Bendigo Regional Employment Precinct: Transport Impact Assessment

This report provides a Transport Impact Assessment for the Bendigo Regional Employment Precinct, and accompanies the Infrastructure Strategy for the site.

Prepared for:
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Prepared by:
Lucy Farmer

Project/File:
304401654

Stantec Australia Pty Ltd

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Prepared by

Signature

Lucy Farmer

Printed Name

Reviewed by

Signature

Alex Blackett

Printed Name

Approved by

Signature

Alex Blackett

Printed Name

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1 Introduction

1.1 Background and Purpose

The City of Greater Bendigo (CoGB) has identified through the Greater Bendigo Industrial Land Development Strategy that their existing available undeveloped industrial land is expected to be exhausted in the next 5 years, and that there is a need for some additional 170ha of developable industrial land over the next 30 years.

As such, CoGB purchased 155ha of land in November 2021 within the 294-hectare Bendigo Regional Employment Precinct (BREP) that is located directly south of the Marong township and some 15km west of central Bendigo. The BREP is proposed to deliver a Regionally Significant Employment Precinct that harnesses diverse and long-term employment opportunities for new and existing businesses to the area with flow on benefits to the neighbouring Marong Township, Bendigo and the broader Loddon-Mallee region.

In November 2022, $6M in funding was announced by the Hon Jacinta Allan MP (now Premier) to deliver key infrastructure and planning for the BREP. The Victorian Planning Authority (VPA) has been authorised as the planning authority for the BREP by the Minister for Planning. CoGB has engaged the VPA to develop a Precinct Structure Plan and undertake rezoning of the BREP land.

Development Victoria (DV) has been engaged by the CoGB to prepare the following for the council owned land within the BREP:

1. An Infrastructure Strategy that identifies the infrastructure works needed to service the first stage of land release. This will form part of an overall cost-efficient servicing strategy for the total precinct.
2. A Development Strategy which outlines the investment attraction strategy, recommended commercial approach, delivery model, and funding/financial model.
3. A Business Case, which culminates from the preparation of the items above.

Stantec has been engaged by DV to prepare the BREP Infrastructure Strategy. This report provides a Transport Impact Assessment (TIA) for the BREP to help determine the transport infrastructure needed to enable it and design guidance on the internal transport arrangements to help inform its development. It should be noted that the scope of this report focuses on the internal and site access transport arrangements. It has utilised work being undertaken by others to understand what broader transport network development contributions will likely be associated with the BREP for consideration within the Infrastructure Strategy.

1.2 BREP Proposal

1.2.1 Concept Plan

The concept plan for the BREP is presented in Figure 1-1. This is preliminary in nature and subject to change but has been used as the basis for the preparation of this TIA.

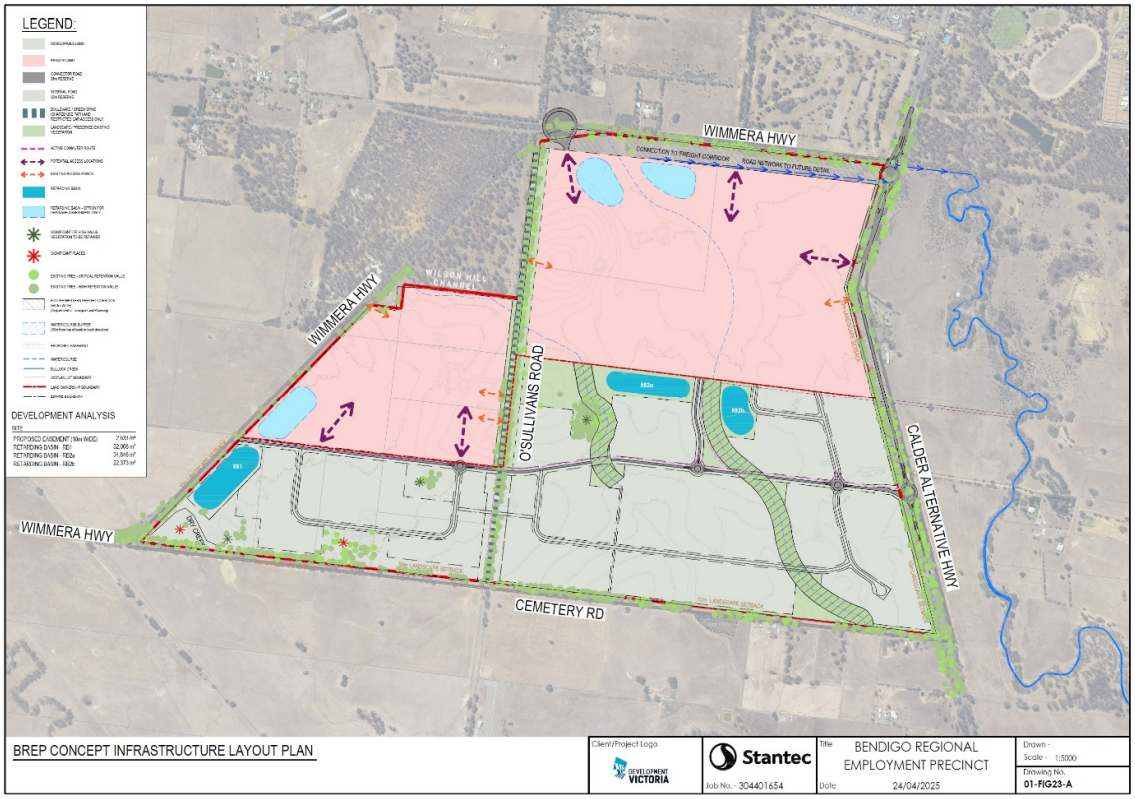

Figure 1-1: BREP Concept Plan

1.2.2 Land Use

The BREP proposal consists of a 293-hectare parcel of land generally bounded by Calder Alternative Highway to the east, Wimmera Highway to the north and west, and Cemetery Road to the south. Of the 293-hectares, the following development areas within the Concept Plan have been identified:

- Net Developable Area = 1,838,655m^2
- Building Floor Area = 735,462m^2

It is noted that the specific proportion of the Developable Area that will be covered by Buildings will be dependent on the eventual occupants, which are expected to be a mix of uses, similar to what we commonly find in Industrial Estates / Business Parks. These types of precincts typically have a 30% to 50% coverage of Building Floor Area to Net Developable Area.

As such, the above adopted Building Floor Area for the purposes of this Transport Impact Assessment has been based on an average of 40% Building Floor Area coverage of the Net Developable Area.

1.2.3 Transport Arrangements

The key transport elements that have been incorporated into the Concept Plan include the following:

- Three primary points of access to the site. These consist of two roundabouts located along the eastern site frontage (Calder Alternative Highway) and in the northwest corner (expected to integrate with the future Marong Western Freight Corridor). The third primary point of access is a give-way controlled intersection along the western site frontage (Wimmera Highway) that will support all turning movements, except for right-turns out of the site.
- Two secondary site access points have also been included, in the form of a left-in only access to the northern site frontage (Wimmera Highway) opposite Landry Lane, and a left-out only to the eastern site frontage (Calder Alternative Highway) just south of the Wimmera Highway.
- Land along the northern site frontage of the BREP is being put aside for the future proposed Marong Western Freight Corridor that will connect the Calder Highway to the northwest and the Calder Alternative Highway to the south of Marong.
- Internal connector roads will extend from each primary site access intersection and intersect at a proposed roundabout. Local roads providing property access come off the connector roads. Majority of the local and connector road intersections will be give-way controlled (priority given to the connector level roads), except the first intersections within the site from the northwestern and eastern site access intersections, which are proposed to be roundabouts.
- Active transport facilities are generally proposed along all the internal roads and landscape features through separated bicycle and pedestrian paths on the connector roads, and shared paths and/or footpaths on the local roads and landscape features.
- Bus services are anticipated to access the BREP. The specific alignment of routes and locations of stops have not been identified at this time by the responsible authority, Department of Transport and Planning (DTP). However, all the roads will be bus capable and the verges are sufficiently wide to accommodate bus stops.
- High Performance Freight Vehicle (HPFV) access will be provided. With the abutting arterial roads adopting a Level 3 classification under the Performance Bases Standards (PBS) Scheme[1], they are expected to accommodate for vehicles up to and including AB-Triple vehicle configurations. Moreover, given BREP's industrial use, the internal roads will support these vehicles through the site, as per the guidance provided in Table 4 of the DTP's Road Design Note 04-01 - Heavy Vehicle Network Access Considerations.

1.3 Marong Township Structure Plan

The Marong Township Structure Plan[2] is a long-term plan for future urban development of Marong as a satellite township of 8,000 people. The Plan establishes a vision and planning framework to enable the next 25 years' of growth that will be built around a vibrant community town centre and civic focus with a well serviced railway station and an outstanding public space network.

The Township Structure Plan refers to the BREP and that it could be expected of accommodate between 2,000 – 3,000 new jobs.

It also sets out the future movement and access approach to support the proposed Township development, which covers all modes of transport, including a freight network to support success to and from the BREP.

[1] Performance Based Standards (PBS) | NHVR
[2] Marong Township Structure Plan | City of Greater Bendigo

The future movement and access plan is reproduced in Figure 1-1, which doesn't specifically identify the BREP but does include the following transport elements that will influence its development:

- Two potential corridors for investigation of the Marong Western Freight Corridor that connects with the BREP (refer to Section 1.4 for further information).
- Primary Public Space Network extending along the Bullock Creek to the east of the BREP that will provide active transport users with a high quality trail.
- Secondary Public Space Network that goes through the BREP, with various connecting routes, such as along the Wimmera Highway, across the Calder Alternative Highway to the Bullock Creek, and along Landry Lane.
- Proposed connector road that is an extension of Salvarezza Road to the west that will connect with the Calder Alternative Highway / Wimmera Highway intersection.
- Roundabouts proposed at the Calder Alternative Highway / Wimmera Highway intersection and the Wimmera Highway / Landry Lane intersection.

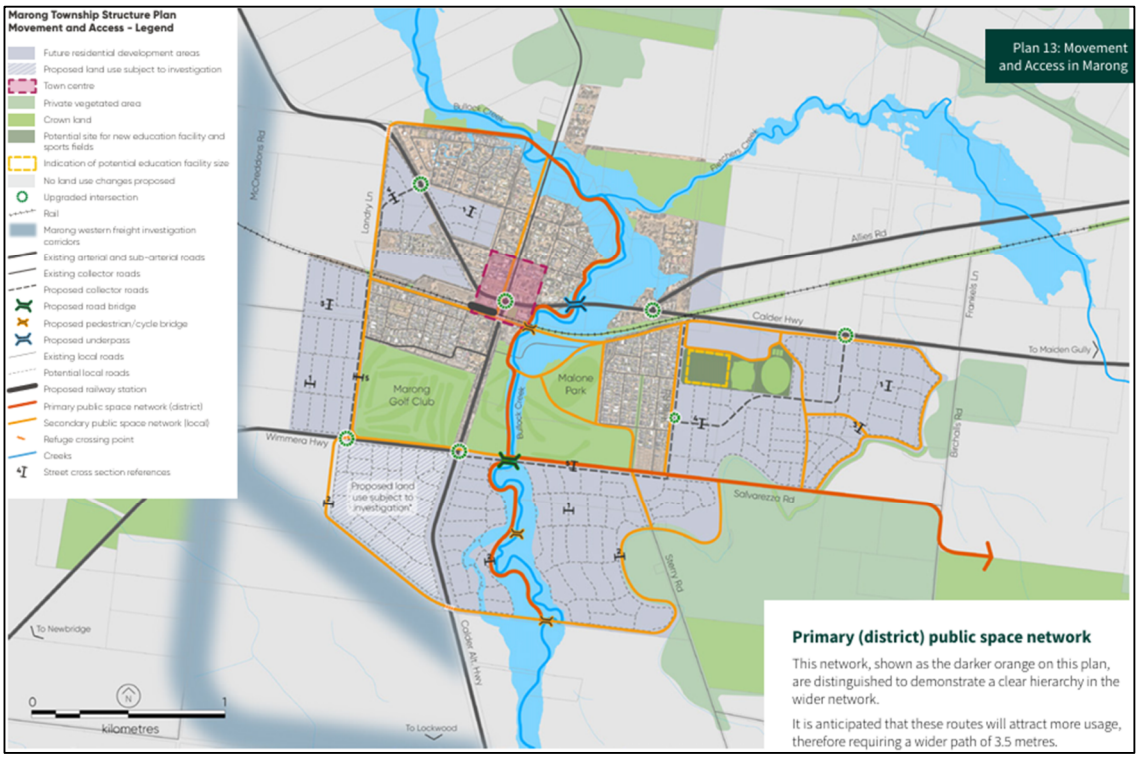

Figure 1-2: Marong Township Structure Plan – Movement and Access

It is also indicated in the Marong Township Structure Plan that a Development Contribution Framework (DCF) will be prepared that will provide information on the crucial infrastructure projects that are to be delivered and the associated funding arrangements and sources for them, including the above transport infrastructure items associated with the future movement and access plan presented in Figure 1-1.

A draft Marong DCF has been prepared by Council. Its general approach to the delivery of critical infrastructure for the Township has been applied to the BREP, with associated detail provided in Section 4.7.

1.4 Marong Western Freight Corridor

The Department of Transport and Planning (DTP) has been investigating options for the proposed alignment of the Marong Western Freight Corridor [3], which aims to link the Calder Highway northwest of Marong to the Calder Alternative Highway south of Marong, removing the need for heavy vehicles to go through the Marong Township via the implementation of a more efficient and safer alternative route. The preferred alignment uses a corridor adjacent to McCreddons Road and the Wimmera Highway, as shown in Figure 1-3.

Figure 1-3: Indicative Alignment for the Western Freight Corridor

[3] Marong Western Freight Corridor - Transport Victoria

Based on this Figure 1-3, the Marong Western Freight Corridor will go along the northern frontage of the BREP and have roundabout treatments at the Wimmera Highway / McCreddons Road / Wilsons Hill Road intersection and the Calder Alternative Highway / Wimmera Highway intersection. No roundabout intersection treatment is proposed at the Wimmera Highway / Landry Lane intersection.

While this project is still only in the planning stage, with preliminary design activities occurring, there is currently no commitment for the delivery of the Marong Western Freight Corridor. However, DTP has requested that land along the northern frontage of the BREP be set aside for it and that the proposed access arrangements for the BREP integrate with it, as discussed further in Sections 3.1 and 4.5.

1.5 References

In preparing this report, reference has been made to the following:

- Great Bendigo Planning Scheme
- Plans for the proposed development prepared by Stantec (Job No: 304401652, Drawing No: 01-FIG23-A, Dated: 24/04/2025)
- Department of Transport and Planning Technical Publications
- Transport surveys as referenced in the context of this report
- An inspection of the site and its surrounds
- Other documents as nominated.

2 Existing conditions

2.1 Location

The BREP site is located approximately 1.2km to the southwest of the Marong township. It is bordered by the Calder Alternative Highway to the east, the Wimmera Highway to the north and the west, and Cemetery Road to the south. The land is currently rural in nature.

The location of the site and the surrounding environs is shown in Figure 2-1.

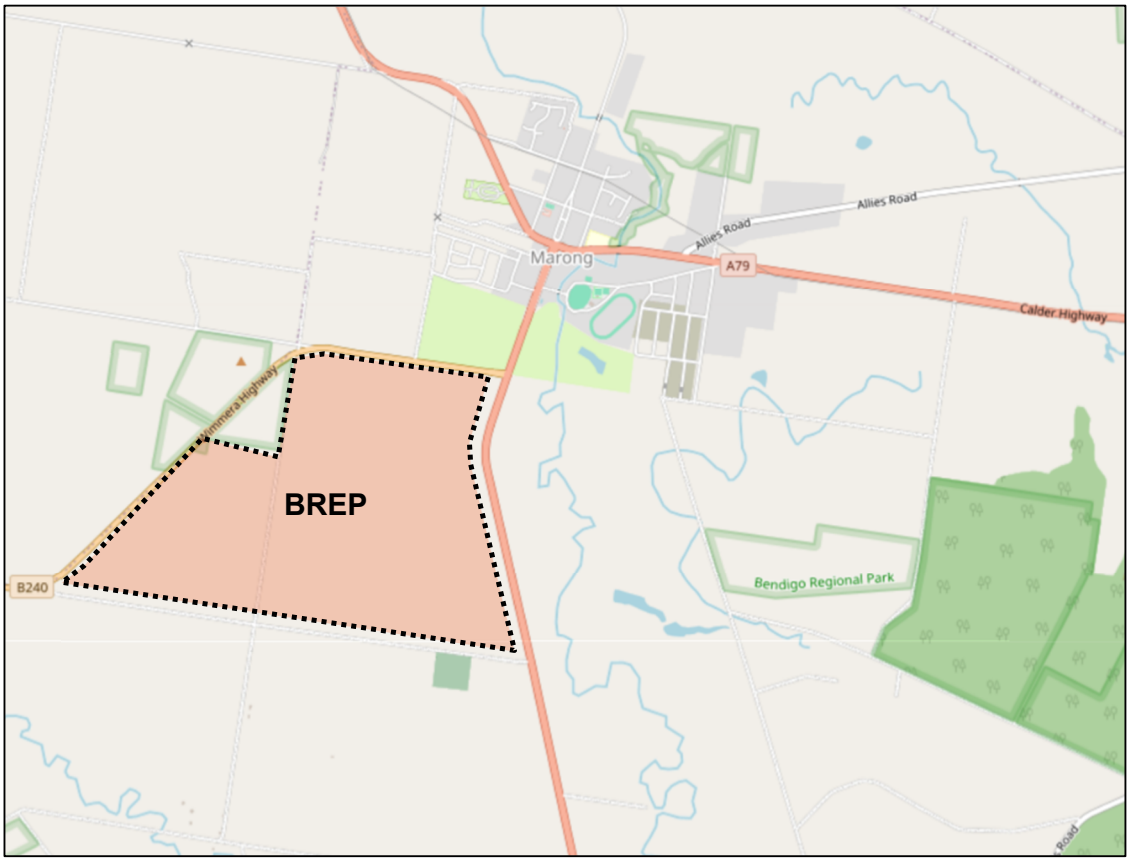

Figure 2-1: Subject Site and its Environs

2.2 Land Use

The site is located within a Farm Zone and is currently used for farming with a small number of residents. The surrounding properties are also generally located within a Farm Zone, exception for the Marong Township to the north that has a mix of Town Zone, Special Use Zone and Public Park and Recreational Zone.

From a transport perspective, the abutting arterial roads have a Transport Zone 2 – Principal Road Network classification.

The location of the site and the land zoning is shown in Figure 2-2.

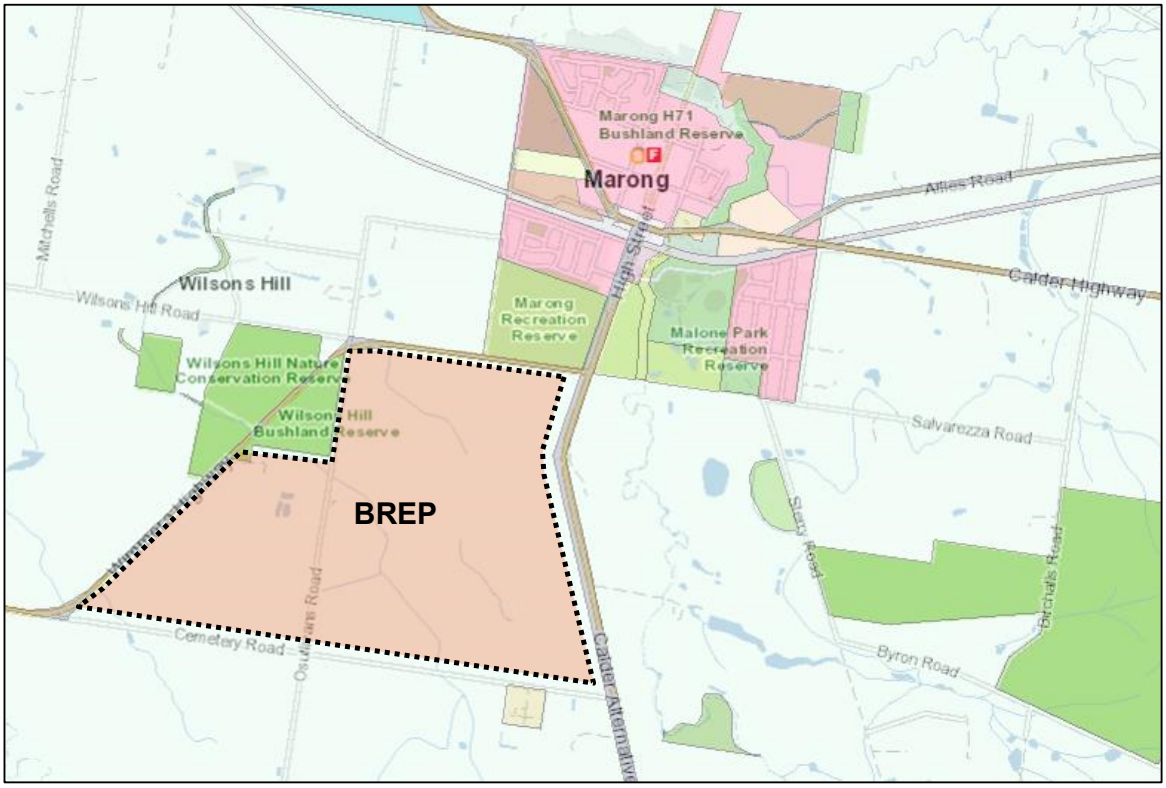

Figure 2-2: Subject Site and Land Zoning

2.3 Road network

2.3.1 Key local roads

The surrounding existing road network internal and external to the BREP are described in Table 2.1, which generally consist of two abutting arterial roads that form part of the HPFV network, and various local roads that are mostly unsealed providing access to farms and associated dwellings.

Table 2.1: Key Local Roads

Road name	Road classification	Authority	Heavy Vehicle Classification [1]	Alignment	Carriageway width	Road reserve width
Calder Alternative Highway	Highway	DTP	PBS-3 A-Triple	North-south	10.2 m	56 m
Wimmera Highway	Highway	DTP	PBS-3 A-Triple	East-west and Northeast-southwest	6.2 m	22 m
Cemetery Road	Local road	Council	N/A	East-west	Unsealed	22 m

Road name	Road classification	Authority	Heavy Vehicle Classification [1]	Alignment	Carriageway width	Road reserve width
O'Sullivans Road	Local road	Council	N/A	North-south	Unsealed	20 m
Landry Lane	Local road	Council	N/A	North-south	Unsealed	20 m
McCreddons Road	Local road	Council	N/A	North-south	Unsealed	21 m
Wilsons Hill Road	Local road	Council	N/A	East-west	3 m	18.5 m

[1] Performance Based Standards (PBS) | NHVR

2.3.2 Key intersections

The key intersections on the periphery of the BREP include:

- Calder Alternative Highway / Wimmera Highway (unsignalised T-intersection)
- Wimmera Highway / O'Sullivans Road / McCreddons Road / Wilsons Hill Road (two adjacent unsignalised X-intersection)
- Wimmera Highway / Landry Lane (unsignalised T-intersection)

2.3.3 Freight Network

Heavy vehicle network maps for Victoria can be viewed through the National Heavy Vehicle Regulator. These maps indicate the approved (full, partial, restricted, etc.) arterial roads for the various different heavy vehicle combinations permitted to use them.

In terms of the arterial roads abutting the BREP and the broader network in the area, AB Triple vehicle combinations are permitted to use them, as shown in Figure 2-3.

However, there is a 68.5T weight restriction for the Calder Highway bridge over the Loddon River in Bridgewater, which is under the maximum weight of 103T permitted for an AB Triple vehicle combination (aligns with the maximum weight of 63T for a B-Double vehicle combination).

This is the lowest weight restriction in the region along the Calder Highway and Calder Alternative Highway, but there are various others with 80T to 90T weight restrictions, including the Calder Highway bridges over the Campaspe River near Kyneton with 81T weight restrictions and the Calder Highway bridges over the Salty Creek in Macedon with an 88T weight restriction (generally align with the maximum weight of 83T permitted for an A Double vehicle combination).

These sort of weight restrictions are fairly wide spread across the Victorian road freight network, so it is not considered to be specific to the freight routes accessing Marong. Rather, it is a network wide issue that various associated State and Federal Government programs, such as the Infrastructure Investment Program, are trying to progressively resolve. In this regard, given the much lower existing weight restriction of 68.5T for the Calder Highway bridge over the Loddon River in Bridgewater, which forms part of a key interstate freight route, it is expected that it will become a committed project in the near future, especially given the planning for the BREP and Marong Western Freight Corridor.

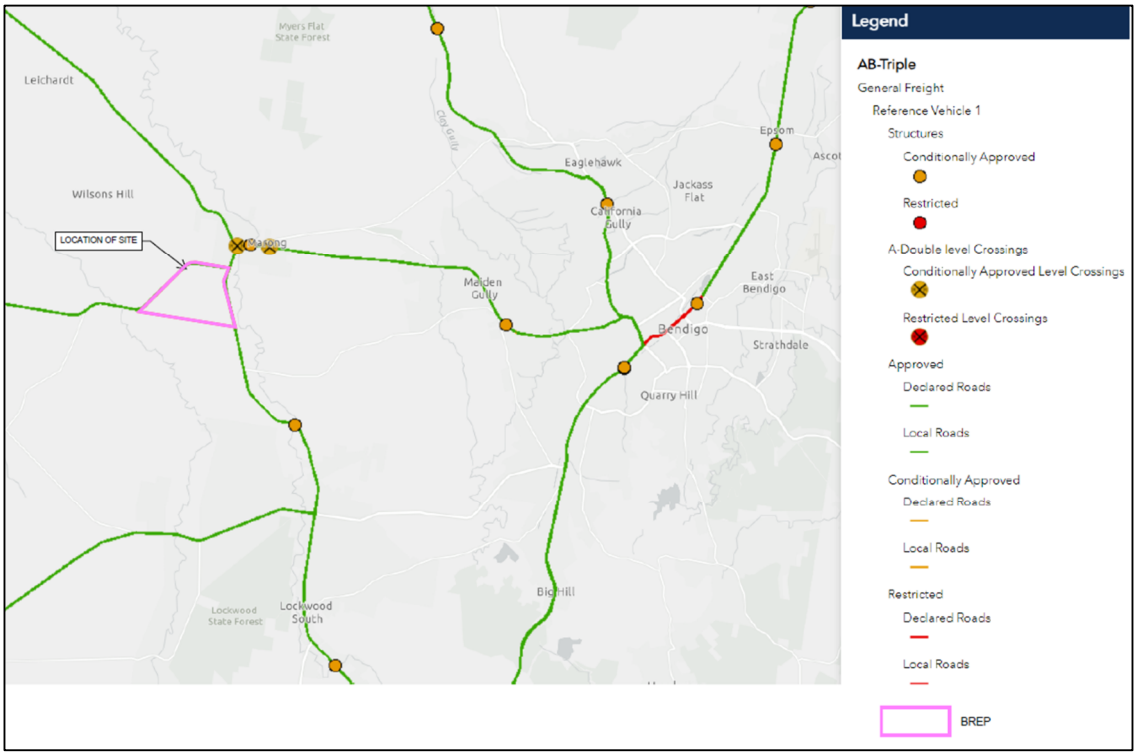

Figure 2-3: Heavy Vehicle Network Map

Source: Victoria's PBS Level 3A AB-Triple General Freight Network for Reference Vehicle 1

2.4 Traffic Volumes

Traffic surveys were conducted by the DTP in November 2023 at various locations across Marong to help inform transport modelling of the Marong Western Freight Corridor. The survey location most relevant to the BREP was at the Calder Alternative Highway / Wimmera Highway intersection, where peak hour turning movement counts were undertaken.

The AM and PM peak hour traffic volumes from this survey is presented in Figure 2-4 and Figure 2-5, respectively. It is also noted that a heavy vehicle percentage of 23% was recorded on the Calder Alternative Highway and 42% on the Wimmera Highway, which have been adopted throughout the analysis presented in this transport impact assessment.

These traffic volumes at the Calder Alternative Highway / Wimmera Highway intersection have been applied along the lengths of the Calder Alternative Highway and the Wimmera Highway that front the BREP. Their application along these roads is considered conservative as traffic volumes are understood to generally reduce as you move away from Marong, at least over their lengths fronting the BREP. However, they don't include any specific turning movements at any of the intersecting roads, such as Landry Lane, Wilsons Hill Road and McCreddon's Road. Turning movements at these intersecting roads has been accounted for in the SIDRA Intersection analysis presented in Section 4 through the application of a generic 10 vehicle movements per hour for each permitted movement we haven't identified a vehicle movement in Figure 2-4 and Figure 2-5.

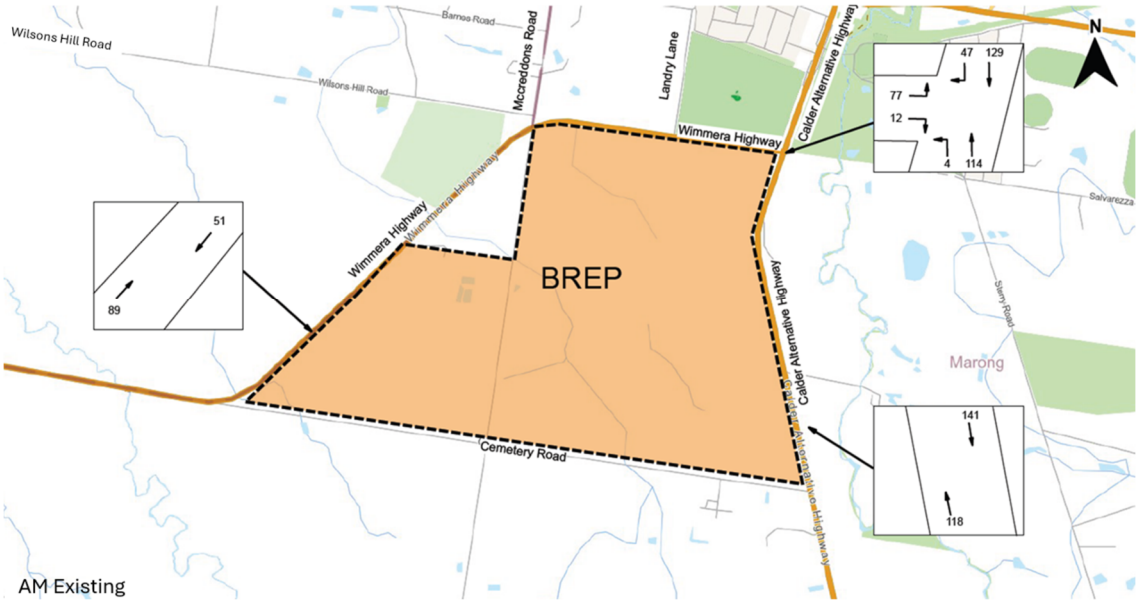

Figure 2-4: AM Peak Hour Traffic Volumes

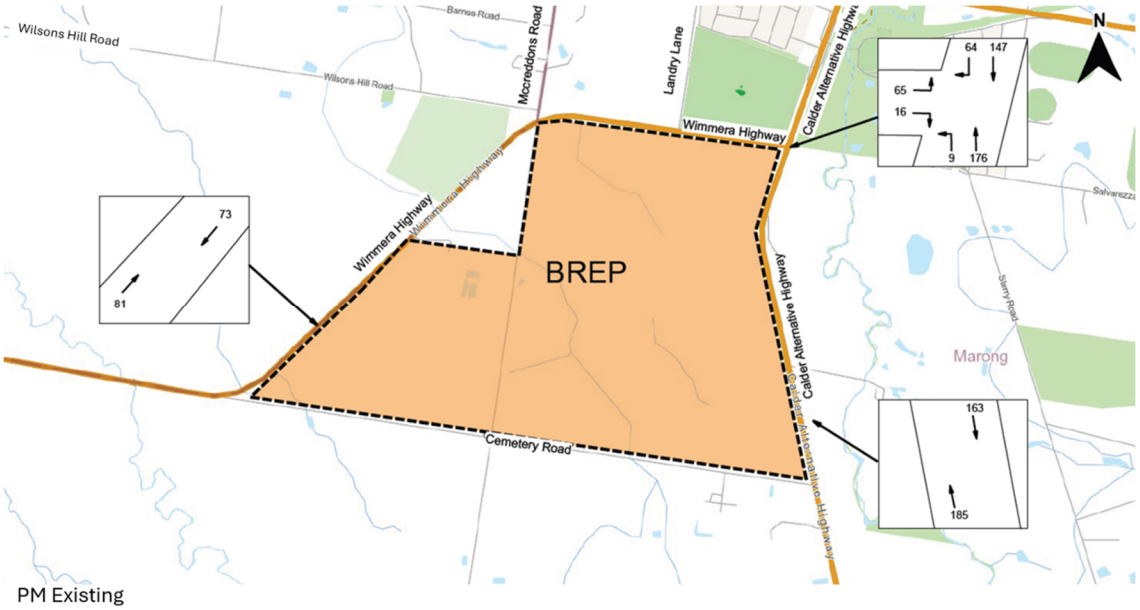

Figure 2-5: PM Peak Hour Traffic Volumes

2.5 Active Transport

2.5.1 Pedestrian

There are currently no pedestrian or bicycle facilities along the roads within, abutting or connecting the BREP given the area is currently rural in nature. There is some basic footpath infrastructure that exists in the Marong Township, especially in the retail core, around the primary school and within some of the more recent residential sub-divisions.

2.6 Public Transport

There are currently no public transport services that connect with the BREP.

However, within the Marong township there is a bus stop at the Calder Highway / Calder Alternative Highway intersection. Table 2.2 summarises the bus services and major destinations that can be reached from the Marong bus stop.

Table 2.2: Bus Routes

Route Name	Distance to Stop	Significant Destinations On Route	Frequency On/Off Peak
Bendigo – Boort via Wedderburn	1.4 km	Bendigo Railway Station	Once a week
Melbourne – Sea Lake via Charlton & Bendigo	1.4 km	Southern Cross Railway Station Bendigo Railway Station	Once a day, Monday to Friday
Melbourne – Swan Hill via Bendigo	1.4 km	Southern Cross Railway Station Bendigo Railway Station	Twice a day, Monday to Friday

In addition to the road based public transport, Bendigo rail station on the Bendigo, Echuca/Moama and Swan Hill lines is located approximately 17 kilometres from the BREP. There is a disused rail station in Marong, but there are no current commitments to re-establish any train services to this station.

2.7 Crash Statistics

In the five years to 9th December 2023, there were three crashes recorded on the road network surrounding the BREP site, as presented in Table 2.3. One of these crashes resulted in a fatality and a serious injury. One resulted in a serious injury, and the third resulted in another injury. All three crashes were single vehicle crashes where the vehicle came left off the carriageway into an object. There have not been any meaningful road safety improvements in the area since these three crashes in 2019 as far as we have been made aware of.

Table 2.3: Casualty Accident History

Severity	Date	Casualties	Location
Fatal	13/10/2019	1 fatality 1 serious injury	Wimmera Highway
Serious injury	09/10/2019	1 serious injury	Calder alternative Highway
Other injury	24/08/2019	2 other injury	Wimmera Highway

2.8 Movement and Place

Modal priorities are classified through the Movement and Place (M&P) Framework[4]. The M&P Framework recognises that streets not only keep people and goods moving, but they are also places for people to live, work, and enjoy. In this regard, road corridors and streets are defined by the context of the interfacing land use and assigned various 'movement' and 'place' classifications. This way of thinking implies that during planning and development of our transport network, we need to consider the needs for movement and placemaking simultaneously (i.e. providing suitable levels of access to places while making them attractive for people to spend time in).

The Department of Transport and Planning (DTP) provides the Movement and Place classification across the Victorian transport network through an online mapping portal. The provided M&P classifications represent the current long-term aspirations, rather than the existing conditions. They are regularly updated as part of typical transport network and land use planning activities, such as the development of the Marong Township Structure Plan and Marong Western Freight Corridor (associated updates to the currently available M&P classification are yet to occur but DTP has advised that they are expected in the near future).

The current M&P classifications for the links within and abutting the BREP are provided in Table 2.3.

Table 2.4: Movement and Place Classifications

Link	Walking	Cycling	General traffic	Freight	Bus	Movement	Place
Wimmera Highway	W3	N/A	GT3	F2	B4	M2	PA5
Calder Alternative Highway	W3	N/A	GT2	F1	N/A	M1	PA5
O'Sullivans Road	W4	N/A	GT5	N/A	N/A	M5	PA5
Cemetery Road	W5	N/A	GT5	N/A	N/A	M5	PA5

Table 2.3 indicates generally low classification for both movement and place functions, except for freight and general traffic on the Calder Alternative Highway and for freight on the Wimmera Highway. Most notable of these is the high freight classification (F1 and F2), which based on Table 3 of DTP's Road Design Note 04-01 - Heavy Vehicle Network Access Considerations, they should support Level 3 classification under the Performance Bases Standards (PBS) Scheme[1] and B-Triple heavy vehicle combinations (largest standard vehicle combination considered through the Movement and Place classifications).

It is also noted, that Table 4 of DTP's Road Design Note 04-01 - Heavy Vehicle Network Access Considerations provides the design and check vehicle types that should be adopted as part of road design, which for an industrial precinct is a B-double (PBS level 2) design vehicle and B-Triple (PBS level 3) check vehicle. The relevant table with the associated advice is provided in Table 2.5.

[4] Movement and Place in Victoria | vic.gov.au (www.vic.gov.au)

Table 2.5: DTP Heavy Vehicle Network Access Design Guidance

Intersecting road types[9]	Design Vehicle & Turn Radius	Check Vehicle & Turn Radius
Arterial to Arterial (Includes Freeways & interchanges)	PBS level 2 Radius 15m	PBS level 3 Radius 12.5m
Arterial to Collector (industrial)	PBS level 2 Radius 12.5m	PBS level 3 Radius 12.5m
Arterial to Collector (residential)	PBS level 1 Radius 12.5m	PBS level 2 Radius 12.5m
Collector to Collector (residential)	Single unit truck/bus Radius 12.5m	PBS level 1 Radius 15m
Collector to Collector (industrial)	PBS level 2 Radius 15m	PBS level 3 Radius 12.5m
Arterial/Collector/ Local to Local (residential)	Service vehicle (8.8m) Radius 9m	Single unit truck/bus Radius 12.5m
Arterial/Collector/ Local to Local (industrial)	PBS level 2 Radius 12.5m	PBS level 3 Radius 12.5m

Table 4: Minimum Intersection Requirements

3 Site Layout

3.1 Site Access Points

Primary Access Points

Three primary points of access to the site are proposed along the arterial road frontages of the BREP as follows:

- Calder Alternative Highway at a mid-block location, approximately two-thirds of the way along the BREP frontage towards Cemetery Road, in the form of a roundabout.
- The Wimmera Highway / Wilsons Hill Road / McCreddon's Road intersection, in the northern western corner of the site (expected to integrate with the future Marong Western Freight Corridor), in the form of a roundabout.
- Wimmera Highway at a mid-block location, approximately two-thirds of the way towards the southern boundary of the site, in the form of a given way controlled intersection that supports all turning movements except for right turns out of the site.

The first two of these primary access points are proposed to be in the form of roundabouts. The specific operational layout from a traffic perspective for these intersections is detailed in Section 4. However, they will also each include the following key design attributes:

- The size of the two roundabouts will be based on the proposed 80 km/h speed limit that DTP plans to introduce along the arterial roads fronting the site, which is a reduction from the 100 km/h speed limit that currently exists.
- Inclusion of reverse curves on the high-speed rural arterial road approaches (not required for the internal BREP roads connecting with the roundabouts).
- Circulating lane widths suitable to support High Performance Freight Vehicles (HPFV).
- Provision of active transport crossings through the splitter islands where vehicles speeds will be reduced in order to connect with the proposed Marong Township Public Space Network.

Various design matters with these two roundabouts are expected to be considered as part of subsequent design stages, noting that they have been included in the Concept Plan for the purposes of general spatial extent and identification of key design elements. Consideration will need to be given around their specific location, as there are meaningful implications associated with the realignment of the connecting arterial roads, impact on trees, utility conflicts and land acquisition requirements.

Secondary Access Points

Two secondary site access points have also been included, as follows:

- Left-in only access to the Wimmera Highway opposite Landry Lane
- Left-out only to the Calder Alternative Highway approx. 250m south of the land set aside for the future Marong Western Freight Corridor along the northern site frontage (Wimmera Highway).

Inclusion of these secondary site access points are supportive of the expected role and function of the Marong Western Freight Corridor, as outlined in Section 1.4, and the relatively short distances between the following three proposed roundabouts:

- The Wimmera Highway / McCreddons Road / Wilsons Hill Road / BREP access intersection
- The Calder Alternative Highway / Wimmera Highway intersection
- The Calder Alternative Highway / BREP access intersection.

Inclusion of these secondary site access points are expected to help support the main northwest traffic movement flow accessing the BREP (associated with Marong and Bendigo based employees), while not unduly impacting the priority movement function of the Marong Western Freight Corridor.

Moreover, these various proposed BREP access points provide flexibility in the staging of BREP itself, Marong Township transport infrastructure works and the Marong Western Freight Corridor, as the northwestern roundabout access point could be delivered separately (before or after) to the left-in and left-out secondary access points, and still provide a good level of access to the BREP in the interim as it gradually develops (most likely develop in a south to north direction that will be able to be supported initially by the Calder Alternative Highway primary access point).

3.2 Internal Road Network and Intersections

The internal road network for the BREP is proposed to generally consist of connector level roads that extend from each of the three primary access points, generally forming an upside-down T, with local roads coming off them to provide property access within the resulting blocks of developable land.

Majority of the local and connector road intersections will be give-way controlled (priority given to the connector level roads), except at the following locations where single lane roundabouts are proposed:

- Intersection of the north-south and east-west connector roads
- The first intersections within the site from the northwestern and eastern primary site access intersections
- Cross intersection along the east-west connector in the western portion.

Roundabouts are proposed at these locations within the BREP due to the relatively high through traffic volumes on the connector roads limiting the number of safe gaps in the traffic flow for drivers to use when turning out from the intersecting roads. Further consideration around their operational layout and requirements is included in Section 4.6.

Initial designs have been prepared for these internal roundabouts and included in the Concept Plan. They are based on an internal 50km/h speed environment and supporting road trains, with the purpose of the designs during the initial concept design development stage to provide the general spatial extent and identification of key design elements.

Subsequent design stages are expected to refine these designs further, including consideration of the specific design and checking vehicles for given movements at the roundabouts and other internal intersections. It is understood that there is a desire to support A-Triples to access the BREP, which is possible via the external road network based on Figure 2-3, but it is unclear at this early stage where these vehicle types are needed to be supported within the BREP.

3.3 Road Cross Sections

As indicated, the internal road network of the BREP consists of connector and local roads. Preliminary cross-sections of these two road types have been developed for general spatial understanding and are presented in the subsequent sections, including detail around the associated elements that will be refined as the BREP is designed in more detail.

3.3.1 Connector Street

The proposed 26m wide cross-section for the connector street within the BREP is presented in Figure 3-1 and the general associated elements discussed thereafter (noting these are preliminary in nature and have been used to inform spatial requirements at this stage, i.e. most space hungry scenario).

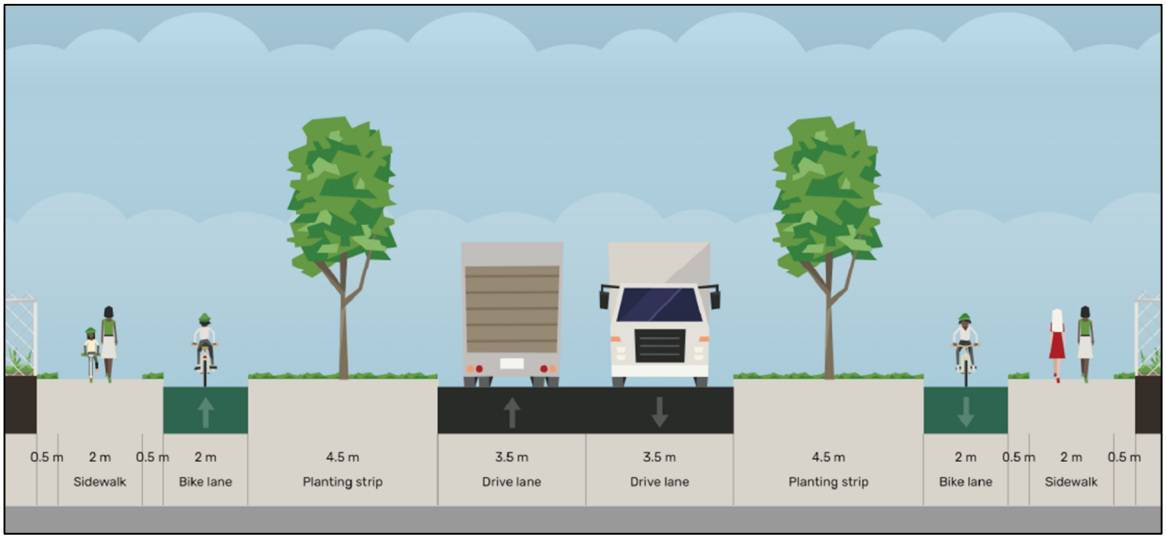

Figure 3-1: 26m Connector Street Cross-Section

No kerbside parking:

- Minimal access to lots from connector therefore no requirement for visitor street parking
- Allows for wider planting stirps:
  - » Increased urban cooling, reduced road surface
  - » Increased canopy, allowance for larger trees
  - » Increased ecological links
- Indented parking can be included where required or where a lot fronts the connector

Cycling lanes:

- Ideally cycle lanes are separated from pedestrian facilities, in direction and sides of the road
- Intersection turning movements are simpler when separated directions are provided
- Negatives in separating directions is that it requires 4m of total cycling lane width, compared with 3m for a bi-directional cycle path on one-side of the carriageway.

No internal median, except on approach to roundabouts:

- Prefer tree canopy is focused on providing shade and urban cooling for the pedestrian and cycling pathways
- Large central median with vegetation would be required to ensure sufficient canopy and remove clashes with truck heights.

Where direct lot access is provided, this should be limited:

- Not over the road sections between the arterial road access intersections and first internal intersections
- Not too close to any internal intersections
- Only on one side of the road, with consideration of right or left turn lanes through localized reduction of planting strip(s).

3.3.2 Local Street

The proposed 22m wide cross-section for the connector street within the BREP is presented in Figure 3-2 and the associated elements discussed thereafter (noting these are preliminary in nature and been used to inform spatial requirements at this stage, i.e. most space hungry scenario).

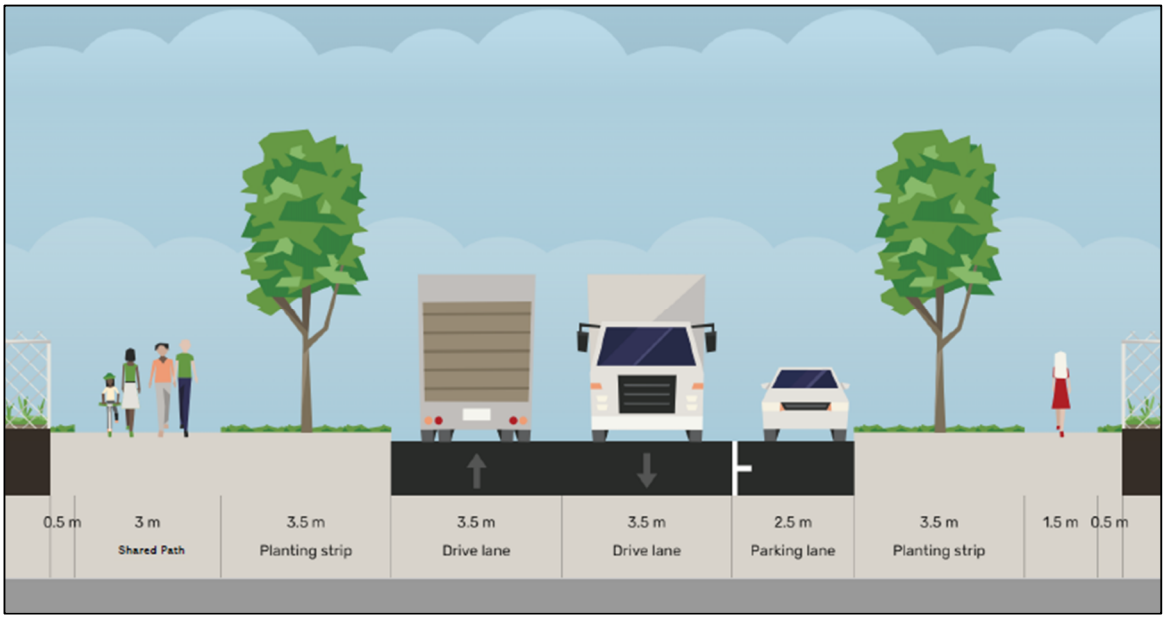

Figure 3-2: 22m Local Street Cross-Section

- One lane of parking is considered sufficient. We don't see street parking being well utilised in industrial estates as most parking provided on lot.
- Provision of a 3m shared path on one side to allow connection of commuter cyclists to each property.

3.4 Active Transport

Based on the proposed cross-sections for the internal roads, active transport facilities are generally proposed along all internal roads through separated bicycle and pedestrian paths on the connector roads, and a shared path on one side and a footpath on the other for the local roads. It is also noted that shared paths and/or footpaths are proposed along the landscape features throughout the BREP.

In totality and as shown in Figure 3-3, the active transport network across the BREP is holistic and will help enable access to all properties within it by the associated transport modes (as well as some potential recreational use).

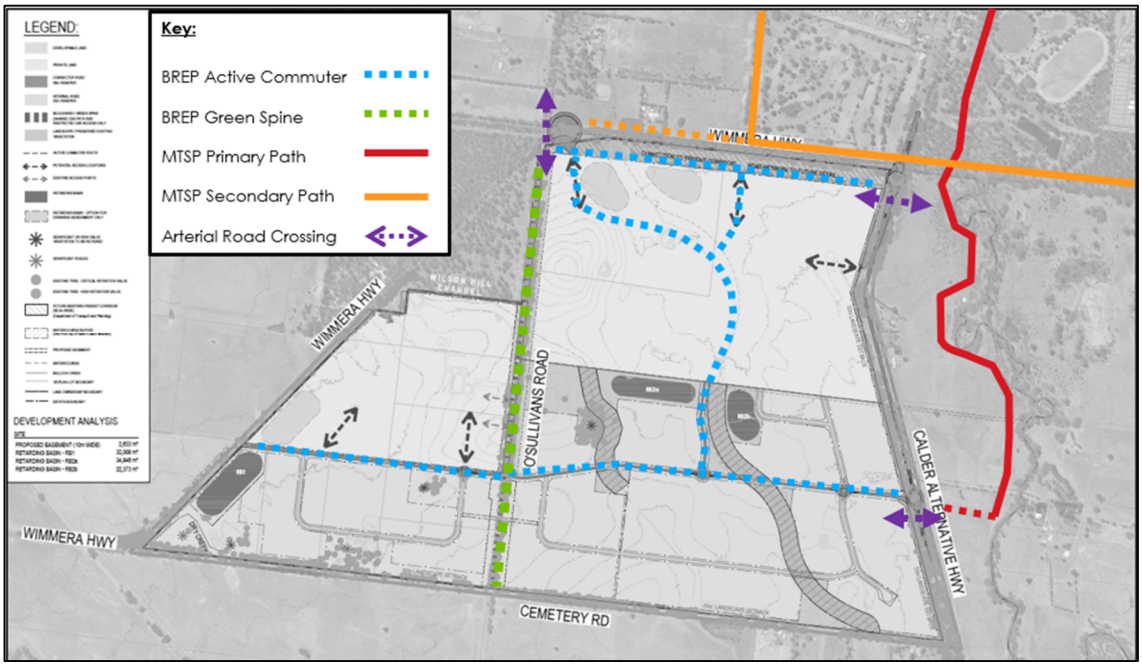

Figure 3-3: BREP Active Transport Plan

To ensure the active transport network supports the intended users, crossing facilities will be critical to connect the paths to residents in the Marong Township with the BREP. As such, suitable crossing facilities will be required, which will vary depending on the road type and associated vehicle volumes and speeds users will be navigating. Where possible the crossing treatments should align with Safe System principals (e.g. impact speeds of 30km/h or less).

Inclusion of active transport crossing facilities as part of the site access roundabout treatments was discussed in Section 3.1.

3.5 Public Transport

Bus services are anticipated to access the BREP to help connect residents in the Marong Township, Bendigo and other proximate residential areas. The specific alignment of routes and locations of stops within the BREP have not been identified at this time by the responsible authority (DTP). However, all the internal roads will be bus capable and the verges are sufficiently wide to accommodate bus stops.

4 Traffic Assessment

4.1 Trip generation

4.1.1 Land use based generation

Traffic generation rates for business parks and industrial estates are available through the RTA NSW Guide to Traffic Generating Developments, which is a widely adopted industry resource for this purpose. However, the surveys undertaken to inform this document were completed in 1994, and while the traffic generation characteristics of various land uses have not changed since then, industrial land uses have due to the various technology advances that have been reducing human labour requirements.

This reduction in employment numbers, and thus traffic generation rates, is reflected in the updated traffic surveys in 2013 of 11 business parks and industrial estates[5], with an almost halving of the previous general traffic generation rates from 1.1 to 0.56 vehicle trips in a peak hour per 100sqm of Gross Floor Area (GFA). Moreover, the 2013 survey results included a meaningful range in daily and peak hour generation rates, which are presented in Figure 4-1 and Figure 4-2, respectively.

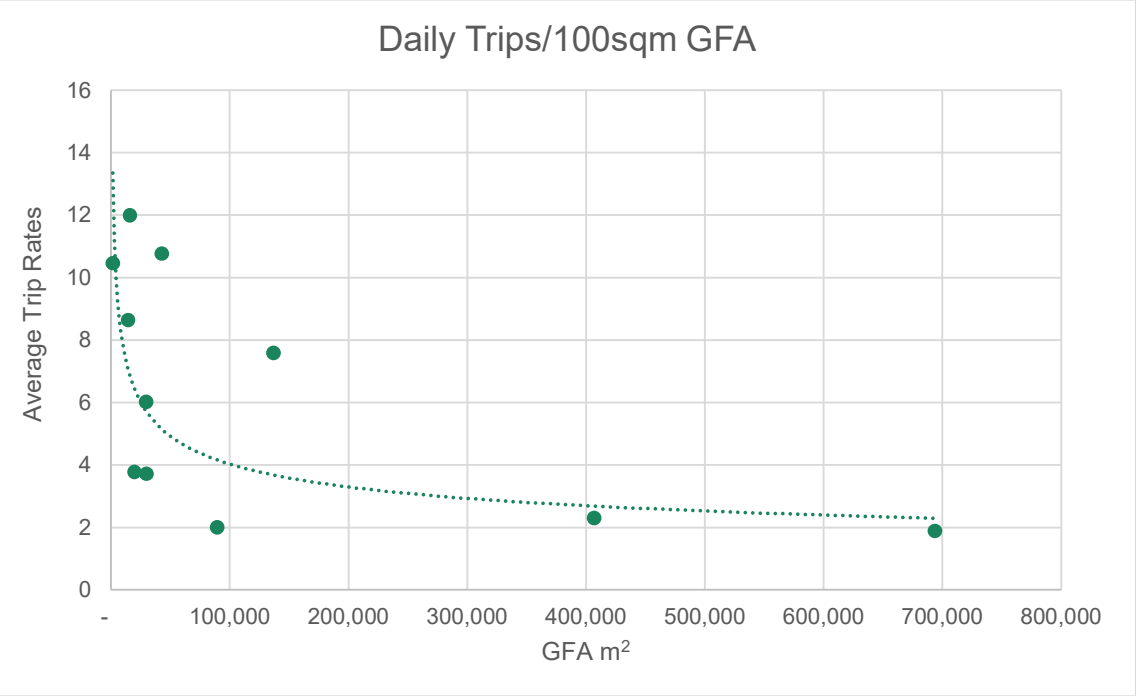

Figure 4-1: Daily Trip Rates for Surveys of Business Parks and Industrial Estates

[5] Guide to Traffic Generating Developments. Updated traffic ... preview / guide-to-traffic-generating-developments-updated-traffic.pdf / PDF4PRO

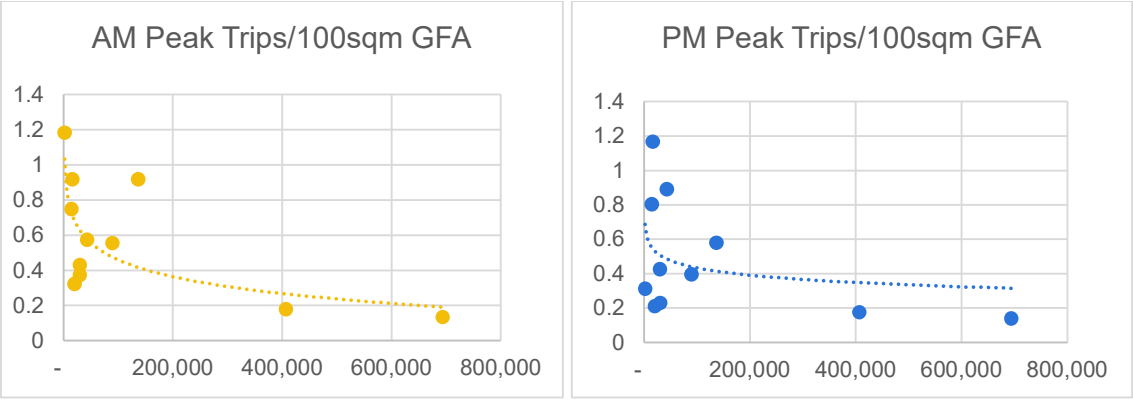

Figure 4-2: Peak Hour Trip Rates for Surveys of Business Parks and Industrial Estates

The analysis of the survey data for the 11 Business Parks and Industrial Estates presented in Figure 4-1 and Figure 4-2 clearly indicates that traffic generation rates tend to decrease as the overall precinct size increases. This trend is likely due to linked and internal trips between the various businesses of a Business Park/Industrial Estate. Given that BREP is expected to be larger than any of the surveyed areas (as set out in Section 1.2.2, it will be almost 75-hecture of GFA), it is considered reasonable to adopt traffic generation rates for the BREP that are towards the lower end of the range and near the generation rates recorded for the two largest surveyed sites (largest surveyed sites had 40 and 70 hectares of GFA).

The above reduction in traffic generation rates due to linked and internal trips as precincts increase in size is explained in Section 5.5.6 of the recently released Guide to Transport Impact Assessment (Transport for NSW, 2024). Moreover, this approach has been applied in this guide to various land use types, such as warehousing and shopping centres. Warehousing will likely form part of the eventual development mix within the BREP, but its specific proportion is not currently known, hence the adoption of the Business Park/Industrial Estate based traffic generation rates.

On this basis, it is proposed to adopt traffic generation rates for the BREP that are 50% of the average urban rates from the 2013 surveys of various Business Parks and Industrial Estates. The resulting rates would still place them higher than the trend lines in Figure 4-1 and Figure 4-2, and the two largest surveyed sites with peak hour traffic generation rates of 0.2 trips per 100sqm of GFA. As such, the proposed traffic generation rates are considered conservative on the high side, ensuring the assessment is robust.

Therefore, the proposed peak hour and daily traffic generation rates for the BREP are as follows:

- AM Peak Hour: 0.29 per 100m^2 of GFA
- PM Peak Hour: 0.24 per 100m^2 of GFA
- Daily: 3.15 per 100m^2 of GFA

In applying the above traffic generation rates to the 735,462m^2 of building area expected to be delivered as part of the BREP, the following peak hours and daily traffic demands:

- AM Peak Hour: 2,133 vehicles
- PM Peak Hour: 1,765 vehicles
- Daily: 23,167 vehicles

4.1.2 Employment based generation (from Strategic Modelling)

The DTP has conducted strategic transport modelling using the Victorian Integrated Transport Model (VITM) as part of the Western Freight Corridor planning study. The strategic modelling includes consideration of the BREP, and the other various development in and proximate the Marong Township.

Traffic generation numbers have been extracted from the VITM zone that relates to the BREP. Strategic modelling calculates the volume of external trips associated with each zone based on the forecast population numbers and mix within them. In terms of the BREP zone, a total of 6,000 jobs in 2046 have been included. This employment forecast for the BREP has been determined through previous analysis by others, which is anticipated to be made up of 3,000 direct and 3,000 indirect jobs.

The resulting traffic generation volumes have been reproduced in Table 4.1, which are 30% to 50% lower than those determined in Section 4.1.1.

Table 4.1: Employment-based traffic generation for BREP (VITM, 2046)

Time Period	Cars	Trucks	Total
AM Peak (8:15 – 9:15)	927	485	1,412
PM Peak (15:15 – 16:15)	948	463	1,411

4.1.3 Traffic generation discussion

The above two estimates for the traffic generation of the BREP differ by as much as 50% in the AM peak hour. This is not uncommon between these two methods of estimating traffic generation, noting the land use based generation relates to a full occupation and operation of the almost 75-hectures of GFA across the BREP, when the employment based generation relates to the likely number of jobs that will be accommodated within the BREP given its location and regional context.

As indicated in Section 4.1.1, the land use based generation is considered to be conservative on the high side given the overall scale of the BREP and associated reductions that tend to occur the larger they are. Moreover, if the trend lines set out in Section 4.1.1 where adopted at the ultimate size of the BREP, the traffic generation rates could potentially be 20% to 45% lower, essentially bringing them into line with the employment based generation from the VITM modelling.

For the purposes of site access and internal intersection design and modelling, as set out in this TIA, the higher land use based traffic generation numbers have been adopted, helping to ensure the site is able to support the peak traffic generation scenario for the site.

As to the use of either traffic generation method for other purposes than the site access and internal intersection design and modelling, it should be considered on a case-by-case basis. In terms of the more broader network modelling, such as for the Marong Western Freight Corridor, the employment-based generation is much more suitable, as it better considers and distributes linked trips between the various land uses proposed in and proximate Marong, as well as the gradual increase of broader background traffic and freight volumes over the coming decades.

This employment (and resident) based generation approach is also considered more suitable to inform what broader transport network infrastructure upgrades are required and any apportionments as part of the Marong Township Development Contribution Framework (DCF).

4.2 Vehicle Trip Distribution

The directional distribution and assignment of traffic generated by the proposed development will be influenced by a number of factors, including the following:

- Configuration of the arterial road network in the immediate vicinity of the site
- Existing intersection operations providing access between the local and arterial road network
- Likely distribution of employee's residences in relation to the site
- Configuration of access points to the site.

It is noted that no consideration has been given to potential (re)distribution of traffic associated with the Marong Western Freight Corridor, as this is a DTP based project. However, the proposed site access arrangements have been developed with the aim to align and ultimately integrate with it providing a significant contribution towards the proposed intersection arrangements at this location with the Marong Western Freight Corridor.

Having consideration to the above and for the purposes of estimating vehicle movements, the following directional distributions have been assumed for the three primary and two secondary points of access to the site, which is also diagrammatically shown in Figure 4-3:

- Calder Alternative (to/from north) = 80% (including 35% via the northwestern primary site access, 30% via the eastern primary site access and 15% via the left-in/left-out secondary access points)
- Calendar Alternative (to/from south) = 10%
- Wimmera Highway (to/from south) = 10%

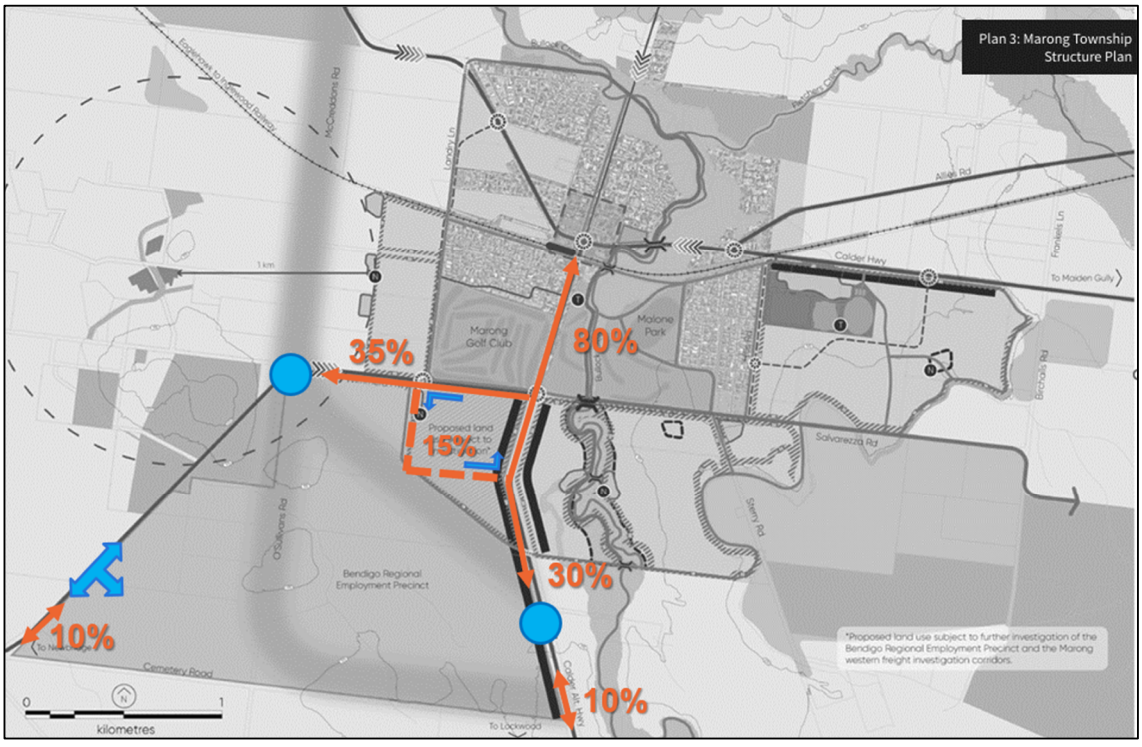

Figure 4-3: Vehicle Trip Distributions

In addition, the directional split of traffic (i.e. the ratio between the inbound and outbound traffic movements) has been assumed to be the following based on similar traffic generation studies:

- AM Peak Hour: 70% into the site, 30% out of the BREP
- PM Peak Hour: 30% into the site, 70% out of the BREP
- Daily: 50% into the site, 50% out of the BREP

Figure 4-4 and Figure 4-5 have been prepared to show the AM and PM peak hour turning movement volumes anticipated to be generated by the BREP at the primary and secondary points of access.

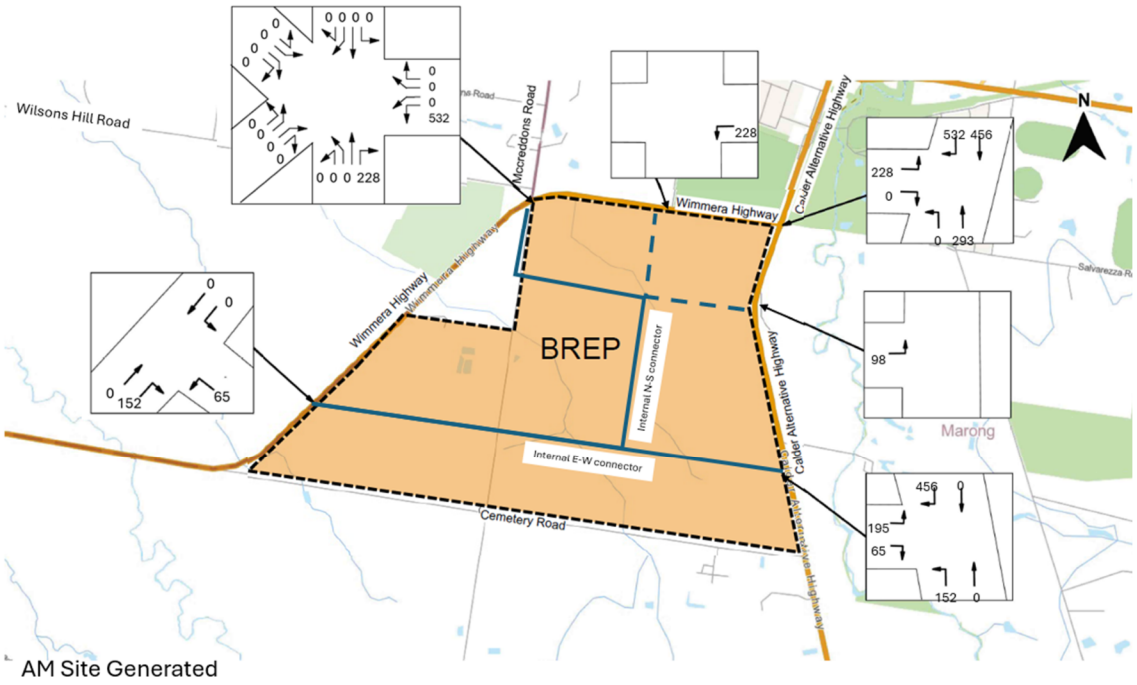

Figure 4-4: AM Peak Hour Site Generated Traffic Volumes

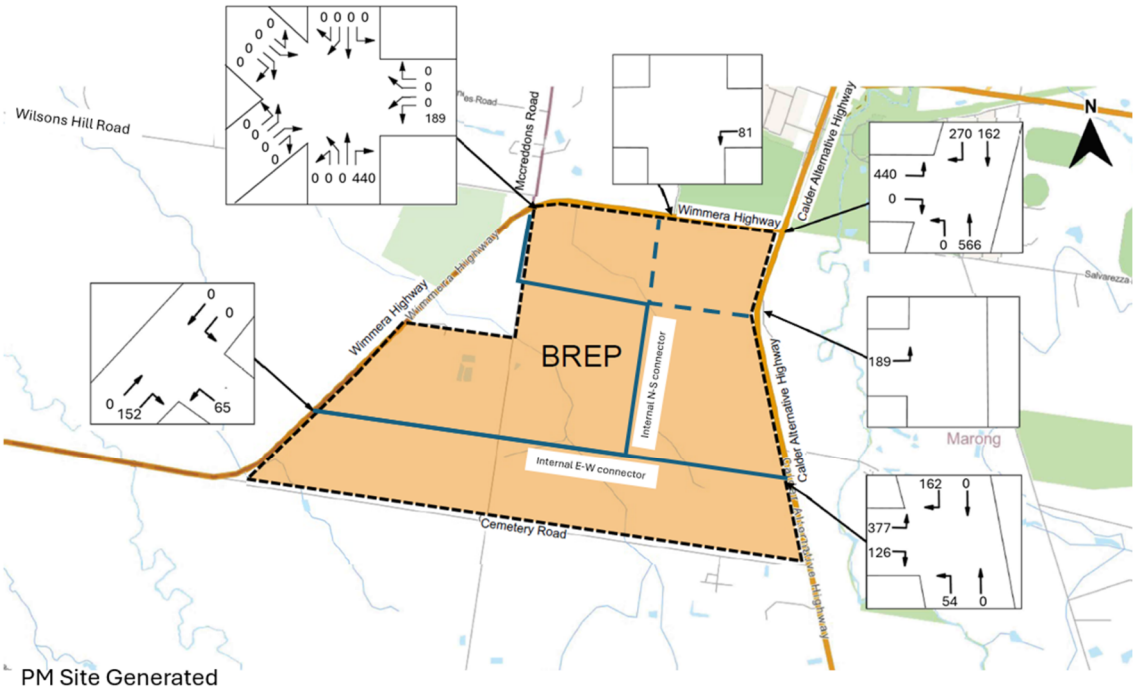

Figure 4-5: PM Peak Hour Site Generated Traffic Volumes

4.3 Background Traffic Growth

It is typical practice to take into account background traffic growth at new site access points and/or intersections as part of new developments. As such, the existing traffic volumes along the abutting arterial roads of the Calder Alternative Highway and the Wimmera Highway, where the BREP primary site access points are proposed, has been increased based on 10 years of background traffic growth.

The background traffic growth rate has been adopted from the modelling conducted by DTP for the Western Freight Corridor, applying the growth in through traffic from the Bendigo Integrated Transport Model (BITM). This corresponded to an average annual growth rate of 1.5% for the AM peak and 1.6% for the PM peak on the through movements along the arterial road network.

4.4 Future Traffic Volumes

Based on the above, Figure 4-6 and Figure 4-7 have been prepared to show the resulting future traffic movement volumes at the three primary site access intersections following full site development and +10 years background traffic growth.

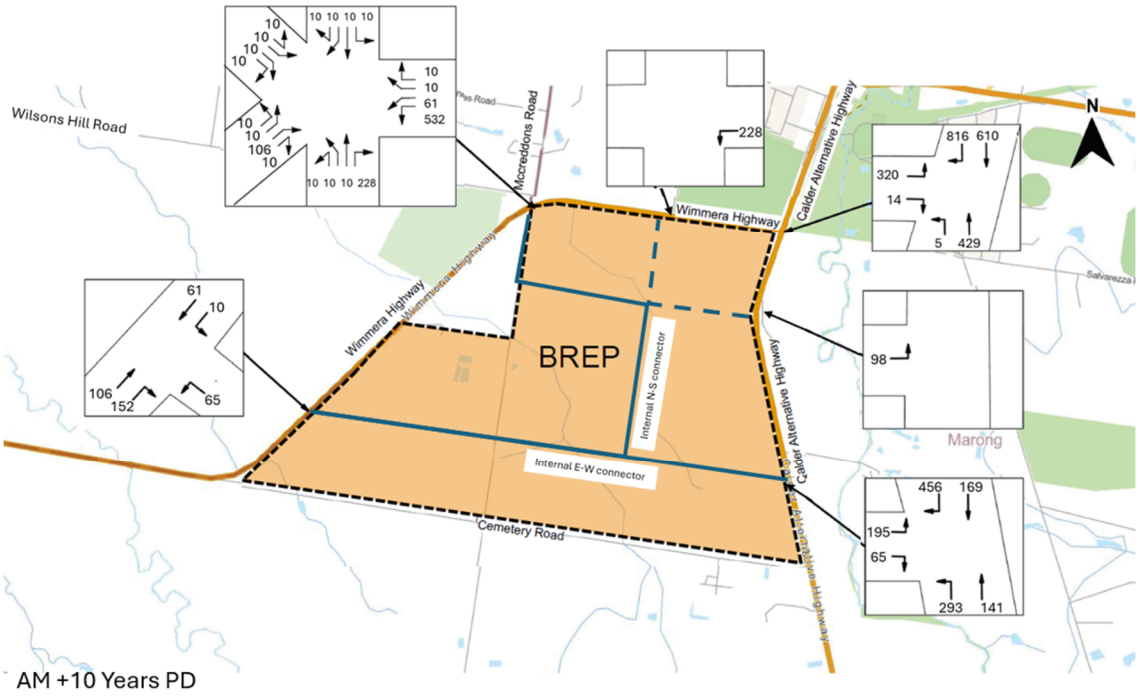

Figure 4-6: AM Peak Hour Post Development Traffic Volumes + 10yr

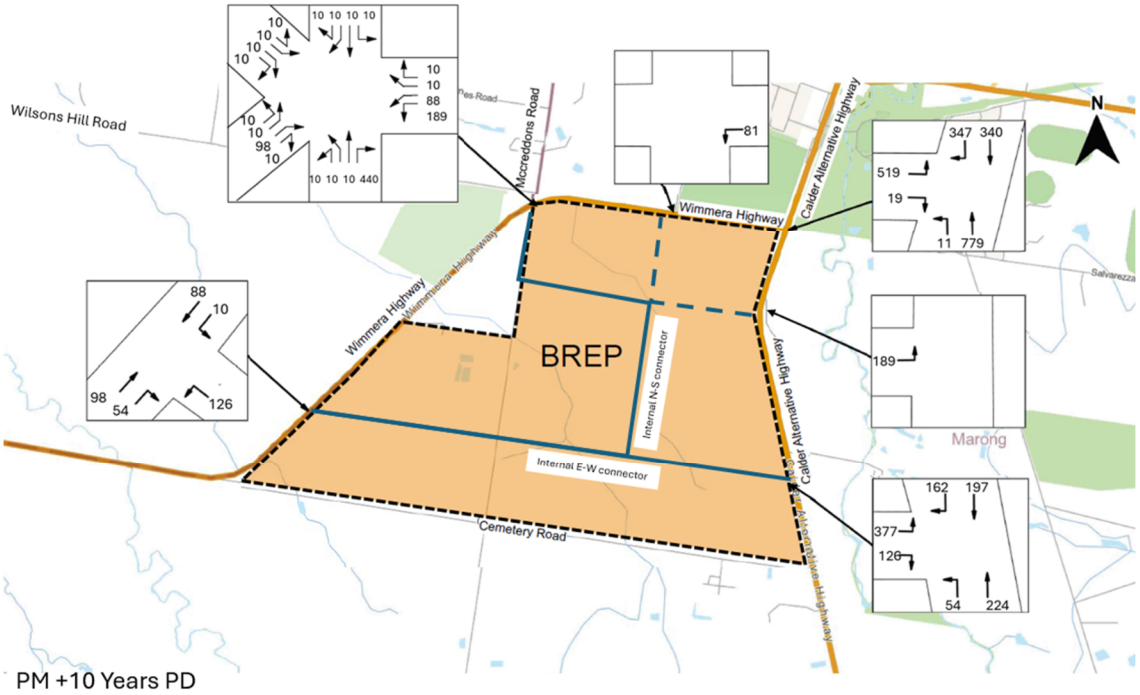

Figure 4-7: PM Peak Hour Post Development Traffic Volumes + 10yr

It is noted that a default value of 10 vehicle movements per hour has been applied to each permitted movement without an identified vehicle volume detailed in Section 4.5.2. This generally relates to the unsealed intersecting roads of Wilsons Hill Road and McCreddon's Road, but also any movements at the primary site access points that haven't been allocated a traffic volume. This is obviously conservative but helps account for any variability in the access routes people will take to/from the BREP.

It is also noted that a heavy vehicle percentage of 23% was applied to the Calder Alternative Highway and BREP movements, and 42% on the Wimmera Highway movements, which are based on the survey data presented in Section 2.4.

4.5 Site Access Layouts and Operations

4.5.1 Primary Site Access Layouts

SIDRA INTERSECTION 9.1 has been used to develop the required operational layouts of the three primary access points to support the future turning movement estimates presented in Figure 4-6 and Figure 4-7. The resulting operational layouts for each of the three primary access points is presented in Figure 4-8, Figure 4-9 and Figure 4-10, with a general description of their layouts provided after each.

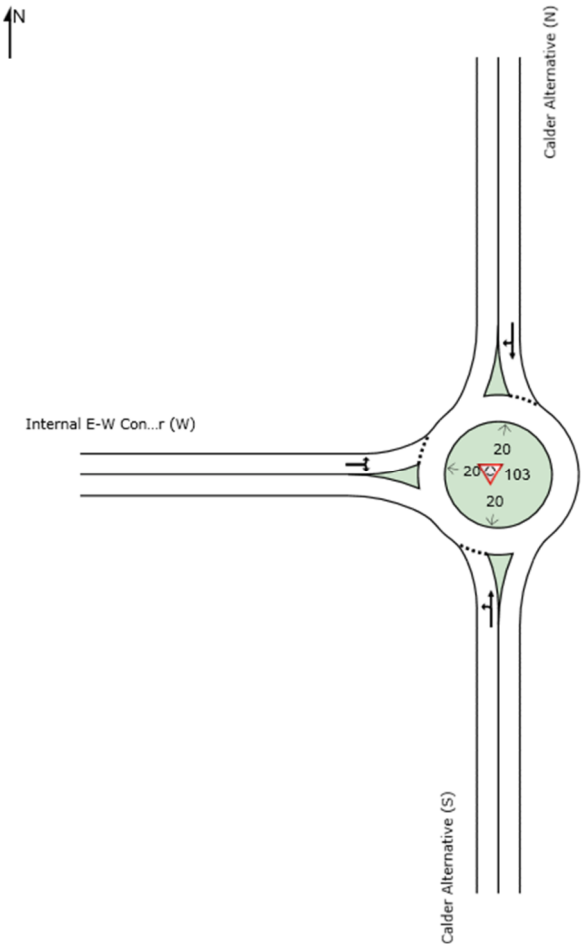

Figure 4-8: Eastern Primary Access - Calder Alternative Highway

The eastern primary access point at a mid-block location along the Calder Alternative Highway is a single lane roundabout. This is able to support the dominant right-turn movements into the BREP in the AM peak hour and left-turn movements out of the BREP in the PM peak hour peak.

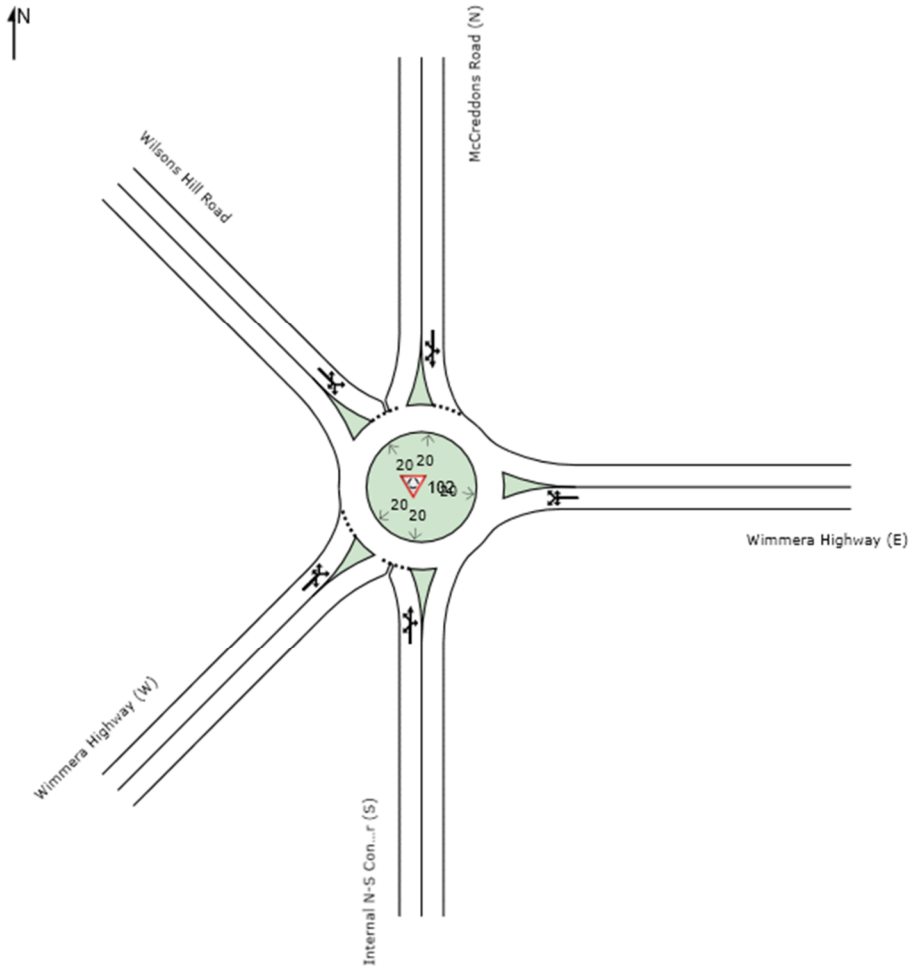

Figure 4-9: Northwestern Primary Access - Wimmera Highway

The northwestern primary access point that is proposed to connect into the Wimmera Highway / Wilsons Hill Road / McCreddon's Road intersection is a single lane roundabout. This is able to support the dominant left-turn movements into the BREP in the AM peak hour and right-turn movements out of the BREP in the PM peak hour peak.

Again, it is noted that this primary access point looks to align and ultimately integrate with future Marong Western Freight Corridor. Consideration of the associated traffic volumes that might result at this roundabout when the Marong Western Freight Corridor is implemented has not been considered as part of this analysis. However, it is intended that the location and general extent of the roundabout will align with and provide a significant contribution towards the proposed intersection arrangements at this location with the Marong Western Freight Corridor.

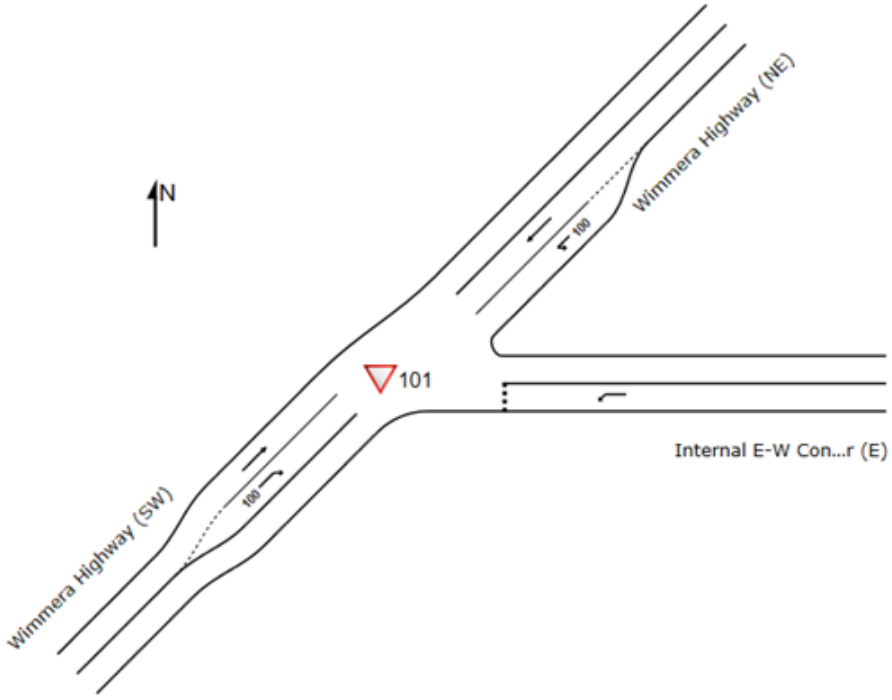

Figure 4-10: Western Primary Access - Wimmera Highway

The western primary access point at a mid-block location along the Wimmera Highway is anticipated to experience the lowest traffic volumes of the primary access points. As such, a give-way controlled intersection that prioritises movements along the Wimmera Highway, and supports left and right turns into the BREP and left out only turns from the BREP is considered suitable at this location to support accessing traffic volumes.

4.5.2 Primary Access Operations

Table 4.2 presents a summary of the anticipated future operation of the primary site access points using *SIDRA INTERSECTION 9.0* and based on the future traffic volumes presented in Figure 4-6 and Figure 4-7, and the operational layouts presented in Figure 4-8, Figure 4-10 and Figure 4-9.

Table 4.2: Site Access Intersections - Post-Development +10yr Operation

Peak Hour	Intersection	Degree of Saturation	Average Delay (sec)	LOS	95th Percentile Maximum Queue (m)
AM	Eastern Primary Access - Calder Alternative Highway	0.49	9.6	A	35
	Northwestern Primary Access - Wimmera Highway	0.43	8.0	A	11
	Western Primary Access - Wimmera Highway	0.15	3.9	A	6
PM	Eastern Primary Access - Calder Alternative Highway	0.50	8.2	A	32
	Northwestern Primary Access - Wimmera Highway	0.43	9.6	A	24
	Western Primary Access - Wimmera Highway	0.12	3.2	A	4

A Degree of Saturation (DOS) of around 0.95 for signalised intersections and 0.90 for unsignalised intersections has traditionally been considered the practical limit beyond which intersection performance is unsatisfactory, as beyond this value queues and delays increase disproportionately. On this criterion, the calculated DOS suggest that the primary site access intersections can be expected to operate satisfactorily following full development of the site and 10 years into the future.

4.5.3 Secondary Site Accesses

The secondary site access points are proposed to be separate left-in and left-out facilities. These essentially operate in a free-flow manner, with only the left-out being impacted by the availability of gaps in the adjacent traffic stream.

In this regard, the left-out onto the Calder Alternative Highway is expected to accommodate up to 185 vehicle movements in the PM peak hour. This averages out to just over 3 vehicles a minute, which as long as it is located beyond the queuing back from the Calder Alternative Highway / Wimmera Highway intersection, it is expected to be able to find a suitable number of opportunities in the adjacent traffic stream.

Given the proposed location of the left-out to Calder Alternative Highway is approx. 250m south of the future Marong Western Freight Corridor, it is expected to be well beyond any queuing back from the Calder Alternative Highway / Wimmera Highway intersection.

4.6 Internal Intersections

The internal intersections won't experience traffic volumes as high as the primary access intersections, as the traffic volumes will decrease as you move further away from them into the BREP with the vehicles dispersing across the internal network and accessing their associated destinations. Moreover, given the tidal nature of the peak hours there will be many opportunities in the opposing traffic stream to make right turns.

The internal intersections that are expected to experience the highest volume of turning vehicles is where the four internal roundabouts along the internal connector roads have been proposed. This provides these intersections with further assistance than give way control. However, only a single circulating lane is considered required for each.

4.7 Mitigating Measures and Intersection Works

It has been noted that there are various and somewhat interdependent development occurring across Marong and the wider region. As such, the BREP has focused on determining its internal and site access arrangements. Consideration of the need for the upgrade of other parts of the road network have not been considered within this TIA, as they require analysis of the broader network and implications of the various development proposals. Moreover, this is already being considered through other planning and development activities, such as the Marong Western Freight Corridor and Township Development Contribution Framework (DCF). The DCF is the most appropriate mechanism to consider the staging and help source relevant contributions for the broader transport network infrastructure upgrades needed to support the overall Townships anticipated growth and envisioned development.

Some of the broader transport network infrastructure upgrades that are expected to be considered as part of the Marong Township DCF includes the proposed roundabouts at the Calder Alternative Highway / Wimmera Highway intersection and the Calder Highway / Calder Alternative Highway intersection, potentially before the implementation of the Marong Western Freight Corridor (MWFC) that will redistribute traffic away from these two key Marong Township intersections.

Both these intersection upgrades are expected to be needed as part of the broader development of the Marong Township and increased background through vehicle movements on the various arterial roads, not just by the BREP.

In this regard, Table 4.3 has been prepared to summarise the contribution approach for the transport infrastructure required to support the site access arrangements of the BREP and those most relevant to the broader Marong Township, as taken from a draft version of the Marong Township DCF provided by Council and engagement with relevant authorities.

Table 4.3: BREP Transport Infrastructure Contributions

Item	Intersection	Proposed Treatment	Contribution Approach	Notes
1	Calder Alternative Highway / Internal E-W Connector (Primary Access)	Single lane roundabout	Directly related to and the responsibility of BREP with no shared use with other developments.	
2	Calder Alternative Highway / Internal Local Street (Secondary Access)	Left-out only	Directly related to and the responsibility of BREP with no shared use with other developments.	
3	Calder Alternative Highway / Wimmera Highway	Bypass Roundabout	Adjacent residential development precincts 2B/3 to upgrade to a single lane roundabout, with BREP contributing any additional capacity needed to support it.	Based on guidance taken from the draft Marong Township DCF.

			Any additional works associated with the MWFC will be DTP's responsibility.	
4	Wimmera Highway / Internal Local Street (Secondary Access)	Left-in only	Directly related to and the responsibility of BREP with no shared use with other developments.	Draft Marong Township DCF indicated a roundabout would be located here. DTP does not support a roundabout, only left-in / left-out treatments.
5	Wimmera Highway / Internal N-S Connector (Primary Access)	Bypass Roundabout	BREP responsible for minimum required roundabout layout to support is access, which is a single lane roundabout. Any additional works associated with the MWFC will be DTP's responsibility.	
6	Wimmera Highway / Internal E-W Connector (Primary Access)	Give-way controlled T-intersection	Directly related to and the responsibility of BREP with no shared use with other developments.	
7	Calder Highway / Calder Alternative Highway	Signalised Intersection	Council has advised that BREP is not expected to contribute towards its upgrade. Any departure from this position would likely require further analysis to suitably apportion the costs associated with the proposed intersection upgrade works.	Based on guidance taken from the draft Marong Township DCF.

While Table 4.3 summarises the contribution approach for various transport infrastructure needed to support the BREP and Marong Township, it does not indicate the specific apportionments and costs for shared intersection works, such as with Item 3 in Table 4.3.

To determine this, further investigations and analysis that goes beyond the scope of this report is required. These further investigations and analysis are recommended to be the following:

- Strategic transport modelling to determine the future traffic volumes associated with the various development scenarios and identify the associated proportion from each development precinct.
- SIDRA modelling to determine the associated layouts for the interim / ultimate transport infrastructure arrangements.
- Preparation of concept designs and costings for the interim / ultimate transport infrastructure arrangements.

5 Conclusion

Based on the analysis and discussions presented within this report, the following conclusions are made:

- The BREP is expected to provide 187-hecture of developable industrial land, which represents 110% of the developable industrial land needs for all of Greater Bendigo over the next 30 years.
- The BREP is expected to generate 2,133 vehicles in the AM peak hour and 1,765 vehicles in the PM peak hour. This level of traffic volumes is not expected to be achieved until the BREP is fully built out, which given the rate of industrial land growth needed across Greater Bendigo will be in a number of decades.
- Allowance has been made along the northern site frontage of the BREP for the future proposed Marong Western Freight Corridor.
- The two proposed roundabouts, give-way controlled T-intersection and two left-in or left-out access points to the arterial road frontages of the BREP are expected to be able to suitably support the future traffic volumes expected to access it. These proposed access arrangements are also proposed to help integrate with the future Marong Western Freight Corridor and provide a level of flexibility in the likely gradual and staged delivery of the BREP and surrounding road network.
- The internal road network is proposed to consist of 26m wide connector streets that extend from each primary site access intersection, through the BREP and connecting via two roundabouts at each end of the north-south connector. There are also 22m wide local streets that come off the connector roads, mostly via give-way controlled intersections but also roundabouts at X-intersections. Collectively, the internal road network and cross-sectional features are considered suitable and able to support vehicles (including freight), active travel users and public transport services.
- High Performance Freight Vehicle (HPFV) access will be provided through the abutting arterial roads that are approved to support up to and including AB-Triple vehicle configurations.

Stantec

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