Evaluation of Shimmy Bicycle Routes

Prepared for City of Darebin

CDM RESEARCH

Contents

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Executive Summary

The City of Darebin has, over a number of years, developed a network of connected local street routes for bicycle riders as an alternative to main roads. These have been termed "shimmy" routes. The present study was commissioned by the Council to evaluate four shimmy routes:

- **Christmas St Shimmy:** from the Darebin Creek Trail at Abbott St to Woolhouse St and Arthurton Rd via Christmas St and Beaconsfield Pde (4.4 km),
- **Great Western Shimmy:** from Arthurton St in Northcote to Edwardes St in Reservoir (7 km), running around 300 m to the west of St Georges Rd,
- **Hurstbridge Line Shimmy:** from Westgarth St along South Cr (Westgarth) and Wingrove St to the Darebin Parklands and the Darebin Creek Trail (3.4 km), and
- **South Morang Line Shimmy:** along the South Morang railway line from Charles St in Northcote to Dundas St in Preston (3.1 km).

The shimmy routes have involved on-road bicycle lanes, cyclist refuges at major road crossings to facilitate multi-stage crossings, traffic calming, and wayfinding including signs on poles and bicycle symbols on the roadway. Council has been promoting the routes through the distribution of paper maps, council newsletters, social media and at rider events.

The present evaluation consisted of five stages:

- literature review of current practices elsewhere in Australia and internationally for these connected local street routes,
- intercept survey with bicycle riders using the four shimmy routes to understand their trip characteristics, awareness and perception towards the shimmy routes,
- observations of delays for bicycle riders crossing intersections along the shimmy routes,
- review of the design practices used for the shimmy routes, and
- a cost-benefit analysis of the routes using Australian Transport Assessment and Planning (ATAP) guidance for active travel.

The key findings from the evaluation were as follows:

- parts of the Great Western and Hurstbridge Line shimmy routes have motor vehicle volumes (2,500 – 3,500 vpd) greater than that recommended by international guidance for these routes (around 2,000 vpd),
- posted speed limits are above the 30 km/h recommended by the international guidance, and operating speeds are generally around 40 km/h (85th percentile) extending up to 50 km/h along Wingrove St east of Grange Rd,
- most bicycle riders using the shimmy routes are travelling for transport (usually commuting), and this is also true on weekends,

- average trip duration is around 30 minutes across all four sites for transport trips, with recreation trips varying from around 36 minutes on the South Morang Line to 88 minutes along Christmas St,
- just over half (56%) of bicycle riders riding for transport had a car available for their trip, and most could have used public transport (92%), however in most cases riders indicated that both driving and public transport would have taken longer than riding,
- most shimmy users would have ridden along these local streets irrespective of the presence of the shimmy treatments (78%); however, 15% would have ridden along a different route (about a third of whom would have ridden along a main road), 4% would have taken public transport, 2% would have driven a car and a further 2% would not have travelled at all,
- most users cited the lack of traffic for choosing to use the shimmy routes, along with it being direct, safer than main roads and that drivers travel more slowly,
- three quarters of bicycle riders had noticed the shimmy treatments, but only around 37% had heard of the “shimmy” name,
- most riders felt the shimmy name was a fun term, although there was some misunderstanding about what it meant,
- just under half of those who had heard of the shimmy name had seen printed maps, and a third had seen information in the council newsletter,
- the vast majority of bicycle riders (92%) support the rollout of the shimmy routes, and most think the median refuges at main streets are the most important treatment, followed by the bicycle symbols on the road and speed humps for traffic calming,
- the most cited improvement was to provide more room from parked cars, as well as having fewer cars, more space to ride without cars having to queue behind and improved driver behaviour,
- of the eleven intersections from which intersection delay was measured those with the highest average delay were Woolhouse St at Arthurton Rd (10.8 s), Wingrove St at Station St (8.4 s) and South Cr at Victoria St (7.2 s),
- the cost-benefit analysis suggests the projects represent very good value for money, with cost-benefit ratios ranging from 1.7 (Christmas St) to 8.7 (Hurstbridge Line).

It is recommended that council continue to improve the existing shimmy routes and develop new routes. Specific recommendations include:

- reduce motor vehicle volumes to around 2,000 vpd and operating speeds to around 30 km/h and no more than 40 km/h (both 85th percentiles),
- continue to rollout median refuges to assist riders in crossing main streets,
- remove or modify local road roundabouts to ensure slower motorist speeds using vertical deflections and a radial roundabout geometry, and

- consider enhanced means of making the busiest sections of the shimmy routes visible using additional pavement markings that reinforce the sharing message.

1 Introduction

1.1 Background

A “shimmy” is a bicycle route that wiggles along quiet residential streets to provide an alternative to main roads and shared paths. The shimmy term is used by the City of Darebin and Moreland City Council to identify these routes, although the general concept is known by a variety of names in other locations (e.g. bicycle boulevards and greenways in the USA and Safe Active Streets in Perth). The City of Darebin has been implementing shimmy routes in stages since 2013, and have involved treatments such as:

- on-road bicycle lanes,
- cyclist refuges at major road crossings to facilitate multi-stage crossings,
- traffic calming, and
- wayfinding.

The infrastructure has been complemented by community engagement and communication through hardcopy maps, online videos and one-on-one engagement at community events.

To date there have been five shimmy routes constructed:

- **Great Western Shimmy:** from Arthurton St in Northcote to Edwardes St in Reservoir (7 km), running around 300 m to the west of St Georges Rd,
- **Hurstbridge Line Shimmy:** from Westgarth St along South Cr (Westgarth) and Wingrove St to the Darebin Parklands and the Darebin Creek Trail (3.4 km),
- **Christmas St Shimmy:** from the Darebin Creek Trail at Abbott St to Woolhouse St and Arthurton Rd via Christmas St and Beaconsfield Pde (4.4 km),
- **South Morang Line Shimmy:** along the South Morang railway line from Charles St in Northcote to Dundas St in Preston (3.1 km), and
- **Northern Shimmy:** from the Darebin Creek Trail at Bundoora Park to Johnson St in Keon Park (2.4 km).

All have been developed at comparatively low cost (around $100,000 each) and have involved negligible impacts on on-street car parking or traffic movement. The shimmy concept fits within the strategic context of the *Darebin Cycling Strategy 2013 – 2018* by contributing a cohesive network of cycle friendly routes, particularly for trips of 2 to 7 km in length. Moreover, the focus on shimmy routes delivers cycling routes at much lower cost than would new shared paths, on-road bicycle lanes or protected on-road bicycle lanes.

Four of the five shimmy routes that have been constructed were subject to the present evaluation; the fifth (Northern shimmy) was considered to have insufficient rider demand to be viable for evaluation at this stage.

1.2 Objectives of this study

The purpose of this study was as follows:

- review the literature with regard to connected local street cycle routes and assess the recommendations within this literature against the as-built shimmy routes,
- determine whether the shimmy routes have encouraged bicycle riding, and whether riders are aware of and value the shimmy routes,
- assess whether the shimmy routes represent value for money, and
- draw recommendations based on the evaluation for the improvement to existing shimmy routes and possible future shimmy routes.

1.3 Structure of this report

This report is structured as follows:

- Chapter 2 describes the shimmy routes and the key treatments along the four corridors subject to this evaluation,
- Chapter 3 reviews the relevant literature and experiences of other jurisdictions in implementing local street cycling routes,
- Chapter 4 describes the intercept survey methodology and presents the results,
- Chapter 5 describes the results of observations of rider delay at eleven major road crossings,
- Chapter 6 identifies possible design issues on the existing shimmy routes,
- Chapter 7 describes the cost-benefit analysis,
- Chapter 8 discusses the key findings and their possible implications for the future development of the shimmy route network, and
- Chapter 9 offers recommendations with regard to improvements to the existing shimmy routes and to possible future shimmy routes.

2 Background

2.1 Design characteristics

The shimmy routes have four main components:

- wayfinding signage on poles at key decision points, all with shimmy branding and some with destination and distance information (Figure 2.1)
- bicycle symbols on the roadway to assist with wayfinding, usually located towards the centre of the carriageway with a dashed centreline and spaced around 100 m apart at mid-blocks and at every intersection and crossroad (Figure 2.2),
- traffic calming, usually in the form of speed humps, and
- median islands with bicycle storage to facilitate staged crossings at unsignalised major road crossings (Figure 2.3).

There are a few relatively short sections of on-road bicycle lanes and off-road shared use paths, but most of the shimmy routes are on local streets with no segregated space for bicycle riders. In most cases the posted speed limit is the default urban speed limit of 50 km/h, with localised speed reductions in the vicinity of schools to 40 km/h.

■ Figure 2.1: Wayfinding signage

(a) Mid-block symbols (Crispe St, Great Western shimmy)

(b) Abbot St at Fulham St (Christmas St shimmy)

■ Figure 2.2: Bicycle symbols on road pavement

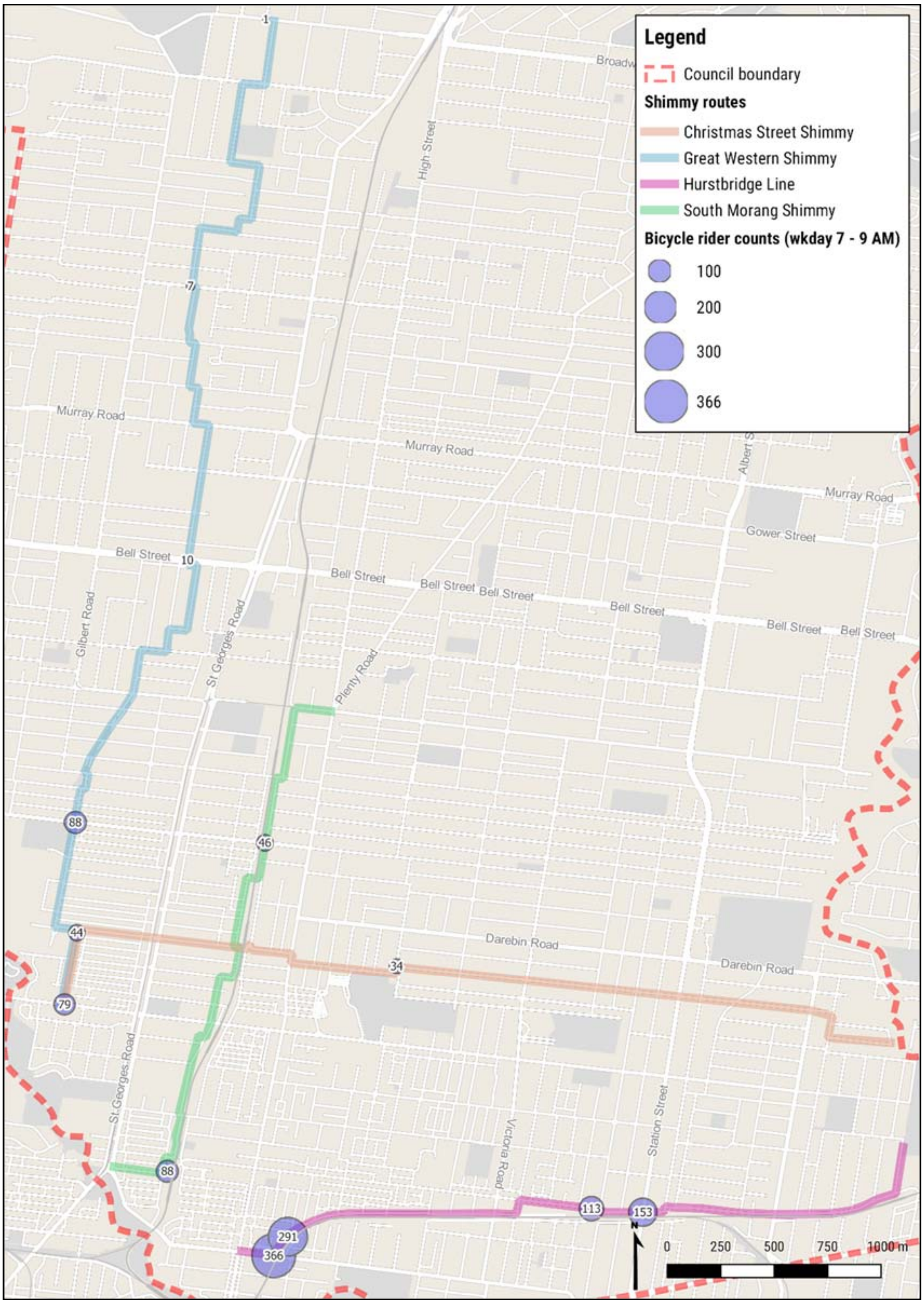
■ Figure 2.3: Median refuges and bicycle storage (Christmas St at Victoria St, Christmas St shimmy)

2.2 Traffic characteristics

The four shimmy routes are shown in Figure 2.4 along with best estimates of the rider demand based on weekday AM 2-hour counts (from 7 to 9 AM). These count estimates are derived from a variety of sources, including one-day counts (using video cameras) and temporary automatic counters. The times of year, and year, in which the counts were obtained varies such that they are not directly comparable. Instead, the counts should be considered only to represent an indication of the *magnitude* of demand. This caveat aside, demand is clearly higher towards the south of the municipality, with greatest demand on South Cr in Westgarth along the Hurstbridge Line shimmy. By comparison, the Great Western shimmy north of Bell St appears to experience the lowest demand of the four routes.

Motor vehicle counts obtained using temporary automatic counts are shown in Figure 2.5. Again, these counts are derived from data obtained at different times of year and across several years. Moreover, the data shown here represents weekday *daily* averages in contrast to the 2-hour counts shown in Figure 2.4 for bicycle riders. These counts suggest motor vehicle demand along Christmas St is well under 1,000 vpd, that demand along Stott St on the South Morang Line shimmy is around 1,200 vpd and the roads constituting the Great Western and Hurstbridge Line shimmy routes have traffic demand from around 2,000 vpd up to a maximum of just over 3,500 vpd along Woolhouse St near Arthurton Rd.

Where available from the automatic counts data 85th percentile motor vehicle speeds are shown in Figure 2.6. These speeds vary from around 40 km/h along Beaconsfield Pde, Christmas St and Leinster Gr down to 32 – 37 km/h along Woolhouse St. Along the Hurstbridge Line shimmy speeds were around 35 km/h in the westernmost sections along South Cr and Wingrove St west of Station St, but increased to around 50 km/h east of Station St.



■ Figure 2.4: Bicycle rider counts (weekday AM peak 7 – 9 am)

■ Figure 2.5: Motor vehicle counts (average weekday)

■ Figure 2.6: 85th percentile motor vehicle speeds

3 Literature review

3.1 Introduction

Local street routes designated as bicycle routes, but operating as shared roadways, are fairly commonplace in Europe and in some North American jurisdictions. In some jurisdictions, such as in the Netherlands, there exists fairly well-defined guidance on when such routes are appropriate and how they should be designed. In other cases, such as in Germany, there appears to be limited national guidance and instead local authorities develop designs suitable to their local contexts. In this section, we review the guidance that does exist, and the experience of other jurisdictions in implementing these routes.

3.2 Australian design practices

There is no explicit reference with the Austroads Guide to Road Design or VicRoads Traffic Engineering Manual to shimmy routes, bicycle boulevards or similar. However, there is general guidance on when sharing and separation is appropriate, and traffic calming treatments and local area traffic management (LATM) measures. Moreover, there exists guidance on wayfinding from Austroads (2015) and the Queensland Department of Transport and Main Roads (TMR 2009). The use of bicycle symbols on roadways as a wayfinding device are less established, although Brisbane City Council have used large yellow bicycle symbols in the roadway to designate bicycle routes for some time (Brisbane City Council 2010; TMR 2016). In the Brisbane guidance, the symbols are 1.1x1.8 m installed at 1.3 m from the road centreline to the centre of the symbol, and at no more than 200 m longitudinal offset.

The most recent Australian application of this treatment are *Safe Active Streets* in Perth. Two corridors have recently (early 2017) been constructed as part of a trial; the designs borrowing heavily from the Dutch *fietsstraat* concept where the full roadway pavement is distinctly coloured and the design principle is to create a shared space (Section 3.3.1). The streets feature 30 km/h speed limits and a complete road resheet with ochre pavement (Figure 3.1). This ochre-coloured pavement is commonly used in Perth for shared paths and on-road bicycle lanes, such that there is a reasonable prospect that road users would associate the colour with bicycle riding. Local street intersection priority was reassigned to the active street and refuges were added at major street crossings. The two trial projects cost around $800,000 per kilometre to construct, most of which could be attributable to the road resheet. As the projects have only recently been constructed it is not yet possible to ascertain the success or otherwise of the trial.

(a) Gateway pavement marking

(b) Chicane and narrowing at mid-block

- Figure 3.1: Safe active streets in Perth

3.3 International design practices

An overview of international design practices for these treatments is provided by Koorey (2012), who argues the key design principles should be (in order from most to least important):

1. traffic volume reduction,
2. traffic speed reduction,
3. intersection treatment and traffic management,
4. reallocation of roadspace, and
5. dedicated cycling facilities.

There is limited quantitative evidence on the impact of shimmy routes on cycling frequency and safety, however:

- The link between motor vehicle speed and cyclist crash severity is well understood; at 50 km/h there is greater than a 70% chance the rider will suffer a fatal injury compared to 5% at 30 km/h (Corben, D'Elia, and Healy 2006).
- Minikel (2012) analysed crash data and rider counts on seven bicycle boulevards and parallel arterial roads in Berkeley (USA) and found the arterial roads experienced a rider crash risk 1.8 to 8.0 times higher than the boulevards.

We summarise the key design criteria used internationally in Table 3.1. The details are described in the following sections.

▪ Table 3.1: International design standards

Name	Country	Speed limit	Motor vehicle volumes	Rider volumes	Comments
Fietsstraat	Netherlands	30 km/h	<2,000 vpd	≥1,000 vpd	Rider vol. must exceed MV vol.
Greenways	Portland, USA	30 km/h	<2,000 vpd (1,000 vpd pref.)	unspecified	≥50 crossing opportunities per hour at roadways (≥100 desirable).
Fahrradstrasse	Germany	30 km/h	unspecified	unspecified	
NACTO	USA	40 km/h (30 km/h pref.)	<3,000 vph (1,500 vph pref.)	unspecified	
Quietways	London, UK	30 km/h	unspecified	unspecified	

3.3.1 Netherlands

The Dutch *fietsstraat* ("bicycle street") is widely used along busy cycling routes where the route extends along a local street (CROW 2016). The key design attributes of these streets are:

- posted speed limits of 30 km/h *and* traffic calming to ensure operating speeds are at or below this speed,
- signage to indicate that bicycle riders have priority ("auto te gast": cars are guests, and sometimes "fietsers gaan voor!": bicycle riders go first! and "matig uw snelheid!": moderate your speed!),
- narrow carriageway (~4.5 m), optionally with indented kerbside parking,
- either a central smooth asphalt strip (3.0 – 3.5 m) and paved shoulder or 2 x 2.0 m asphalt "lanes" with a central traversable paved strip 0.8 – 1.5 m wide,
- suppression of through-motor vehicle movement using road closures,
- priority of the bicycle street across intersecting roads, and
- distinctive red-coloured road pavements in a manner consistent with the Dutch design palette to designate cycling routes.

The road user volume criteria for bicycle streets are as follows:

- rider volumes must be equal to, or exceed, motorist volumes across a typical 24-hour period,
- rider volume ≥ 1,000 per day, and
- no more than 2,500 motor vehicles per day.

There are likely to be very few local streets in Darebin which meet these criteria[1], particularly that rider volumes exceed motorist volumes.

The low motor vehicle volumes are commonly achieved through a strong emphasis on a road hierarchy whereby some roads are designated as major motor vehicle routes (usually arterials around or between towns or major suburbs) with lower standard residential roads restricted to an access function. Through-vehicle movement is largely eliminated using localised road closures that prevent through movement. However, bicycle riders can navigate through these road closures. This approach is sometimes referred to as *filtered permeability*; that is, access is provided for desired modes (walking and riding) and precluded for others (motor vehicles). Moreover, this approach tends to encourage riding and walking for short journeys because driving requires a longer, more circuitous route[2].

[1] Note, for example, that the St Georges Road path at the southernmost end carries around 1,500 riders per day and this is likely to be the busiest route in the municipality.

[2] One way of thinking about the road network in these situations is as a group of cells or compartments through which riders can readily permeate but motorists must go around.

Typical examples of these streets are illustrated in Figure 3.2. These examples illustrate two of the most typical designs:

a) Full-width coloured pavement with signage to encourage riders to travel in the middle of the road; note in this example the street is one-way (but two-way for bicycle riders) and very narrow (< 5m between parking) such that it is impractical in most instances for a motorist to be able to overtake a rider. Riders are encouraged to ride towards the centre by the presence of smooth asphalt in the centre (around 3.2 m) and pavers on the road shoulder (~0.8 m). Doing so also discourages riders from travelling within the reach of opening parked car doors. Bicycle riders and motorists travelling in the same direction generally travel head-to-tail, while contraflow riders move into the right shoulder and slow when encountering an oncoming motorist, as would the motorist.

b) On wider carriageways, and where there is higher rider demand, a treatment with two asphalt strips and paving in the shoulder and along the centre of the road is used (both of which are trafficable); the photo illustrates that riders (at least in this photo) appear to feel comfortable riding side-by-side even in the presence of a motorist *and* that motorists feel sufficiently confident to move to the farside of the roadway to overtake riders.

(a) Bicycle street with riders in middle of carriageway (Conradkade, den Haag: https://goo.gl/maps/AFC8WZqNEwF2, note that street is one-way for motor vehicles)

(b) Bicycle street with carriageway separation (Vaart N. Z., Assen: https://goo.gl/maps/FembsGzfHAF2)

- Figure 3.2: Typical fietsstraat in the Netherlands

3.3.2 Portland Bureau of Transportation (USA)

Portland is credited with introducing the concept of calmed local street cycling routes into the USA. These routes are called "greenways" in Portland. The main design attributes of these streets are (Walker, Tresidder, and Birk 2009):

- posted speed limit of 20 mph (~ 30 km/h) (previously 25 mph (~ 40 km/h) until 2011) and accompanying traffic calming,
- suppression of through-motorist traffic with road closures,
- traffic volumes under 1,500 vpd preferred with a maximum of 3,000 – 4,000 vpd,
- no centreline,
- wayfinding guidance, and
- provision of improved main road crossing opportunities through refuges and traffic signals.

An evaluation of existing greenways recommended that (PBOT 2015):

- target motorist volume be 1,000 vpd with a maximum of 2,000 vpd, and
- at road crossings there would be a minimum of 50 crossing opportunities per hour with 100 being preferred.

The Portland greenways have been subject to a number of evaluations, for which the most pertinent findings are:

- bicycle boulevards may have improved resident perceptions of their neighbourhood for walking attractiveness but not of traffic safety (Ma and Dill 2015),
- resident surveys suggested some positive association of the boulevard with self-reported walking and cycling activity, but no change in objectively measured behaviour along one boulevard (Dill et al. 2014),
- 85th percentile motorist speeds of under 20 mph (30 km/h) at 16% of sites, and speeds of 23 mph (37 km/h) or less at half of sites (PBOT 2015), and
- 72% of sites have motorist volumes less than 1,000 vpd with 85% having volumes less than 1,500 vpd (PBOT 2015).

3.3.3 NACTO

The US National Association of City Transportation Officials (NACTO) have developed an Urban Bikeway Design Guide in part to encourage more innovative use of cycling infrastructure within US cities. The guide includes a section on bicycle boulevards[3]. That guidance provides detailed advice on route planning, traffic management and wayfinding. It notes that:

- routes should be attractive to riders; they must be well connected and avoid frequent or unnecessary stopping,

[3] http://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/

- routes should have priority at minor street intersections and some form of safe and convenient crossing assistance at major roads,
- routes should be relatively continuous (3 – 8 km, or the length of a typical urban cycling trip),
- 85th percentile speeds no greater than 25 mph (40 km/h) with 20 mph (30 km/h) preferred, and
- 3,000 vehicles per day maximum (only over limited sections) with 1,500 vehicles per day preferred.

3.3.4 Fahrradstrasse

There is limited published guidance on the German bicycle street (*Fahrradstrasse*), which appear to have been implemented primarily by local authorities in isolation. The treatments appear to have many of the same characteristics as these streets elsewhere, including 30 km/h speed limits, traffic calming and filtered permeability.

3.3.5 London Quietways

Quietways have been implemented by Transport for London as connected, local street routes that are a complement to the “Superhighways” that are the main radial routes into central London. The design principles applying to quietways are as follows (Transport for London 2014):

- routes should be on the quietest available roads consistent with directness,
- routes should be as straight and direct as possible,
- routes should try to avoid unnecessary turns,
- at some points, for the sake of directness, Quietways may need to join main roads, but this should be as brief as possible; where they have to join busier roads, or pass through busy, complicated junctions, segregation must be provided,
- routes should use the same road in both directions unless it is absolutely unavoidable; one-way streets should be made two-way for cyclists wherever possible,
- right turns in traffic, which require cyclists to filter into the middle of other vehicles, should be avoided wherever possible; right turns on quiet roads are acceptable,
- right turns which require cyclists to filter in busy traffic should always be avoided; if it is unavoidable, a short stretch of segregation or other road rearrangement should be provided,
- wayfinding will largely be on-carriageway, though signs will be necessary at some junctions,
- routes need to operate full-time; where routes are through parks that are closed at night, then an acceptable and sufficiently direct alternative night route, on similarly quiet roads, will need to be well signposted, and
- partners should consider ‘social safety’ as a central and integral part of Quietway design and delivery; lighting and CCTV should be improved where necessary.

All local streets in London have 20 mph (30 km/h) speed limited. Quietways have been implemented by local authorities (boroughs) in London in conjunction with Transport for London – similarly to the Australian context local roads are managed by local authorities. The first quietway was constructed in 2016. While still in their infancy, the program has been subject to criticism for failing to adequately consider major road crossings[4] and excessive traffic volumes[5] as well as slower than anticipated rollout (Transport for London 2016). Given the relative infancy of Quietways as a formal treatment within UK design practice there is not yet formal quantitative guidance on rider or motor vehicle traffic volumes.

3.4 Conclusion

Current experience with shimmy routes would suggest that the following general design practices should be followed in designing these routes:

- **Speed limits:** Posted speed limits should be 30 km/h, with 85th percentile speeds at or below this speed.
- **Traffic volumes:** Motor vehicle volumes should be under 2,000 vpd and ideally rider volumes should be equivalent or greater than the motor vehicle volume.
- **Segregated cycling infrastructure:** Should be avoided except in isolated locations (e.g. at major road intersections).
- **Wayfinding and signage:** Should be consistent and clear along the route, possibly branded, and ideally be placed as pavement markings to have maximum visibility to both bicycle riders and motorists.
- **Minor street crossings:** The route should have priority over minor crossing streets; this implies give way or stop signs for the intersecting street and, optionally, a raised table to encourage Safe System speeds[6]. Roundabouts should be avoided given the elevated rider crash risks compared to other intersection types.
- **Major road crossings:** There should be refuges or signals to facilitate safe and convenient roadway crossings.
- **Promotion:** Targeted promotion towards riders and the community should focus on the connectivity and convenience of the route, and the obligations of motorists along these routes.

[4] http://lcc.org.uk/articles/quietways-they-arent-working

[5] https://aseasyasridingabike.wordpress.com/2016/04/22/quietway-1/

[6] We use the term “Safe System speeds” to refer to speeds which ensure a very low risk of serious or fatal injury being incurred should a collision occur. In practice this means speeds of around 30 km/h, and certainly no more than 40 km/h.

4 Intercept surveys

4.1 Introduction

Intercept surveys, where interviewers position themselves adjacent to the roadway and interview bicycle riders along the shimmy routes, were used in this study as a cost-effective means of obtaining information from bicycle riders. These surveys were used to develop an understanding of the purpose for which shimmy routes are used, motivations towards their use and perceptions of how well they function.

4.2 Methodology

Intercept interviews were conducted at four locations along existing shimmy routes:

- **Hurstbridge Line:** South Cr @ Westgarth St
- **South Morang Line:** Hartington St @ Westbourne Gr
- **Christmas St:** Christmas St @ St David St
- **Great Western Shimmy:** Leinster Gr @ Normanby Av

The surveys were conducted on three weekdays between 7 – 10 am and 3:30 – 6:30 pm, and on two weekend mornings from 9 – 12 pm to cover a wide range of riders during the busiest times of day.

4.3 Results

A total of 397 interviews were completed across the four sites (Table 4.1). While convenience sampling was used (that is, all riders were invited to stop without any formal sampling procedure) the interviewers felt that the majority of regular riders on these routes were subject to the interview by the final session (i.e. after eight sessions). As such, it is suggested the population coverage (at least across the times of day and days of week in the fieldwork) is very high and we can have confidence the sample is representative of the wider shimmy user population.

■ Table 4.1: Completed interviews by site and date

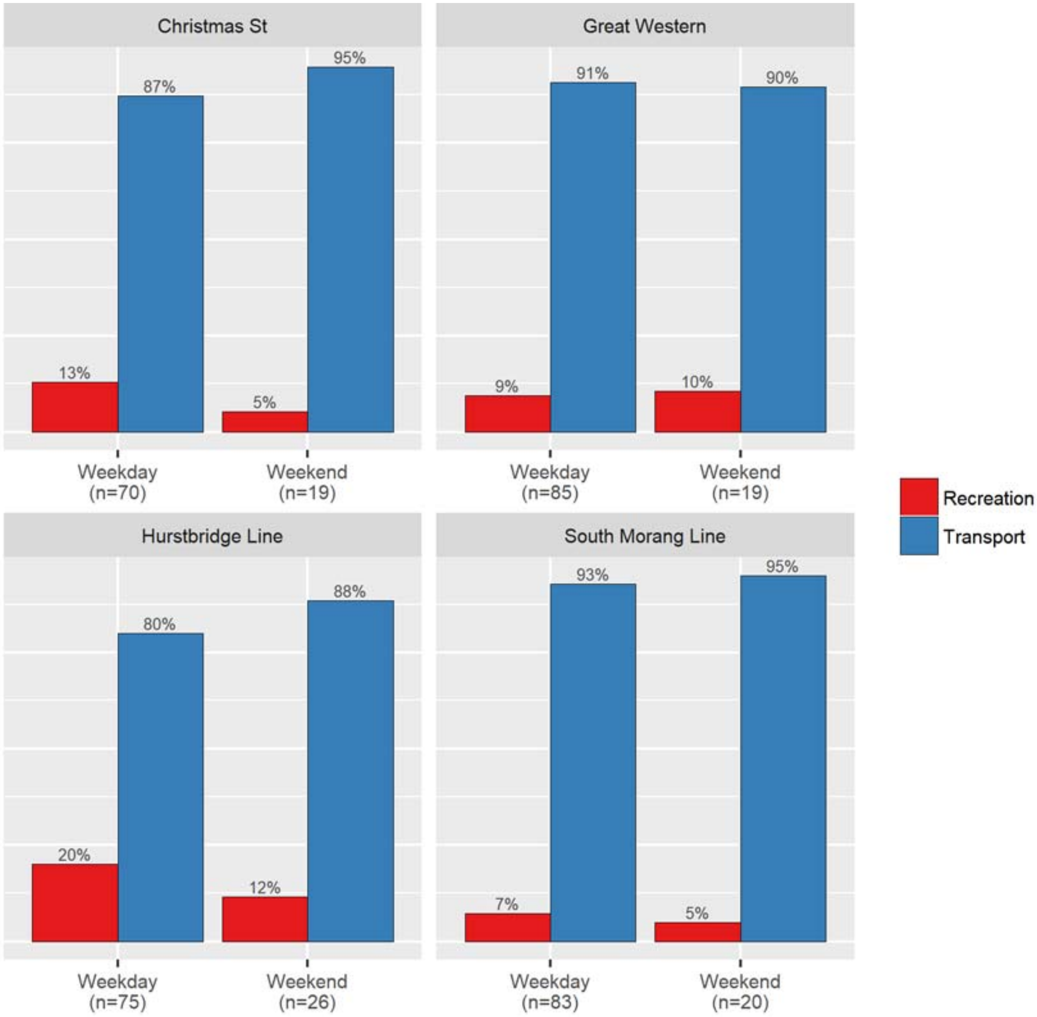
Date	South Cr @ Westgarth St	Hartington St @ Westbourne Gr	Christmas St @ St David St	Leinster Gr @ Normanby Av
Wed 10 May	33	33	38	38
Thu 11 May	26	41	24	32
Fri 12 May	26	20	19	19
Sat 13 May	7	5	6	11
Sun 14 May	9	4	2	4
Total	*101*	*103*	*89*	*104*

4.3.1 Trip characteristics

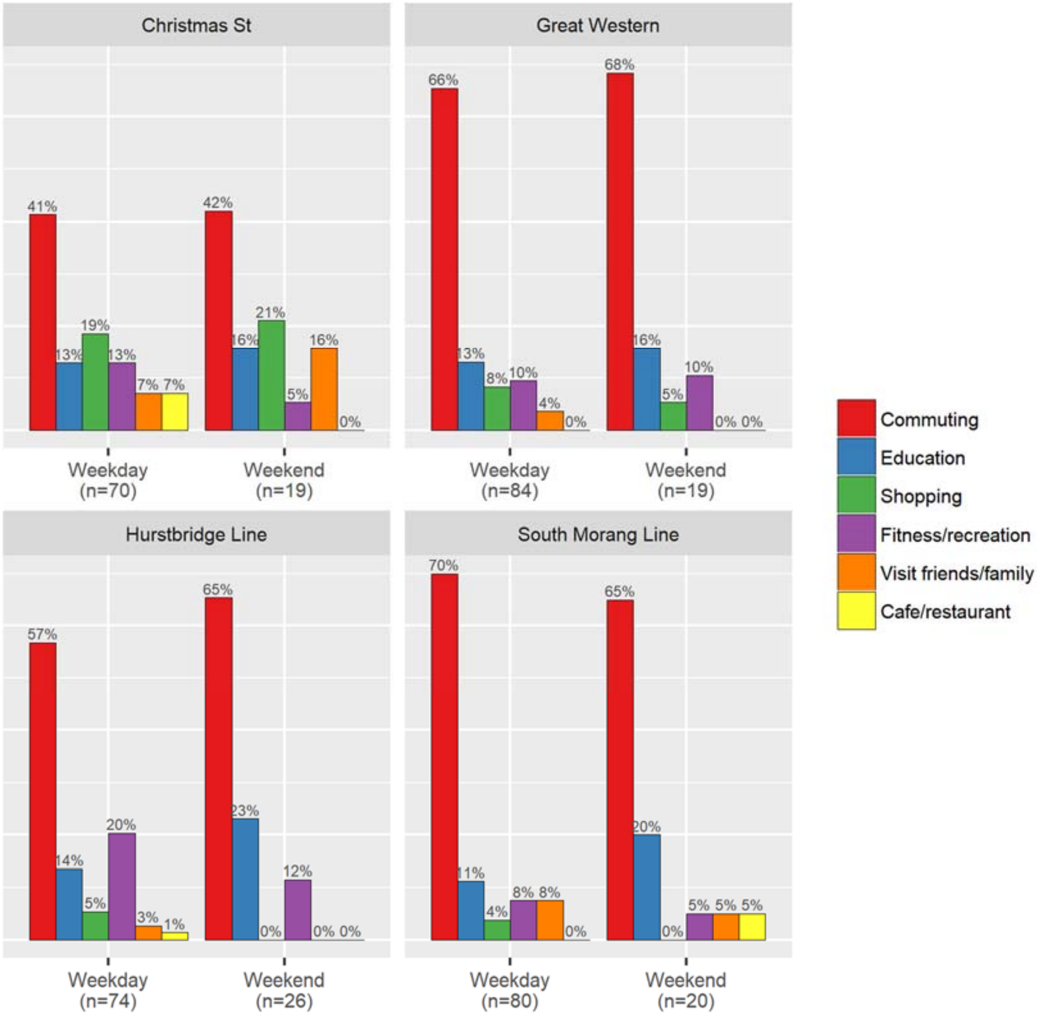
The dominant purpose for riding along the shimmy routes was for transport; 91% of riders on weekdays were travelling for transport purposes, as were 69% on weekends (Table 4.2). Transport purposes dominated at all sites, especially on weekdays (Figure 4.1). Travelling to work was by far the most common trip purpose across all sites, and even at weekends (Figure 4.2). The other main purposes were travelling to education or for shopping, with fitness and recreational riding constituting a minor trip purpose.

■ Table 4.2: Main trip purpose by site and day of week

		Purpose					
		Transport		Recreation		Total	
Site	**Day of Week**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Hurstbridge Line	Weekday	75	88%	10	12%	85	100%
	Weekend	8	50%	8	50%	16	100%
South Morang Line	Weekday	88	92%	6	8%	96	100%
	Weekend	8	89%	1	11%	9	100%
Christmas St	Weekday	73	90%	8	10%	81	100%
	Weekend	6	75%	2	25%	8	100%
Great Western	Weekday	83	93%	6	7%	89	100%
	Weekend	11	73%	4	27%	15	100%
Total	Weekday	319	91%	30	9%	349	100%
	Weekend	33	69%	15	31%	48	100%



- Figure 4.1: Main purpose by shimmy and day of week



■ Figure 4.2: Detailed purpose by site and day of week

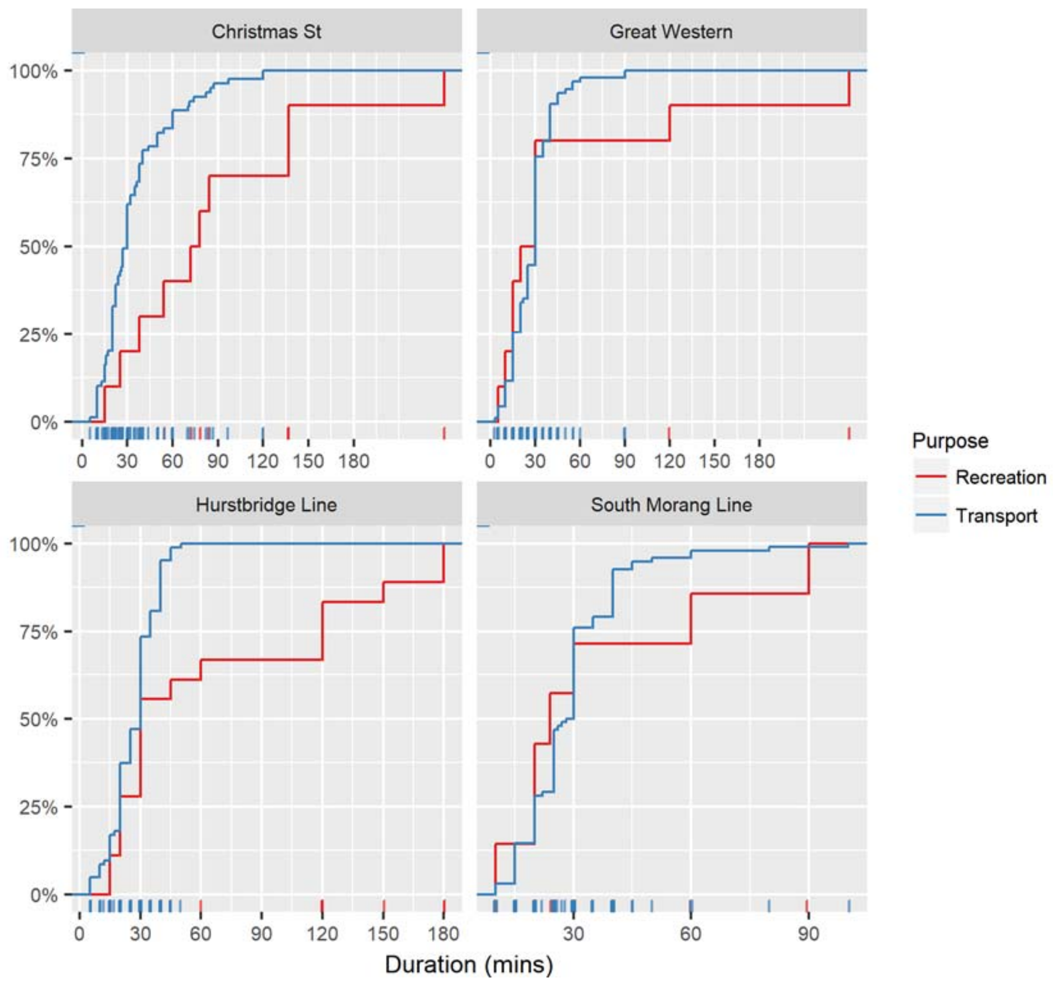
The average transport cycling trip across all four sites had a duration of 30 minutes, with recreation trips having an average duration of 64 minutes. The average and median trip distances by site are summarised in Table 4.3 and the cumulative distributions shown in Table 4.3. This analysis suggests that:

- transport trip durations across the four locations are similar, with very few trips taking longer than an hour, and
- recreational trips at all sites aside from the South Morang Line are significantly longer than transport trips; the average recreational trip has a duration of around twice that of transport trips.

■ Table 4.3: Trip duration

	Purpose					
	Transport		Recreation		All purposes	
Shimmy	**Average**	**Median**	**Average**	**Median**	**Average**	**Median**
Christmas St	34.8	30	88.0	75	40.8	30
Great Western	28.0	30	51.5	25	30.3	30
Hurstbridge	26.8	30	67.5	30	34.0	30
South Morang	29.1	29	36.3	24	29.6	28
All routes	*29.6*	*30*	*63.6*	*30*	*33.4*	*30*

Units are minutes

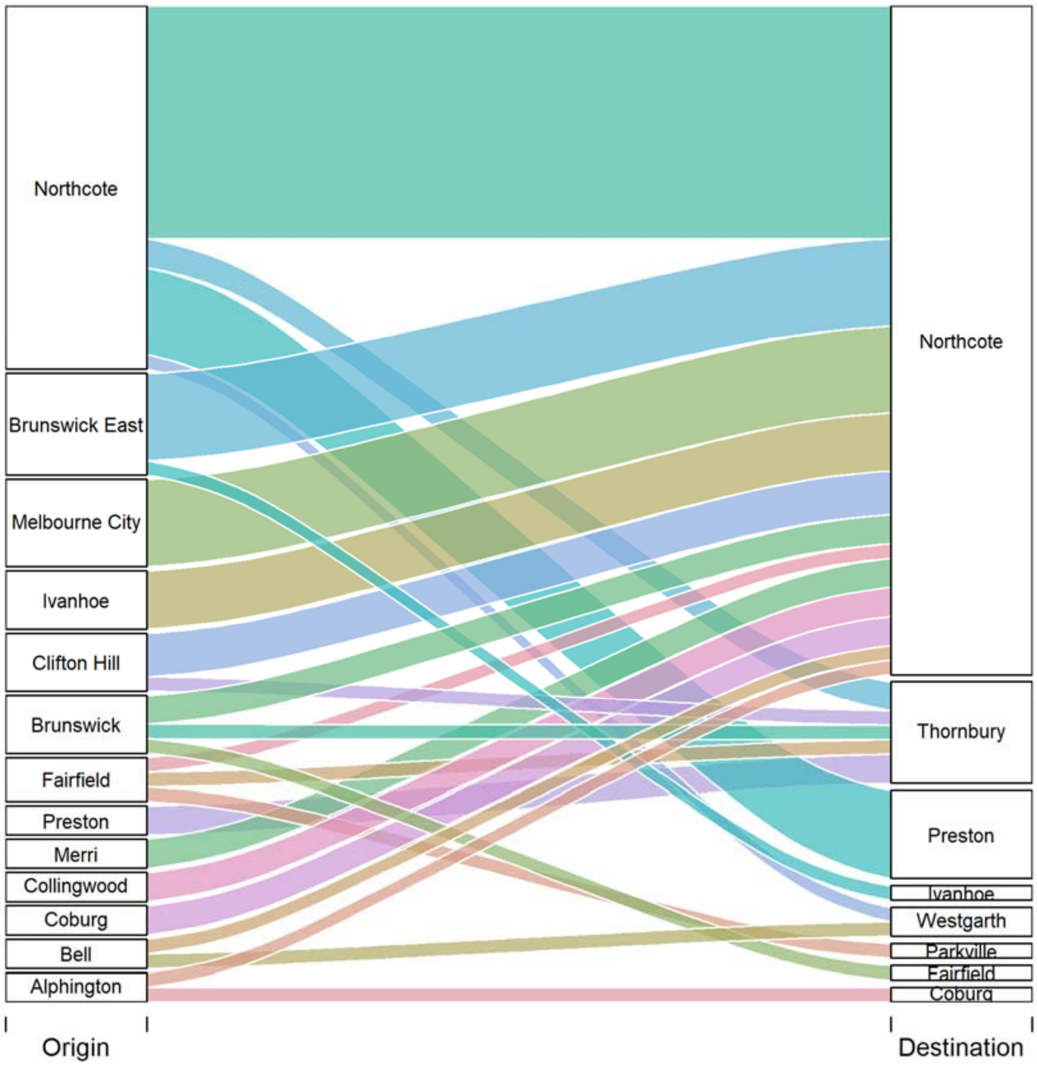


■ Figure 4.3: Cumulative distribution of trip duration by site and purpose

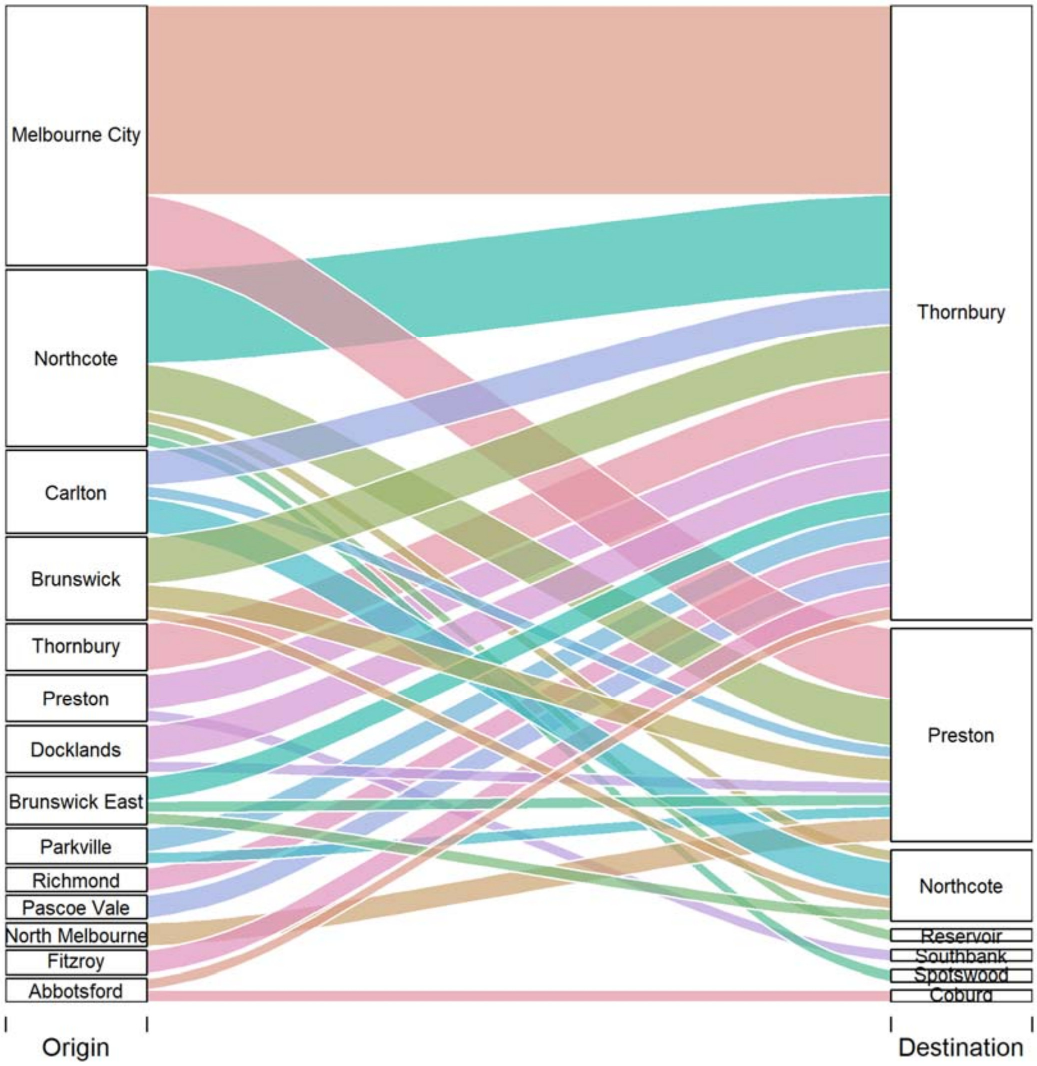
Respondents were asked in which suburb their bicycle trip would start and finish. Considering only transport trips:

- 22% of trips along Christmas St were starting and finishing in Northcote, followed by Northcote to the City (8%) and to Brunswick East (8%) (Figure 4.4).
- 17% of trips along the Great Western shimmy were between Thornbury and the City, followed by Northcote to Thornbury (9%) and Preston to the City (7%) (Figure 4.5).
- 21% of trips along the Hurstbridge Line shimmy were between Northcote and the City, followed by trips entirely within Northcote (8%) and between Northcote and Parkville (6%) (Figure 4.6).
- 32% of trips along the South Morang Line shimmy were between Northcote and the City, followed by Thornbury and the City (10%) and Northcote and Parkville (6%).

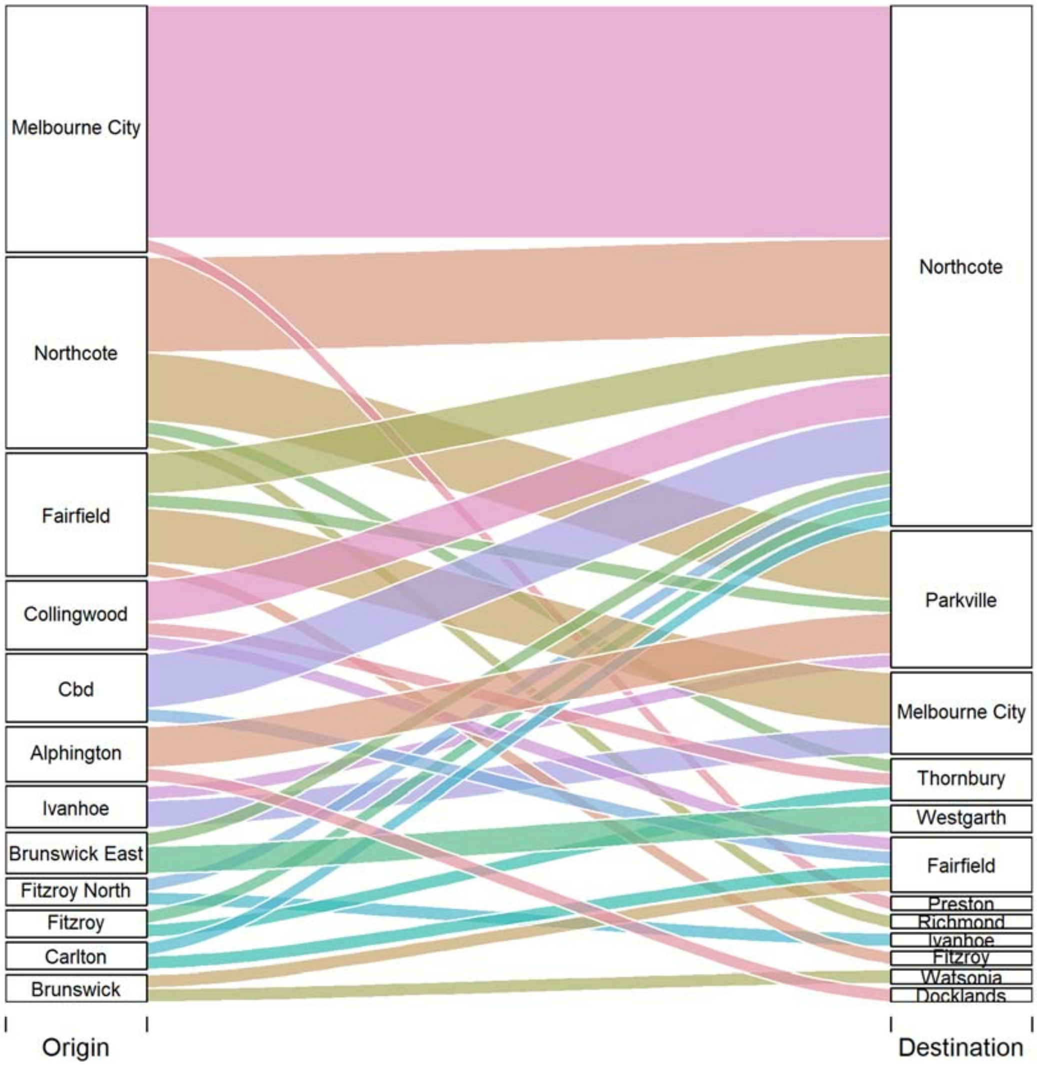
Unsurprisingly, recreation trips were far less dispersed than transport trips – and most finished at the same location as they started.



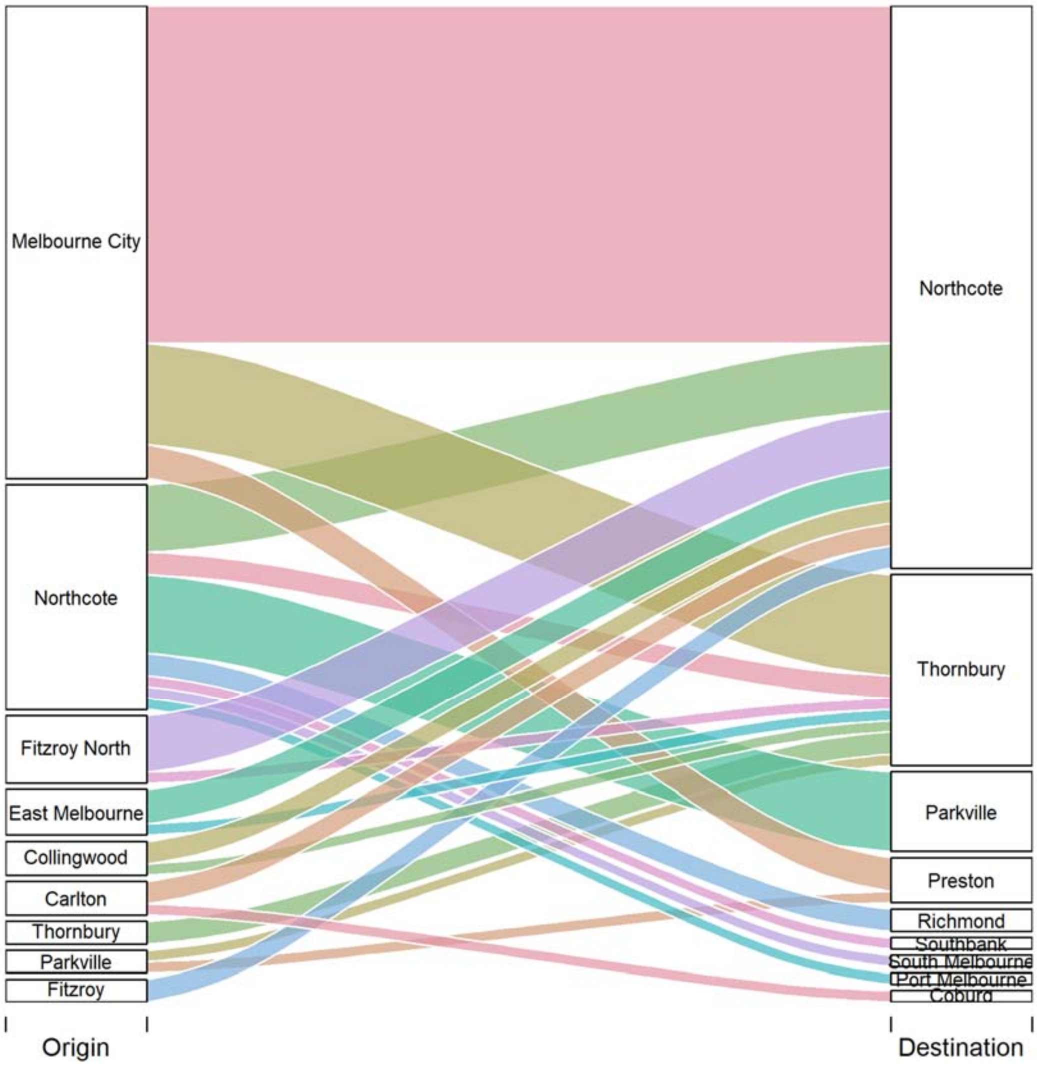
■ Figure 4.4: Transport trips (Christmas St) origin and destination suburb



■ Figure 4.5: Transport trips (Great Western) origin and destination suburb

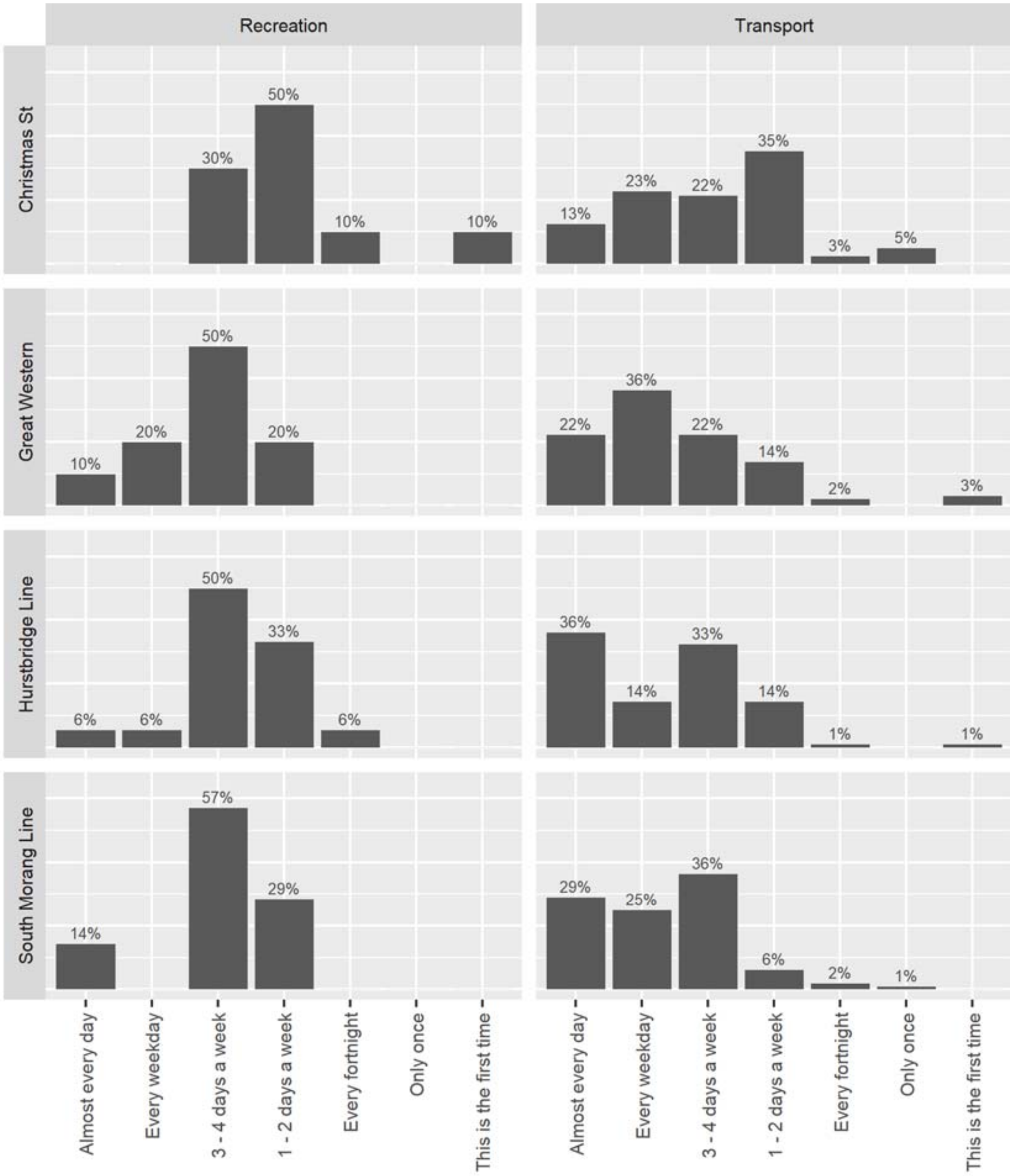


- Figure 4.6: Transport trips (Hurstbridge Line) origin and destination suburb



■ Figure 4.7: Transport trips (South Morang Line) origin and destination suburb

Most users of the shimmy routes ride along the route regularly; 50% of transport riders ride along the shimmy at least every weekday, as do 13% of recreational riders. The Great Western, Hurstbridge and South Morang shimmy routes appear to attract somewhat more regular riders than Christmas St (Figure 4.8). Irrespective, this analysis would suggest most of the sample of respondents have good familiarity with the route such that they are likely to be able to report on their experiences riding along the route.



■ Figure 4.8: Frequency of visitation

4.3.2 Alternative modes

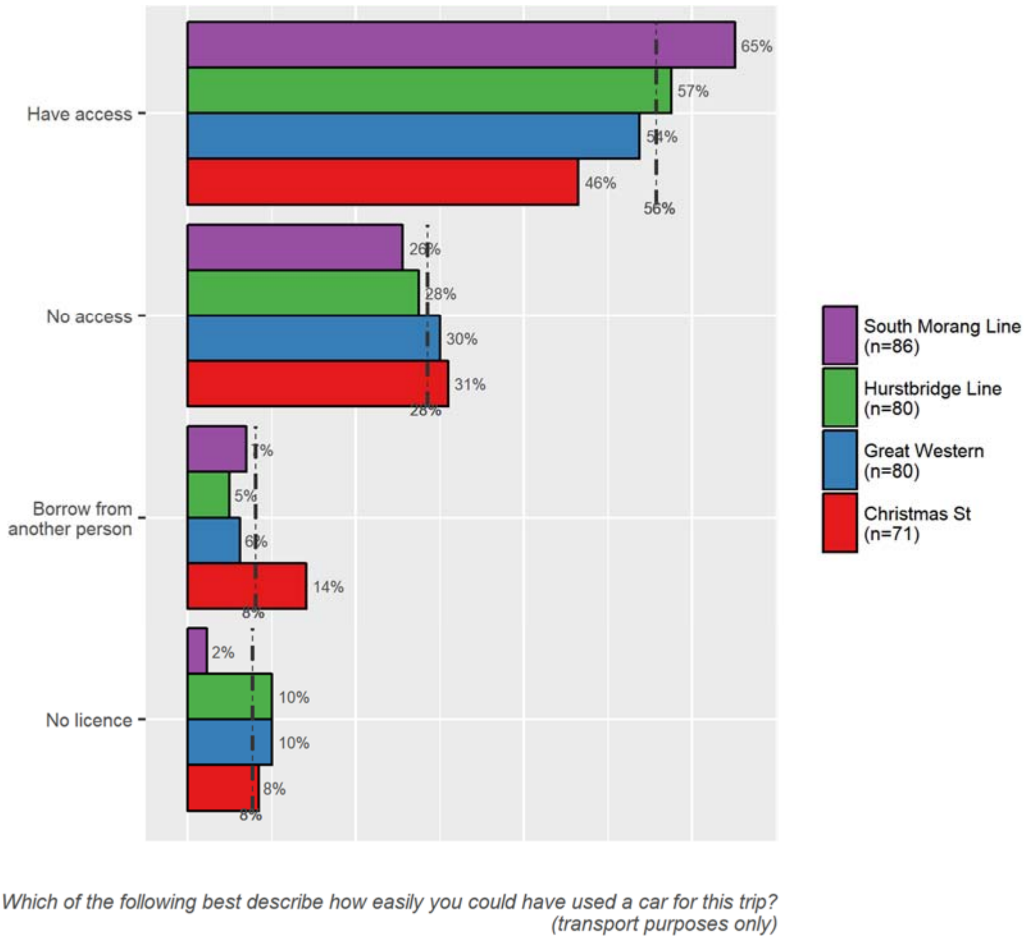
One of the key objectives of Darebin's Cycling Strategy is to encourage riding for trips of 2 to 7 km in length. To assess the shimmy policy against the strategy, and for the purposes of the cost-benefit analysis, respondents were asked:

- the availability of alternative modes for their trip (car and public transport),
- what they would have done in the absence of the shimmy treatments, and
- what they would have done if they could not have ridden their bicycle.

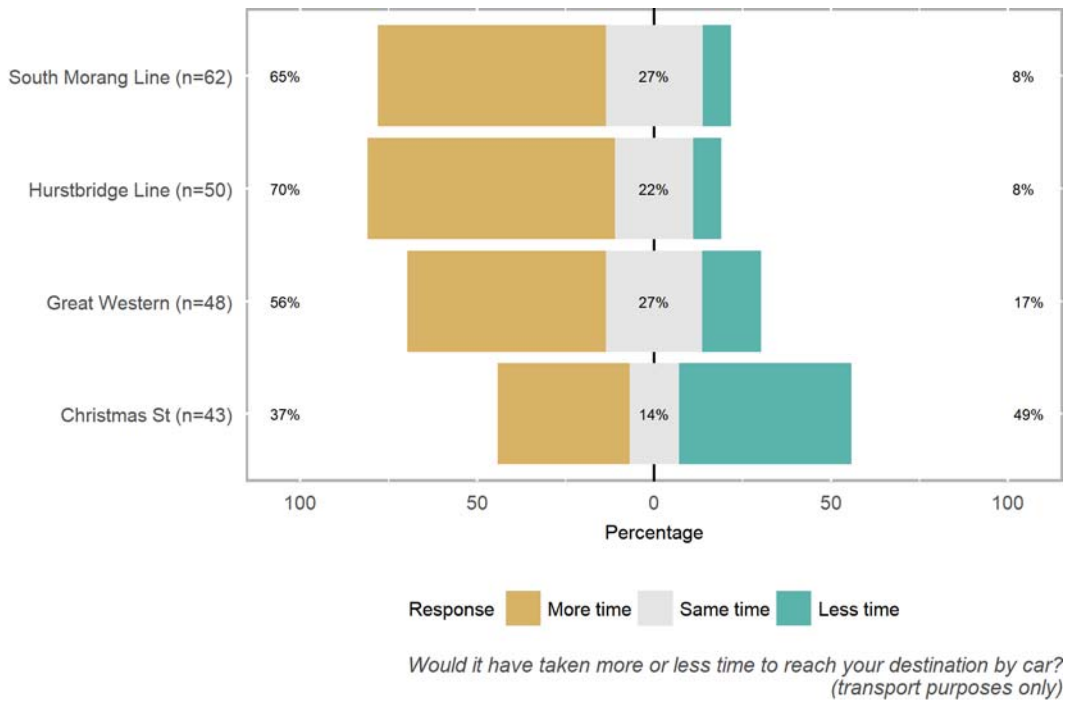
These questions were only asked of those riding for transport purposes given that for many recreational trips it would be nonsensical to substitute riding with car or public transport.

Overall, 56% of bicycle riders had access to a car they could have used for their transport trip, with most of the remainder (28%) having a driver's licence but no car access, or no drivers licence (8%). The proportion with car access was highest on the South Morang Line (65%) and lowest on Christmas St (46%) (Figure 4.9). Notably, 58% of respondents indicated that substituting bicycle riding for driving a car would have *increased* their journey time. The proportion for whom car travel times would have been greater than riding is similar across all sites except for Christmas St (Figure 4.10). It is possible the more competitive travel time offered by car driving along the Christmas St Shimmy can be attributed to the more local nature of trips along this corridor, and that many trips do not have destinations in the inner city (where congestion and parking are most problematic).

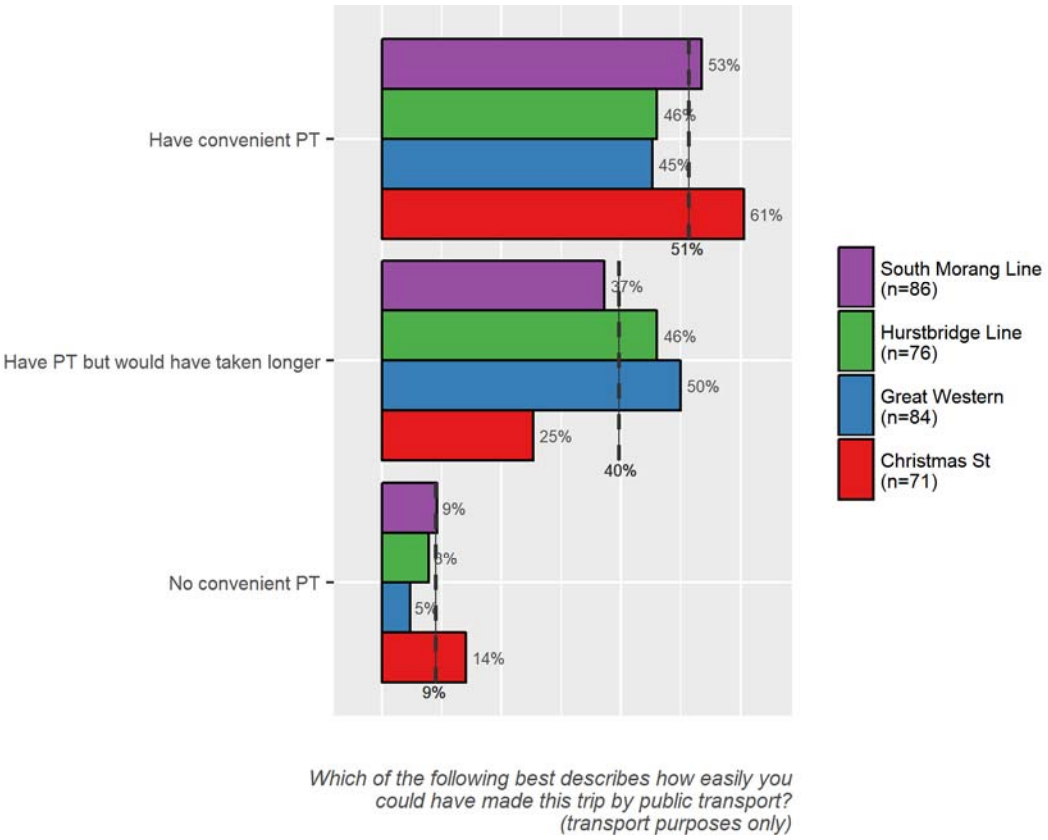
Reflecting the high quality of public transport in the area, around 51% of respondents reported having a convenient public transport alternative and a further 40% stated they could have taken public transport but it would have taken longer than riding (Figure 4.11). Even among those who did have convenient public transport most indicated it would have taken longer than riding (Figure 4.12). Again, only along Christmas St was public transport perceived as being time competitive with cycling.



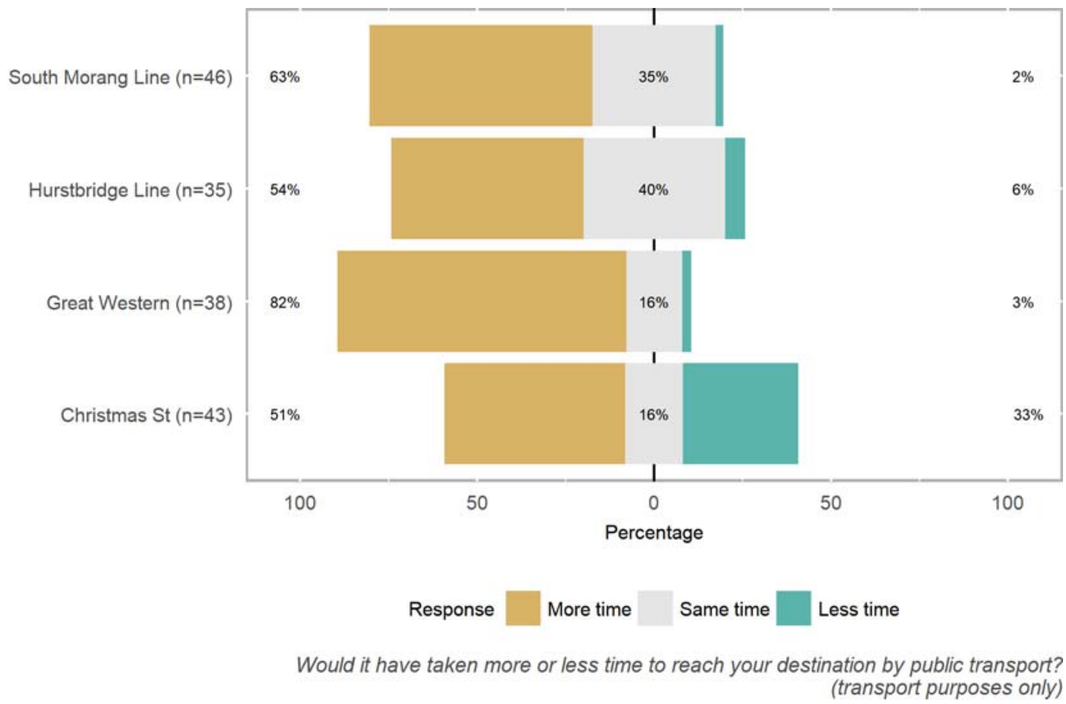
■ Figure 4.9: Car availability



■ Figure 4.10: Change in travel time from bicycle to car

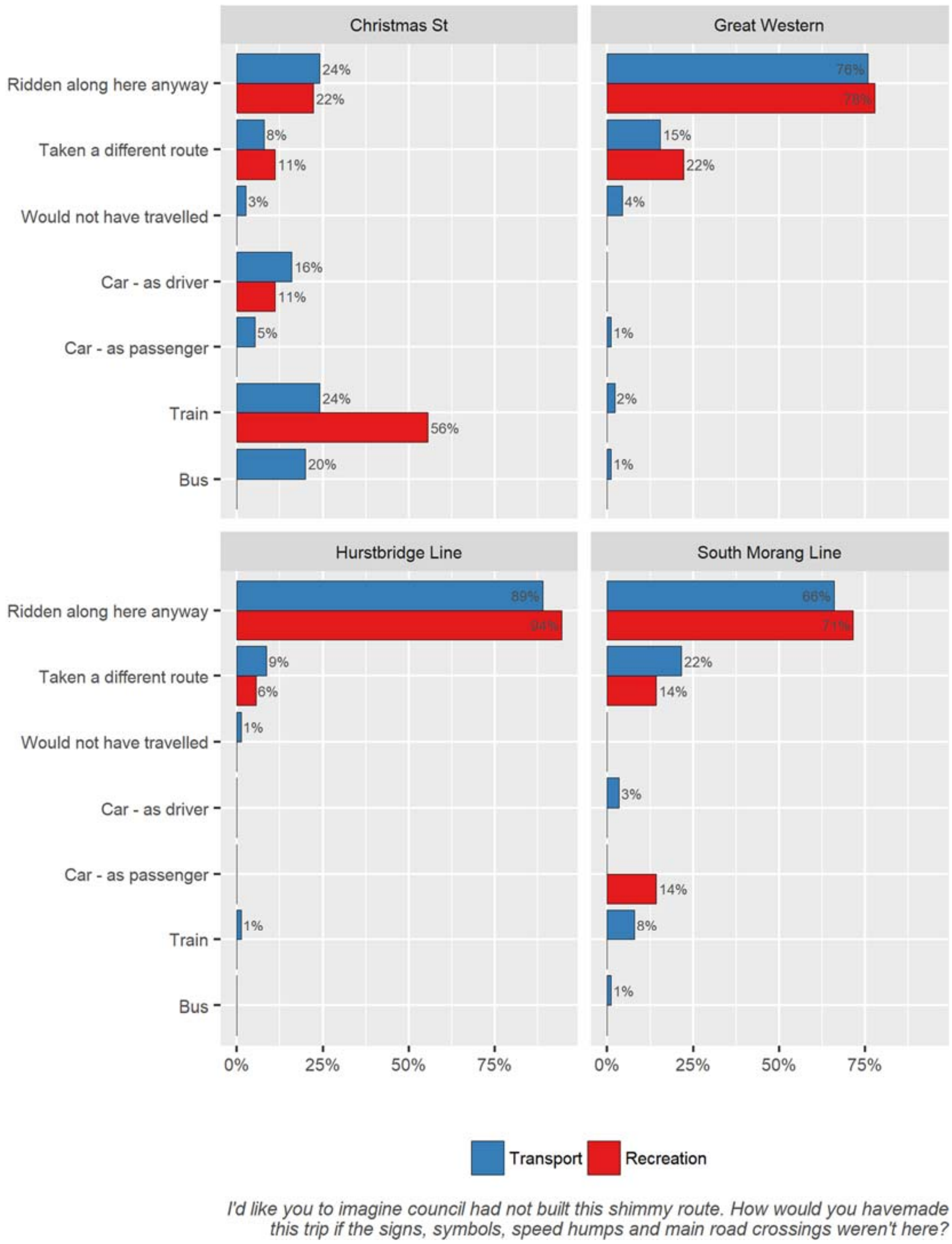


■ Figure 4.11: Public transport availability

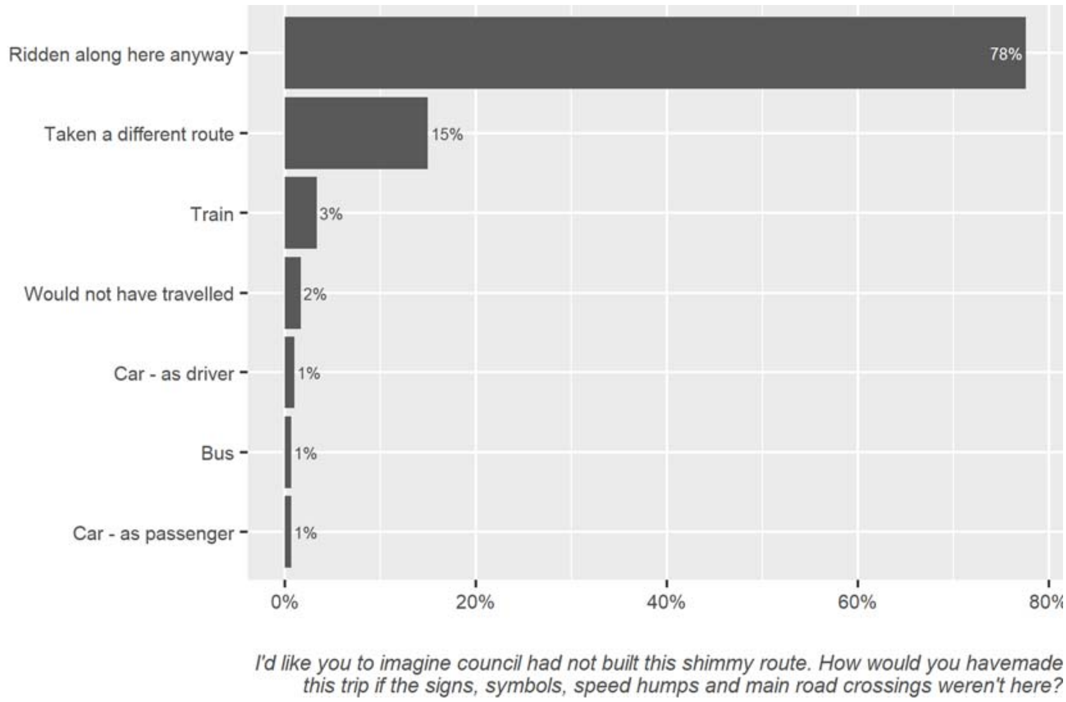


■ Figure 4.12: Change in travel time from bicycle to public transport

Respondents were asked what they would have done for their trip if the shimmy route were not present; that is, if the signs, bicycle symbols, speed humps and improved main road crossings weren't present. On most shimmy routes between 66% and 89% of transport riders indicated they would have ridden along this local street in any case (Figure 4.13). However, only around a quarter of riders on Christmas St indicated likewise. Moreover, around 44% of riders on Christmas St indicated they would have taken a train or bus in the absence of the shimmy, with a further 21% taking a car (either as a driver or passenger). This result suggests far higher levels of diversion than have been observed using the same survey methodology as part of other studies, including of major cycling infrastructure projects that would be expected to have very substantial impacts. It is suspected the interviewers at this site have misinterpreted the field codes, such that these results are invalid. As such, this diversion data for Christmas St is excluded from the cost-benefit analysis presented in Section 7. Instead, and in order to more robustly handle the small number of respondents who indicated they would otherwise have driven, taken public transport or not travelled, the data across the other three sites was pooled as summarised in Figure 4.14. That most riders, around 78%, would have ridden along these streets irrespective of the shimmy corridor seems intuitively reasonable given the shimmy routes do not represent a step change in the level of rider provision. However, this is not to discount the observation from this data that around 15% of users would otherwise have ridden on another route, and there has been minor diversion from public transport (4%) and motor vehicle (2%). Given the modest cost of the treatments this behavioural response does not seem to be unreasonable.



■ Figure 4.13: Alternatives if shimmy route were not present by site and purpose



■ Figure 4.14: Alternatives if shimmy route were not present (excluding Christmas St)

The modal diversion at the other sites is low, suggesting that the most significant impact on rider behaviour has been diverting riders from other routes. When asked what other route they would have taken, between a third and a half of respondents would have chosen a main road (Table 4.4). It would seem reasonable to argue that those diverting from main roads are exposed to lesser risks of conflict with high speed motor vehicles, and are therefore safer[7].

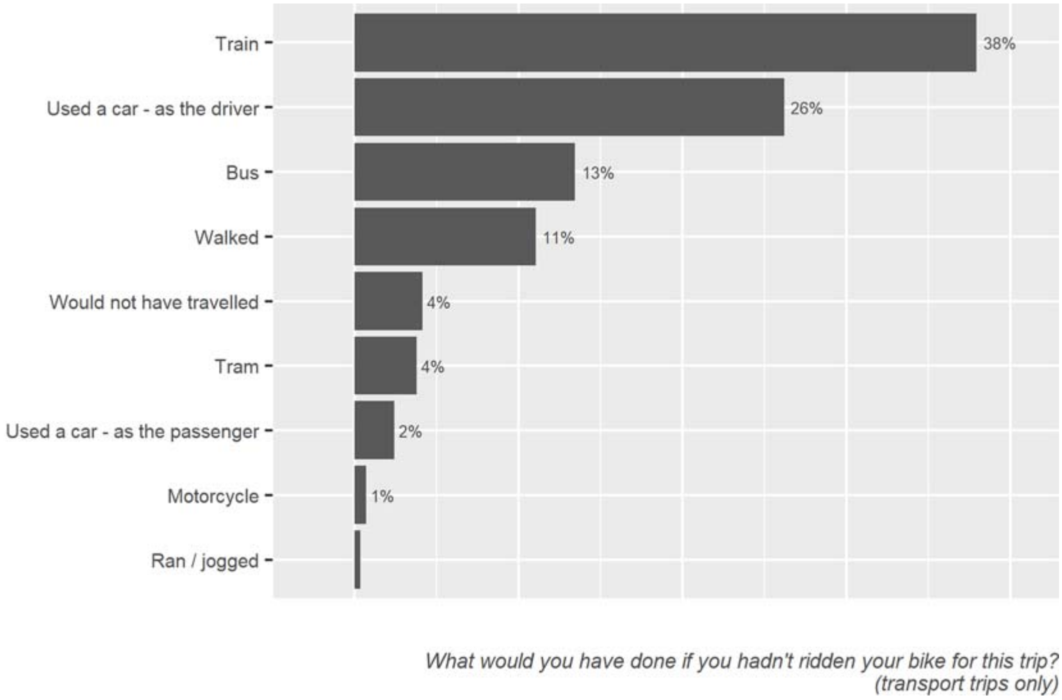
■ Table 4.4: Diversion from other local streets or main roads

	Different side street		Main road	
Shimmy	**No.**	**%**	**No.**	**%**
Christmas St	4	66%	2	33%
Great Western	12	75%	4	25%
Hurstbridge Line	4	50%	4	50%
South Morang	13	65%	7	35%
All sites	*33*	*66%*	*17*	*33%*

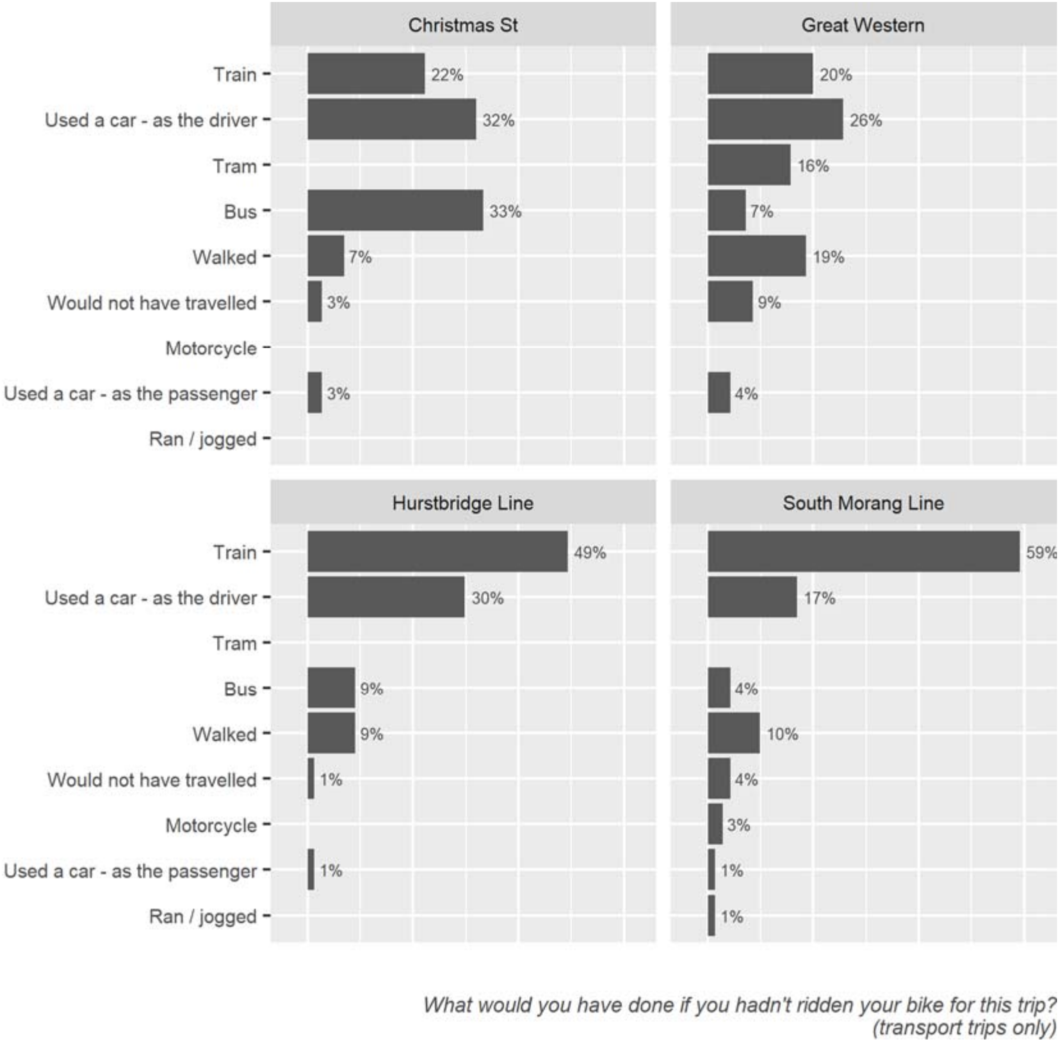
Would your alternative route have been down side streets or along main roads?

[7] However, this general statement may not always hold true. For example, if the local road route is longer there may be greater overall exposure to risk. Moreover, most motorist-rider collisions occur at intersections – these are still present on shimmy routes and may, or may not, be safer than major signalised intersections.

Given that many respondents would have ridden irrespective of the presence of the shimmy, they were further probed to ask what they would have done if they could not have ridden their bicycle. This provides an indication of the possible alleviation of motor traffic and public transport crowding that riding may provide to the broader transport network. As most recreation trips will be undertaken for the very purpose of riding (that is, the activity *is* the purpose) this question was only asked of those riding for transport. Of this sample around 38% would have used a train if they could not ride and 25% would have used a car (Figure 4.15). Unsurprisingly, the proportion who would use a train was higher along the Hurstbridge and South Morang Line shimmy routes (Figure 4.16).

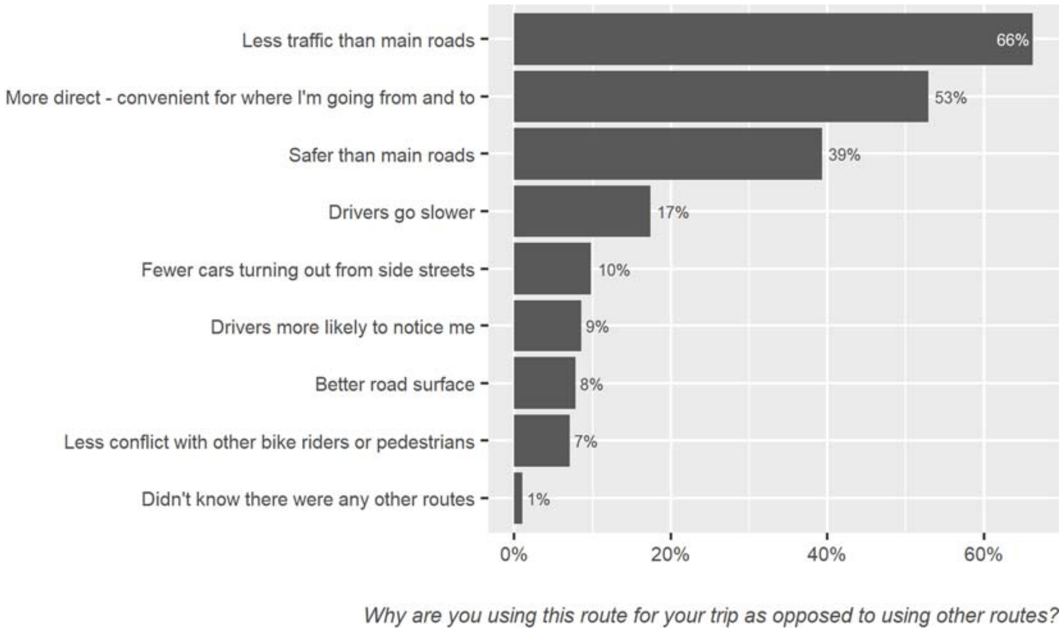


■ Figure 4.15: Travel choice if bicycle riding were not an option

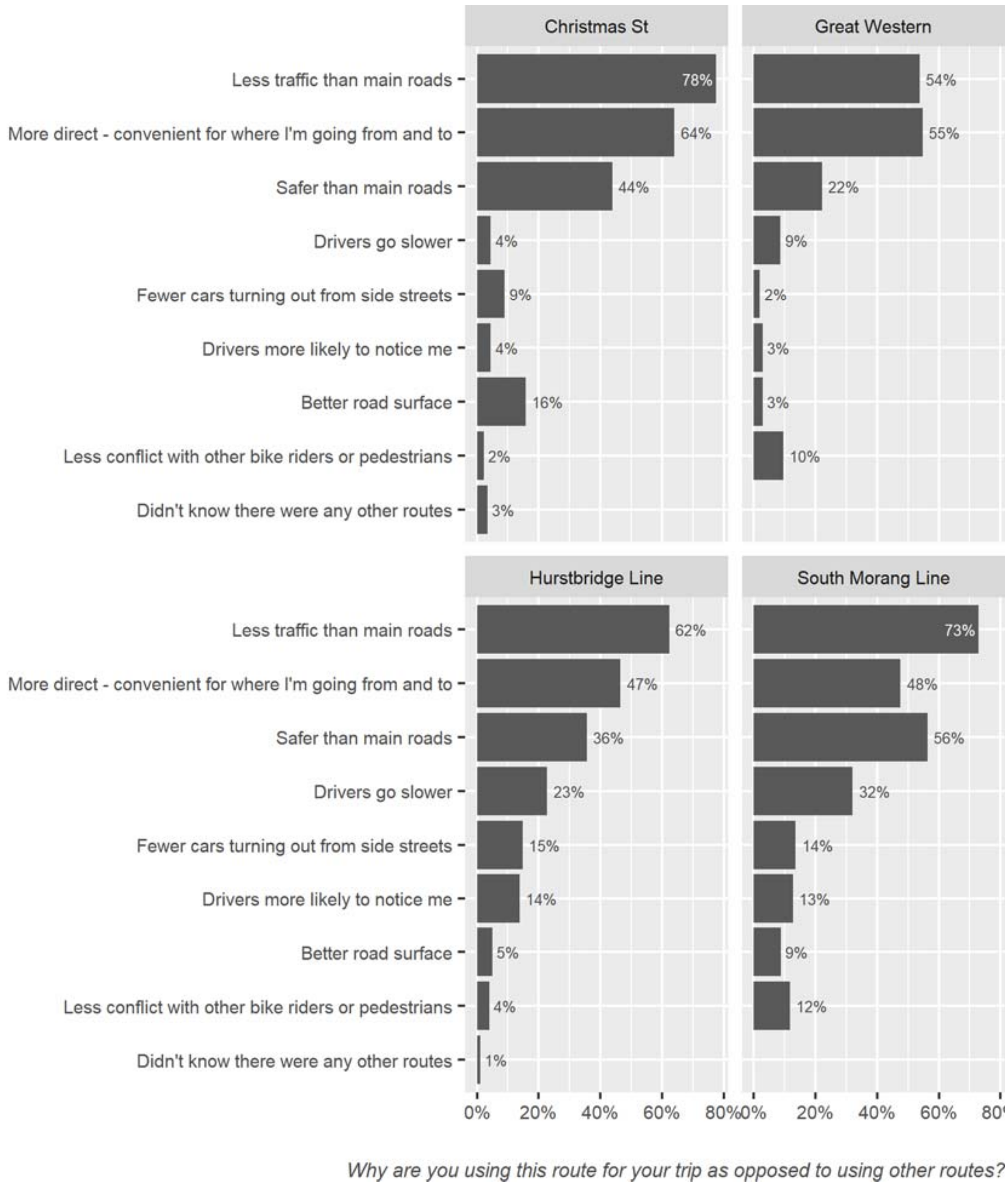


■ Figure 4.16: Travel choice if bicycle riding were not an option by shimmy

Two thirds of respondents indicated they chose the shimmy route because of less traffic than main roads, and just over half indicated it was a direct and convenient route for their trip (Figure 4.17). These motivations, along with the shimmy being safer than main roads, were highly rated by respondents at all shimmy locations (Figure 4.18).



■ Figure 4.17: Reasons for using the shimmy route



■ Figure 4.18: Reasons for using the shimmy route by site

4.3.3 Awareness of shimmy routes

Bicycle riders were asked whether they had noticed the shimmy treatments and whether they heard the "shimmy" term used to describe these bicycle routes. Overall, 75% of respondents had noticed the signs and road markings with the lowest proportion being along the Hurstbridge Line (Table 4.5). While three quarters of respondents had seen the signs and symbols only 37% had heard of the "shimmy" term, with the lowest proportion again being along the Hurstbridge Line.

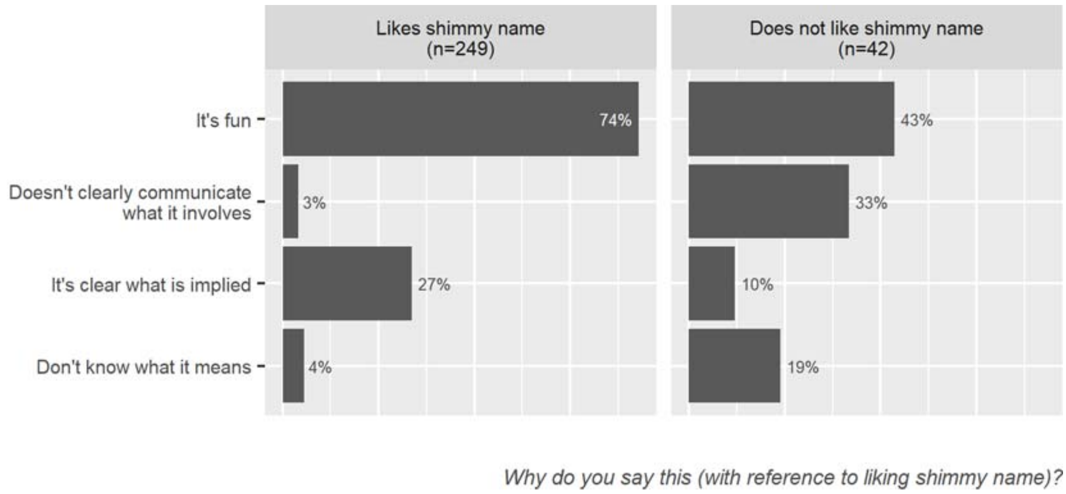
■ Table 4.5: Awareness of the shimmy treatments and name

Shimmy	Noticed treatments[1]	Heard of "shimmy"[2]
Christmas St	82%	51%
Great Western	77%	48%
Hurstbridge Line	58%	18%
South Morang Line	83%	33%
All sites	*75%*	*37%*

[1] The council has been putting in signs and road markings for bike riders along local streets to encourage bike riding. Have you noticed these on this street?

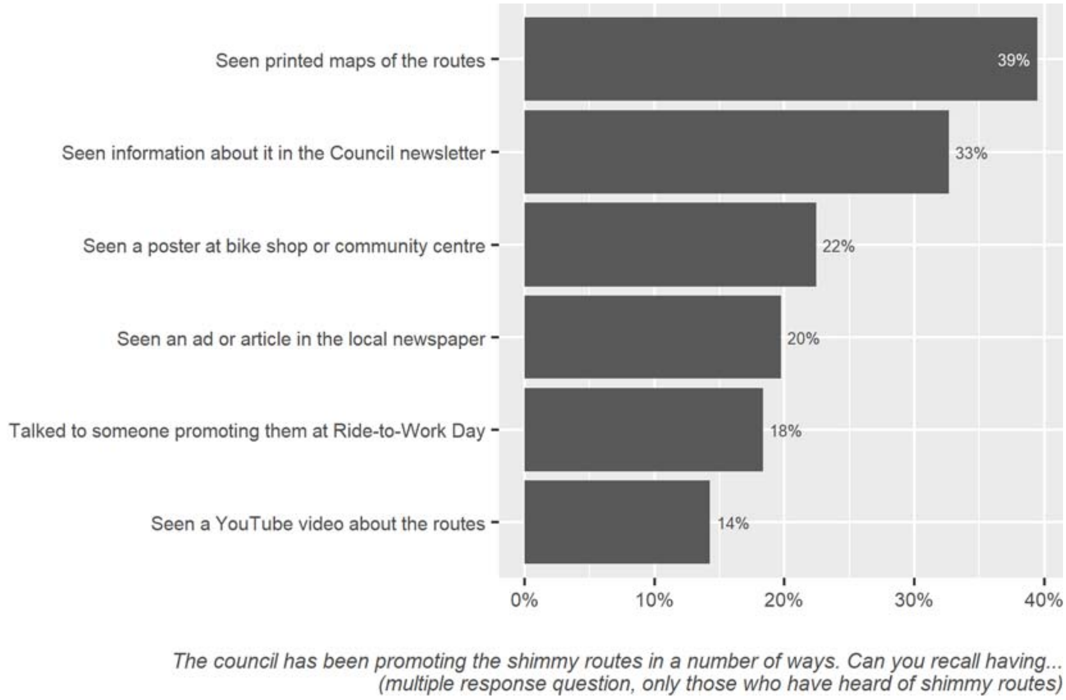
[2] Did you know that the bike route you are riding on is referred to as a shimmy route?

Overall, 64% of respondents liked the shimmy term and a further 25% had no opinion either way. The remaining 10% did not like the term. Of those that liked the term, most thought it was fun while 27% felt it was clear what was implied by the term (Figure 4.19). Even among those who did not like the term just under half thought it was fun. However, a third felt it did not clearly communicate a meaning and a fifth didn't know what it meant.



■ Figure 4.19: Reaction to the shimmy name

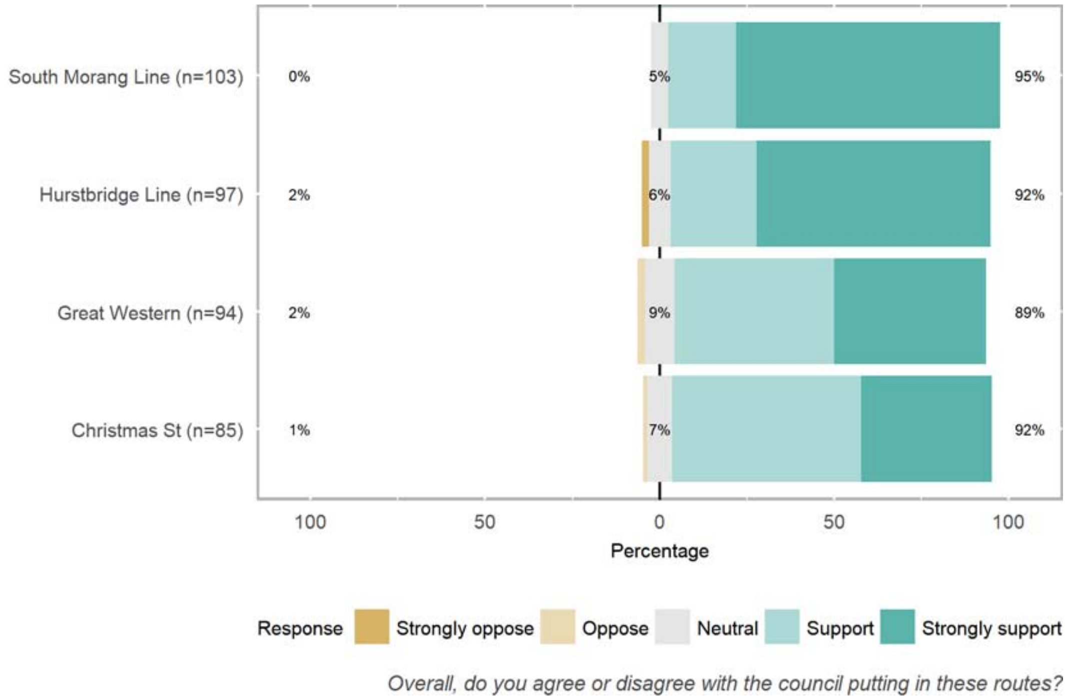
Those that had heard of the shimmy term were asked where they had heard of it. The most commonly cited source was printed maps produced by the council, followed by the council newsletter and posters in bike shops or community centres (Figure 4.20).



■ Figure 4.20: Awareness of shimmy promotions

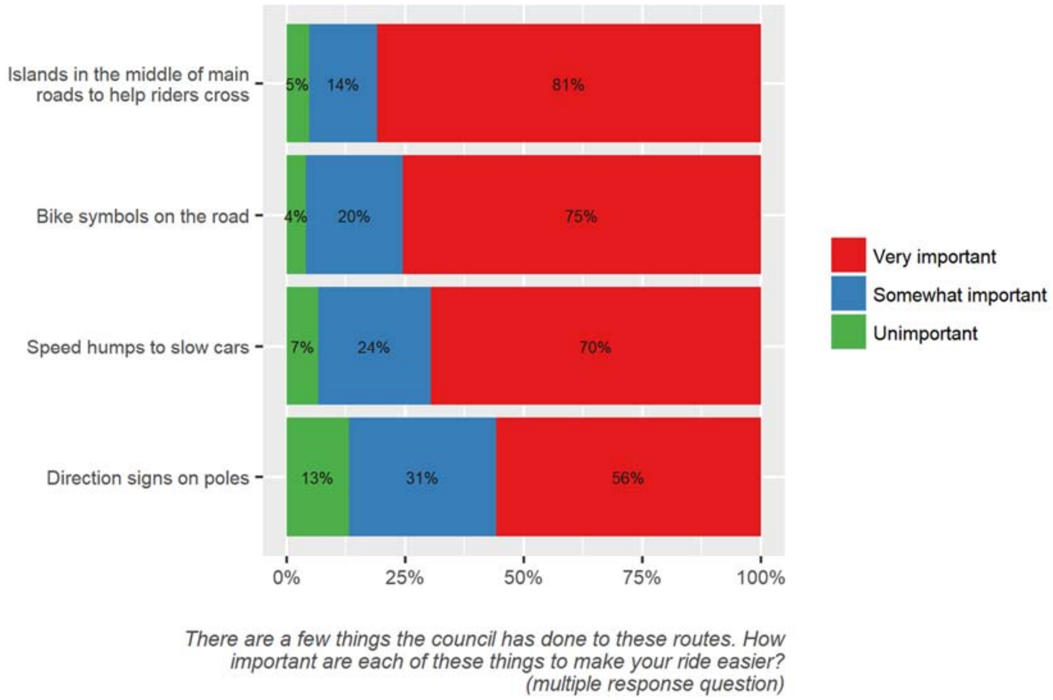
4.3.4 Opinions of shimmy routes

There was overwhelming support from the bicycle riders towards the shimmy routes; 57% strongly supported and a further 35% supported the development of these routes. Comparatively few were neutral (7%), opposed (1%) or were strongly opposed (1%). These opinions held across all four shimmy routes (Figure 4.21).



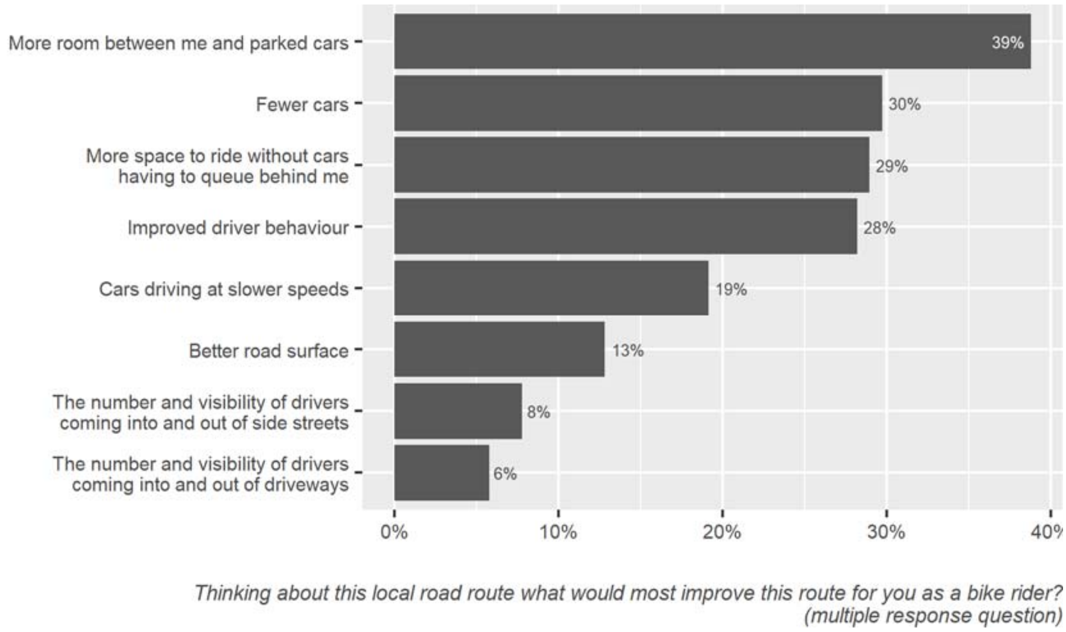
■ Figure 4.21: Support for shimmy routes

Of the four main treatments applied to shimmy routes 81% of riders felt islands in the middle of main roads were the most important treatment (Figure 4.22). While more than half of respondents felt all four treatments were important or very important, the direction signs on poles rated lowest among the treatments.



■ Figure 4.22: Importance of shimmy treatments

Riders were asked what improvements could be made to the shimmy routes. Around 39% indicated more room between themselves and parked cars would be desirable, followed by fewer cars (30%), more space to ride without cars having to queue behind (29%) and improved driver behaviour (28%) (Figure 4.23).

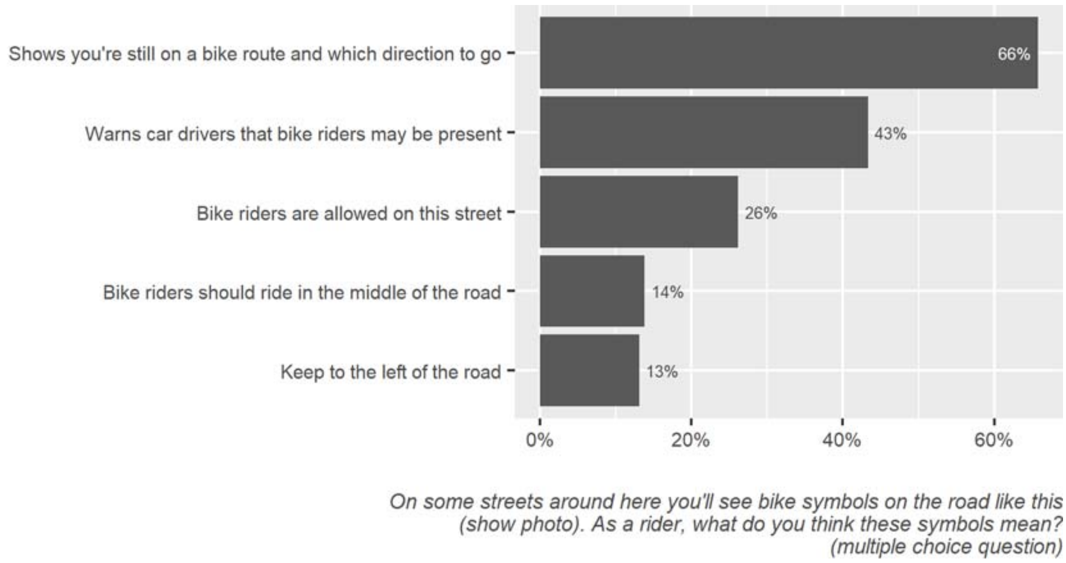


■ Figure 4.23: Potential improvements to shimmy routes

Other suggested improvements were:

- providing gaps for riders in speed humps,
- traffic signals or improved main road crossings (e.g. Merri Pde, Westbourne Gr), and
- education of both riders and motorists.

The bicycle symbols on the road pavement are intended to act as a wayfinding device, as well as serving the dual purpose of encouraging bicycle riders to use these routes and to reinforce the legitimate right for riders to be present to motorists. Two thirds of riders correctly identified that the symbols were for wayfinding, while 43% thought they served to warn motorists of the presence of riders (Figure 4.24). Very few felt the symbols were to encourage riders to track along the roadway in a particular location. This is interesting insofar as the other main use of bicycle symbols on roadways away from bicycle lanes is in the “sharrow” form, where an explicit intent is to encourage riders to take a central lane position. While the latter was not examined in this study, it is possible the “arrows” on top of the bicycle symbol in a sharrow, as well as their typical use in the middle of traffic lanes, serves this purpose.



■ Figure 4.24: Understanding of bicycle symbols on road pavement

Where respondents provided additional comments on the operating of the shimmy routes these are presented verbatim in Appendix A.

5 Intersection delay

5.1 Introduction

One of the attractions of main road routes for all road users, including bicycle riders, is likely to be infrequent delays at intersections. Conversely, one of the potential disadvantages of shimmy routes is that the local roads are unlikely to have priority at major road intersections. This is likely to cause both travel delays for riders[8] and be inconvenient given that riders will lose momentum and may have to entirely stop and then start again. At least one set of guidance offers recommendations as to acceptable levels of delay that may be encountered at major road crossings along shimmy routes (PBOT 2015). That guidance recommended that intersections offer 100 crossing opportunities per hour, with 50 being an acceptable lower limit.

5.2 Methodology

In order to assess delay at intersections along existing shimmy routes a sample of 11 intersections were observed on a typical working weekday (Monday 15 May 2017) during the AM peak period from 7 – 10 AM. These observations were made with video cameras positioned discretely along the roadside. Observers subsequently examined this footage and measured (using the timestamp on the video to the nearest second) whether riders stopped and if so for how long. In considering these results it should be noted that in many cases riders were observed to slow ahead of the intersection and judge their crossing around conflicting traffic. As such, the delay times reported here will be underestimates – only those delays that required riders to physically stop are measured. However, it is suggested that it is the frequency of these full-stop events which are most critical to the level of service given the inconvenience stopping presents for riders. Furthermore, in some instances a rider had to stop behind a queue of traffic on the minor street out of the field of view of the camera, but then did not have to stop at the stop line.

The sites chosen were based on (a) how representative they are of major road crossings in Darebin, (b) the presence of reasonable rider and motorist demand (such that delay is possible), (c) the presence (or likelihood in the future) of median refuges to assist multi-stage crossings, and (d) were not signal controlled. The chosen sites are shown in Figure 5.1. Rider observations were obtained only of riders travelling straight across the main road expect at the T-intersections of South Cr at Westgarth St, Woolhouse St at Arthurton St, Railway Pde at Beavers Rd and Spencer St at Beaconsfield Pde; in these cases riders turning both left- and right out of the terminating minor street were considered.

[8] It is noted that most motorised transport investments such as roads and public transport are largely justified on the grounds of travel time savings and the economic benefits that accrue from these savings. This accrues both from the personal value of travel time (such as for commuting) and business value for trips being undertaken for business purposes. It seems incongruous to value travel time savings for a commuter travelling to work by car or public transport but not do likewise for bicycle riders.

■ Figure 5.1: Intersection locations

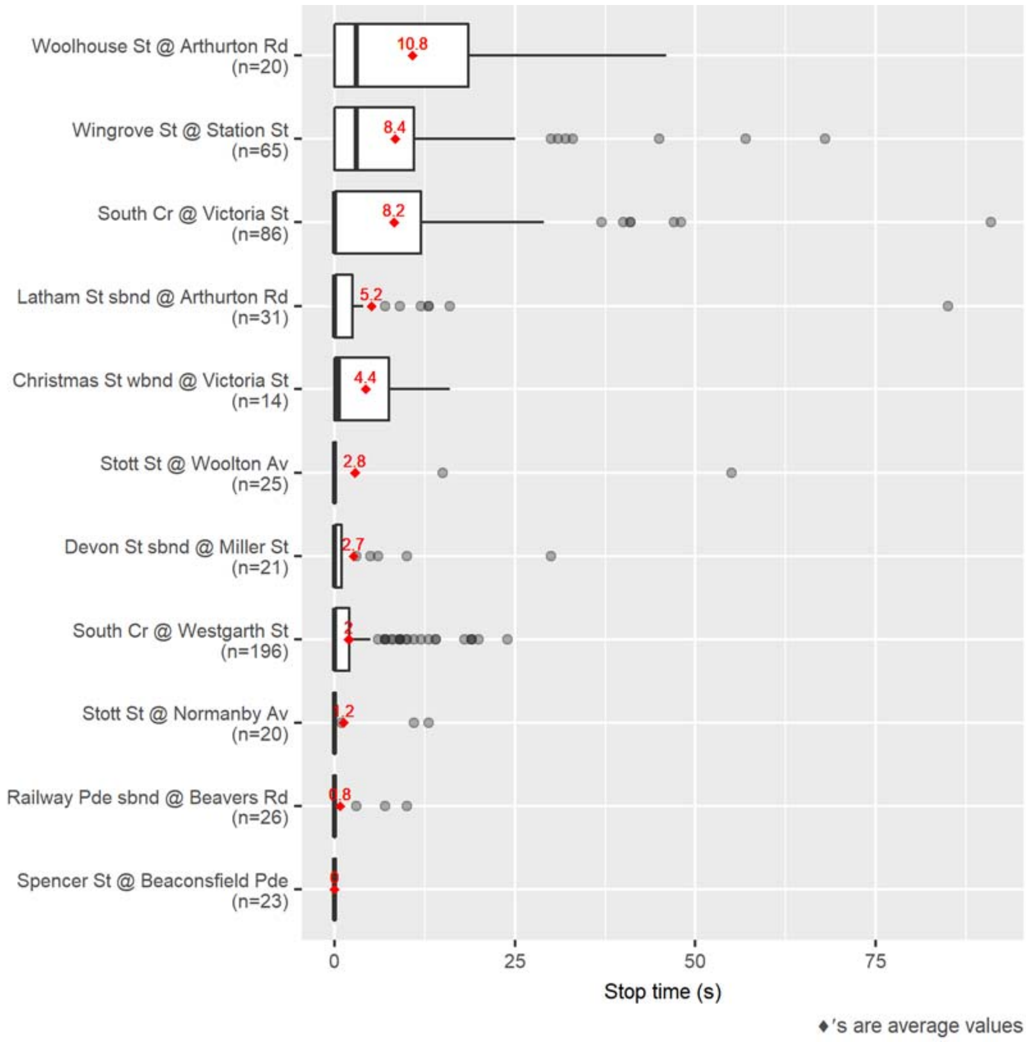
5.3 Results

5.3.1 Average delay

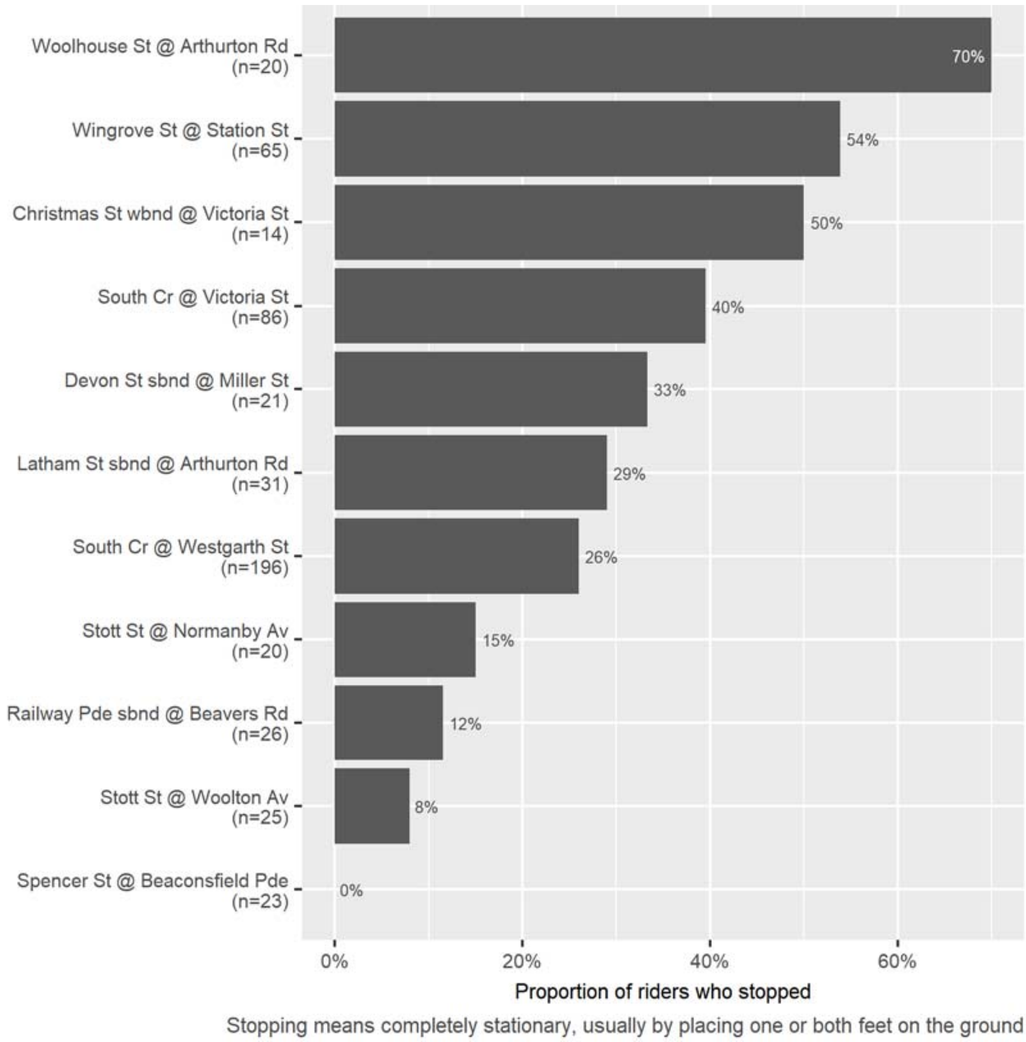
A total of 527 observations were made of riders crossing the intersecting road at the 11 sites (Table 5.1). The average delay across the sites varied from no delays (Spencer St @ Beaconsfield Pde) to 8.4 s (Wingrove St @ Station St). The distribution of delay by site is shown in Figure 5.2. At all sites the proportion who needed to stop varied widely, from none at Spencer St @ Beaconsfield Pde to 70% at Woolhouse St at Arthurton Rd (Figure 5.3). While the average delay was generally low, the maximum delays could be significant – instances of delay of 85 seconds at Latham St at Arthurton Rd and 91 seconds at South Cr at Victoria St were observed.

■ Table 5.1: Intersection delay summary statistics

Site	Description	No. events	Average delay (all) (seconds)	Max delay (seconds)	% stopped	Average delay (only stopped) (seconds)
Christmas St wbnd @ Victoria St		14	4.4	16	50%	8.7
Devon St snd @ Miller St	Crosses Miller St into off-road path	21	2.7	30	33%	8.0
Latham St sbnd @ Arthurton Rd	Adjacent to railway xing	31	5.2	85	29%	17.8
Railway Pde sbnd @ Beavers Rd	T-intersection, adjacent to railway xing	26	0.8	10	12%	6.7
South Cr @ Victoria Rd	Adjacent to railway xing	86	8.2	91	39%	20.8
South Cr @ Westgarth St	T-intersection	196	2.0	24	26%	7.6
Spencer St @ Beaconsfield Pde	T-intersection	23	0.0	0	0%	n/a
Stott St @ Normanby Av	Adjacent to railway xing	20	1.3	13	15%	8.3
Stott St @ Woolton Av	Adjacent to railway xing	25	2.8	55	8%	35.0
Wingrove St @ Station St	Adjacent to railway xing	65	8.4	68	54%	15.6
Woolhouse St @ Arthurton Rd	T-intersection	20	10.8	46	70%	15.4



■ Figure 5.2: Distribution of intersection delay times



■ Figure 5.3: Proportion of bicycle riders who stopped

5.3.2 Staged crossings

Three of the intersections featured median refuges and painted storage boxes for bicycle riders to cross the intersection in stages:

- South Cr at Victoria St (Hurstbridge Line shimmy)
- Christmas St at Victoria St (Christmas St shimmy), and
- Stott St at Normanby Av (South Morang Line shimmy).

There were comparatively few staged crossings compared to single stage crossings. No staged crossings were observed at Stott St at Normanby Av, but 3 of 14 (21%) at Christmas St at Victoria St and 9 of 86 (10%) at South Cr at Victoria St were staged (Table 5.2). The average time spent in the median was short at Christmas St (around 1 s), while at South Cr riders often waited for a significant period of time – on average 10 s with a maximum of 29 s.

■ Table 5.2: Staged crossings

	South Cr @ Victoria St	Christmas St @ Victoria St	Stott St @ Normanby Av
No. of crossings	86	14	20
No. of staged crossings	9	3	0
% staged crossings	10%	21%	0%
Average wait time in median	10 s	1 s	n/a
Max. wait time in median	29 s	2 s	n/a

6 Design review

The purpose of this section is to provide a brief review of the design features along the existing shimmy routes based on brief site inspections. The intention here is to provide a review of the key design attributes which council may wish to consider in improving the existing shimmy routes and incorporating into the design standards for future shimmy routes.

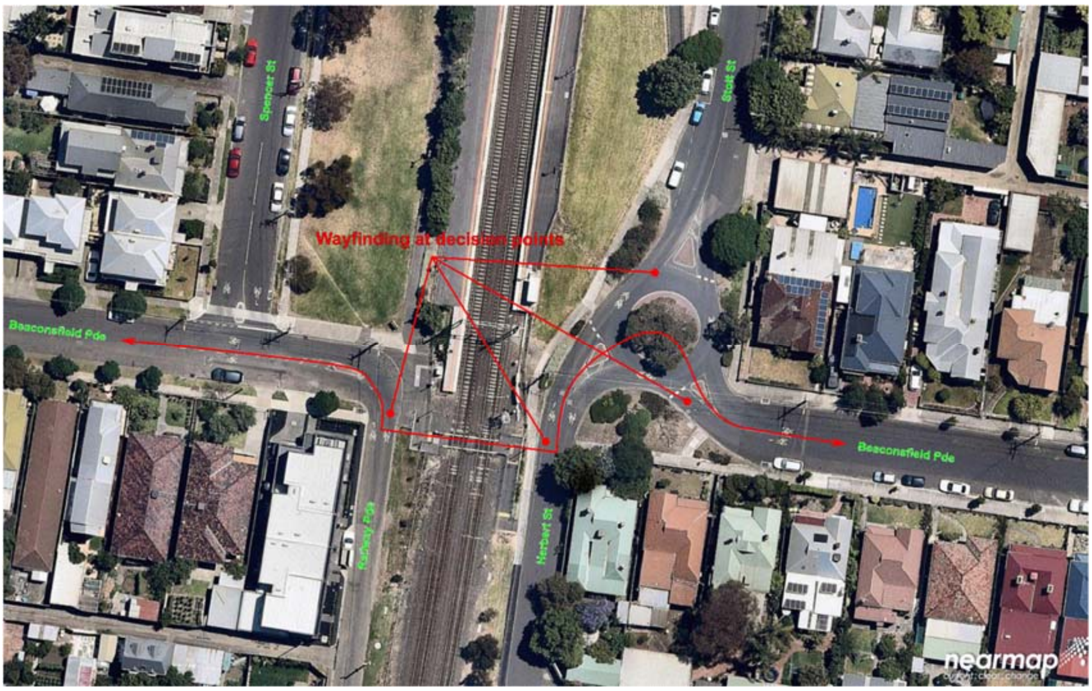
6.1 Wayfinding

The routes are marked with pole-mounted signs at key design points (i.e. intersections) and with bicycle symbols on the road pavement at around 100 m intervals at mid-block locations and at every intersection. Moreover, where riders are required to turn the symbols are complemented by small arrows above indicating the direction of travel for riders (Figure 2.2).

Our view is that the wayfinding i generally excellent; the pavement symbols provide clear guidance as to the direction of travel and – importantly – regular reassurance that the rider remains on the shimmy. The pole-mounted signs are much harder to spot, particularly in the more cluttered inner-city environments such as through Northcote and Fairfield, where there were already a large amount of street furniture, signs on poles and established street trees. However, these signs did provide shimmy branding and, more importantly, distances to key destinations.

It is suggested that the most significant missing wayfinding are:

- signs on the Darebin Creek Trail at the end of Abbot St to mark the start of the Christmas St Shimmy,
- bicycle symbols on the east end of Abbot St to provide further route guidance for riders following the shimmy from the Darebin Creek Trail (the first symbol is 300 m west at the intersection of Fulham St), and
- improved wayfinding along Beaconsfield Pde from the roundabout east of the railway across the at-grade railway crossing to Railway Pde in the west (Figure 6.1).



■ Figure 6.1: Wayfinding issues near Croxton station

We now consider the detailed use of the symbol, specifically the use of the dashed centreline (Figure 2.2a) and its lateral position on the roadway. In our view the dashed centreline does not add meaning to the device and is unnecessary. We would note that it is generally accepted that local streets should not have centrelines, and similar logic to their exclusion ought apply to the use of the symbols. However, we acknowledge the dashed centreline is highly unlikely to have an adverse safety impact and have at most maginal impacts on legibility. It does not seem warranted to actively remove existing centrelines, but rather not renew them and not to use them in future installations.

The lateral positioning of the symbols seems to be relative to the centreline of the roadway. In many instances this results in an intuitive position, such as the narrow road with high parking demand shown in Figure 2.2a. In other cases, such as the examples shown in Figure 6.2, the symbols are far from where a rider would typical expect to track. While not detrimental from a wayfinding perspective we suggest the symbols in these locations may confuse both riders and motorists if they were to be interpreted to suggest where riders should track on the roadway. It is suggested a more intuitive position may be a position midway between the outer edge of parked cars (i.e. around 2 m from the kerb face) and the centreline. However, it is acknowledged that most riders appear not to interpret the symbols as an indication of where they should ride (Figure 4.24).

(a) Jessie St (Great Western shimmy)

(b) Oakover Road (Great Western shimmy)

■ Figure 6.2: Examples of bicycle symbols towards centre of roadway

6.2 Bicycle lanes

As noted in the intercept surveys, bicycle riders have a preference to position themselves away from parked cars (Figure 4.23). This suggests, at least in part, an awareness on behalf of riders of the risks associated with opening car doors, which are the third most common injury crash type involving motorists. These issues of proximity to parked cars are, presumably, most acute in areas with high parking demand and narrow street widths. However, along Wingrove St east of Grange Rd bicycle lanes are marked on the road. In the westbound direction the bicycle lane is adjacent to the kerb and is not of concern. However, in the eastbound direction a narrow bicycle lane of around 1.2 m width is immediately adjacent to narrow parallel parking of around 2.0 m (Figure 6.3). Farther east adjacent to Alphington train station the bicycle lane becomes a narrow wide kerbside lane (Figure 6.4). We suggest the presence of both the bicycle lane and wide kerbside lane here is counterproductive:

- it encourages riders to travel in very close proximity to parked cars, which is likely to be the least safe positioning on this roadway,
- it may serve to “delegitimise” riders who, recognising the risks of dooring, choose to travel in the main carriageway and then are subject to aggressive behaviour by motorists, and
- it encourages segregation of modes on a local street where, in our view, it would be preferable to create a speed environment that facilitates safe and equitable sharing of the roadspace between motorists and bicycle riders.

One argument in favour of retaining the bicycle lanes would be that it creates a sense of narrowing of the carriageway that may encourage lower motorist speeds. We suggest such an effect is pretty marginal at this location given the flat topography, minimal side friction and absence of horizontal curves. As such, we would err towards removing the eastbound bicycle lane and installing traffic calming devices to encourage safe sharing of the roadspace.

We note a similar issue applies to the bicycle lane on Murray Rd between Jessie St and Fettling St (Great Western shimmy). Although a comparatively short section (70 m) the bicycle lane passes adjacent to car parking on the north side adjacent to shops, which is likely to exacerbate the car dooring risk given the higher parking turnover than would be present in a residential area. While a shared environment would clearly be impractical on Murray Rd (given the traffic volumes) it is suggested that parking removal on the south (residential) side of the street would enable wider bicycle lanes in both directions, thereby reducing the crash risk.

■ Figure 6.3: Eastbound bicycle lane on Wingrove St east of Grange Rd

■ Figure 6.4: Bicycle advisory lane on Wingrove St near Alphington Station

6.3 Roundabouts

The shimmy routes feature a number of local road roundabouts, particularly along the Hurstbridge Line shimmy near Fairfield. Council have, rightly, encouraged bicycle riders to claim a central lane position through these roundabouts by using sharrows on the approaches and in the gyratory (Figure 6.5). There is clear evidence to suggest that roundabouts improve safety, at least at major roads, for motor vehicle occupants. The evidence on local roads is less clear cut. Moreover, there is evidence to suggest that bicycle riders are over-represented in crashes at roundabouts; 3.1% of police-reported cyclist crashes between 2008 and 2016 in Victoria occurred at roundabouts compared to 0.6% of motor vehicle occupant crashes. In around 80% of these crashes the rider was travelling straight-ahead and a motorist emerged into the gyratory from the riders' left (CDM Research 2015).

■ Figure 6.5: Sharrow markings within roundabout gyratory (Jessie St / Leicester St, Preston)

Positioning riders in the middle of the roundabout, as is the intention with sharrows, is likely to increase motorists' likelihood of seeing riders and giving way. However, as noted in a review of design practices for local road roundabouts (CDM Research 2015) sharrows are unlikely to be sufficient in themselves. Instead, other treatments are warranted such as:

- tightening approach lanes and the width of the gyratory,
- increasing the deflection by increasing the diameter of the central island,

- straightening the splitters and using kerb blisters to encourage road users to approach the roundabout from a more “head-on” approach (i.e. a radial instead of tangential geometry), and
- vertical deflections on the approaches to encourage lower motorist speeds.

These treatments have the intention of creating operating speeds in the vicinity of the roundabout of around 20 – 25 km/h, thereby providing more time for road users to scan to their right before entering the roundabout *and* encouraging a fault tolerant environment where mistakes and collisions are far less likely to result in serious injury. The latter is key to the Safe System approach to road safety which is embedded within the Victorian road safety strategy.

6.4 Path priority crossings

The Great Western shimmy runs along a shared use path from Harold St to Miller St. In so doing it crosses minor residential streets at Hutton St, Fyffe St, Rennie St and Keon St. All except Rennie St feature a raised table crossing with distinctly coloured pavement (Figure 6.6). The speed environment and relative demand (i.e. pedestrian and rider demand on the path is probably similar if not greater than motorist demand) would suggest that formal path priority crossings would be appropriate design responses. Moreover, we suggest the use of the vertical deflection and continuation of the path material across the roadway would suggest to a reasonable road or path user that the path user has priority. However, this is not formally defined through the use of appropriate signs and line marking. We see such a situation as ambiguous, if not confusing, to road and path users. Furthermore, we suggest there is no safety case why this situation could not be formalised to ensure both a high level of service for path users and to remove the ambiguity that currently exists for all road users. The relevant design guidance provides examples of the requisite signage that would formalise this priority situation (Austroads 2009). Finally, it is suggested that holdrails present at the Keon St crossing are unnecessary now (there being few instances in which a rider would meet a motorist and therefore need to use a holdrail) and would certainly become so if the crossings were formalised with path priority. Moreover, the holdrails present an additional hazard (and therefore distraction) at the intersection. Indeed, we note that many crashes on shared paths involve riders colliding with pathside objects. Avoiding such objects, particularly at locations such as this where our preference would be for riders to be observing the road for conflicting motorists, would seem warranted.

(a) View from path facing south

(b) View from roadway facing west

- Figure 6.6: Path crossing at Fyffe St

7 Cost-benefit analysis

7.1 Introduction

It is common practice to evaluate and prioritise among motorised transport (i.e. motor vehicle and public transport) projects using cost-benefit analysis, where the costs are assessed against monetised social benefits over the expected economic life of the project. For conventional motorised transport cost-benefit analysis the main benefit stream is usually travel time savings. In the case of active transport, and specifically cycling, the benefits may be rather different. While there may well be travel time benefits for those choosing to ride instead of driving or taking public transport in congested inner-city areas[9], there cannot be any meaningful benefit assigned to recreational riders having a shorter journey. Moreover, there will be wider benefits that accrue both to the individual and society associated with riding, particularly health, which are not accrued by motorised travel.

The Australian Transport Assessment and Planning (ATAP) guidelines have been developed by the state road agencies along with the Bureau of Infrastructure, Transport and Regional Economics (BITRE), provides advice for transport planning and assessment, including advice on the economic evaluation of active travel (Transport and Infrastructure Council 2016). This guidance incorporates assumptions about the monetary benefits and costs of increased active travel as part of an infrastructure investment, including aspects such as health benefits and crash disbenefits. As part of work for the Queensland Department of Transport and Main Roads (CDM Research 2016) this guidance has been implemented as an online tool to aid with rapid cost-benefit analysis.[10] This tool was used to rapidly assess the economic benefits of the shimmy program using the assumptions that will now be described.

7.2 Assumptions

The cost-benefit analysis, using the ATAP method, makes the following key assumptions:

- 10-year economic life with no residual value at the end of the appraisal period (that is, it is assumed the line markings and wayfinding would need to be completely replaced after 10 years – this is probably conservative, particularly given that the physical traffic calming will last far longer than 10 years),
- estimates mortality and morbidity health benefits using a willingness to pay methodology for valuing statistical life,
- no safety in numbers effect,
- 60% of bicycle travel in the area occurs on-road without dedicated provision, 10% on-road with bicycle lanes, 25% on off-road shared paths and 5% on footpaths,

[9] Indeed, this is what the intercept surveys suggest for transport riding trips on the shimmy routes (Figure 4.10).

[10] https://cdmresearch.shinyapps.io/ActiveTravelBenefits/

- relative risks for bicycle lanes of 0.5, off-road shared paths of 0.3 and footpaths of 1.8 (all relative to on-road with no provision),
- cumulative annual demand growth of 3%,
- rule-of-half applies to the willingness-to-pay component of health costs, vehicle operating and parking costs, PT fares for all users and travel time savings for new users only,
- Monte Carlo simulation to represent parameter uncertainty, and
- demand estimates to +/-20% at a 95% confidence level.

The input assumptions to the cost-benefit analysis are summarised in Table 4.1, and are based wherever possible on the available counts and intercept survey data. The project cost estimates were provided by the council and are uplifted to 2017 values using CPI.

■ Table 7.1: Economic assumptions

Parameter	Christmas St	Great Western	Hurstbridge Line	South Morang Line	Comment
General assumptions					
Economic life	10 years				Assume full replacement reqd after 10 yrs
Discount rate	7%				Typical central assumption
Health benefit ramp-up period	5 years (linear)				Genter et al. (2009)
Effective average motorist speed (km/h)	15.4	15.0	13.3	13.3	As per Section 7.2.1
Effective average cyclist speed (km/h)	16.8	17.4	16.8	16.8	As per Section 7.2.1
Effective average PT speed (km/h)	14.7	14.6	17.4	17.4	As per Section 7.2.1
Opening year demand (AADT)	90	270	600	180	Avg weekday AM 2-hr counts expanded using auto counter expansion factors (<100 riders = 3.0, >=100 riders = 2.4
Average trip distance	13.6 km	10.1 km	11.3 km	9.9 km	Intercept survey duration x effective rider speed
Diversion: car	2%				Intercept surveys, all sites except Christmas St
Diversion: PT	4%				Intercept surveys, all sites except Christmas St
Diversion: reassign	92%				Intercept surveys, all sites except Christmas St
Diversion: induced	2%				Intercept surveys, all sites except Christmas St
Transport purpose split	89%	90%	82%	93%	Intercept survey

Parameter	Christmas St	Great Western	Hurstbridge Line	South Morang Line	Comment
Change in trip distances	0 km				Assume no change
Facility					
Length (km)	1.5	1.5	2.0	2.0	Estimated average length ridden on shimmy
Diverted motor vehicle travel time by period	Busy: 50% Medium: 30% Light: 20%				Assume traffic congestion is high during peak rider times
Investment					
Capital cost	$67,000	$56,000	$109,000	$90,000	Council estimates, escalated to 2017 values using CPI
Operating cost	$3,000 p.a.				Guesstimate

7.2.1 Travel time assumptions

The travel time assumptions are one of three key benefit streams (the other two being health benefits and crash reduction benefits). The health and crash benefits are stipulated within the ATAP guidance and are used directly in the present study. With regard to travel time savings:

- travel time (dis)savings are assumed to apply only to transport trips,
- the majority of shimmy route users indicated that if they were to instead use car or public transport their journey would take longer (Figure 4.10 and Figure 4.12), and
- rule of half[11] is applied to travel time savings for new users (i.e. those who shift from car or public transport, and all-new riding trips).

The travel time savings are input into the model as effective speeds, and are converted internally into travel times using these speeds and the average trip distance. The effective speeds are estimated using Google Maps assuming a departure at 8 AM on a typical weekday between the most common suburb origins and destinations identified from the survey. It should be noted these estimates of effective speed exclude public transport waiting time and times to search for car parking.

Christmas St

The most common transport origin-destination pair was trips entirely within Northcote, followed by trips from Northcote to the City (Figure 4.4). Taking the latter origin-destination pair and using the intersection of Darebin Rd and Victoria Rd as a centroid for Northcote, public transport trips to the city are estimated by Google Maps to take 40 minutes over 9.8 km, by car between 20 and 50 minutes over 9 km and 31 minutes over 8.7 km for bicycle riders. These are equivalent to 14.7 km/h by public transport, 15.4 km/h by car and 16.8 km/h by bicycle.

Great Western

The most common transport origin-destination pair was between Thornbury and the City (Figure 4.5). Public transport trips from and to the centroid of these destinations is estimated by Google Maps to take 40 minutes over 9.7 km, by car between 22 and 50 minutes over 9 km and 31 minutes over 9 km by bicycle. This is equivalent to 14.6 km/h by public transport, 15.0 km/h for car (using the midpoint of the travel time estimate) and 17.4 km/h by bicycle.

Hurstbridge Line

The most common transport origin-destination pair was between Northcote and the City (Figure 4.6). Public transport trips from and to the centroid of these destinations is estimated by Google Maps to take 30 minutes over 8.7 km, by car between 18 and 45

[11] "Rule of half" is an economic concept that states that when travellers change their travel choices the average net consumer surplus is half the difference in generalised costs.

minutes over 7.0 km and 25 minutes over 7.0 km by bicycle. This is equivalent to 17.4 km/h by public transport, 13.3 km/h by car and 16.8 km/h by bicycle.

South Morang Line

The most common transport origin-destination pair was between Northcote and the City (Figure 4.7). As for the Hurstbridge Line, this equates to effective speeds of 17.4, 13.3 and 16.8 km/h for public transport, car and bicycle respectively.

7.3 Results

The results of the cost-benefit analysis are provided in Table 7.2. All projects have social benefits that exceed the costs by a significant margin, with the BCR ranging from 1.7 for the Christmas St shimmy to 8.7 for the Hurstbridge Line shimmy. The detailed breakdown of the benefits is provided in Appendix B. The key drivers behind these results are as follows:

- The benefits accrue primarily from health, with additional benefits due to travel time savings and some congestion and vehicle operating cost savings.
- The health benefits accrue to those who shift from car and public transport to riding, and also from all-new riding trips which are generated by the investment (these can be thought of as discretionary recreational trips which would not otherwise have occurred).
- While these riding trips diverted from car and public transport provide health benefits they also represent an increased crash risk given that riding is estimated by the ATAP model to have an elevated crash risk compared to car and, particularly, public transport. Moreover, we have not assumed any safety benefit from the shimmy investment nor a safety-in-numbers effect; both assumptions, but particularly the former, is conservative. The net result is that the crash risks heavily reduce, but do not nullify, the health benefits.
- The injury disbenefits apply not only along the shimmy route itself but along the entire riding route. Note that the typical riding trip was around 10 km, of which only a small proportion (perhaps 1 – 5 kilometres) will be on a shimmy. Most of the remainder of the ride occurs on the wider road and path network. These diverted and new riders will be exposed to the greatest risks riding to and from the shimmy, rather than on the shimmy itself given that many of the most convenient roads will be arterial roads.
- The differences in benefit-cost ratio between the sites can be explained primarily by the varying demand; the routes with the lowest demand (Christmas St and the South Morang Line) have the lowest BCRs. Other contributing factors are the variation in capital costs, the average trip lengths, differing assumptions about effective speeds (and hence travel time savings) and the proportion of trips for transport purposes.

■ Table 7.2: Cost-benefit analysis summary

	Christmas St	Great Western	Hurstbridge Line	South Morang Line
Benefit-Cost-Ratio (BCR)	1.7	6.0	8.7	2.7
Net Present Value (NPV)	$69,000	$432,000	$1,071,000	$201,000
Internal Rate of Return (IRR)	12%	73%	86%	21%
Present Value of Benefits (PVB)	$166,000	$518,000	$1,210,000	$321,000
Present Value of Costs (PVC)	$97,000	$86,000	$139,000	$120,000

8 Discussion

In this section we seek to collate and interpret the evidence in such a way as to provide practical guidance as to the future role of shimmy routes within Darebin's Cycling Strategy.

8.1 Awareness

Around three quarters of bicycle riders have observed the main treatments that constitute the shimmy routes (Table 4.5). However, comparatively few had heard of the "shimmy" name (around a third) and within this sub-sample less than half had seen printed maps or could recall other means of promotion (Figure 4.20). Whether this lack of awareness is an issue is clearly a value judgment, but it is notable that most shimmy users were already using these routes prior to the shimmy treatments (Figure 4.13). In our view this level of brand awareness is not unreasonable given the modest promotional activity that has been undertaken. Moreover, we suggest that brand awareness is not a critical outcome but rather the more important evaluation criteria is whether broader community is being encouraged to ride as a result of the investment.

8.2 Impact on cycling demand

There is some evidence to suggest the shimmy routes have encouraged a modest shift towards bicycle riding:

- 4% of users would otherwise have used public transport,
- 2% would otherwise have driven a car, and
- 2% would not have travelled at all.

While a small proportion of all bicycle riders on the routes, this impact has been achieved off a commensurately small investment. Moreover, as the cost-benefit analysis in Section 7 illustrates it is these users (few in number though they are) that represent most of the benefits of the project. Furthermore, and not explicitly accounted for within the cost-benefit analysis is the benefits that must accrue to the 15% of users who were previously riding along other routes. Clearly, by choosing instead to use the shimmy they have assigned some value to this route in preference to their previous route. This value may extend from perceived safety, to convenience or simply the amenity and comfort that may accrue from riding on a local street in preference to a higher order arterial road.

More broadly, it was observed that just over half of shimmy users had options beyond riding; 56% had access to a car (Figure 4.9) and 91% could have taken public transport (Figure 4.11). That they have chosen not to do so is a benefit to other motorists and public transport users, for whom the roads will be marginally less congested and public transport marginally less crowded.[12] Moreover, there are marginal benefits to society more broadly in avoiding the need for additional road and public transport infrastructure investment. Given

[12] Or alternatively, in theory, the shift of one car driver to riding allows for one more car driver to use the road network.

the transport-oriented function of the shimmy routes, and in an inner-city area with significant traffic congestion and public transport crowding during peak periods, these benefits are not inconsequential.

Finally, bicycle riders reported that riding represented the *fastest* means for them to get to their destination (Figure 4.10 for driving and Figure 4.12 for public transport). This is a significant finding, and is supported by as simple a tool as Google Maps (Section 7.2.1). These travel time savings make significant positive contributions, in most cases, to the cost-benefit analysis for the shimmy routes. In this way these cycling investments can be justified in exactly the same manner as for motorised transport; namely, that the investment provides travel time savings to users. It is suggested the travel time savings to users are often underplayed from cycling investments in congested inner-city areas but can, as in this instance, be significant.

8.3 Rider comfort

As well as attracting bicycle riders, the shimmy routes would appear to be beneficial insofar as pre-existing riders find the routes more comfortable. Around two thirds of riders chose the routes because they had less traffic than main roads, were direct and they felt safer than on other roads (Figure 4.17). These all suggest riders are valuing the routes. Furthermore, there was overwhelming user support for the routes; over 90% of users supported the council in building the routes (Figure 4.21). Given the low cost of the treatments this would appear to be an overwhelming endorsement of the shimmy strategy.

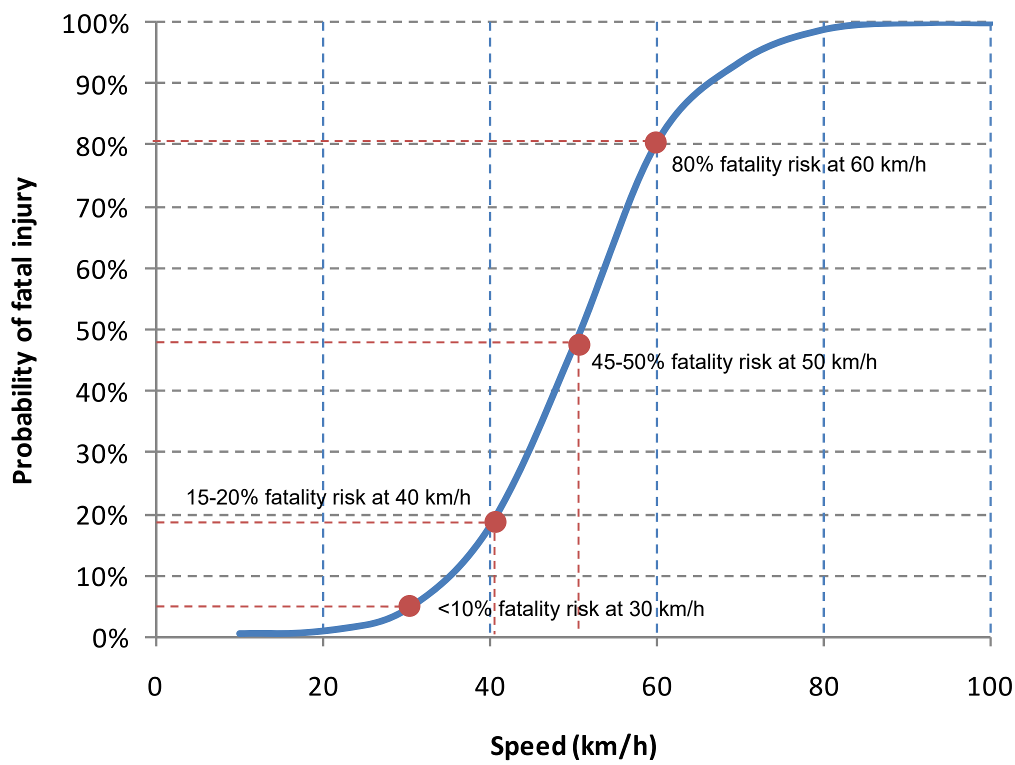
8.4 Improvements

In considering potential improvements to the shimmy routes we consider both the routes against the international guidance and improvements suggested by users.

Firstly, the international guidance on these routes generally recommends:

- speed limits of 30 km/h, and
- motor vehicle volumes of no more than 2,000 vpd.

The posted speed limits along most of the existing shimmy routes is 50 km/h, with limited sections of 40 km/h. Moreover, the 85th percentile speeds seem to generally be around 40 km/h, with speeds of around 50 km/h along Wingrove St east of Grange Rd (Figure 2.6). These effective vehicle speeds present an elevated risk of injury to all road users, including bicycle riders, as well as being contrary to the design intent whereby bicycle riders and motorists *share* the roadway. There is overwhelming evidence that speed limit reductions, even in the absence of physical traffic calming, can result in marked improvements in road safety. This has been demonstrated, for example, by the decreases in crashes after the default urban speed limit was reduced from 60 km/h to 50 km/h in Victoria (Hoareau, Newstead, and Cameron 2006), Western Australia (Hoareau and Newstead 2004) and South East Queensland (Hoareau et al. 2002). These decreases in crash frequency are particularly strong for unprotected road users such as bicycle riders and pedestrians, for whom marginal reductions in motorist speeds below 60 km/h have profound effects on injury severity (Figure 8.1). This evidence would suggest that reducing operating speeds from 50 km/h to 40 km/h would reduce fatal injury risks by around 60% and reducing further to 30 km/h would reduce risks by 80 – 90%. The Safe System approach to road safety which governs Victoria's road safety strategy recognises that road users will invariably make mistakes, but that those mistakes ought not result in serious injury or death. Given this principle, that there are local amenity benefits, and recognising that the adverse implications on motorist travel time would be negligible, 30 km/h speed limits would be highly desirable.



■ Figure 8.1: Probability of pedestrian/cyclist fatality by motor vehicle speed

Motor vehicle volumes along the Christmas St shimmy, and possibly along the South Morang shimmy, appear to be well below the 2,000 vpd threshold used in the guidance. However, vehicle volumes along Wingrove St, South Cr and particularly Leinster Gr and Woolhouse St appear to be above this threshold (Figure 2.5). This, in combination with excessive vehicle speeds, is likely both to exacerbate the safety risks and deter those new to riding or who are uncomfortable riding in traffic. Given that the majority of the population fall into this latter category, and that the current cycling strategy has as its' goal to build a culture of cycling, both vehicle speeds and volumes warrant further attention. We suggest this is particularly true where a significant proportion of traffic, at least during peak periods, is likely to be rat running. While traffic calming can have a marginal impact on traffic volumes it is suggested that this of itself is unlikely to be sufficient (and in any case has already been implemented to a significant extent). Instead, it is suggested that council consider greater use of *filtered permeability* whereby localised road closures are used to prevent through-motorist movement but continue to facilitate bicycle rider and pedestrian movement.[13] Moreover, this approach is consistent with road management practices that recognise that arterial and collector roads serve through-traffic functions while local roads purely serve as local feeders. Ideally, the local road network would be considered in its entirety and local streets closed in such a way as to divide the network into "cells" whereby motor vehicles must leave each cell and enter a collector or arterial road to proceed to the next cell in the network.

Priority should also be assigned to assisting riders to cross main streets, which was most highly rated improvement noted by riders (Figure 4.22). We would however caveat this by noting that the delays at the sample of intersections observed in Section 5 do not appear to be unduly onerous.[14] However, given the inconvenience stopping represents to bicycle riders avoiding them having to do so is a worthy goal, even if the actual travel time savings are comparatively small.

With reference to other potential improvements identified in Figure 4.23 most identified were interactions with motorists (both moving and stationary). It is possible the most frequently cited improvements (more room between the rider and parked cars, fewer cars, more space to ride without cars having to queue, and improved driver behaviour) all relate to the cultural deference[15] attached to motor vehicles on Australian roads. It is suggested that most bicycle riders, most of the time, do not wish to delay motorists. And equally most motorists, most of the time, do not wish to intimidate bicycle riders. On narrow local streets, particularly where there is high parking demand, such interactions are inevitable. Effort should be expended to avoid, or at least minimise, these types of interactions. While parking prohibitions may be difficult to achieve in practice (and inappropriate in areas where there is limited off-street parking) efforts to constrain motor vehicle access to only those vehicles which absolutely must use these streets is desirable to reduce these interactions.

More broadly, enhanced physical measures such as bicycle boulevards (Figure 3.1) or bicycle streets (Figure 3.2b) may be worthy of consideration to encourage greater recognition of the legitimacy (and possibly primacy) of bicycle riders on shimmy routes. This may include enhanced gateway treatments such as raised thresholds and pavement markings to attempt to redefine the purpose of the street (Figure 3.1).

[13] There are numerous examples of such treatments in Melbourne, but good examples on highly utilised local cycling routes include along Napier St (Fitzroy) and Canning St (Carlton).

[14] This is not intended to be dismissive of these delays however, as the inconvenience for riders of having to stop is far greater than that for motorists.

[15] This is not purely cultural; clearly, a bicycle rider is highly motivated to ensure they do not collide with a motor vehicle given that they will invariably be more likely to incur an injury than the vehicle occupants.

9 Recommendations

Shimmy routes represent a cost effective and pragmatic approach to expanding the local cycling network and encouraging bicycle riding. Their use should be continued and expanded. The following specific recommendations are proposed to enhance the current shimmy routes and to develop future routes:

- Effort should be expended to reduce motor vehicle volumes to around 2,000 vpd through the use of enhanced traffic calming and filtered permeability. Doing so would improve rider levels of service and safety as well as improving local amenity for residents by reducing rat-running.
- Where 85th percentile motor vehicle speeds exceed 40 km/h, such as along Wingrove St east of Grange Rd, council should consider additional traffic calming measures to reduce these speeds to at **most** 40 km/h and ideally closer to 30 km/h.
- Council should consider wider use of 40 km/h speed limits on residential streets (and ideally 30 km/h) more broadly, and particularly along shimmy routes. Where necessary, these lower speed limits can be accompanied by physical traffic calming measures.
- Median refuge crossings of major roads are strongly supported by bicycle riders, and their use should be expanded wherever possible on existing and proposed shimmy routes.
- Council should consider removing or modifying local road roundabouts on shimmy routes to reduce the elevated rider crash risks; these modifications should include vertical deflections on approach arms, kerb blisters and straightened splitter islands.
- It is suggested that the bicycle symbol treatments on the roads be continued, as they seem to be a highly effective wayfinding device, but that the use of a dashed centreline be discontinued and they be placed centrally between the outer edge of kerbside parking and the centre of the road.
- On streets with higher traffic volumes additional measures to encourage sharing are advisable, such as raised thresholds or pavement markings that either "brand" the shimmy route or encourage road users to think of the roadspace as a shared environment. The use of the "Safe Active Street" moniker as trialled in Perth may be one approach.
- The "shimmy" term seems to be appreciated by users, and should be retained as part of the branding and marketing of the routes.

Finally, we suggest shimmy routes represent an opportunity to develop and enhance the local cycle network *incrementally*; council can initially develop a corridor with the local cost, modest impact approach currently adopted and the development can evolve as demand increases and community support develops.

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Appendix A: Verbatim comments

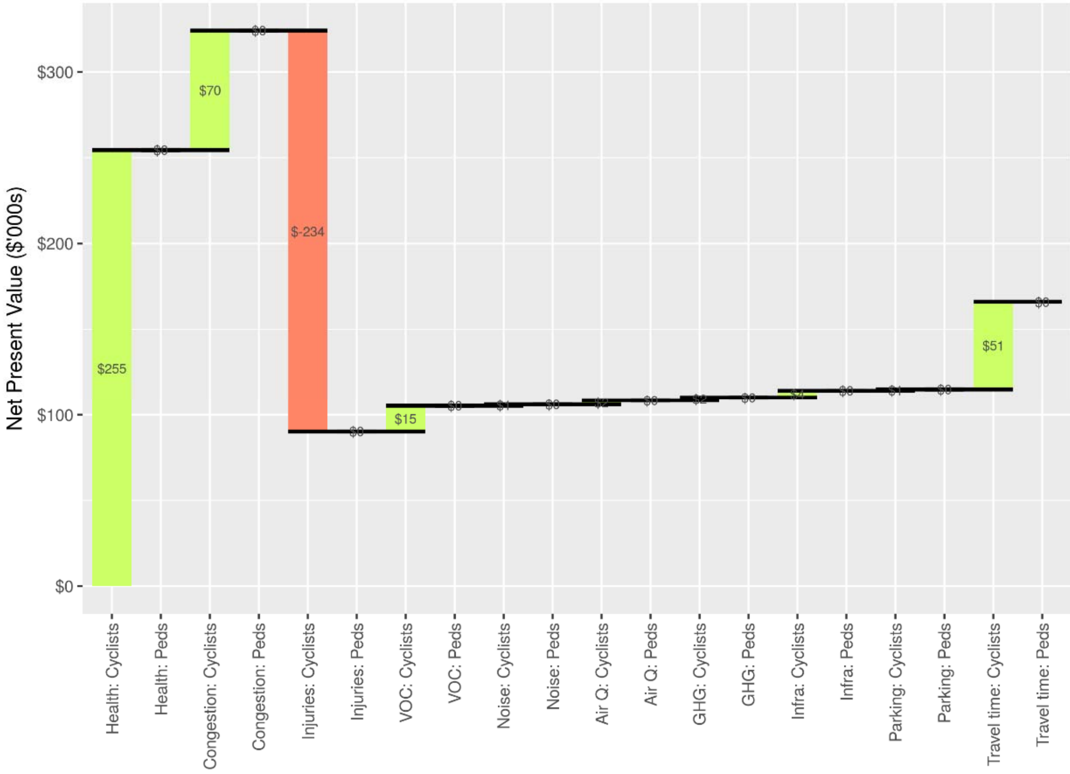
Shimmy	Purpose	Comment
Great Western	Recreation	It's really good and busy on this street especially in the evening at 5-6 pm. too much traffic.
Great Western	Recreation	The only problem is that the route to the city goes through a park which is a problem at night
Great Western	Transport	Anything you can improve is good because many drive along this street very fast instead of driving on main road (St Georges Rd).
Great Western	Transport	Try to have cars slow down on this street.
Great Western	Transport	The interviewee wishes to have more crossing signs on the road. Otherwise they have to wait 10 minutes to cross the road.
Great Western	Transport	The link between the Normanby Rd bike path (south side) and the Merri Creek bike path needs to be connected so children don't have to ride on the road at Clara St.
Great Western	Transport	Complaint about driver behaviour
Great Western	Transport	Signs to make her to welcome and more surface improvement would be good.
Great Western	Transport	One lane for cars would be easier for bike riders.
Great Western	Transport	Make sure bikes can cross St Georges Rd at regular intervals and safely.
Great Western	Transport	The interviewee said the signs of bike riding in the middle of the road didn't help improve the safety of the riders.
Great Western	Transport	More cars along here since they are shut off St Georges Rd . Shimmy route to Turner reserve doesn't work. Cyclist drive through park, dangerous for kids.
Hurstbridge Line	Transport	Suggested for the council should develop an app for the shimmy routes for this area. That could be much easier for bike riders.
Hurstbridge Line	Transport	Remove the dangers
Great Western	Transport	Car parked on this street . Cars also drive fast and squeeze people on bikes.
South Morang Line	Transport	Rat running worse in last month- need to address please!
South Morang Line	Transport	I appreciate the council improving the route and safety of its residents
South Morang Line	Transport	It's important cyclists have dedicated routes that are able to cope with some speed particularly for commuters. Cyclists should be given priority on minor roads crossings it would make it much safer.
South Morang Line	Transport	Aggressive car drivers on the blind corner north where the lane way runs parallel to the train line. Blind corner, every time I ride south a car enters that lane at high speed. Very dangerous and needs speed humps or block the street to non local traffic.
South Morang Line	Transport	Speed humps need to have bike gaps in them so bikes don't go over humps. Also drains and lips of roads should be tested by bike rides - there are too many bumps! At the bottom of the

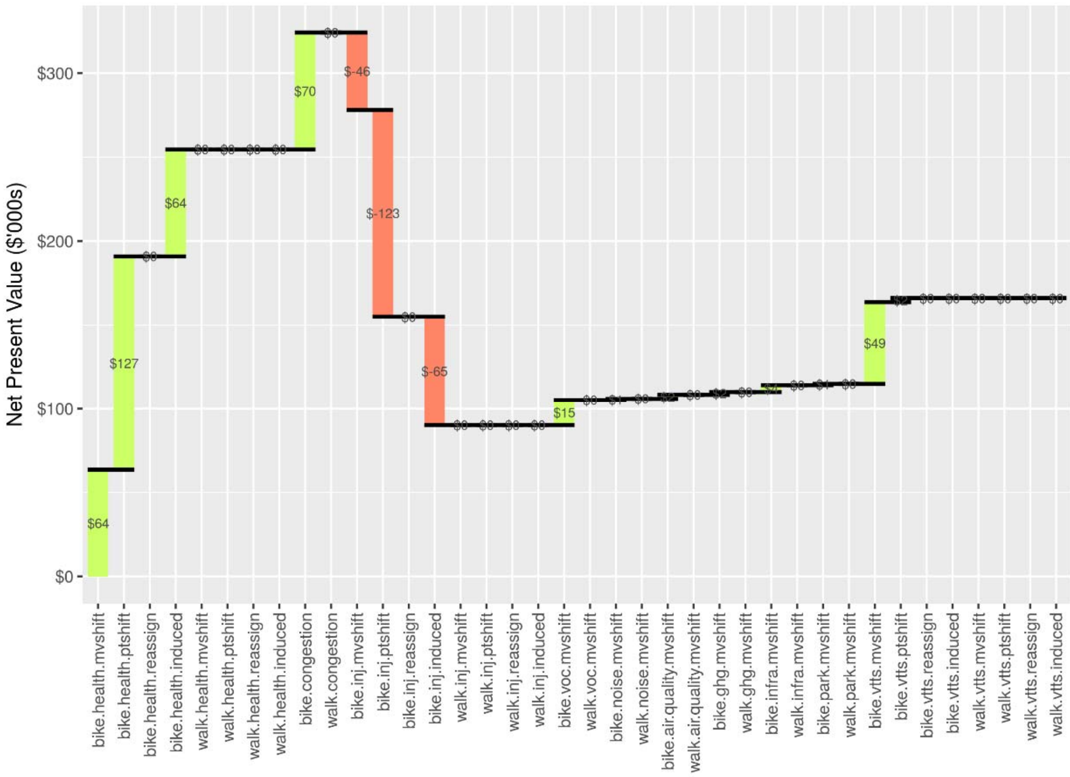
Shimmy	Purpose	Comment
		little road b/w Westbourne and Clarke St, there is a big drain edge - all of these in a designated routes should be smoothed.
South Morang Line	Transport	Bike/pedestrian crossings across Westbourne Grove and across Clarke Street are missing. There should be pedestrian crossings where cars ought to stop, especially if school kids want to cross.

Appendix B: Cost-benefit analysis

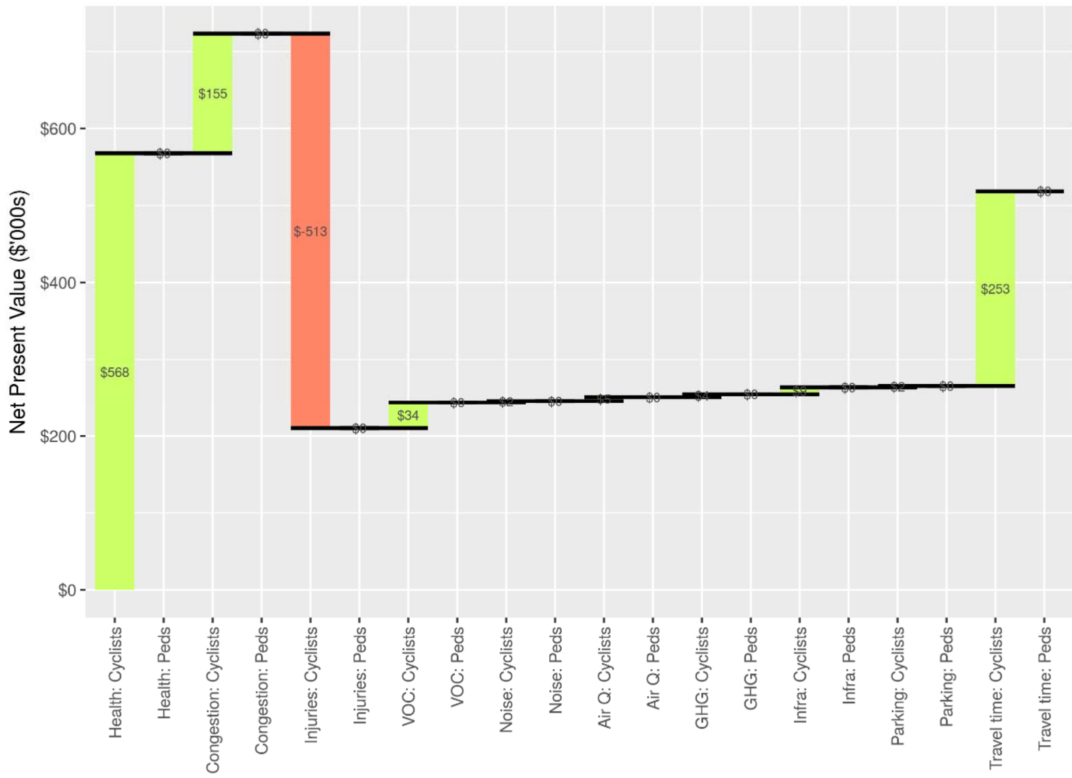
This appendix illustrates the breakdown of the benefit streams for each shimmy. The results are presented in net present values (that is, future benefits are discounted by the discount rate). Two graphs are presented for each shimmy route; the first provides a high level summary of the benefits and the second divides each benefit class into the four user categories: shift from motor vehicle (*mvshift*), shift from public transport (*ptshift*), would have ridden anyway (*reassign*) and all-new trips (*induced*).

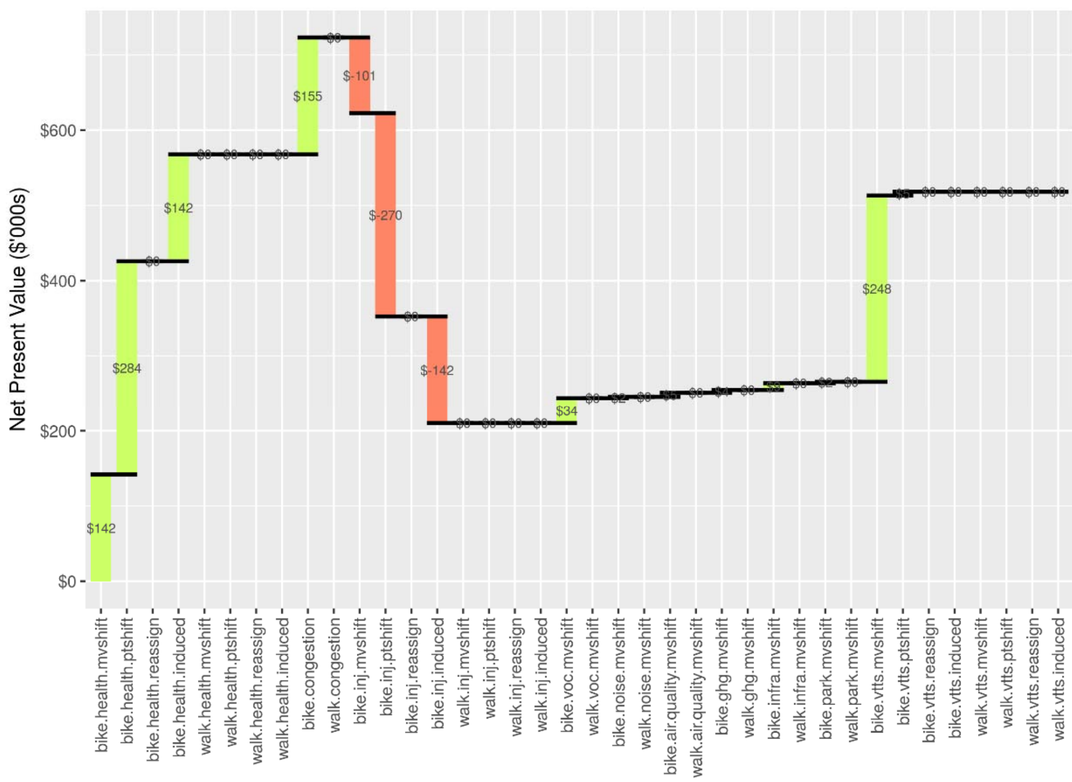
B.1 Christmas St



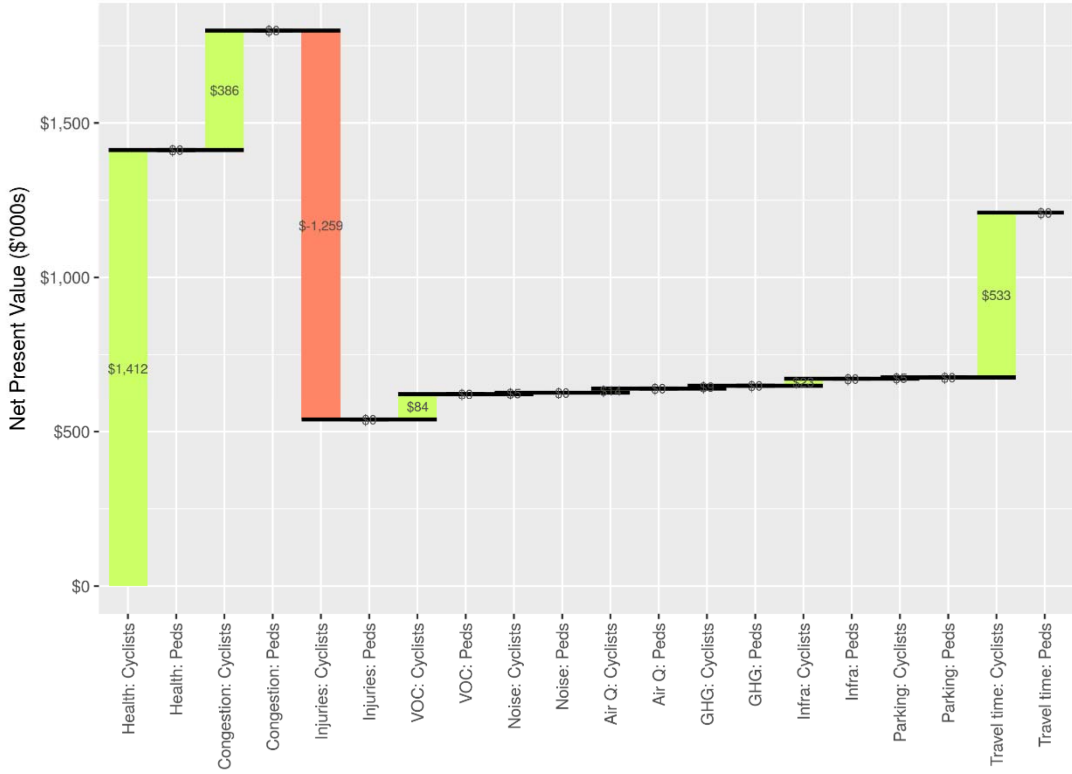


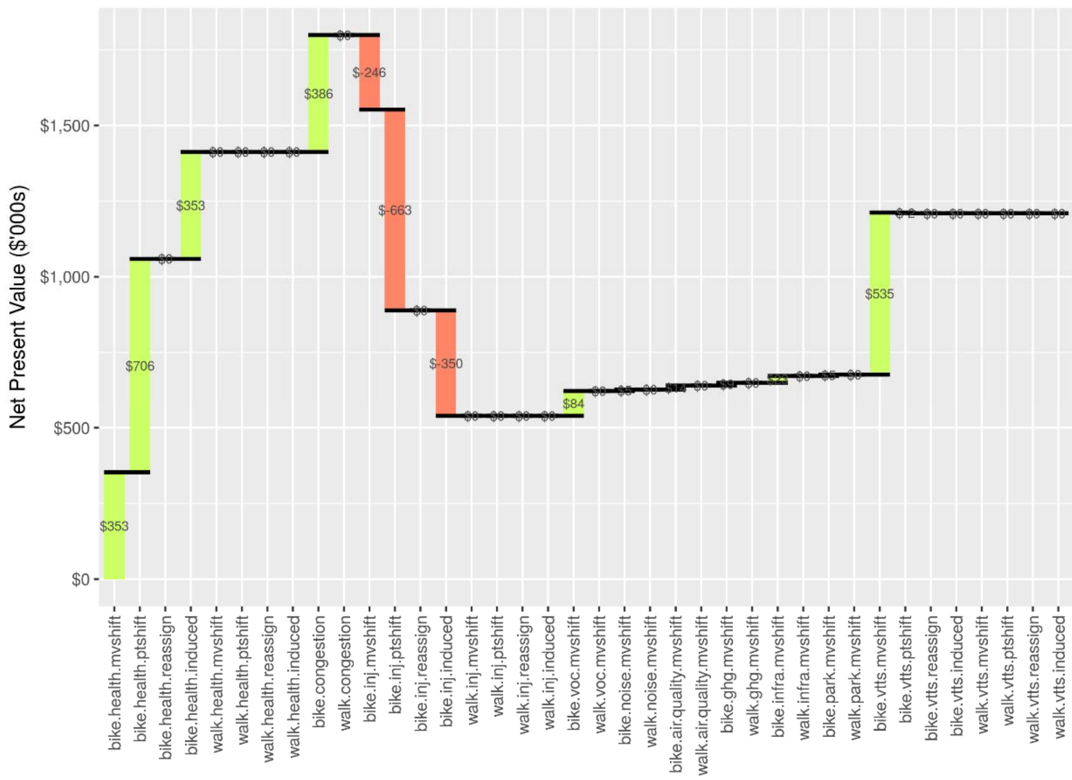
B.2 Great Western





B.3 Hurstbridge Line





B.4 South Morang