The potential for carpooling as a more sustainable transport option

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Abstract

The Victorian Transport Plan has allocated $6 million to the development and delivery of a carpooling program to reduce greenhouse gas emissions and congestion in peak periods. The target audience is commuters as the journey to work is the major contributor to the morning peak, making up more than 60 per cent of travel. This paper aims to identify employment locations with the most potential for travel behaviour change through car pooling. The level of potential is based on the degree of car dependency, and the availability and viability of alternative travel options. The analysis used three variables to analyse ABS Journey to Work data; the total number of 'car as driver' trips, the mode share of 'car as driver' trips and the percentage of 'car as driver' trips of more than 5 km in distance. The findings indicated that there is potential for carpooling to employment locations in outer Melbourne suburbs, particularly for journeys originating from growth areas.

Introduction

Carpooling is commonly understood as occurring when several people or their children travel together in one privately-owned vehicle, sharing the costs and often taking turns to drive. Carpooling is often used for commuting to school, university or work. Carpooling can result from existing connections between people, matches made on an open access carpooling web-site or can be formally organised through programs delivered through workplaces or schools. People are often motivated to participate in carpooling by fuel savings and reduced vehicle maintenance and servicing costs.

Carpooling is one of several options for reducing the greenhouse gas emissions from transport, for reducing traffic and parking congestion and for increasing the resilience of car dependent communities to increasing transport costs. If carpooling occurs where previously two or more people were driving their own vehicles to the same location then the greenhouse gas emissions from one or more of these trips are saved. It is noted that depending on the proximity of the points of origin, the amount of saving may be reduced if a substantial deviation from the original route is required to pick up the passenger.

This work aims to investigate locations with the highest potential for carpooling. As part of the *Victorian Transport Plan*, the Victorian Government has committed $6 million to increasing vehicle occupancy. In light of this commitment, this paper does not aim to assess the role of car pooling as a sustainable transport option, rather it focuses on identifying locations where there is potential for car pooling to be undertaken as a sustainable transport option. Paterson (2004) acknowledges the need to identify locations with potential for carpooling prior to the commencement of program delivery to ensure that funds are well spent and carpooling programs are successful.

It is recognized that factors other than location are important in developing carpooling programs, including the design of ride matching services, the development of incentives programs and

marketing and communication strategies. These factors have been widely reviewed and evaluated (Brownstone (1991), DGMT (1999), US EPA (2005), DeGruyter (2006), Menczer (2007), Kwon (2008). Therefore, this paper aims to identify priority locations in Melbourne for delivering car pooling programs with these available funds.

The potential for carpooling is premised on the degree of car dependency for the journey to work. Car pooling has potential for other trip purposes but international evidence and Victorian travel patterns suggest most likely to have an impact on journey to work trips. If people are dependent on their cars to get to work then they will have no capacity to avoid price increases in fuel, car insurance and vehicle maintenance and servicing costs. People who are car dependent have stronger incentives to consider and participate in carpooling.

Journeys to work which leverage intrinsic incentives and opportunities will have a stronger chance of supporting behaviour change to carpooling. It is premised that destinations[1] with potential for carpooling mode shift need to demonstrate the following three characteristics travel patterns:

- A destination with potential needs to contain a high number of journeys to work by single occupant vehicles (SOV). If there are large numbers of SOV journeys to work to the same destination, then the chances of making a match with someone who is making the same journey and is working for the same organisation (or is part of the same area-based scheme) is increased. In addition this is also a proxy measure for the level of traffic, the higher the number of journeys to a location, the more likely it is to experience congestion during peak periods.
- A destination with potential needs to have few other transport options. If it is difficult to access using public transport (relative to their point of origin or their time of journey) people are reliant on their cars.
- A destination with potential needs to contain a high proportion of long-distance SOV journeys. The longer the distance travelled to work, the greater the potential savings on fuel and vehicle costs and the less viable are alternatives such as walking or cycling.

These characteristics are based on factors which have been shown to influence the levels of participation in carpooling programs, namely the potential for making a ride match (Paterson (2004),TravelSmart (2006)), availability and viability of alternative options (DeGruyter (2006)) and level of inherent incentives (Jacobson (2009)).

Methodology

Potential destinations were identified by analysing the Journey to Work (JTW) data collected by the Australian Bureau of Statistics (ABS) as part of the Census in 2006. This data only included travel to places of employment and did not include trips undertaken for other purposes.

This work focused on approximately 1,500,000 journeys to work within Melbourne. As such, all destinations and origins in this analysis were located in the Melbourne Statistical Division (MSD). Approximately 26,000 journeys to work originating from outside of the MSD were excluded from this analysis. This may have undervalued destinations such as Melbourne Airport which has the potential to attract specialised workers from outside the MSD.

[1] This work focuses on identifying destinations with high potential as the delivery of formal carpooling programs is most often achieved through engaging with people through their workplace i.e. their destination.

This work used the ABS category 'car as driver' as the unit of measure[2]. Car as driver captured the potential to add passengers to journeys which were already being undertaken. Data was also obtained on other methods of travel to enable percentages to be calculated. There were 913,491 'car as driver' journeys to work originating and concluding within the MSD on census day.

This work used suburbs as the unit of measure for the origins and destinations, which is unusual as ABS data generally uses areas defined by the Australian Standard Geographical Classification (ASGC). The choice of a suitable geographic unit was considered crucial to the data analysis and evolved after some early trials with both smaller and larger units. Statistical local areas (SLA) were considered too large to be useful, particularly as outer metropolitan SLAs can be more than 100 km^2. A smaller unit, destination zone[3] (DZ) was found to be too small, particularly for considering the CBD as an area, where DZs can be the size of one city block. In addition the large number of units involved, approximately 2,375, would have added complexity to the data manipulation without adding to the clarity of the analysis.

Suburbs were considered to be a good balance between managing the complexity of the analysis, delivering usable results and enabling the results to be easily communicated[4]. There were 439 destination suburbs and 463 origin suburbs[5] used in this analysis. The size of each suburb was typically a few square kilometres, enabling sufficient number of journeys to be captured without the need to consider privacy issues but not so many that the data became unusable. In addition, suburbs were an easier unit of measure to comprehend than SLAs or DZs when communicating findings to audiences such as employers and local councils.

Three variables were developed from the ABS Census data set to identify destinations with potential for delivering car pooling outcomes:

Variable 1: The total number of 'car as driver' journeys to work originating and concluding within the MSD at a suburb level.

Variable 2: The percentage of 'car as driver' journeys to work originating and concluding within the MSD as a proportion of all trips at a suburb level.

Variable 3: The percentage of 'car as driver' journeys to work originating and concluding within the MSD of a distance equal to or greater than 5 km at a suburb level.

These variables are aligned to the characteristics discussed above which it is premised are necessary for a destination to have potential for carpooling. It is acknowledged that these

[2] Whilst the term 'single occupant vehicle' is used in the introduction and conclusion, the term 'car as driver' is used in the discussion of findings. 'Car as driver' does not exclude the possibility that the vehicle also contains a 'car as passenger'; however in the majority of cases it is hypothesised that there will be at least one free seat in a vehicle.
[3] Destination zones as defined by VicRoads are the smallest spatial unit for place of work.
[4] There were some compromises from recoding the data – chiefly the imperfect fit between suburbs and both collector districts (CDs) and DZs. This impact fit resulted in the creation of some origins known as 'balances' – referring to an area that is not formally recognised as part of a suburb or locality. There were approximately 50 of these balance areas within the origin dataset, mainly occurring in low-population density areas outside metropolitan Melbourne and contributing a very small proportion (~ 0.5%) of the total trips to MSD destinations. The treatment of these balance areas varied slightly in the analysis. Such origins were mostly excluded from the data for Variables 1 and 3 (marginally reducing total trips), while they were incorporated into adjoining suburbs for Variable 2. Therefore care should be taken in directly comparing the pure number of car as driver trips or total (all-modal) trips used for Variable 2 with trips used for Variables 1 and 3.
[5] This difference is due to the different parameters on data collected for origins and destinations

variables are constrained by the data sets which are available. However as this work aims to provide a high level analysis so that priority locations can be identified the level of data is sufficient for this purpose.

All three variables were measured on an integer scale from 1 to 5, with a rating of '5' referring to high score for the variable and a rating '1' indicating a low score. The scores for all three variables were summed for each destination, with the highest possible score being 15. This score across all three variables provided the measure of a destination's potential for carpooling.

For efficient and practical evaluation of destinations against each variable, the principle aim was to allocate a relatively low proportion of destinations to the higher rating categories (4 and 5) and a higher proportion of destinations to the lower ratings (1 and 2). This enabled the destinations which perform strongly on each variable and across all three variables to be readily identified.

The development of the ratings for each variable involved reviewing the frequency distribution of the data sets for each variable, and then testing and evaluating the capacity of the rating thresholds to meet the criteria above. A less critical but desirable consideration was the selection of 'rounded' ratings thresholds for easier data analysis and a simpler methodology.

The scores for each variable are then aggregated. Variable 1 focuses on identifying locations with a high volume of 'car as driver' journeys to work. Experience with successful carpooling programs suggests that the greater the size of the potential pool the better the chance of making a match [insert refs]. There is a risk that considering Variable 1 in isolation simply identifies locations where there are high levels of employment, rather than areas where there is a sufficient degree of car dependency to induce carpooling. Variable 2 and 3 provide an additional layer of analysis which suggests why there is a high volume of 'car as driver' journeys to work. In the case of Variable 2 this is demonstrated by assessing the availability and viability of alternative sustainable transport options such as public transport, walking and cycling. And in the case of Variable 3 this specifically excludes locations with high volumes of 'car as driver' journeys originating from less than 5km as these can be substituted by walking or cycling and its is anticipated that the fuel and vehicle savings are not sufficient as to outweigh the organisational costs of participating in a carpooling program. Aggregating the variables enables a greater level of understanding to be gained about the locations and a stronger sense of priority relative to other possible locations.

If the three variables are highly correlated then there would be limited change to the locations which score highly across all three variables compared to the results for each individual variable. A high level of correlation would give rise to concerns about the statistical significance of using the combined variables. Detailed statistical testing has not been undertaken for the purposes of this analysis. However as the results demonstrate a reasonable degree of variation high levels of correlation are not likely to have occurred.

Variable 1

Variable 1 was the simplest of the three variables and forms the base for the other two. It comprised the total number of 'car as driver' journeys to work originating and concluding within the MSD at a suburb level. The volume of trips was found to be an important success factor for carpooling; the more trips that occur to a common destination, the greater the chance of being able to generate enough matches between potential carpooling participants.

Table 1, shows the rating thresholds for Variable 1.

Table 1: Rating thresholds for Variable 1

Rating	Rating thresholds (Total number of 'car as driver' trips)		Description
	Minimum	Maximum*	
1	0	499	Very low
2	500	999	Low
3	1,000	2,499	Medium
4	2,500	4,999	High
5	5,000	-	Very high

***** Maximum trips to a destination within MSD: Melbourne (47,190 trips)

The total trips to each destination were graded into the five ratings using a lookup table. A pivot table was subsequently used to assess the suitability of the rating regime.

Variable 2

Variable 2 represented the ratio of 'car as driver' trips to journey to work trips by all modes commencing and finishing within the MSD and was expressed as a percentage.

Variable 2 used the outputs for 'car as driver' trips from Variable 1 and the sum of all six transport modes provided in the requested dataset (see Table 1 above). It should be noted that for this work 'all modes' included respondents who did not got to work and 'all other methods' including 'unstated'.

Table 2, shows the rating thresholds for Variable 2.

Table 2: Rating thresholds for Variable 2

Rating	Ratings thresholds (% mode share for 'car as driver' trips)		Description
	Minimum	Maximum	
1	0.0%	49.9%	Very low
2	50.0%	59.9%	Low
3	60.0%	64.9%	Medium
4	65.0%	74.9%	High
5	75.0%	100.0%	Very high

At this point, the sum of variables 1 and 2 was calculated for all destinations, enabling a score out of 10 to be calculated.

Variable 3

Variable 3 comprised the percentage of 'car as driver' journeys to work originating and concluding within the MSD of a distance equal to or greater than 5 km at a suburb level. It was the most complex variable to calculate, requiring the outputs for Variable 1 to be matched to the distance between the destination and origin.

The distance between the destination and origin was initially calculated by measuring the straight-line distance between the centroids of the origins and destinations. This methodology was improved through the application of a more advanced model to the base suburb grid[6]. This

[6] The Department of Planning and Community Development provided valuable assistance with this calculation.

permitted a much more accurate distance calculation by assuming travel to be via the most direct road route rather than by straight line. While useful in the inner suburban areas, the major benefit of this improved model was the enhanced capacity for more realistic distance measurements in outer suburban, bay-side and elevated parts of the MSD. In such areas, roads were rarely linear and road distances were often considerably greater then the straight-line equivalent.

Table 3, shows the rating thresholds for Variable 3.

Table 3: Rating thresholds for Variable 3

Rating	Ratings thresholds (% 'car as driver' trips equal to or greater than 5kms)		Description
	Minimum	Maximum*	
1	0.0%	64.9%	Very low
2	65.0%	74.9%	Low
3	75.0%	84.9%	Medium
4	85.0%	94.9%	High
5	95.0%	100.0%	Very high

It should be noted that Variable 3 was only applied to destinations which had scored seven or more out of ten on the basis of scores for Variables 1 and 2, resulting in a set of 132 destinations. This decision was taken to speed up the analysis and to focus attention on destinations with potential for achieving high overall scores.

The results for Variable 3 were then added to those for Variables 1 and 2, generating a total score out of 15. A total of 56 suburbs were found to have a score of 12 or more. Mapping the results revealed that some of these were clustered geographically.

Origin analysis

The aim of this analysis was to examine the origins of trips to destinations that had been found to have potential for carpooling. A similar methodology was applied as used for Variable 1 and 2.

This analysis was limited to destinations which had scored at least 12 out of a possible 15 for the sum of variables 1, 2 and 3. For each of the selected destinations, the number of trips per origin was calculated. Table 4 shows the rating thresholds for the origin analysis.

Table 4: Rating thresholds for origin analysis

Rating	Ratings thresholds ('car as driver' trips from origin)		Description
	Minimum	Maximum	
1	1	49	Very low
2	50	99	Low
3	100	199	Medium
4	200	299	High
5	300	-	Very high

Only those destinations which scored 14 and 15 out of 15 were mapped and to improve map clarity, only the three highest ratings of origins were included.

Findings

This section provides an overview of the data analysis and highlights the findings.

Variable 1

The top ten destinations which generated the most 'car as driver' journey to work trips are noted in Table 5.

Table 5: Top 10 destinations for total number of 'car as driver' journey to work journeys to work originating and concluding within the MSD; ABS, 2006

Rank	Destination	Number of 'car as driver' trips	Score
1	Melbourne	47,190	5
2	Dandenong South	24,571	5
3	Clayton	16,583	5
4	Port Melbourne	15,116	5
5	Mulgrave	14,085	5
6	Campbellfield	13,625	5
7	South Melbourne	12,604	5
8	Dandenong	12,008	5
9	Frankston	10,841	5
10	Preston	10,766	5

There were a total of 49 suburbs which scored a ranking of 5 on the total number of 'car as driver' journeys to work; i.e. the total number of trips was 5,000 or more. There were a further 71 suburbs which scored a rank of 4 where the total number of trips was between 2,500 and 4,999.

The Melbourne CBD (including Melbourne Park, the Royal Botanic Gardens and a narrow northern spur along Elizabeth Street near Queen Victoria Market) was easily the biggest trip attractor, with more than 47,000 journeys to work each day. This was 5.2 per cent of the total number of 'car as driver' journeys to work. Dandenong South, with 25,571 (2.7 per cent) was the second-largest trip attractor.

Of the total 46 destinations with scores of 5, 15 were in the south-east of Melbourne, a further 9 were in the inner city, 8 were in the eastern suburbs and 7 were in the north of the city. It is noteworthy that that there were only four locations in the western suburbs which were destinations for large numbers of car as driver trips: Laverton North (9,254); Alton North (8,463); Werribee (5,316) and Hoppers Crossing (5,302). Footscray in the inner west attracted 7,710 'car as driver' journeys to work. These travel patterns would appear to reflect the location of jobs rather than people's mode choice.

With the exception of Dandenong South and Campbellfield, the other destinations which generated lots of car as driver journeys did not appear in the top 10 of other variables. However, when all three variables were considered, other destinations including Port Melbourne and Mulgrave achieved total scores of 14, while Clayton and Dandenong achieved total scores of 13.

Variable 2

The top ten destinations which had the highest percentage of 'car as driver' journey to work trips as a proportion of all journeys to work are presented in Table 6.

Table 6: Top 10 destinations for the highest percentage of 'car as driver' journeys to work originating and concluding within the MSD as a proportion of all trips; ABS, 2006

Rank	Destination	Percent of 'car as driver' trips as a proportion of all trips	Score
1	Laverton North	83.8	5
2	Somerton	83.3	5
3	Dandenong South	82.8	5
4	Braeside	82.8	5
5	Scoresby	82.4	5
6	Campbellfield	82.3	5
7	Tottenham	82.2	5
8	Noble Park North	82.1	5
9	Tullamarine	82.1	5
10	Brooklyn	81.7	5

There were a total of 45 suburbs which scored a ranking of 5 on the mode share for number of 'car as driver' journeys to work; i.e. the mode share was 75% or more. There were a further 127 suburbs which scored a rank of 4 where the mode share for 'car as driver' is between 70 – 74.9%.

For variable 2, Laverton North had highest proportion of journeys to work undertaken by 'car as driver', followed closely by Somerton, while third was a tie between Dandenong South and Braeside.

The travel patterns for a destination are related to what transport options were available to them. None of the destinations with high mode shares for 'car as driver' were easily accessible by the metropolitan rail network.

Variable 3

The top ten destinations which had the highest percentage of 'car as driver' journey to work trips greater than or equal to 5km are presented in Table 7.

Table 7: Top 10 destinations for the percentage of 'car as driver' journeys to work originating and concluding in the MSD for distances equal to or greater than 5 km; ABS, 2006

Rank	Destination	Percent of 'car as driver' trips equal to or greater than 5 km	Median distance (km)	Score
1	Truganina	100.0	16.8	5
2	Dandenong South	99.0	13.4	5
3	Lyndhurst	98.1	14.0	5
4	Melbourne Airport	98.0	19.6	5
5	Laverton North	97.6	13.9	5
6	Braeside	97.6	15.2	5
7	Tyabb	97.5	15.1	5
8	Oakleigh South	97.1	17.8	5
9	Campbellfield	95.7	13.3	5
10	Somerton	95.3	14.6	5

There were a total of 10 suburbs which scored rankings of 5 on the highest proportion of 'car as driver' journey to work trips greater than or equal to 5km; i.e. the proportion was 95% or more.

There were a further 33 suburbs which scored rankings of 4 where the impact of journeys greater than or equal to 5km was between 85 – 94.9%.

For variable 3, Truganina had the highest percentage of 'car as driver' trips equal to of greater than 5km (100%), followed by Dandenong South (99%);and Lyndhurst and Melbourne Airport at or just above 98%.

None of the destinations with a high percentage of journeys to work longer than 5 km will be viable for walking or cycling. Of the top-ranked destinations on variable 3, the median trip distances ranged between 13.3 and 19.6 km, significantly greater than 5 km. The relatively long distances meant that fuel costs and other vehicle operating costs will be greater for these destinations.

Combined variables

Destinations which scored a total of 14 or 15 (the two highest possible scores) are presented in Table 8. The table includes the scores for each of the destinations across the three variables.

Table 8: Destinations which achieve a total score of 14 or 15 across all three variables

Rank	Destination	Variable 1 – total number of 'car as driver' trips		Variable 2 – 'car as driver' mode share of total trips		Variable 3 – percent of 'car as driver' trips ≥ 5km		Sum of scores
		Number	Score	Percent	Score	Percent	Score	
1	Dandenong South	24,571	5	82.8	5	99.0	5	15
2	Campbellfield	13,625	5	82.3	5	95.7	5	15
3	Laverton North	9,254	5	83.8	5	97.6	5	15
4	Melbourne Airport	8,993	5	75.4	5	98.0	5	15
5	Braeside	7,409	5	82.8	5	97.6	5	15
6	Port Melbourne	15,116	5	75.3	5	94.3	4	14
7	Mulgrave	14,085	5	80.1	5	94.0	4	14
8	Tullamarine	8,612	5	82.1	5	93.3	4	14
9	Altona North	8,463	5	81.3	5	88.9	4	14
10	Kilsyth	7,476	5	78.5	5	87.4	4	14
11	Hallam	6,035	5	79.6	5	88.4	4	14
12	Clayton South	5,026	5	77.7	5	91.9	4	14
13	Somerton	2,981	4	83.3	5	95.3	5	14

There were five destinations which scored a total of 15 and a further eight which scored 14. In addition, sixteen destinations scored 13 and a further 27 achieved totals of 12. Map 1 in Appendix 1 presents the total findings for these top 56 destinations across Melbourne which were expected to have a high potential for car pooling.

Dandenong South and Campbellfield were in the top 10 across all three variables, achieving total scores of 15. In addition, Laverton North, Melbourne Airport and Braeside also achieved total scores of 15, although they were not in the top ten for each of the individual variables. Laverton North and Braeside were in the top 10 for variables 2 and 3, while Melbourne Airport was in the top ten for variable 3.

The top five destinations were spread across Melbourne, with Dandenong South and Braeside in the south-east, Campbellfield in the north, Laverton North in the western suburbs and

Melbourne Airport to the north west of the city. It is notable that all of these highest-potential destinations, with the exception of Braeside were also bordered by destinations with total values of 14, see Map 1. In particular Dandenong South, Campbellfield and Laverton North were nearly surrounded by other destinations scoring values of 13 and 14, creating clusters of potential in the south-east, to the north of the city centre and in the western suburbs. It is notable that all three clusters were located close to or in designated growth areas, where land is still being developed for residential and employment purposes and which is largely beyond the reach of the radial train network.

All of the top ten destinations for variables 2 and 3 were within the top 56 with potential for carpooling behaviour change. However three destinations which performed strongly on variable 1, the total number of 'car as driver' journeys to work, did not score well on the other variables, namely Melbourne, South Melbourne and Frankston.

Melbourne as a destination had the most 'car as driver' journeys to work across the city and suburbs. It scored 4 on variable 3. Whilst people were driving a median distance of 14.5 km to the city, there was a number of people driving much shorter distances from suburbs close to the city such South Yarra (540 trips), Richmond (461) and Southbank (381), suggesting that walking and cycling were viable options. However, Melbourne failed to score higher on the basis of variable 2, where the 'car as driver' as a proportion of mode share was low at 25.3 per cent, earning it a score of 1. This suggested that public transport was available and viable as high proportion of employees travelling to the city were in fact using it (or walking or cycling).

With the largest volume of 'car as driver' journeys to work coming to Melbourne there was some benefit in understanding in more detail the potential for behaviour change in relation to carpooling to the CBD. Additional analysis of the 'car as driver' work trips to the Melbourne LGA[7] – which is larger than the area categorised as Melbourne as a suburb –revealed that the travel to Melbourne CBD originates from a dispersed range of suburbs with the most common origins being Manningham (C) and Moonee Valley (C) - Essendon. However this data was indicative rather than definitive as the units of measure were LGAs rather than suburbs. A finer grained understanding of origins for the smaller area defined as the suburb Melbourne would be useful.

A carpooling program for the Docklands and Victoria Harbour end of the CBD is currently being developed by Access Melbourne, the transport management association for the CBD. Since the Journey to Work data was collected in the 2006 Census, employment opportunities in these areas have expanded substantially with several financial institutions consolidating and relocating their headquarters to the area.

In contrast, Lyndhurst scored low on the total number of 'car as driver' trips (852), achieving a rank of 2. However it scored very highly on variables 2 and 3, suggesting that there were no available or viable options for getting there. This will become increasingly important if more employment opportunities are generated in Lyndhurst.

Origin Analysis

[7] The Melbourne LGA includes the following suburbs in its boundaries: Southbank; Docklands; North, West and East Melbourne; Parkville; Melbourne; Carlton and Carlton North; and parts of: Kensington; Port Melbourne. In contrast, Melbourne at a suburb level only includes the Melbourne CBD, a wedge of land to the south east incorporating Melbourne Park and the Royal Botanic Gardens and a narrow northern spur along Elizabeth Street near Queen Victoria Market.

Travel patterns with common points of origin and destination demonstrated the potential to find a match for carpooling rides. The origins for 'car as driver' journeys to work for the top 13 destinations (with scores of 14 or 15) were analysed to further understand the potential for carpooling.

Dandenong South, see Map 2 in Appendix 1, showed 'car as driver' trips originating from several concentrated clusters of suburbs, with a high volume of trips originated from suburbs in the south, around Frankston; from the south east in the growth areas of Casey and Cardinia and from suburbs to the immediate north. With the exception of the suburbs to the south-east, none of these were on or would connect to the train line which serviced Dandenong. However, even for those employees who lived on or near the Pakenham or Cranbourne train lines there was not actually a train station available to disembark for Dandenong South. In addition, with the exception of some suburbs to the north and north-east, most points of origin were beyond 5 km in distance, reducing the viability of walking and cycling as sustainable options. This analysis revealed potential for car pooling from clusters of suburbs in the growth areas of Casey and Cardinia and also from Frankston to Dandenong South.

Campbellfield, see Map 3 in Appendix 1, showed 'car as driver' trips originating from several concentrated clusters of suburbs, with a high number of trips originated from suburbs to the east and to the west, with large numbers also coming from Sunbury, a satellite town to the west. Suburbs to the east and west were serviced by train line which radiates from the city but did not provide a connection to the Craigieburn line which services Campbellfield. Whilst walking or cycling may have been viable for nearby suburbs, this was not an option for Sunbury residents who are approximately 20km away. This analysis showed potential for car pooling from clusters of suburbs in the growth areas of Whittlesea and Hume.

Laverton North, see Map 4 in Appendix 1, showed 'car as driver' trips originating from a more dispersed range of suburbs, with a small concentration in the growth area of Wyndham. As previously discussed under variable 3, Laverton North was not accessible by train. In addition, with the exception of origins to the immediate south and north (which are not part of the growth areas) most origins were well beyond 5 km in distance. There was potential for carpooling to Laverton North from suburbs in the growth area of Wyndham and there is emerging potential in the growth area of Melton-Caroline Springs which has been further developed since the 2006 Census.

The three destinations with the most potential for mode shift to carpooling all demonstrated that a high volume of journeys to work were originating in the surrounding or nearby growth areas.

Conclusion

This work has identified that there is potential for mode-shift to car pooling for people driving to jobs in Melbourne's outer suburbs. There were clusters of potential destinations spread across Melbourne, centred on Dandenong South in the south-east, Campbellfield in the north, Laverton North in the western suburbs and Melbourne Airport to the north-west of the city. These particular suburbs were adjacent to and in some cases, surrounded by suburbs with potential as well. This potential was supported by analysis of the origins of journeys to these locations, which indicated there were large numbers of trips originating from growth areas of Melbourne. The level of car dependency for journeys to outer metropolitan jobs, especially those originating in the growth areas, provides an opportunity to target carpooling programs where there are strong inherent incentives for participation.

It would be useful to do some analysis of 'car as passenger' data in the ABS census to understand the level of existing car pooling, particularly to identify whether this is occurring to locations which are considered to have potential in this paper.

The next step, which is currently underway, is to analyse the potential to deliver carpooling programs in these destinations. This work involves identifying large employers or clusters of employers. Carpooling depends on being able to generate matches between people travelling from similar origins to the same/similar destinations. The larger the potential pool, either on the basis of a single employer or an area-based approach, the better the chance of being able to generate a suitable match. More detailed travel data would then need to be collected directly from employees in the same company or those participants to be covered by the same area-based. Further analysis would be necessary to identify whether there are sufficiently common origins and thus potential matches for the pool of participants.

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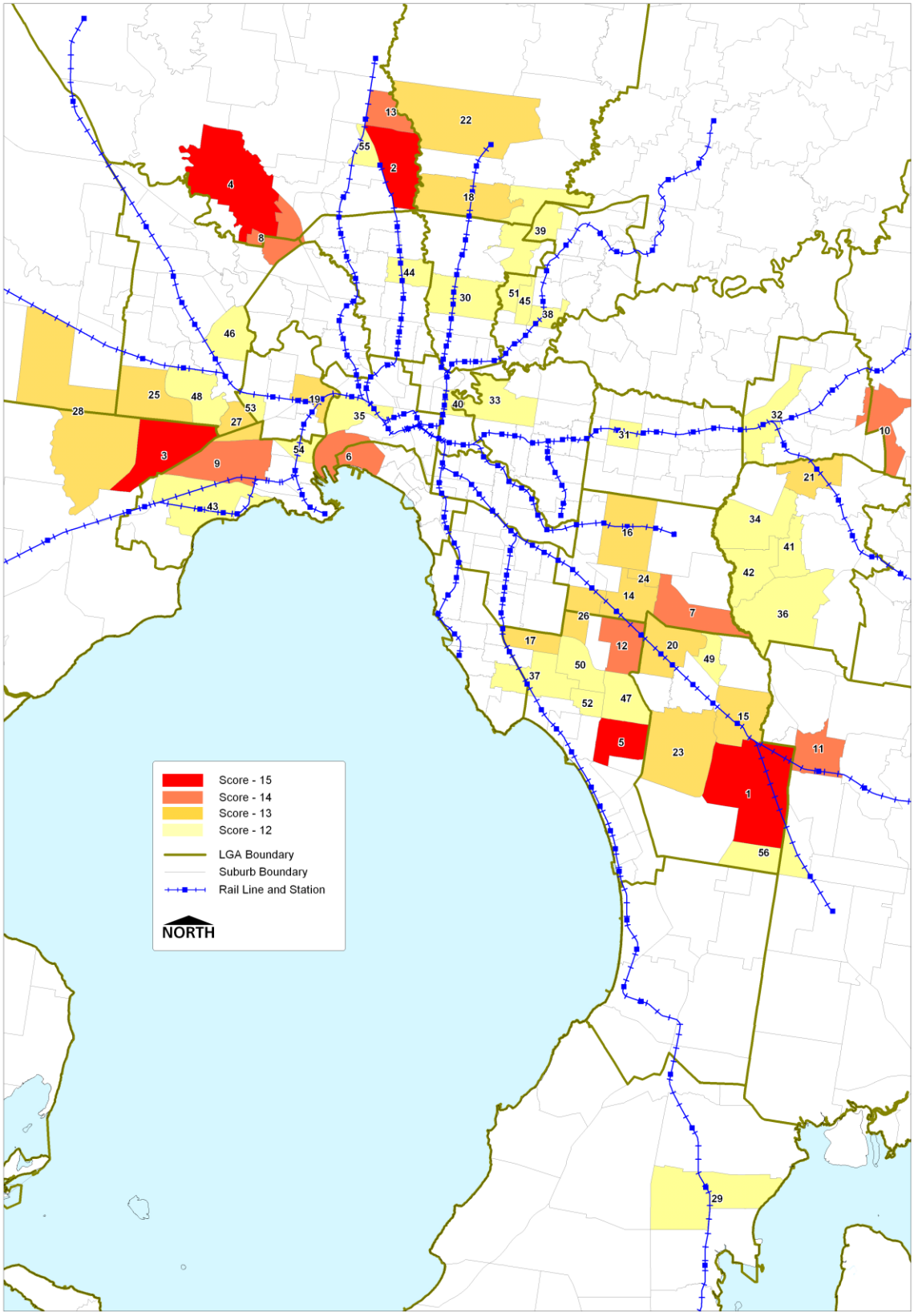
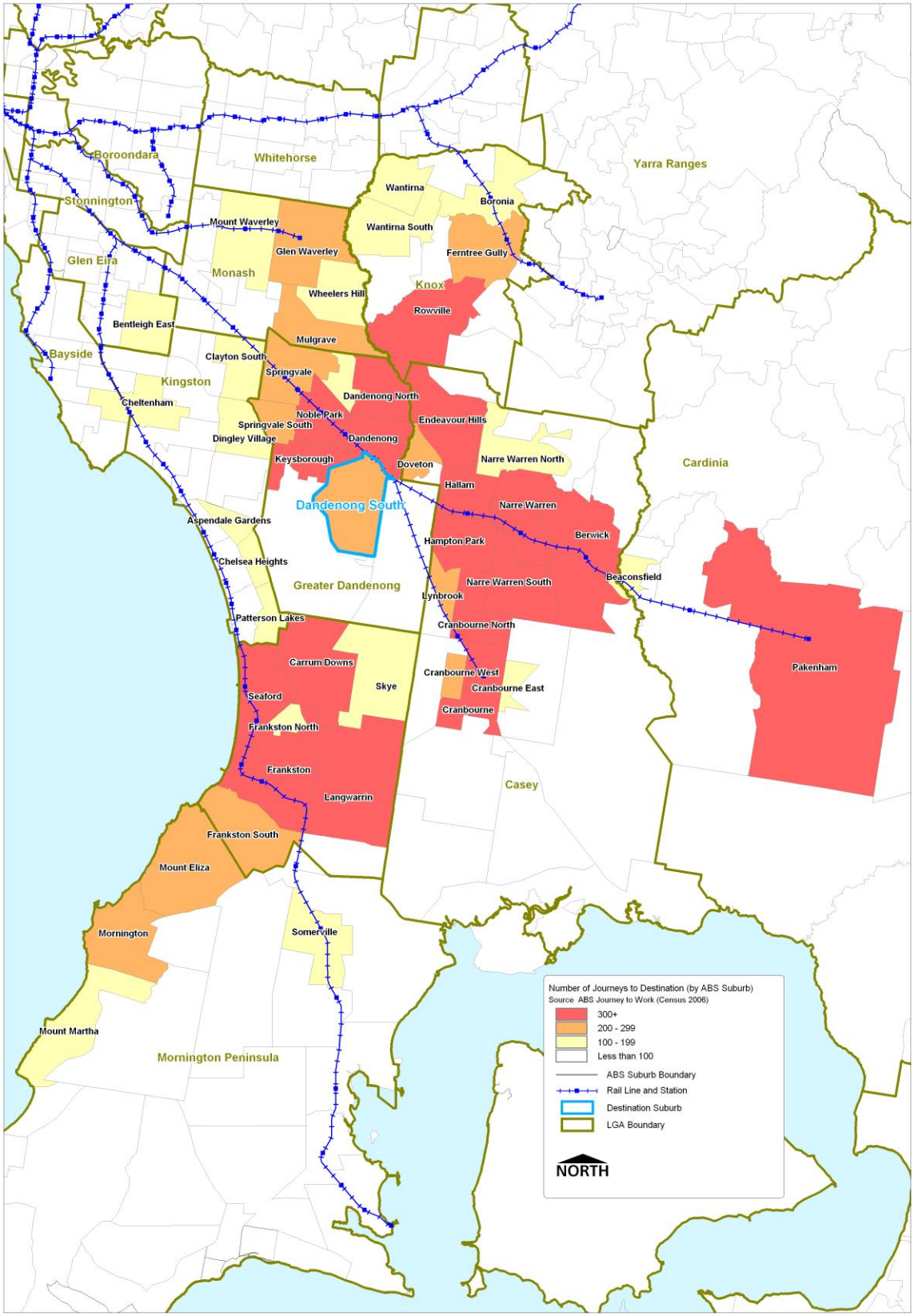
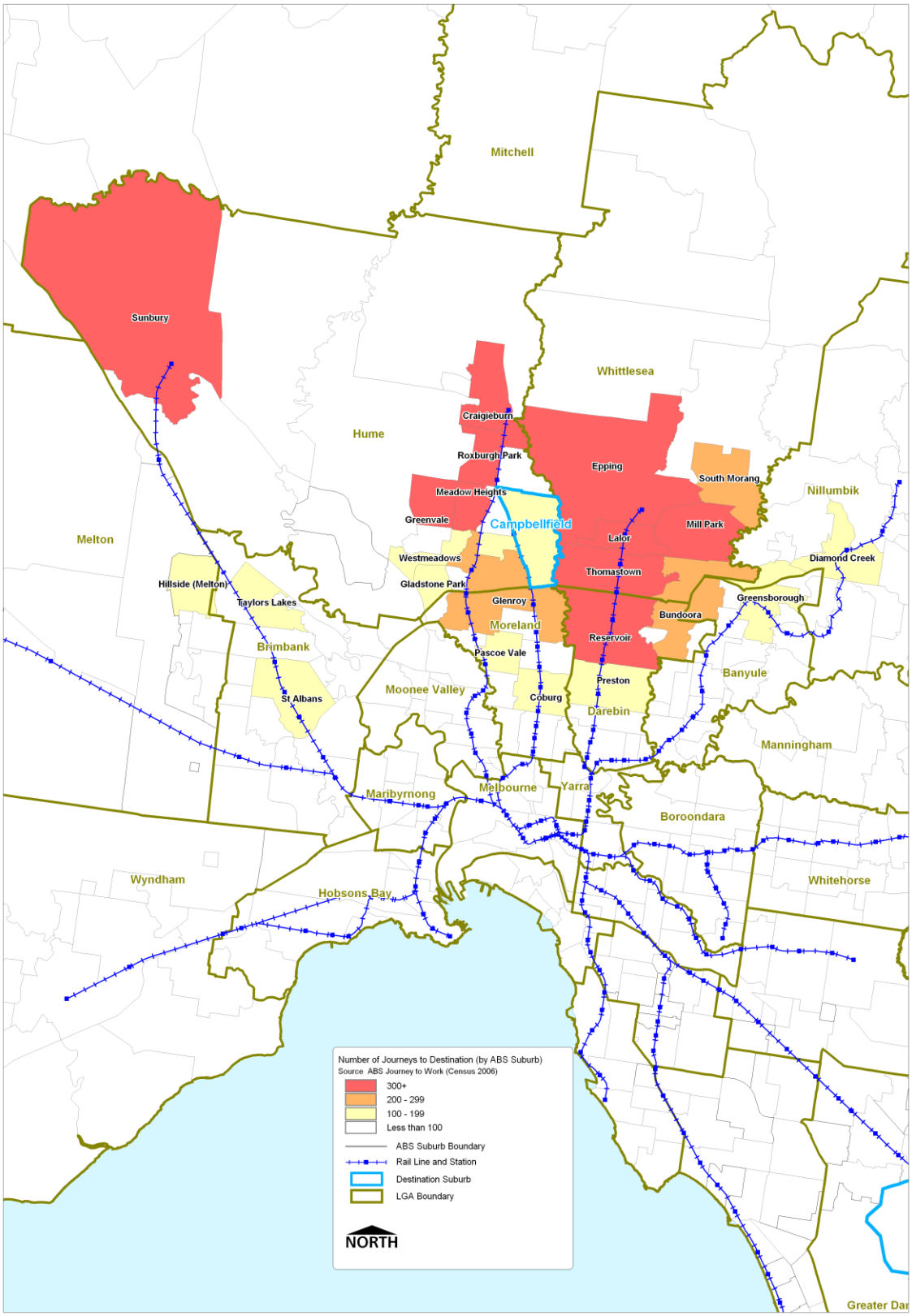
Map 1: Destinations which achieve a total score of more than 12 across all 3 variables



Map 2: Number of 'car as driver' journey to work trips by origin for Dandenong South



Map 3: Number of 'car as driver' journey to work trips by origin for Campbellfield



Map 4: Number of 'car as driver' journey to work trips by origin for Laverton North