this Statement and then annually from the date of submission of the first Compliance Assessment Report, or as otherwise agreed in writing by the CEO.

The Compliance Assessment Report shall:

(1) be endorsed by the proponent's Chief Executive Officer or a person delegated to sign on the Chief Executive Officer's behalf;

(2) include a statement as to whether the proponent has complied with the conditions;

(3) identify all potential non-compliances and describe corrective and preventative actions taken;

(4) be made publicly available in accordance with the approved Compliance Assessment Plan; and

(5) indicate any proposed changes to the Compliance Assessment Plan required by condition 4-1.

5 Public Availability of Data

5-1 Subject to condition 5-2, within a reasonable time period approved by the CEO of the issue of this Statement and for the remainder of the life of the proposal, the proponent shall make publicly available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (e.g. maps)), management plans and reports relevant to the assessment of this proposal and implementation of this Statement.

5-2 If any data referred to in condition 5-1 contains particulars of:

(1) a secret formula or process; or

(2) confidential commercially sensitive information;

the proponent may submit a request for approval from the CEO to not make these data publicly available. In making such a request the proponent shall provide the CEO with an explanation and reasons why the data should not be made publicly available.

6 Bennett Brook – Social Surroundings (Aboriginal Heritage), Inland Waters, Terrestrial Fauna

6-1 The proponent shall design and manage the implementation of the proposal to meet the following environmental objective:

(1) maintain the hydrological regime and water quality in Bennett Brook that supports:

(a) important Aboriginal cultural associations and heritage;

(b) Carter's freshwater mussel (*Westralunio carteri*); and

(c) the **ecological integrity** of Bennett Brook, incorporating **Conservation Category Wetland** Unique Feature Identifier 15259.

6-2 To ensure that the objective of condition 6-1 is being met, the proponent shall:

(1) construct bridge footings or pillars, drainage structures and abutments outside of the bed and banks of Bennett Brook;

(2) ensure no excavation activities occur within the bed of Bennett Brook;

(3) not dispose or discharge dewatered effluent to the Bennett Brook or its tributaries;

(4) not allow access for the purposes of construction activities within the bed of Bennett Brook with the exception of tree removal necessary for bridge construction, unless agreed in writing by the CEO; and

(5) within twelve (12) months following construction of the proposal, undertake **rehabilitation** of areas temporarily disturbed during construction with locally native species to reinstate fauna habitat.

7 Social Surroundings (Aboriginal Heritage)

7-1 The proponent shall consult with appropriate and relevant Whadjuk Noongar representatives regarding how access to **Registered Sites** 551 and 552 can be maintained for the purpose of cultural practice.

7-2 The proponent shall undertake consultation with appropriate and relevant Whadjuk Noongar representatives and Registered Knowledge Holder families of Bennett Brook prior to and during construction of the Bennett Brook rail bridge regarding the retention of **paperbark trees** at and adjacent to the Bennett Brook crossing.

7-3 Prior to commencement of construction activities at Bennett Brook, the proponent shall provide evidence to the CEO of the consultation required by condition 7-2, including how input received was addressed.

8 Construction Impacts – Flora and Vegetation, Terrestrial Fauna, Inland Waters

8-1 During construction of the proposal the proponent shall:

(1) not clear more than:

(a) 10.05 ha of Banksia woodlands of the Swan Coastal Plain priority ecological community;

(b) 81.4 ha of Carnaby's cockatoo (*Calyptorhynchus latirostris*) **foraging habitat**;

(c) 68.1 ha of forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) **foraging habitat**; and

(d) 423 **black cockatoo** potential breeding trees.

(2) implement hygiene protocols, consistent with the ***Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia, Part 2 National Best Practice Guidelines*** as amended or replaced from time to time;

(3) manage soil and groundwater disturbing activities in accordance with the Acid Sulfate Soil Guideline Series *Identification and investigation of acid sulfate soils and acidic landscapes* (2015) and *Treatment and management of soils and water in acid sulfate soil landscapes* (2015), or any approved update of these guidelines;

(4) not dispose of dewatered effluent to **Conservation Category Wetlands** or **Resource Enhancement Wetlands**;

(5) not locate **abstraction bores** within fifty (50) metres of:

(a) identified Banksia woodlands; or

(b) **Conservation Category Wetlands**,

that are located adjacent to the **development envelope** or within native vegetation retention areas **(NVRA)**;

(6) ensure that no refuelling, chemical storage or stockpiling occurs within fifty (50) metres of a **Conservation Category Wetland**;

(7) undertake weed control and management measures to prevent the introduction or spread of weeds;

(8) implement measures to ensure there are no direct or **indirect impacts**, when compared to pre-construction **baseline conditions**, to native vegetation or wetlands in **NVRA**, or directly adjacent to the **development envelope** from dewatering activities; and

(9) implement measures to minimise indirect threatening processes, including grazing, on native vegetation within the **Patch 1 Malaga NVRA**.

8-2 Following construction of the proposal, the proponent shall:

(1) ensure there are no direct or **indirect impacts**, when compared to pre-construction **baseline conditions**, to native vegetation within the **NVRA** within five (5) years post construction that are attributable to the proposal;

(2) undertake weed control and management for five (5) years post construction within:

(a) the **NVRA**;

(b) Bush Forever site 304 in the **development envelope**; and

(c) Bush Forever site 304 within twenty (20) metres of the **development envelope.**

(3) implement measures for three (3) years post construction to manage indirect threatening processes, including grazing, within the **Patch 1 Malaga NVRA,** to ensure vegetation structure and condition is maintained when compared to pre-construction **baseline conditions**;

(4) within twelve (12) months, undertake **rehabilitation** of native vegetation with locally native species to achieve pre-construction vegetation densities in all areas disturbed during construction activities that are not required for the ongoing operation of the proposal; and

(5) undertake annual monitoring and any remedial measures to ensure **rehabilitation** required by condition 8-2(4) will successfully establish within five (5) years post construction.

8-3 The proponent shall prepare and submit a report to demonstrate that the requirements of condition 8-2 have been met. The first report shall be submitted within three (3) months of the completion of construction and then annually with the Compliance Assessment Report, until the CEO has confirmed by notice in writing that the requirements of condition 8-2 have been met.

9 Malaga Dive Structure – Inland Waters and Flora and Vegetation

9-1 The proponent shall manage dewatering, excavation activities, and the treatment, re-use and disposal of acid sulfate soils at the **Malaga dive structure** to meet the following environmental objective:

(1) maintain the quality and hydrological regime of groundwater that supports the biological diversity and **ecological integrity** of:

(a) Banksia woodlands of the Swan Coastal Plain priority ecological community;

(b) **Conservation Category Wetlands**; and

(c) **Resource Enhancement Wetlands**.

9-2 Prior to excavation or dewatering activities associated with construction of the **Malaga dive structure**, whichever occurs first, the proponent shall:

(1) undertake appropriate investigations for acid sulfate soils in accordance with the Department of Water and Environmental Regulation's acid sulfate soil guidelines for the identification and investigation of acid sulfate soils and acidic landscapes;

(2) prepare and submit an Acid Sulfate Soils and Dewatering Management Plan based on the findings of the investigations required by condition 9-2(1) and in accordance with the Department of Water and Environmental Regulation's acid sulfate soil guidelines for the treatment and management of soils and water in acid sulfate soil landscapes; and

(3) specify the measures to meet the objective in condition 9-1(1) in the Acid Sulfate Soils and Dewatering Management Plan.

9-3 The proponent shall implement the Acid Sulfate Soils and Dewatering Management Plan required by condition 9-2(2) which the CEO has advised in writing satisfies the requirements of condition 9-2(2).

9-4 Following the completion of construction of the **Malaga dive structure**, the proponent shall:

(1) within thirty (30) days, prepare, in accordance with the Department of Water and Environmental Regulation's acid sulfate soil guidelines for the treatment and management of soils and water in acid sulfate soil landscapes, and submit, a report to demonstrate compliance with the Acid Sulfate Soils and Dewatering Management Plan required by condition 9-2(2);

(2) undertake post-dewatering monitoring for a minimum of six (6) months to determine whether the environmental objective specified in condition 9-1(1) is being met; and

(3) within thirty (30) days of the last monitoring event required by condition 9-4(2), prepare and submit a post-dewatering monitoring report to demonstrate compliance with the environmental objective specified in condition 9-1(1).

9-5 The proponent:

(1) may review and revise the Acid Sulfate Soils and Dewatering Management Plan; or

(2) shall review and revise the Acid Sulfate Soils and Dewatering Management Plan as and when directed by the CEO by a notice in writing.

9-6 The proponent shall implement the latest revision of the Acid Sulfate Soils and Dewatering Management Plan, which the CEO has confirmed by notice in writing, satisfies the requirements of condition 9-2(2).

10 Terrestrial Fauna

10-1 The proponent shall undertake the following actions to minimise impacts to terrestrial fauna:

(1) within seven (7) days prior to clearing, using a qualified and licensed terrestrial **fauna spotter**(s) with experience in surveying for **black cockatoos**, inspect all **potential nesting trees** with hollows within the **development envelope** to determine if any hollows are being used for nesting by **black cockatoos**; and

(2) if any hollows are in use by **black cockatoos** for nesting, the proponent shall not **disturb** or clear the nesting tree, or vegetation within a ten (10) metre radius of the nesting tree, until after the cockatoos have naturally completed nesting (young have fledged and dispersed) and an appropriately qualified and licensed terrestrial **fauna spotter** has verified that the hollow(s) are no longer being used by the **black cockatoos**.

10-2 During activities associated with the construction of the proposal, the proponent shall undertake as required the following actions to minimise impacts to terrestrial fauna:

(1) ensure the use of appropriately qualified and licensed terrestrial **fauna spotter**(s) during clearing activities;

(2) ensure that during **trenching activities** inspection for, and clearing of, fauna from open trenches by appropriately qualified and licensed terrestrial fauna rescue personnel occurs at least twice daily and not more than one (1) hour prior to backfilling of trenches, with the first daily inspection and clearing to be undertaken no later than three (3) hours after sunrise prior to any construction, and the second inspection and clearing to be undertaken daily between the hours of 3:00 pm and 6:00 pm;

(3) ensure that open trench lengths do not exceed a length capable of being inspected and cleared by appropriately qualified and licensed fauna rescue personnel within the required times set out in condition 10-2(2); and

(4) provide egress points, ramps and/or fauna refuges that provide suitable shelter from the sun and predators for trapped fauna in open trenches at intervals not exceeding fifty (50) metres.

11 Social Surroundings (Noise)

11-1 The proponent shall implement the proposal to meet the following environmental objective:

(1) minimise operational noise and vibration impacts on existing noise sensitive receptors **as far as practicable**.

11-2 At least three (3) months prior to the operation of the proposal, in order to meet the requirements of condition 11-1(1), the proponent shall submit a further revision of the Morley-Ellenbrook Rail Line Part 2 Malaga to Ellenbrook Noise and Vibration Management Plan (Reference: 675.11323-R05, June 2020) to include:

(1) the details of relevant noise mitigation measures to confirm that noise and vibration criteria will be met;

(2) an update to Section 5 Management Measures, to show the locations and minimum heights of noise walls; and

(3) demonstration that the design and construction of noise mitigation measures will meet the noise and vibration objectives set out in Section 2 Transport noise and vibration objectives.

11-3 The proponent shall implement the revised Morley-Ellenbrook Rail Line Part 2 Malaga to Ellenbrook Noise and Vibration Management Plan, or the most recent version, which the CEO has confirmed by notice in writing satisfies the requirements of condition 11-2.

11-4 The proponent shall continue to implement the revised Morley-Ellenbrook Rail Line Part 2 Malaga to Ellenbrook Noise and Vibration Management Plan, or any subsequently approved revisions until the CEO has confirmed by notice in writing that the proponent has demonstrated that the objective in condition 11-1(1) is being and will continue to be met.

11-5 In the event of failure to implement management actions detailed in the approved Morley-Ellenbrook Rail Line Part 2 Malaga to Ellenbrook Noise and Vibration Management Plan, the proponent shall meet the requirements of condition 4-5 (Compliance Reporting) and shall implement the measures outlined in the approved Morley-Ellenbrook Rail Line Part 2 Malaga to Ellenbrook Noise and Vibration Management Plan, including, but not limited to, actions and investigations to be undertaken.

12 Offsets

12-1 The proponent shall undertake offsets to achieve the objective of counterbalancing the significant residual impact on the following environmental values as a result of the implementation of the proposal:

(1) 10.05 ha of Banksia woodlands of the Swan Coastal Plain priority ecological community;

(2) 81.4 ha of Carnaby's cockatoo (*Calyptorhynchus latirostris*) **foraging habitat**;

(3) 68.1 ha of forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) **foraging habitat**;

(4) 423 **black cockatoo** potential breeding trees;

(5) 1.9 ha of **Conservation Category Wetlands**;

(6) 0.5 ha of **Resource Enhancement Wetlands**; and

(7) 17.2 ha of Bush Forever site 304,

On-ground Management Offset Plan

12-2 Within twelve (12) months of the publication of this Statement or as otherwise agreed by the CEO, the proponent shall prepare and submit an On-ground Management Offset Plan to the requirements of the CEO, with the environmental objective of counterbalancing the significant residual impact to:

(1) 1.9 ha of **Conservation Category Wetlands**;

(2) 0.5 ha of **Resource Enhancement Wetlands**; and

(3) 17.2 ha of Bush Forever site 304.

12-3 The On-ground Management Offset Plan required by condition 12-2 shall:

(1) spatially define and map the vegetation condition of an area or areas within Whiteman Park, or other suitable location as agreed by the CEO, where **on-ground management** actions are proposed to counterbalance the significant residual impacts to the environmental values specified in condition 12-2;

(2) detail the proposed **on-ground management** actions to be implemented, objectives and targets to be achieved, a timeframe for the actions to be undertaken, completion criteria, funding arrangements for these actions and any **contingency actions** to be undertaken within Whiteman Park, or other suitable location as agreed by the CEO;

(3) define the role of the proponent and/or any relevant management authority or other third party involved in delivering the offset;

(4) include evidence of consultation with stakeholders including:

(a) Department of Biodiversity, Conservation and Attractions;

(b) Department of Planning, Lands and Heritage; and

(c) Friends of Bennett Brook;

(5) demonstrate how the **on-ground management** actions to be undertaken within Whiteman Park, or other suitable location as agreed

by the CEO, will result in a tangible improvement to the environmental values being offset;

(6) demonstrate how the **on-ground management** actions counterbalance the significant residual impact to the environmental values identified in condition 12-2 through application of the principles of the WA Environmental Offsets Policy 2011 and completion of the WA Offsets Template, as described in the WA Environmental Offsets Guidelines 2014 or any subsequent revisions of these documents; and

(7) detail the monitoring, reporting and evaluation mechanisms for actions identified under conditions 12-3(2).

12-4 The proponent:

(1) may review and revise the On-ground Management Offset Plan; or

(2) shall review and revise the On-ground Management Offset Plan as and when directed by the CEO by notice in writing.

12-5 The proponent shall implement the latest revision of the On-ground Management Offset Plan approved by the CEO by notice in writing.

12-6 The proponent shall continue to implement the On-ground Management Offset Plan until the CEO has confirmed by notice in writing that the proponent has demonstrated that the objective in condition 12-2 has been met.

12-7 The proponent shall notify the CEO within twenty-one (21) days if any of the actions or outcomes set out in the On-ground Management Offset Plan are unable to be achieved, and provide the detail and timing of **contingency actions** to be undertaken.

Offset Strategy

12-8 Within six (6) months of the publication of this Statement, or as otherwise agreed by the CEO, the proponent shall prepare and submit an Offset Strategy to the requirements of the CEO, with the environmental objective of counterbalancing the significant residual impact to:

(1) 10.05 ha of Banksia woodlands of the Swan Coastal Plain priority ecological community;

(2) 81.4 ha of Carnaby's cockatoo (*Calyptorhynchus latirostris*) **foraging habitat**;

(3) 68.1 ha of forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) **foraging habitat**; and

(4) 423 **black cockatoo** potential breeding trees.

12-9 The Offset Strategy required by condition 12-8 shall:

(1) demonstrate that the objective in condition 12-8 will be met;

(2) identify an area, or areas, (the **Proposed Offset Conservation Area**) to be **acquired** with **on-ground management**, managed for conservation purposes, and contains the environmental values identified in condition 12-8;

(3) demonstrate how the environmental values within the **Proposed Offset Conservation Area** counterbalances the significant residual impact to the environmental values identified in condition 12-8(1), condition 12-8(2) and condition 12-8(3) through application of the principles of the WA Environmental Offsets Policy and completion of the WA Offsets Template, as described in the WA Environmental Offsets Guidelines 2014, and the *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy Assessment Guide (October 2012), or any subsequent revisions of these documents;

(4) demonstrate that the **Proposed Offset Conservation Area** contains at least 1,269 **black cockatoo** breeding trees or potential breeding trees;

(5) demonstrate how the **Proposed Offset Conservation Area** aligns with:

(a) Approved conservation advice (incorporating listing advice) for the Banksia woodlands of the Swan Coastal Plain Ecological Community 2016*;*

(b) Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan 2013; and

(c) Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksia naso*) Recovery Plan 2008,

or any subsequent revisions of these documents;

(6) identify how the **Proposed Offset Conservation Area** will be **acquired** and specify:

(a) a timeframe and quantum of works associated with establishing the **Proposed Offset Conservation Area**, including a contribution for maintaining the offset for at least seven (7) years after completion of purchase and details pertaining to monitoring, evaluating and reporting; and

(b) the **relevant management body** for the on-going management of the **Proposed Offset Conservation Area,** including its role,

and the role of the proponent, and confirmation in writing that the **relevant management body** accepts responsibility for its role.

(7) where **on-ground management** is proposed:

(a) state the objective(s) and target(s) to be achieved, including completion criteria, which result in a tangible improvement to the environmental value(s) being offset;

(b) demonstrate the consistency of the objective(s) and target(s) with the objectives of any relevant conservation advice and recovery plans;

(c) detail the **on-ground management** actions with associated timeframes for implementation, including **contingency actions**, to achieve the objective(s) and target(s) identified above; and

(d) detail the monitoring, reporting and evaluation mechanisms for the objective(s), target(s) and actions identified above.

12-10 The proponent:

(1) may review and revise the Offset Strategy; or

(2) shall review and revise the Offset Strategy as and when directed by the CEO by a notice in writing.

12-11 Where research project(s) are proposed to offset the significant residual impacts to Carnaby's cockatoo and forest red-tailed black cockatoo, the proponent shall prepare and submit with the Offset Strategy required by condition 12-8, a Black Cockatoo Research Plan to the requirements of the CEO that will increase the scientific knowledge of black cockatoos relevant to improving conservation and management of the species and its habitat in the Perth and Peel regions. The Black Cockatoo Research Plan shall:

(1) demonstrate how the research project(s) will provide a positive and long-term conservation outcome for Carnaby's cockatoo and forest red-tailed black cockatoo and addresses agreed research priorities, considering key knowledge gaps identified in the EPA Technical Report: Carnaby's Cockatoo in Environmental Impact Assessment in the Perth and Peel Regions (2019), the relevant black cockatoo recovery plans and/or other research priorities agreed with the Department of Biodiversity, Conservation and Attractions;

(2) identify the objectives and intended outcomes, and details of success criteria;

(3) provide an implementation schedule including an outline of key activities, deliverables, stages of implementation, and milestones towards completion;

(4) identify the agreed governance arrangements including stakeholder responsibilities for implementing the research, and agreements with any third parties involved and legal obligations;

(5) identify any potential risks involved and appropriate **contingency actions**;

(6) identify monitoring activities to assess progress with research implementation and for compliance purposes;

(7) provide details on the:

(a) financial and financial auditing arrangements including project budget and recipients of funds if project(s) are to be undertaken by any third parties;

(b) funding arrangements including the methodology to determine the amount of funding to be spent on research project(s); and

(c) timing of funding for the research project(s);

(8) identify procedures for reporting to the CEO and Department of Biodiversity, Conservation and Attractions, including the content, format, timing and frequency for reporting and provisions of data and information against the objectives and outcomes identified in condition 12-11(2); and

(9) identify how the results of the research offset will be communicated and/or published in an **open access** format for the benefit of future assessments and public understanding of the species.

12-12 The proponent:

(1) may review and revise the Black Cockatoo Research Plan; or

(2) shall review and revise the Black Cockatoo Research Plan as and when directed by the CEO by notice in writing.

12-13 Within six (6) months of receiving notice in writing from the CEO, on advice of the Department of Biodiversity, Conservation and Attractions, that the Offset Strategy satisfies the requirements of conditions 12-8, 12-9 and/or 12-11 the proponent shall implement the actions in accordance with the approved Offset Strategy.

12-14 The proponent shall implement the latest version of the Offset Strategy, which the CEO has confirmed by notice in writing, satisfies the requirements of conditions 12-8, 12- 9 and/or 12-11.

12-15 The proponent shall notify the CEO within twenty-one (21) days if any of the actions or outcomes set out in the Offset Strategy are unable to be achieved, and provide the detail and timing of **contingency actions** to be undertaken.

[signed on 15 December 2020]

Hon Stephen Dawson MLC
MINISTER FOR ENVIRONMENT

Schedule 1

Table 1: Summary of the proposal

Proposal title	Malaga to Ellenbrook Rail Works
Short description	The proposal is to construct and operate a new 13 kilometre dual railway line from Malaga to Ellenbrook in the City of Swan. The proposal includes the construction and operation of new intermodal transit stations at Malaga, Whiteman Park and Ellenbrook, with provision for a future station at Bennett Springs East. The proposal includes construction of a principal shared path, bridge infrastructure (including over Gnangara Road), a dive structure, and construction laydown and access areas.

Table 2: Location and authorised extent of physical and operational elements

Column 1	Column 2	Column 3
Element	**Location**	**Authorised extent**
Clearing and disturbance for construction of the railway, stations, principal shared path, dive structure, drainage structures, fencing, bridges, noise walls, and construction laydown and access areas.	Located within the development envelope as shown in Figure 1.	Clearing and disturbance of no more than 249 ha of which 152.1 ha is native vegetation within a 463.8 ha development envelope.

Table 3: Abbreviations and Definitions

Acronym, Term or Abbreviation	Definition
Abstraction bores	Bores used for construction water supply.
Acquired	The protection of environmental values on an area of initially unprotected land for the purpose of conservation through improved security of tenure or restricting the use of land (e.g. ceding land to the Crown or perpetual conservation covenants). This includes upfront costs of establishing the offset site and the on-going management of costs of maintaining the offset for the long term.
As far as practicable	As far as reasonably achievable or feasible as determined by the CEO having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge.
Baseline conditions	The environmental conditions prior to being subject to pressures from a development or operation of concern. This may include natural environmental conditions that are largely un-impacted by human influences or state of the environment just prior to influences and effects of development.

Acronym, Term or Abbreviation	Definition
Black cockatoos	Includes Carnaby's cockatoo (*Calyptorhynchus latirostris*), forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) and Baudin's cockatoo (*Calyptorhynchus baudinii*).
Foraging habitat	Foraging habitat described in *EPBC Act referral guidelines for three threatened black cockatoo species* (Commonwealth of Australia 2012), or any subsequent revisions of this document.
CEO	The Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the *Environmental Protection Act 1986*, or his delegate.
Conservation Category Wetland	As identified in the Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019) dataset as updated from time-to-time.
Contingency actions	Actions to be implemented when monitoring determines that a management target may not be met, and where the actions will bring the impact within the management target.
Development envelope	The area within the yellow line marked in Figure 1 of this Statement and defined by coordinates in Schedule 2.
Disturb	Is to be defined as per the definition of 'disturb' in section 5 [subsection disturb — (a)(i)(ii)(iii) and (iv)] of the *Biodiversity Conservation Act 2016.*
Ecological integrity	Ecological integrity is the composition, structure, function and processes of ecosystems, and the natural variation of these elements.
Fauna spotter	A person who is qualified and licenced under section 40 of the *Biodiversity Conservation Act 2016*.
ha	Hectare
Indirect impacts	Any potential impacts outside the development envelope or to NVRA as a result of the clearing and disturbance authorised in Table 2 of Schedule 1. This includes but is not limited to: hydrological change, weed invasion, altered fire regimes, introduction or spread of disease, changes in erosion/deposition/accretion and edge effects.
Malaga dive structure	Where the railway extends below ground surface west of the Malaga station and connects to the Bayswater to Malaga rail line.

Acronym, Term or Abbreviation	Definition
Management of <u>Phytophthora cinnamomi</u> for Biodiversity Conservation in Australia, Part 2, National Best Practice Guidelines	E O'Gara, K Howard, B Wilson and GEStJ Hardy (2005) *Management of <u>Phytophthora cinnamomi</u> for Biodiversity Conservation in Australia: Part 2 – National Best Practice Guidelines*. A report funded by the Commonwealth Government Department of the Environment and Heritage by the Centre for Phytophthora Science and Management, Murdoch University, Western Australia, or any subsequent revisions of this document.
NVRA	Native vegetation retention areas, as shown in Figure 2 and defined by coordinates in Schedule 2
On-ground management	This includes revegetation (re-establishment of native vegetation in degraded areas) and rehabilitation (repair of ecosystem processes and management of weeds, disease or feral animals) with the objective to achieve a tangible improvement to the environmental values in the offset area.
Open access	The provision of free access to peer-reviewed, scholarly and research information to all, that removes restrictions on use and reuse.
Paperbark trees	*Melaleuca* tree species within the riparian zone or channel of Bennett Brook.
Patch 1 Malaga NVRA	Patch of Banksia woodlands of the Swan Coastal Plain priority ecological community located within the development envelope near the location of the proposed Malaga station, that will be retained within a NVRA, as shown in Figure 3 and defined by coordinates in Schedule 2.
Potential nesting trees	Any existing tree of a species known to support black cockatoo breeding which has a hollow and therefore may be being used for nesting.
Proposed Offset Conservation Area	The area of land identified in condition 12-9(2).
Registered Sites	Means a place to which the *Aboriginal Heritage Act 1972* applies by the operation of section 5 of that Act.
Rehabilitation	Repair of ecosystem processes and management of weeds, disease or feral animals.
Relevant management body	A party that is directly responsible for the on-going management of the Proposed Offset Conservation Area.
Resource Enhancement Wetlands	As identified in the Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019) dataset as updated from time-to-time.

Acronym, Term or Abbreviation	Definition
Trenching activities	Trenches used for utilities such as communications. Trenches do not include excavation for the sinking of the railway line.

Figures (attached)

Figure 1 Malaga to Ellenbrook Rail Works development envelope and disturbance footprint (This figure is a representation of the co-ordinates shown in Schedule 2)

Figure 2 Native vegetation retention areas relevant to condition 8 (This figure is a representation of the co-ordinates shown in Schedule 2)

Figure 3 Native vegetation retention area at Patch 1 Malaga relevant to condition 8-1(9) and condition 8-2(3) (This figure is a representation of the co-ordinates shown in Schedule 2)

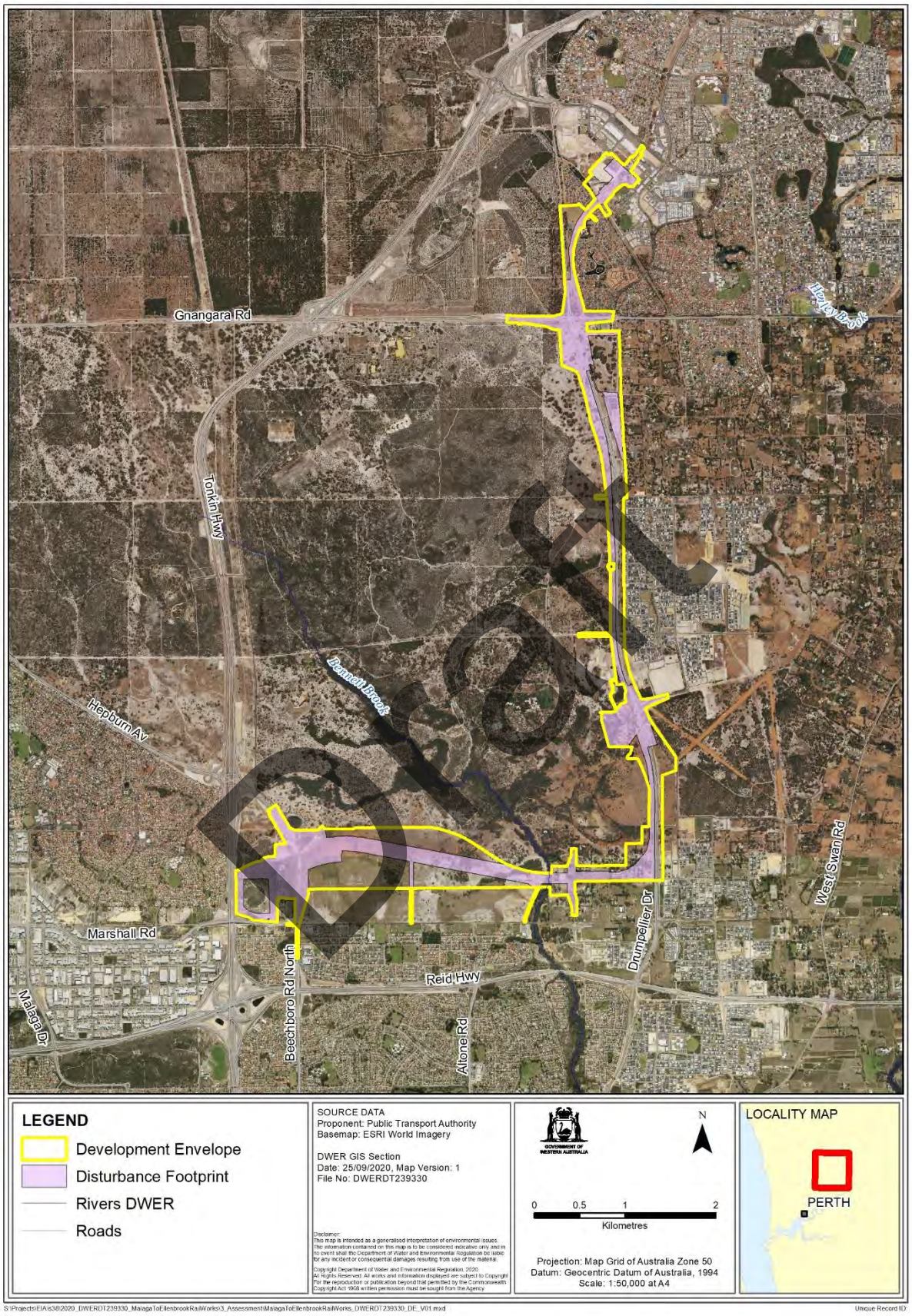


Figure 1: Malaga to Ellenbrook Rail Works development envelope and disturbance footprint

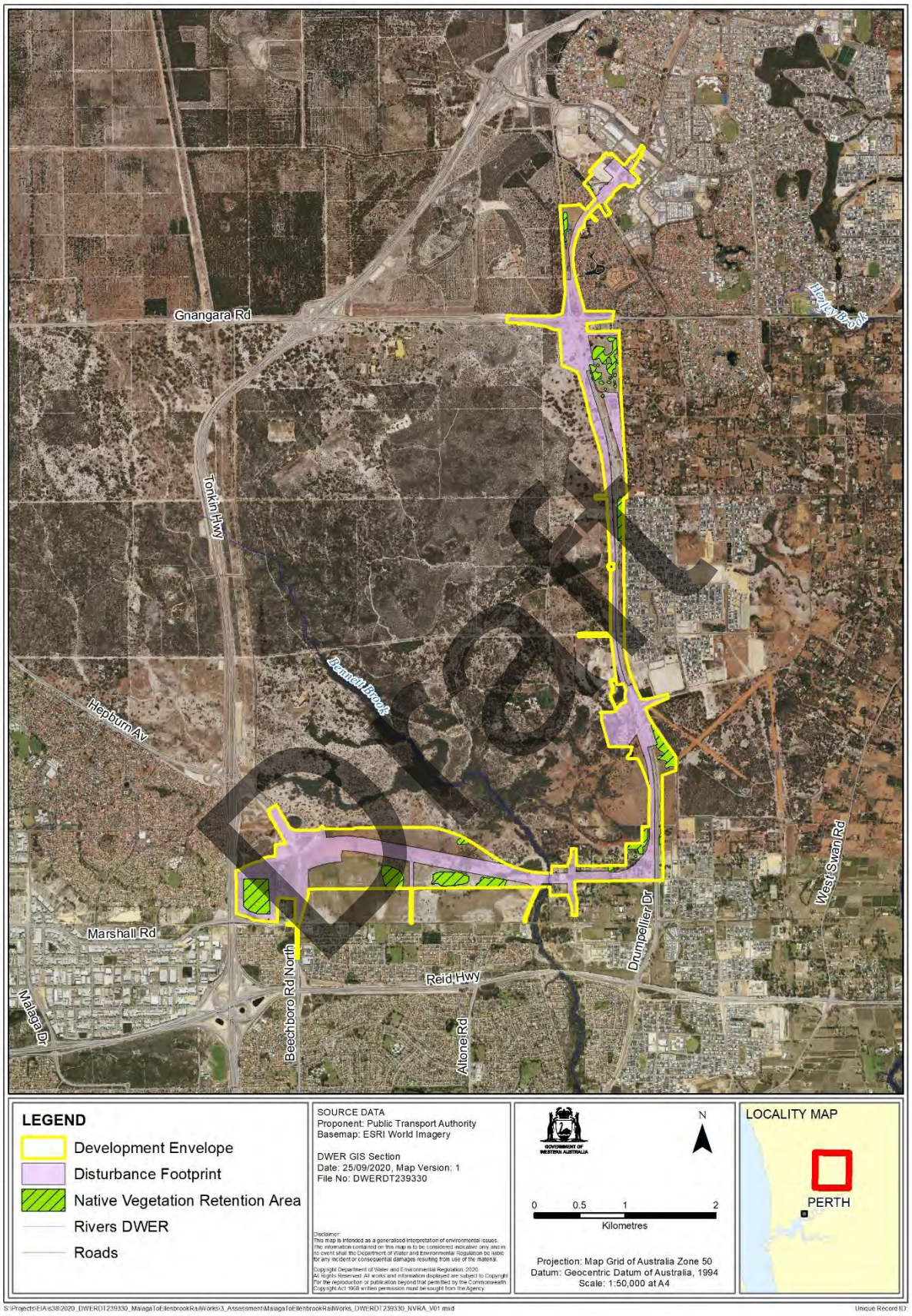


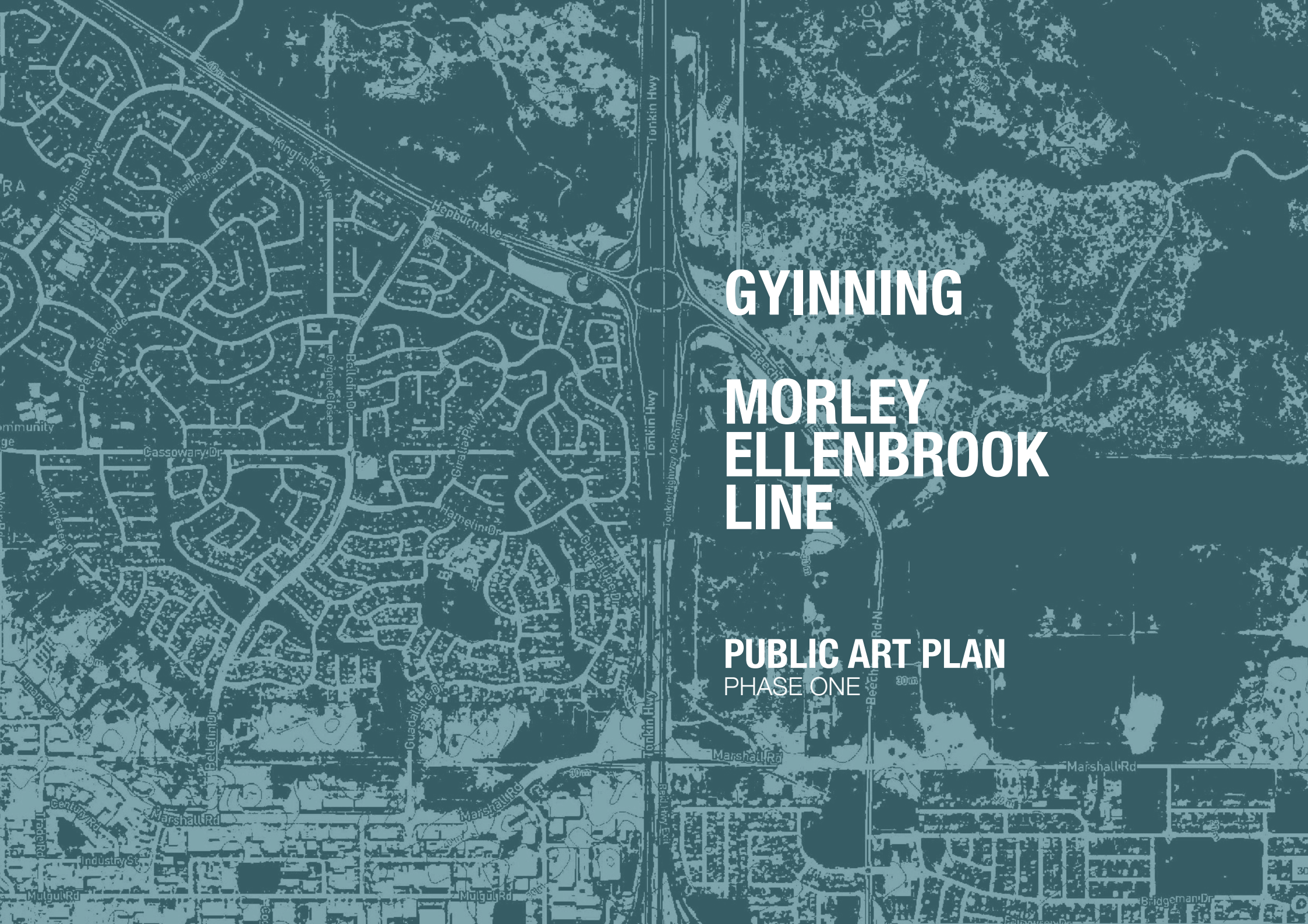
Figure 2: Native vegetation retention areas relevant to condition 8

Figure 3: Native vegetation retention area at Patch 1 Malaga relevant to condition 8-1(9) and condition 8-2(3)

Schedule 2

Coordinates defining the Malaga to Ellenbrook Rail Works development envelope and disturbance footprint in Figure 1 and coordinates defining the Native Vegetation Retention Areas in Figures 2 and 3 are held by the Department of Water and Environmental Regulation, Document Reference Number DWERDT349019.

Appendix H – Public Art Plan



GYINNING

MORLEY ELLENBROOK LINE

PUBLIC ART PLAN

PHASE ONE

Public Art Consultant
Malcolm McGregor

TITLE	AUTHOR	REVISION	DATE
PUBLIC ART PLAN	M MCGREGOR	A	1 JUN 21
	M MCGREGOR	B	14 JUL 21

CONTENTS

Acknowledgement of Country

We acknowledge the People of the Noongar Nation as the Traditional Custodians of the land and waters on which the MELconnx program of projects is located.

We pay our respect to their Elders, both past, present and emerging and thank them for their continuing connection to country, culture and community.

We acknowledge that Noongar languages are oral in nature and this can result in the same word being spelt in multiple ways.

Boorloo, Charmaine Cole

01

INTRODUCTION

1.1 PURPOSE

PUBLIC ART PLAN

The Public Art Plan (the Plan) will guide the planning and delivery of public artworks undertaken as part of the Morley-Ellenbrook Line project.

The Public Art Plan: Phase One addresses the three northern stations at Ellenbrook, Whiteman Park and Malaga, that are currently more advanced in their design.

The Public Art Plan: Phase Two will address the remaining southern stations at Noranda and Morley.

It is envisioned that the Plan will be used by artists, architects, landscape architects, project managers, contractors, LGA's and community groups, as part of the Morley-Ellenbrook Line's program of works.

The Plan acknowledges existing local, state government and private sector plans and policies. It will acts as a guide for organisations such as the City of Bayswater, City of Swan, Development WA and private developers involved in public art commissioning within the greater station precincts. It will:

- Outline METRONET's expectations for integration of public artworks into the planning and delivery of the Morley Ellenbrook Line.
- Provide a curatorial framework to assist in the preparation of artist briefs and to ensure consistency across the METRONET public art program.
- Develop the Sense of Place Statements, with input from the broader project team, for inclusion in the Final Place Plans and to guide the artwork briefs.
- Identify a variety of art types for each station and common elements across stations that can be developed as a coherent suite of artworks along the line.
- Identify the forms, locations and budget allocations for public art across the project;
- Outline the artwork procurement process through to delivery, including commissioning, contracts, management and review.
- Identify strategies for incorporating artworks from emerging artists, or other creatives unfamiliar with public art commissioning processes; and
- Identify stakeholder engagement associated with the METRONET public art process, including, but not limited to, Noongar Reference Group, METRONET Office, LGAs, community and other stakeholders.

1.2 BACKGROUND

METRONET

METRONET is the State Government's vision to integrate transport and land use planning and provide a framework to support sustainable growth in Perth over the next 50 to 100 years.

More than just a rail infrastructure program of works, METRONET planning goes beyond the station forecourts to shape and support development of communities within the surrounding walkable catchments.

Stage One of METRONET is proposed to deliver approximately 72km of new passenger rail and up to 18 new stations which represents the single largest investment in public transport in Perth's history.

METRONET will create the opportunity to transform Perth through an expanded rail network that will see urban intensification in more than 5,000 hectares of land within walking distance of the stations, supporting delivery of the State's metropolitan growth strategy for Perth and Peel.

MORLEY-ELLENBROOK LINE

The Morley-Ellenbrook Line will give people living and working in Perth's north-eastern suburbs more transport choice and will be a catalyst for future urban growth.

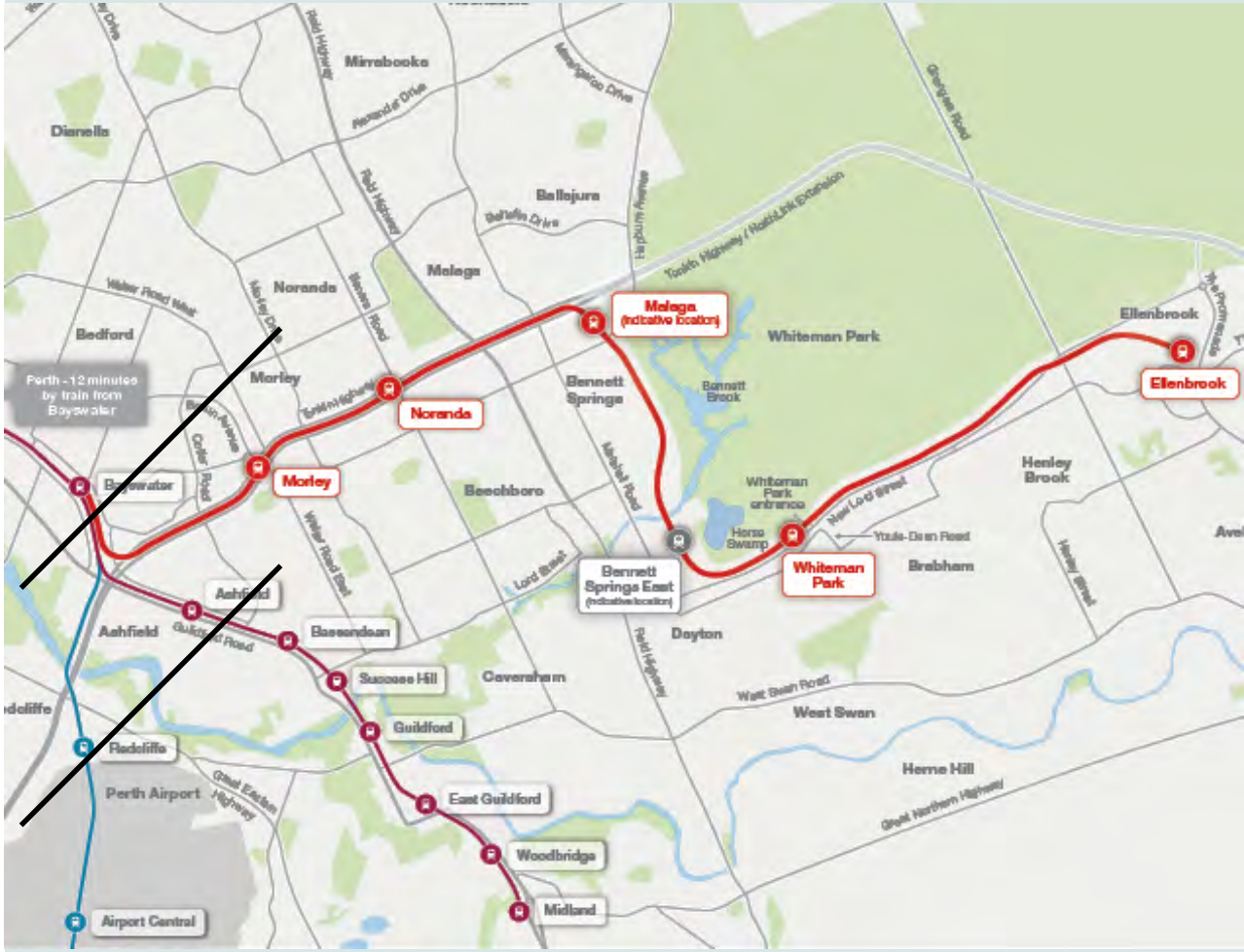
The project will provide 21km of new track spurring from the existing Midland Line east of Bayswater Station and includes five new integrated station precincts.

The new rail line extends from the existing Bayswater Station, enters the median of Tonkin Highway where it heads north to include new stations at Morley and Noranda. The line then dives under Tonkin Highway north of Marshall Road and runs east to Malaga Station, before turning north along Drumpellier Drive to Whiteman Park Station.

The line ends at the new station within the town centre of Ellenbrook. Future-proofing also includes provision for an additional station at Bennett Springs. In addition to the station and station precincts, the project incorporates site wide civil and rail works within the rail corridor and Tonkin Highway median.

Major new structural elements include grade separated structures such as ramps, viaducts, dives, tunnels and bridges extending over and under the new rail

The MELconnx Consortium has been awarded the contract to build the Morley Ellenbrook Line. Laing O'Rourke Australia Construction is leading the consortium.



02

CONTEXT

2.1 GUIDING DOCUMENTS

OVERVIEW

The early planning stage has involved DevelopmentWA and PTA, led by METRONET and the Department of Local Government Sports & Cultural Industries (DLGSC).

Complementary documents have been developed to guide ongoing planning and delivery of key elements of the METRONET program, including.

- METRONET Public Art Strategy;
- METRONET Public Art Guide;
- METRONET Gnarla Biddi Aboriginal Engagement Strategy;
- METRONET Noongar Cultural Context Document; and
- METRONET Station Precinct Design Guide.

The documents support a holistic and integrated design approach, with each discipline contributing to the overarching project vision.

METRONET
Public Art Strategy

The METRONET Public Art Strategy guides decision making and selection of public art across the METRONET program for both transport infrastructure and station precincts.

The strategy provides a thematic guide and identifies program level art opportunities that will be refined and developed for each project in the Public Art Plan. The strategy aims to:

- Delivery of a diverse program of high-quality public art;
- Support the legibility of public spaces connected to stations and other transport infrastructure;
- Animate public spaces, showcase local cultures and build place identity;
- Promote Aboriginal connection to place, culture and community;
- Encourage creativity and innovation;
- Support employment opportunities for professional and emerging artists; and
- Leave a positive and enduring legacy.

METRONET
Public Art Guide

The Public Art Guide provides details for how the METRONET Lead Agency will meet the requirements outlined in the Public Art Strategy by:

- Inspiring the project's overall design and delivery to ensure the infrastructure connects with place and community;
- Creating a Sense of Place Statement, that recognises the histories, stories, beliefs and value of Noongar and non-Noongar people;
- Identifying public art themes and approaches;
- Describing public art types and allocations;
- Providing line-wide and station priorities;
- Identifying stakeholders and engagement processes;
- Describing the expected management, procurement and review processes; and
- Completing the Public Art Plan to guide the forms, locations and budget allocation for public artworks.

GNARLA BIDDI
Aboriginal Engagement Strategy

The METRONET Aboriginal Engagement Strategy outlines the WA State Government commitment to embed genuine engagement with the Aboriginal community across the METRONET program.

It recognises that appropriate and authentic Aboriginal engagement can contribute to the delivery of enhanced place and project delivery outcomes, whilst also achieving significant community, social and economic benefits through cultural contribution and participation.

The strategy supports outcomes that align with the METRONET vision, purpose and objectives by ensuring:

- Noongar culture is reflected in the infrastructure designed and built as part of the METRONET program;
- Education for those involved in the METRONET program on the significance of Noongar culture;
- Ongoing Noongar input into project planning and delivery processes; and
- Workforce and industry participation for Noongar and other Aboriginal people.

METRONET
Noongar Cultural Context

The Noongar Cultural Context document has been developed in close consultation with the METRONET Noongar Reference Group (MNRG).

The group provided input and comment on the document to convey a Noongar 'sense of place' for the Gyinning / Morley-Ellenbrook Line by sharing stories and cultural themes behind each place and its people.

The document summarises both publicly available content and stories for the project area and seeks to:

- Facilitate early and ongoing engagement between METRONET, the Public Transport Authority and the Noongar Reference Group;
- Describe the 'sense of place' by mapping the storylines that have created the place or other relevant cultural themes;
- Inspire project designers, architects and artists to develop themes and concepts during the design process; and
- Promote artwork opportunities for Noongar artists.

METRONET
Station Precinct Design Guide

The METRONET Station Precinct Design Guide (Station Precinct Guide) outlines key objectives and specific design advice to be considered in the design and planning of station precincts across the Perth metropolitan rail network as part of the METRONET program.

The intent is to provide guidance for decision making, planning and design of newly developing and redeveloping station precincts.

It aims to embed best practice sustainable place-making principles into the design, development and ongoing function of station precincts.

The Station Precinct Guide introduces design objectives that are fundamental to supporting the delivery of all METRONET station precinct and provides long-term expectations for station precincts based on a range of place types.

2.2 PUBLIC ART POLICIES

WA STATE GOVERNMENT
Percent for Art Scheme

The State Government's Percent for Art Scheme encourages art in the built environment by using a percentage of a development's overall budget to commission art on new public buildings such as schools, police stations and hospitals.

The scheme is managed by the Department of Finance in partnership with the Department of Local Government, Sport and Cultural Industries, which is responsible for arts policy in the State.

The scheme requires up to one percent of the construction budget for new works over $2 million, to be spent on public artwork.

It has established industry standards for public art, including procurement models and 'fit for purpose' artist contacts that have been adopted by other State Government agencies such as Main Roads WA, PTA, DevelopmentWA and LandCorp.

CITY OF BAYSWATER
Percent for Public Art (2017)

The City of Bayswater's 'Percent for Public Art' policy relates to the provision of public art for development proposals and provides guidance on how and where the City of Bayswater will apply the policy to enhance and promote the public realm and streetscape to:

- Facilitate public art that contributes towards creating a strong sense of place, which promotes the expression of local identity and responds to the culture and character of the community.
- Facilitate public art that positively contributes to its streetscape.
- Improve legibility by introducing public art which assists in making streets and buildings more identifiable.

The policy applies where a development proposal on private land has a construction cost of $1 million or greater and is a commercial, non-residential or mixed use development.

The cost of any public art provided under this policy is to be no less than 1% of the construction value of the eligible development proposal.

CITY OF SWAN
Public Art Policies

The City of Swan's policy supports public art by:

- Developing and locating public artworks in areas of significance and meaning to the community;
- Ensuring public artworks are sensitive to their local environment and communities of interest;
- Installing public artworks on sites selected specifically for their suitability with regard to the conception, development and installation of a work of art;
- Where possible, supporting and promoting high calibre local artists;
- Building strong partnerships with the Federal Government, State Government, other Local Governments, and the City's Art sector to ensure that the opportunities for quality public art are maximised;
- Funding public artwork through the City's capital works program and operational budget processes; and
- Utilising private developer cash-in-lieu contributions as per policy POL-LP-1.10 Provision of Public Art.

03

APPROACH

3.1 GUIDING PRINCIPLES

CONNECTIONS AND PATHWAYS

Transport infrastructure projects can be complex, with delivery occurring over an extended timeframe. The five stations and associated civil infrastructure provide numerous public art opportunities.

The success of these projects will be largely dependent on an art procurement model that is equitable and responsive to evolving project needs. Along with other objectives, the public art program aims to:

- Deliver a diverse program of high-quality public art;
- Encourage creativity and innovation;
- Support opportunities for professional and emerging artists;
- Promote Noongar cultural input into place making; and
- Ensure commissioning, mentoring and training opportunities for Noongar and Aboriginal artists.

Meeting these goals requires an art procurement approach that is equally creative, flexible and innovative. It enlists a number of strategies to enable the participation of a wide range of artist and creatives over the duration of the project.

OPEN AND EQUITABLE

The Expression of Interest will be widely promoted to Western Australian artists and creatives. The aim is to establish a creative pool that can be drawn upon as art projects are developed.

The pool will include highly experienced and emerging artists, as well as other creatives that may contribute to the art program.

PARTNERSHIPS

The art program will foster connections between artist, creatives design professionals, suppliers and fabricators. One of the biggest challenges for emerging artists is access to the skills, specialist expertise and resources needed to undertake a public art project.

The procurement process will explore ways of up skilling artists through strategic partnerships. The Alliance team can assist by providing information on designers, materials, suppliers, fabricators and installers.

MENTORING

The art program will include mentorship opportunities designed to provide career pathways that build new skills and employment opportunities for Aboriginal artists, with a focus on Noongar artists.

Collaborative design workshops will allow Aboriginal artists to develop their skills though a structured and supported process. More detail is provided in the following sections.

OPEN COMPETITION

Open competition is fair and equitable in that it allows all artists and creatives to be considered for station projects. The Expression of Interest can be widely promoted to Western Australian artists and creatives, with submission requirements tailored to achieve the best outcome for the project.

The open competition process can establish a creative pool of suitably qualified artists and creatives that can be drawn upon as art projects are developed.

The pool will include highly experienced and emerging artists, as well as other creative that may contribute to the program. Artists can submit Expressions of Interest as individuals or as part of a creative team that includes the requisite skills and capabilities.

NOONGAR PROJECTS

The procurement model seeks to minimise potential barriers to participation by new and emerging Noongar artists, in line with other State Government initiatives.

The public art program will explore multiple pathways for Noongar artists to contribute to the project. This may include open competition, limited invitation, direct engagement or a structured workshop process.

The Expression of Interest for Noongar artists will allow for a targeted response to project requirements and support a collaborative approach to Noongar place making. Selected artists may participate through the following pathways:

- Shortlisted artists invited to prepare a Design Concept, or
- Selected artists invited to participate in design workshops for ‘design only’ elements, or
- Selected artists invited to participate in mentoring opportunities.

ABORIGINAL ENGAGEMENT FRAMEWORK

The METRONET Aboriginal Engagement Framework sets targets for engagement with Noongar and other Aboriginal stakeholders during planning and delivery. The Plan establishes actions to address the relevant engagement streams.

STREAM ONE
Noongar Cultural Recognition

- Ensure 'Welcome to Country' occurs at all appropriate art events in accordance with advice provided by the METRONET Noongar Reference Group;
- Include Acknowledgement of Country in the design of built form and/or landscape for all five stations

STREAM TWO
Noongar Cultural Input into Place Making

- Initiate a collaborative design process that allows the local community to be involved in identifying appropriate themes;
- Enable Noongar artists to contribute to the architectural and landscape design of stations;
- Embed themes and stories contained within the Noongar Cultural Context Document within the architectural and landscape design,
- Liaise with the METRONET Noongar Reference Group, though the development of designs and approval.

STREAM THREE
Aboriginal Procurement

- Encourage Noongar artists and creatives to register as Aboriginal Businesses with the Aboriginal Business Directory WA (ABDWA) and Supply Nation;
- Explore opportunities for Noongar suppliers and fabricators in delivering the public art program;

STREAM FOUR
Aboriginal Employment

- Facilitate career development opportunities for Noongar artists and creatives;
- Engage Noongar cultural advisors to contribute to the inter-disciplinary design approach
- Enable skills development and capacity building for Noongar artists through structured mentoring opportunities.

PUBLIC ART PRINCIPLES

The METRONET Public Art Strategy identifies six public art principles that will guide decision making through the planning and delivery of the Public Art Program.

Place Making

Public art contributes to place making and interpretation of place. It can aid the understanding of the area's history or cultural heritage, assist how people currently understand or use a space, or provide new interpretations and meanings.

Site Specific

Artworks are to be designed specifically for the site and are to be responsive to the site context - its surrounds, its use and users, and reflecting the relevant precinct art themes.

Scale and Fit

The scale of artwork needs to be consistent with the artwork brief and intent. Artwork scale also needs to be responsive to the site context - such as the surrounding landscape and buildings and pedestrian circulation.

Well Considered & Managed

Artworks must be designed and constructed with best practice risk and asset management, being mindful of public safety, straightforward and low-cost maintenance, resistance to vandalism, and constructed with robustness appropriate for the lifespan of the artwork.

Attractor

Public art can be used as an attractor for visitors and tourists – particularly places with landmark artworks or seasonal art programs.

Sustainable

Public art is designed to consider key environmental, social and economic opportunities for both procurement/delivery and ongoing function and use.

3.2 CURATORIAL FRAMEWORK

The curatorial framework identifies themes and narratives to encourage a cohesive approach to public art across the five stations.

The framework responds to planning, place-making and station design principles established across the Morley-Ellenbrook Line. It acknowledges METRONET's attitudes towards site context, urban character, landscape values and the station's architectural typology.

The curatorial framework acknowledges the values and future aspirations of all stakeholders, local community members and transport users. It includes a vision for public art, describing what it aspires to achieve within the project.

CURATORIAL VISION

The curatorial vision is a resource for artists in developing site-specific responses to culture, landscape and place. It provides contextual inspiration and a starting point for artistic exploration.

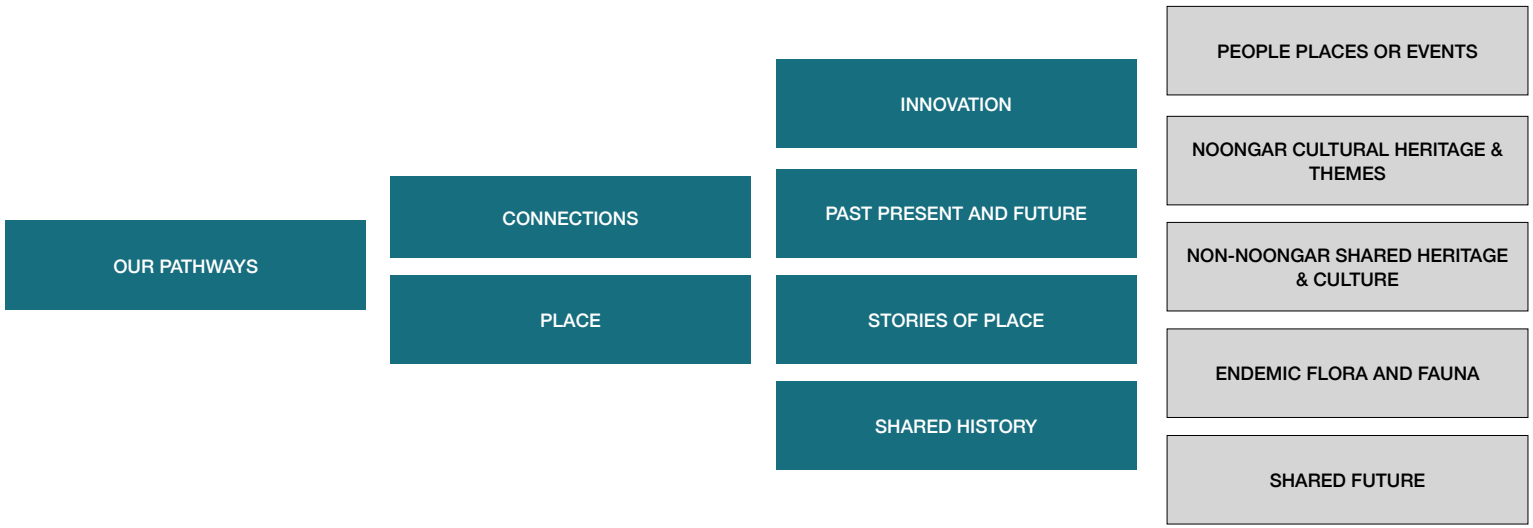
Every station has unique physical and functional characteristics that will affect its potential to develop as a liveable, vibrant urban centre. Public art will build on broader initiatives within the project to:

- Embody notions of identity and place, benefit local communities and leave a positive legacy for future generations;
- Foster connections between people and places, revealing embedding stories, ideas and authentic experiences within the stations and surrounding public space;.
- Celebrate the cultural diversity of communities and people;
- Draw on community values to provide active public spaces that can be enjoyed day and night;
- Contribute to the activation of new town centres, neighbourhood centres and transit node precincts;
- Create new gateway and arrival experiences for public transport users and the broader community; and
- Enrich daily life and support community gathering in a vibrant and safe environment.

3.3 CURATORIAL THEMES

The Curatorial Themes provide a high-level thematic guides which encapsulate various qualities of the diverse topographies, station types and communities along the Morley-Ellenbrook Line.

Evoking elements of the local history, landscape and people, they can act as an initial source of inspiration for artists, ensuring that artworks forge meaningful connections to the locality and community.



The three broad themes below encompass both universal experiences and evoke stories and narratives specific to people and places along the new rail line.

GATHER
Social Encounters

Stations and their surrounding precincts are places of arrival and departure. They are meeting and gathering points that are an expression of local identity and the communities that they service.

Local life can be described by the social encounters in a vibrant town centre. Whether spontaneous or planned, social experiences add to the richness of daily life. Within the station they can us make us feel comfortable and safe.

Before their was a city, Noongar people gathered on the Swan Coastal Plain to hunt, fish and celebrate culture. New stations, town centres and public spaces will become the places where people meet, rest and play.

DWELL
Being of a Place

The landscapes and places along the line have changed significantly over time. From the wetlands and banksia woodland that was once there, the land has been shaped and altered.

The new line will accelerate that rate of change, creating new places and making the familiar less so. Though much of the original vegetation is gone, the line continues to reveal its topography and offer spectacular vistas to places beyond.

The pattern of land subdivisions, laid across the landscape largely remain today. Their boundaries shape the networks of roads that connect the suburbs and people.

Communities continue to evolve as farmlands give way to suburbs and commercial areas. As the city moves outward, people seek new ways of connecting to places and making it their home.

STREAM
Passing Through

The streams and wetlands are ancient. They have sustained life in the area for millennia. From deep beneath the surface, the water rises and flows towards the river.

The stream exists within the landscape and as a metaphor for the confluence of pathways, routes and cultures. It is a place where people camped, gathered food. It sustains farmlands and is an attractor for recreation .

The stream can be the experience of travel and transition across the landscape. It embodies the experience of movement and change that defines the rail journey. It is the life force that connects places.

Beneath the station the stream is still there, hidden.

3.4 ARTWORK TYPES

The METRONET Public Art Strategy uses the DLGSC Public Art Commissioning Guidelines to define main categories of public art, recognising that boundaries between art types overlap.


Barry McGuire


Madeleine Brown


Jill Anholt Studio

Hannah Quinliven

STAND ALONE

Stand-alone artworks are arguably, the best known and recognised form of public art. They include sculptural works at a variety of scales, from landmark artworks that are major attractors and destinations through to small-scale elements interwoven within the landscape design.

They can be singular works sited at locations with high visual impact or be a series of small scale elements disbursed throughout a public space.

Stand-alone artworks are usually acquired through a standard artist commissioning process, with the artist responsible for design, fabrication and installation.

On more complex construction projects, artworks are sometimes delivered to site, with installation by the construction contractor or their subcontractors.


Stuart Green


Rod Garlett


Kylie Graham


Phil Gamblen

INTEGRATED

Integrated artworks is a broad category that includes art concepts and design elements integrated into the fabric of built form and urban environments. Often developed through a collaborative design process, the artist is best engaged during the early design stage.

Art concepts can be incorporated into the overall design as ‘value added’ elements, allowing artist to response to the scale of the buildings and landscaped environments. This could include treatments to walls, ceilings, glazing, screens and floors, landscape elements and paving.

Integrated artworks can be developed as ‘design only’ or through a standard commissioning process. There can be a combination of approaches with the artists sometimes responsible for documenting, fabricating and installing the artwork elements.


Jon Tarry


Judy Watson


Nandy Blum


Unknown

APPLIED

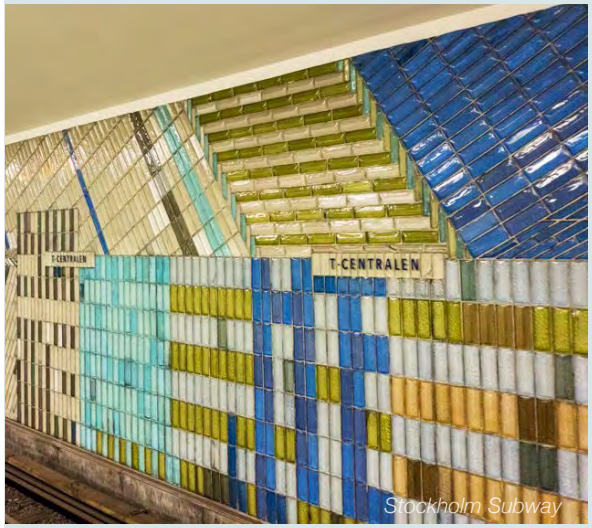
Applied public art is defined as elements applied to existing surfaces and structures. It may include, but not limited to, painted finishes, tiling, metal or other elements fixed to existing walls, floors or ceilings. They can be permanent or semi-permanent in nature.

Applied artworks are often designed and fabricated by the artist with installation towards the end of construction or after project completion.

To some extent, the artist is able to develop and fabricate artworks independently of the built form, meaning that they can be introduced later in the design process.

Applied artworks are usually acquired through a standard artist commissioning process, with the artist responsible for design, fabrication and installation.

On more complex construction projects, artworks are sometimes delivered to site, with installation by the construction contractor or their subcontractors.



Stockholm Subway


David Franklin


Superflex


Paul Deej

TEMPORARY

Temporary or programmed artworks include non-permanent artworks or events which activate a specified space or location for a pre-determined amount of time.

Temporary artworks add a vital layer of life and energy to public spaces, providing new experiences that build a sense of place over time, engage the community and encourage repeat visitation.

Temporary or programmed works can be curated as part of festivals or events and include a wide variety of art forms including hoardings, art installations, light festivals, musical and theatrical performances.

Art events can play a crucial role in place activation over time. During the station construction phase they can be a vehicle for positive community engagement. Post construction, they can be instrumental in the activation of new spaces and building a sense of community ownership.


Mel McVee


Bewley Shaylor


Guido Van Helten


Gare du Nord, Paris

LIGHT

Light can be a crucial component of any artwork types. At its most simple level, it may involve the illumination of artworks to enhance their night-time presence. At its best, it becomes an integral component of the artwork concept.

Light may be integrated into the fabric of the built form and urban environments as art concepts. They can become part of the overall design, allowing artist to response to the scale of the buildings and landscaped environments.

Sculptural works may incorporate light at a variety of scales, from landmark artworks that are major attractors and destinations through to small-scale elements interwoven within the landscape design.

Light can be an integral component of temporary or programmed works, curated as part of festivals or events. it can play a crucial role in place activation and safety.


Jim Sanborn


Chris Nixon and Tom Lucey


Midland Railway Square


Dan Templeman

3.5 PROCUREMENT MODELS

ART COMMISSIONS

The majority of public artworks are procured through a standard commission process. The artist is usually responsible for the full scope of work, including design, documentation, fabrication and installation of the artwork.

The method is most relevant for stand-alone and applied artworks, which constitute the majority of public art projects.

The art commission model can also be appropriate for some integrated artworks, depending on the nature of the integration. The standard two stage process for artist selection involves:

- Shortlisted artists from the Expression of Interest are invited to prepare a detailed Design Concept;
- Shortlisted artists present their Design Concepts to the selection panel who select one artist or artist team;
- Alternatively, the selection panel may interview shortlisted artists and invite one artist to prepare design options before completing the Design Concept.

DESIGN COLLABORATIONS

Sometimes referred to as 'Design Only', artworks are developed through a collaborative design process.

Design elements are incorporated into the overall design as 'value added' elements, allowing artist to respond to the scale of the buildings and landscaped environments.

The artist is responsible for the Design Concept and Design Development only. The documentation, fabrication and installation is delivered as part of the larger project. Artist selection involves the following:

- Shortlisted artists from the Expression of Interest are interviewed by the selection panel. Alternately, artists may be shortlisted from a limited invitation.
- One artist or artist team is selected and engaged to prepare design options through a collaborative design process.
- The preferred options are developed into the Design Concept for approval before proceeding to Design Development.

A variation of this model can be applied to artworks developed through design workshops.

DESIGN WORKSHOPS

The Gnarla Biddi Art and Placemaking Workshops are a vehicle for ensuring that Noongar culture is reflected in the infrastructure designed and built as part of the MEL program of works.

The workshops are a direct response to requirements of the Gnarla Biddi Engagement Strategy and Gyinning/ Morley- Ellenbrook Noongar Cultural Context Document, which promote Aboriginal connection to place, culture and community.

The model aims to reduce barriers for participation by Noongar artists. The workshops will identify public art opportunities for both experienced and emerging Noongar artists.

Artists will develop concepts that can be incorporated into the overall design as 'value added' elements, with artists only be responsible for the Design Concept and Design Development. The documentation, fabrication and installation is delivered as part of the larger project.

Workshop participants will also gain insight into the documentation process. Their involvement may extend into the implementation phase through visits to fabricators and station sites.

3.6 PROCUREMENT PHASES

ARTIST SELECTION

EXPRESSION OF INTEREST

- Nomination of art procurement model and process
- Prepare Expressions of Interest and Artist Brief documents
- Advertise and invite artists to respond to the Expressions of Interest
- Manage the artist shortlisting process, including identifying and liaising with the selection panel.

DESIGN CONCEPT

- Prepare RFP documents, including the Stage 2 Artist Brief
- Compile drawings and models for issue for issue to shortlisted artists
- The selection panel Invite shortlisted artists to prepare Design Concepts
- Arrange artist briefings and site visits
- Manage stakeholder engagement as part of the artist selection process.
- The selection panel conduct interviews and select artists
- Assist with the preparation of artist contractual documents

DESIGN

DESIGN DEVELOPMENT

- Manage the interface between the artist and Alliance team
- Support the artist in negotiating the complexity of the project and assist with reporting to the Alliance team
- Provide a program and update, as required
- Preliminary engineering advice and liaison with design consultants and construction team
- Artists and/or Alliance team provide final models and computer generated visualisations, where required.
- Arrange artist payments
- Manage review and approval of Design Development Report

DESIGN DOCUMENTATION

- Manage liaison with design consultants and construction team
- Full construction documentation and engineering certification including samples and prototypes, where required
- Final construction budget review with Alliance team
- The art consultant manages the review and approval of the Design Documentation Report

CONSTRUCTION

FABRICATION

- Alliance approvals for material samples and prototypes
- Quality control of materials and fabrication process
- Monitor fabrication and arrange periodic inspections
- Project management and budget control of artwork fabrication
- Ensure artists meet Alliance program requirements
- Coordinate transport and on-site storage, where required

INSTALLATION

- Ensure necessary insurances and permits for artists to work on site, where required.
- Contract administration to final completion.
- Arrange Project Handover documentation and Maintenance Manual.
- Arrange attribution plaques
- Project close out

3.7 ARTIST CONTRACTS

Artist agreements will set out the obligations and conditions of all parties involved in the public art program.

MELconnx has been nominated as the commissioning body for public artworks delivered through the art program. 'Fit for purpose' contracts will need to be developed that address the various ways that artists may be engaged.

The DLGSC Commissioning Guidelines (2019) provides a best practice model for engagement of artists. The BMW Artwork Commission Agreement is used for artist commissioned through the State Government Percent for Art Scheme and is based on the Arts Law standard agreement.

Other State Government departments and agencies such as PTA, LandCorp, DevelopmentWA and Main Roads WA have also adopted the agreement.

Design Concepts

Shortlisted artists are invited to prepare a Design Concept in response to a Stage 2 Artwork Brief, which sets out the conditions and submission requirements. Artists are paid a fee which is based on the value of the commission and the complexity of submission requirements. Conditions can be usually be addressed though a Letter of Agreement and reference to the Stage 2 Artwork Brief.

Design Agreement

A design agreement can be used when the artist is engaged for the Design Concept and Design Development stage only. In some instances, the agreement may also specify limited involvement in the implementation phases.

Documentation, fabrication and installation is delivered as part of the larger project and is not the artists' responsibility. The agreement provides details of the artist's moral and intellectual property rights in the design.

Commission Agreement

Artists commissioned through the State Government Percent for Art Scheme are engaged through a standard artist commission agreement. This form of contract is widely used when the artist is responsible for the full scope of work, including design, documentation, fabrication and installation of the artwork.

3.8 PRELIMINARY BUDGET

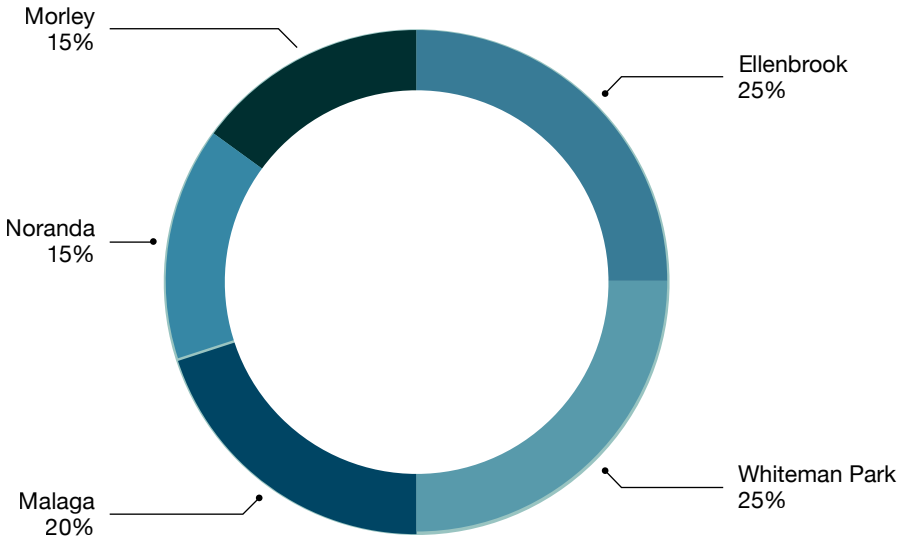
The preliminary budgets provides high level allocations for public artworks. Percentages have been assigned to zones within the station precincts rather than to individual art projects. Budgets for individual project will be determined as the opportunities become more defined. The amounts are currently inclusive of:

- Design Concept fees
- Commission budgets
- Design Workshop costs. (Artist fees associated with Noongar input into placemaking will be covered by a separate budget allocated to implementation of the Gnarla Biddi Strategy)
- 'Value added" costs. This is the additional cost for artwork treatment of an exisiting element above the estimated base cost
- Contingencies and disbursements
- Contractors' margin for management of the public art process

The allocations are based on the ability to maximise the visual impact of public art by 'value adding' to existing architectural and landscape elements, where appropriate.

This will be particularly crucial when considering potential input into urban design solutions for civil infrastructure that are currently not included in the scope of works.

An updated schedule for all five stations will be included in the Phase 2 Plan.



STATIONS

Ellenbrook	Welcome Place	30%
	Gateway	27%
	Station Building	24%
	Place Activation	10%
	Fees & Contingencies	9%
Whiteman Park	Welcome Place	33%
	Pedestrian Link	33%
	Station Building	20%
	Place Activation	5%
	Fees & Contingencies	9%
Malaga	Welcome Place	46%
	Station Building	40%
	Place Activation	5%
	Fees & Contingencies	9%

04

LINE WIDE

4.1 CONTEXT

The Morley-Ellenbrook Line is a connector for the central and northern suburbs of Perth. It creates an expanded web of connected places in distinctive landscapes and settings on the Swan Coastal Plain.

The new rail line echoes the path of the Swan River, which provides landscape markers as it meanders northwards into the Avon Valley. The line will become an equally distinctive marker and corridor in the urban landscape.

The rail line, like the river, links various points along the way. The idea of connection along the trail translates into a more integrated family of station buildings and precincts: a line and an extension to the greater transport network.

Initially tracking north through established suburbs and road infrastructure, it cuts east below Whiteman Park and across Bennett Creek.

As it swings north towards Ellenbrook, and up the eastern flank of Whiteman Park, it shadows the upper reaches of the Swan River to the east, forming a man-made reflector of light along the length of the line.

Each station is conceived as an important civic place – distinctive, contextually appropriate and a safe and inviting setting for the gathering and movement of people on and off the train line.

STATIONS

Stations and their immediate surrounds are convergence points and places of transition between transport modes and the surrounding environment. Public art can contribute to the legibility of these functional spaces by responding to the way people use them.

WELCOME PLACE

The Welcome Place is the heart of the station. It is the place where people arrive in the town or suburb and can be an expression of the community's identity and sense of place.

The Welcome Place is a meeting place where people congregate or wait before proceeding on their journeys. It is also the place where people need to make decisions when making transfers. It is also a primary focus for public artworks, including:

- Large-scale destination artworks intended to be an iconic attractor that is easily identifiable and highly memorable;
- Medium-scale markers that define nodes. focal points and decision points;
- Small-to-medium scale artworks and integrated elements that introduce elements of surprise, pause and intrigue.

KISS AND RIDE

The Kiss and Ride is a focal point within the car park. It is a transitional zone where the user's priority is accessing vehicles, drop-offs and passenger pick-up.

Public artworks may assist with guiding people towards the station building. They may take the form of elements integrated into canopies, arbours or pavement treatments.

BUS INTERCHANGE

Located at bus stands, along pathways and routes, artworks can be a variety of forms, primarily integrated into the fabric of transport infrastructure.

They can tell stories, explore themes or assist in orientation while guiding users towards the station building.

ENTRIES

Entry points need to provide clear connections and pathways to the Welcome Place, Station and Bus Interchange. Public art in these locations needs to be appreciated at a vehicular, cyclist and pedestrian scale and may:

- Reinforce major gateways or arrival points; and
- Strengthening wayfinding along key pedestrian corridors.

CIVIL INFRASTRUCTURE

Civil infrastructure along the 21km route includes roads, tunnels, underpasses, viaducts, retaining walls and noise walls. Most of this infrastructure is currently not included in the scope of the public art program, which focuses on station buildings and immediate surrounds.

In some instances, the impact of civil infrastructure can be significant. Public art can respond to the scale of the infrastructure by contributing to urban design solutions that provide gateway experiences or mitigate visual impact.

STATION BUILDINGS

As people arrive at the train station the experience must be quick and easy. The space needs to be organised around smooth flows and intuitive wayfinding, that provides all the clues before relying on signage.

Artworks may be experienced progressively as station users move along pathways and through zones. They may frame and direct attention towards spaces beyond.

Artworks may be incorporated into the fabric of the building to provide a more diffused or immersive experience. They can be integrated into surface treatments, such as walls, metal screens, soffit treatments or glazing.

4.2 SENSE OF PLACE

The Sense of Place Statements are intended to ensure that design decisions for public artworks in station buildings and their immediate surrounds align with community values and expectations.

The Public Art Plan includes Sense of Place Statements for each station on the Gyinning/Morley-Ellenbrook Line. They draw sources, including on the METRONET Noongar Cultural Context Document, Preliminary Place Plans and relevant Local Area Plans.

The Sense of Place Statements have also benefited from the input of community reference groups established for each project areas along the line, with the City of Bayswater and City of Swan playing key roles in representing community interests.

The statements establish common themes, narratives and stories for the whole line, as well as distinct local stories specific to certain localities.

They are not intended to be an extensive history for each station area. However, they will be available as a resource when developing the curatorial framework and themes included in artwork briefs.

Mussel Pool, Whiteman Park

THEMES AND STORIES

Sense of Place

The Morley-Ellenbrook Line encapsulates a variety urban and natural experiences as it travels through diverse landscapes along its 21km journey.

The rail line, like the Swan River, links various points along the way. The idea of connecting stories and themes along the line translates into a more integrated family of stations: a line and an extension to the greater transport network.

Line wide and location-specific stories and themes are addressed in detail under the relevant station heading.

Gnarla Biddi

" Since the Koondarm our ancestral pathways have guided us through Noongar Boodjar from significant place to significant place from one water body to another.

Now we work together to strengthen Gnarla Biddi, the way that people travel and connect to places, still linked to our shared history and culture."

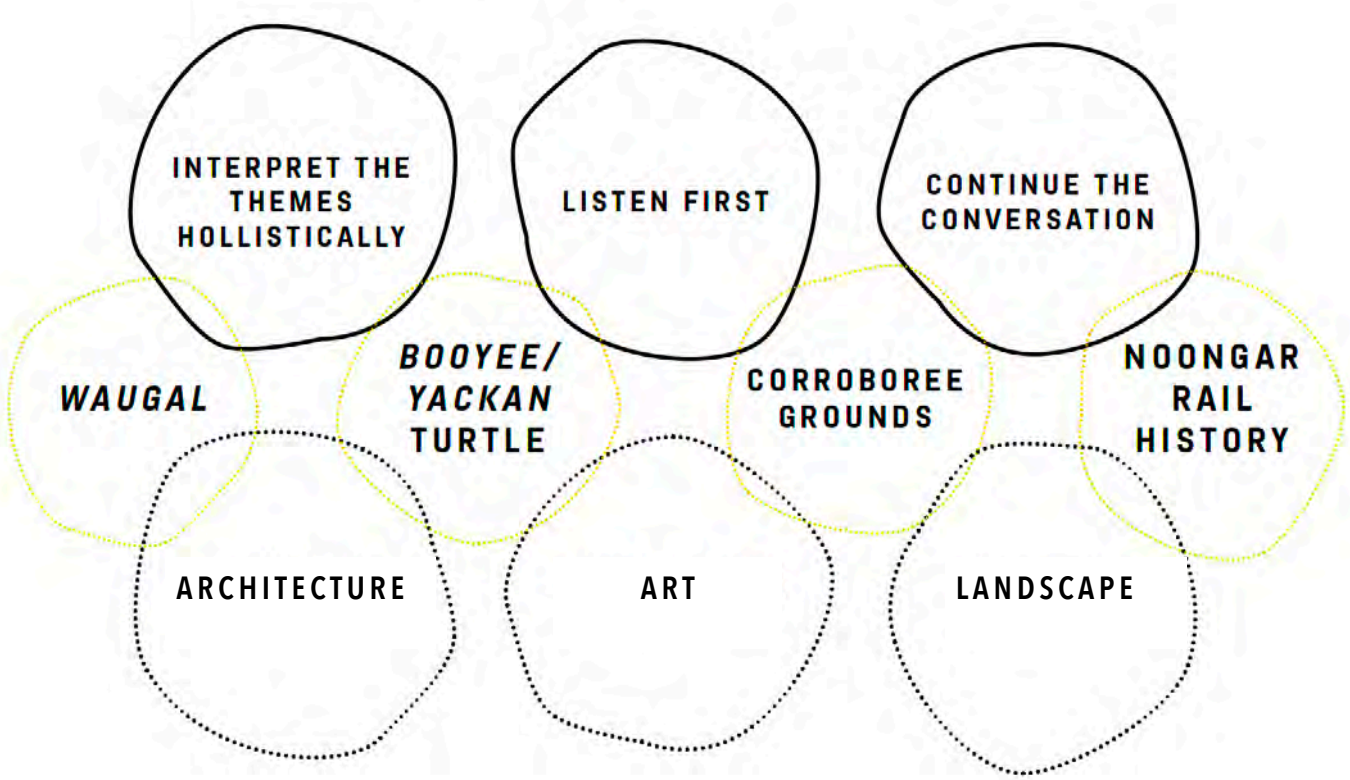
The Gnarla Biddi statement, contained in the METRONET Aboriginal Engagement Strategy, provides a unifying and all encompassing theme that is relevant to all artists, whether Noongar or non-Noongar.

Noongar Cultural Context

Significant local Noongar themes include, but are not limited to:

- Waugul - the creation story of the spirit/rainbow serpent; a place of water with many wetland and river features;
- Turtle (Boyee or Yackan) - Illustrating belief in the shared spiritual essence of all living things
- Corroboree Grounds - Important meeting and ceremony places within the biddi network;
- Noongar Rail History - Language maintenance, cultural renewal and resistance, travelling, residence and return to country through the railways.

NOONGAR THEMES



The Noongar Cultural Context Document identifies line-wide themes that will be further developed through a collaborative design approach led by Noongar cultural advisors and artists.

The approach is intended to ensure that Noongar culture and placemaking is embedded in the design of stations and their immediate surrounds. Artwork concepts will initially be developed to reinforce and complement elements of the landscape design, including planting, furniture, paving and signage.

Artwork concepts and design elements may also be incorporated as 'Design Only' elements in station buildings.

Design workshops will facilitate input into the design of stations and their surrounds. They will involve input from both experienced Noongar artists and emerging Noongar artists.

Design fees directly associated with Noongar input into placemaking will be covered by a budget allocated to support the implementation of the Gnarla Biddi Engagement Strategy.

The Noongar Design Workshops will play an important role in Noongar story telling and interpretation of cultural material.

DESIGN WORKSHOPS

The workshop process will allow sufficient time for artists to have meaningful engagement with the Noongar Reference Group, cultural advisors and the Alliance team.

It will also allow time for artists to become familiar with the complexities of the rail project and to develop concepts through a structured and supported process.

The thematic approach will be informed by the overarching Gnarla Biddi theme of ‘Our Pathways” while also addressing the following sub-themes:

- Acknowledgement of Country
- Shared Stories and Knowledge
- Cultural Mapping
- Noongar Language
- Dual Naming
- Meeting Place
- Culturally Significant Plants
- Bush Foods & Medicine
- Seasonal Flowers & Fruits
- Totemic Species

The initial focus will be on concepts that can be incorporated into landscape elements in stations at Ellenbrook, Whiteman Park and Malaga. Potential design elements may include:

- Garden beds
- Furniture and paving
- Wayfinding signage
- Interpretation

Architectural elements may include, but is not limited to:

- Facade treatments
- Metal screens
- Glass balustrades

4.3 OPPORTUNITIES

Stations are convergence points and places of transition between transport modes and the surrounding environment. They need to be organised around smooth flows and intuitive wayfinding.

Artworks may be experienced progressively, as station users move along pathways and through zones. They may frame and direct attention towards spaces beyond.

Artworks can emphasise arrival or meeting points,. They can also be part of the fabric of the station building and surrounding landscaped spaces, as more diffused or immersive experiences.

Stand-alone artworks may include sculptural works at a variety of scales. They can be singular works sited at locations with high visual impact or a series of small scale elements disbursed throughout landscaped spaces.

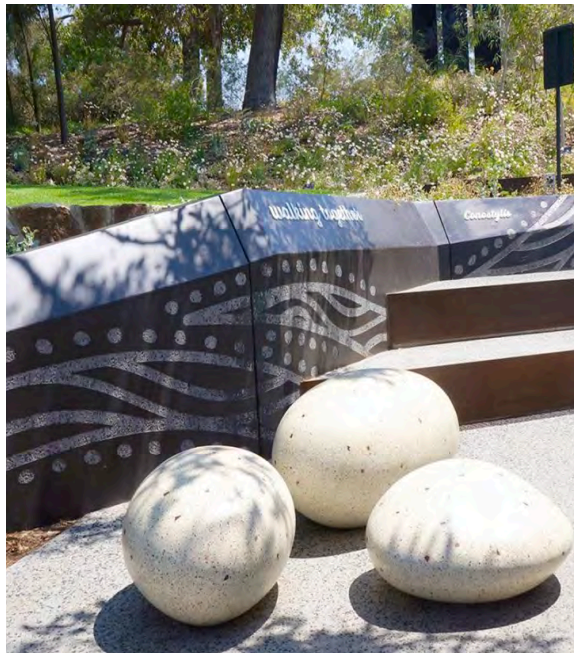
Art concepts may also be incorporated into the overall design as ‘value added’ elements, allowing artist to response to the scale of the buildings and landscaped environments. This could include treatments to walls, soffits, glazing, screens and floors, landscape elements and paving.

Some artwork opportunities have already been identified within the station designs. They will be refined and added to as station designs progress. They may include, but are not limited to the following examples;

MARKERS

Stand-alone artworks provide markers and episodes along a journey and can operate at different scales:

- Landmark artworks can emphasise arrival or gateways points where their scale and visibility make them identifiable and memorable
- Medium scale artworks may consist of a single focal element or multiple elements extending along pathways or routes.



LANDSCAPE

Small-to-medium in scale, fine grained artworks can be incorporated into the landscape design as integrated or stand-alone elements.

They may be integrated into functional elements, such as retaining walls, screens, informal seating, paving and interpretive signage.

SCREENS

Station buildings include extensive areas of permeable metal panels. The artwork may ‘value add’ to these existing elements as:

- Screen walls on vertical circulation buildings
- Weather screening on platforms
- Perimeter fencing
- Balustrading on elevated concourses and walkways

CANOPIES

Stations and bus interchanges are connected by a series of canopies and arbours. The canopies guide transport users towards the station while also offering weather protection. The artwork may take the form of treatments to:

- Fabrics on green and/or unplanted arbours
- Soffits in linking canopies

GLAZING

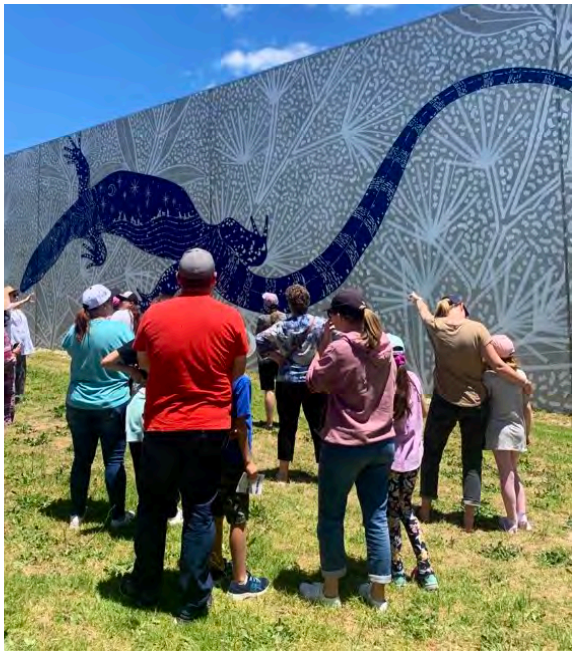
Station buildings and bus interchanges include glass panels as weather, privacy and security protection. Artworks may be incorporated as fritted designs to:

- Skylights located centrally along the length of the station and platform canopies
- Internal waiting areas in station buildings
- Bus stands

PLAY

Forecourt areas connect stations to the bus interchanges, car park and surrounding precinct. These ‘Welcome Places’ are the social ‘heart’ of the station and important places of social gathering and interaction.

Informal playscapes can offer a wide range of open-ended play options that allow people to be creative and use their imagination. They can have multi-generational appeal to children, families, and people of all ages.



MURALS

Along its length the rail line rises and dives as it travels though different environments. Artworks may include:

- Constuction hoardings
- Painted mural treatments to noise walls
- Applied or cast panel treatments to noise walls
- Integrated lighting to noise walls
- Painted ancillary buildings, such as bike storage.
- Service buildings on platforms and surround areas

CIVIL INFRASTRUCTURE

Grade separated structures such as ramps, viaducts, dives, tunnels and bridges extending over and under the new rail. Artwork opportunities include;

- Vertical surfaces of viaducts
- Painted or applied soffit treatments
- Painted or applied columns
- Retaining walls and bridge embankments
- Integrated lighting solutions

05

MALAGA STATION

URBAN CONTEXT

OVERVIEW

Malaga is the City of Swan's major industrial precinct and its largest employment centre. Malaga has evolved into a precinct that is home to over 3,000 businesses employing approximately 15,500 workers.

Malaga Station is located in close proximity to the surrounding suburbs of Ballajura and Bennett Springs, with Beechboro and Malaga also nearby.

Situated on the edge of an important remnant banksia woodland, the station and its surrounding precinct will be the heart of a large residential and mixed-use development planned for the area.

Malaga Station is where the train experience changes from the freeway rail to the bushland rail. Rising out of the tunnel from under Tonkin Highway, the train arrives at Malaga Station before traveling through the Whiteman Park landscape.

The rail corridor passes near low banksia bushland hills that forms a crescent around land feeding water into the Bennett Brook. The site provides sweeping views over the Whiteman Park plains to the Darling Scarp beyond.

Although the station will deliver connectivity to the adjoining residential communities and the Malaga industrial precinct, these areas lie behind the hills and out of view.

Future development of the Town Centre will bring radical change to area, though the landscape setting and connections to Whiteman Park, Bennett Brook Catchment, Swan River and the Darling Scarp are retained.

HISTORY

Malaga formed as an industrial centre, focussed around the Manx Brickworks and a sand quarry. In 1963 the area was reserved as an industrial area and in 1969 the name 'Malaga' was registered as a suburb.

It's not clear whether the name Malaga was adopted from the Spanish city of the same name or the Aboriginal word "malaga" meaning "ironstone".

Over the past 30 years, the industrial area has grown rapidly and now has more than 3,000 businesses with a workforce of almost 16,000 people.

Malaga is surrounded by residential suburbs. The largest is Ballajura which has a range of community facilities such as an aquatic centre, library, community centre, parks and public open spaces.

The Ballajura area, particularly Emu Swamp and the surrounding wetlands, has cultural significant for Aboriginal people as a source of fresh water and a hunting ground. [4]

The Ballajura area was first settled in 1905, when Ernest Maltby Kerruish, an immigrant from the Isle of Man, purchased land for a farm at the present site, which at the time was located in Caversham. He named it Ballajora, after a farm at Maughold on the Isle of Man.

Bennett Brook ran through the Ballajora Farm. It was named after Matilda Bennett, also an Isle of Man descent who was the wife of John Septimus Roe, the first surveyor general of Western Australia under the first governor of the state, Sir James Stirling.

John Creer and Arthur Eaton, who also emigrated with Kerruish from the Isle of Man, joined him in clearing the land to build a house and begin farming the land. After a few years, Kerruish decided the soil was not fertile enough and moved his operations to an established vineyard in the present-day Caversham area, a few kilometres southeast.

By 1970, the Ballajura area was part of a larger pastoral holding and remained leased as a cattle farm until 1977.

Ballajura was developed as a residential suburb from 1978 and by 1981. The suburb was further developed in the 1980s with the establishment two sub-divisions at Lakeshore and the Lakes Estate. The population increased rapidly during the early 1990s and then slowed in the early 2000s.

[4] *Ballajura Local Area - City of Swan website*

ENVIRONMENT

The station is located on the south west boundary of Whiteman Park and within the Bennett Brook Catchment. The majority of the catchment is covered by the Gnangara Pine Plantation and Whiteman Park.

Bennett Brook was once a natural creek system; however its tributaries to the west have been modified over time. The Brook is fed primarily by groundwater seepage from the Gnangara Mound and stormwater from the surrounding industrial, residential and rural areas.

The water system flows south-east before entering the Swan River, upstream of Success Hill in Bassendean.

Increased groundwater pumping in the northern part of the catchment has lowered groundwater levels, consequently reducing flow into the brook.

Conversely, the southern part of the catchment has elevated flow due to the construction of drainage networks and increased runoff from hard surfaces.

SENSE OF PLACE

Currently the station site is located on semi-rural land and has no urban setting. With the future development of a town centre, the Sense of Place will change radically.

Malaga Station will become the heart of the new Town Centre and should be a place that feels occupied and owned by the community it services.

In order to achieve a distinct urban experience and eliciting a sense of belonging in the community, the Malaga Station should have the following qualities:

Spring

'The station feels like a bubbling spring reviving liveliness. People, nature and water are flowing through the spaces, aerating and animating the precinct. It is the source that is connected to the Bennett Brook system as well as the metropolitan area.'

Young

' The new Town Centre is an opportunity for a new start, with fresh concepts to reconcile with the original values of the site.'

Outwards

' The station feels open and outward looking, both physically and mentally. It maximising the topographic qualities, with views to the surrounding landscape and connections outwards. It is future-orientated and looking for new horizons.' [5]

[5] *Malaga Station Precinct-Preliminary Place Plan*

THE STATION

Malaga Station is located between the suburbs of Ballajura and Bennett Springs, with Beechboro and Malaga in close proximity.

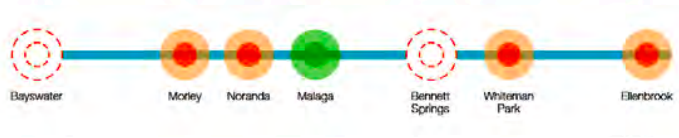
The station will be constructed on a greenfield site between Beechboro Road North, Marshall Road and Tonkin Highway in the suburb of Whiteman, allowing for future development around the station.

A large car park, located south-east of the station, will provide eleven hundred car bays and a drop off area.

A dedicated bus interchange with twelve bus stands will be constructed as well, providing feeder bus services to nearby suburbs.

Future development of a Town Centre will bring radical changes to the stations urban context. The station is likely to become the town's civic heart, delivering connectivity to the adjoining residential communities and the Malaga industrial precinct.

1 Welcome Place

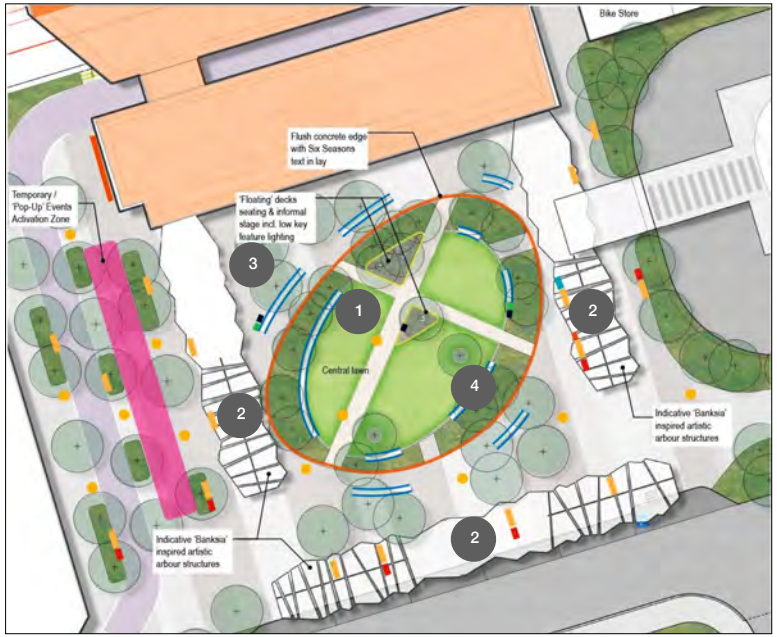


Curatorial Vision

The Welcome Place will be the heart of both the station and the new Malaga Town Centre. It is a meeting place where people congregate or dwell before proceeding on their journeys.

The artworks will celebrate emergence of the town centre and be inspired by the Bennett Brook Catchment and natural bushland setting that lies beyond. They will celebrate Noongar connection to place through the expression of cultural stories and themes.

Artworks may express line wide and location specific themes developed through a collaborative design process.



Artwork Intention

Integrated landscape elements are part of the line-wide approach that explores shared themes and narratives across stations.

Artworks may be large-scale or fine-grained expressions of place that build a community identity. They can:

- Celebrate local culture, history and stories.
- Encourage exploration and discovery
- Enrich the user experience by providing arrival experiences and assisting with wayfinding.

Scale

- Medium scale markers that define destinations. meeting points and decision points;
- Small-to-medium scale artworks and integrated elements that contribute to the waiting experience.

Opportunities

1. Stand-alone nodal artworks;
2. Arbour treatments;
3. Coloured, sandblasted or inlayed paving;
4. Interpretive signage and text elements;.

Budget

46% of the overall station art budget

Procurement Method

The development of line wide integrated landscape elements may be achieved by:

- Open Competition
- 'Design only' elements developed as line wide themes through Noongar Design Workshops

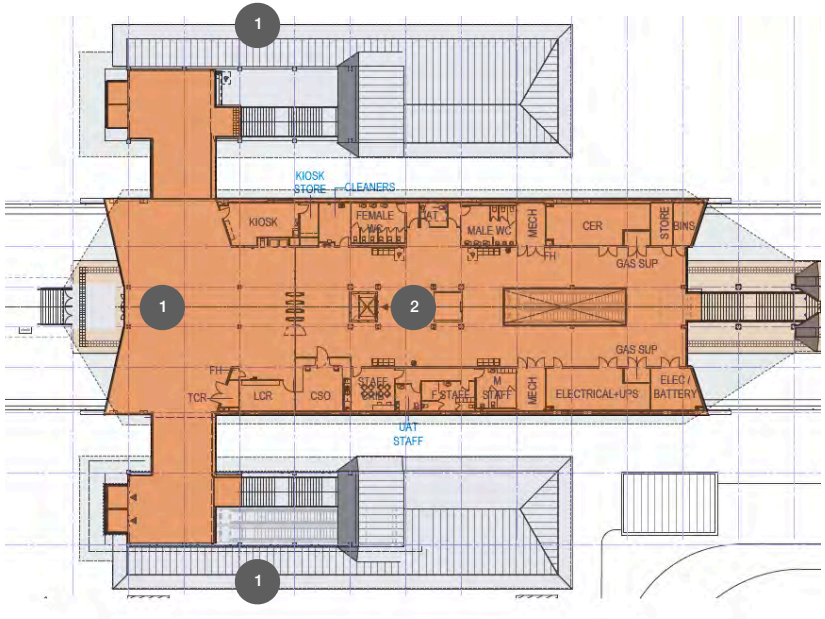
2 Station Building

Curatorial Vision

Integrated into the fabric of the station building, the artworks will be 'value added' elements that can be appreciated from multiple external vantage points, including the Kiss and Ride, Welcome Place, car parks, bus interchanges, pathways and landscaped spaces.

They artworks may be experienced when approaching the building from a distance or internally as part of the vertical circulation. They may include screening treatments to the entry building facades and concourse glass balustrading.

The approach may be line-wide, emphasising the connections between stations or a more localised response to the Malaga site and the surrounding environment.



Artwork Intention

Integrated landscape elements are part of the line-wide approach that explores shared themes and narratives across stations.

Artworks may be large-scale or fine-grained expressions of place that build a community identity. They can:

- Provide common elements and thematic connections between stations;
- Celebrate local culture, history and stories;
- Enrich the user experience by providing arrival experiences and assisting with wayfinding.

Scale

- Large to medium scale integrated elements that may extend over large areas;
- Fine grained elements of patterned and texture.

Opportunities

1. Perforated metal screens in concourse and vertical circulation buildings;

2. Fritted glass to station canopy skylight (refer to Whiteman Park Station image for typical skylight detail);

Budget

40% of the overall station art budget

Procurement Method

The development of line wide integrated architectural elements may be achieved by:

- Open Competition
- 'Design only' elements developed as line wide themes through Noongar Design Workshops

06

REFERENCES

The following documents and websites have been referenced in the preparation of the Plan:

- METRONET Public Art Strategy
- METRONET Morley-Ellenbrook Line Public Art Guide
- METRONET Aboriginal Engagement Strategy (Gnarla Biddi)
- METRONET Noongar Cultural Context - Gyinning/Morley-Ellenbrook Line
- METRONET Station Precinct Guide
- Ellenbrook Station - Preliminary Place Plan (Place Laboratory)
- City of Swan - Ellenbrook Local Area Plan
- City of Swan - Growth Corridor Local Area Plan
- Whiteman Park Station Station - Preliminary Place Plan (Place Laboratory)
- Whiteman Park Strategic Plan 2017-2021 (Department of Planning)
- https://www.whitemanpark.com.au/
- https://www.bushlandperth.org.au/treasures/whiteman-park/
- Malaga Station - Preliminary Place Plan (Place Laboratory)
- City of Swan - Malaga Local Area Plan
- City of Swan - Ballajura Local Area Plan
- Beeralain/Bayswater - Station Precinct Placemaking Plan (UDLA and Apparatus)
- https://www.noongarculture.org.au/

Appendix I – Bushfire Management Plan

Metronet – Malaga Station

Beechboro Road North, Malaga

Bushfire Management Plan

Date: 13 August 2021

Prepared For: Perth Transport Authority

Linfire Ref: 20210416136LOR-BMP-001_1a

Linfire Consultancy

ABN: 577 930 47299

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

Revision	Issue Date	Revision Description	Approved By
0	11 June 2021	Issued for Approval	Linden Wears (Level 3 BPAD 19809)
1a	13 August 2021	Issued for Approval	Linden Wears (Level 3 BPAD 19809)

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Fire is an unpredictable force of nature. Changing climatic factors (whether predictable or otherwise) either before or at the time of a fire can also significantly affect the nature of a fire and in a bushfire prone area it is not possible to completely guard against bushfire. The mitigation strategies contained in this Bushfire Management Plan (BMP) are considered to be prudent minimum standards only, based on the standards prescribed by relevant authorities. It is expressly stated that Linfire do not guarantee that if such standards are complied with or if a property owner exercises prudence, that a building or property will not be damaged or that lives will not be lost in a bush fire.

Further, the achievement of the level of implementation of fire precautions will depend on the actions of the landowner or occupiers of the land, over which Linfire has no control. If the proponent becomes concerned about changing factors then either a review of the existing BMP, or a new BMP, should be requested. Linfire accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report and its supporting material by any third party.

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1.0 Proposal details

1.1 Background

Melconnx, on behalf of the Perth Transport Authority (PTA; the Proponent) is seeking to lodge a Development Application (DA) in relation to proposed development of a Malaga Train Station at Lots 11 and 810 Beechboro Rd North, Whiteman (the project area) located in the City of Swan.

The development plan (see Figure 1) identifies that the proposed development will comprise the following elements:

- Station building with platform and concourse areas
- Roof canopy
- Bus interchange including fire booster connection and DFES hardstand
- Kiss n Ride drop off area
- Bike shelter
- Signalling Equipment Room (building) and radio mast
- Services area including bins, irrigation tanks and Western Power infrastructure
- Fire pumps and tanks
- Welcome Place outdoor plaza
- Onsite carparking.
- Onsite roads consisting of:
    - Public roads
    - Internal driveways
        - Internal access roads
        - Services roads
- Pedestrian shared path (PSP) - footpaths
- Onsite landscaping/drainage
- 4No. Future Development lots (developments not included in this DA)
- A future carpark (not included in this DA)
- Metronet railway track and associated batters (not included in this DA)
- Beechboro Road North upgrade works (not included in this DA)
- Western Power substation and Traction Power substations, and access road, to the south of the development (none of this is included in this DA)

The project area extends around the portions of the overall Metronet project that are included in this development application, as shown in Figure 2. The 4 future development lots and the future carpark are included in the project area, however these will simply be cleared of vegetation and levelled for future development. These will be subject to future development applications and are not addressed as part of this BMP which will assume they are cleared and maintained in a non-vegetated or as low threat vegetation. The roads will be constructed as shown on Figure 2.

The construction of the railway line and the modification of Beechboro Road North are parts of separate work packages and not part of this development application. It has been assumed as part of this BMP that both the railway construction and Beechboro Road North upgrade will be completed prior to occupancy. The proposed Western Power and Traction Power substations to the south of the project area, and the access road, will all be subject to a separate planning application and are not considered as part of this BMP.

The station will be operated by PTA and is manned at all times that it is open to the public.

Vehicular access to the station for the public is via the main entrance south of the project area, from Beechboro Road North, with buses able to enter the bus interchange via another entrance further north also from Beechboro Road North. The main entrance road along the southern boundary of the project area is a public road that extents up to the Welcome Place, and spurs into the carpark in four locations to serve the Future Development lots, as depicted on Figure 2. The public road also extends west to a temporary turning head. Future public roads are proposed within future development to the south-west of the station and also to the north the railway, via a bridge over the rail alignment.

The remainder of the roads within the project area are all considered private driveways including:

- the internal carpark roads
- the bus interchange driveway
- the service road from the temporary turning head to the firewater pumps/tanks
- the service road to the bins/irrigation tanks/substation area
- the maintenance track to the rear of the future carpark site
- the service road providing access along the southern railway alignment boundary, connecting to the bus interchange road and extend to the north-east along the alignment.

Access control will be provided on the following roads, to prevent unauthorised access or use by the public

- the service road to the fire pumps and tanks and
- the on-tracking service road located immediately to the west of the future carpark
- the service road from the bus interchange

A temporary Emergency Access Way (EAW) is also proposed to connect the internal carpark driveway to the bus interchange driveway, to permit vehicles to use the other Beechboro Road North connection, in an emergency bushfire situation. This EAW is a temporary measure required to until the internal road network is provided with a second connection to the existing public road network.

Given the nature of the facility, this station has its own onsite fire hydrant system which consists of dedicated fire water tanks, pump room and booster connection. Emergency management provisions, including evacuation, is expected to be conducted in accordance with the PTA Emergency Management Manual (EMM). Linfire note that while the PTA EMM details the response to a variety of onsite emergencies, including station fires, there isn't any specific information in the EMM relating to bushfire emergencies, which may require different responses and evacuation protocols to other emergencies. As outlined in Section 1.4, it is proposed that bushfire emergency management measures be incorporated into the PTA EMM to satisfy bushfire policy requirements.

1.2 Site description

The project area extends around the overall development boundary for this development application, as shown in Figure 2, and is surrounded by:

- remnant bushland to the north with Whiteman Park to the north-east
- remnant bushland and Tonkin Highway to the west
- remnant bushland immediately to the south, with the existing Potters House Christian Centre and Marshall Road further south
- Beechboro Road North immediately to the east, with grazed agricultural land further west.

1.3 Habitable buildings and assets

Review of the proposed development has identified the following proposed habitable buildings and assets that Linfire consider require protection from bushfire impact:

- Main station rooms and infrastructure (beneath the main station canopy) on both the platform and concourse levels including toilets, staff crib, kiosk, offices, cleaners room, electrical and communications rooms and other infrastructure.
- Lift lobby building located immediately south of the main station canopy
- Toilets/Communications/Electrical/Mechanical building on the eastern part of the platform, not located beneath the main canopy
- The Signalling Equipment Room located to the east of the main station
- Fire pumps and tanks

The various buildings and assets are depicted on Figures 1 and 2, and in Appendix 1.

Linfire note that the fire pump and tanks are not considered habitable buildings, however given the importance of this asset it is considered appropriate that are provided a level of protection from bushfire, especially given loss of this infrastructure would result in a lack onsite water supply.

1.4 Purpose

The project area contains proposed habitable development located within a designated bush fire prone area that is subject to a BAL rating above BAL-Low. On this basis, this Bushfire Management Plan (BMP) has been prepared to address requirements under Policy Measures 6.2 and 6.5 of *State Planning Policy 3.7 Planning in Bushfire-Prone Areas* (SPP 3.7; WAPC 2015) and *Guidelines for Planning in Bushfire-Prone Areas* (the Guidelines; WAPC 2017).

The proposed development is considered to be a vulnerable land use which triggers additional requirements under Policy Measure 6.6 of SPP 3.7. In accordance with Policy Measure 6.6.1 and Section 5.5 of the Guidelines, development applications for vulnerable land uses require a Bushfire Emergency Evacuation Plan (BEEP) detailing the emergency management provisions for the facility, accompanies the BMP.

For this project, it is proposed that a BEEP is not prepared at this time, but is included as a future implementation measure within this BMP and conditioned as part of the DA approval. Linfire consider the most appropriate approach is to have the proposed bushfire emergency management arrangements for this station be incorporated into the existing PTA EMM to standardise the procedures. To achieve this, there is a significant liaison process required with PTA, which given occupation of the station by vulnerable occupants (i.e the public) isn't likely until 2024, there is considerable time to define these bushfire emergency management arrangements. This BMP will provide some guidance about the overall strategy, to provide decision-makers some information regarding the anticipated emergency management measures. Notwithstanding, a standalone BEEP for the station may still be an option if this is PTA's preference, however it should be aligned and referenced in the EMM.

1.5 Other plans/reports

There are no known bushfire or assessments that have been prepared previously for the project area.

Plate 1: Map of Bush Fire Prone Areas (DFES 2021)

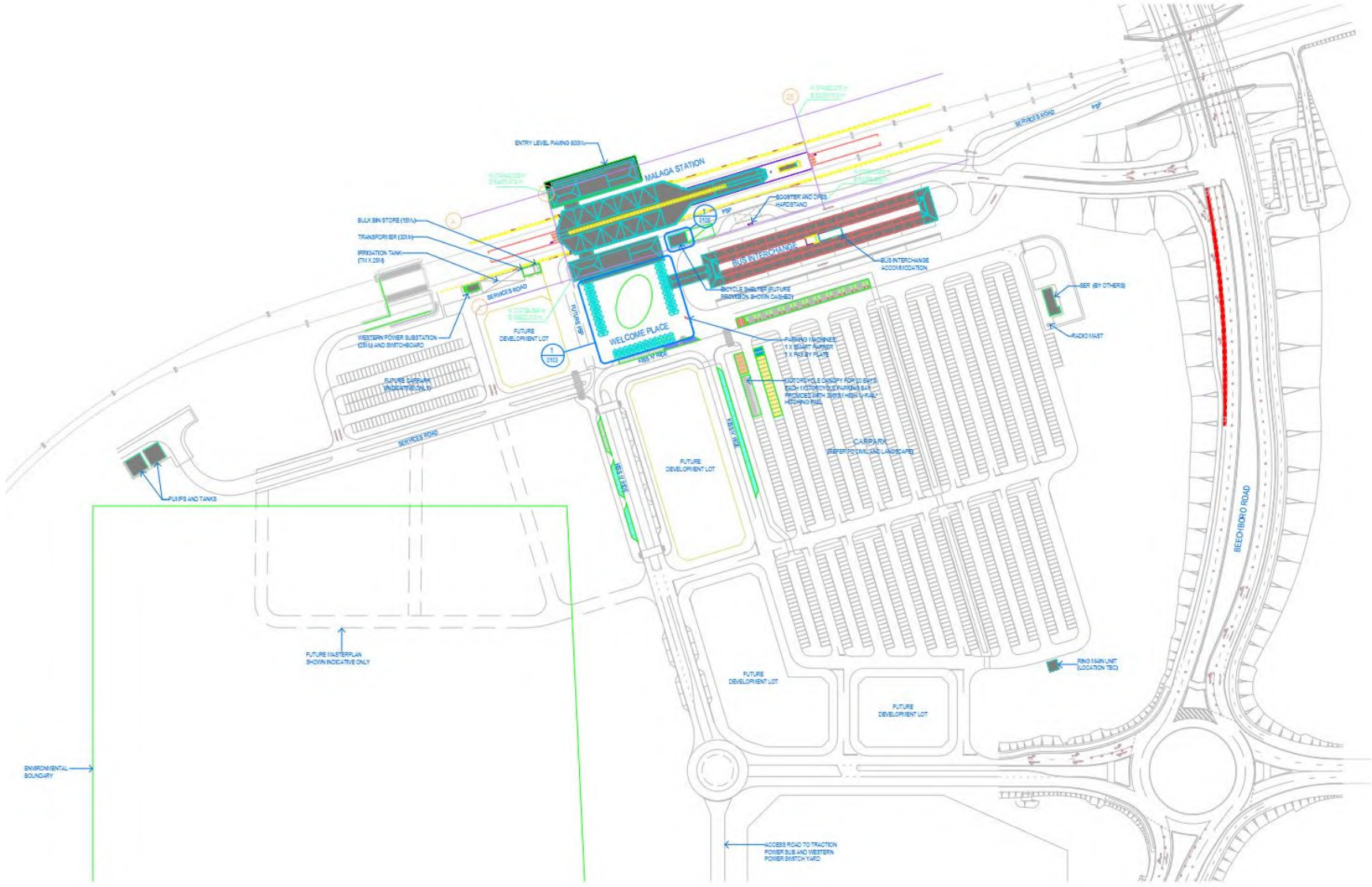

Figure 1: Development Plan

Legend

- Access Gate (locked)
- Access Gate (unlocked)
- Turning Head
- Temporary Turning Head
- Proposed Development
- Public Road
- Emergency Access Way
- Private Driveway
- Project Area
- 100m Assessment Area
- 150m Assessment Area

Scale 1: 3,500

0 40 80 120 Metres

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Public Transport Authority

Metronet: Malaga Station

Figure 2: Site Overview and Vehicular Access

2.0 Environmental considerations

2.1 Native vegetation - modification and clearing

The project area contains both areas of remnant vegetation and regenerated vegetation on previously cleared land, and all this vegetation will require clearing as part of the proposal. Table 1 provides a summary of a search of free publicly available environmental data.

Linfire understand all environmental impacts resulting from implementation of the proposal, if any, will be addressed under standard State and Federal environmental assessment and referral requirements under the Environmental Protection Act 1986 and Environment Protection and Biodiversity Conservation Act 1999.

Table 1: Summary of environmental values

Environmental value	Not mapped as occurring within or adjacent to the project area	Mapped as occurring within or adjacent to the project area		Description
		Within	Adjacent	
Environmentally Sensitive Area			✓	No Environmentally Sensitive Area have been identified within the project area but has been immediately to the north of Beechboro Rd North
Swan Bioplan Regionally Significant Natural Area	✓			No Regionally Significant Natural Areas were identified.
Ecological linkages	N/A	N/A	N/A	This layer not publicly available at the time of document preparation.
Wetlands			✓	No Conservation Category wetlands are identified within the project area however one is located to the north of Beechboro Road North. A Resource Enhancement wetland is located over the eastern portion of the project area. No Ramsar sites are mapped as occurring within or adjacent to the project area.
Waterways	✓			No waterways or lakes within or adjacent to the project site.
Threatened Ecological Communities listed under the EPBC Act		✓	✓	National Map shows the project area and the surrounding area as containing Threatened Ecological Communities.
Threatened and priority flora	N/A	N/A	N/A	This layer not publicly available at the time of document preparation.

Environmental value	Not mapped as occurring within or adjacent to the project area	Mapped as occurring within or adjacent to the project area		Description
		Within	Adjacent	
Fauna habitat listed under the EPBC Act	✓			No Fauna habitat listed under the EPBC Act is mapped as occurring within the project area. Land within the project area is mapped as being a potential roosting area for endangered Carnaby's Black Cockatoo, and also an area requiring investigation for feeding habitat. The project area shows no potential Western Ringtail Possum habitat.
Threatened and priority fauna	N/A	N/A	N/A	This layer not available at the time of document preparation.
Bush Forever Site			✓	No Bush Forever site is identified within the project area. Bush Forever site 304 is located to the north and east of Beechboro Rd North
DBCA managed lands and waters (includes legislated lands and waters and lands of interest)	✓			No DBCA managed or legislated land and waters were identified within or adjacent to the project area.
Conservation covenants	✓			No information has been provided by the client regarding Conservation Covenants.
Aboriginal Heritage		✓	✓	The project area and surrounds are mapped as being a Register Aboriginal Site.
Crown Reserves	✓			No Crown Reserves were identified within or adjacent to the project area.

2.2 Revegetation and Landscaping

The proposed development is to include a combination of proposed revegetation and onsite managed landscaping as part of the proposal. The landscaping strategy for the project area is to include the following treatments:

- proposed revegetation planting along the eastern and southern interfaces of the carpark with a Class B woodland vegetation structure (low understorey species <0.5 m high with trees between 10% - 30% canopy cover). This occurs both within the project area and adjacent to the proposed Beechboro Road North upgrade as part of a separate work package.

- landscaping within the carpark and, along the roads and around the proposed station.

Asset Protection Zones (APZs) are to be implemented around nominated buildings, to the dimensions detailed in this BMP, and complying with the APZ standards from the Guidelines (see Schedule 1 in Appendix 3). Outside the APZs, the managed landscaping around the station is to consist of either non-vegetated elements or low threat landscaping in accordance with *AS 3959—2018* Clauses 2.2.3.2 (e) and (f).

Linfire understand that there will no revegetation, landscaping or drainage basins along the rail alignment, within 150 m of the project area. Additionally, the batters from the railway alignment will be maintained in a non-vegetated state. As such, the proposed rail alignment and batters has been excluded from classification on the basis it will be non-vegetated or managed as low threat vegetation.

The Future Development lots and carpark are understood to be cleared and levelled (and most likely sprayed with hydromulch to prevent wind erosion) as part of this DA, and as such, have been excluded as non-vegetated or managed low threat landscaping in accordance with *AS 3959—2018* Clauses 2.2.3.2 (e) and (f).

3.0 Bushfire assessment results

3.1 Assessment inputs

3.1.1 Vegetation classification

Linfire assessed classified vegetation and exclusions within 150 m of the project area through on-ground verification on 26 May 2021 in accordance with *AS 3959—2018 Construction of Buildings in Bushfire-Prone Areas* (AS 3959; SA 2018) and the *Visual Guide for Bushfire Risk Assessment in Western Australia* (DoP 2016). Georeferenced site photos and a description of the vegetation classifications and exclusions are contained in Appendix 1 and depicted in Figure 3 and Table 2.

The following vegetation classifications were identified during the site inspection within the project area and adjacent 150 m assessment area:

- Class G grassland
  - Unmanaged grassland with isolated mature trees to the north, south and east of the project area
- Class D scrub
  - predominately comprised of low groundcovers and small trees (3-6 m high) with a significant number of banksia species.
  - Remnant scrub vegetation occurs to the north, north-east, west and south of the project area
- Class A forest
  - Occurs to the north of the project area at higher elevation with a structure of low groundcovers and small trees, with more mature trees (>6m high) also throughout the plot
  - Also occurs in a small plot to the south of the project area, adjacent to the existing Christian Centre.
- Class B woodland
  - The proposed revegetation to the south and east of the carpark, both within the project area and also as part of the Beechboro Road North upgrade, is to consist of low understorey species (<0.5 m high) and trees that will be between 10% - 30% canopy cover.

The project area and adjacent 150 m assessment area also contains land excluded from classification, including:

- existing non-vegetated areas and low threat vegetation including buildings, roads, managed road verge along Beechboro Road North (to be retained post-development) and managed gardens within the Christian Centre to the south, excluded under Clauses 2.2.3.2 (e) and (f).
- areas of existing vegetation to be modified to non-vegetated areas and low threat vegetation as part of the proposed development in accordance with Clauses 2.2.3.2 (e) and (f).

The vegetation mapping in Figure 3 reflects the post-development outcome anticipated following completion of the railway alignment construction and the Beechboro Road North upgrade. This includes the following:

- creation and management of APZs in a non-vegetated state or as low threat vegetation compliant with the APZ standards

- the railway alignment and associated batters being constructed and maintained in a non-vegetated state (or low threat vegetation, however this is unlikely)
- the Future Development lots and carpark being created and maintained as either non-vegetated or as low threat vegetation
- Beechboro Road North being constructed as per the proposed plan with revegetation to be established within the existing road reserve as detailed above and depicted Figure 3. Where it is unclear what the revegetation might be it has been assumed to be Class B woodland on the western boundary and Class G grassland on the eastern interface. These areas will have no BAL impact on the proposed buildings.

3.1.2 Effective slope

Linfire assessed effective slope under classified vegetation through on-ground verification on 26 May 2021 in accordance with AS 3959. Results were cross-referenced with Landgate 5m contour data and are depicted in Table 2 and Figure 3.

Site observations indicate that land within the project area, and within the 150 m assessment area, are situated on land sloping from the north to the south-east, with variation in slope beneath classified vegetation ranging from flat/upslope to less than 5° downslope in relation to the project area. On this basis, Linfire has assigned effective slopes accordingly, ranging from flat/upslope to downslope 0°-5° for the various classified vegetation plots.

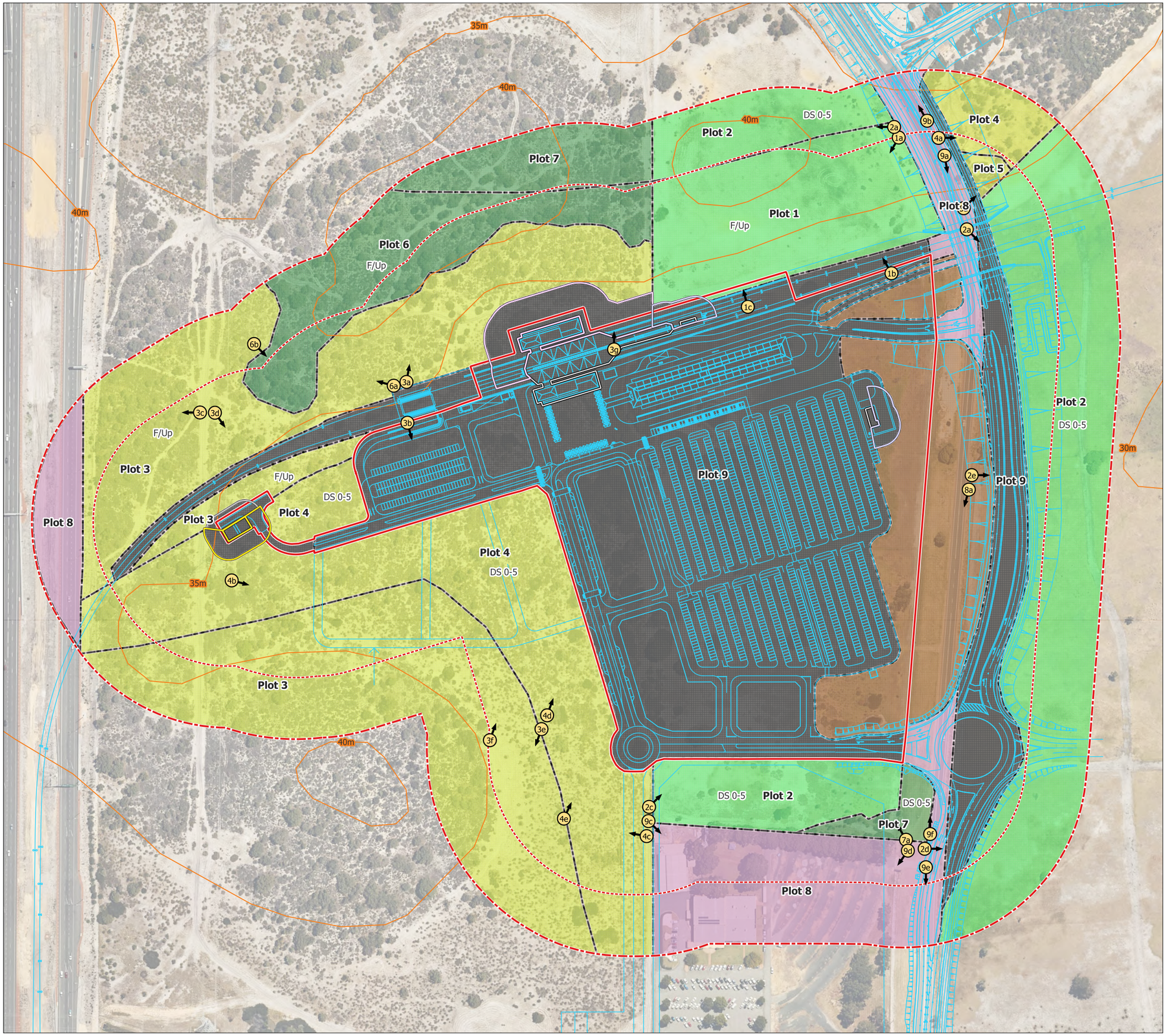
3.1.3 Summary of inputs

Table 2 illustrates the anticipated post-development vegetation classifications and exclusions following completion of development works and modification of existing vegetation to a non-vegetated or low threat state, throughout much of the project area and along the railway alignment and batters. The post-development vegetation classifications/exclusions and effective slope are summarised in Table 2.

Table 2: Post-development vegetation classifications/exclusions and effective slope

Vegetation plot	Vegetation classification	Effective slope	Comments
1	Class G Grassland	Flat/upslope (0°)	Plot of unmanaged grassland vegetation to the north of the railway alignment
2	Class G Grassland	Downslope >0–5°	Small plots of grassland north and south of the project area, with another to the east of Beechboro Road North
3	Class D Scrub	Flat/upslope (0°)	Plots of remnant banksia dominated scrub vegetation to the north, north-west and west of the project area. Contains vegetation <6m in height, however much of the vegetation is <1m high with areas that are non-vegetated.
4	Class D Scrub	Downslope >0–5°	Plots of remnant banksia dominated scrub vegetation to the west of the project area. Similar to Plot 3, contains vegetation <6m in height, however much of the vegetation is <1m high with areas that are non-vegetated.
5	Class D Scrub	Downslope >5–10°	Small plot of scrub vegetation to the north-east of the project area on a steeper downslope

Vegetation plot	Vegetation classification	Effective slope	Comments
6	Class A Forest	Flat/upslope (0°)	Located to the north of the project area. Similar scrub structure to Plots 3 and 4, but with mature trees >6m height that also >10% canopy cover.
7	Class A Forest	Downslope >0–5°	Located in small plots to the north and south of the project area. Similar scrub structure to Plots 3 and 4, but with mature trees >6m height that also >10% canopy cover.
8	Class B Woodland	Downslope >0–5°	To be introduced as part of proposed revegetation to the south and east of the carpark, both within the project area and also as part of the Beechboro Road North upgrade. Will consist of low understorey species (<0.5 m high) and trees that will be between 10% - 30% canopy cover.
9	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Existing non-vegetated elements (buildings, roads etc) and low threat vegetation, adjacent to the project area
10	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Existing classified vegetation within the project area to be modified to non-vegetated or low threat vegetation as part of the proposed development This includes the non-vegetated elements and managed landscaping within the project area, the APZs and the railway reserve. The proposed vegetation within the carpark has been excluded on the basis that it will be managed by the PTA on an ongoing basis, and the vegetation is contained in isolated



Legend

- Site Photo
- Contours
- Proposed Development
- Project Area
- 100m Assessment Area
- 150m Assessment Area
- Building Outline

Asset Protection Zone

- 13m
- 15m
- 17m
- 27m
- Vegetation Plot

Classified Vegetation

- A. Forest
- B. Woodland
- D. Scrub
- G. Grassland
- Excluded Clause 2.2.3.2(e&f)
- Modified to non vegetated and low threat

Scale 1: 3,500

0 40 80 120 Metres

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Figure 3: Post-development vegetation classification and effective slope

3.2 Assessment outputs

3.2.1 Bushfire Attack Level (BAL) contour assessment

Linfire has undertaken a BAL contour assessment in accordance with Method 1 of AS 3959 for the project area (see Figure 4). The Method 1 procedure incorporates the following factors:

- state-adopted FDI 80 rating
- vegetation classification
- effective slope
- distance maintained between proposed development areas and the classified vegetation.

The BAL rating gives an indication of the level of bushfire attack (i.e. the radiant heat flux) that may be received by proposed future development and subsequently informs the standard of building construction and/or setbacks required for proposed habitable development to potentially withstand such impacts.

The BAL contours are based on:

- the vegetation classifications and effective slope observed at the time of inspection as well as consideration of the post-development conditions resulting from proposed on-site clearing extent and vegetation management, resultant vegetation exclusions and separation distances achieved in line with the Development Plan and Sections 2.2 and 3.1.1.
- the proposed revegetation around the southern and eastern extents of the carpark and within upgraded Beechboro Road North reserve, with woodland vegetation structure as per AS 3959
- the Proponent maintain landscaping within the carpark as low threat vegetation on an ongoing basis to enable exclusion of the carpark as non-vegetated and low threat vegetation under Clauses 2.2.3.2 (e) and (f).

Should there be any changes in development design or classified vegetation extent that results in a modified BAL outcome, then the BAL contours will need to be reassessed.

The results of the BAL contour assessment are detailed in Table 3 and illustrated in Figure 4. The highest BAL applicable to the proposed buildings and elements is BAL-29, following implementation of the proposed Asset Protection Zones and other vegetation modification in line with the Landscaping Plan ensuring all development will be in BAL-29 or less.

Table 3: BAL contour assessment results to proposed buildings and assets

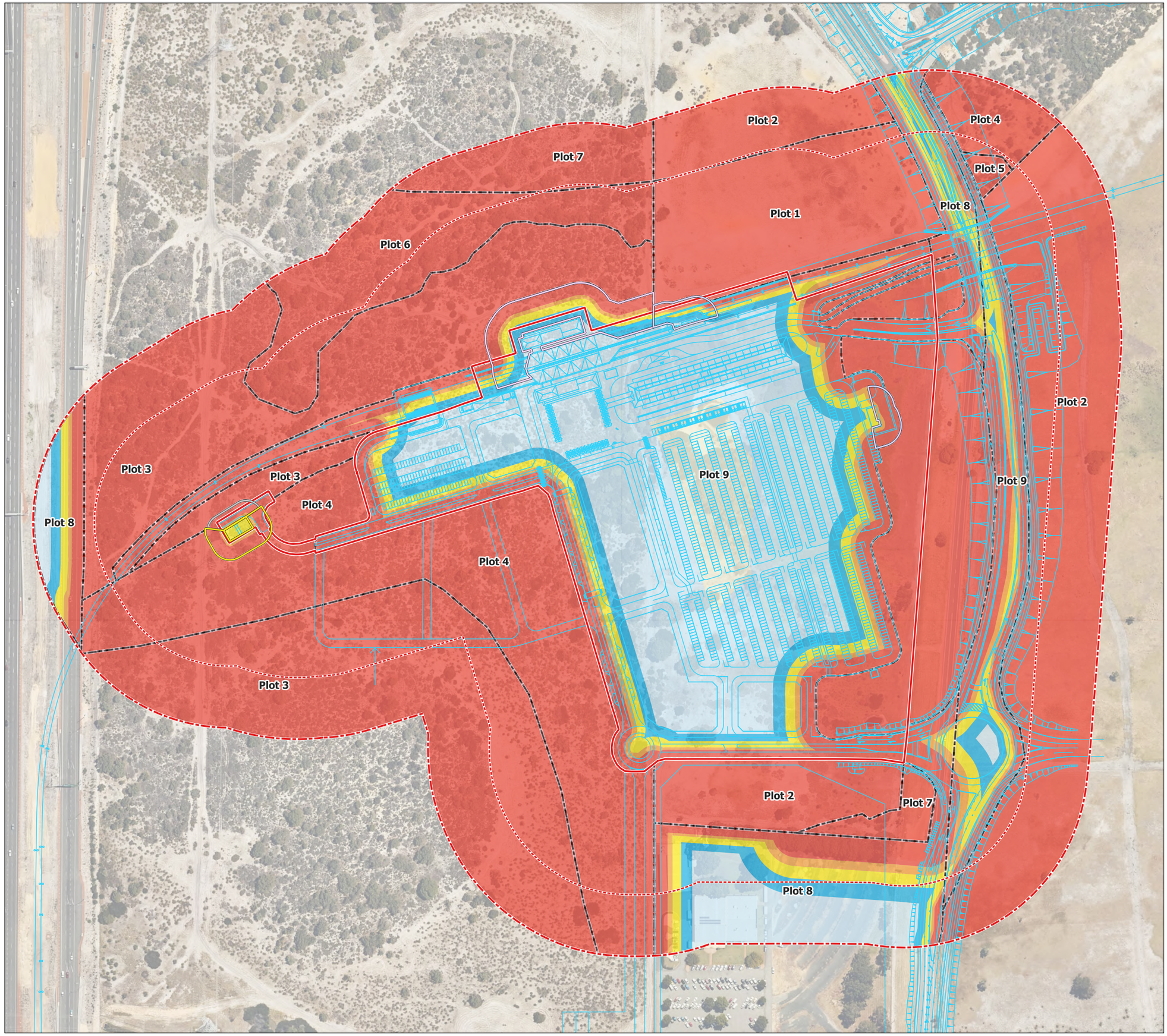
Method 1 BAL determination				
Plot	**Vegetation classification**	**Effective slope**	**Separation distance**	**Highest BAL**
1	Class G Grassland	Flat/upslope (0°)	17 m	BAL–12.5
2	Class G Grassland	Downslope >0–5°	>100 m	BAL–Low
3	Class D Scrub	Flat/upslope (0°)	13 m	BAL–29
4	Class D Scrub	Downslope >0–5°	15 m	BAL–29
5	Class D Scrub	Downslope >5–10°	>100 m	BAL–Low
6	Class A Forest	Flat/upslope (0°)	69 m	BAL–12.5
7	Class A Forest	Downslope >0–5°	>100 m	BAL–Low

Method 1 BAL determination				
Plot	**Vegetation classification**	**Effective slope**	**Separation distance**	**Highest BAL**
8	Class B Woodland	Downslope >0–5°	17 m	BAL–29
9	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
10	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low

Table 4 lists the BAL applicable to each building or element within the proposed development.

Table 4: BAL applicable to each building/element

Building / element	Initial BAL (no management)	Proposed vegetation management	Revised BAL
Station building including lift lobby building (south of the main station canopy)	BAL–FZ	17 m -27 m variable width APZ around the building, in conjunction with onsite landscaping and revegetation and the proposed clearing along the rail alignment.	BAL–12.5
Toilets/Communications/ Electrical/Mechanical building (on platform)	BAL–FZ	17 m -27 m variable width APZ around the building, in conjunction with onsite landscaping and revegetation and the proposed clearing along the rail alignment.	BAL–12.5
Signalling Equipment Room	BAL–FZ	17 m wide APZ around the building, in conjunction with onsite landscaping and revegetation and the proposed clearing along the rail alignment.	BAL–29
Fire Pumps and Tanks	BAL–FZ	13 m -15 m variable width APZ around the proposed pumps and tanks	BAL–29



Legend

- Proposed Development
- Project Area
- 100m Assessment Area
- 150m Assessment Area

Asset Protection Zone

- 13m
- 15m
- 17m
- 27m
- Vegetation Plot

BAL Contours

- BAL FZ
- BAL 40
- BAL 29
- BAL 19
- BAL 12.5
- BAL Low

Scale 1: 3,500

0 40 80 120 Metres

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Figure 4: BAL Contour map

4.0 Identification of bushfire hazard issues

4.1 Bushfire context

The project area is located within an area comprising both native vegetation and previously cleared or grazed land that has had some regeneration. In close proximity to the west of the project area is Tonkin Highway with the residential land use in Ballajura further to the west. To the south is Marshall Road with Bennett Springs residential area further south.

The greatest bushfire threat to the proposed development is from Whiteman Park to the north, north-east and east of the project area in the form of forest, woodland, scrub and grassland vegetation. Some level of separation will be provided by Beechboro Road North and the proposed rail alignment, however long fire runs exceeding several kilometres will still exist following development. It is noted that there is a considerable level of fragmentation of the vegetation as it approaches the project area from these directions, which will likely produce a natural reduction in bushfire behaviour. Notwithstanding, fully developed bushfire behaviour would be expected over long fire runs with elevated radiant heat and ember attack, if left unmanaged.

A bushfire approaching from the north-east would be on a much shorter fire run of 400-500 m long however could still exhibit steady state bushfire behaviour through scrub vegetation, albeit quite stunted scrub in various area in this direction.

Based on the above, bushfire impact on the proposed development is expected to be relatively short, given the quick residence time associated with bushfire spreading through the grassland and scrub vegetation. Linfire consider it unlikely that the current fuel structure would result in the peak bushfire behaviour anticipated by AS 3959, however, if left unprotected, the project area would be expected to receive elevated levels of radiant heat and ember attack from a bushfire approaching the development.

4.2 Bushfire hazard issues

Examination of the environmental considerations (Section 2.0) and the bushfire risk assessment (Section 3.0) has identified the following bushfire hazard issues:

1. Based on the existing extent of vegetation outside proposed buildings and roads, the proposed facility is subject to an initial BAL of BAL-FZ. In order for the habitable buildings and other assets to achieve a compliant rating of BAL-29 or less, sufficient separation will be required in the form of APZs, low threat vegetation or permanent non-vegetated elements
2. Ensuring sufficient vehicular access to the proposed development, to enable egress by onsite occupants and facilitating access for fire brigade and emergency services.
3. Ensuring access to bushfire fighting water supply, to limit the travel time to water supplies for appliance refills.
4. The proposed development constitutes a vulnerable land use, primarily due to the presence of the public who may not be familiar with the facility or what to do in a bushfire emergency.

4.3 Bushfire safety strategy

The following bushfire safety strategy is proposed to demonstrate compliance with the Bushfire Protection Criteria of the Guidelines and address the bushfire hazards identified above:

1. Create sufficient separation from surrounding classified vegetation, by ensuring appropriately sized APZs are implemented around proposed buildings and assets to achieve BAL-29 or lower, and comply with the APZ standards of the Guidelines. Given

the importance of the station building, the decision has been made to implement an APZ to voluntarily achieve BAL-12.5 or lower.

2. Providing compliant vehicular access within, to and from the proposed development, consisting of public roads, private driveways and a temporary EAW, to enable occupant egress and facilitate firefighter access to the project area and in particular the firewater supply.
3. Providing a secure bushfire fighting water supply by installing the proposed on-site fire hydrant system to provide hydrant coverage to the station building. Static water tanks on the hydrant system will also enable refill of bushfire fighting appliances from the fire booster connection.
4. Ensure appropriate bushfire emergency management procedures are incorporated into the overarching PTA EMM, to enable onsite staff to appropriately manage a bushfire event impacting the proposed development including:
    a. Monitoring of forecast Fire Danger Rating during bushfire season, and Total Fire Ban Days, to anticipate bushfire risk for the next day and consider pre-emptive actions
    b. Maintaining situational awareness during day in bushfire season by monitoring emergency services information
    c. Emergency management procedures for bushfire events including ceasing train and bus services and evacuating the train station.

Based on the above, Linfire considers the bushfire hazards within and adjacent to project area and the associated bushfire risks are manageable through standard management responses outlined in the Guidelines. These responses will be factored into proposed development as early as possible at all stages of the planning process to ensure a suitable, compliant and effective bushfire management outcome is achieved for protection of future life, property and environmental assets.

5.0 Assessment against the bushfire protection criteria

5.1 Compliance table

An acceptable solutions assessment against the bushfire protection criteria is provided in Table 5.

Table 5: Compliance with the bushfire protection criteria of the Guidelines

Bushfire protection criteria				Linfire response		
Element	**Intent**	**Performance Principle**	**Acceptable solutions**	**Method of compliance**	**Proposed bushfire management measures**	**Compliance Comment**
Element 1: Location	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.	Performance Principle P1 Development location The strategic planning proposal, subdivision and development application is located in an area where the bushfire hazard assessment is or will, on completion, be moderate or low, or a BAL-29 or below, and the risk can be managed. For unavoidable development in areas where BAL-40 or BAL-FZ applies, demonstrating that the risk can be managed to the satisfaction of the Department of Fire and Emergency Services and the decision-maker.	A1.1 Development location The strategic planning proposal, subdivision and development application is located in an area that is or will, on completion, be subject to either a moderate or low bushfire hazard level, or BAL–29 or below.	**Acceptable Solution**	The BAL contour map (see Figure 4) indicates that all proposed buildings and infrastructure can be sited in an area of BAL-29 or lower, upon completion of development and implementation of the proposed Asset Protection Zones (APZs) and other onsite landscaping, in addition to the construction of the railway line and associated non-vegetated batters. The decision has been made to voluntarily achieve BAL-12.5 or lower on the station building, and the APZ around this building has been sized on this basis.	• Compliance of the Performance Principle and Intent of Element 1 is achieved through compliance with Acceptable Solution A1.1
Element 2: Siting and design of developme nt	To ensure that the siting and design of development minimises the level of bushfire impact.	Performance Principle P2 The siting and design of the strategic planning proposal, subdivision or development application, including roads, paths and landscaping, is appropriate to the level of bushfire threat that applies to the site. That it incorporates a defendable space and significantly reduces the heat intensities at the building surface thereby minimising the bushfire risk to people, property and infrastructure, including compliance with AS 3959 if appropriate.	A2.1 Asset Protection Zone (APZ) Every habitable building is surrounded by, and every proposed lot can achieve, an APZ depicted on submitted plans, which meets the following requirements: **Width**: Measured from any external wall or supporting post or column of the proposed building, and of sufficient size to ensure the potential radiant heat impact of a bushfire does not exceed 29kW/m² (BAL–29) in all circumstances. **Location:** the APZ should be contained solely within the boundaries of the lot on which the building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity (see explanatory notes) **Management:** the APZ is managed in accordance with the requirements of 'Standards for Asset Protection Zones' (see Guidelines Schedule 1).	**Acceptable Solution**	On completion of development, the following APZs are to be implemented as non-vegetated elements or maintained low threat vegetation: • Station and lift lobby building: 17m to 27m wide APZ • Toilet/Comms/Elec/Mech building: 17m to 27m wide APZ • Signal Equipment building: 17m wide APZ • Fire pump and tanks: 13m to 15m wide APZ The APZs are to be implemented and maintained in accordance with Schedule 1 of the Guidelines (see Appendix 3). The railway alignment to the east and west is to be kept in a non-vegetated state, as will the railway batter immediately north of the alignment. However further north of the batter, the remainder of the APZ extent is to be established and managed as low threat vegetation in compliance with the APZ standards. The APZ for the Station and lift lobby building extends north into land that is under WAPC tenure. It is a requirement of this BMP that a Maintenance Agreement to obtained from WAPC, that permits PTA access to their land to establish the APZ where it exists on WAPC land, and also permits ongoing access to conduct routine maintenance of the APZ. This is proposed as a development condition in Section 5.2.5 Similarly, the proposed APZ for the fire pumps and tanks extends into the Western Power easement, and a Maintenance Agreement will be required from them to establish and maintain the APZ on their land.	• Compliance of the Performance Principle and Intent of Element 2 is achieved through compliance with Acceptable Solution A2.1
Element 3: Vehicular access	To ensure that the vehicular access serving a subdivision/develop ment is available	Performance Principle P3 The internal layout, design and construction of public and private vehicular access and egress in the subdivision / development allow emergency and other vehicles to move	A3.1 Two access routes Two different vehicular access routes are provided, both of which connect to the public road network, provide safe access and egress to two different destinations and are	**Acceptable Solution**	The proposed new public road network has been detailed in Section 1.1, with new public roads to be created as shown in Figure 2. Eventually new public roads are expected to be constructed to enable travel north over the railway to future development, and also south to proposed development with likely road connections south of project	• Compliance of the Performance Principle and Intent of Element 2 is achieved through compliance with

Bushfire protection criteria				Linfire response		
Element	**Intent**	**Performance Principle**	**Acceptable solutions**	**Method of compliance**	**Proposed bushfire management measures**	**Compliance Comment**
	and safe during a bushfire event.	through it safely and easily.	available to all residents/the public at all times and under all weather conditions.		area to Beechboro Road North and/or Marshall Road. The timing of these roads is not currently known, and this creates a temporary non-compliance, with an overlength cul-de-sac road which exceeds 200 m in length. To address the non-compliance, a temporary Emergency Access Way (EAW) is proposed from the carpark to the bus interchange road, to enable emergency egress/access from the northern interconnection with Beechboro Road North. This ensures that there is a point of choice from the public road network immediately south of the Welcome Place, as well as from around the three Future Development lots in the south of the project area. On this basis, the only cul-de-sac will be the public road to the west of the Welcome Place, which is 200 m long and will have a compliant temporary turning head. Based on the above all occupants can move through the public road network to both connections with Beechboro Road North, with the option of travelling to more than two different destinations: • travelling south to Marshall Road where further travel is possible to the east, west or further south. • travelling north to Tonkin Highway where further travel can be undertaken north or south on Tonkin Highway or to the north-west on Hepburn Avenue. In this regard, the proposed development is provided with at least two access routes which meets and exceeds the requirements of Acceptable Solution A3.1.	Acceptable Solution A3.1, A3.5 and A3.8
			A3.2 Public road A public road is to meet the requirements in Table 2, Column 1.	**Not applicable**	All public roads proposed as part of the development are to be constructed to the relevant technical requirements of the Guidelines (see Appendix 4). The existing public roads sighted whilst travelling to the site appeared compliant with public road specifications of the Guidelines and will be sufficient for emergency egress or firefighter access to the site.	
			A3.3 Cul-de-sac (including a dead-end-road) A cul-de-sac and/or a dead-end road should be avoided in bushfire prone areas. Where no alternative exists (i.e. the lot layout already exists and/or will need to be demonstrated by the proponent), detailed requirements will need to be achieved (refer to the Guidelines for detailed cul-de-sac requirements).	**Not applicable**	A temporary cul-de-sac road less than 200 m in length is proposed to the west of the Welcome Place (see Figure 2), will include a temporary 17.5 m diameter turn-around head and are to be constructed to the relevant technical requirements of the Guidelines (see Appendix 4).This cul-de-sac is to be eventually removed once the road network is expanded as part of future development. The project area is not serviced by an existing cul-de-sac.	
			A3.4 Battle-axe Battle-axe access leg's should be avoided in bushfire prone areas. Where no alternative exists, (this will need to be demonstrated by the proponent) detailed requirements will need to be achieved (refer to the Guidelines for detailed battle-axe requirements).	**Not applicable**	No battle-axe legs are proposed as part of the development and the project area is not serviced by an existing battle-axe.	
			A3.5 Private driveway longer than 50 m A private driveway is to meet detailed requirements (refer to the Guidelines for	**Acceptable Solution**	The proposed private driveways are depicted on Figure 2, and include: • the bus interchange driveways, to and from Beechboro Road	

Bushfire protection criteria				Linfire response		
Element	**Intent**	**Performance Principle**	**Acceptable solutions**	**Method of compliance**	**Proposed bushfire management measures**	**Compliance Comment**
			detailed private driveway requirements).		North • the service road from the temporary turning head to the firewater pumps/tanks • the service road to the bins/irrigation tanks/substation area, to the south-west of the station building • the on-tracking road to the west and north of the future carpark site • the service road from the bus interchange, along the southern side of the rail alignment to the east of the station building • the road around and within the main station carpark (noting Figure 2 doesn't highlight all internal roads within the carpark). Access control will be provided on several of the driveway roads, to prevent unauthorised access or use by the public. This is shown on Figure 2. The private driveways will be constructed in accordance with the technical requirements of the Guidelines for private driveways (see Appendix 4). Most proposed roads will exceed 6 m in width, so passing bays are not considered to be required within the project area. Similarly compliant turning arrangements are provided for most driveway dead-ends, with the on-tracking road being the only exception. This road is to provide access to the railway alignment, and will have a locked gate (or other access control) as depicted on Figure 2, to prevent public access. Use of this on-tracking road is to be by unauthorised personnel only.	
			A3.6 Emergency access way An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an emergency access way is to be provided as an alternative link to a public road during emergencies. An emergency access way is to meet detailed requirements (refer to the Guidelines for detailed EAW requirements).	**Not applicable**	It is expected that eventually the public road network will connect to surrounding public roads such that no permanent emergency access ways (EAW) will be required, however given this development is the first stage of a larger overall development, there is a need to create a second access point to the existing wider public road network to avoid a temporary non-compliance. The proposed emergency access way (EAW) from the carpark to the bus interchange road, is to be constructed to the relevant technical requirements of the Guidelines (see Appendix 4). The EAW will need to be signposted, and if fitted with gates, these shall be kept unlocked at all times. The EAW is no further than 600 m from a public road at any point but it does connect to two private driveways, rather than directly to the public roads, however given the development is for public infrastructure, it is considered that these driveways are permanent access routes that will not be altered or removed. Similarly, given the EAW is expected to be temporary, it is not considered necessary to nominate this small EAW as a right of way or public easement in gross. Notwithstanding, this BMP does require that the temporary EAW is established and maintained in accordance with the requirements of Appendix 4 and this BMP until such time that the public road network provides an additional compliant connection that permits decommissioning of the EAW. The establishment and ongoing maintenance of the EAW is the responsibility of the PTA.	
			A3.7 Fire service access routes (perimeter	**Not applicable**	The proposed development does not require fire service access routes	

Bushfire protection criteria				Linfire response		
Element	**Intent**	**Performance Principle**	**Acceptable solutions**	**Method of compliance**	**Proposed bushfire management measures**	**Compliance Comment**
			roads) Fire service access routes are to be established to provide access within and around the edge of the subdivision and related development to provide direct access to bushfire prone areas for fire fighters and link between public road networks for firefighting purposes. Fire service access routes are to meet detailed requirements (refer to the Guidelines for detailed fire service access route requirements).		(FSARs) to achieve access within and around the perimeter of the project area. DFES have previously indicated that they do not require vehicular access along the northern boundary of the rail alignment. This correspondence is provided in Appendix 5.	
			A3.8 Firebreak width Lots greater than 0.5 hectares must have an internal perimeter firebreak of a minimum width of three metres or to the level as prescribed in the local firebreak notice issued by the local government.	**Acceptable Solution**	On completion of development, the project area will be developed with non-vegetated surfaces, cleared land and low threat landscaping with some revegetation along the eastern and southern project area extent and as such, perimeter firebreaks are not considered to be required around the project area. The balance portion of Lots 11 and 810, not included within the project area, shall comply with relevant requirements of the City of Swan firebreak notice (see Appendix 5)	
Element 4: Water	To ensure that water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	Performance Principle P4 The subdivision, development or land use is provided with a permanent and secure water supply that is sufficient for firefighting purposes.	A4.1 Reticulated areas The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services.	**Not applicable**	The proposed development is not located within an existing reticulated area, however a Water Corporation town main is to be extended to the main roundabout in the south to provide water supply to the development. It is expected that town main supply will be required to the Future Development lots, however the timing of this is not clear nor whether street hydrants will also be installed on the new main at this stage, and as such this has not been relied upon to achieve compliance with A4.1. The nearest existing street hydrants are located at the intersection of Beechboro Road North and Marshall Road, approximately 500 m from the project area. Whilst the project area is located near these street hydrants, the main bushfire fighting water supply is likely to be accessed from the dedicated onsite fire hydrant system detailed below in A4.2 below.	• Compliance of the Performance Principle and Intent of Element 4 is achieved through compliance with Acceptable Solution A4.2
			A4.2 Non-reticulated areas Water tanks for firefighting purposes with a hydrant or standpipe are provided and meet detailed requirements (refer to the Guidelines for detailed requirements for non-reticulated areas).	**Acceptable Solution**	The proposed development is to have an on-site fire hydrant system, designed, installed and maintained in accordance with the National Construction Code and relevant Australian Standards. The fire hydrant system is expected to include dedicated firewater storage tanks and duty/standby pumpset located to the west of the main station, with a booster connection situated within the proposed bus interchange. Onsite fire hydrants are sited throughout the development provide attending fire fighters with fire hydrant coverage of the railway station, including the platform and concourse levels. Given the onsite water storage (and infill) associated with the proposed wet fire systems, the addition of an extra 50 kL to the proposed storage capacity for bushfire fighting purposes is considered appropriate. This static water supply will be available for attending firefighters from the firewater storage tanks, via the booster connection. Appliance turnaround will be achieved using the loop road within the bus interchange. The firewater tank/s are to be installed, filled and maintained for the	

Bushfire protection criteria				Linfire response		
Element	**Intent**	**Performance Principle**	**Acceptable solutions**	**Method of compliance**	**Proposed bushfire management measures**	**Compliance Comment**
					life of the project by the Proponent.	
			A4.3 Individual lots within non-reticulated areas (Only for use if creating 1 additional lot and cannot be applied cumulatively) Single lots above 500 m^2 need a dedicated static water supply on the lot that has the effective capacity of 10,000 L.	**Not applicable**	The proposed development is being addressed in accordance with A4.2	

5.2 Additional management strategies

Linfire makes the following additional bushfire management recommendations to inform ongoing planning stages of the development and increase the level of bushfire risk mitigation across the site.

5.2.1 Onsite landscaping and revegetation

The BAL contour assessment is reliant on all landscaping and revegetation being implemented and maintained in accordance with the standards detailed in Section 3.1.1 and depicted on Figure 3.

All vegetation immediately south of the development and within the carpark is expected to be managed as low threat vegetation, in perpetuity, by the Proponent. All proposed revegetation to the east and south of the carpark is to be established as a woodland vegetation structure as per AS 3959. The Future Development lots and carpark are to be maintained in a non-vegetated and/or low threat state.

5.2.2 Road verge fuel management

Existing and proposed public road verges that have been excluded as low threat are to be managed to ensure the understorey and surface fuels remain in a low threat, minimal fuel condition in accordance with Clause 2.2.3.2 (f) of AS 3959. Ongoing management of proposed road reserves is the responsibility of the Proponent, until handed over to the City, with management of any existing road verges to continue to be the responsibility of the City.

5.2.3 Building construction standards

The proposed development does not include any Class 1, 2, or 3 residential buildings and associated Class 10a structures, and as such, there is no statutory requirement for proposed buildings to meet the construction requirements of AS 3959.

5.2.4 Staging of access

If development (and therefore construction of vehicular access) is to occur on a staged basis, vehicular access arrangements will need to ensure that all occupiers and visitors are provided with compliant access at all stages. This can be achieved via construction of access in advance of stages or through provision of temporary access should it be required. A temporary EAW is proposed to connect the carpark to the bus interchange, to provide an alternative exit to Beechboro Road North, and address a temporary non-compliance, which is expected to be addressed as part of future development.

5.2.5 APZ Maintenance agreement

The APZ for the main station building, extends north into land under WAPC tenure, while the APZ proposed for the fire pumps and tanks, extends into a Western Power easement. To ensure the APZs are able to be implemented and managed on an ongoing basis, a Maintenance Agreement will be required with both landowners, to enable access to their land so PTA can undertake the works.

The Maintenance Agreement is to specify responsibilities for maintenance of the APZ outside PTA control, as well as access arrangements if the PTA will be taking on responsibility for maintenance. The Maintenance Agreement will only be required until such the land within the AP is developed, in which case low threat landscaping and/ or non-vegetated paved areas will replace the unmanaged scrub and grassland vegetation.

5.2.5.1 Recommended development conditions

The following condition is recommended for the development application approval (subject to City of Swan wording):

A Maintenance Agreement is to be prepared and implemented to relation to establishment and ongoing maintenance of the nominated APZs, within WAPC and Western Power land in perpetuity, or until such a time that the unmanaged vegetation is either permanently removed or managed as low threat vegetation.

5.2.6 Vulnerable land use and recommended development condition

The proposed development constitutes a vulnerable land use. On this basis, a Bushfire Emergency Evacuation Plan (BEEP) is required to address the requirements of Policy Measure 6.6.1 of SPP 3.7.

The preference is that the BEEP is not prepared at this time, but is included as a future implementation measure within this BMP and conditioned as part of the DA approval. Instead of producing a standalone BEEP for the station, the ideal approach is to incorporate the proposed bushfire emergency management arrangements for this station into the existing PTA Emergency Management Manual (EMM) to standardise the procedures. To achieve this, there is a significant liaison process to be undertaken with PTA, and given occupation of the station by vulnerable occupants (i.e the public) is to be in 2024, there is considerable time to define these arrangements.

Based on the above, the following is proposed:

- The preparation, endorsement, and implementation of the bushfire emergency management arrangements (preferably within the PTA EMM) is specifically nominated as a condition of development approval (see Section 5.2.6.1)
- The bushfire emergency management arrangements consider the proposed philosophies outlined in Section 5.2.6.2, which have been included to provide some guidance about the overall strategy.

5.2.6.1 Recommended development condition

The following condition is recommended for the development application approval (subject to WAPC wording):

Bushfire emergency management procedures, detailing the management of vulnerable occupants at the proposed station, is to be prepared, endorsed by WAPC and implemented prior to occupation by any vulnerable occupants (i.e. the public). The proposed emergency management procedures will preferably be incorporated into the overarching PTA Emergency Management Manual (EMM) as standardised procedures, however it may also be documented within a standalone BEEP for the station that is aligned with the EMM.

5.2.6.2 Indicative Bushfire Emergency Management Procedures

It is expected that the bushfire emergency management procedures or arrangements would consider the following, to be incorporated into the PTA EMM (or a standalone BEEP that aligns with the EMM):

- Monitor the forecast Fire Danger Rating (FDR) each day (at 4pm) to enable consideration of any pre-emptive actions including
    - Heighten alertness for staff and public, including warnings when FDR is Extreme or Catastrophic
    - Consider adding extra staff to manage a bushfire emergency

    - Buses on standby for evacuation
    - DFES liaison
- Consider similar pre-emptive actions to the above, when a Total Fire Ban is declared and ensure no hot works or no other activities that may start a fire are conducted.
- Monitor emergency services information during the day (especially during bushfire season or days with elevated FDR) and conduct regular visual assessments, to maintain situation awareness during these days.
- Consider triggers for:
    - Alerting DFES
    - Ceasing train and bus services to train stations
    - Evacuating train station
    - This above would likely be station specific triggers
- Consider using Transperth buses for offsite evacuation of occupants
- Otherwise utilising the existing relevant PTA emergency management procedures and infrastructure as much as possible from the EMM, to manage bushfire emergencies.
- Ensure sufficient training for staff and regular exercise drills are conducted

5.2.7 BAL compliance and/or BAL assessment report

A BAL compliance and/or BAL assessment report may be prepared at the discretion of the Shire following completion of construction works and prior to issue of certificate of occupancy to validate and confirm the accuracy of the BAL contour assessment.

5.2.8 Compliance with annual firebreak notice

The Proponent or landowner is to comply with the current City of Swan annual firebreak notice as amended (refer Appendix 5).

6.0 Responsibilities for implementation and management of the bushfire measures

Implementation of the BMP applies to the Proponent (landowner, facility manager) and the City to ensure bushfire management measures are adopted and implemented on an ongoing basis. A bushfire responsibilities table is provided in **Error! Reference source not found.** to drive implementation of all bushfire management works associated with this BMP.

Table 6: Responsibilities for implementation and management of the bushfire measures

Implementation/management table	
Decision maker – prior to development approval	
No.	*Implementation action*
1	Condition the preparation of the Bushfire Emergency Management Procedures for the station prior to occupation as part of the development approval
2	Condition the provision of a Maintenance Agreement to address the establishment and ongoing management of the APZs within WAPC land and the Western Power easement.
Proponent – prior to development occupation	
No.	*Implementation action*
1	Develop a Maintenance Agreement to address the establishment and ongoing management of the APZs within WAPC land and the Western Power easement, to the standards stated in the BMP.
2	Establish the Asset Protection Zones (APZs) around nominated buildings and infrastructure assets to the dimensions and standards stated in the BMP and Appendix 3, and in accordance with the Maintenance Agreement.
3	Establish low threat landscaping and revegetation throughout the project area, including the Future Development lots and carpark, in accordance with the standards outlined in the BMP. This is to include the establishment of woodland vegetation structure as the revegetation to the east and south of the project area.
4	Install the public road, cul-de-sac road, private driveway network within the project area to the relevant technical requirements under the Guidelines (refer to Appendix 4). Ensure access gates and the temporary cul-de-sac turning head are installed at the locations nominated in the BMP.
5	Install the temporary EAW within the project area to the relevant technical requirements under the Guidelines (refer to Appendix 4), and at the location nominated in the BMP.
6	Construct proposed onsite fire hydrant system for the proposed development, including the additional 50 kL firewater capacity in the tanks for bushfire fighting purposes as stated in this BMP.
7	Develop the Bushfire Emergency Management Procedures for the station, ideally incorporated into the PTA EMM, as documented in this BMP
8	If development is staged, ensure that all occupiers and visitors are provided with compliant access at all stages.
9	Comply with the City of Swan annual firebreak notice issued under s33 of the Bush Fires Act 1954.
10	If required by the City, individual BAL assessment prior to issuing of building permits.
Proponent – ongoing	
No.	*Implementation action*
1	Maintain the Asset Protection Zones (APZs) around the nominated buildings and assets to the dimensions and standards stated in the BMP and Appendix 3, and in accordance with the Maintenance Agreement.
2	Maintain low threat landscaping and revegetation throughout the project area, including the Future

Implementation/management table	
	Development lots and carpark, in accordance with the standards outlined in the BMP, including management of vegetation within the carpark as low threat vegetation.
3	Maintain the public road, cul-de-sac road, private driveway network to the standards stated in the BMP.
4	Maintain the temporary EAW to the standards stated in the BMP.
4	Maintain the onsite fire hydrant system in accordance with relevant Australian Standards and the standard stated in the BMP.
6	Conduct ongoing review of the Bushfire Emergency Management Procedures to ensure they remain appropriate to the facility
7	Comply with the City of Swan annual firebreak notice issued under s33 of the Bush Fires Act 1954.
Local government – ongoing management	
No.	*Implementation action*
1	Maintain road verges in a low threat minimal fuel condition as per Clause 2.2.3.2 (f) of AS 3959.

7.0 References

Department of Fire and Emergency Services (DFES) 2021, *Map of Bush Fire Prone Areas*, [Online], Government of Western Australia, available from: https://maps.slip.wa.gov.au/landgate/bushfireprone/,.

Department of Planning (DoP) 2016, *Visual guide for bushfire risk assessment in Western Australia*, Department of Planning, Perth.

Standards Australia (SA) 2018, Australian Standard *AS 3959–2018 Construction of Buildings in Bushfire-prone Areas*, Standards Australia, Sydney.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC) 2017, *Guidelines for Planning in Bushfire Prone Areas*, Version 1.3 August 2017, Western Australian Planning Commission, Perth.

Appendix 1: Development Plans

Appendix 2: Vegetation plot photos and description

Photo ID: 1a

Photo ID: 1b

Photo ID: 1c

Plot number		Plot 1
Vegetation classification	Pre-development	Class G Grassland
	Post-development	Class G Grassland
Description / justification		Grassland greater than 100 mm in height

Photo ID: 2a

Photo ID: 2b

Photo ID: 2c

Plot number		Plot 1
Vegetation classification	Pre-development	Class G Grassland
	Post-development	Class G Grassland
Description / justification		Grassland greater than 100 mm in height

Photo ID: 2d

Photo ID: 2e

Plot number		Plot 2
Vegetation classification	Pre-development	Class G Grassland
	Post-development	Class G Grassland
Description / justification		Grassland at maturity, greater than 100 mm in height

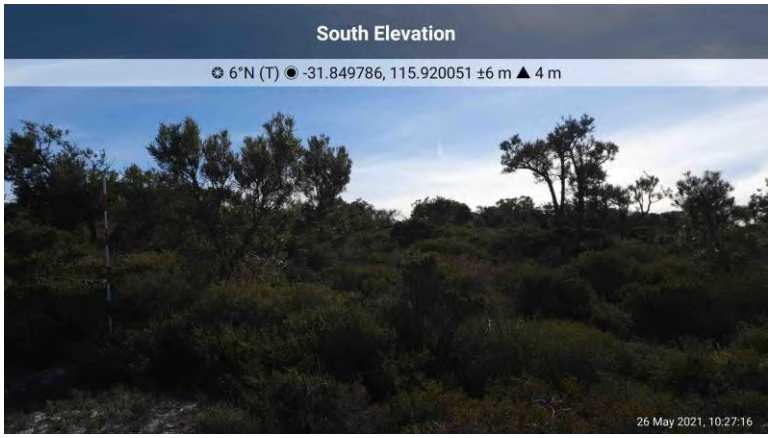


Photo ID: 3a

Photo ID: 3b

Photo ID: 3c

Plot number		Plot 3
Vegetation classification	Pre-development	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity

Photo ID: 3d

Photo ID: 3e

Plot number		Plot 3
Vegetation classification	Pre-development	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity

Photo ID: 3f

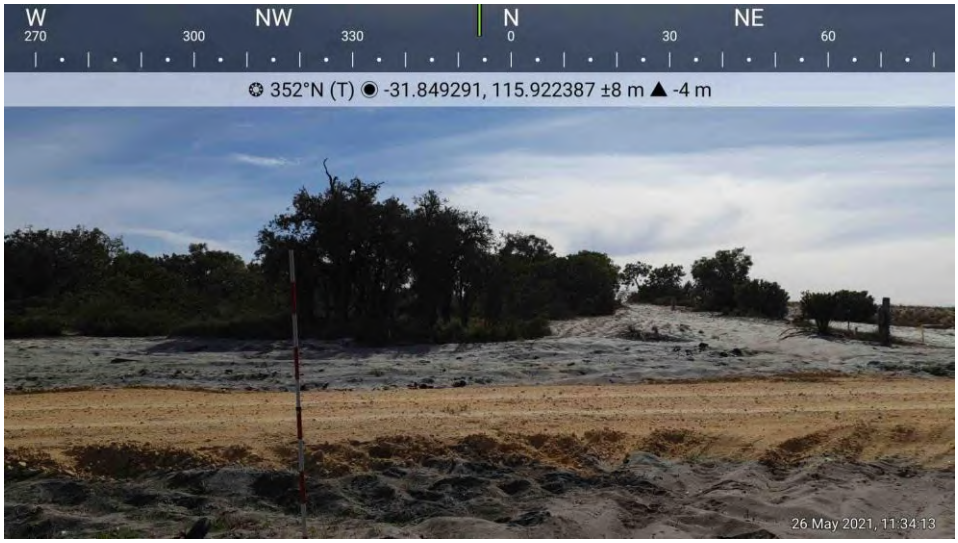


Photo ID: 3g

Plot number		Plot 3
Vegetation classification	Pre-development	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity

Photo ID: 4a

Photo ID: 4b

Photo ID: 4c

Plot number		Plot 4
Vegetation classification	Pre-development	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity

Photo ID: 4d

Photo ID: 4e

Plot number		Plot 4
Vegetation classification	Pre-development	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity

Photo ID: 5a

Plot number		Plot 5
Vegetation classification	Pre-development	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity

Photo ID: 6a

Photo ID: 6b

Plot number		Plot 6
Vegetation classification	Pre-development	Class A Forest
	Post-development	Class A Forest
Description / justification		Trees 10-30 m high at maturity, dominated by Eucalypts, multi-tiered structure comprising tall canopy layer, shrubby middle layer and grass/herb/sedge understorey

Photo ID: 7a

Plot number		Plot 7
Vegetation classification	Pre-development	Class A Forest
	Post-development	Class A Forest
Description / justification		Trees 10-30 m high at maturity, dominated by Eucalypts, multi-tiered structure comprising tall canopy layer, shrubby middle layer and grass/herb/sedge understorey

Photo ID: 8a

Plot number		Plot 8
Vegetation classification	Pre-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
	Post-development	Modified to non-vegetated (exclusion 2.2.3.2 [e]) and/or low threat (exclusion 2.2.3.2 [f]) state
Description / justification		Revegetated with low understorey species (<0.5 m high) and trees that will be between 10% - 30% canopy cover

Photo ID: 9a

Photo ID: 9b

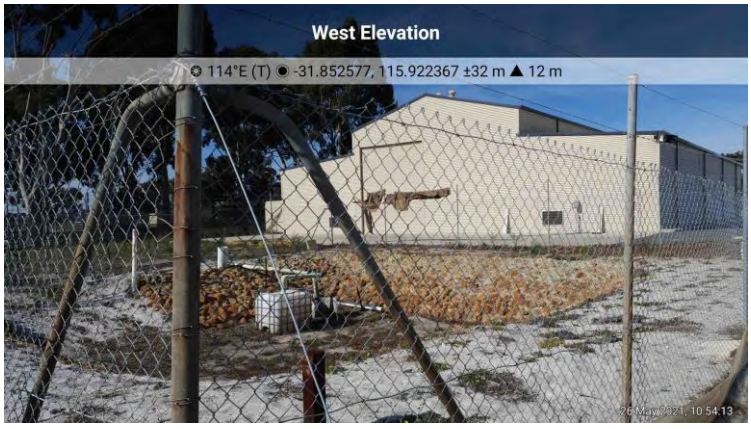


Photo ID: 9c

Plot number		Plot 8
Vegetation classification	Pre-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
	Post-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
Description / justification		Low threat cultivated gardens and maintained lawns within surrounding properties and non-vegetated areas including roads, footpaths, driveways and building footprints

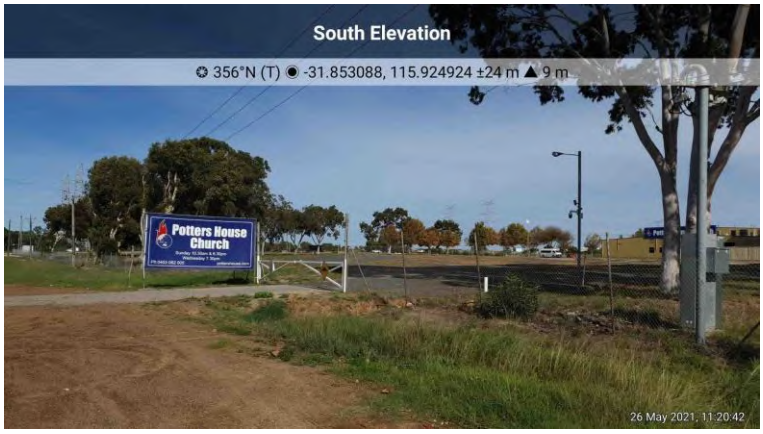


Photo ID: 9d

Photo ID: 9e

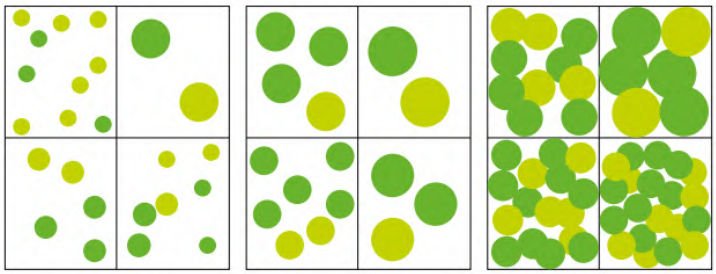
Photo ID: 8f

Plot number		Plot 8
Vegetation classification	Pre-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
	Post-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
Description / justification		Low threat cultivated gardens and maintained lawns within surrounding properties and non-vegetated areas including roads, footpaths, driveways and building footprints

Appendix 3: APZ standards (Schedule 1 of the Guidelines)

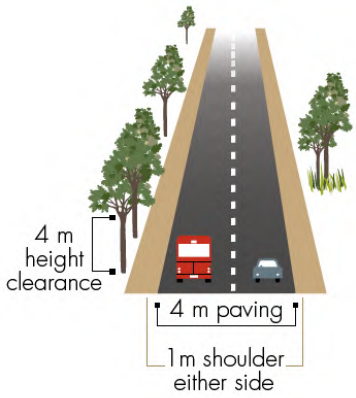
Schedule 1: Standards for Asset Protection Zones

- **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
- **Objects:** within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.
- **Fine Fuel load:** combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare.
- **Trees (> 5 metres in height):** trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.

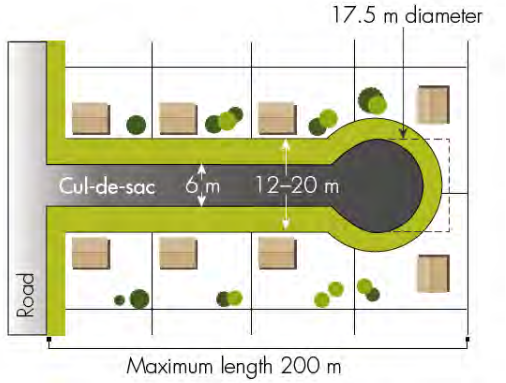


- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5 m^2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

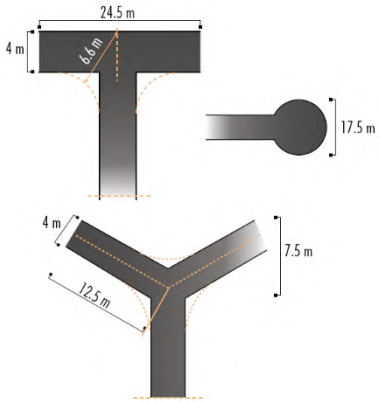
Appendix 4: Vehicular access technical standards of the Guidelines

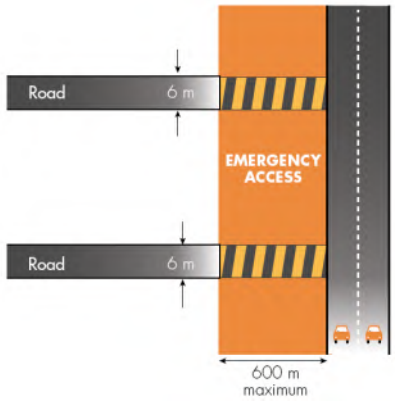
Public roads	
Acceptable solution A3.2	A public road is to meet the requirements in Table 1, Column 1.
Explanatory note E3.2	**Trafficable surface:** Widths quoted for access routes refer to the width of the trafficable surface. A six metre trafficable surface does not necessarily mean paving width. It could, for example, include four metre wide paving one metre wide constructed road shoulders. In special circumstances, where eight lots or less are being serviced, a public road with a minimum trafficable surface of four metres for a maximum distance of 90 metres may be provided subject to the approval of both the local government and Department of Fire and Emergency Services. **Public road design:** All roads should allow for two-way traffic to allow conventional two-wheel drive vehicles and fire appliances to travel safely on them. 

Cul-de-sac (including a dead-end road)	
Acceptable solution A3.3	A cul-de-sac and/ or a dead end road should be avoided in bushfire prone areas. Where no alternative exists (i.e. the lot layout already exists and/ or will need to be demonstrated by the proponent), the following requirements are to be achieved: • **Requirements in Table 1, Column 2** • **Maximum length:** 200 metres (if public emergency access is provided between cul-de-sac heads maximum length can be increased to 600 metres provided no more than eight lots are serviced and the emergency access way is no more than 600 metres) • **Turn-around area requirements**, including a minimum 17.5 metre diameter head.
Explanatory note E3.3	In bushfire prone areas, a cul-de-sac subdivision layout is not favoured because they do not provide access in different directions for residents. In some instances it may be possible to provide an emergency access way between cul-de-sac heads to a maximum distance of 600 metres, so as to achieve two-way access. Such links must be provided as right of ways or public access easements in

Cul-de-sac (including a dead-end road)	
	gross to ensure accessibility to the public and fire services during an emergency. A cul-de-sac in a bushfire prone area is to connect to a public road that allows for travel in two directions in order to address Acceptable Solution A3.1. 

Private driveway longer than 50 metres	
Acceptable solution A3.5	A private driveway is to meet all of the following requirements: • **Requirements in Table 1, Column 3** • **Required where a house site is more than 50 metres from a public road** • **Passing bays:** every 200 metres with a minimum length of 20 metres and a minimum width of two metres (i.e. the combined width of the passing bay and constructed private driveway to be a minimum six metres) • **Turn-around areas:** designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) and within 50 metres of a house • **Any bridges or culverts:** are able to support a minimum weight capacity of 15 tonnes • **All-weather surface (i.e. compacted gravel, limestone or sealed).**
Explanatory note E3.5	For a driveway shorter than 50 metres, fire appliances typically operate from the street frontage however where the distance exceeds 50 metres, then fire appliances will need to gain access along the driveway in order to defend the property during a bushfire. Where house sites are more than 50 metres from a public road, access to individual houses and turnaround areas should be available for both conventional two-wheel drive vehicles of residents and type 3.4 fire appliances. Turn-around areas should be located within 50 metres of a house. Passing bays should be available where driveways are longer than 200 metres and turn-around areas in driveways that are longer than 500 metres. Circular and loop driveway designs may also be considered. These criteria should be addressed through subdivision design. Passing bays should be provided at 200 metre intervals along private driveways to allow two-way traffic. The passing bays should be a minimum length of 20 metres, with the combined width of the passing bay and the access being a minimum of six metres. Turn-around areas should allow type 3.4 fire appliances to turn around safely (i.e. kerb to kerb 17.5 metres) and should be available at the house sites and at 500 metre intervals along the driveway.

Private driveway longer than 50 metres	
	

Emergency access way	
Acceptable solution A3.6	An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an emergency access way is to be provided as an alternative link to a public road during emergencies. An emergency access way is to meet all of the following requirements: • **Requirements in Table 1, Column 4** • **No further than 600 metres from a public road** • **Provided as right of way or public access easement in gross to ensure accessibility to the public and fire services during an emergency** • **Must be signposted.**
Explanatory note E3.6	An emergency access way is not a preferred option however may be used to link up with roads to allow alternative access and egress during emergencies where traffic flow designs do not allow for two-way access. Such access should be provided as a right-of-way or easement in gross to ensure accessibility to the public and fire emergency services during an emergency. The access should comply with minimum standards for a public road and should be signposted. Where gates are used to control traffic flow during non-emergency periods, these must not be locked. Emergency access ways are to be no longer than 600 metres and must be adequately signposted where they adjoin public roads. Where an emergency access way is constructed on private land, a right of way or easement in gross is to be established. 

Technical requirement	1	2	3	4	5
	Public road	Cul-de-sac	Private driveway longer than 50 m	Emergency access way	Fire service access routes
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal distance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 m	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius	8.5	8.5	8.5	8.5	8.5
* Refer to E3.2 Public roads: Trafficable surface					

Appendix 5: DFES Correspondence

Appendix 6: City of Swan Firebreak Notice