St Kilda Road and Royal Parade Bicycle Lane Monitoring

SINCLAIR KNIGHT MERZ
SKM

Contents

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Executive Summary

VicRoads Metropolitan North West Region commissioned Sinclair Knight Merz (SKM) to monitor the effectiveness of the improvements recently implemented along St Kilda Road and Royal Parade in Melbourne. Three treatments were evaluated:

1. Green coloured surface treatments within advanced storage boxes for cyclists
2. Green surface treatments for bicycle lanes at conflict points
3. Audio-tactile line marking to reinforce bicycle lanes at mid-block locations.

The three treatments were evaluated across six sites selected to cover a representative variety of road conditions. Before and after video observations were undertaken of motorist and cyclist behaviour, measuring encroachment into advanced storage boxes and conflict between turning motorists and cyclists at side streets. Lateral vehicle tracking positions were measured at one site to evaluate the change in motorist compliance with the bicycle lane in the presence of audio-tactile line marking. Finally, intercept surveys were undertaken with cyclists to ascertain their views towards the treatments.

Four research questions guided the research:

Does the presence of a green surface improve motorist compliance with bicycle storage boxes?

- Each of the three sites with bicycle storage boxes experienced a decrease in the proportion of motorists encroaching on the box after the installation of the green surface treatment, although this change was not statistically significant at the 5% level.
- The proportion of motorists entering the storage box reduced from 39% to 20% after the green surface treatment was installed (p=0.0859).

Does the presence of green surfaces on bicycle lanes at conflict points reduce the level of conflict between cyclists and motorists?

- While the level of conflict between left turning vehicles and through cyclists varied markedly across the three sites that were evaluated, each experienced a statistically significant decrease in conflict with the green surface treatment.
- Together, all three sites experienced a decrease in the proportion of left turning vehicles conflicting with cyclists from 28% to 3% (p=0.0214).

Does the presence of audio-tactile line marking reduce the level of motorist encroachment into a bicycle lane?

- Audio-tactile line marking reduced the proportion of vehicles encroaching at St Kilda Road approaching Barkly Street from 2.7% to 0.7% (p=0.0010).
- The average lateral position of vehicles in the kerbside traffic lane moves away from the bicycle lane by, on average, 0.14 m (p=0.0000). Both of these changes were highly statistically significant.

Do cyclists perceive these treatments, both individually and together, as improving their comfort and/or perceptions of safety along these routes?

- 76% of cyclists felt more at ease as a result of the green surface treatments at conflict points and in bicycle storage boxes (compared with 4% less at ease).
- 47% of respondents felt more at ease with the audio-tactile line marking compared with 35% less at ease.
- Overall, 73% of respondents viewed the changes positively compared with 3% negatively. This overwhelmingly positive perception was reflected in 37% of respondents indicating they were more likely to ride more often on the route as a result of the treatments.

1 Introduction

VicRoads Metropolitan North West Region commissioned Sinclair Knight Merz (SKM) to monitor the effectiveness of the improvements recently implemented along St Kilda Road and Royal Parade in Melbourne. The new treatments along both roads consisted of a combination of green surface treatments at conflict points and audio-tactile line marking to reinforce the presence of the bicycle lane.

1.1 Research questions

The combination of treatments and different site configurations provide an opportunity to test four research questions:

1) Does the presence of a green surface improve motorist compliance with an advanced stop line?
2) Does the presence of green surfaces on bicycle lanes at conflict points reduce the level of conflict between cyclists and motorists?
3) Does the presence of audio-tactile line marking reduce the level of motorist encroachment into a bicycle lane?
4) Do cyclists perceive these treatments, both individually and together, as improving their comfort and/or perceptions of safety along these routes?

The first three of these research questions concern behaviours – that is, how significantly do the treatments influence motorist and cyclist behaviour? The fourth is an indicator of how cyclists perceive the benefits (if any) of these treatments. These research questions are the focus of this report.

1.2 Site selection

The large number of sites that were treated meant that the most expeditious approach was to classify the sites into combinations of (a) similar roadway configurations, and (b) similar treatments. From this classification a subset of sites were selected for monitoring and evaluation. This process resulted in the selection of a total of six sites for observation, described in Table 1.1.

■ Table 1.1: Site description

Site	Direction	Configuration	Treatment	Research question[1]
St Kilda Road at Albert Road Nth	Northbound	Advanced stop line in kerbside lane	Green surface	1
St Kilda Road at Park Street Nth	Northbound	Advanced stop line in leftmost through lane	Green surface	1
St Kilda Road at Dorcas Street	Northbound	T-intersection	Green surface	2
St Kilda Road at Albert Road Sth	Northbound	T-intersection	Green surface	2
Royal Parade at Grattan Street	Southbound	Advanced stop line with feeder bicycle lane and left turn traffic lane	Green surface	1
St Kilda Road at Barkly Street	Northbound	Bicycle lane with kerbside parking approaching left slip lane	Audio-tactile line marking	3

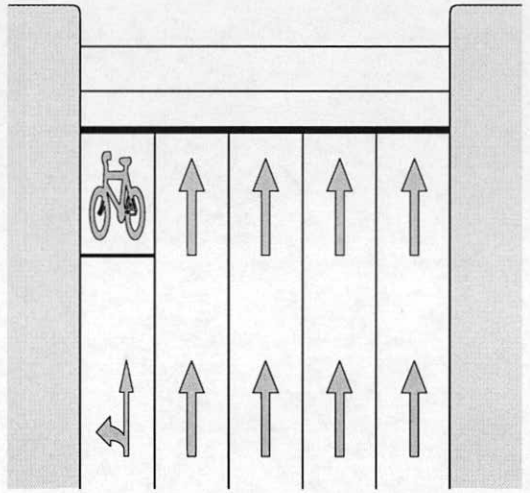
[1] As described in Section 1.1.

Screenshots from the video observations at each site before and after the installation of the treatments are shown in Figure 1.1 for the sites with bicycle storage boxes and Figure 1.2 for the sites with bicycle lanes.

- Figure 1.1: Bicycle storage box sites

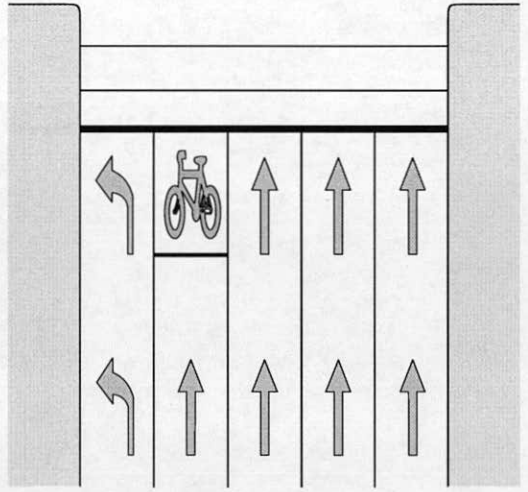
BEFORE: St Kilda Road at Albert Road Nth (Nbnd)

AFTER: St Kilda Road at Albert Road Nth

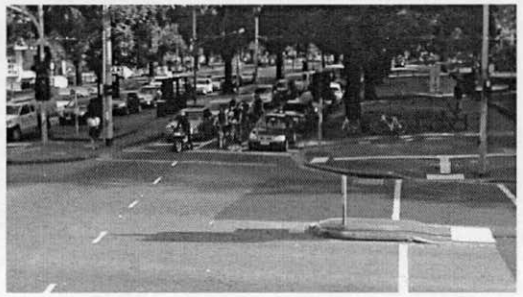


BEFORE: St Kilda Road at Park Street (Nbnd)

AFTER: St Kilda Road at Park Street (Nbnd)



BEFORE: Royal Parade at Grattan Street (Sbnd)



AFTER: Royal Parade at Grattan Street (Sbnd)

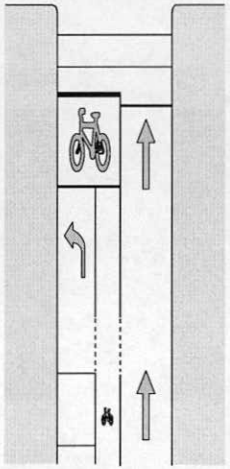
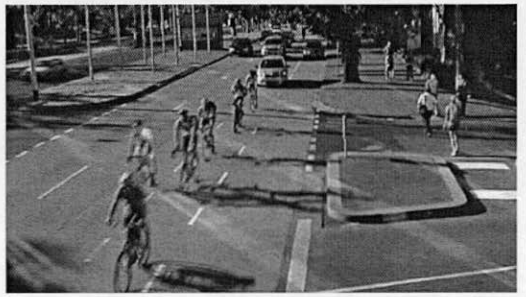
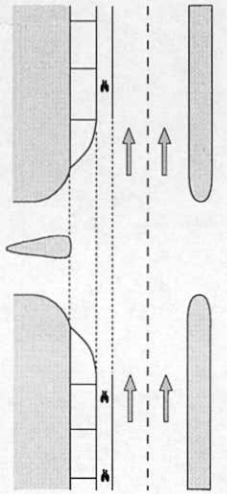


Figure 1.2: Green surfaces at conflict points sites

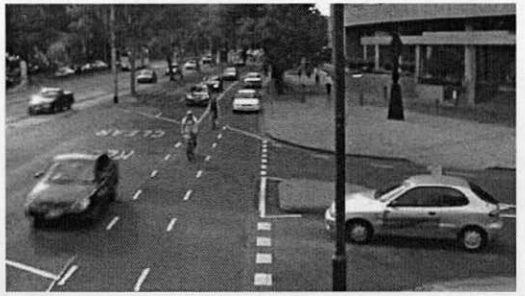
BEFORE: St Kilda Road at Dorcas Street (Nbnd)



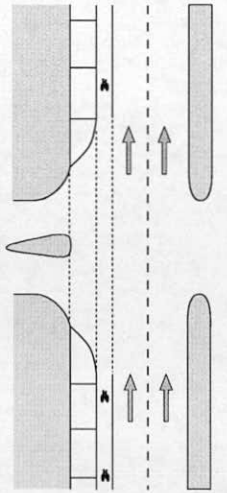
AFTER: St Kilda Road at Dorcas Street (Nbnd)



BEFORE: St Kilda Road at Albert Road Sth (Nbnd)



AFTER: St Kilda Road at Albert Road Sth (Nbnd)



2 Methodology

Observations were undertaken in the AM peak period between approximately 7 and 9 AM in December 2010 for the before situation and in April and May for the after situation. The monitoring consisted of three activities:

1. Before and after video observations of cyclist and motorist behaviour
2. Before and after lateral vehicle tracking measurements of vehicle positions relative to the kerb using an ultrasonic sensor (St Kilda Road at Barkly Street)
3. Intercept survey of cyclists using the route after the changes were implemented.

Each of these activities is described in brief below.

2.1 Video observations

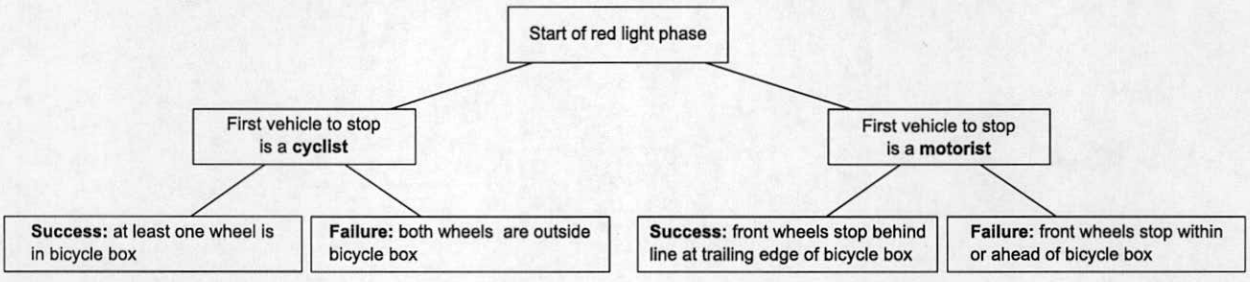
Video recordings were undertaken at a number of sites using a mast to mount the camera above the traffic. The mast and camera were located so as to be largely inconspicuous (Figure 2.2).

■ Figure 2.1: Camera installation on Royal Parade at Grattan Street (southbound)

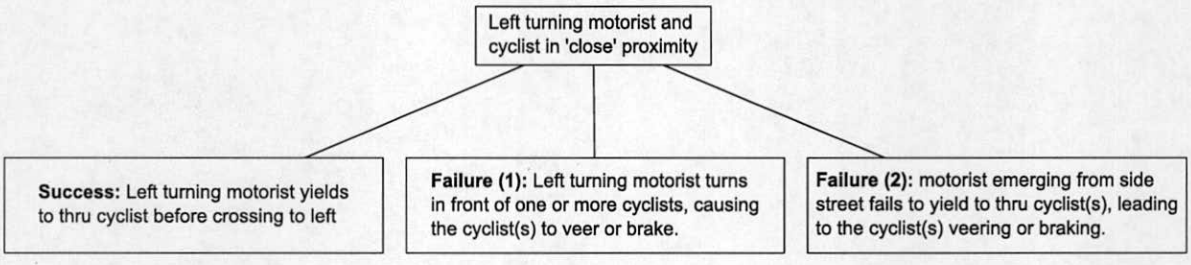
The videos provided a qualitative assessment of the behaviour of motorists and cyclists in close proximity to one another. The video was reviewed after the fieldwork to classify the behaviours into groups for subsequent analysis. The classifications are summarised in Figure 2.2 for bicycle storage boxes (St Kilda Road at Albert Road North, Park Street and Royal Parade at Grattan Street) and Figure 2.3 for treatments where there were left turning

vehicles (St Kilda Road at Alma St, Dorcas Road and Albert Street South and Royal Parade at Grattan Street).

- Figure 2.2: Classification of behaviours at bicycle storage boxes (RQ #1)



- Figure 2.3: Classification of behaviours at intersection sites (RQ #2)



2.2 Lateral tracking

We may expect audio-tactile line marking to have two effects:

1) reduce the level of encroachment by motorists into the bicycle lane, and
2) improve the comfort and perceived safety of cyclists using the lane.

The level of encroachment into the bicycle lane was measured using an ultrasonic sensor. This sensor can detect objects from 15 cm to 650 cm away and measure their distance to a resolution of less than 2.5 cm. As shown in Figure 2.5, the sensor and logger unit are very small and so can be discreetly attached to street furniture such that they will not be observed by road users. The sensor measures the distance from the sensor face to the side of a car, truck or bicycle. By correcting for the distance of the sensor to the kerb face an accurate measurement for the lateral tracking position of a vehicle can be established.

■ Figure 2.4: Audio-tactile line marking monitoring site (St Kilda Road northbound near Barkly Street)

Two measures of effectiveness were used to evaluate the performance of the audio-tactile line marking on motorist behaviour:

1) proportion of motor vehicles encroaching into the bicycle lane before and after the installation of the line marking, and

2) average lateral position of motor vehicles in the kerbside general purpose lane (relative to the kerb face).

While the audio-tactile line marking was installed along many sections of St Kilda Road and Royal Parade as part of this study in many locations the level of encroachment prior to the installation would be expected to have been minor. As such, we would expect to observe little to no change in motorist encroachment. Only at the northbound approach to Barkly Street on St Kilda Road would we expect the audio-tactile line marking to have a significant effect, as left turning vehicles tend to encroach into the bicycle lane during peak periods.

In addition to measuring motorist behaviours before and after the installation of the audio-tactile line marking, cyclists were asked their opinion of the treatment, as discussed in the next section.

2.3 Intercept survey

A brief intercept survey of cyclists travelling towards the CBD was conducted on two mornings (Tuesday 10 May and Friday 13 May) between 7 and 9 AM. The northbound intersection of St Kilda Road at Albert Street (North) was selected for the interviews as this site is one of only a few locations on either Royal Parade or St Kilda Road where cyclists queue at an intersection in the kerbside lane. The survey was designed to be quickly administered and obtain attitudinal data on the green surfaces and audio-tactile line marking and is attached as Appendix A. It is noted that the types of cyclists using Royal Parade are likely to differ from those on St Kilda Road, and so the views of these cyclists could be expected in turn to differ.

3 Results

In this section results are presented in order of the research questions outlined in Section 1.1. Discussion of the results is deferred until Section 4.

3.1 RQ1: Bicycle storage box compliance

Compliance with the bicycle storage box with and without the green surface was evaluated at three sites:

- St Kilda Road at Park Street (northbound)
- St Kilda Road at Albert Road North (northbound)
- Royal Parade at Grattan Street (southbound)

The results from the video observations at each of these sites are summarised in Table 3.1.

■ Table 3.1: Bicycle storage box data summary

		St Kilda Rd @ Park St		St Kilda Rd @ Albert Rd Nth		Royal Pde @ Grattan St		All	
		Before	After	Before	After	Before	After	Before	After
Cyclist in first	No. of obs.	36	18	26	31	30	29	92	78
	% compliant	100%	100%	85%	94%	100%	100%	96%	97%
	% non-compliant	0%	0%	15%	6%	0%	0%	4%	3%
Motorist in first	No. of obs.	66	42	56	39	41	47%	163	128
	% compliant	76%	81%	46%	72%	56%	85%	61%	80%
	% non-compliant	24%	19%	54%	28%	44%	15%	39%	20%
Hypothesis testing									
' – Cyclist in first	SE	n/a		0.0834		n/a		0.0278	
	p-val	n/a		0.1372		n/a		0.0457	
'- Motorist in first	SE	0.0803		0.0982		0.0933		0.0522	
	p-val	0.1321		0.1614		0.1535		0.0859	

A p-value of 0.05 indicates a 95% probability the difference is not due to chance. The lower the p-value the greater the likelihood the difference is not simply due to chance. All t-statistics are one sided.

All three sites experienced a reduction in motor vehicle encroachment into the bicycle storage box; across all three sites the proportion of vehicles encroaching into the storage box decreased from 39% to 20% (p=0.0859). Cyclist compliance with the bicycle box was at a very high level both before and after the green surface treatment. Only the Albert Road North site experienced any non-compliance by cyclists, and this reduced from 15% to 6% (p=0.1372) with the introduction of the green surface. The overall cyclist non-compliance decreased from 4% to 3% (p=0.0457).

3.2 RQ2: Green surfaces at conflict points

Compliance with green surface treatments running across side streets was evaluated on St Kilda Road at Dorcas Street and Albert Road (south). The feeder lane on Royal Parade at

Grattan Street provided a third site with potential conflict between through-cyclist movements and left turning motorists. As summarised in Table 3.2, all sites experienced a reduction in conflict between through cyclists and left turning motorists. The Dorcas Street site had a very high level of conflict prior to the treatment (53% of all left turning vehicles conflicted with through cyclist movements); this proportion dropped to 5% after the treatment. The reductions at all sites were statistically significant at the 95% level.

■ Table 3.2: Green surfaces at conflict points summary

	St Kilda Rd @ Dorcas St		St Kilda Rd @ Albert Rd Sth		Royal Pde @ Grattan St		All	
	Before	After	Before	After	Before	After	Before	After
No. of obs.	701	394	430	375	261	315	1,392	1,084
Does not impede	47%	95%	97%	99%	98.1%	99.0%	71.7%	97.3%
Impedes	53%	5%	3%	1%	1.9%	1.0%	28.3%	2.7%
Hypothesis testing								
SE	0.0220		0.0106		0.0101		0.0130	
p-val	0.0362		0.0175		0.0166		0.0214	

An observation was defined as a situation where a motorist turned left into a side street (or left turn lane) or was turning left out of a side street in the proximity of a through cyclist.

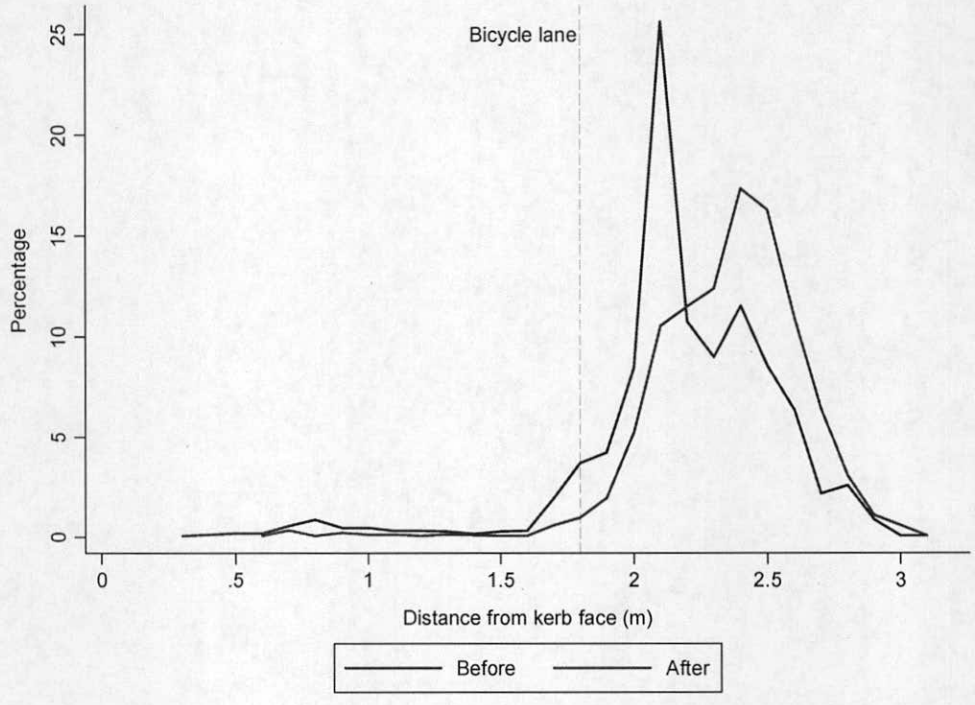
3.3 RQ3: Audio-tactile line marking impact on encroachment

Audio-tactile line marking was applied on the outer edge of the bicycle lane at a number of mid-block locations along both St Kilda Road and Royal Parade. The site chosen for monitoring was St Kilda Road northbound just upstream of the left filter lane to Barkly Street. This site was chosen because in our view it represented the greatest likelihood of vehicle encroachment into the bicycle lane (as vehicles veer left into Barkly Street).

The distribution of vehicle lateral tracking positions before and after installation for the forward-most site[1] are given in Figure 3.1. The proportion of motor vehicles in the kerbside general purpose lane which encroached into the bicycle lane reduced from 2.7% to 0.7% (p=0.0010) with the installation of the audio-tactile line marking. Further, the average lateral vehicle position shifted away from the kerb by 0.14 m (p=0.0000) after the installation of the audio-tactile line marking.

[1] This site corresponds to position 2 in Figure 2.5; a technical failure in the after-situation at position 1 prevented comparison at this position.

■ Figure 3.1: Lateral position of vehicles before and after installation of audio-tactile line marking



■ Table 3.3: Summary statistics for lateral tracking distance before and after installation of audio-tactile line marking

	Before	After
No. of obs.	2,176	1,849
Mean distance from kerb	2.28 m	2.42 m
Std. Dev.	0.26 m	0.24 m
No. of obs. In bicycle lane	59 (2.7%)	13 (0.7%)
Statistical tests		
Change in average lateral distance		
Δ(distance)	0.14 m	
SE	0.0078 m	
t-statistic	17.8	
p-value	0.0000 [1]	
Change in proportion of motor vehicles in bicycle lane		
SE	0.0006	
p-value	0.0010 [1]	

[1] A p-value of 0.05 indicates a 95% probability the difference is not due to chance.

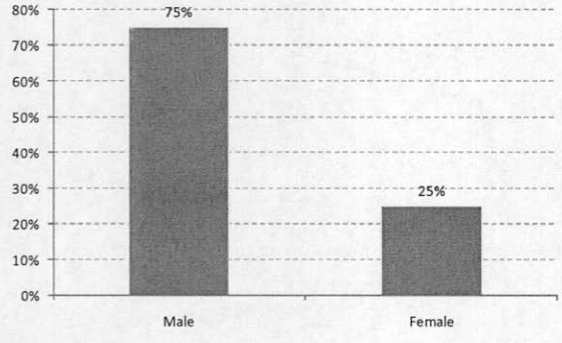
Observations less than 0.8 m from the kerb were discarded on the basis that these observations were most likely cyclists.

3.4 RQ4: Cyclist perceptions

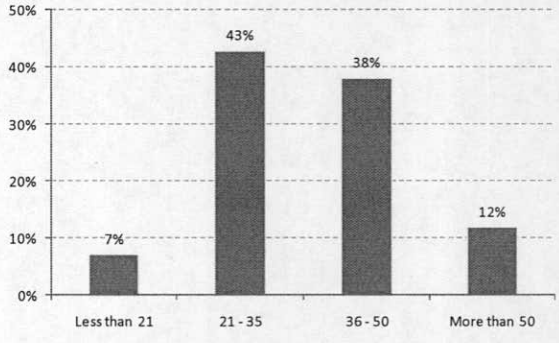
A total of 46 cyclists were interviewed[2] at the corner of St Kilda Road and Albert Street North during weekday commuting hours. Three quarters of respondents were male and 45% wore lycra (Figure 3.2).

■ Figure 3.2: Respondent demographics

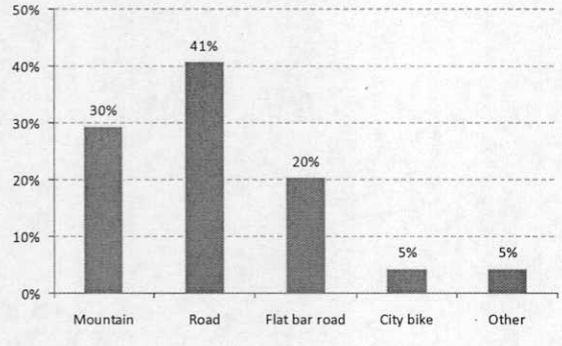
■ (a) Gender



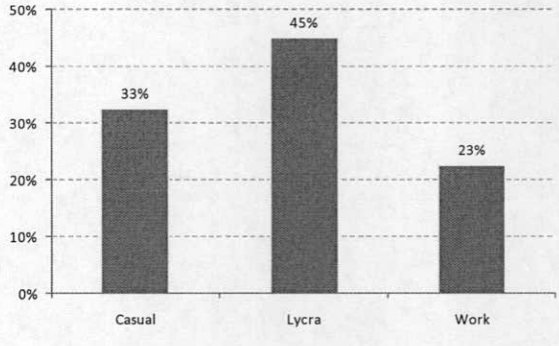
■ (b) Age group



■ (c) Type of bicycle



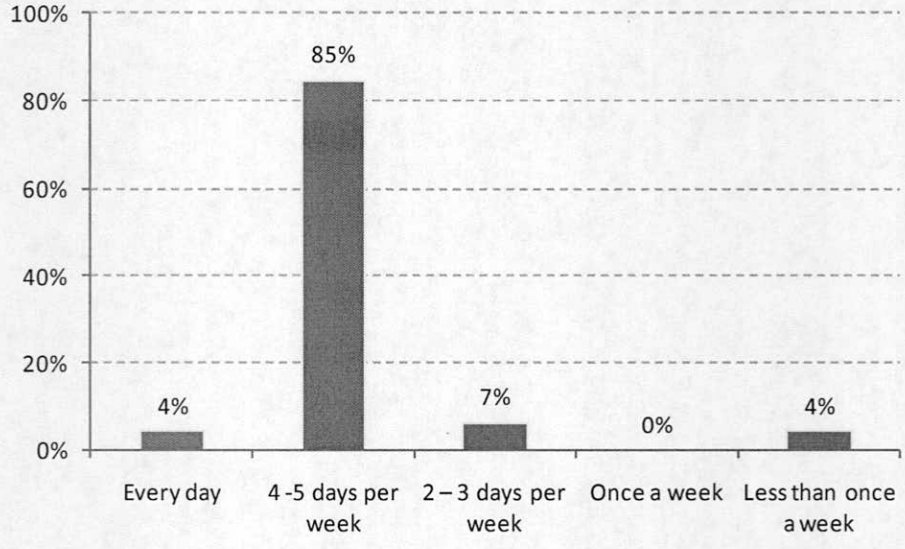
■ (d) Type of clothing



The vast majority of cyclists interviewed travel along St Kilda Road on most weekdays (Figure 3.3), suggesting a high level of familiarity with the route. Every respondent indicated they had ridden the route prior to the treatments being installed (about four weeks previously), suggesting they would be in a reasonable position to compare the pre- and post-treatment situations.

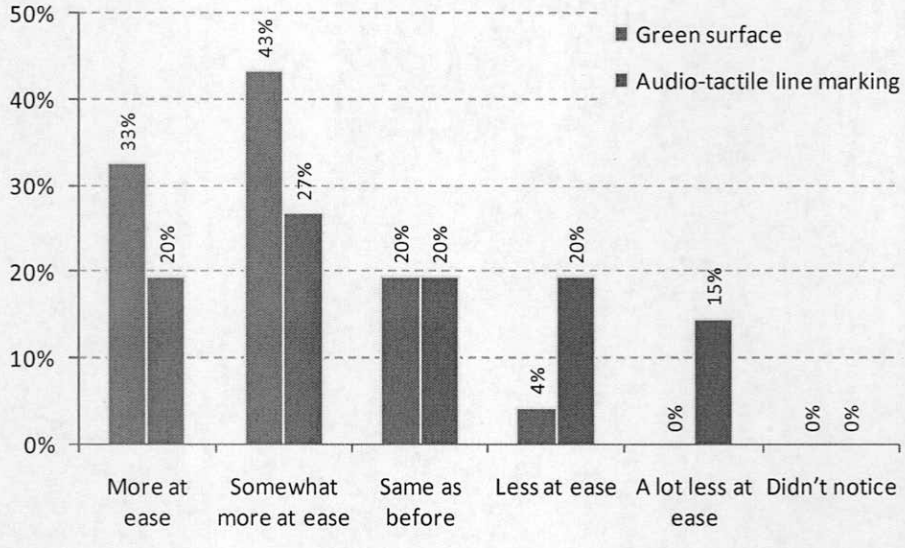
[2] Ten cyclists terminated the survey without completion, resulting in 36 complete surveys.

■ Figure 3.3: Frequency of travel along St Kilda Road



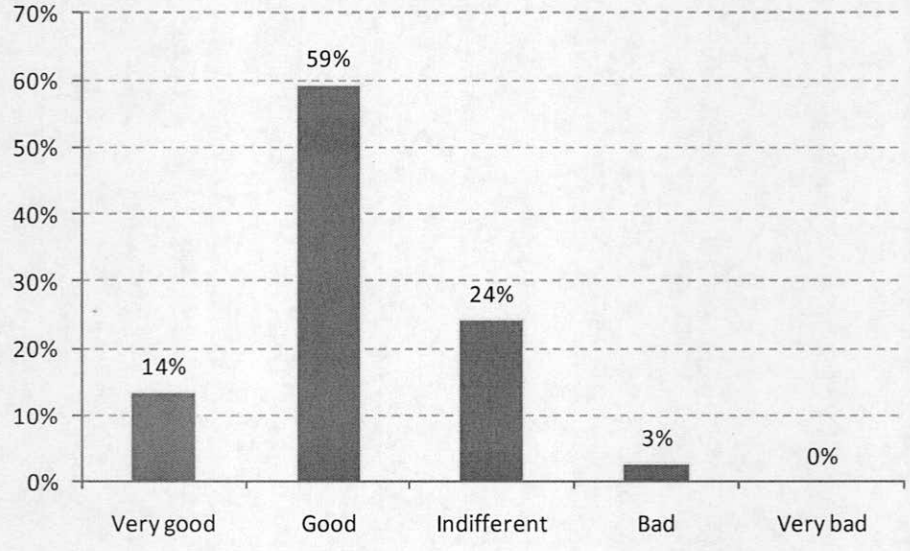
When asked whether they felt more or less at ease as a result of the changes 76% of respondents felt somewhat or more at ease due to the green surface treatments compared with 47% for the audio-tactile line marking (Figure 3.4).

■ Figure 3.4: Do you feel more or less at ease with the green surface / audio-tactile marking?



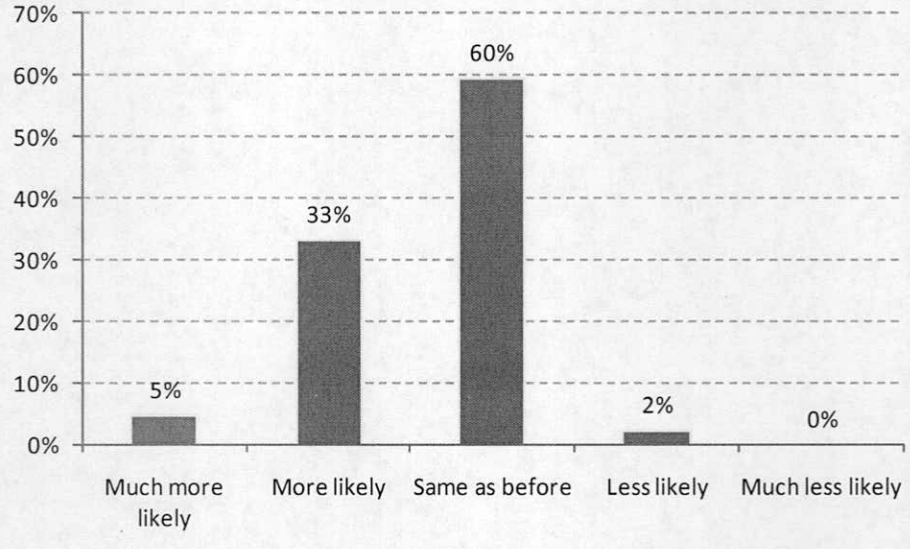
Considering the treatments in combination, 73% of respondents viewed the changes favourable with most of the remainder indifferent (Figure 3.5).

■ Figure 3.5: Overall, how would you rate the changes?



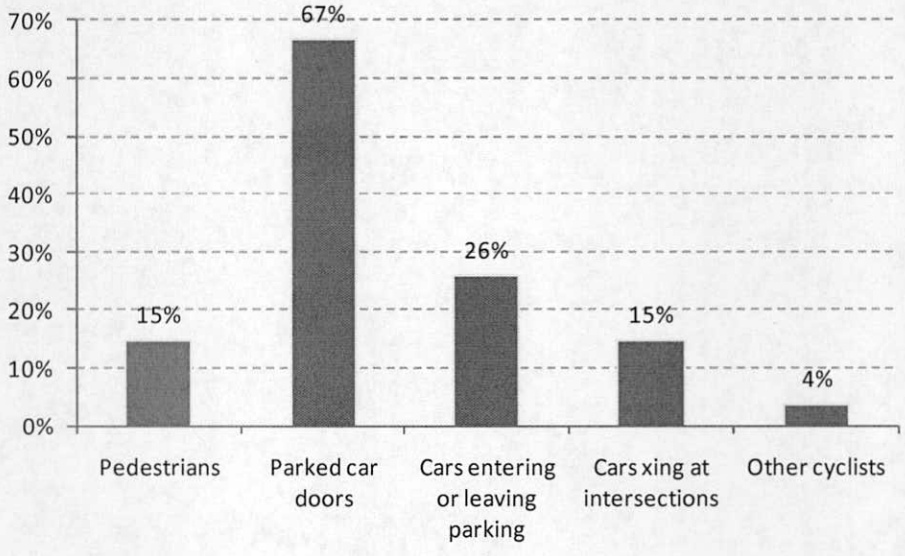
37% of respondents indicated they are more likely to ride along St Kilda Road as a result of the changes (Figure 3.6).

■ Figure 3.6: Are you more or less likely to ride along St Kilda Road with the changes?



Finally, respondents were asked what risks most concerned them when riding along St Kilda Road. Two thirds identified parked car doors as a concern, followed by cars, taxis or delivery vehicles entering and leaving kerbside parking (Figure 3.7). Other risks most cited by respondents were erratic or inattentive driving, lack of continuity of the bicycle lane and improperly parked vehicles.

■ Figure 3.7: What risks concern you when riding along St Kilda Road (select up to two)?



4 Discussion

In this section we summarise the relevant literature on advanced stop lines and marking bicycle lanes across side streets, which together with the research findings described in Section 3 are used to draw conclusions and recommendations in Section 5.

4.1 Existing research evidence

4.1.1 Storage boxes

Storage boxes provide a visible location at the front of the traffic queue for cyclists to wait for a green light phase. They also provide space for hook turning cyclists from the road on the right to store ahead of the traffic stream on the road which the cyclists is joining; this can be particularly advantageous at intersections where right turning is unattractive, such as roads with trams. Further, by providing a dedicated space at intersections there may be a reduced likelihood that cyclists will store ahead of the stop line and over a pedestrian crossing, so impeding the movement of pedestrians.

VicRoads guidance on storage boxes (VicRoads, 2000) recommends that storage boxes be located ahead of the motor vehicle stop line in order to maximise vehicle compliance[3]. Bicycle storage boxes as typically configured ahead of the stop line and with a large painted bicycle symbol exhibit a large degree of encroachment by motor vehicles:

- A study of 10 storage box locations in London (each varying somewhat in configuration, traffic and cyclist volumes – most had green surface treatment) found that vehicle non-compliance (defined as a vehicle encroaching into the box by 25% or less of its' length) varied between 9% and 54% with non-compliance generally around 20-30% (Atkins, 2005). Cyclist counts increased by 27% along two routes where the treatment was applied and intercept surveys indicated that cyclists generally liked the treatment.
- TRL (2005) conducted a similar observational study in London and found no statistically significant reduction in vehicle encroachment at sites with coloured surfaces. They did however find that storage boxes in general reduced vehicle encroachment into pedestrian crossings that 54% of cyclists encroached into the pedestrian crossing at control sites and 40% at sites treated with a storage box. On 36% of occasions the lead motor vehicle during a red light phase would encroach to some extent into the storage box.

[3] This has been done in the storage boxes investigated in the present study.

- Dill *et al.* (2011) conducted a before-after evaluation of 10 storage box treatments at signalised intersections in Portland (USA). Seven sites included coloured surface treatments and the remaining three had only an advanced stop line and bicycle symbol. 73% of motorists did not encroach into the storage box; there was no statistically significant difference in encroachment between those sites with and without coloured surface treatments. Prior to the installation of the storage box 41% of cyclists encroached into the pedestrian crossing, reducing to 25% afterwards. Cyclist volumes increased by 94% after the treatmet was installed, while the number of observed conflicts between cyclists and motorists dropped from 29 to 20.
- Johnson *et al.* (2010) observed kerbside bicycle storage boxes on St Kilda Road at Lorne Street and Kingsway (both northbound) and in the second lane at Moubray Street and High Street (southbound). These observations were undertaken prior to the modifications which are the subject of the present study (i.e. without green surfaces). In a manner consistent with the present study, events were recorded based on the first vehicle (cyclist or motor vehicle) to approach the intersection. Motorist non-compliance was 50% at both of the storage box sites.

In summary, the evidence to date suggests that:

- cyclists perceive an improvement in their comfort with the presence of storage boxes,
- this improvement in comfort appears to contribute to an increase in cycling on routes that are treated with storage boxes,
- between one third and one half of motorists who approach a storage box in the absence of a cyclist will encroach into the storage box,
- storage boxes reduce cyclist encroachment into pedestrian crossings, and
- there is no evidence on the efficacy of coloured surface treatments at increasing motorist compliance or improving cyclist perceptions of a route.

4.1.2 Coloured surfaces across side streets

Coloured surface treatments are recommended for use at conflict points, such as side streets and property entries where there is an elevated risk of conflict between turning motor vehicles and cyclists (VicRoads (2005) and Australian Bicycle Council (2010)).

Hunter *et al.* (2000) found that painting on-road bicycle lanes across off-ramps and side streets increased the proportion of turning motorists who yielded to cyclists from 72% to 92%. Cyclists reported feeling more comfortable in the post-treatment situation, and this was reflected in a reduced tendency by cyclists to perform a head check or signal when crossing through the treated sections. In a subsequent study in Florida on an arterial road with a kerbside turning lane and adjacent bicycle lane (similar to the situation on Royal Parade southbound at Grattan Street) marking the bicycle lane increased motorist give way compliance from 87% to 99% (Hunter *et al.*, 2008). Unlike most other studies, it was also found that the proportion of cyclists detected to perform a head check increased from 6% to 12% after the treatment was installed.

There are very few studies that attempt to quantify the direct safety benefits to cyclists of coloured surfaces at conflict points. A cross-sectional study in the Netherlands (Schepers *et al.*, 2011) suggested that coloured surfaces may *increase* cyclist crash risk relative to sites without coloured surfaces. It is conceivable that such a result may be plausible if it improves cyclist comfort, so reducing their attentiveness to their surroundings. A study of painted surface treatments for bicycle lanes at intersection approaches in Christchurch suggests there is a 39% reduction in cyclist injury crashes (Turner *et al.*, 2011); however, this application for the treatment is rather different to that under investigation in this study.

4.1.3 Audio-tactile line marking

To our knowledge this study represents the first evaluation of the use of audio-tactile line marking for reinforcing on-road bicycle lanes; there is however an extensive literature on the use of audio-tactile line marking for use on rural road shoulders (e.g. Finley *et al.* (2009)) and centrelines (e.g. Porter *et al.* (2004)).

4.2 Discussion

There is good evidence to suggest that bicycle storage boxes and coloured surface treatments at conflict points are perceived by cyclists to improve their safety. The intercept surveys in this study found a strong positive perception by cyclists towards green surface treatments. This in turn would likely contribute to more cycling on routes where these treatments are implemented (again, 38% of cyclists interviewed on St Kilda Road they would be more likely to use the route as a result of the treatments). However, there remains scarce evidence to suggest that such treatments do indeed result in improved safety outcomes. Indeed, a counter argument could be made that these treatments improve perceived safety, which result in cyclists reducing their awareness of their surroundings and resulting in more crashes. Again, such theories have not been substantiated with evidence.

If safety were to be improved through the use of these treatments it may come from at least two effects:

1) improved conspicuity of cyclists and awareness by motorists, and
2) safety in numbers.

The latter effect of safety in numbers is based on the observation that increasing numbers of cyclists result in reduced risks of injury (Jacobsen, 2003). The mechanism by which this is purported to occur is the same as (1) above; that is, increasing numbers of cyclists increase the awareness of motorists to the presence of cyclists. By setting the storage box ahead of the stop line the cyclist is more conspicuous to drivers, and particularly those turning left, than if the cyclist were to remain in the traffic stream. Given that the evidence would suggest that these treatments are attractive to cyclists, and do attract new cyclists, it is likely that both factors are contributing to any increase in safety.

The short period over which the St Kilda Road and Royal Parade treatments have been in place preclude a before-after evaluation based on cyclist crash data. However, the proxy measures used in this report – of measuring vehicle and cyclist compliance and conflict by observation, suggest that safety improvements are likely with these treatments.

Irrespective of the improvement in actual safety, which cannot be conclusively demonstrated at this point, there is clearly an improvement in perceived safety for cyclists with these treatments. Furthermore, there is an improvement in motorist compliance with coloured bicycle storage boxes and a decrease in encroachment into bicycle lanes by motor vehicles due to audio-tactile line marking. These behavioural changes on the part of motorists are likely to be correlated with an improvement in cyclist safety. Assuming this to be true, the findings from this study suggest there are real safety benefits from the chosen treatments.

5 Conclusion

The conclusions of this study are presented as our answers to the original research questions (Section 1.1).

Does the presence of a green surface improve motorist compliance with bicycle storage boxes?

There was an observed decrease in the proportion of motorists encroaching into the storage box at all three sites. The proportion of motorists entering the storage box reduced from 39% to 20% after the green surface treatment was installed (p=0.0859). The baseline level of encroachment of around 40% is consistent with other studies; the implication of this finding is that encroachment can be reduced by around half with the use of green surface treatments.

Does the presence of green surfaces on bicycle lanes at conflict points reduce the level of conflict between cyclists and motorists?

The presence of the green surface treatment at conflict points reduces the occurrence of conflicts between motorists and cyclists. While the level of conflict between left turning vehicles and through cyclists varied markedly across the three sites that were evaluated, each experienced a statistically significant decrease in conflict with the green surface treatment. Together, all three sites experienced a decrease in the proportion of left turning vehicles conflicting with cyclists from 28% to 3% (p=0.0214).

Does the presence of audio-tactile line marking reduce the level of motorist encroachment into a bicycle lane?

While the overall level of vehicle encroachment into the bicycle lane was low prior to treatment, the effect of audio-tactile line marking appears to be to reduce the proportion of vehicles encroaching at St Kilda Road approaching Barkly Street from 2.7% to 0.7% (p=0.0010). Furthermore, the average lateral position of vehicles in the kerbside traffic lane moves away from the bicycle lane by, on average, 0.14 m (p=0.0000).

Do cyclists perceive these treatments, both individually and together, as improving their comfort and/or perceptions of safety along these routes?

The presence of the green surfaces at bicycle storage boxes and at conflict points was very positively received by cyclists, with 76% indicating they felt more at ease as a result of the treatment (compared with 4% less at ease). Audio-tactile line marking was less well received, but still received positively overall, with 47% of respondents indicating they felt more at ease compared with 35% less at ease. Overall, 73% of respondents viewed the changes positively compared with 3% negatively. This overwhelmingly positive perception was reflected in 37% of respondents indicating they were more likely to ride more often on the route as a result of the treatments.

We conclude that the treatments appear to reduce the risk of conflict between motorists and cyclists and improve the perceived safety for cyclists. Whether these changes result in longer term actual safety improvements should be a subject of ongoing monitoring.

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Appendix A: Intercept survey

Hi, we're doing a survey for VicRoads about the bike lane. Can I ask you a few quick questions?

	1	2	3	4	5	6
1. How often do you use this route?	Every day	4 -5 days per week	2 – 3 days per week	Once a week	Less than once a week	
Recently VicRoads installed green paint at intersections along St Kilda Road and bumpy lines between the bike lane and traffic lane.						
2. Thinking first about the **green paint**, does this make you feel more or less at ease riding this route?	More at ease	Somewhat more at ease	Same as before	Less at ease	A lot less at ease	Didn't notice
3. Thinking now about the **bumpy line**, does this make you feel more or less at ease riding this route?	More at ease	Somewhat more at ease	Same as before	Less at ease	A lot less at ease	Didn't notice
4. Are you more or less likely to ride along St Kilda Road with the changes?	Much more likely	More likely	Same as before	Less likely	Much less likely	
5. Overall, how would you rate the changes?	Very good	Good	Indifferent	Bad	Very bad	
6. What risks concern you most when riding on St Kilda Road? (select up to two)	Pedestrians	Parked car doors	Cars entering or leaving parking	Cars xing at intersections	Other cyclists	Other: _____

Interviewer to record:

Gender – M / F

Age group – Under 20 / 21 – 35 / 36 – 50 / >50

Bike type – Mountain / Road / Flat bar road bike / City bike (step thru frame) / Other

Clothes – Casual / lycra / work

Cairns Regional Council

STRATEGIC LEISURE GROUP

Cairns Cycling & Walking Strategy Review

Part B – Network Plan 2010-2030

Final Draft Report – April 2010

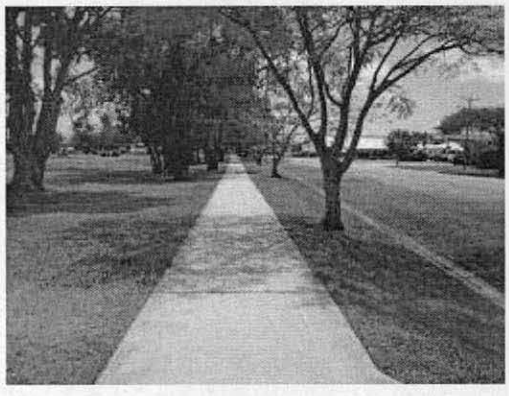
STRATEGIC LEISURE GROUP

in association with

MCCORMICK RANKIN CAGNEY

McCormickRankinCagney

Accordingly, works proposed in this Strategy Review reflect Council's current policy. The Network Implementation Plan has allowed for paths to have a minimum width of 2.0m, together with required signage and line marking advising users that the path is a shared facility. Existing path width was only proposed in 'retrofit' locations where a missing link of less than 200m was identified i.e. to allow for width continuity over a short distance.

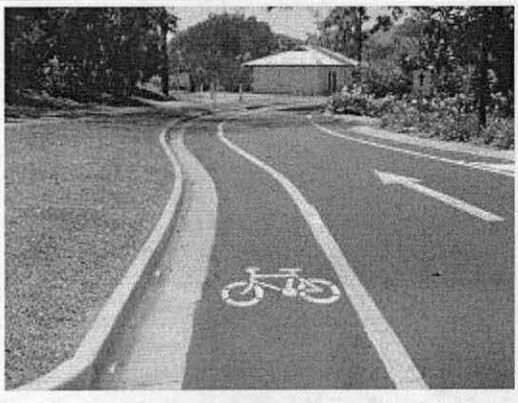
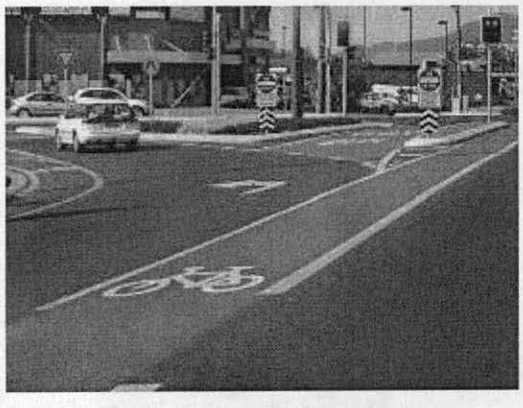
Facility Type	Facility Code	Example (Indicative Only)
OFF-ROAD SERIES		
Shared Path Wide off-road path provided for the shared use by cyclists, pedestrians, wheeled recreational devices (WRD's) including skateboards, roller skates, and rollerblades, as well as micro-electrics and wheelchairs. Signs, lines and pavement symbols can be used on busy shared paths to reinforce shared use etiquette or minimise conflict potential. Concrete construction preferred. Council design guidelines nominate 2.0m as the absolute minimum width of a shared path. The FNQ Design Manual allows for Council discretion in highly constrained situations, to determine if reduced with is acceptable.	**SP**	 Example – Gordonvale
Path Upgrade Widening or reconstruction of an existing narrow footpath to provide a shared facility.	**UP**	As above.
Separated Path(s) One side of the path is for cyclists, WRDs and micro-electrics, the other is for pedestrians. Wheelchairs may be on either side. Path may have separate designated areas, or comprise 2 physically separated paths. Regulatory signage required.	**SEP**	 Example – Brisbane

5.1.2. *On-Road Series*

The On-Road Series comprises four core forms of facility which are a distillation of various treatments included in the national and state guidelines:

- Exclusive Bicycle Lane (EBL)
- Shared Bicycle & Parking Lane (SBPL)
- Copenhagen Style Bike Lane (COP)
- Advisory Treatment (AT)

Although there are many factors which will influence the nature of on-road facilities (e.g. design speed, patronage, functional classification, parking demand etc), fundamentally, all on-road treatments are variations of these four forms.

Facility Type	Facility Code	Example (Indicative Only)
ON-ROAD SERIES		
Exclusive Bicycle Lane *Standard Treatment* Formally defined kerbside lane for dedicated use by cyclists, with full edge line marking, white pavement symbols and regulatory signage. Motorists may only enter this lane to park, enter or exit a property, or turn left. Motorists must give way to cyclists in these lanes. Parking in / over bike lane not permitted. *Coloured Lane Treatment* Green pavement treatments may be considered for bike lanes in order to minimise conflict between cyclists and motor vehicles, particularly on State Controlled Roads, multi-lane roundabouts and where vehicles turn across the path of cyclists at major intersections. The coloured material used should be skid resistant, so it can be safely negotiated by cyclists when slowing or cornering. Due to high implementation and maintenance costs, consideration should be given to treating only specific sections of the bike lane e.g. approach to major intersections. The 'NSW Bicycle Guidelines' recommend limiting application of coloured treatments to critical locations to increase delineation, and provides a useful reference when considering use of this type of treatment. Extensive application of coloured lanes is not recommended in Cairns.	EBL	 Example - Collins Ave, Edge Hill  Example – Mulgrave Rd, Parramatta Park

Facility Type	Facility Code	Example (Indicative Only)
Shared Bicycle / Parking Lane (Parallel) This treatment is applied where kerbside parking is a permanent allocation of the road space (and is not used as a traffic lane during peak demand). The SBPL treatment comprises shared kerbside lane, with formally designated bike lane and adjacent parallel on-street parking space. Facility formally defined with edge lines, white bicycle symbols and regulatory signage. Facility to be of adequate width to cater for parked vehicle, bicycle design envelope and open car door. No loss of car parking. **Shared Bicycle / Parking Lane (Angled)** Shared kerbside lane, comprising formally designated bike lane and adjacent angled on-street parking space. Facility formally defined with edge lines, white bicycle symbols and signage.	SBPL	 Example – Lake St, Cairns North  Example – McLeod St, Cairns CBD
Copenhagen Style Bicycle Lane Bicycle lane on the road that is physically separated from other road users e.g. median, island, barrier. Bike lane runs alongside the footpath, with cars parking on the outside of the bike lane, closest to the road. This style of bike lane has been used successfully in Europe. The first bike lanes of this type were constructed in Copenhagen in Denmark. Copenhagen Bicycle Lanes will be implemented by Council for the CBD-Aeroglen Bikeway Project.	COP	 Example – CBD to Aeroglen Bikeway (artist's impression)  Example - Melbourne