Strategic Transport Modelling Assessment Report

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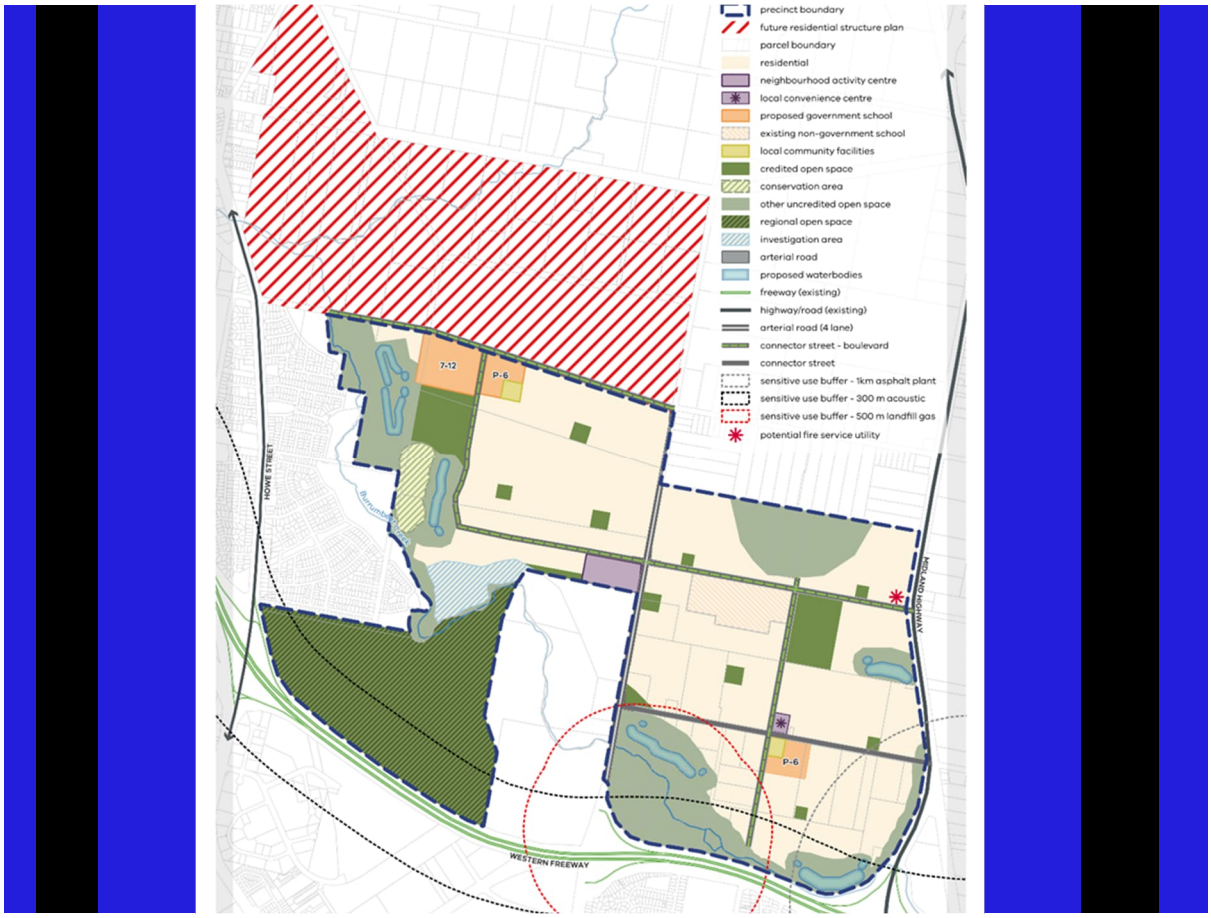
Victorian Planning Authority
N/A

Ballarat North PSP - Transport Modelling Assessment
11 July 2025



Strategic Transport Modelling Assessment Report

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Executive summary

The Victorian Planning Authority (VPA) is currently developing the Ballarat North Precinct Structure Plan (PSP). Jacobs has been engaged by the VPA to undertake an assessment of the proposed future transport network for the Ballarat North PSP. The Project involves preparing a Strategic Transport Modelling Assessment to examine traffic impacts of the proposed development of the PSP and understand future transport planning requirements. It includes a review of the validation of the Ballarat Link Road model and the development of a 2051 project-specific model. The adoption of the Ballarat Link Road model ensured the latest inputs from that study were incorporated into this study.

The 2051 Project Case model includes the latest proposed land use and transport networks for the Ballarat North PSP. Overall, the full development scenario (core + expanded area) includes 26,600 residents, 980 jobs and 4,700 school enrolments.

This report details the results of the 2051 Project Case model runs. The strategic transport modelling assessment shows that the proposed road network within the PSP will be appropriate for the projected traffic volumes. In addition, accessible bus routes (within 400m of houses) have been considered which provide connectivity through the PSP and connect to the two closest rail stations (Wendouree and Ballarat).

External to the PSP, the crossings of the Western Freeway are forecast to be at or approaching capacity during the AM and PM peak periods and will require further investigation with the Department of Transport and Planning.

Important note about this report

The primary purpose of this report and the associated services performed by Jacobs is primarily to document the assumptions used in the development of the VITM 2051 Project Case and the model outputs for the Ballarat North PSP in accordance with the scope of services set out in the contract between Jacobs and the VPA (the Client).

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate, or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client, as available in the public domain at the time or times outlined in this report and from industry and business operator contacts as set out in the report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the Project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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Acronyms and abbreviations

BWEZ	Ballarat West Employment Zone
BLR	Ballarat Link Road
DTP	Department of Transport and Planning
ITAR	Integrated Transport Assessment Report
LGA	Local Government Area
PSP	Precinct Structure Plan
SALUP	Small Area Land Use Projection
STMA	Strategic Transport Modelling Assessment
VITM	Victorian Integrated Transport Model
V/C	Volume Capacity
VPA	Victorian Planning Authority
VPD	Vehicles Per Day

1. Introduction

1.1 Background

The Victorian Planning Authority (VPA) is currently developing the Ballarat North Precinct Structure Plan (PSP). Jacobs has been engaged by the VPA to undertake an assessment of the proposed future transport network for the Ballarat North PSP.

The Ballarat North PSP area has been rezoned to the Urban Growth Zone (UGZ). However, no immediate urban development can take place until a PSP and Developer Contribution Plan have been finalised and implemented into the Ballarat Planning Scheme. An area to the north of the PSP (north of Cummins Road), will remain in the farming zone until additional greenfield land is needed at which time a PSP will be prepared. To ensure that the appropriate infrastructure and services are provided for the entire northern growth area, it is noted that some technical work prepared for the Ballarat North PSP has considered the additional area to enable it to be 'future-proofed'.

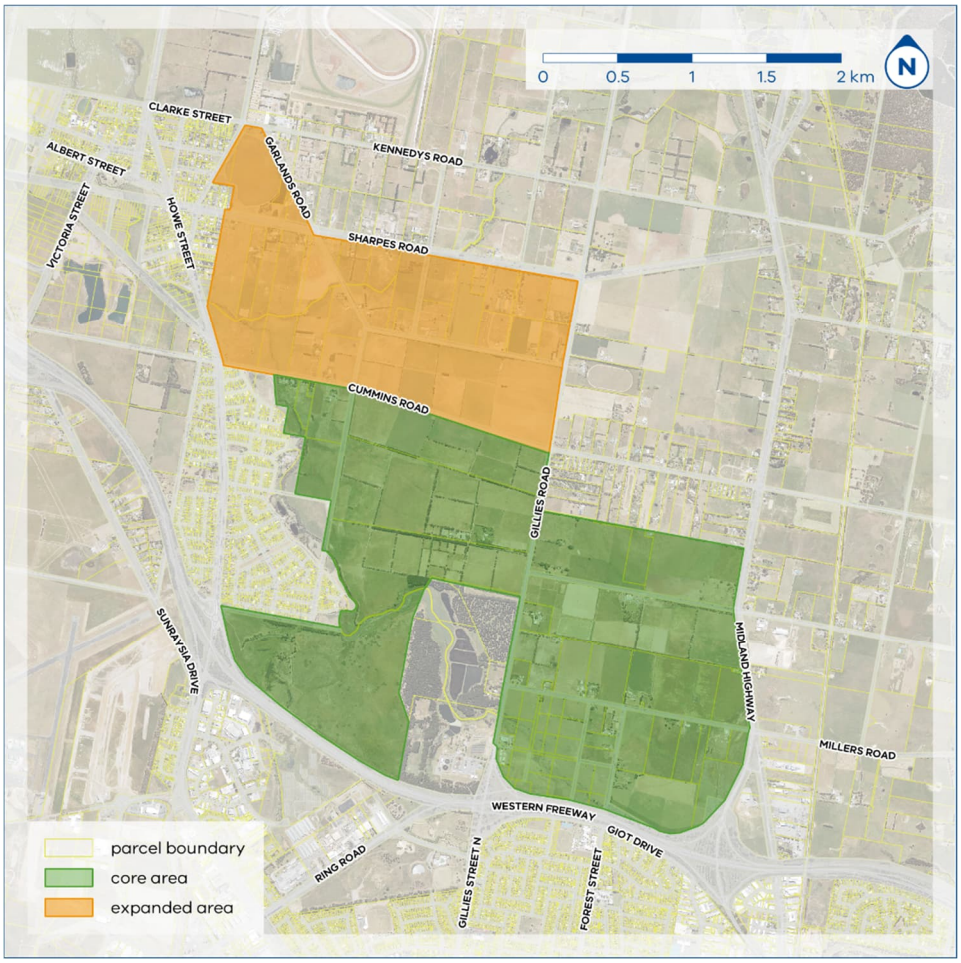


Figure 1.1: Ballarat North core and expanded areas (Source: Ballarat North - VPA)

1.2 Study Overview

This study involves preparing a Strategic Transport Modelling Assessment (STMA) to examine traffic impacts of the proposed development of the PSP and understand future transport planning requirements. It includes a review and validation of the Victorian Integrated Transport Model (VITM) 2018 Reference Year model and development of a future (2051) project-specific model which is then used for option testing.

An Integrated Transport Assessment Report (ITAR) will also be undertaken to provide recommendations for the Ballarat North PSP to support the development of a complete, integrated multi-modal precinct. This will involve a detailed background review and understanding of the existing conditions and draft PSP. The findings from the STMA will then be considered to develop recommendations for the public transport, active travel and road networks within the precinct.

1.3 Study Area

Determined in discussions with VPA, the agreed study area is shown in yellow in Figure 1.2, the background reflects the original VITM zones in the starting model. Model updates and validation have concentrated on the study area with impacts reported for a wider study area when appropriate.

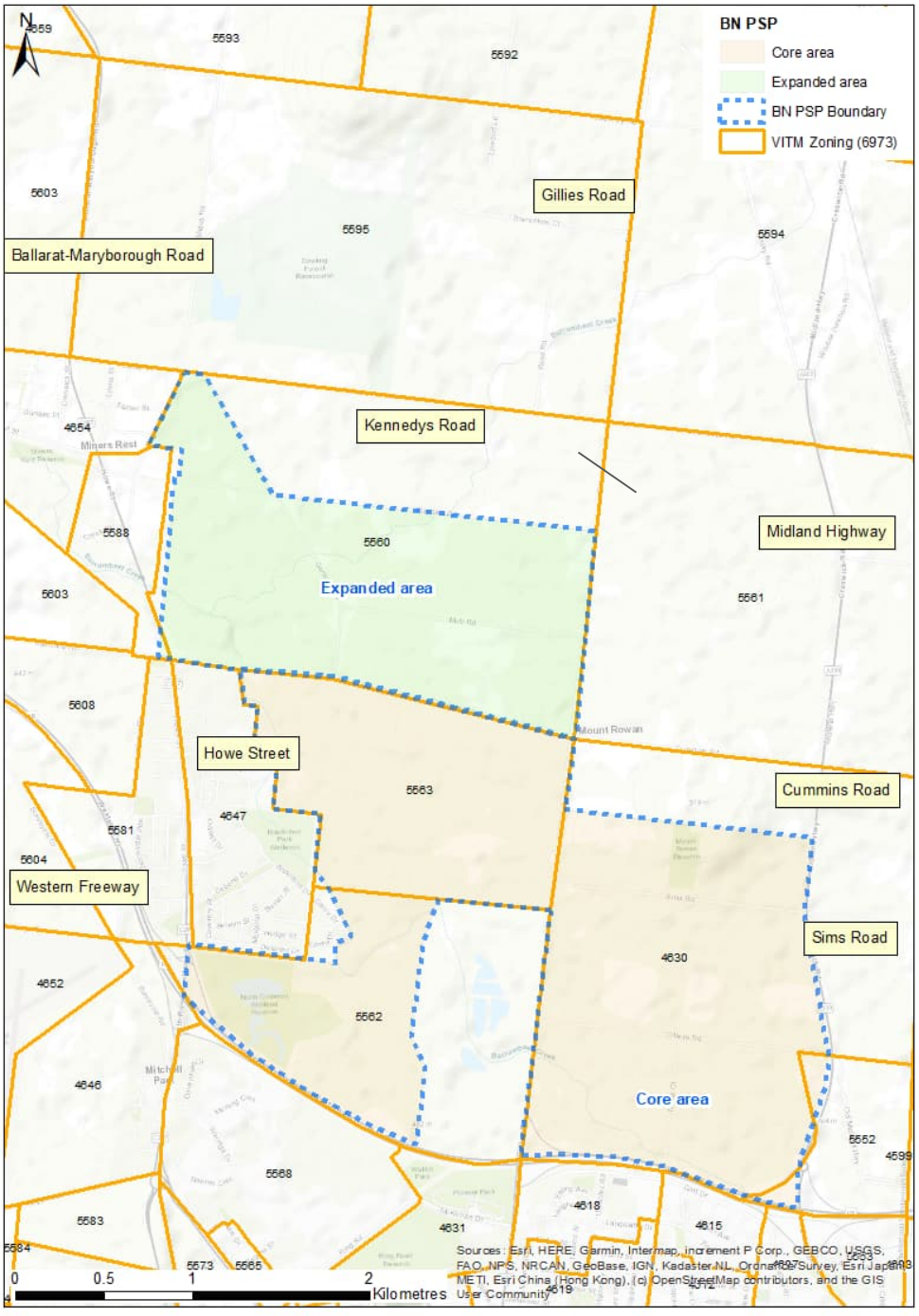


Figure 1.2: Project study area (blue boundary) with original VITM zones

2. Model

2.1 Base Model

VITM was provided by the Department of Transport and Planning (DTP) for the strategic modelling of the Ballarat North PSP. VPA and the DTP made a prior evaluation and advised that for this project the most appropriate version of the VITM to use was *VITM22v2_03_RC22v1_06*, a version developed by Stantec to evaluate the Ballarat Link Road for the City of Ballarat (henceforth called BLR-VITM). This model includes a subarea model with matrix estimation to improve the validation of the Ballarat region.

DTP also provided the most recent available version of VITM[1], so that Jacobs could evaluate the differences in reference case land use assumptions and model outputs between these two model versions. After reviewing both models, BLR-VITM was confirmed as suitable for this study. The model was validated to a 2018 base year and deemed fit for purpose for assessing the transport impacts in and around the Ballarat North PSP. Further details of the model review are included in Appendix A. Changes required to update the zoning system for the Ballarat North PSP assessment are detailed in the following section.

2.2 Zone disaggregation

Considering the vision for the Ballarat North PSP, the VITM zone system inside the study area was disaggregated so that it could provide traffic forecasts at a finer level of detail when used for forecasting. The zone system outside the study area was also reviewed and found to be suitably disaggregated for the purposes of this study. The disaggregated zones and zone connectors are shown in Figure 2.1 and Figure 2.2.

[1] *VITM24_v2_03* (VITM24)

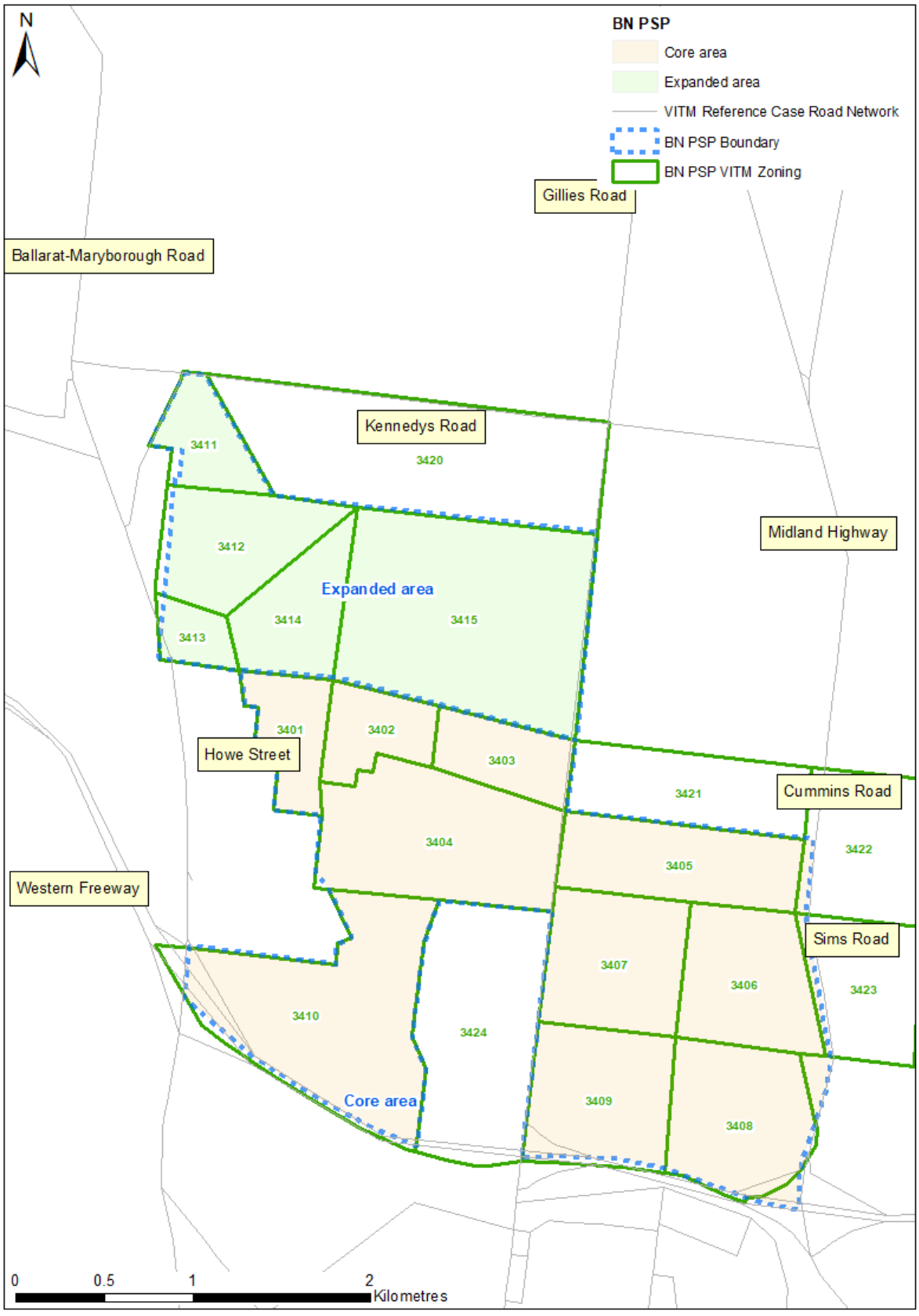


Figure 2.1: Ballarat North PSP - Disaggregated zones

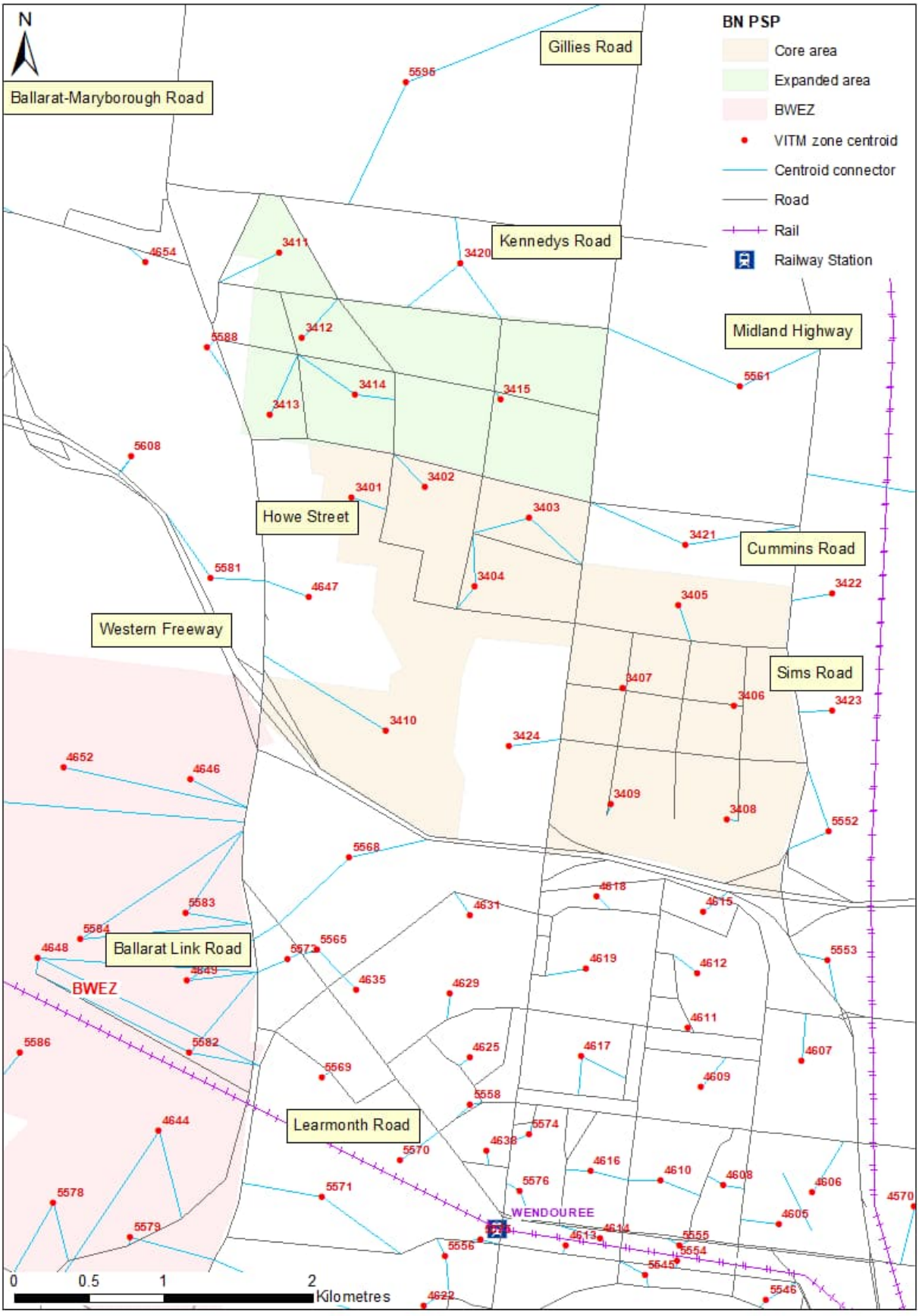


Figure 2.2: Updated VITM Zone connectors

3. 2051 Project Case Model Inputs

This section describes the 2051 VITM Project Case inputs which includes updated land use and transport networks for the Ballarat North PSP.

3.1 Future Transport Network

The 2051 BLR-VITM transport network has been updated to align with the proposed transport network within the Ballarat North PSP (core area shown in Figure 3.1) and a representative network for the expanded area. In addition, local roads were added to enable the full distribution of traffic across the PSP.

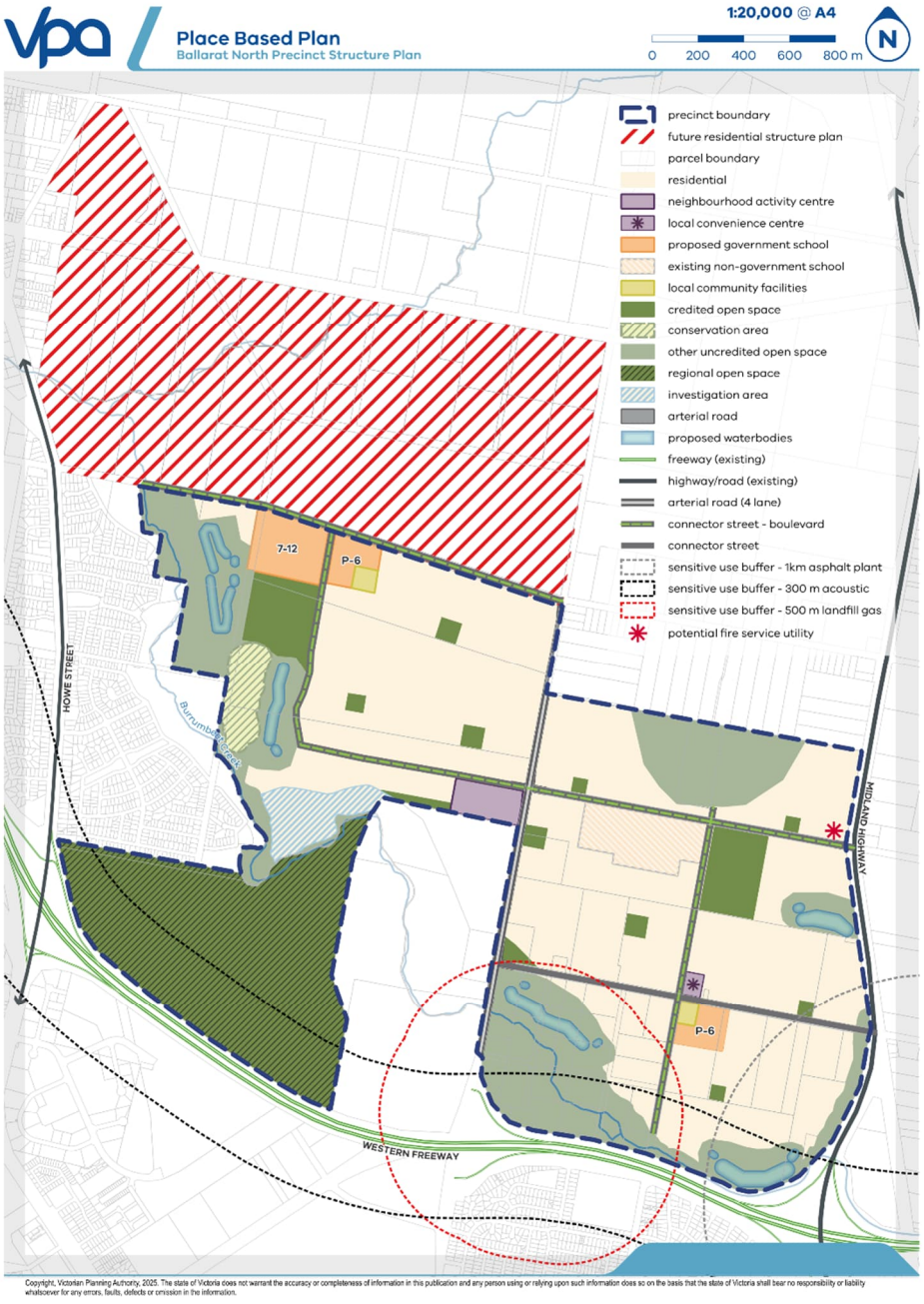


Figure 3.1: Ballarat North PSP, Place Based Plan (Source: VPA)

The updated 2051 (core + expanded) road network is shown in Figure 3.2 (road class), Figure 3.3 (number of lanes) and Figure 3.4 (posted speeds). The number of lanes within the PSP are for modelling an unconstrainted network, the final recommendation may vary.

In addition to the PSP road network, key changes to the wider transport network (between 2018 and 2051) that are included in the VITM reference case include:

- Midland Highway duplication (to 4 lanes divided) from Howitt Street to the Western Freeway (north side of interchange)
- Ballarat Link Road:
    - 2 lanes from Learmonth Road to the Railway line
    - 4 lanes from the Railway line to Cuthberts Road
    - 2 lanes from Cuthberts Road to Ross Creek Road
    - 2 lanes from Ross Creek Road to Midland Highway
- New East-West Connector (2 lanes) from Ballarat Link Road to Gillies Street (between Ballarat-Carngham Road and Cuthberts Road)
- Ballarat-Carngham Road (4 lanes) from Ballarat Link Road to Midland Highway
- Glenelg Highway - Cherry Flat Road to Midland Highway (4 lanes)

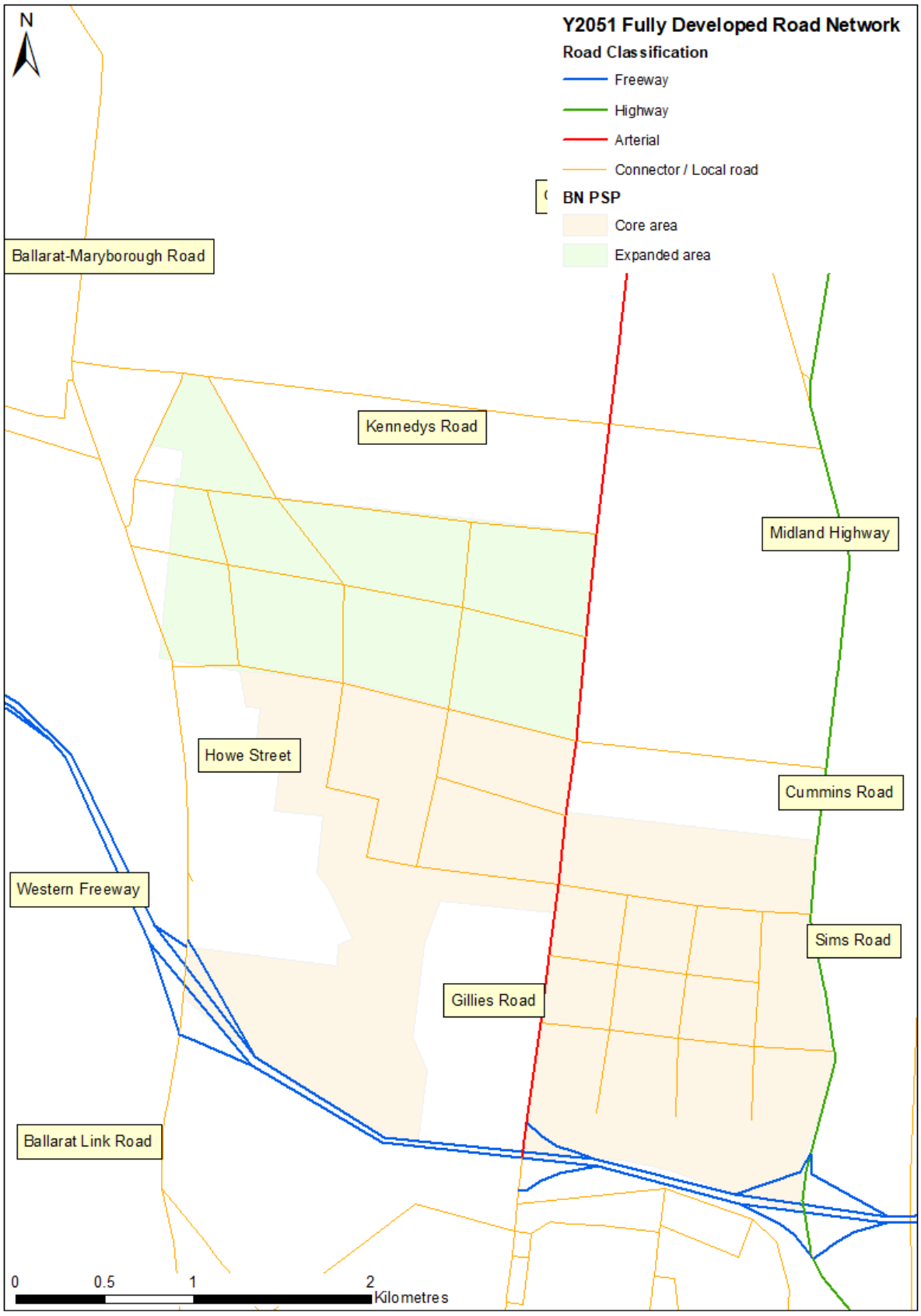


Figure 3.2: 2051 Core + Expanded, road network classes

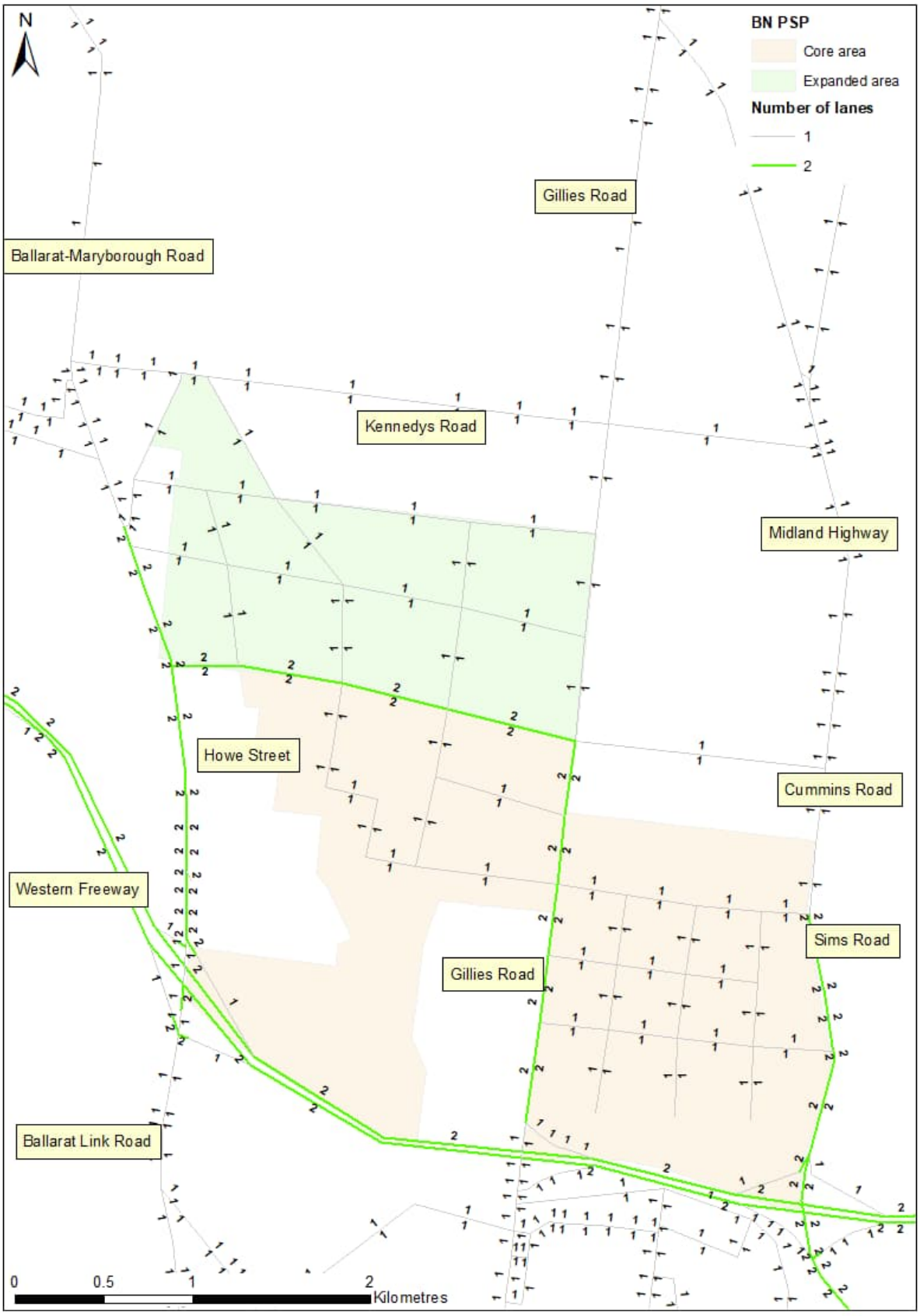


Figure 3.3: 2051 Core + Expanded, road network number of lanes

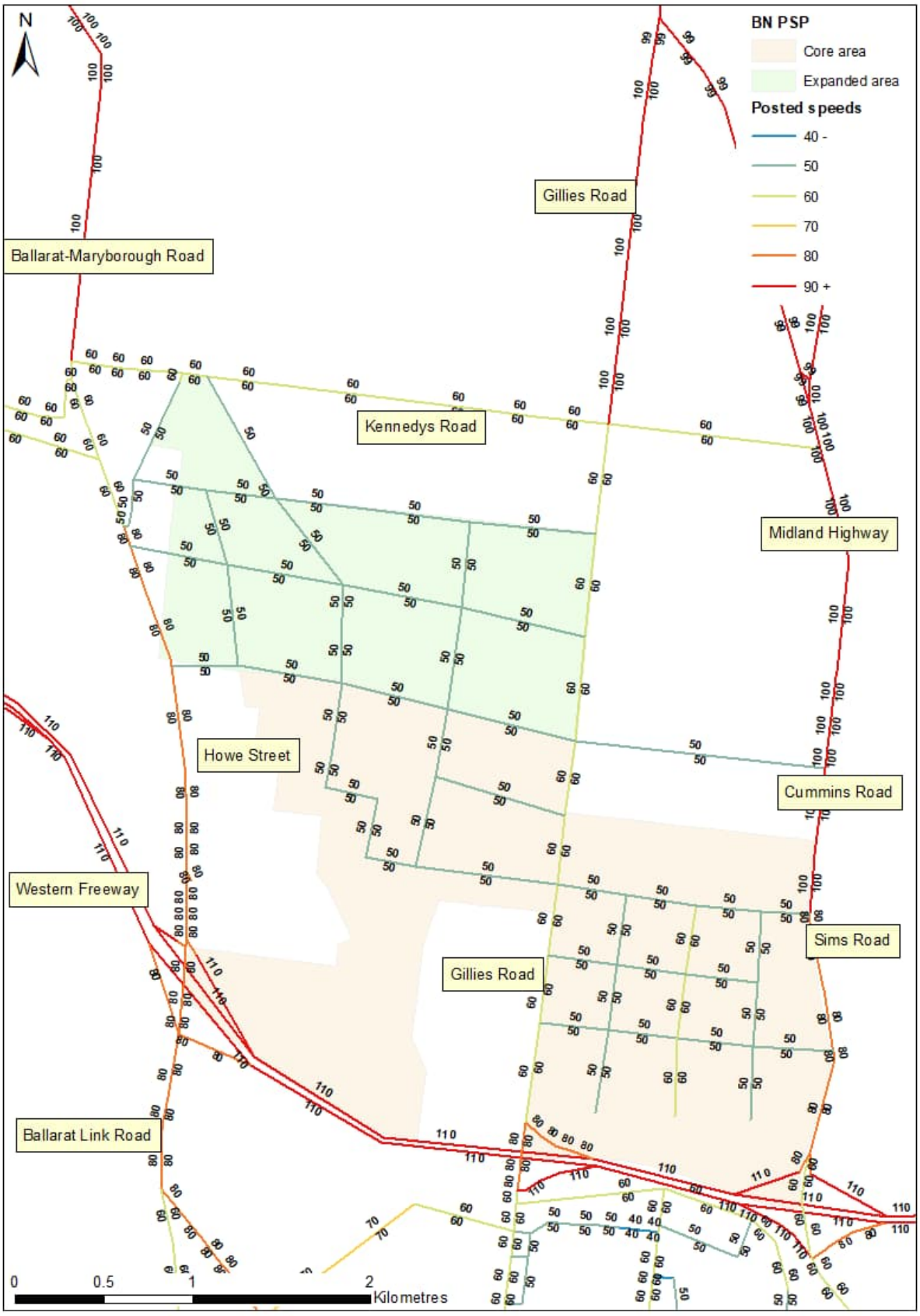


Figure 3.4: 2051 Core + Expanded, road posted speeds

3.2 Future Public Transport Network

Two bus routes were added to service the Ballarat North PSP as shown in Figure 3.5, these ensure that the majority of the PSP is within 400m of a public transport service. They also provided connectivity to Wendouree and Ballarat Stations. The assumed frequency of each service is shown in Table 3-1.

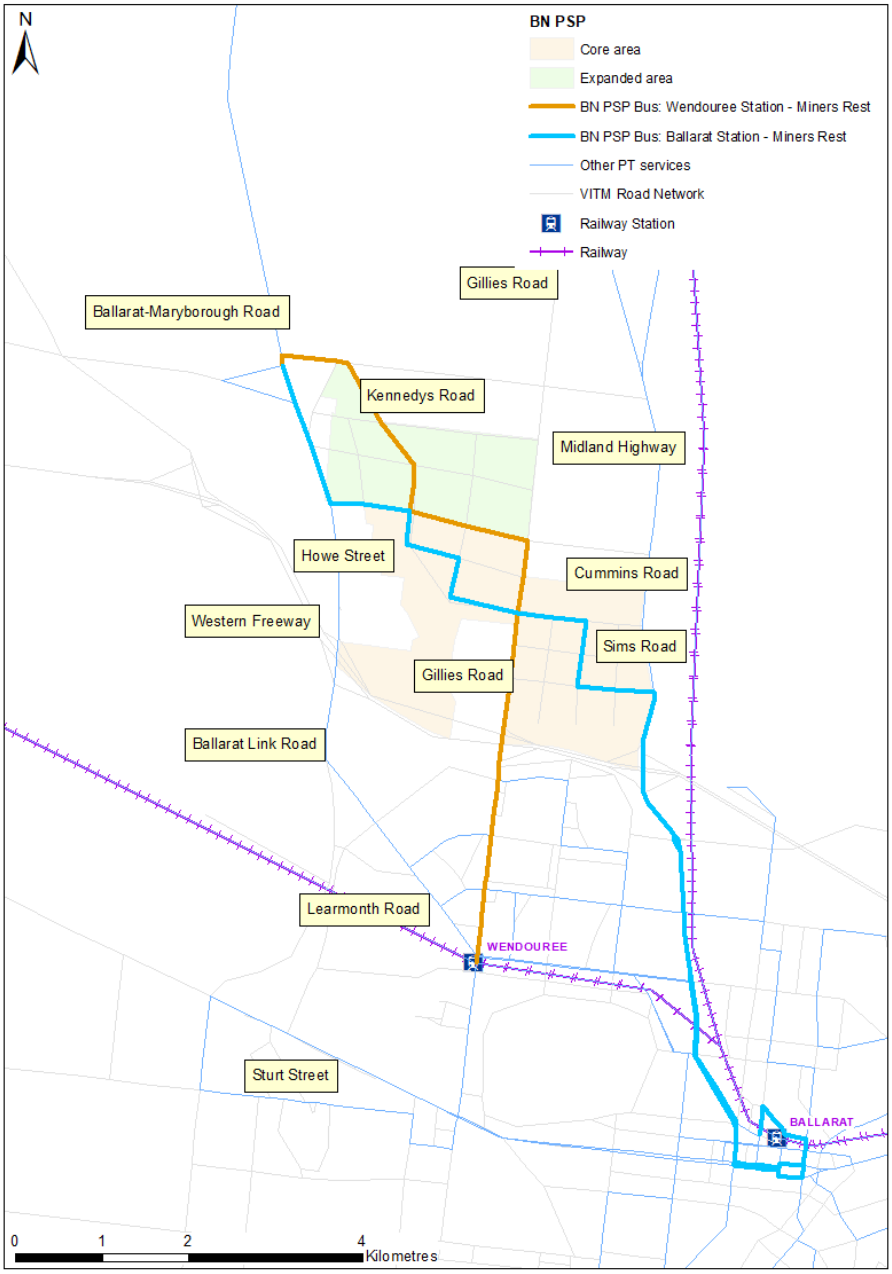


Figure 3.5 Bus route changes: future bus routes through the PSP

Table 3-1: Bus network changes

Route	Colour on map	Frequency - 2051 Project Case
Wendouree Station to Miners Road	Blue	Every 30 minutes
Ballarat Station to Miners Road	Orange	Every 30 minutes

3.3 Future Land Use

3.3.1 PSP Demographic Assumptions

Population and employment values were provided by VPA as overall totals for the PSP (see Table 3-2).

Table 3-2: 2051 Demographic totals (Source: VPA)

Demographic Input	Core Area	Expanded Area	Combined Core and Expanded Area
Dwellings	6,000	3,496	9,496
Population @ 2.8 persons per dwelling	16,800	9,790	26,590
Jobs	619	381	900-980
Enrolments	3,800	900	4,700

The values from Table 3-2 were assigned to travel zones within the PSP for the 2051 Project Case model as follows, the resulting demographic inputs are shown in Table 3-3:

- Based on a review of the Place Based Plan, households and population were distributed across travel zones based on the amount of available residential land within each zone. The same age and profile as the whole of the Ballarat LGA (from the 2051 BLR-VITM) were applied to each zone.
- The assumed size of each school was provided by VPA, each primary school is assumed to have 900 enrolments and the secondary school is assumed to have 2,000 enrolments.
- The Urbis Economics & Planning report "*Ballarat North Precinct Structure Plan Economic & Retail Assessment, June 2024*", Table 15, Scenario 2, form the basis of the employment total, with the higher end of the range modelled (980).
- Employment was first assigned in a staged approach as follows:
    - Firstly, to schools based on student to teaching staff ratios in Victoria across all schools in 2024[2]. This was 14.0 students per teacher for primary schools and 11.7 students per teacher for secondary schools.
    - Then employment was assigned to each activity centre and local convenience centre based on the available land.
    - Any remaining employment was then distributed across the remaining zones based on their size.
- The same job type profile as zones across the whole of the Ballarat LGA (from the 2051 VITM Reference Case) were applied to each zone, except for the schools (which was allocated to education).

[2] Schools, 2024 | Australian Bureau of Statistics

Table 3-3: Project case demographics

TZN	PSP	Population	Employment	Primary Enrolments	Secondary Enrolments
3401	Core	627	8	-	-
3402	Core	-	235	900	2,000
3403	Core	1,557	9	-	-
3404	Core	4,038	175	-	-
3405	Core	2,339	18	-	-
3406	Core	1,643	71	-	-
3407	Core	2,768	19	-	-
3408	Core	2,398	64	900	-
3409	Core	1,431	19	-	-
3410	Core	-	-	-	-
3414	Expanded	1,742	173	-	-
3411	Expanded	250	25	-	-
3413	Expanded	582	25	-	-
3412	Expanded	1,916	25	-	-
3415	Expanded	5,300	114	900	-
3420	Outside	-	-	-	-
3421	Outside	-	-	-	-
3422	Outside	-	-	-	-
3423	Outside	-	-	-	-
3424	Outside	-	-	-	-
Total Core		16,800	619	1,800	2,000
Total Expanded		9,790	361	900	-
Total Core + Expanded		26,590	980	2,700	2,000

3.3.2 Wider Area Demographic Inputs

Appendix A provides further details on how the demographics for the wider Ballarat Local Government Area LGA) were compiled, including the Ballarat West Employment Precinct. For the 2051 full development scenario (core + expanded PSP), the model adopted the following headline demographic inputs:

- Ballarat LGA:
    - Population: 219,594
    - Employment: 87,930
    - Enrolments: 70,239
- Ballarat West Employment Precinct (BWEZ)
    - Employment: 2,000

4. 2051 Project Case Model Performance

This study has looked at the following three scenarios, outputs for each are presented in their own section and then comparisons are made in Section 4.4.

- 2051 Base Case (Section 4.1)
- 2051 Core only (Section 4.2)
- 2051 Core + expanded (Section 4.3)

4.1 2051 Base Case

4.1.1 Model Inputs

The 2051 Base Case scenario adopts the following key model assumptions.

- Demographics – no development within the Ballarat North PSP core and expanded area
- Road Network – adopts the existing road network, as shown in Figure 4.1
- Public Transport – no bus routes through the PSP area

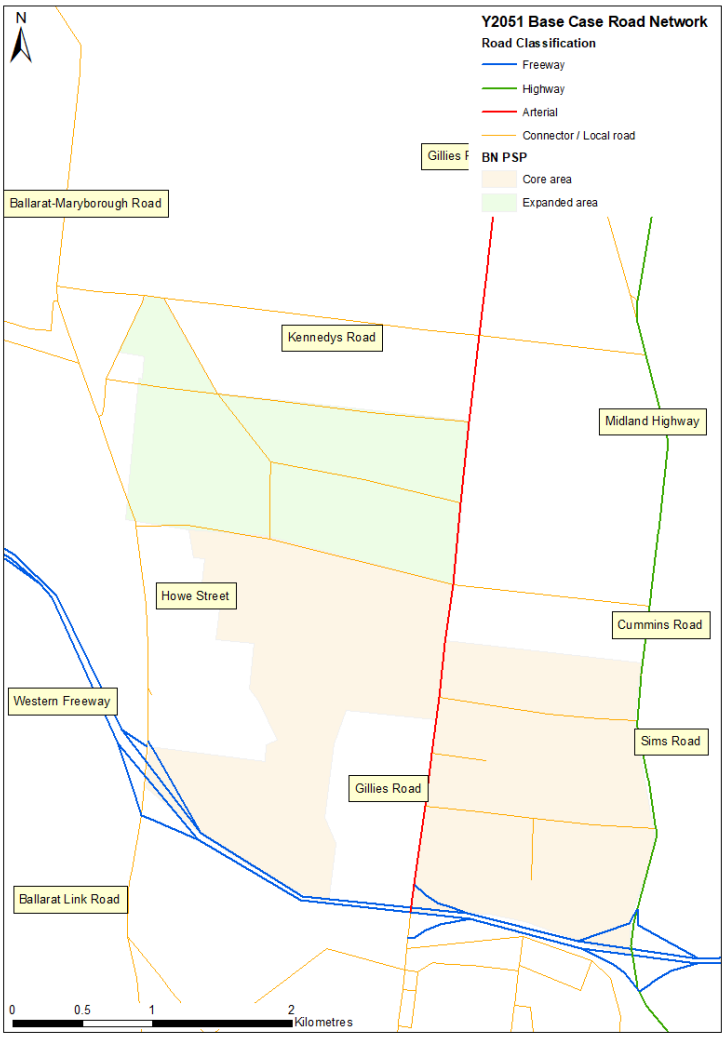


Figure 4.1: 2051 Base Case, Road Network

4.1.2 Model Outputs

The performance of the 2051 Base Case model is presented in this section; this scenario sets the platform for the performance of the transport network in the absence of the PSP development occurring.

Figure 4.5 (AM peak) and Figure 4.6 (PM peak) highlight that there is minimal congestion on the road network surrounding the study area, the only areas of note are the Western Freeway crossings at Howe Street, Gillies Road and the Midland Highway, which are likely to reflect travel time variability in the peak periods.

Results across scenarios are summarised in Section 4.5.

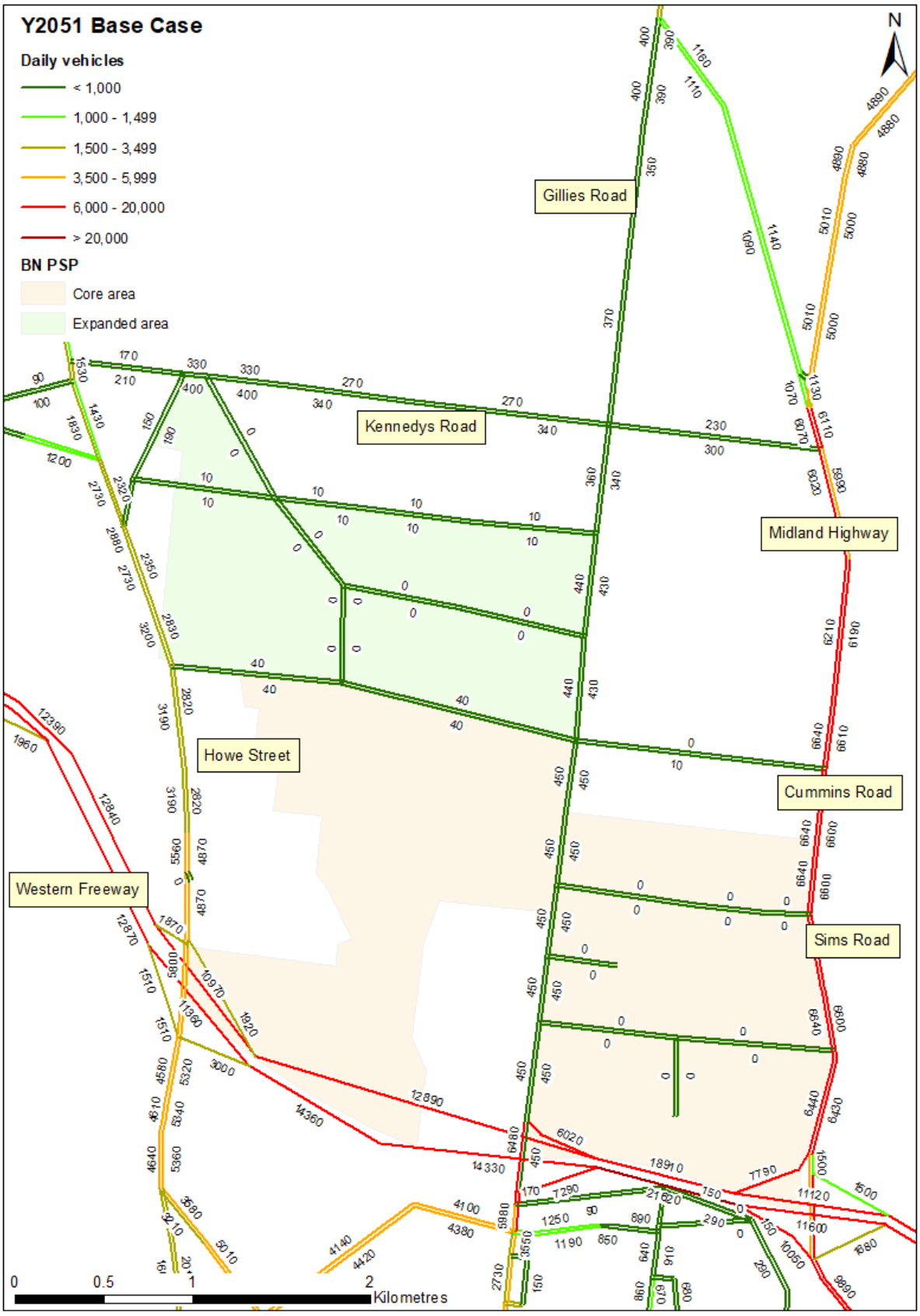


Figure 4.2: 2051 Base Case, Daily Vehicle Volumes

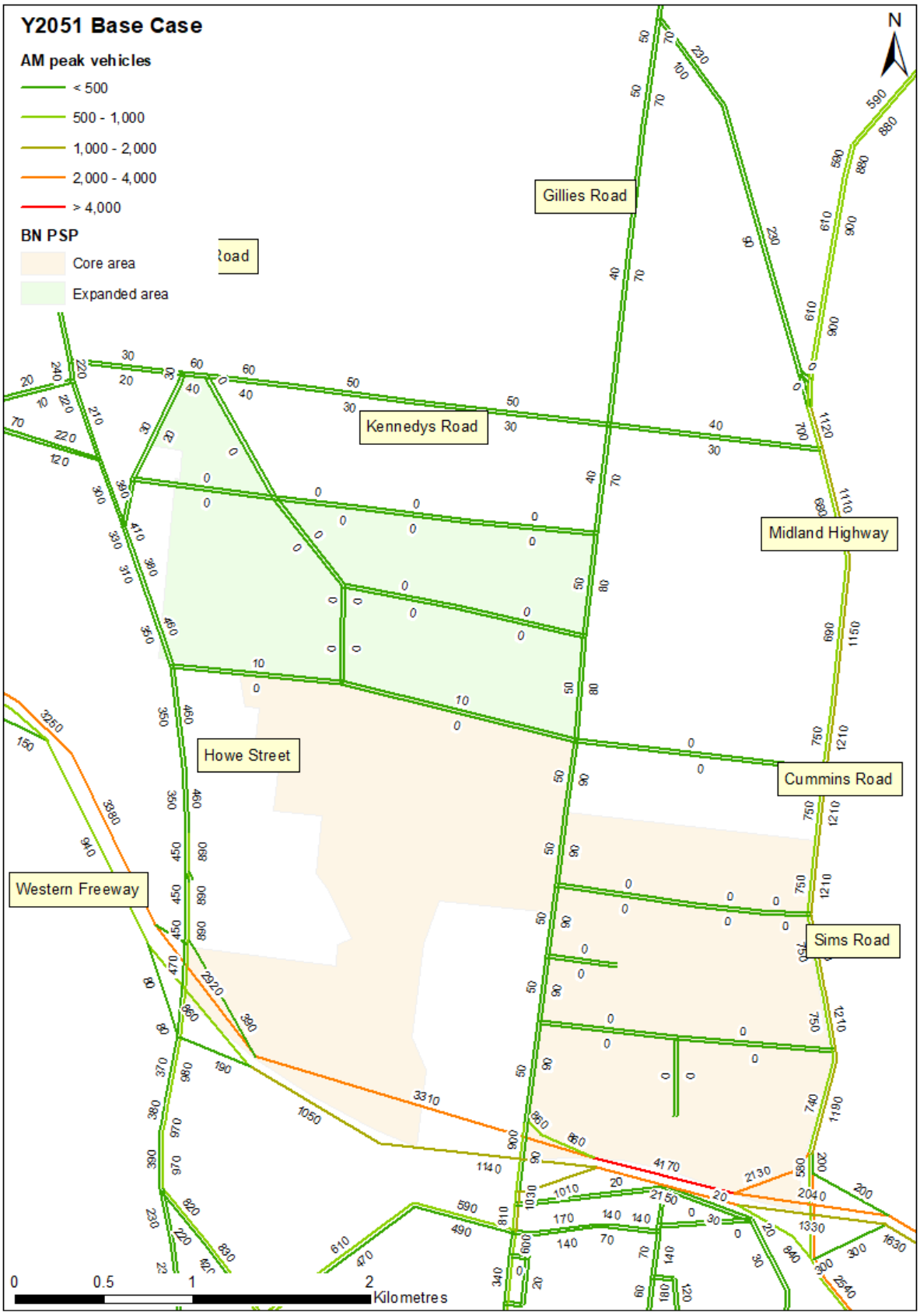


Figure 4.3: 2051 Base Case, AM Peak Volumes

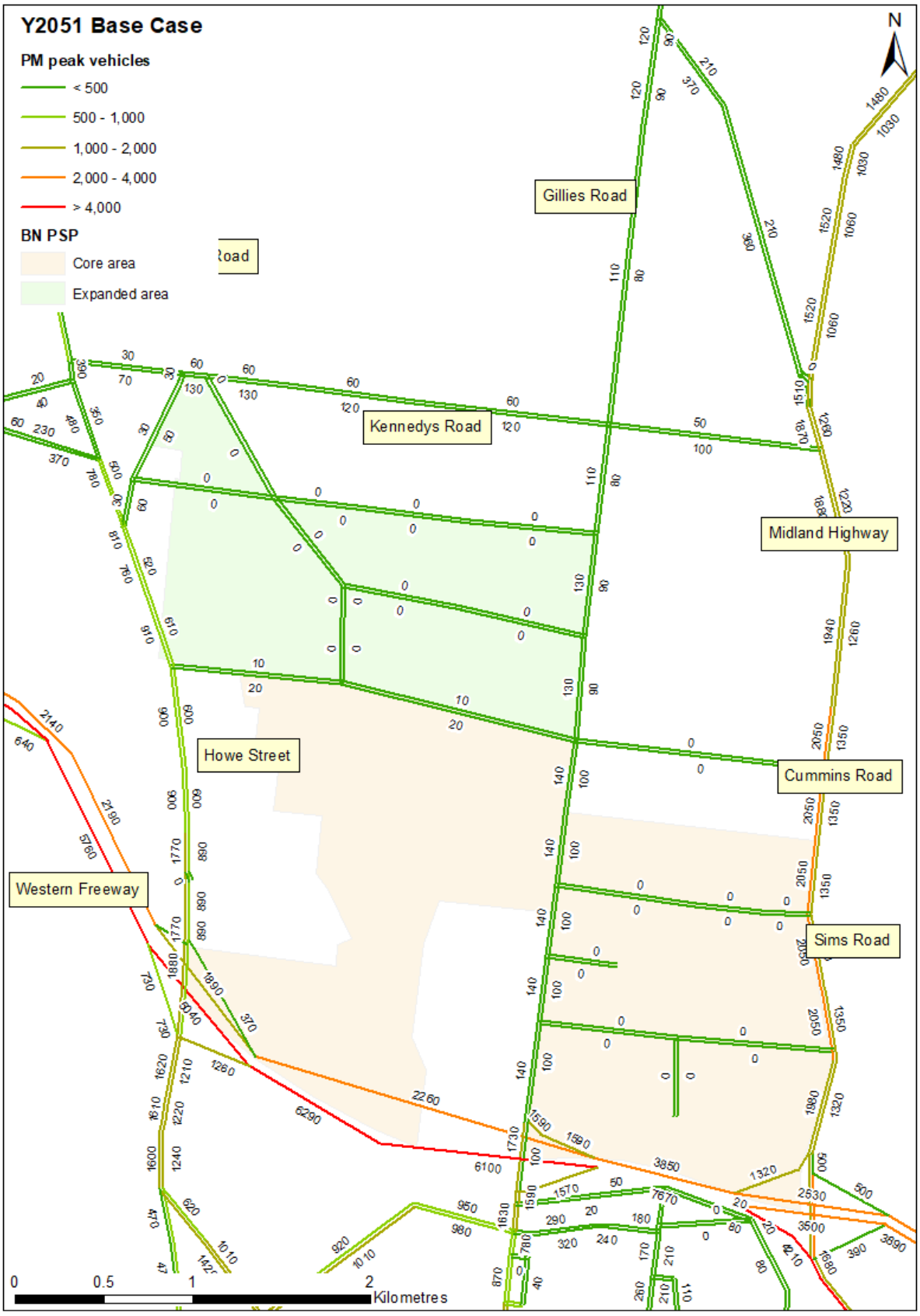


Figure 4.4: 2051 Base Case, PM Peak Volumes

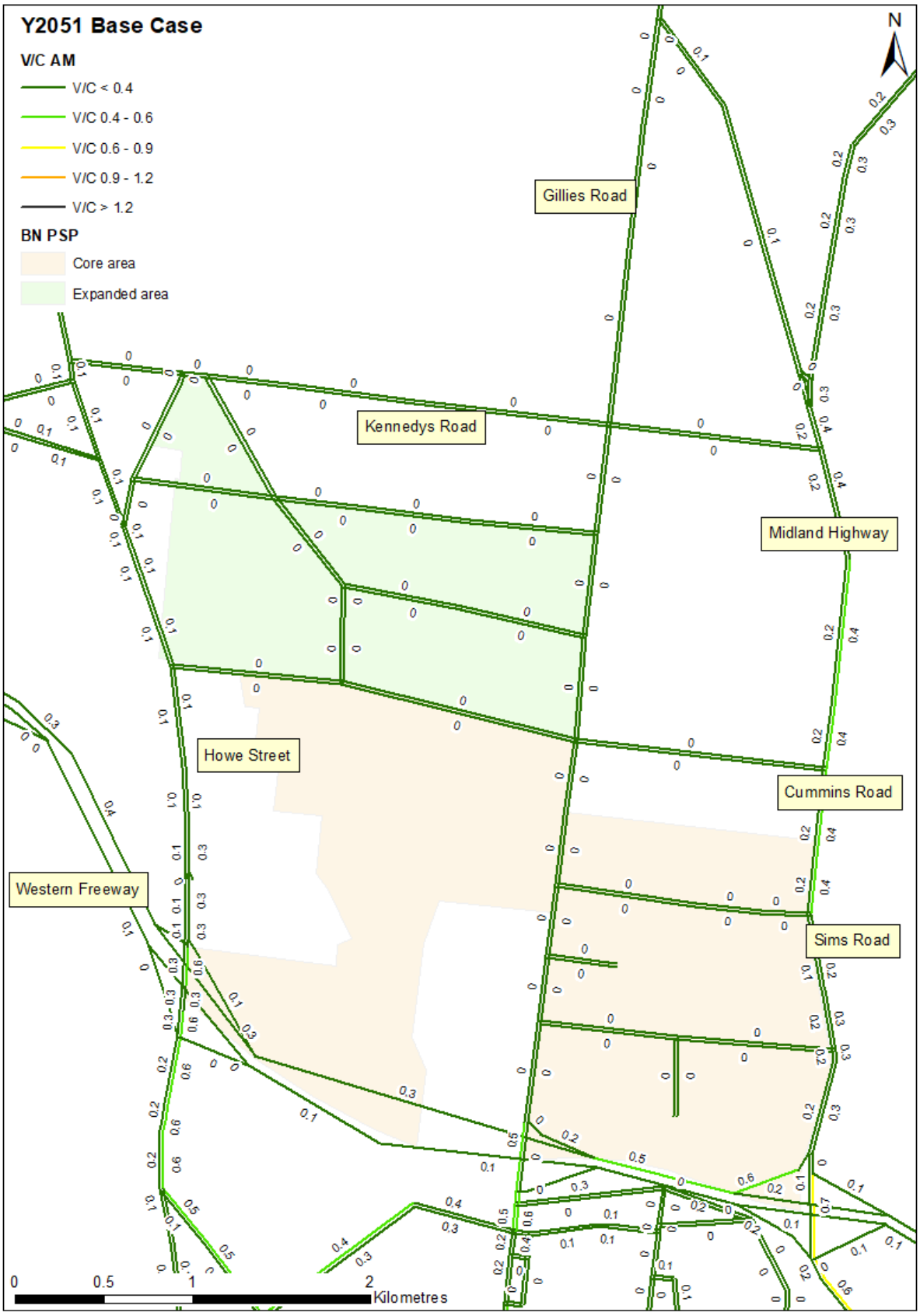


Figure 4.5: 2051 Base Case, AM Peak Volume / Capacity Ratios

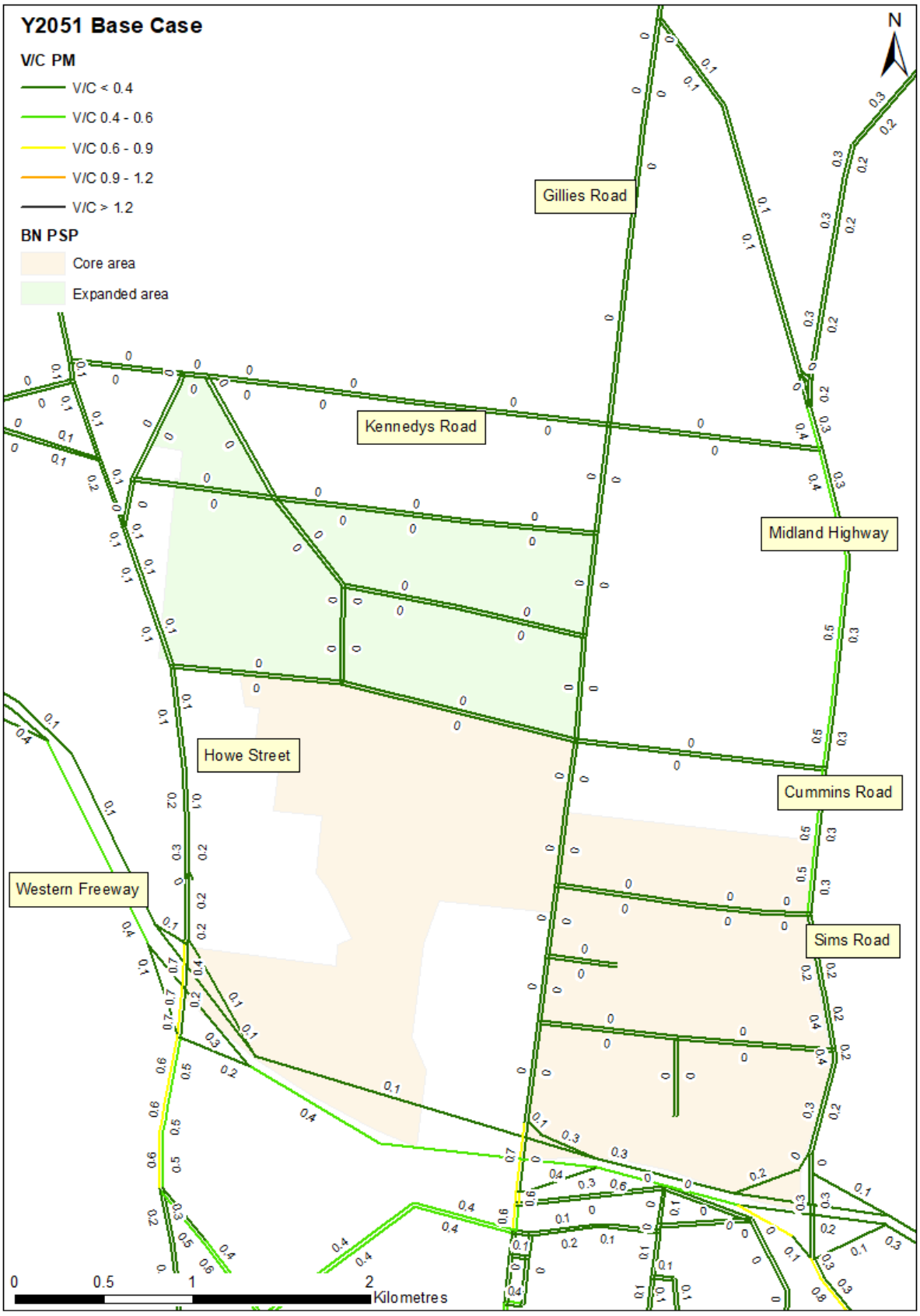


Figure 4.6: 2051 Base Case, PM Peak Volume / Capacity Ratios

4.2 2051 Core Only

4.2.1 Model Inputs

The 2051 Core Only scenario adopts the following key model assumptions.

- Demographics – population, jobs or enrolments within the Ballarat North PSP core area are as per Table 3-3, the expanded area remains undeveloped
- Road Network – adopts the updated road network as shown in Figure 4.7
- Public Transport – two new bus routes through the PSP as per Figure 3.5

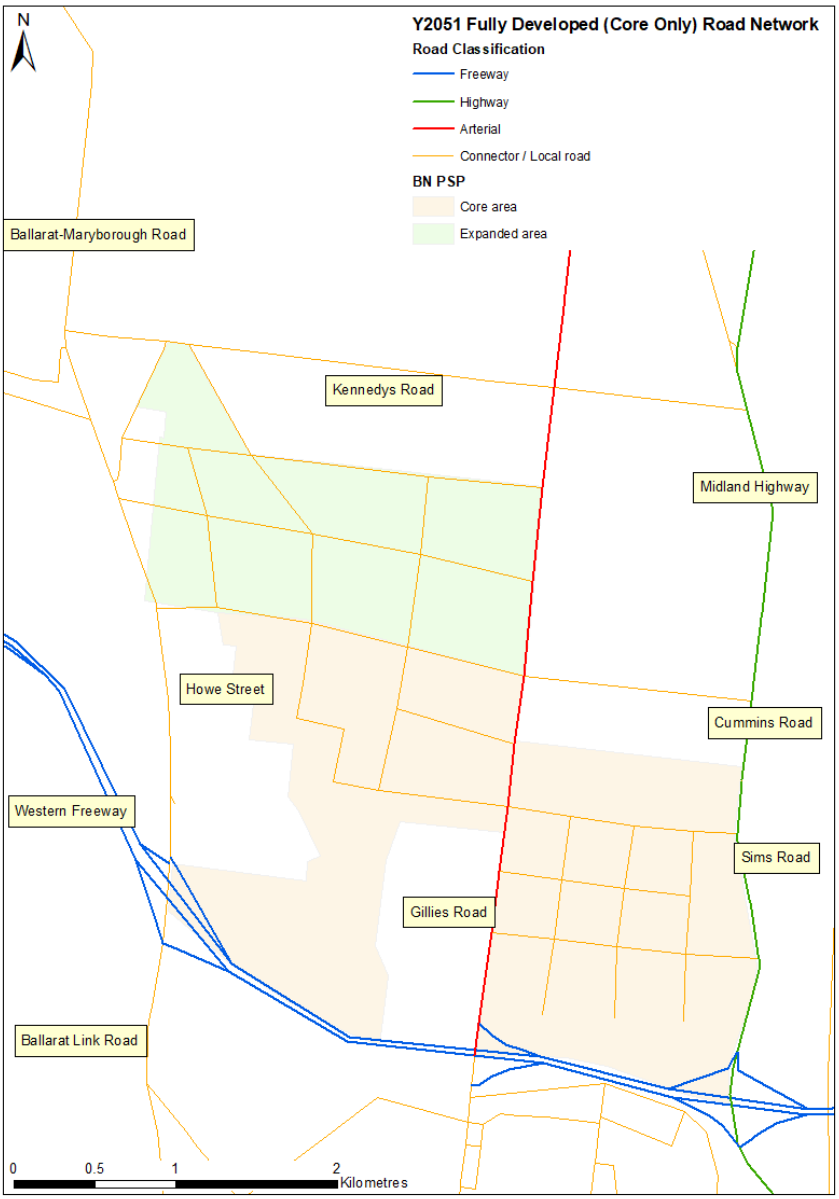


Figure 4.7: 2051 Core Only, Road Network

4.2.2 Model Outputs

The performance of the 2051 Core Only model is presented in this section, to assist with the review of the transport needs for the study area.

Figure 4.11 (AM peak) and Figure 4.12 (PM peak) highlight that there is no observed congestion on the internal PSP road network. Surrounding the study area, the only areas of note are the Western Freeway crossings at Howe Street, Gillies Road and the Midland Highway which are reaching capacity, particularly at the Gillies Street crossing.

Results across scenarios are summarised in Section 4.5.

Figure 4.8: 2051 Core Only, Daily Vehicle Volumes

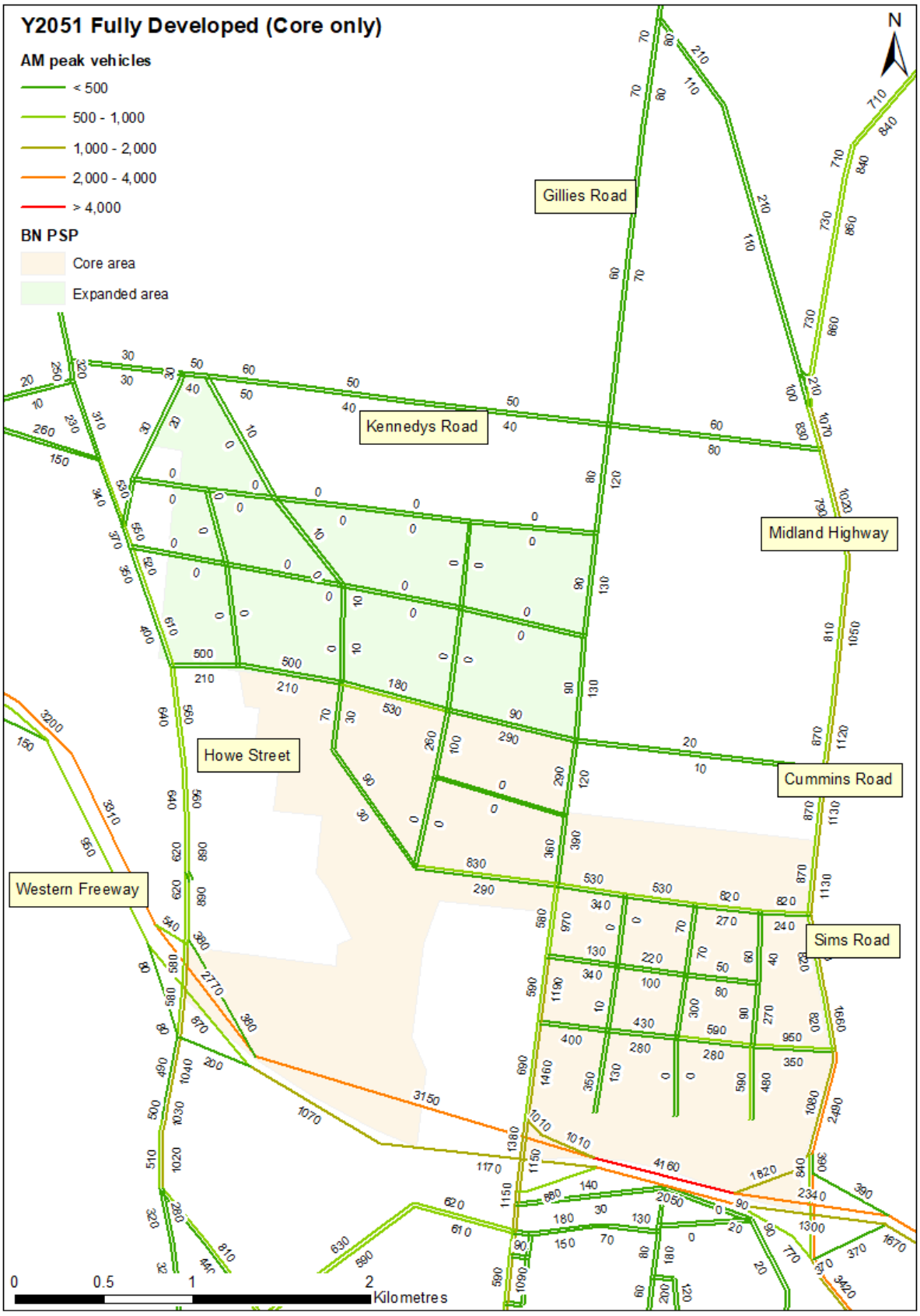


Figure 4.9: 2051 Core Only, AM Peak Volumes

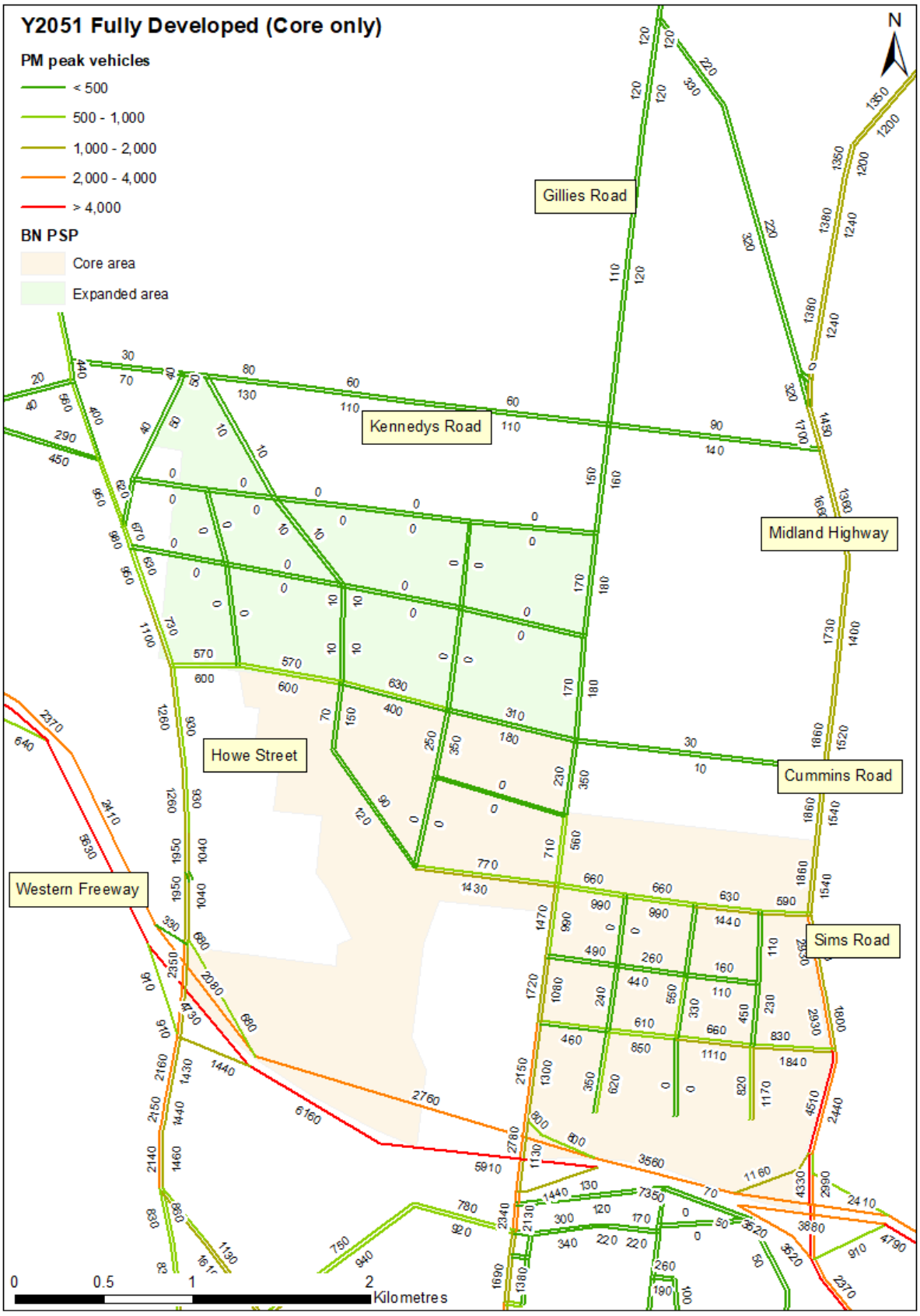


Figure 4.10: 2051 Core Only, PM Peak Volumes

Figure 4.11: 2051 Core Only, AM Peak Volume / Capacity Ratios

Figure 4.12: 2051 Core Only, PM Peak Volume / Capacity Ratios

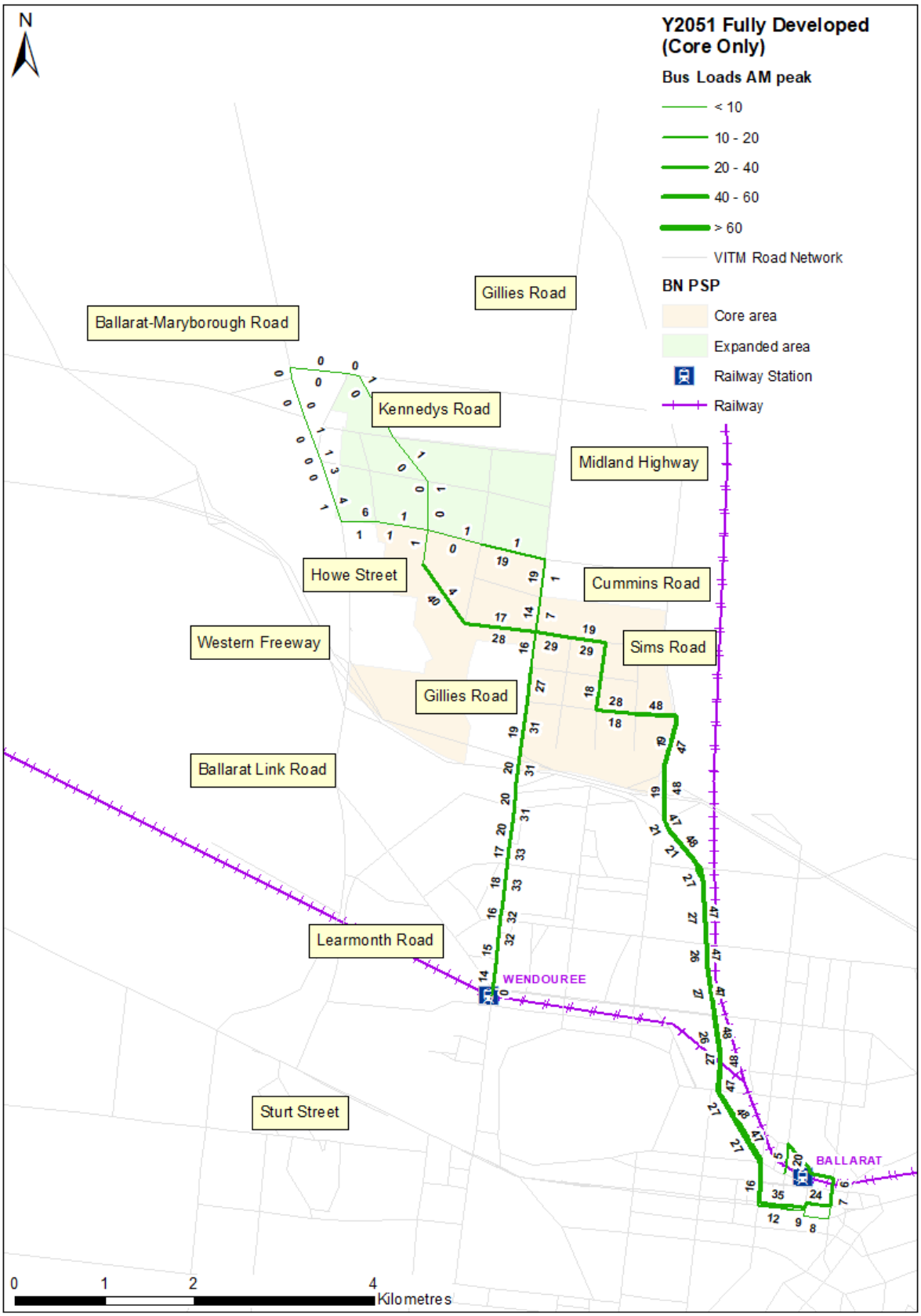


Figure 4.13: 2051 Core Only, AM PSP Bus loads

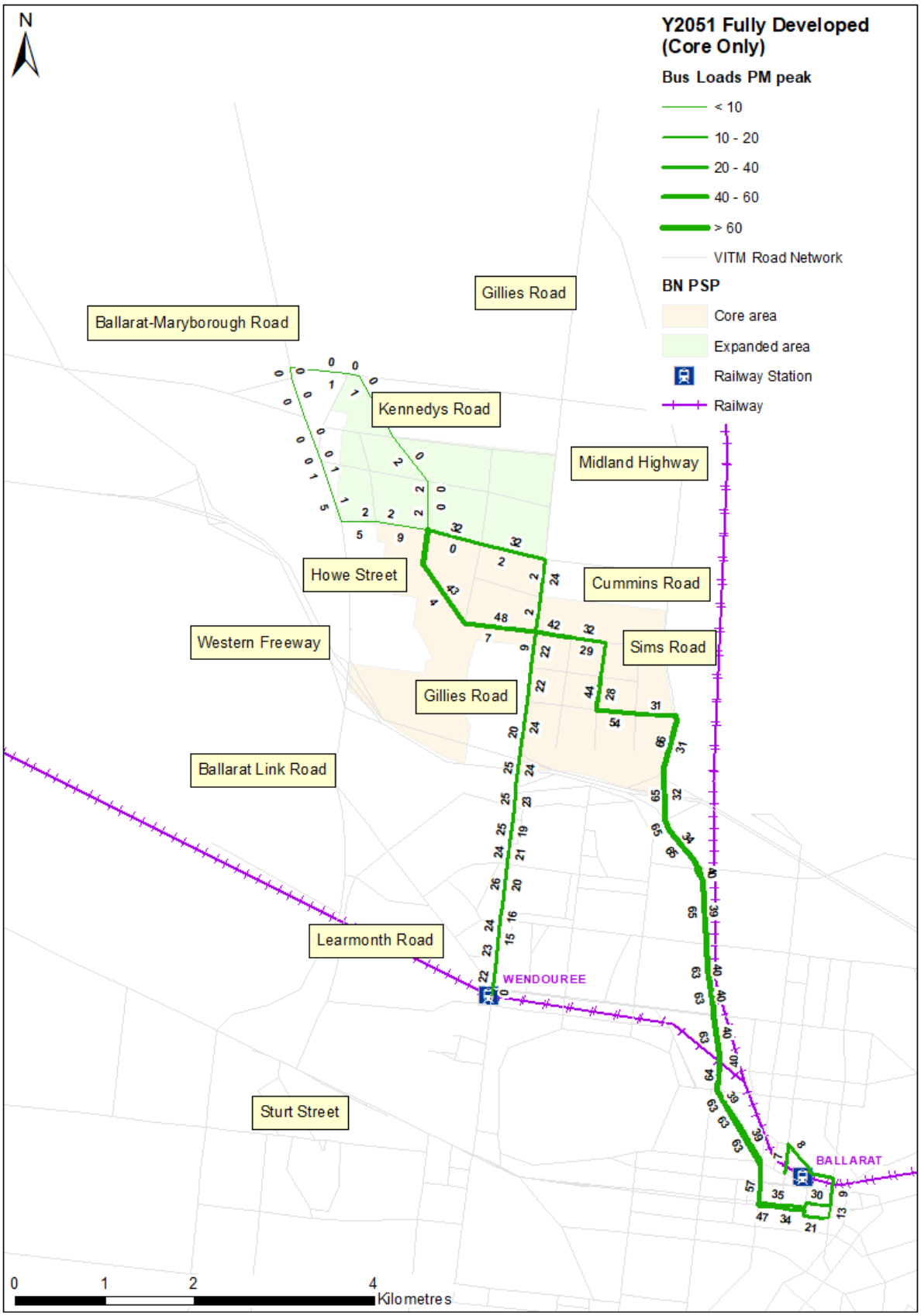


Figure 4.14: 2051 Core Only, PM PSP Bus loads

4.3 2051 Core + Expanded

4.3.1 Model Inputs

The 2051 Core + Expanded scenario adopts the following key model assumptions.

- Demographics – population, jobs or enrolments within the Ballarat North PSP core and expanded area are as per Table 3-3
- Road Network – adopts the updated road network as shown in Figure 4.15
- Public Transport – two new bus routes through the PSP as per Figure 3.5

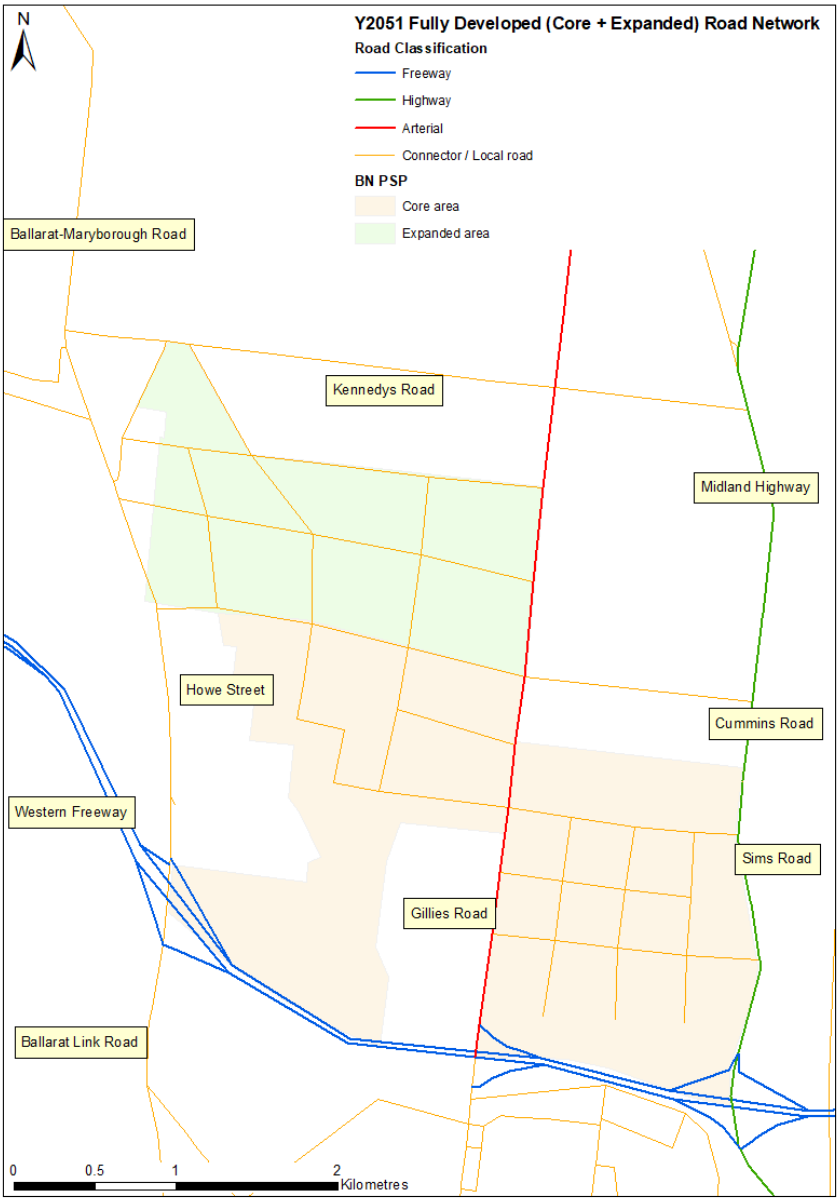


Figure 4.15 2051 Core + Expanded, Road Network

4.3.2 Model Outputs

A comparison of the scenarios modelled is included in this section to assist with the review of the transport needs for the study area.

Figure 4.19 (AM peak) and Figure 4.20 (PM peak) highlight that there is no observed congestion on the internal PSP road network. Surrounding the study area, the only areas of note are the Western Freeway crossings at Howe Street, Gillies Road and the Midland Highway which are all reaching or exceeding capacity.

Results across scenarios are summarised in Section 4.5.

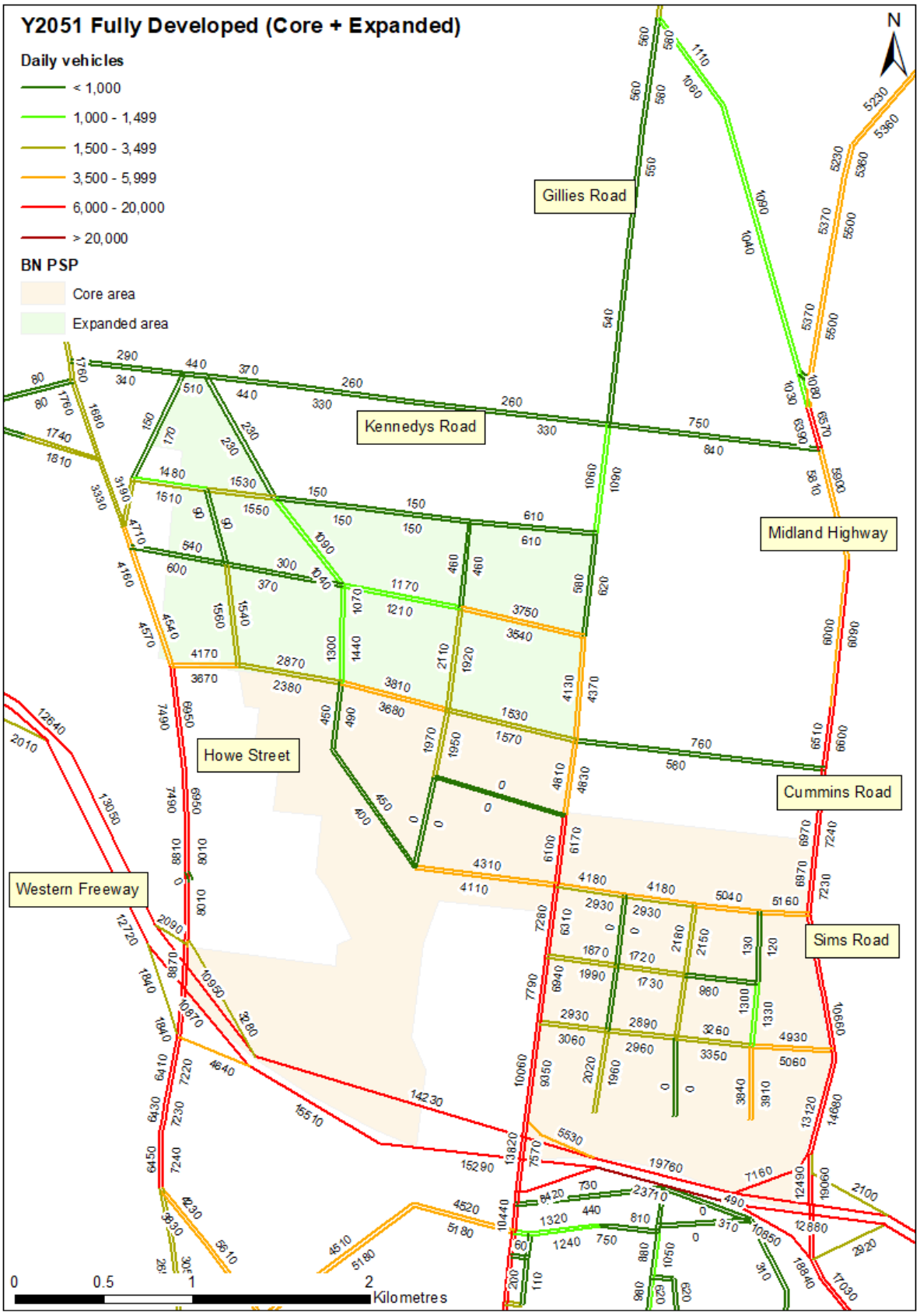


Figure 4.16: 2051 Core + Expanded, Daily Vehicle Volumes

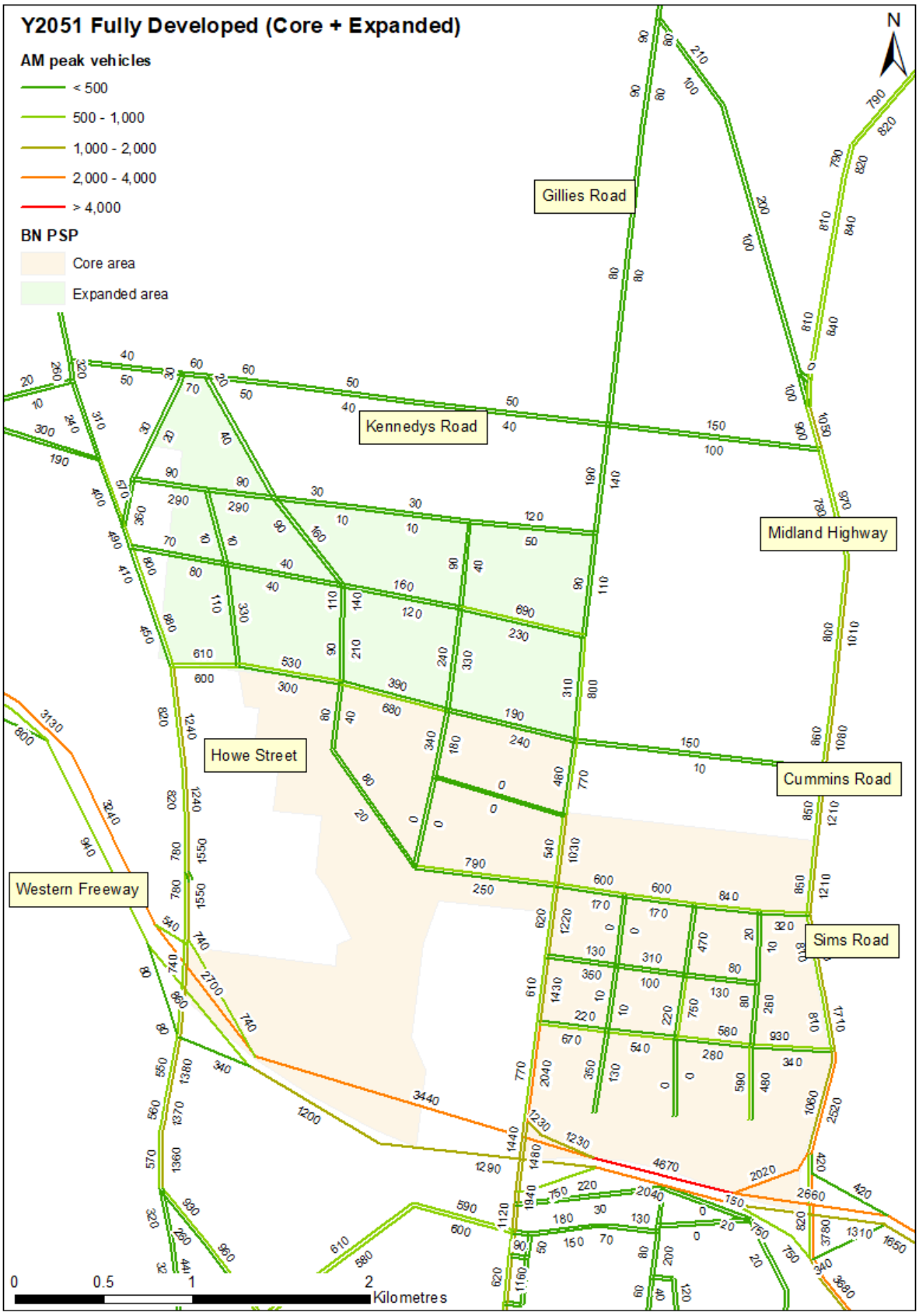


Figure 4.17: 2051 Core + Expanded, AM Peak Volumes

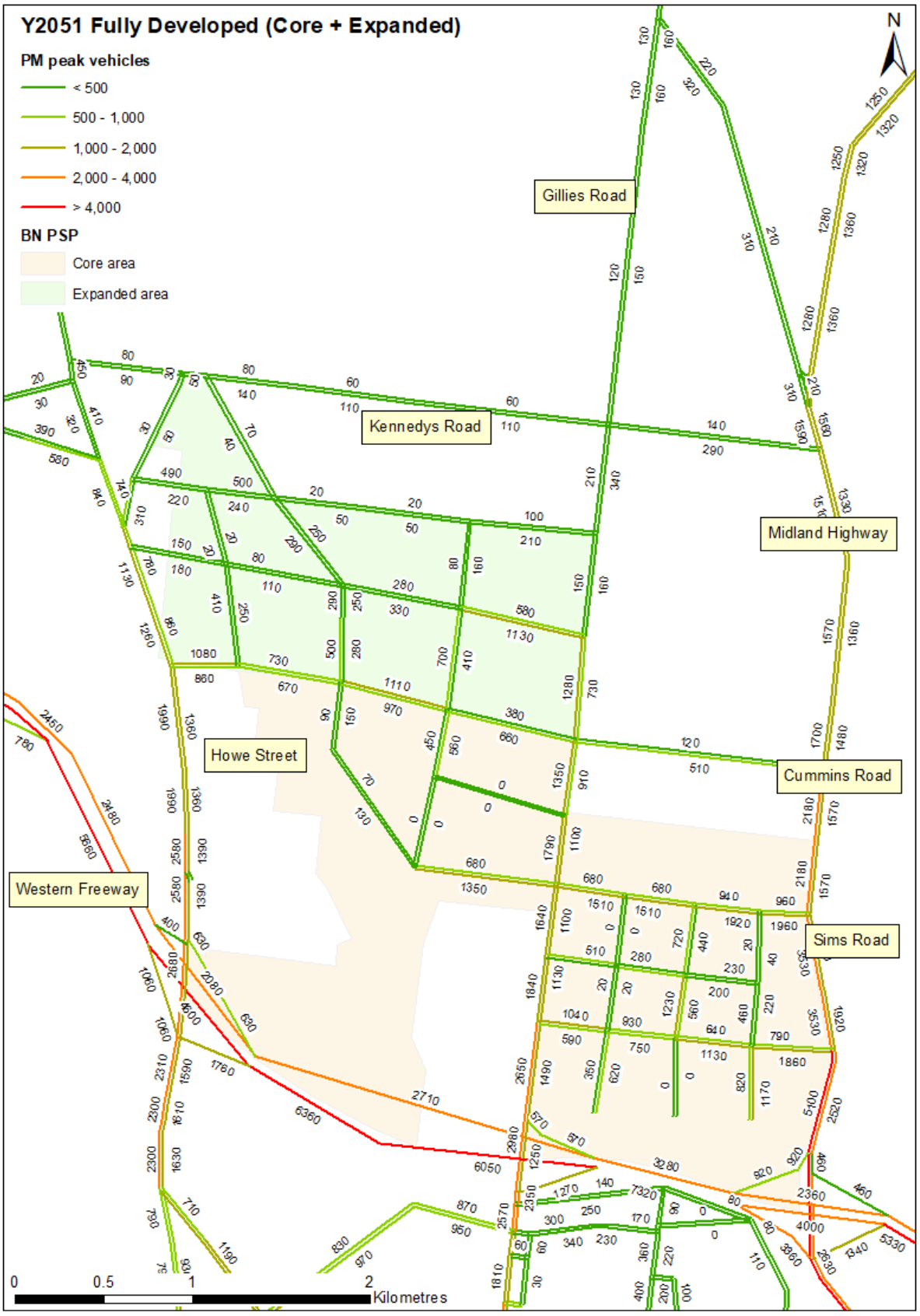


Figure 4.18: 2051 Core + Expanded, PM Peak Volumes

Figure 4.19: 2051 Core + Expanded, AM Peak Volume / Capacity Ratios

Figure 4.20: 2051 Core + Expanded, PM Peak Volume / Capacity Ratios

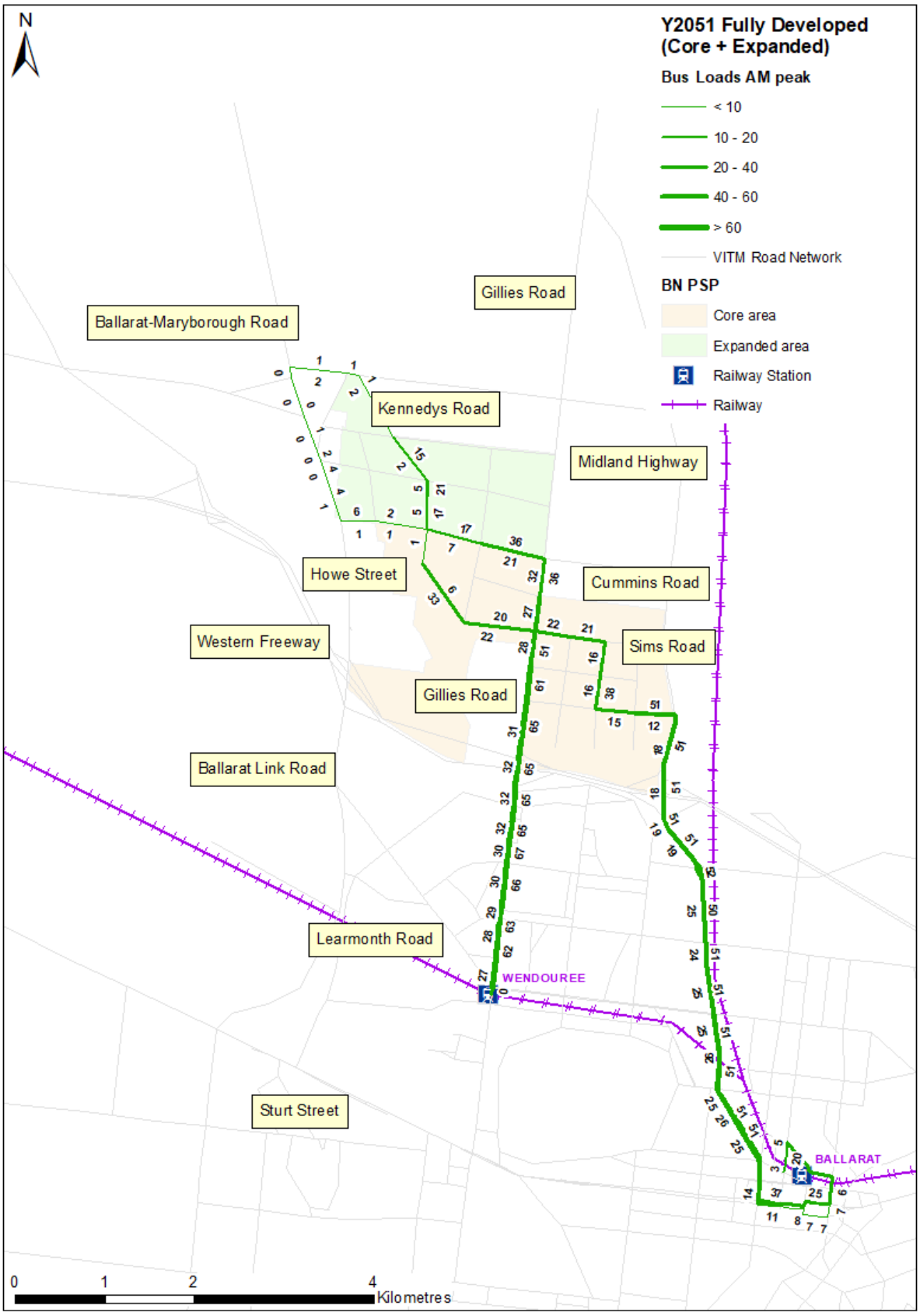


Figure 4.21: 2051 Core + Expanded, AM Peak, PSP Bus loads

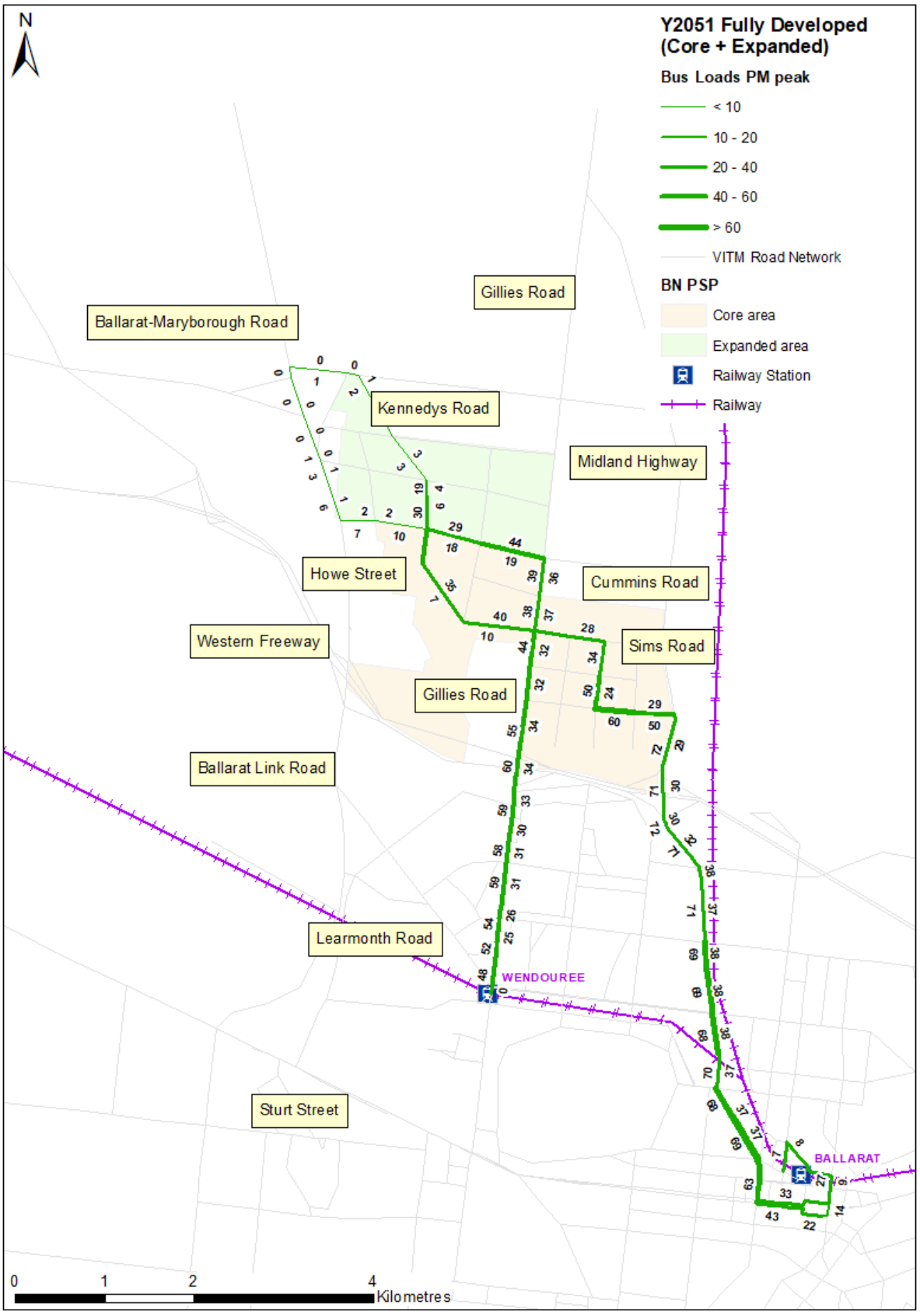


Figure 4.22: 2051 Core + Expanded, PM Peak, PSP Bus loads

4.4 Burrumbeet Creek Bridge

Jacobs were requested to assess the criticality of maintaining the Cummins Road crossing of Burrumbeet Creek. This was assessed by looking at the volume of traffic using the bridge in the '2051 Core Only' and '2051 Core + Expanded' scenarios. Select Link plots (refer to Figure 4.23 and Figure 4.24:) have been used to assess who is using this road link and how they might detour if it where closed. A summary of the two scenarios is provided below:

- 2051 Core Only Scenario:
    - 4,200 vehicles per day.
    - Primarily used to access houses and schools in the north-west corner of the PSP. Limited through traffic to the south-east corner of the PSP.
    - The most likely detour route is via Sharpes Road and Garland Road, an additional travel distance of up to 2.2km from Miners Rest South. However, Garland Road is a single lane gravel road that also includes a crossing of Burrumbeet Creek. It is not suitable to accommodate more than a few hundred vehicles per day.
    - The next best alternate routes are north via Sharpes Road and Gillies Road or to the south via the Western Freeway and Gillies Road, both add a travel distance of more than 5km.
- 2051 Core + Expanded Scenario:
    - 7,800 vehicles per day.
    - Primarily used to access the expanded PSP (51%), schools in the north-west corner of the core PSP (32%) and houses in the north-west corner of the core PSP (17%). There is very limited through traffic to the south-east corner of the core PSP.
    - Outside of the PSP area, trips originate from north of Cummins Road (19%), Miners Rest South (15%) or further south (66%). The most inconvenienced of these will be trips from the Miners Rest South area. These trips are likely to reroute as follows:
        - Assuming that the expanded PSP includes a crossing of Burrumbeet Creek, trips from north of Cummins Road will use Sharpes Road instead, a minor inconvenience.
        - Trips from Miners Rest South are also likely to reroute via Sharpes Road, an additional travel distance of up to 2.2km.
        - Trip from further south are likely to be reroute via either Gillies Road, Midland Highway or Sharpes Road.

This suggests poor transport outcomes in both scenarios, with local residents needing to make substantial detours to access the new schools as well as placing additional pressure on the Western Freeway interchanges. The '2051 Core Only' scenario is the most impacted, as they will need to make longer detours due to the lack of alternate crossings of Burrumbeet Creek.

It is recommended that as a minimum that the Cummins Road crossing of Burrumbeet Creek be maintained as an active transport crossing, with bus only access investigated. A second active transport crossing of Burrumbeet Creek around the Malahide Drive region should also be considered, regardless of the decision on the Cummins Road bridge.

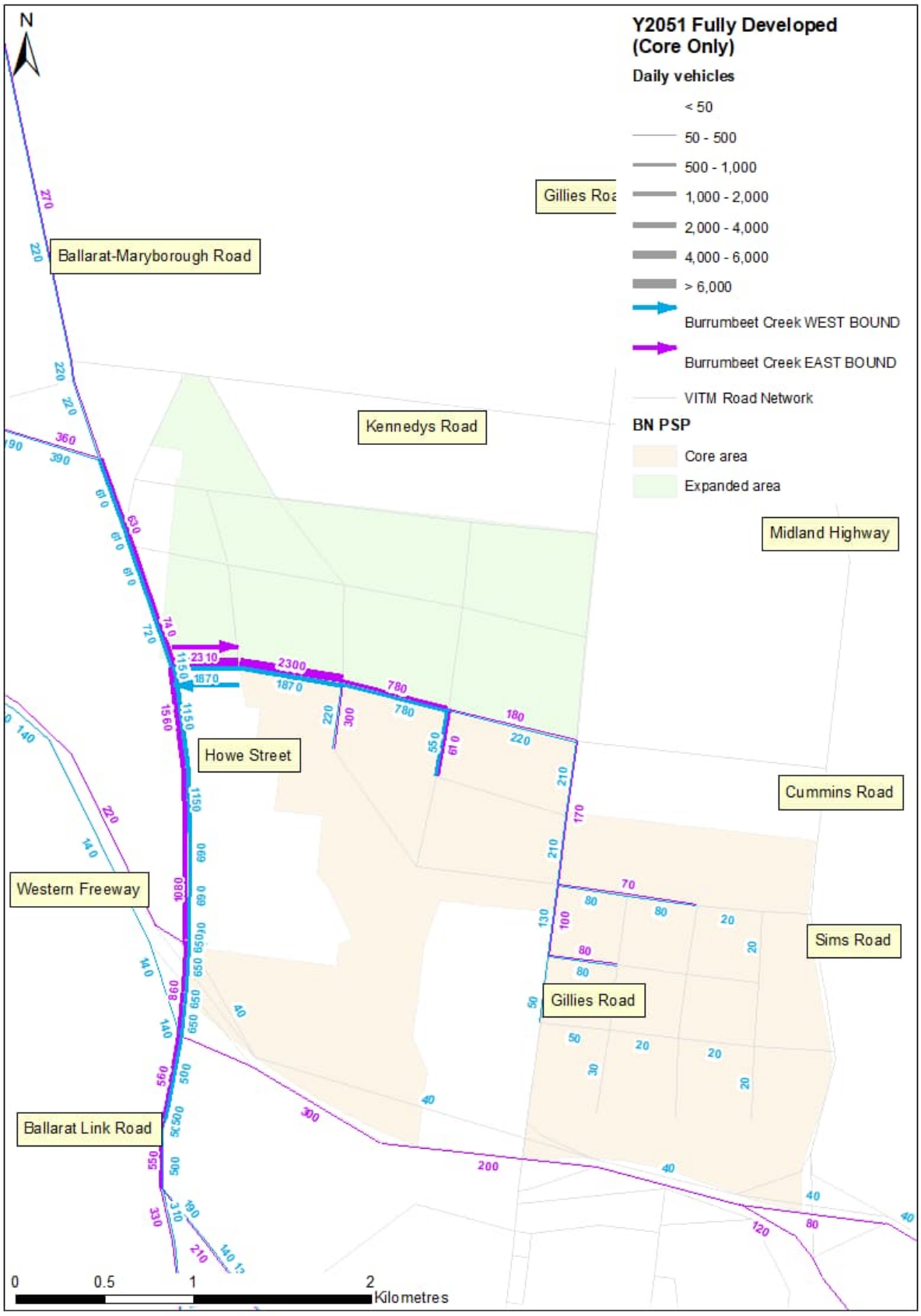


Figure 4.23: 2051 Core Only, Burrumbeet Creek, Daily Select Link Volumes, All Vehicles

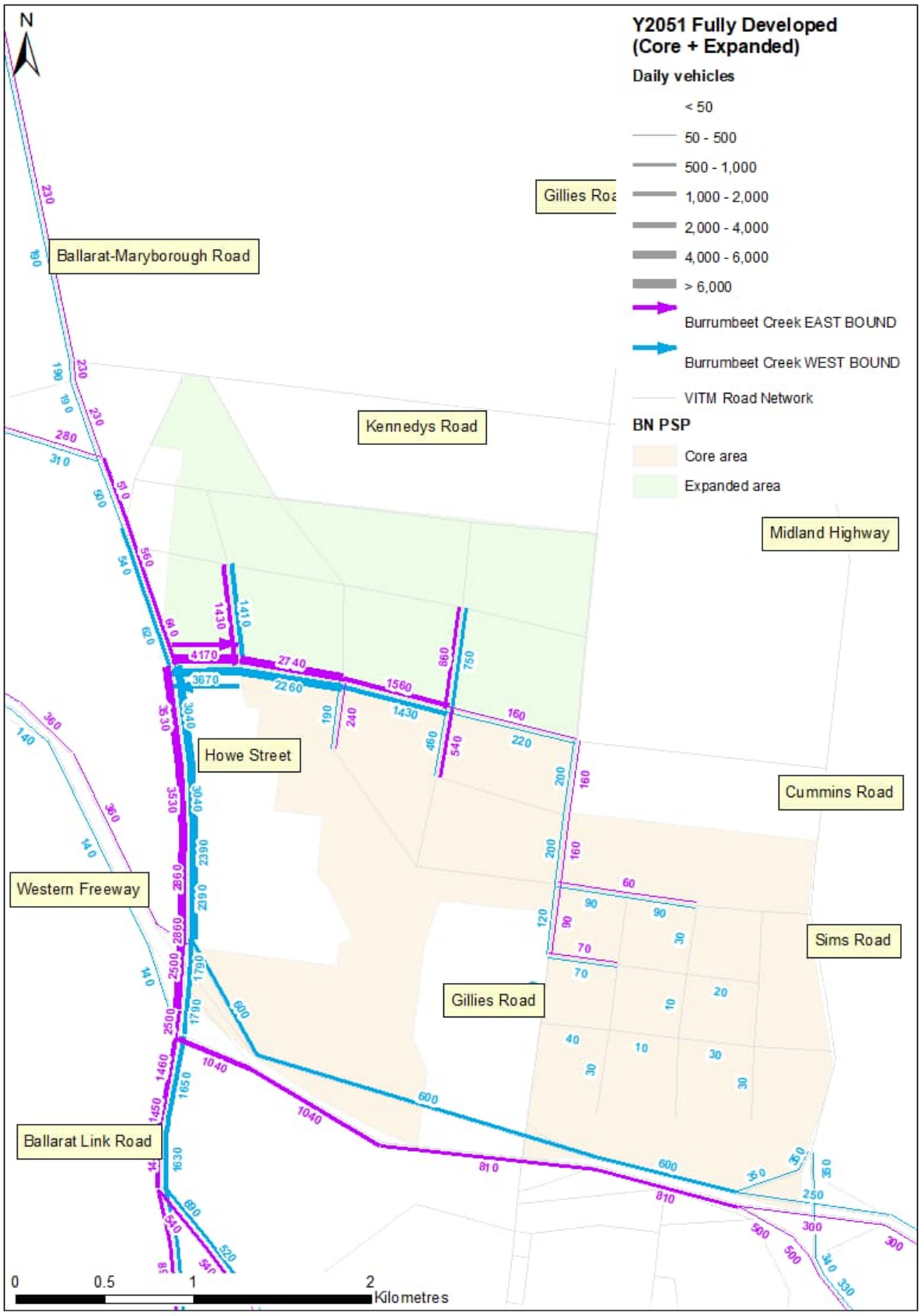


Figure 4.24: 2051 Core + Expanded, Burrumbeet Creek, Daily Select Link Volumes, All Vehicles

4.5 2051 Comparison

4.5.1 Key road links

A range of select link plots have been produced to analyse where trips using key road links are starting and ending (refer to Appendix B). This helps to understand the role that each road plays in the wider network, based on these plots the function of each road is as follows:

- **Midland Highway**: a key link between Ballarat and Creswick, the highway will be a key route for accessing the core PSP area.
- **Gillies Road**: currently used as an alternative to the Midland Highway for access into Ballarat, the function of the road will change to catering primarily to local traffic as the key north-south arterial through the PSP.
- **Howe Street**: the key access route for the Miners Rest area and part of Victoria's Principal Freight Network that connects Ballarat through to Maryborough and beyond. Will be a key route for accessing the expanded PSP area.
- **Cummins Road**: along with Sims Road and Gillies Road forms the key links between the two PSP areas (core and expanded), is the primary access route for the expanded PSP area to Howe Street. Assuming that the Burrumbeet Creek Bridge is constructed (refer to Section 4.4 for further context).
- **Sims Road**: along with Olliers Road will become the primary access points to the core PSP area from Midland Highway

The daily volumes on each of the key road links is provided in Table 4-1. To assist with the apportionment of costs, the share of traffic on each road that can be attributed to the PSP is calculated by excluding the baseline traffic from the '2051 Base Case' scenario.

Table 4-1: Select Link volumes (2051 Scenarios)

Location	Direction	2051 Daily Volumes (vpd[1])			PSP share of traffic	
		Base Case	Core Only	Core + Expanded	Core Only	Core + Expanded
Midland Highway (between Western Fwy and Olliers Rd)	Northbound	6,440	12,330	13,120	48%	51%
	Southbound	6,430	13,690	14,640	53%	56%
Gillies Road (between Western Fwy and Olliers Rd)	Northbound	450[3]	8,420	10,070	95%	96%
	Southbound	450	7,610	9,350	94%	95%
Howe Street (between Western Fwy and Normlyttle Pde)	Northbound	5,560	6,240	8,770	11%	37%
	Southbound	4,870	5,190	8,010	6%	39%
Cummins Road (Burrumbeet Creek Bridge)	Eastbound	40	2,310	4,170	98%	99%
	Westbound	40	1,870	3,670	98%	99%
Sims Road (between Midland Hwy and Gillies Rd)	Eastbound	0	4,220	5,160	100%	100%
	Westbound	0	3,070	3,800	100%	100%

[1] = vehicles per day

[3] Gillies Road traffic is lower than currently observed, as the 2051 Base Case downgrades posted speeds from 80-100kph to 60kph which diverts most traffic back onto the Midland Highway. This provides a better reflection of the share of future traffic attributed to the PSP.

4.5.2 Internal road network recommendations

The internal road network modelled (refer to Section 3.1) included duplications of Cummins Road, Gillies Road (between Cummins Road the Western Freeway) and the Midland Highway (between Sims Road and the Western Freeway). This enabled modelling of a relatively unconstrained network, such that roads would not become heavily congested and impact on route choice. Reviewing the model outputs presented in Sections 4.2.2 (Core Only) and 4.3.2 (Core + Expanded), suggest that:

- **Cummins Road**: there is no long-term need for duplication, daily traffic volumes are only 7,800vpd in 2051 with the inclusion of both the core and expanded areas. Close to 100% of the future traffic on Cummins Road is attributed to the PSP.
- **Midland Highway**: there is a strong need for duplication between Sims Road and the Western Freeway. A single lane in the base case (no development) would be approaching capacity and without duplication the highway would be over capacity in both the core only and core + expanded scenarios. Approximately 60% of the future traffic on the Midland Highway (immediately north of the Western Freeway) is attributed to the PSP.
- **Gillies Road**: provided that the Midland Highway is duplicated, there is not a strong case for duplication of Gillies Road even with the expanded area. However, the expanded area does trigger the need for future proofing the ability to duplicate between Sims Road and Western Freeway, this would be prudent planning to accommodate for future growth[4]. Around 95% of the future traffic on Gillies Road is attributed to the PSP, the majority of the traffic that used the road prior to the PSP now seek alternate routes (such as the Midland Highway) as it is no longer an 80-100kph rural arterial with limited intersections.

4.5.3 External road network recommendations

The modelling results highlight that the main concern is external to the Ballarat North PSP. Namely the three crossings of the Western Freeway at Howe Street, Gillies Road and the Midland Highway. Each of these are one-lane in each direction, with varying interchange configurations. The most congested section of each interchange is the traffic crossing over the freeway, the ramps appear to have sufficient capacity. The most congested sections have been summarised in Table 4-2 and show the impact that the PSP has on the crossings.

Table 4-2: Western Freeway Interchanges – volume capacity ratio of most congested section

Location	Direction	2051 V/C Ratios					
		Base Case		Core Only		Core + Expanded	
		AM	PM	AM	PM	AM	PM
Midland Highway	Northbound	0.1	0.3	0.2	0.7	0.2	0.9
	Southbound	0.7	0.3	0.9	0.5	0.9	0.5
Gillies Road	Northbound	0.5	0.7	0.7	1.1	0.9	1.2
	Southbound	0.6	0.6	1.1	0.9	1.1	1.0
Howe Street	Northbound	0.3	0.7	0.3	0.9	0.4	1.0
	Southbound	0.6	0.4	0.6	0.4	0.8	0.5

[4] It would also need widening of Gillies Road over and south of the Western Freeway

5. Summary Findings

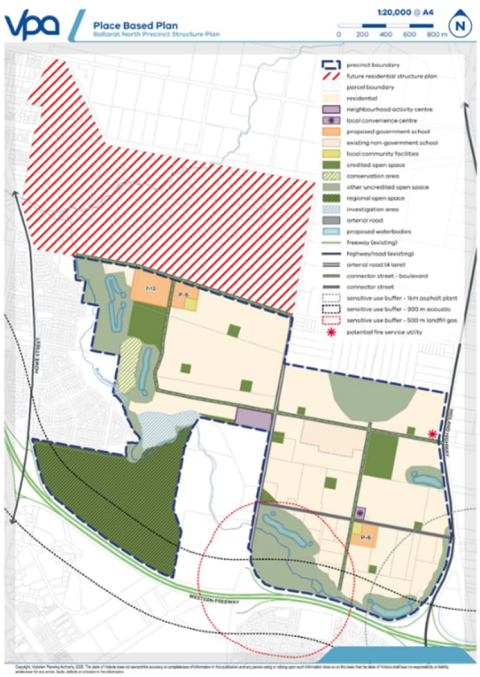
The full build out of the PSP (core and expanded areas) includes a substantial 26,600 residents, 1,000 jobs and 4,700 school enrolments. The strategic transport modelling assessment shows that the proposed road network and classifications will be appropriate for the traffic volumes forecast in 2051 for both the 'core only' and 'core + expanded' scenarios. The transport network modelled can be amended as follows:

- **Cummins Road**: there is no need for duplication, the construction of the Burrumbeet Creek bridge could potentially be avoided provided mitigation measures are put in place such as an alternate creek crossing and at least two active transport links are provided.
- **Midland Highway**: there is a strong need for duplication between Sims Road and the Western Freeway in both the 'core only 'and 'core + expanded' scenarios. The intersection of Midland Highway and Olliers Road will be the busiest intersection in/out of the PSP area and will need to be investigated further.
- **Gillies Road**: provided that the Midland Highway is duplicated, there is not a strong need for duplication even with the expanded area, however future proofing for duplication between Sims Road and the Western Freeway is recommended.

The internal road network will be confirmed in the next phase of the project, the ITAR. The suitability of bus routes and the connections to rail stations and services should also be considered.

The main concern is external to the Ballarat North PSP. Namely the three crossings of the Western Freeway at Howe Street, Gillies Road and the Midland Highway. Each of these are one-lane in each direction, with varying interchange configurations. The most congested section of each interchange is the traffic crossing over the Freeway, with both the 'core only' and 'core + expanded' scenarios leading to peak hour capacity being reached which will ultimately lead to traffic delays. The main observations are summarised in Table 5-1.

Table 5-1: Transport network summary

Proposed Road Network	Project Case Daily Volumes
	
All roads within the PSP only need to be one-lane in each direction. Gillies Road should be future proofed for duplication to Sims Road. Outside of the PSP, the Midland Highway will need to be duplicated between the Western Freeway and Sims Road.	The crossings of the Western Freeway (Howe Street, Gillies Road and the Midland Highway) are likely to be heavily congested by 2051 and will need to be reviewed by DTP.

Appendix A. Ballarat Link Road Model Review

A.1 Introduction

Jacobs has been commissioned by the Victorian Planning Authority (VPA) to conduct strategic transport modelling for the Ballarat North Precinct Structure Plan (BN-PSP). The Victorian Integrated Transport Model (VITM) provided by the Department of Transport and Planning (DTP) will be used for the strategic modelling of this study. VPA and the DTP have made a prior evaluation and advised that for this project the most appropriate version of the VITM for this project is the *VITM22v2_03_RC22v1_06,* a version of VITM developed by Stantec who included a subarea model for the Ballarat region to evaluate the Ballarat Link Road (BLR) for the City of Ballarat. In addition to the BLR version of the VITM (BLR-VITM), Jacobs also obtained the latest VITM version from the DTP, *VITM24_v2_03* (VITM24), so that Jacobs could evaluate the differences in land use assumptions between these two model versions.

This appendix presents a summary of the BLR-VITM modelling current state, as provided, to undertake the modelling task for the BN-PSP. A comparison between the BLR-VITM and the VITM24 has been made to understand the differences and decide what inputs and assumptions of the VITM24 may be integrated in the BLR-VITM. In addition, relevant aspects are laid out and brought into VPA's consideration to obtain agreement on what is to be included in the model.

These aspects are discussed in detail in the following sections and include:

- The representation of the modelled core and expanded study area in the model
- A refined VITM zone system for the study area
- Land use assumptions to adopt for the future year of 2051
- The fitness for purpose of the BLR-VITM version of the model

Jacobs has completed a review of the BLR-VITM and it is clear that it provides improved forecasts for the Ballarat region when compared with the VITM24 (Table A.1). Although the technical details of the matrix estimation completed for the BLR-VITM have not been made available to Jacobs and remain hidden and not documented, Jacobs is confident in adopting the BLR-VITM for the BN-PSP project.

A.2 Study area and VITM zoning

To capture sufficient detail to inform the BN-PSP strategic modelling, the standard VITM zone configuration requires further disaggregation. This section outlines Jacobs approach for disaggregation zones within the study area and the zone configuration. VITM has been set up in terms of land use inputs and transport networks with a maximum of 6,973 zones. For most projects, the 6,973 zones are aggregated to around 3,000 zones to allow for faster model run times. The exact number of additional zones will be confirmed upon implementation.

An approach to aggregate and split zones for this study is proposed below:

- Use the most detailed zone system for the Ballarat region as a starting point
- Disaggregate the zones within the BN-PSP. Section A.3 discusses the detailed zone splitting for the BN-PSP
- Adopt standard model aggregations for zones outside the study area (i.e. other regional centres and metropolitan Melbourne)

This creates a total of about 3,000 zones and will allow reasonable granularity for the study area and model run time. Figure 1.2 shows the existing VITM zones within the BN-PSP.

Jacobs proposes a layout of zones based on VPA's Draft Place Based Plan from October 2024. Each zone in the BN-PSP (as shown in Figure 1.2) has been individually considered and split based on the following factors:

- The BN-PSP Draft Place Based Plan from October 2024
- 20,000 detailed Small Area Land Use Projections (SALUP) land use zones, which is the finest granularity to which DTP produces land use forecasts
- Homogeneousness of land use
- Using natural or other barriers as zone boundaries

Figure 2.1 in the body of the report shows the disaggregation of zones within the BN-PSP boundaries. The break-down introduces 17 additional zones to represent the BN-PSP.

A.3 Validation check

This modelling exercise relies on work undertaken by Stantec as part of the Ballarat Link Road Preliminary Business Case. A full validation of the VITM-BLR is out of scope for this study. However, Jacobs has reviewed the validation previously undertaken[5] and confirms that it meets standard validation guidelines with respect to convergence and traffic volumes in the peak periods. There is no validation of trip lengths, travel times, public transport volumes or daily traffic volumes.

Given that the traffic volumes are the most important for the BN-PSP study, we can confirm that the model validation appears appropriate. To support this, Jacobs has completed an additional high-level validation check using independent traffic volumes in the study area and surrounding region, to confirm it is fit for purpose. Figure A.1 shows the locations of the validation checks.

[5] Ballarat Link Road – VITM Modelling Report, Prepared for City of Ballarat, Stantec, 11th June 2024

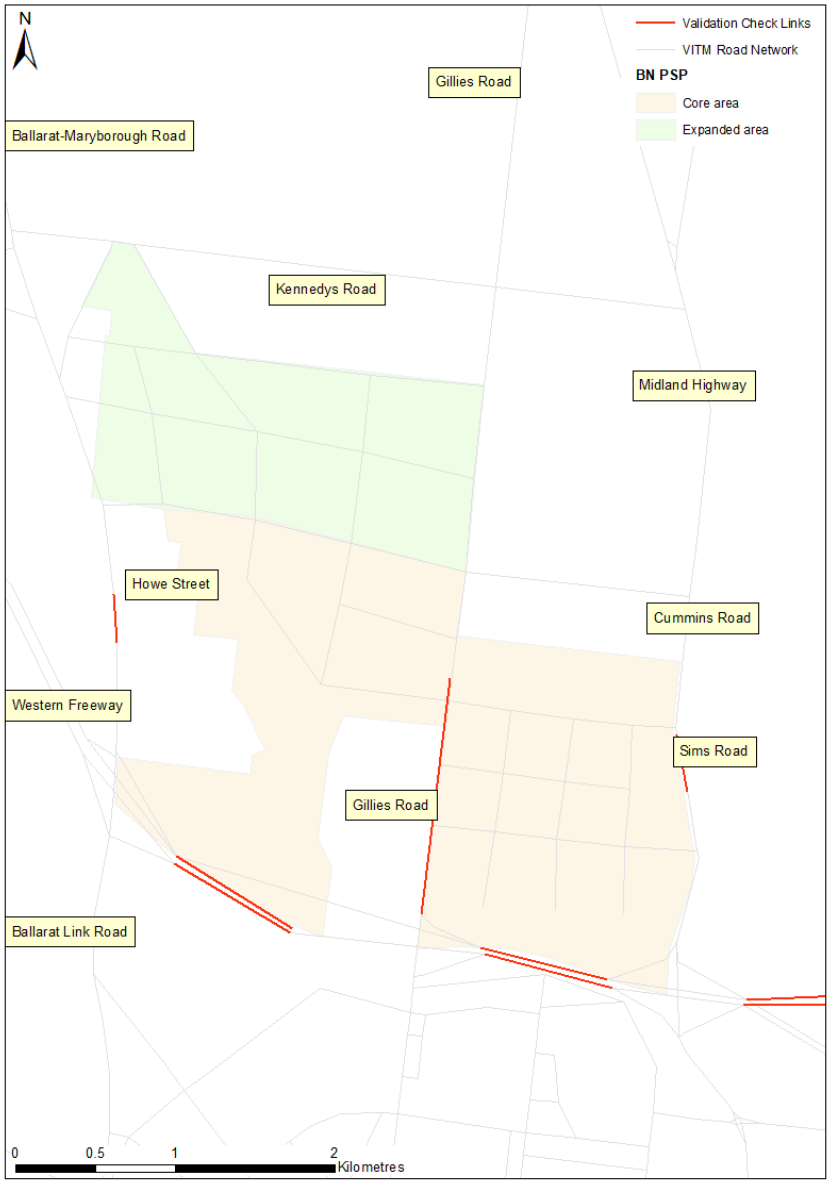


Figure A.1: Road volume validation check locations

The BLR-VITM includes a set of traffic counts that were used to inform the calibration validation task, however none of those counts were in the BN-PSP area, therefore they are not reported here Table A.1 presents a comparison of daily volumes between the available observed data from 2020 obtained on the DataVic.gov.au website (https://discover.data.vic.gov.au/dataset/traffic-volume) and the modelled volumes in the BLR-VITM model and the VITM24 for 2018.

Figure A.2 graphically compares the volumes from, this shows that the BLR-VITM subarea and matrix estimation implementation improves the fit of the model to the observed data on the majority of roads shown. Also important to note that Gillies Road volumes are significantly underestimated in both directions, this suggests that the road is a popular alternative to the Midland Highway. This is an important aspect to consider at a later stage when analysing future year volumes.

Table A.1: Comparison of daily volumes on the main arterials surrounding the BN-PSP

Location	DataVic 2020	BLR-VITM 2018	VITM24 2018 RC	Difference BLR minus DataVic	% Difference BLR minus DataVic
Western Fwy Westbound (West of Gillies Rd)	5,700	5,900	5,200	200	4%
Western Fwy Eastbound (West of Gillies Rd)	6,200	5,600	5,100	- 600	-9%
Western Fwy Westbound (East of Gillies Rd)	7,300	9,900	8,600	2,600	35%
Western Fwy Eastbound (East of Gillies Rd)	8,300	8,700	7,500	400	4%
Western Fwy Westbound (East of Midland Hwy)	7,900	7,500	6,800	- 400	-5%
Western Fwy Eastbound (East of Midland Hwy)	7,900	8,000	6,600	100	1%
Howe St Southbound	3,400	2,400	1,500	- 1,000	-29%
Howe St Northbound	3,500	2,100	1,400	- 1,400	-40%
Gillies Rd Southbound	4,600	2,000	1,800	- 2,600	-57%
Gillies Rd Northbound	5,000	2,000	1,800	- 3,000	-61%
Midland Hwy Southbound	4,100	4,100	5,500	-	0%
Midland Hwy Northbound	4,000	4,000	5,200	-	-1%

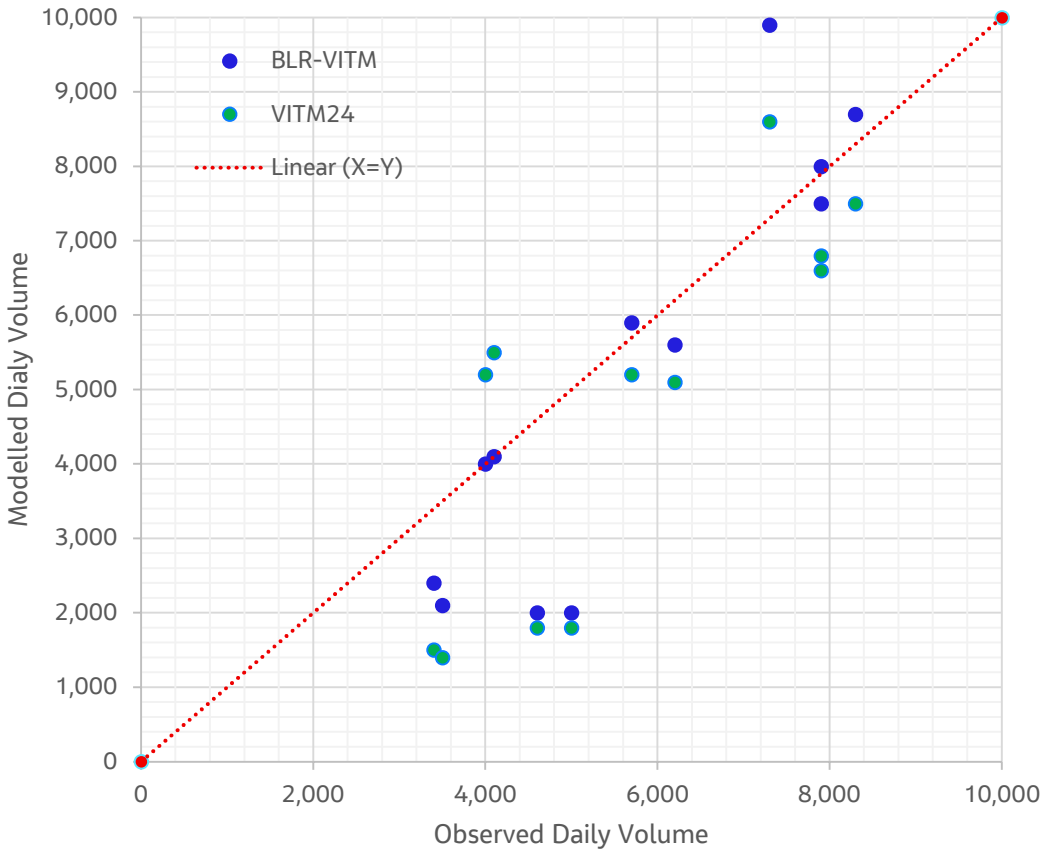


Figure A.2: Modelled vs Observed daily volume comparison

Figure A.3 represents the daily road volumes in the region surrounding the BN-PSP for 2018 as produced by the BLR-VITM model.

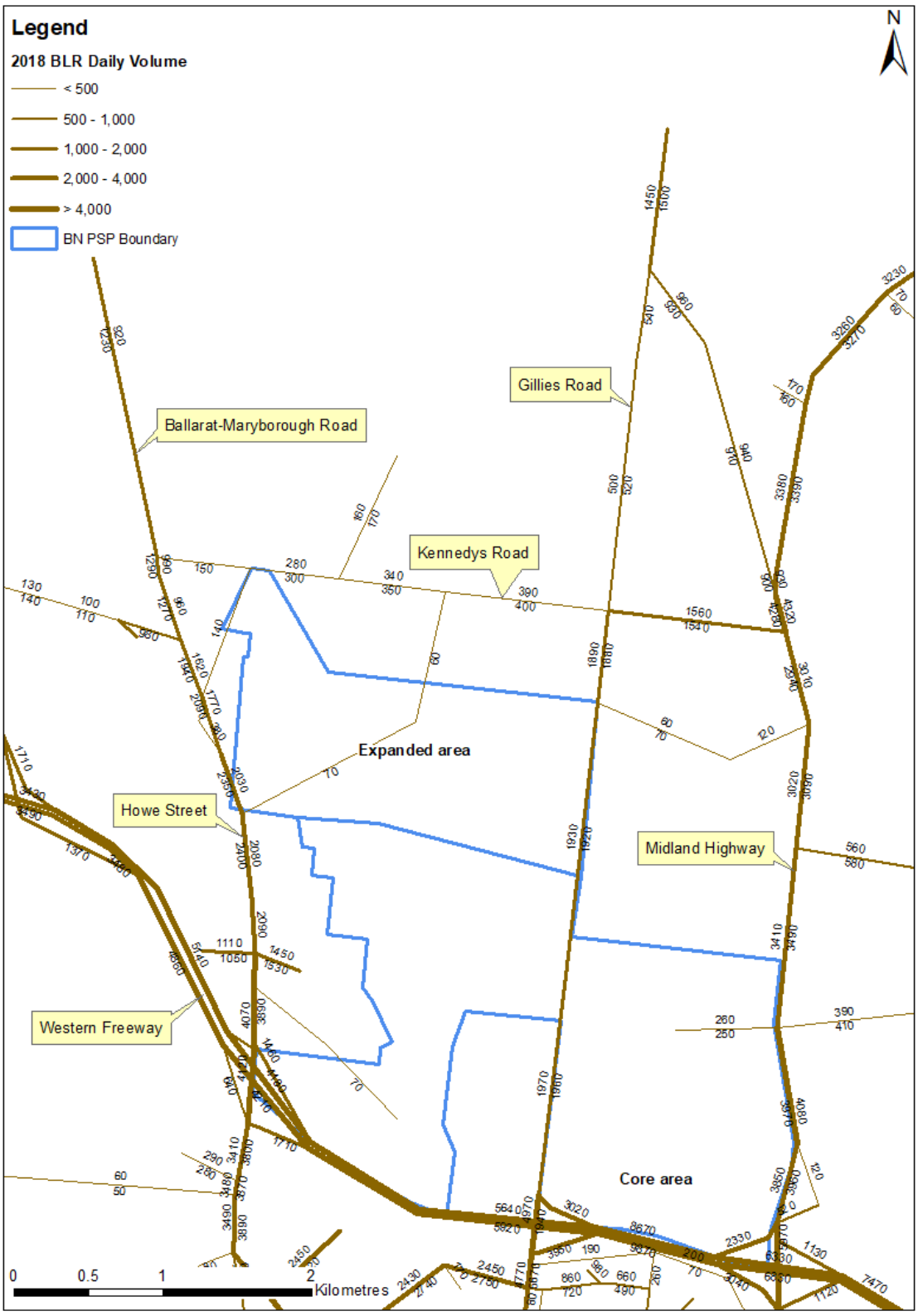


Figure A.3: 2018 VITM-BLR, daily volumes

For comparison, the daily road volumes produced by the VITM24 version of the model for 2018 are presented in Figure A.4.

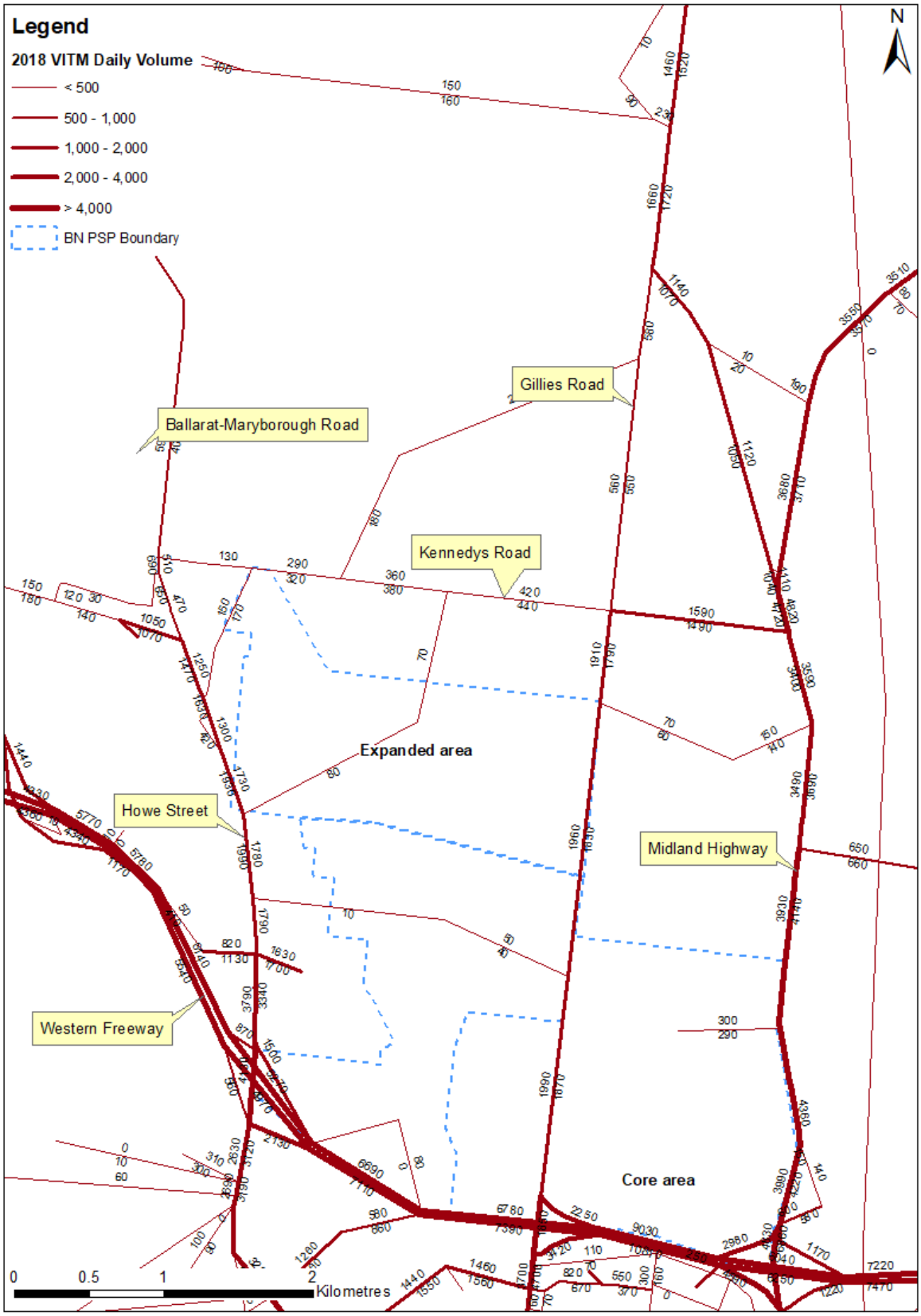


Figure A.4: 2018 VITM24, daily volumes

A.4 Land use assumptions

A summary of the population, employment and school enrolments within the BN-PSP (core + expanded) for 2018 and 2051 in the newer VITM24 Reference Case scenario[6] compared to the BLR-VITM model[7] is shown in Table A.2 and Table A.3 that uses the SALUP22 projections. Both projections have the same population, employment and school enrolment values in 2018 however there are differences in all 3 categories for the year 2051.

Table A.2: 2018 VITM24 and BLR-VITM land use statistics

Area	2018 Reference Case (VITM24 and BLR-VITM)		
	Population	Employment	Enrolments
BN-PSP	296	111	0
Ballarat LGA	107,054	54,399	34,842
Victoria	6,459,959	3,248,095	1,499,205

For 2051, the SALUP24 projections consider significant growth in population within the PSP. For the whole State of Victoria, the SALUP24 population projection is higher than the SALUP22, and for the Ballarat LGA the opposite is the case. Within the Ballarat LGA although the SALUP24 projections consider less population than in the SALUP22, the employment projections are higher in the SALUP24.

Table A.3: 2051 VITM24 and BLR-VITM land use statistics

Area	VITM24 SALUP24 2051 Reference Case			BLR-VITM SALUP22 2051 Reference Case		
	Population	Employment	Enrolments	Population	Employment	Enrolments
BN-PSP	9,781	179	0	951	166	0
Ballarat LGA	174.688	83,956	48,889	177,567	79,130	48,365
Victoria	10,325,553	5,457,501	2,339,730	10,072,045	5,226,586	2,254,348

Given the differences outlined above, Jacobs adopted DTP's advice and developed an updated scenario for 2051 which was used as a base case for 2051 scenario testing. This considered the latest SALUP24 projections for the whole State and adopted the VPA's projections for the BN-PSP and the BWEZ outlined in Table A.4, Table A.5 and Table A.6. This way, the latest DTP projections for population, employment end school enrolments are considered along with the projections for the relevant study area.

[6] Based on Small Area Land Use Projections from 2024 (SALUP24)

[7] Based on Small Area Land Use Projections from 2022 (SALUP22)

Table A.4: Population and employment projections (VPA)

	Residents	Dwellings	Employment
Core area	18,726	6,688	644
Expanded area	9,790	3,496	336
Total	**28,516**	**10,184**	**980**

Table A.5: School enrolment guidelines (VPA)

School location	Enrolments
Government Primary School (SE)	900
Government Primary School (NW)	900
Government Primary School (Expanded area)	900
Government Secondary School (NW)	2,000

Table 3-3 in the body of this report summaries the final land use assumptions adopted for the BN-PSP. These assumptions follow the guidelines and figures provided by VPA for this project and outlined in Table A.4 and Table A.5

A.4.1 Ballarat West Employment Precinct

In addition to the changes in land use assumptions to be considered within the BN-PSP, the Ballarat West Employment Precinct (BWEZ) has been identified as relevant for this modelling exercise because it is planned to generate significant employment in the future and attract a number of trips from the BN-PSP given the PSP has limited employment. With that in mind, the BWEZ employment forecasts will be added to the land use assumptions.

Figure A.5 shows the location of the BWEZ in relation to the BN-PSP and how its zones have been coded in the VITM.

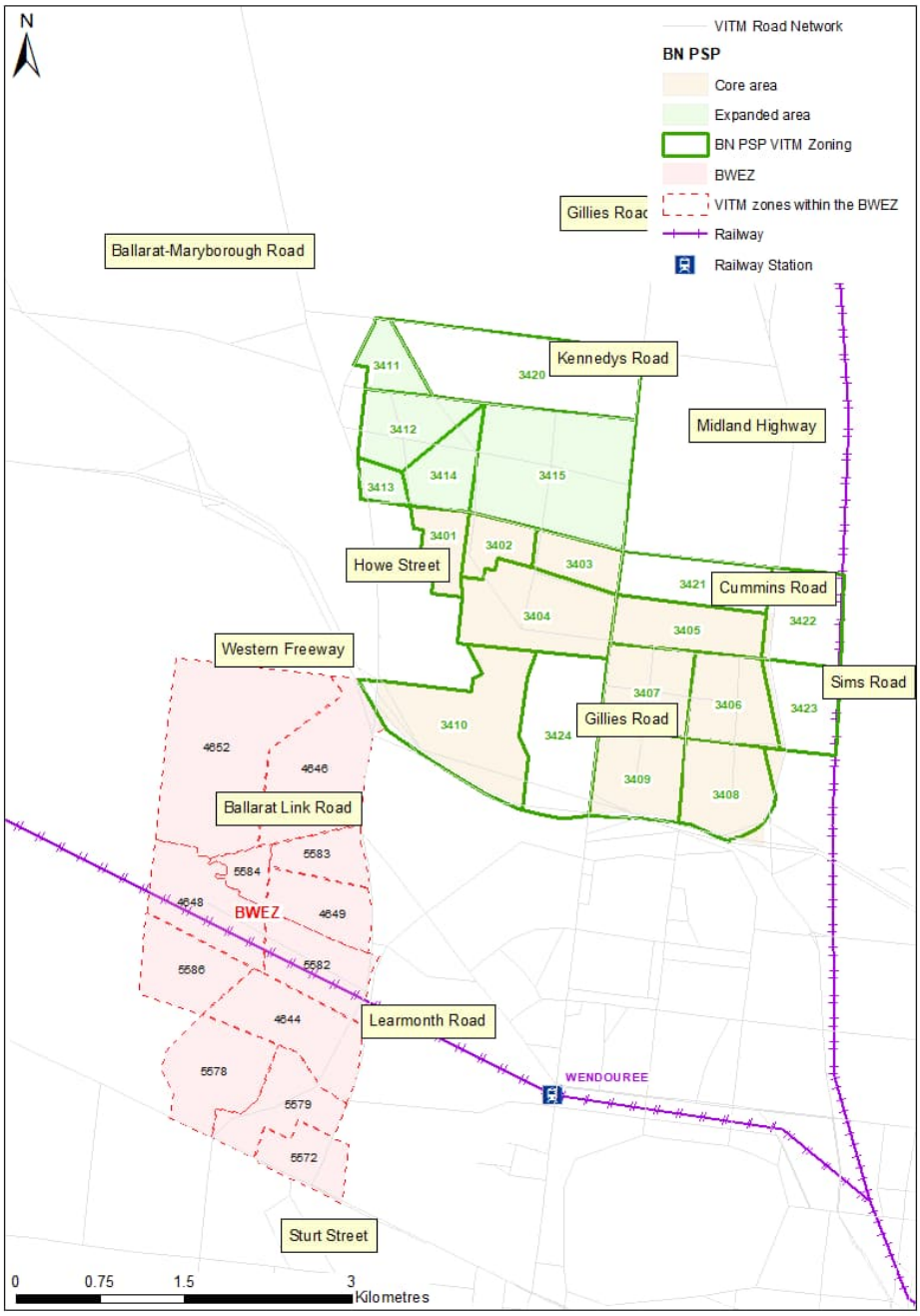


Figure A.5: Overview of the BWEZ in the context of the BN-PSP

The VITM-BLR model provided to Jacobs contained three land use files, as below:

- SALUP22 Core - Reference case version
- SALUP22 BLR - used for the BLR modelling
- SALUP22 Council – City of Ballarat population and employment growth projections for both the BN-PSP and the BWEZ

Table A.6 summarises the 2051 population and employment projections and also includes the latest VITM24 Reference Case projections and VPA's projections for the BN-PSP for reference. It was decided to adopt VPA's projections for the BWEZ for this study.

Table A.6: 2051 Population and employment for the BN-PSP and the BWEZ

2051	BN-PSP		BWEZ	
	Population	Employment	Population	Employment
VITM 2024 RC	9,781	179	623	150
VITM SALUP22 Core	951	166	540	87
VITM SALUP22 BLR	951	166	540	299
VITM SALUP22 Council	18,053	8,110	-	1,200
VPA 2025	28,516	980	-	2,000

Appendix B. Select Link Plots

Table B.1 along with Figure B.1 show the select location included within this report.

Table B.1: Select Link locations

Number	Location	Direction
1	Cummins Rd (West of Gillies St)	East Bound
2	Cummins Rd (West of Gillies St)	West Bound
3	Howe St	South Bound
4	Howe St	North Bound
5	Gillies St	South Bound
6	Gillies St	North Bound
7	Sims Rd	East Bound
8	Sims Rd	West Bound
9	Midlands Hwy	South Bound
10	Midlands Hwy	North Bound
11	Burrumbeet Creek Bridge	East Bound
12	Burrumbeet Creek Bridge	West Bound

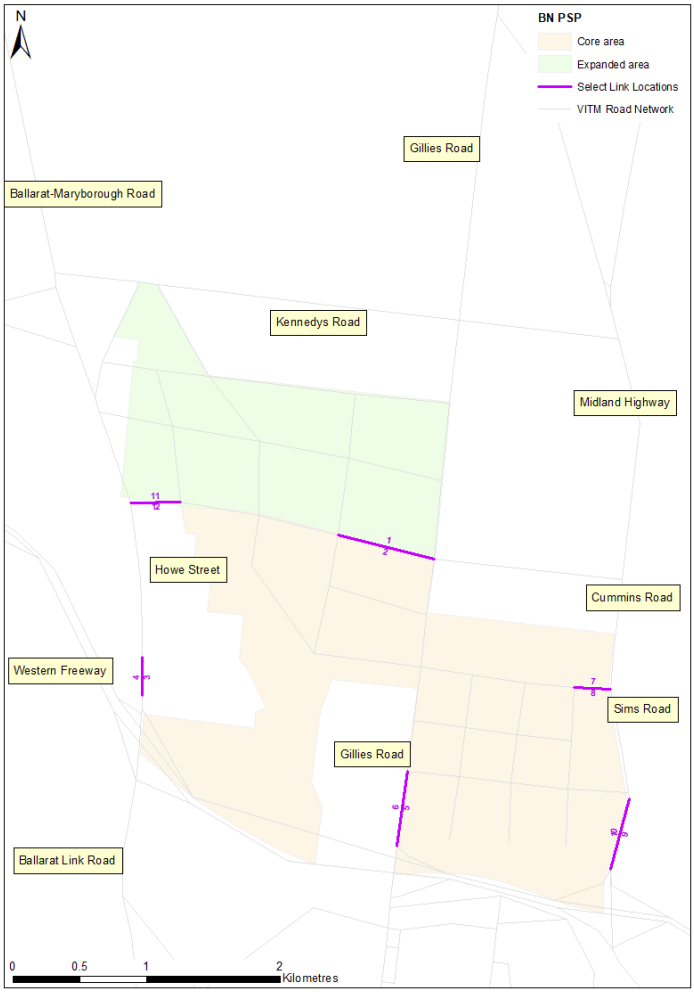


Figure B.1: Select Link Locations

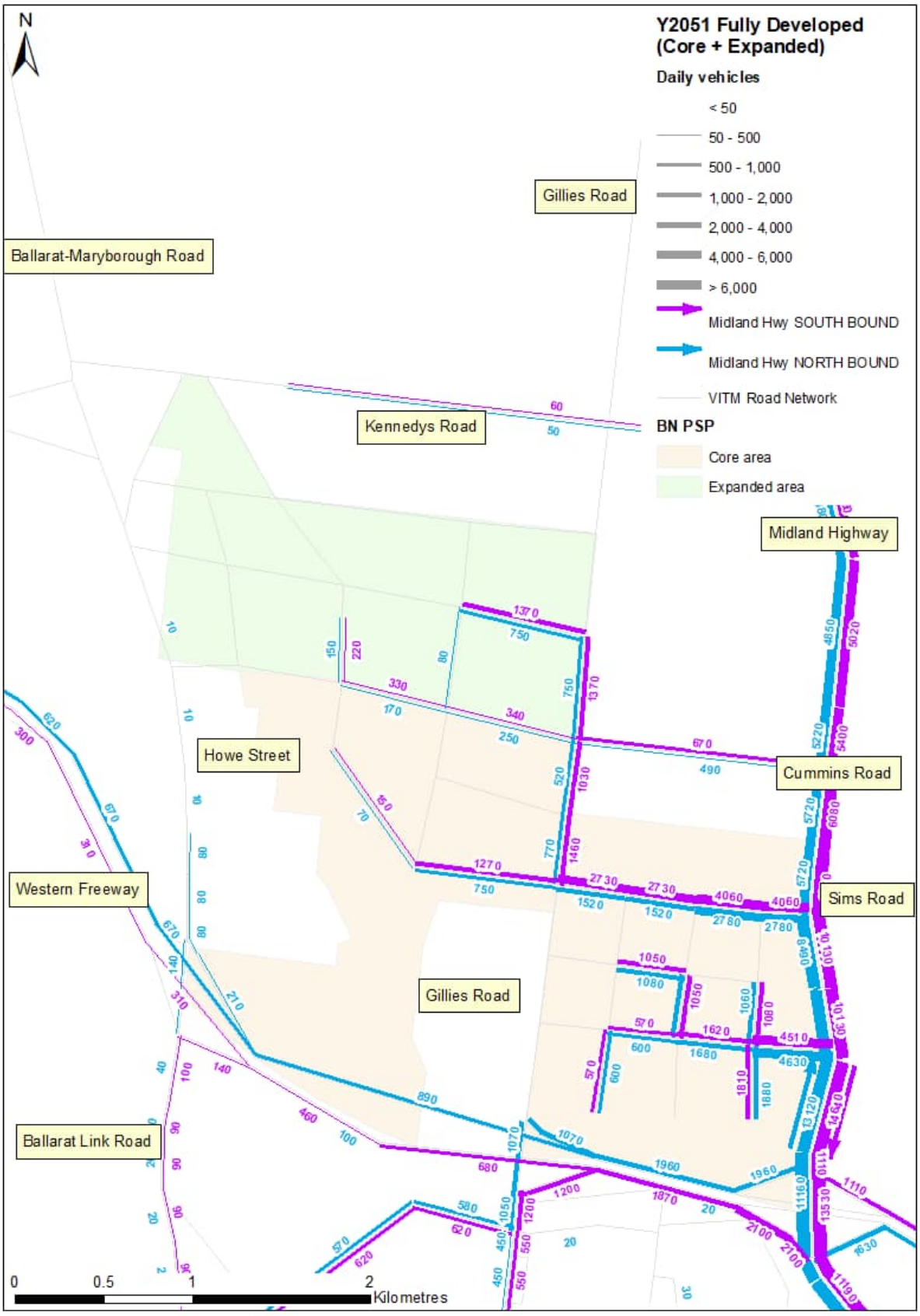


Figure B.2: 2051 Core + Expanded, Midland Highway, Daily Select Link Volumes, All Vehicles

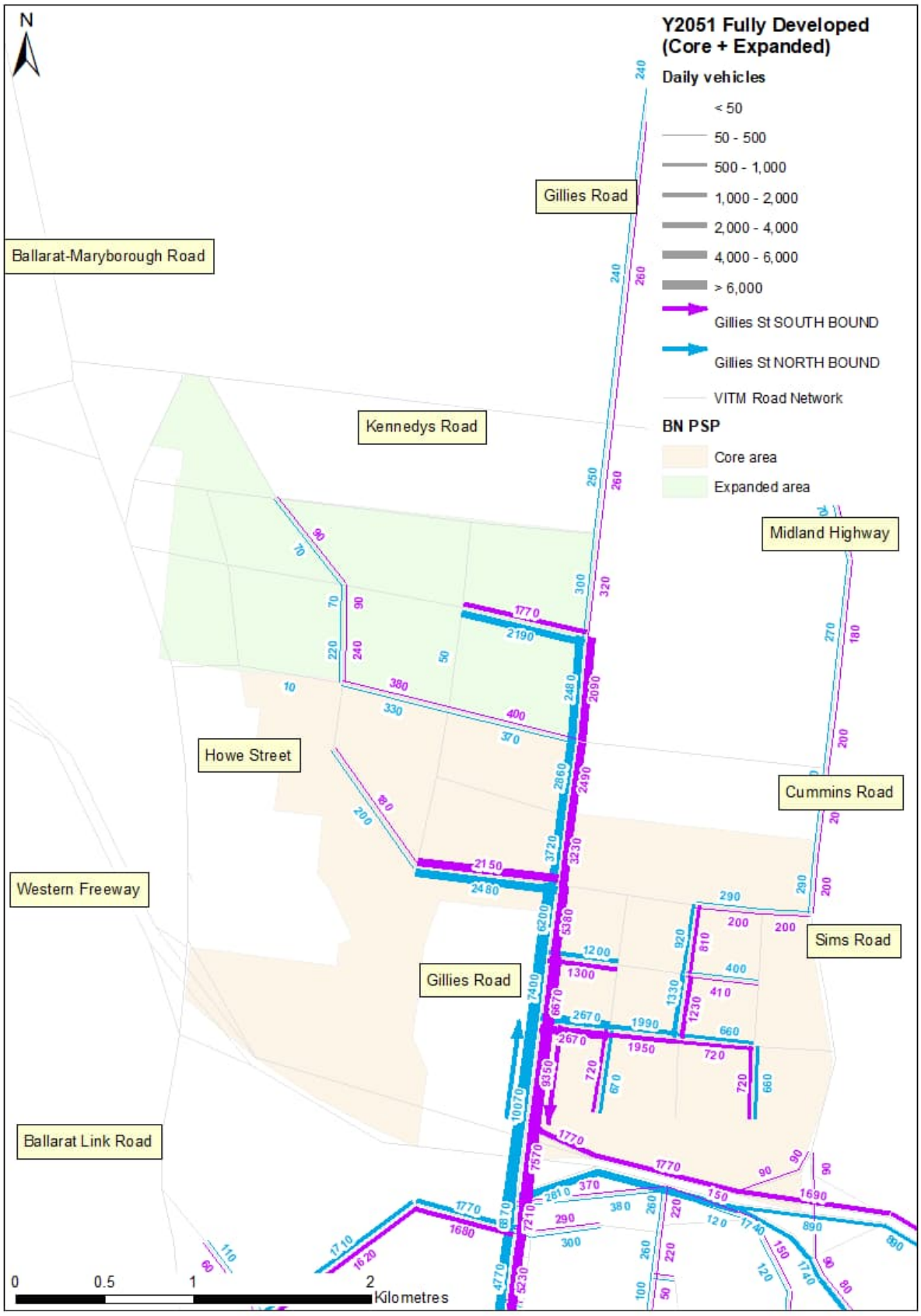


Figure B.3: 2051 Core + Expanded, Gillies Road, Daily Select Link Volumes, All Vehicles

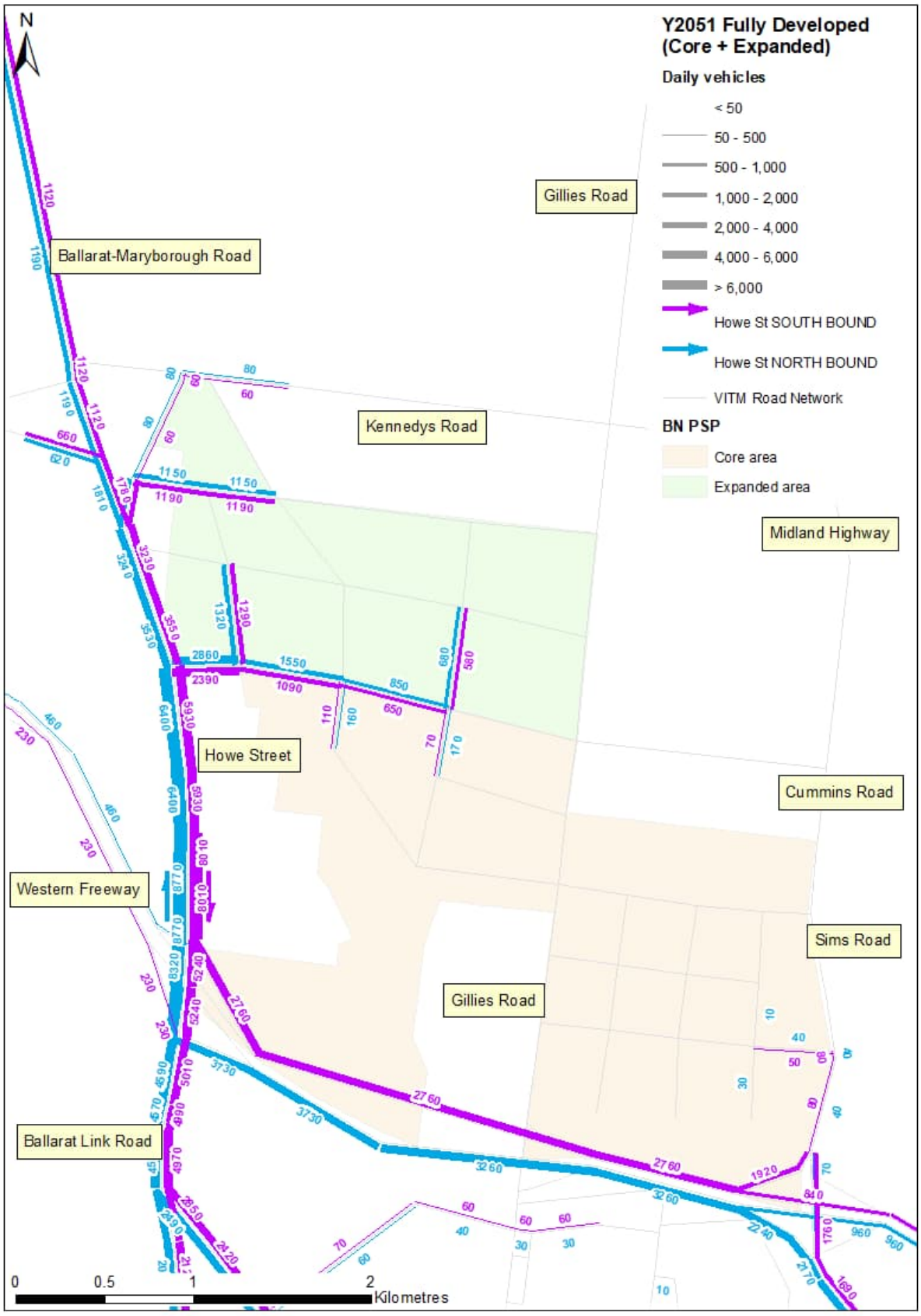


Figure B.4: 2051 Core + Expanded, Howe Street, Daily Select Link Volumes, All Vehicles

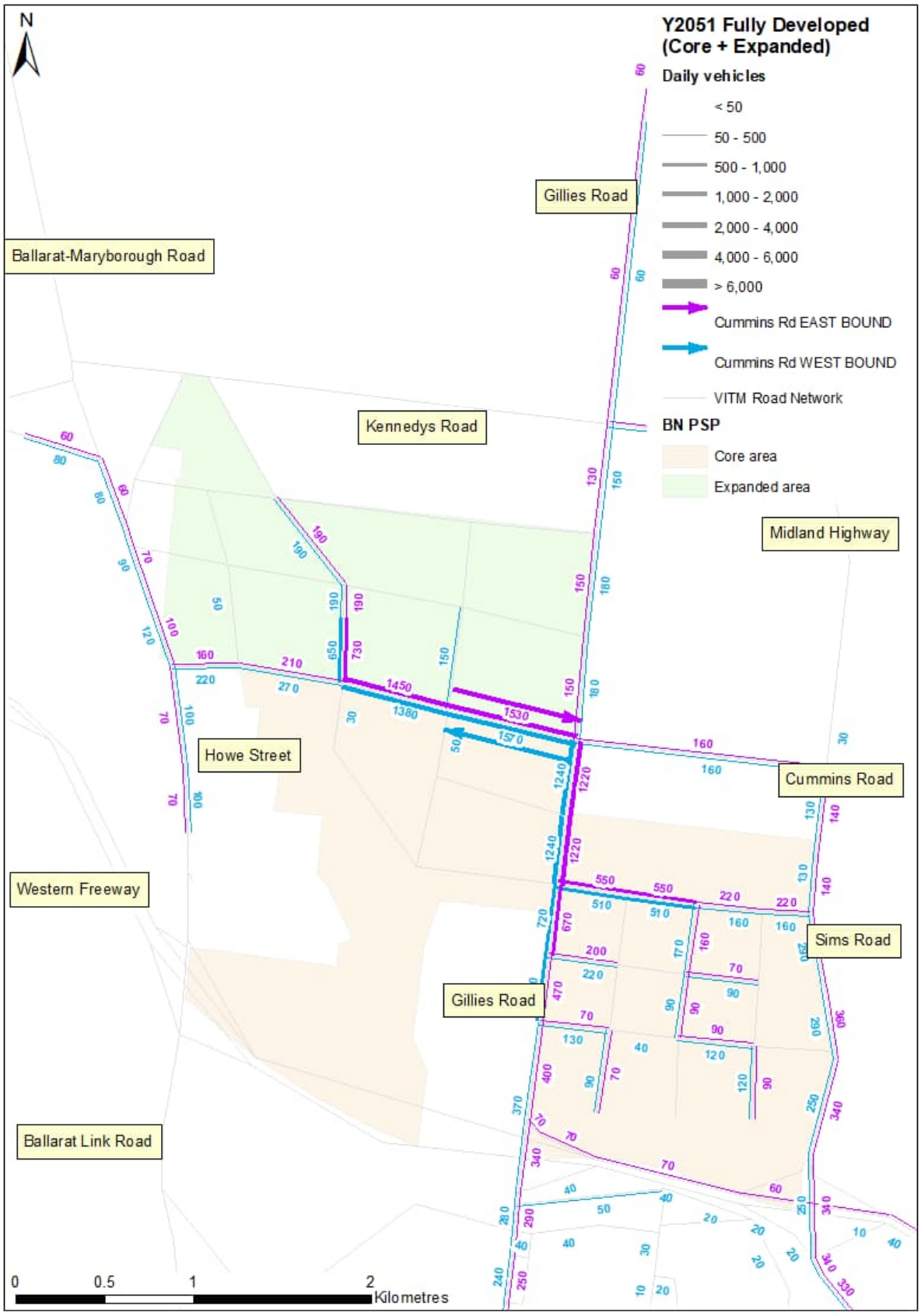


Figure B.5: 2051 Core + Expanded, Cummins Road, Daily Select Link Volumes, All Vehicles

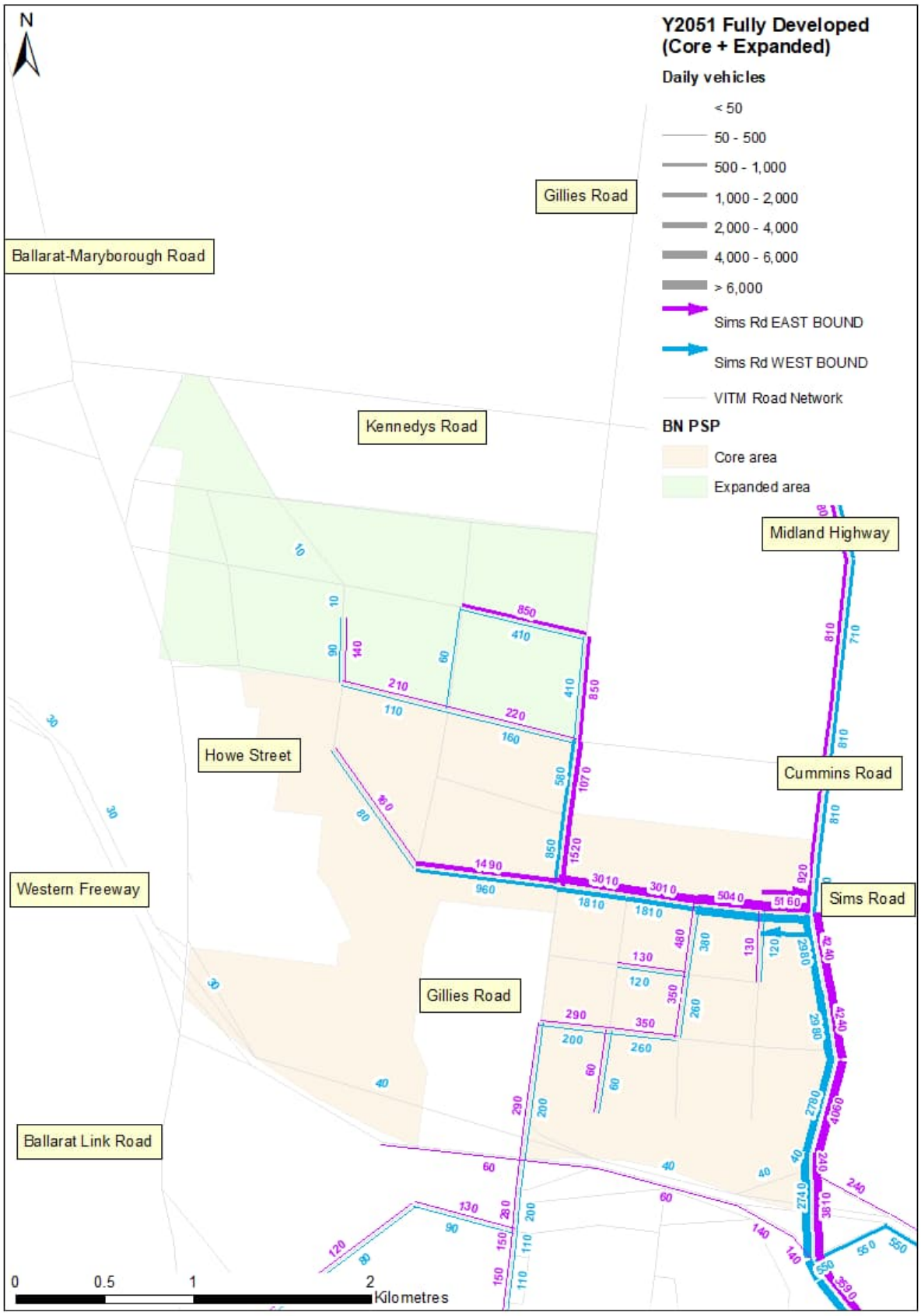


Figure B.6: 2051 Core + Expanded, Sims Road, Daily Select Link Volumes, All Vehicles