

Cambridgeshire 'floating bus stops' interaction analysis

Final report

December 2015

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Head Office
Sustrans
2 Cathedral Square
College Green
Bristol
BS1 5DD

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Registered Charity No. 326550 (England and Wales) SC039263 (Scotland)
VAT Registration No. 416740656

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1 Executive Summary

Cambridgeshire County Council (CCC) are implementing a series of 'floating bus stops' within the Cambridgeshire area. Due to this new planned infrastructure, CCC are interested in establishing whether the new 'floating bus stops' designs are generating any unsafe interactions between road users, in particular cyclists and pedestrians. To do this, two sites where 'floating bus stops' are already in place were monitored: Huntingdon Road and Hills Road.

The specific interactions that were closely observed included any interactions between cyclists and pedestrians, any interactions between cyclists and buses and any interactions between cyclists and cars. An interaction score was assigned to the interactions relating to their risk and severity. It was also noted whether cyclists continued to use the road or the new cycle lane.

The main findings:

- Overall, 42 cyclists were involved in an interaction with another road user at both Huntingdon Road and Hills Road
- All interactions were scored as a 1 or 2 which is generally considered safe and normal behaviour according to an interaction scoring system used
- Most interactions involved a cyclist and a pedestrian, with only 1 interaction observed between a cyclist and another cyclist at Huntingdon Road (there were no interactions between a cyclist and a car or between a cyclist and a bus) at any of the 'floating bus stops'
- All interactions took place during weekday peak times (there were no interactions seen during off-peak times and no interactions at the weekend) at both sites

Huntingdon Road

- 6 cyclists were involved in an interaction with another road user
- 4 interactions were scored at 1: Precautionary or anticipatory braking/slowing down when risk of collision was minimal
- 2 interactions were scored at 2: Controlled braking, slowing down or stepping aside to avoid collision (but with ample time for manoeuvre)
- Most interactions occurred between a pedestrian moving away from the bus stop and a cyclist (50%)
- 84% of cyclists performing movement **E** (cycling on the pavement to the left of the bus stop) moved on to the cycle lane
- There were no obvious patterns in time period that would determine when an interaction between a cyclist and another road user was deemed more probable. There was an even spread between peak-am and peak-pm

Hills Road

- 36 cyclists were involved in an interaction
- 35 interactions were scored at 1: Precautionary or anticipatory braking/slowing down when risk of collision was minimal
- 1 interaction was scored at 2: Controlled braking, slowing down or stepping aside to avoid collision (but with ample time for manoeuvre)

- Most interactions occurred between a pedestrian moving towards the bus stop and a cyclist (86%)
- 95% of cyclists who passed with a bus in the bus stop did not have an interaction with another road user
- 2% of cyclists performed movement **C** and moved on to the cycle lane
- The peak-pm time period at Hills Road generated the majority of interactions between cyclists and other road users. This was closely linked to when school was finished and students were waiting or overcrowding the bus stop. 72% of all interactions at Hills Road occurred at peak - pm on Wednesday and Thursday

Other observations:

Additionally there were other activities that were observed which did not result in an interaction at these 'floating bus stop' sites but which could have potential future safety implications. This was most prominent at Hills Road which is the busier of the two sites.

- Large groups of pedestrians were observed using the cycle lane as an extension of the pavement at Hills Road especially when the bus stop was congested. If cyclists are coming down the cycle lane and pedestrians are crowding the lane this could lead to conflicts between these road users.
- After school has been let out many young people can be seen crowding around the bus stop at Hills Road which usually causes them to stand in the cycle lane. They usually do not appear to be as attentive to the flow of traffic with some students appearing to cross back and forth along the cycle lane without any apparent justifications for these movements

2 Introduction

Cambridgeshire County Council (CCC) are implementing a series of 'floating bus stops' within the Cambridgeshire area.

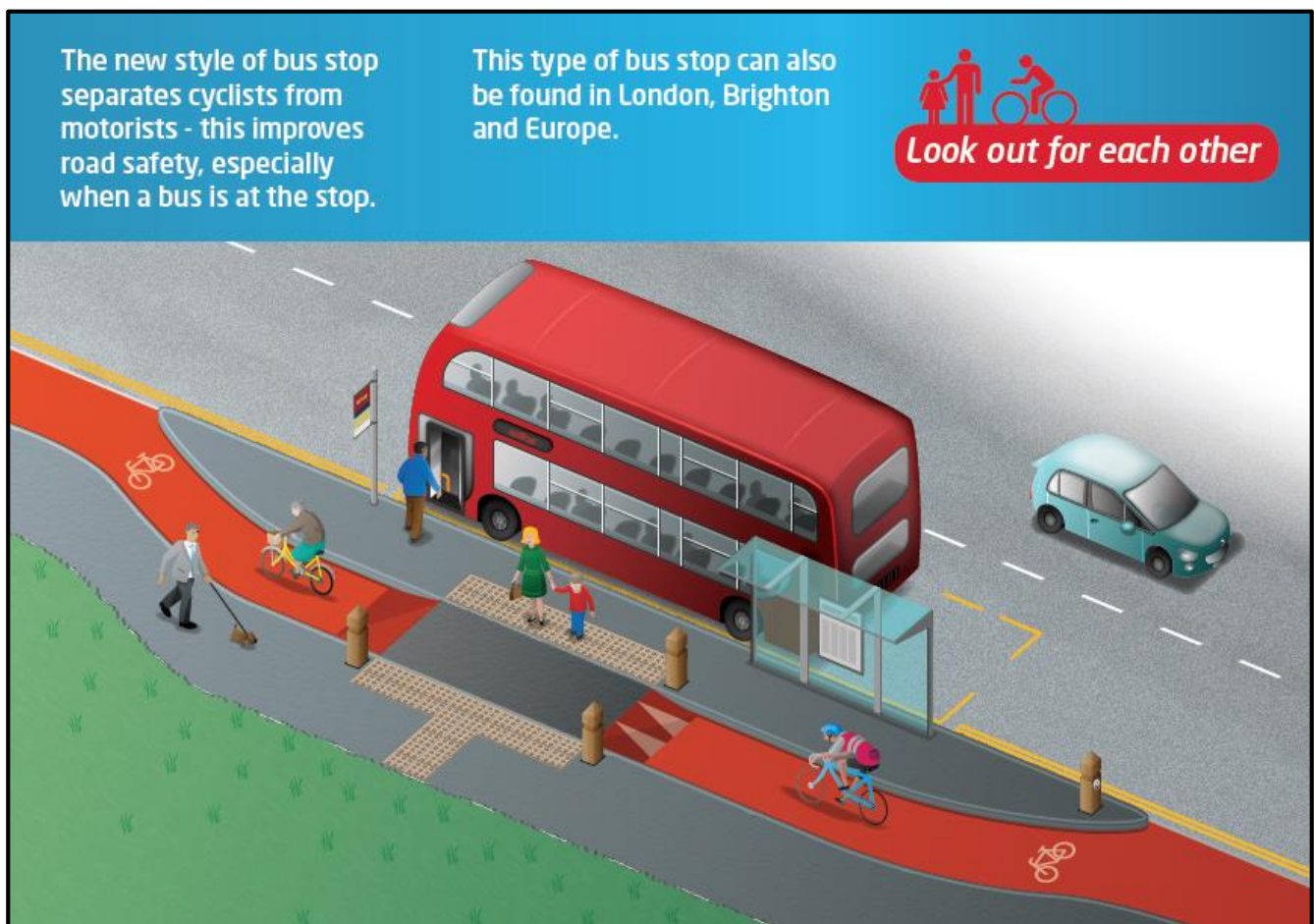
These new bus stop designs are popular in other European cities and are intended to increase the safety of cyclists, removing them from the direct path of buses at bus stops.

Two 'floating bus stops' have already been constructed at Hills Road and Huntingdon Road.

Local stakeholders have raised some safety concerns related to these new designs. The key concern is that the design creates the potential for increased conflict between cyclists and pedestrians, and vice versa. The designs of these 'floating bus stops' are illustrated below in **Image 1**.

The council has communicated with the community on the designs and provided educational material to explain their use. CCC commissioned Sustrans RMU to conduct interaction analysis of Hills Road and Huntingdon Road to investigate potential safety-related interactions at the bus stops.

Image 1 Cambridgeshire 'floating bus stops' illustrations



3 Aims and objectives

The aim of the monitoring is to identify the interactions that relate to pedestrian and cyclist safety at Hills Road and Huntingdon Road 'floating bus stops'.

The specific interactions we are interested in are:

- Interaction of cyclists and pedestrians on the new cycle lane by the bus stop (Pedestrians either side of the lane and cyclists using the length of the cycle lane)
- Interaction between cyclists and buses at the stop
- Interaction between cars and cyclists at the stop
- Whether cyclists are using the new cycle lane or staying on the road

4 Methodology

4.1 Sample

A video sample of key times at both 'floating bus stop' sites were selected for video monitoring and interaction analysis.

A sample of hours from peak morning, and peak afternoon on three separate days (Wednesday, Thursday and Saturday) were selected. These times were chosen because they provided a useful sample of key commuter and travel times within the working week and weekend which could potentially give rise to more opportunities for interactions and potential conflicts between road users. This methodology is a standard approach used within Sustrans RMU and has been utilised in projects and reports for the Department for Transport.

For Huntingdon Road one off-peak hour was chosen on the Wednesday to observe behaviour at this time. At Hills Road initially, one-off peak hour on the Wednesday was meant to be monitored. However, at this time the bus stop was closed due to the cycle lane being painted so for Hills Road we selected an off-peak hour on the Thursday as an alternative.

With the exception of the off-peak hour on the Wednesday at Hills road, the chosen time period did not coincide with school holidays, special events or periods of road closure and therefore was representative of a normal busy day around these 'floating bus stops'. The times were selected in collaboration between Sustrans RMU and CCC.

Initially, both Hills and Huntingdon Road were planned to record video footage on the 21st, 22nd and 24th October, however there were some quality issues with the Hills Road video and new video footage needed to be commissioned.

4.2 Huntingdon Road

Video footage was recorded on the 21st, 22nd and 24th October.

The times and movements for the Huntingdon Road 'floating bus stop' can be seen below:

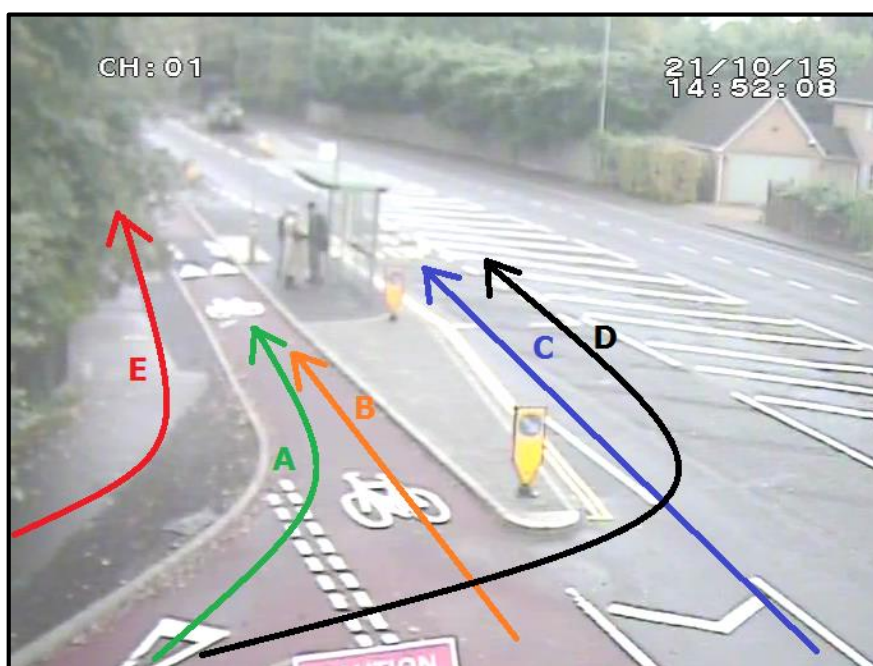
- a. Wednesday – Peak Morning 7.45-9.45 (2hrs), Peak afternoon 16.30-18.30 (2hrs), 1 off peak hr 14.00-15.00 (1 hr)
- b. Thursday - Peak Morning 7.45-9.45 (2hrs), Peak afternoon 16.30-18.30 (2hrs)
- c. Saturday - Peak Morning 8.30-10.30 (2hrs), Peak afternoon 16.00-18.00 (2hrs)

There were 5 movements the assessors observed and monitored at Huntingdon Road shown in **Image 2**. These movements were selected to address the aims of the interaction analysis.

A and **B** represented cyclists moving along the new cycle lane and the zone in which conflict with pedestrians crossing towards the bus stop or away from the bus stop to the pavement could occur. **C** and **D** looked at the interactions between cyclists and buses or cyclists and cars respectively.

In the process of video monitoring we noticed many cyclists performing movement **E** on the pavement. In consultation with CCC the decision was taken to monitor the number of cyclists who performed this movement and differentiate whether the cyclist performing this movement stayed on the pavement or moved on to the new cycle lane at the bus stop. Some foliage on the left hand side of the video obstructed the full view of the pavement, however we were able to reasonably determine what the cyclist did within the shot.

Image 2 Huntingdon Road movements



4.3 Hills road

Video footage was recorded on the 11th, 12th and 14th November.

- a. Wednesday - Peak Morning 7.45-9.45 (2hrs), Peak afternoon/evening 15-30-18.30 (3hrs)
- b. Thursday - Peak Morning 7.45-9.45 (2hrs), Peak afternoon/evening 15-30-18.30 (3hrs), 1 off peak hr 14.00-15.00 (1 hr)
- c. Saturday - Peak Morning 8.30-10.30 (2hrs), Peak afternoon/evening 15-30-18.30 (3hrs)

For Hills Road there were 3 movements we were particularly interested in, these movements can be seen in **Image 3**. These movements were selected to address the aims of the interaction analysis taking into account the particularities of the bus stop design at this site compared to Huntingdon Road.

Movement **A** relates to cyclists moving along the new cycle lane and the zone in which conflict with pedestrians crossing towards the bus stop or away from the bus stop to the pavement could occur. Movement **B** looks at the interactions between cyclists and buses or cyclists and cars.

Prior to planning the monitoring scope it was unknown that there was a bi-directional shared-use foot/cycleway present at the Hills Road site. CCC explained that the intention is to keep this shared-use facility open whilst the works on the other side of the road are being carried out in order to give cyclists another option for cycling rather than through the other building works. They will then widen the verge on the side closest to the bus stop and finish off the pavement works.

In order not to complicate and detract from the original aim of this specific project which was to monitor the interactions and any conflicts due to the new 'floating bus stop' design, we did not count the cyclists on this path nor interactions on this path as it is not a part of this new infrastructure and is a temporary measure.

However, similar to Huntingdon Road (Movement **E**), we looked at movement **C** to ascertain if people came off the sidewalk at any point and on to the new cycle lane or whether they stayed on the pavement.

Image 3 Hills Road movements



4.4 Interaction analysis

Interaction analysis allows an assessment of how route users move in relationship to each other along a road or path. By observing the potential for collision and the actions taken to avoid it, a rating system can be applied to each individual interaction.

The interaction analysis was carried out using the footage provided by CCC with the purpose of detailing the number of cyclists that interacted with pedestrians and other road users around the new 'floating bus stop' and the level of action required to avoid collision in each case.

For this specific project, interaction scoring helped us to determine:

- Frequency and severity of interactions between cyclists and pedestrians on the new lane by the bus stop (Pedestrians either side of the lane and cyclists using the length of the lane)
- Frequency and severity of interactions between cyclists and a bus at the stop
- Frequency and severity of interactions between cyclists and cars at the stop

This scoring method was adapted from a technique used by MVA Consultants in 2010 for a report commissioned by Transport for London (TfL)² and uses a scale of 0-5 to rank each interaction, see **Table 1**. The scale ranges from level 0; where two users pass each other on the route but do not have to change their behaviour at all, to level 5; where two users actually collide with each other. Some interactions are within the realms of normal behaviour exhibited while others give rise to varying degrees of conflicts that typically have varying degrees of safety implications

Table 1 Interaction scores

	Description	Safety consideration
0	No response required by either road user	Green: Generally safe, normal behaviour
1	Precautionary or anticipatory braking/slowing down when risk of collision is minimal	
2	Controlled braking, slowing down or stepping aside to avoid collision (but with ample time for manoeuvre)	
3	Rapid deceleration, stopping or quickly moving aside to avoid collision, resulting in a near miss situation	Amber: Generally unsafe; near-miss situation
4	Emergency braking, violent serve or movement to avoid collision resulting in a near miss situation	
5	Emergency action followed by collision	Red: Collision

² MVA Consultants, 2010 - 'No Entry Except Cycles' Signing Review.

4.5 Limitations of the analysis

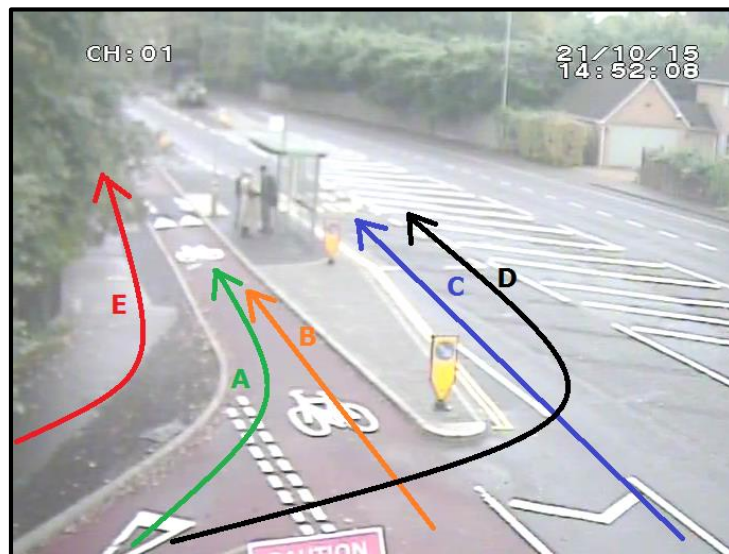
Given the high level of cyclist traffic coming through both sites we did not use **0** as a score. We only noted the actual interactions that occurred from **1-5** to demonstrate those occasions when a direct interaction occurred between cyclists and other road users (pedestrians, cars, buses). As a result we are not able to say what potential conflicts could have occurred but what actual conflicts happened. The analysis in this report is also limited to observed actions and levels of safety, it does not account for personal perceptions of safety.

A key limitation is that there is no baseline data at these sites to indicate the levels of interactions between different road users at these bus stops prior to the new design being implemented. This did not allow us to compare whether the new 'floating bus stops' have increased or decreased interactions between different road users. In the future it would be recommended to conduct a baseline video analysis prior to a 'floating bus stop' being built and then some post footage once it is implemented. This would give a stronger indication of the levels of interactions affected by the new design. Additionally, automatic counts at the bus stop as well as traffic speed and volume data at the site would build a more rounded picture of the potential for conflict at these sites.

5 Findings

5.1 Huntingdon Road

Image 4 Huntingdon Road movements



5.1.1 Movements and interactions at Huntingdon Road

Table 2 shows the total levels of cyclists who performed one of the 5 movements observed across all sampled days and times as well as the level and frequencies of interactions. It was found that the majority of cyclists monitored at Huntingdon Road performed movements **A** and **B** (47% and 45% of total cyclist counts respectively). This could reasonably indicate that based on the monitored video footage most cyclists seem to be making use of the cycle lane at the new 'floating bus stop' and not going on to the road.

We only noticed one cyclist making the movement from direction **B** to **C** i.e. leaving the cycle lane and choosing to cycle on the road and it seems this was done because the cyclist wanted to pass some slower cyclists by moving to the road.

At movement **E** it was observed that 96 cyclists started their journey on the pavement opposite the cycle lane representing 8% of all cyclists observed at the bus stop.

Table 2 Interaction frequency as a proportion of total cyclist count on Huntingdon Road

Direction	Count of cyclists	% cyclists	Number of interactions	Proportion of those making movement involved in an interaction
A	558	47%	5	0.90%
B	545	45%	1	0.18%
C	1	0%	0	
D	0	0%	0	
E	96	8%	0	
Total	1200	100%	6	

Positively of the 1103 cyclists doing movement **A** and **B**, 99% were not involved in an interaction. This is particularly encouraging taking into consideration that at peak times up to an estimated 20 cyclists per minute passed the ‘floating bus stop’.

Additionally, **Table 2** shows the level of interactions that occurred at each movement. Out of a total of 1200 cyclists using the cycle lane over the three days and sample video times, only 6 cyclists were involved in an interaction with a score of 1 or more. Most of the interactions, (5 out of 6) occurred at movement **A** when cyclists came on to the ‘floating bus stop’ cycle lane from the side road. Only 1 interaction occurred between cyclists and pedestrians on movement **B**. There were no interactions between a cyclist and other road users at any of the other movements.

Looking at **Table 3**, it can be seen that 3 cyclists who made movement **A** and had an interaction with another road user (pedestrian), generated an interaction score of 1 which indicated there was some precautionary or anticipatory braking or slowing down when a risk of collision was minimal. Furthermore, 2 cyclists that had an interaction on movement **A** with another road user (pedestrian/cyclist), resulted in an interaction score of 2. In these 3 incidents there was some controlled breaking, slowing down or stepping aside to avoid collision (but with ample time for manoeuvre). For Movement **B** only one cyclist making this movement had an interaction with another road user (pedestrian) with an interaction score of 1.

Table 3 Relationship between movement and interaction score at Huntingdon Road

Interaction score	Movement A	Movement B
1	3	1
2	2	
Total	5	1

Most of the interactions between cyclists and pedestrians on Huntingdon Road fall into a behaviour that is classed as generally safe normal behaviour according to the interaction scale (see **Table 1**).

Looking at **Table 4** it can be seen that the majority of interactions occurred between cyclists and pedestrians crossing the cycle lane. The table indicates that that the majority of interactions are occurring when pedestrians are moving away from the bus stop (50%) but also when they are moving towards the bus stop (33%). There was only one interaction with another cyclist and no interactions with a bus or car.

Table 4 Interaction count according to types of road users at Huntingdon Road

	Interaction with Bus	Interaction with car	Interaction with Pedestrian moving towards the bus stop	Interaction with Pedestrian moving away from the bus stop	Interaction with Cyclist	Total
Count	0	0	2	3	1	6
%	0%	0%	33.33%	50%	16.67%	100%

Table 5 shows the number of cyclists using the pavement (movement **E**) and the subsequent actions they took. There were no interactions with other road users and cyclists on the pavement from what was visible to the assessors. However, we did observe that 84% (81) cyclists who started on the pavement moved at some stage onto the cycle lane. 16% of (15) cyclists continued their journey on the pavement.

Table 5 Actions taken by cyclists performing movement E

	Count of cyclists on movement E which performed action	% of Cyclists doing movement E
Stayed on the pavement	15	16%
Moved on to cycle lane	81	84%
Total	96	100%

5.1.2 Interactions and time periods

Table 6 shows the interaction of cyclists with pedestrians or other cyclists according to the time period when the interaction occurred. There were no obvious trends in time periods in which interactions were more likely to have occurred. However, there were no interactions observed on the weekend

(Saturday peak am or pm). All interactions occurred on the two weekdays assessed (Wednesday and Thursday).

On the Wednesday peak am there were 2 interactions with an interaction score of 1. Additionally, 1 interaction on the Wednesday peak pm with an interaction score of 2 was observed. On Thursday, the majority of interactions occurred at the peak-afternoon, with 2 interactions with a score of 1 being identified. However, 1 interaction with a score of 2 was observed on the am peak.

Table 6 Interaction of cyclists with pedestrians or other cyclists according to day and time

Interaction score	Wednesday			Thursday		Saturday		Grand total
	am - peak	pm-peak	off - peak	am - peak	pm-peak	am-peak	pm-peak	
1	2				2			4
2		1		1				2

5.2 Interactions observed on Huntingdon Road

5.2.1 Cyclist interaction with pedestrian moving towards the bus stop

There were 2 incidents in which an interaction occurred between a cyclist and a pedestrian moving towards the bus stop (**Table 7**).

A description of incident **1** can be found below .

Table 7 Cyclist interaction with pedestrian moving towards the bus stop

Incident	Date	Time	Movement	Interaction score	Notes
1	21/10/2015	08:13:08	A	1	Pedestrian having to make a small step onto island to get out of cyclist's way
2	21/10/2015	09:40:13	B	1	Pedestrian having to wait on pavement for cyclists in order to cross

Incident 1:

At peak morning on the Wednesday, two pedestrians were seen stopping and having a conversation by the bus stop. One of the pedestrians (circled in red Screenshot 1) stands in the cycle lane while their companion stands on the bus stop border. Two cyclists come out of the side road (Movement **A**) and appear to be heading toward the direction of the pedestrian stood in the lane (Screenshot1 in **Image 5**). As the first cyclist approaches the pedestrian notices and steps forward on to the bus stop

edge (Screenshot 2). The stepping forward was interpreted as being of a casual nature and the chance of collision was deemed minimal. Therefore incident 1 was scored as a 1 instead of a 2 despite the stepping aside movement. Also, it was difficult to attribute the movement solely on to the cyclist so we adopted a more conservative score. Scores 1 and 2 are still within the realms of normal behaviour and are considered generally safe.

Image 5 Screenshots of Incident 1: Cyclist interaction with pedestrian moving towards the bus stop at Huntingdon Road



5.2.2 Cyclist Interaction with pedestrian moving away from bus stop

As indicated in **Table 8** there were 3 incidents where an interaction occurred between a cyclist and a pedestrian moving away from the bus stop. A more detailed description of incident 1 and 2 can be found below.

Table 8: Cyclist interaction with pedestrian moving away from the bus stop

Incident	Date	Time	Movement	Interaction score	Notes
1	22/10/2015	08:42:27	A	2	Pedestrian walking across cycle lane and into junction, causing cyclist to take precautionary action by moving and braking.
2	22/10/2015	17:28:33	A	1	Pedestrian crossed without looking, cyclist calmly braked and moved to the right to give ample space.

3	22/10/2015	17:29:16	A	1	Pedestrian stood in cycle lane for a minute and has to move on to pavement when a cyclist comes along the cycle lane.
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Incident 1:

At Thursday peak morning a pedestrian (circled in red) moves from the 'floating bus stop' island across the cycle lane towards the cycle lane on movement **A** (Screenshot 1 **Image 6**). He does not use the official crossing allocated at the bus stop. A cyclist emerges on the side road making movement **A** and has to take precautionary action by moving and braking to ensure they do not collide with the pedestrian (Screenshot 2). We scored this incident with a score of 2 because the cyclist had to break and move to the left to avoid a collision but there was ample time to manoeuvre.

Image 6 Screenshots of Incident 1: Cyclist interaction with pedestrian moving away from the bus stop at Huntingdon Road



Incident 2:

Image 7 shows two pedestrians talking at the 'floating bus stop' island with the back to the cyclist joining the cycle lane from movement **A** (Screenshot 1). One of the pedestrians (circled in red) started to cross the cycle lane moving away from the bus stop island without looking behind to see if a cyclist might be approaching. The cyclist possibly anticipated the movement from the pedestrian, slowed down and moved to the right avoiding the pedestrian (Screenshot 2). This incident was scored as 1 because the cyclist took precautionary actions with the risk of collision was minimal.

Image 7 Screenshots of Incident 2: Cyclist interaction with pedestrian moving away from the bus stop at Huntingdon Road



5.2.2 Cyclist interaction with other cyclist

Incident	Date	Time	Movement	Interaction score	Notes
1	21/10/2015	17:46:41	A	2	Cyclist entering the cycle lane from the wrong end and almost caused a collision with another cyclist

Incident 1

We observed a cyclist (circled in red) crossing the road from the opposite side of the road (Screenshot 1) and entering the cycle lane at the opposite end of the 'floating bus stop' (Screenshot 2). Subsequently there was an interaction with a cyclist coming from Movement **A** (at the left hand bottom corner in Screenshot 2) who was turning into Movement **B**. Evasive action was required by the cyclist on movement **A** not to collide with the cyclist using the cycle lane in Screenshot 3. This behaviour was scored as a 2.

Image 8 Screenshot of cyclist interacting with another cyclist



5.2.3 Other observations

Cyclist moving from B to C

Image 9 shows a cyclist (circled in red) moving from the cycle lane in direction **B** on to the road doing movement **C** (Screenshot 1). Please take note of the cyclist circled in blue in front of the cyclist circled in red. Screenshot 2 shows the cyclist on movement **C** passing on the left of the cars queuing on Huntingdon Road. It gave the impression that the cyclist was trying to overtake the cyclist in the cycle lane (circled in blue) by moving onto the road.

Image 9 Screenshot of cyclist moving from B to C



5.3 Hills Road

Image 10 Hills Road movements



5.3.1 Movements and interactions at Hills Road

Table 9 shows the total number of cyclists who performed one of the 3 movements observed across all sampled days and times as well as the level and frequencies of interactions. It can be seen that the majority of cyclists monitored at Hills Road performed movement **A** (98%) with a small amount using movement **C** (2%) and very few using movement **B**. This could reasonably indicate that based on the monitored video footage most cyclists seem to be making use of the cycle lane at the new 'floating bus stop' and not using the road for this section of their journey.

At movement **C** it was observed that 49 cyclists start their journey on the pavement alongside the cycle lane, joining the cycle lane later on, which represents 2% of all cyclists observed at this bus stop.

Table 9 also shows that there were 36 interactions observed out of a total of 2407 cyclists performing Movement **A** throughout the time periods monitored. This accounts for just 1.5% of all the cyclists on movement **A** and **B**, and positively, indicates that about 99% of the cyclists monitored were not involved in an interaction.

Table 9 Interaction frequency as a proportion of total cyclist count on Hills Road

Direction	Count of cyclists	% cyclists	Number of interactions	Proportion of those making movement involved in an interaction
A	2404	98%	36	1.50%
B	3	0.12%	0	0.00%
C	49	2%		
Total	2456	100%	36	

Table 10 shows the level of interactions that occurred at each movement. All of the interactions, occurred on movement **A** when cyclists continued on to the ‘floating bus stop’ cycle lane on Hills Road. No interactions occurred on movement **B** between cyclists.

Looking at **Table 10**, it can be seen that of the 36 interactions that were observed with cyclists who made movement **A** and had an interaction with another road user (pedestrian) the majority of interactions generated an interaction score of 1 (97%), indicating there was some precautionary or anticipatory braking or slowing down when the risk of collision was minimal. Furthermore, 1 cyclist had an interaction on movement **A** with another road user (pedestrian), resulting in an interaction score of 2. This indicates in this incident there was some controlled breaking, slowing down or stepping aside to avoid collision but with ample time for manoeuvre.

Table 10: Relationship between movement and interaction score at Hills Road

Interaction Score	Movement A	Movement B	Movement C	Total
1	35	0	N/A	35
2	1	0	N/A	1
Total	36	0	0	36

Looking at **Table 11** it can be seen that the majority of interactions occurred between cyclists and pedestrians crossing the cycle lane. The table indicates that the majority of interactions occurred between cyclists and pedestrians moving towards the bus stop (86%) and a small number of interactions took place with pedestrians moving away from the bus stop and a cyclist (14%). There were no recorded interactions with a cyclist and a bus, car or another cyclist. This suggests that pedestrians tend to have the most interactions with cyclists, in particular when pedestrians are crossing the cycle lane towards the bus stop.

Table 11: Interaction count according to types of road user

	Interaction with Bus	Interaction with Car	Interaction with Pedestrian moving towards bus stop	Interaction with Pedestrian moving away from bus stop	Interaction with Cyclist	Total
Count	0	0	31	5	0	36
%	0%	0%	86%	14%	0%	100%

However, taken together, for Hills Road we have observed that most of the interactions that have occurred between a cyclist and a pedestrian fall into behaviour which is classed as generally safe normal behaviour according to the interaction scale.

5.3.2 Interactions and time periods

Table 12 highlights the time of day the interactions were found and their corresponding interaction scores. Looking at the interaction scores there appears to be a clear trend evolving in the time period's observed which show that interactions are more likely to occur on a specific type of day and during a specific time range. For example, there were no interactions found on Saturday (peak-am and peak-pm), compared to 36 interactions observed on weekdays (Wednesday and Thursday). Additionally, the majority of interactions occurred during weekday pm-peak times (72 %) with the remaining incidents taking place during weekday am-peak times (27 %), implying that during weekday peak times more interactions are most likely to generate minor interactions. There were no interactions observed during weekday off-peak times. This suggests that weekday pm-peak sees more interactions than other times, both weekday and weekend. It was also found that the only interaction with a score of 2 observed throughout all of the monitoring at Hills road was found during this particular time (Wednesday peak-pm) again supporting the notion that weekday pm-peak times are more likely to see interactions between cyclists and road users.

It was observed that when school was let out this resulted in greater chances of interactions between pedestrians and cyclists. It was observed that students are crowding around the bus stop and sometimes in the cycle lane and or crossing the lane in a haphazard manner.

Table 12 Interaction of cyclists with pedestrians or other cyclists according to day and time

Interaction score	Wednesday		Thursday			Saturday		Grand total
	am-peak	pm-peak	am-peak	off-peak	pm-peak	am-peak	pm-peak	
1	8	13	2	0	12	0	0	35
2	0	1	0	0	0	0	0	1

For Hills Road we conducted additional monitoring and noted when a bus was at the stop. This allows us to observe whether there were more interactions between road users when the bus was at the stop. **Table 13** highlights the frequency of interactions that took place when cyclists passed the ‘floating bus stop’ when a bus was stationary at the stop. There were 60 cyclists that used the cycle lane over the three day observation time when a bus was at the stop which resulted in no interactions with the bus or other road users. There were 3 interactions between a pedestrian and a cyclist when a bus was in the bus stop, accounting for only 5% of all cyclists who passed whilst a bus was at the stop. Of these, all interactions received a score of 1, indicating there was some precautionary or anticipatory braking or slowing down when the risk of collision was minimal, with 2 out of the 3 interactions observed with pedestrians moving away from the bus stop and 1 with a pedestrian moving towards the bus stop. There were no interactions between a cyclist and the bus as the cyclists tended to stay on the cycle lane as opposed to the road.

Table 13 Number of interactions seen as a cyclist passed with a bus in the stop

Interaction	Count of Cyclists	% of Cyclists
No interactions at stop	60	95.2%
Interaction	3	4.8%
Grand Total	63	100.0%

5.4 Interactions observed on Hills Road

5.4.1 Cyclist Interaction with pedestrian moving towards the bus stop

Table 14 provides 5 examples of interactions that occurred between a cyclist and a pedestrian moving towards the bus stop. A description of incident 1, 2 and 3 can be found below. Additional incidents from Hills Road can be seen in the Appendix.

Table 14: Cyclist interaction with pedestrian moving towards the bus stop

Incident	Date	Time	Movement	Interaction score	Notes
1	11/11/2015	16:08:23	A	2	Pedestrian is walking slowly down the pavement but runs quickly across the cycle lane in a sudden movement when he sees the approaching cyclist. Cyclist has ample time to brake.
2	11/11/2015	16:09:04	A	1	Pedestrian waited for cyclist to go past before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
3	12/11/2015	16:08:35	A	1	Pedestrian (school child) walking across cycle lane to bus stop; cyclists have to slow down.

4	11/11/2015	07:58:34	A	1	Pedestrians waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
5	11/11/2015	08:51:33	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.

Incident 1:

At peak afternoon on the Wednesday, the bus stop was busy with young people leaving school, both waiting for a bus and walking on the pavement next to the cycle lane. At this time many pedestrians were moving across the cycle lane particularly with those walking towards the bus stop. There also appears to be many young people walking up and down the bus stop area, as they wait for the bus, with some crossing back and forth on the cycle lane. This sometimes made it hard for the assessors to determine the reasons behind some of their movements. Incident 1 involved a school child seen in the red circle in Screenshot 2 who was walking along the pavement in the direction of movement **A** (see **Image 11**).

A cyclist was approaching from movement **A** at a pace deemed 'normal' (Screenshot 2 in the blue circle). The pedestrian looked right (Screenshot 2) and appeared to see the approaching cyclist but still decided to cross the cycle lane. The pedestrian then runs across the cycle lane seemingly to avoid any collision with the cyclist (Screen shots 3 and 4). The cyclist appears to react to the pedestrian by altering their cycling route slightly, swerving slightly to the left to change their path and to avoid the pedestrian (see Screenshots 5 and 6). The interaction was scored as a 2 due to the sudden movement seen by the pedestrian and precautionary measures adopted by the cyclist. Scores of 2 are still within the realms of normal behaviour and are considered generally safe.

Image 11 Screenshots of Incident 1: Cyclist with pedestrian moving towards the bus stop at Hills Road



Incident 2:

At peak afternoon on Wednesday, the bus stop was busy with young people leaving school, both waiting for a bus and walking next to the cycle lane along the pavement. There were many pedestrians moving across the cycle lane particularly with those walking towards the bus stop. There also appears

to be a lot of young people walking across the area, as they wait for the bus, with no real justification for their movements. There are also a lot of cyclists using the cycle lane during these peak pm hours. Incident 2 involved a school child who is walking along the pavement in the direction of movement **A** (See **Image 12**).

A cyclist approached from movement **A** at a normal pace seen along the cycle lane and can be seen in the blue circle in Screenshot 1. The pedestrian (red circle Screenshot 1) looked right and sees the approaching cyclist so waits for the cyclist to pass before crossing the cycle lane (Screenshot 2). The pedestrian waited as a precautionary measure, with minimal chance of collision with the cyclist (Screenshots 3 and 4). The cyclist does not appear to slow down or change direction but continues on the cycle lane at the same speed. The interaction was scored as a 1 due to there being no sudden or quick reaction needed by the road users, but an anticipatory waiting behaviour shown by the pedestrian with lots of time to do so. This behaviour is deemed normal road-using behaviour. This behaviour was seen on many occasions during this time period, with a steady flow of cyclists and lots of pedestrians around the bus stop.

Image 12 Screenshots of incident 2: Cyclist interaction with pedestrian moving towards the bus stop at Hills Road



Incident 3:

Many young people were crossing the cycle lane to the bus stop and walking around the area during this period. In this incident, a pedestrian (one of these young people Screenshot 1 red circle **Image**

13) appears to stop and wait for a number of cyclists (blue circle Screenshot1) to perform movement A before crossing the cycle lane (Screenshot 2 red circle). The pedestrian took a precautionary action with very minimal chance of collision with the approaching cyclists. This time of day is busy with both cyclists and pedestrians and it appears the pedestrian chooses a safe time to cross in between cyclists who are approaching at a steady flow (Screenshot 3). The behaviour is deemed normal road user behaviour, with an anticipatory action taken by the pedestrian, so was scored a 1.

Image 13 : Screenshots of incident 3: Cyclist with pedestrian moving towards the bus stop at Hills Road



5.4.2 Cyclist Interaction with pedestrian moving away from bus stop

Looking at **Table 15** there are 5 examples of incidents in which an interaction occurred between a cyclist and a pedestrian moving away from the bus stop. Incidents 1, 2 and 3 are described in more detail below. Additional incidents can be found in the Appendix.

Table 15: Cyclist interaction with pedestrian moving away from bus stop

Incident	Date	Time	Movement	Score	Notes
1	11/11/2015	08:35:23	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
2	11/11/2015	08:22:18	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
3	12/11/2015	08:34:52	A	1	Pedestrian having to wait for two cyclists to pass.

4	11/11/2015	08:41:39	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
5	12/11/2015	08:29:04	A	1	Bus still in bus stop; pedestrian crossing in front of cyclists who might be slowing down, difficult to see; other pedestrian waits for the two cyclists to pass.

Incident 1:

At peak time on Wednesday morning a pedestrian exits the bus which was in the bus stop and enters the ‘floating bus stop’ island (see **Image 14** Screenshot 1 red circle). A cyclist approached from Movement **A** (See screenshot 1 blue circle) causing the pedestrian to wait for the cyclist to pass before continuing to cross the cycle lane. The pedestrian took a precautionary action with very minimal chance of collision (Screenshots 2 and 3). The behaviour is deemed normal road user behaviour, with an anticipatory action taken by the pedestrian, so was scored a 1.

Image 14 Screenshots of Incident 1: Cyclist interaction with pedestrian moving away from bus stop at Hills Road



Incident 2:

At peak time on Wednesday morning a pedestrian exited the bus which had stopped in the bus stop and walked in to the ‘floating bus stop’ island (see **Image 15**). The pedestrian (red circle Screenshot 1) appeared to walk directly in the direction of the pavement adjacent to the cycle lane. As the pedestrian approached the cycle lane, a cyclist was coming along Movement **A** (Screenshots 1 and 2), causing the pedestrian to wait for the cyclist to pass before continuing to cross the cycle lane. The pedestrian took a precautionary action with very minimal chance of collision. The behaviour is deemed

normal road user behaviour, with an anticipatory action taken by the pedestrian, for this reason the interaction was scored a 1.

Image 15 Screenshots of Incident 2: Cyclist interaction with pedestrian moving away from bus stop at Hills Road



Incident 3:

At peak time on Thursday morning a pedestrian exited the bus which stopped at the bus stop. A number of pedestrians left the bus at the same time (see **Image 16** red circle Screenshot 1). As the pedestrian approached the cycle lane, two cyclists were performing Movement **A**. The pedestrian appears to walk along the bus stop and stop to allow the cyclists to pass in order to cross the cycle lane and reach the adjacent pavement (Screenshot 2). The pedestrian takes a precautionary action with very minimal chance of collision. The behaviour is deemed normal road user behaviour, with an anticipatory action taken by the pedestrian to wait and cross when safe. As a result the interaction was scored as a 1.

Image 16 Screenshots of Incident 3: Cyclist interaction with pedestrian moving away from bus stop at Hills Road



5.3.1 Other observations

Throughout the course of the monitoring there were other things that were observed that could have safety implications.

Cyclists making movement C

It was observed that many cyclists use the pavement to the right of the bus stop in both directions, and were found to weave in and out of pedestrians. Some cyclists used the pavement and then joined the cycle lane on Movement C which is shown below in (Image 17).

Image 17 Screenshots of cyclists making movement C



After school crowding at the bus stop

It was observed that during weekday afternoon peak times, there tended to be a lot of young people after school waiting in the area in and around the bus stop. The young people appeared to be waiting for a bus after school, and tended to congregate at the 'floating bus stop' and from there into the cycle lane. The young people were observed using the cycle lane as an extension of the bus stop when the bus stop was overly congested. In **Image 18** young people circled in red stood in the cycle lane when the stop becomes crowded. This was exacerbated by the bus being at the stop. The screenshot shows an incident that took place at Thursday peak-pm and shows the young people using the cycle lane as an extension of the bus stop. This particular incident did not cause any conflictual interactions with other road users but has the potential to cause conflict in the future with cyclists on Movement **A**.

Image 18 Screenshots of after school crowding at the bus stop



Large groups using the cycle lane as an extension of the pavement

It was also observed on a few occasions that large numbers of young people walked along the pavement in a group and used the cycle lane as an extension of the pavement. It was seen that some young people used the cycle lane for the entire duration of their journey whilst others used it temporarily and re-joined the pavement at different sections of the cycle lane. **Image 19** provides an example of this behaviour. The incident took place at Thursday peak afternoon and shows a pedestrian (circled in red) on the cycle lane, using it as an extension of the pavement. Two of the pedestrians can be seen walking along with their bikes, while two are walking alongside before re-joining the pavement further along to the right. They did not appear to be paying heed to cyclists or the function of the cycle lane. In this instance there were no conflictual interactions between road users and so was not included in the interaction score.

Image 19 Screenshots of large groups using the cycle lane as an extension of the pavement



It was also observed that young people often used the cycle lane for the duration of their journey. The incident in **Image 20** took place on Wednesday peak afternoon and shows pedestrians on the cycle lane, using it as an extension of the pavement for their journey (see Screenshot 1). The pedestrians caused the cyclist to anticipatory brake and swerve to reduce the chance of collision but with ample time to manoeuvre. If this type of interaction were included in the interaction analysis, it would have been scored a 1, as the cyclist took precautionary action with minimal chance of collision. This type of interaction was not scored in the report, as the pedestrians did not attempt to cross the cycle lane at any time or attempt to use the 'floating bus stop'.

Image 20 Screenshots of large groups using the cycle lane as an extension of the pavement



6 Conclusions

Based on the sample videos and times monitored and analysed, the findings suggest that the levels of interactions between cyclists and pedestrians at the 'floating bus stops' are relatively infrequent and of low severity at both Huntingdon and Hills Road. The majority of interaction scores are within the 1-2 range which is generally considered safe and normal behaviour. It is unclear due to a lack of baseline data whether the new bus stops have increased or decreased interactions at these sites. However, from what has been observed these seem to be limited in scope and severity.

The low scoring assigned to the interactions suggests, but cannot prove that the 'floating bus stops' pose minimal risk to road users, with pedestrians and cyclists appearing to take normal and safe precautionary actions when interacting at this site. That being said, it does appear that pedestrians are making more adjustments at these sites than cyclists. Where interactions have occurred this is primarily due to interactions between cyclists and pedestrians moving away from the bus stop during weekday peak times, particularly in the afternoon. This is particularly true after school has been closed at Hills Road.

At Hills Road the presence of a bus at the bus stop appears not to influence the frequency of interactions and of all the interactions observed there were none deemed as unsafe. Furthermore, at both sites the majority of cyclists are choosing to use the cycle lanes rather than go on to the road and only 1 instance of a cyclists interacting with a car was observed at Huntingdon Road.

There were observations of behaviours (especially from school children) which could have future safety implications. This occurs when pedestrians stand in the lane or use it as an extension of the pavement. The majority of pedestrians are looking out for cyclists and cyclists are looking out for pedestrians. While interactions have occurred it appears that road users are safely negotiating the use of the space.

7 Appendix:

Table 16 Additional incidents with pedestrians moving towards the bus stop on Hills Road

Date	Time	Movement	Interaction Score	Notes
11/11/2015	08:41:39	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
11/11/2015	09:28:40	A	1	Pedestrian waited for cyclist to go pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
11/11/2015	15:31:20	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
11/11/2015	16:01:18	A	1	Pedestrian looked behind at cycle lane and stopped when he saw the cyclist. He then kept walking in the same direction.
11/11/2015	16:06:48	A	1	Pedestrian crossed cycle lane causing cyclist to anticipatory brake/slow down with the risk of collision minimal
11/11/2015	16:08:59	A	1	Pedestrian is running across pavement to avoid cyclists on the pavement and is forced to stop abruptly to avoid stepping on cycle lane as a cyclist is passing and subsequently runs across to island.
11/11/2015	16:09:22	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
11/11/2015	16:09:50	A	1	Pedestrian (same one that caused previous interaction) stops suddenly whilst about to walk off the pavement towards the bus stop.
11/11/2015	16:15:30	A	1	Pedestrian crossed cycle lane without looking, causing cyclist to anticipatory brake/slow down with the risk of collision minimal.
11/11/2015	16:22:10	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
11/11/2015	16:41:43	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.

11/11/2015	16:41:44	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
11/11/2015	16:41:47	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
11/11/2015	16:41:48	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.
12/11/2015	16:06:36	A	1	Pedestrian waiting for cyclists.
12/11/2015	16:08:33	A	1	Young person just walking across cycle lane to bus stop; cyclists having to slow down.
12/11/2015	16:08:46	A	1	Pedestrian having to wait for cyclists.
12/11/2015	16:14:30	A	1	Pedestrian waiting for cyclists.
12/11/2015	16:14:39	A	1	Pedestrian making move to cross, pulls back but subsequently does not cross.
12/11/2015	16:15:05	A	1	Pedestrian has to wait for cyclist to pass.
12/11/2015	16:15:08	A	1	Pedestrian has to wait for cyclist to pass.
12/11/2015	16:15:34	A	1	Two pedestrians having to wait.
12/11/2015	17:05:29	A	1	Pedestrian having to wait.
12/11/2015	17:28:30	A	1	Pedestrian crossing onto bus island without looking but cyclist was far enough away that a collision did not occur.
12/11/2015	18:24:13	A	1	Pedestrian running across cycle lane to catch bus; cyclist on A did not have to take any evasive action.

Table 17 Additional incidents with pedestrians moving with pedestrians moving away from the bus stop on Hills Road

Date	Time	Movement	Interaction Score	Notes
11/11/2015	08:25:19	A	1	Pedestrian waited for cyclist to pass before crossing the cycle lane. Precautionary measure, with minimal chance of collision.

