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GMPTE Metrolink

The Implications of the Carriage of Bicycles on Trams

April 2009

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Issue and Revision Record

Rev	Date	Originator	Checker	Approver	Description
A	23/10/08	A Barnes	T Young	A Parke	Draft - First Issue for Comment
B	30/01/09	T Young	A Parke	A Parke	Final Issue – Amended to incorporate GMPTE comments
C	21/04/09	A Parke	D Hand	N Searle	Report reformatted to align with further comments from GMPTE

List of Contents

Page

Tables

Figures

Executive Summary

Under the current Manchester Metrolink By-laws, bicycles are not permitted at any time on any part of the Metrolink network unless they are folded and fully encased. Greater Manchester Passenger Transport Executive (GMPTE), as the Promoter of Metrolink, continues to receive representations from cycling groups to permit the carriage of bicycles on trams. The Metrolink Directorate of GMPTE is therefore considering whether it is safe to permit the carriage of bicycles on trams and whether such a practice could be adopted.

Mott MacDonald has been appointed to undertake a research study to assess readily available information in relation to this subject, identify the issues which may arise and discuss viable measures that may help address the issues.

Metrolink's policy with regard to the carriage of bicycles is similar to that of all other UK light rail systems in that they do not permit at any time bicycles to be carried on normal passenger services. However, on a limited number of occasions bicycles have been carried by special arrangement on Sheffield Supertram and Docklands Light Railway (DLR). The majority of light rail systems in Europe do not permit cycles to be carried but a limited few do at weekends, during off peak periods or in a very few cases at any time.

Her Majesty's Rail Inspectorate (HMRI), now part of the Office of Rail Regulation (ORR), have raised no fundamental objection to the carriage of bicycles on trams. However, they would look to the relevant duty holder, Stagecoach Metrolink Limited (SML) as the Operator, to manage the risks so far as reasonably practicable. Under the Railways and Other Guided Systems (Safety) regulations (ROGS), the Operator is required to self certify the safe operation of the system. It is therefore ultimately for SML to determine whether they will accept and can manage the associated risks. They will need to be consulted, and their agreement sought, if this policy is to be pursued.

A bicycle within the saloon of a tram introduces objects that are hazardous to passengers, e.g. sharp points such as handlebars and pedals. Should the carriage of bicycles be permitted then there is an increased risk of passengers incurring minor injuries through collision with bicycles whilst bicycles are manoeuvred on to and off a tram. In addition, as a result of the effects of jerk, standing passengers (which can be significant in number for large parts of the day), would be at an increased risk of injury from falling into or against part of a bicycle. The level of risk is increased when coupled with the use of emergency braking, the need for which can arise particularly in the highway environment. The carriage of bicycles on trams would also create risks in and around the stop, such as a mounted cyclist colliding with another passenger.

Complete segregation of bicycles and passengers on trams is not considered practical as it would have a detrimental impact on the passenger capacity of the tram. A bicycle could be adequately secured with restraints during transit to minimise the extent of the hazard it presents to passengers. The layout of the new M5000 trams could readily incorporate such features, but the existing T68 / T68A trams would require significant internal modification.

To significantly reduce the level of the risk, in terms of the likelihood of occurrence, it may be possible to minimise the number of passengers exposed to the associated hazards by restricting the time periods during which the carriage of bicycles would be permitted.

However, Metrolink trams can be heavily loaded at most times during the operational day, not just during the peak periods, with a significant number of standing passengers. In addition, growth in passenger numbers is inevitable with the future expansion of the network.

The point at which the risks might be reduced to an acceptable level is difficult to define. The carriage of bicycles may be acceptable where the number of passengers aboard the tram is not substantially greater than the seated capacity, thereby minimising the number of passengers standing. Such levels of usage are not uniform by time of day across the various lines, and the Phase 3 extensions will complicate matters further. A detailed assessment of passenger loadings by line, direction, day of week and time would be required to determine if there were suitable common time periods. This may only be at the extremities of the operational day where the benefit to cyclists would be questionable.

The carriage of bicycles aboard a tram raises a number of operational issues, including:

- An interaction between cyclists and other priority users (particularly the mobility impaired) that would need to be carefully managed through the application of an appropriate policy and with current operating practice overseen by the tram driver.

- A high risk of damage and or soiling of passengers clothing will occur. This could be particularly prevalent given the Manchester climate.

- Difficulties for cyclist travelling together e.g. parents with children if the number of bicycles carried on a single tram were to be limited.

- Two types of tram in service (from autumn 2009), one with and one without (unless modified) provision for securing bicycles. If restricted, cyclists will find it difficult to know whether a bicycle is permitted aboard a tram once the fleet are in the same livery.

- Extended dwell times, and hence journey times, could potentially result from:
    - The additional time for a cyclist to secure the bicycle with a restraint system.
    - Resolving issues arising from the application of priority users regulations;
    - Resolving issues arising from the mixed vehicle fleet; and
    - The need to assess, with reference to passenger loading, whether it is safe for a bicycle to board a tram or remain aboard a tram.

  As the network is expanded and the operation becomes more complex the impact of extended dwell times would be more profound on overall service reliability.

It is likely that to adequately manage the risks associated with bicycles on trams, through the enforcement of rules of carriage and associated operational issues, further dedicated personnel on each tram may be required. The modification of infrastructure and provision of clear signage would be required to mitigate off tram risks with enforcement via the CCTV and the PA systems or revenue protection staff / public safety officers when present on the stop.

There is little readily available evidence on which to base estimates of repair costs or the costs of claims resulting from damage or injury caused by bicycles on trams. Examples of the anticipated costs range from dry cleaning charges for passengers' clothes which are soiled by oily bike chains or wet bike tyres to the repair, painting or replacement of interior panels, seats, trim or door rubbers of the vehicles damaged by the bikes. The cost of claims is similarly difficult to quantify but could be more significant if there were to be a serious injury resulting from impact with a bicycle either correctly or incorrectly stored.

To improve provision for cyclists, and particularly those commuting, it may be more appropriate to make provision for secure bicycle storage at tram stops rather than their carriage on trams. This will require capital expenditure but may be partially offset through increases in revenue, and the option of a daily usage charge.

1 Introduction

At present, under the current Metrolink By-laws, bicycles are not permitted at any time on any part of the Metrolink network (including both stops and trams) unless they are folded and fully encased.

All trams are currently operated by one person, the driver, and there are only other staff present on the tram when ticket revenue protection staff are undertaking ticket inspections or during times when public safety officers are deployed. As a result drivers provide the principal point of enforcement regarding the carriage of bicycles primarily through the use of the trams external rear view mirrors and internal mirrors (providing a view of the passenger saloon) whilst waiting at stops for passengers to board and alight. The CCTV cameras at stops and Public Address (PA) system provide a secondary means for the Operator, via control room staff, to enforce the Regulations.

1.1 PTE / PTA Policy

At the Development Working Group of 15th October 2002, Greater Manchester Passenger Transport Authority (GMPTA) members agreed to support in principle the carriage of bicycles on trams in off-peak hours, subject to the satisfactory resolution of a number of issues. These included:

- The practical constraints of carrying bicycles on trams;
- The impact on other users, in particular disabled people, passengers with prams and other passengers whose mobility is impaired; and
- Safety implications for all passengers.

A consultation exercise in 2003[1] which included surveys and focus groups indicated a significant majority of all respondents were in favour of permitting bicycles on trams but also raised safety issues that would need to be resolved.

1.2 The Metrolink Network

The existing Metrolink Network comprises the Bury Line (Bury to Victoria), City Centre line (Victoria to Cornbrook including the branch line to Piccadilly station), the Altrincham line (Cornbrook to Altrincham), which are collectively known as Phase 1 and the Eccles line (Cornbrook to Eccles) known as Phase 2.

Metrolink services currently operate between Bury and Altrincham every 12 minutes, Bury and Piccadilly every 12 minutes and Altrincham and Piccadilly every 12 minutes, giving a combined 6 minute service over these sections during the working day. The Eccles service operates between Eccles and Piccadilly every 12 minutes giving a combined service of 15 trams per hour between Cornbrook and the city centre.

1.2.1 Network Expansion

Metrolink has been very successful, enjoying significant usage and patronage across the operational day, in addition to the peak periods. Greater Manchester Passenger Transport Executive (GMPTE) is committed to increasing the use of public transport within the Greater Manchester area, which includes the further growth in the use of Metrolink. In addition to the procurement of additional rolling stock (M5000 trams being supplied by Bombardier Transportation) to increase passenger carrying capacity on the existing network, particularly during the peak periods, they are also in the process of implementing a number of extensions, as part of the Phase 3A works, which comprise;

- Oldham and Rochdale Extension but excluding Oldham and Rochdale town centres;
- East Manchester and Ashton-under-Lyne Extension as far as Droylsden stop;
- South Manchester and Manchester Airport as far as St. Werburgh's Road stop; and
- The spur to mediacity:uk from the Eccles line and associated turn-back at Cornbrook.

1.3 Demand for the Carriage of Bicycle Carriage on Trams

The demand for carriage of bicycles on trams is dependent on a number of factors including the level of cycling in the area served, the location and length of tram route, comparative journey times and fares using other modes e.g. heavy rail, the topography and hilliness of the area and the potential for accessing leisure destinations including national bicycle network routes.

GMPTE continue to receive representations from cycling groups to permit the carriage of bicycles on trams. This is reportedly more prevalent at present owing to ongoing expansion to the network. At this time we are not aware of any data collection exercises and or studies that have been undertaken to quantify the level of demand for the carriage of bicycles on trams. It is claimed that demand on the Oldham and Rochdale line will be high because the existing trains that will be replaced by trams do currently carry bicycles. However, initial inquiries with Northern Rail, the current train operator, have indicated that they do not have records of cycle use on the Oldham Line, but it is believed to be low.

The Metrolink Directorate of GMPTE is therefore considering whether it is safe to permit the carriage of bicycles on trams and whether such a practice should be adopted on the Metrolink network.

1.4 Objectives of the Study

To support the Metrolink's Directorate decision making process they have appointed Mott MacDonald to undertake a research study to collate and assess readily available information in relation to the carriage of bicycles on trams considering the following key issues:

- The hazards and risks associated with the carriage of bicycles on trams and measures that could be taken to mitigate these risks.

- How passenger loadings during the weekday peak, off-peak periods and at weekends, affect the practicality of carrying bicycles on trams and how passenger safety may be affected.

- The impact that the carriage of bicycles would have on operational issues such as the stop dwell times, passenger capacity, impact on priority passengers (e.g. wheelchair users), the number of bicycles that could be carried simultaneously and the practicality of enforcing rules and regulations.

- The practices, with respect to the carriage of bicycles that are prevalent elsewhere in the UK and in Europe and how other light rail systems compare to Metrolink in terms of physical and operational composition.

- The additional costs that may arise from repairing damage to the trams caused by bicycles and the third party claims from injuries and damage to property resulting from interaction with bicycles.

1.5 HMRI (ORR)

The view of Her Majesty's Railway Inspectorate (HMRI), which is now part of the Office of Rail Regulation (ORR), on the issue of the carriage of bicycles on trams was set out in a letter to GMPTE on 20 May 2003, a copy of which is included in Appendix A.

The HMRI raised no objection to the principle of the carriage of bicycles on trams. However, as with all aspects of tram operation they would look to the relevant duty holder to manage risks associated with their undertaking so far as reasonably practicable. Their view is that bicycles should be adequately secured during transit but they accept that this could include being held by the user. They noted that other aspects related to the carriage of bicycles on trams that would need careful consideration would include emergency evacuation and escape routes, tram stop design including ramp widths and measures to make cyclists dismount before accessing the platform area, as a minimum dismount signs.

It is clear that ORR has no fundamental objections to carriage of bicycles on trams but they would expect risks to be managed as for any aspect of tramway operation.

1.6 The Operator (Duty Holder)

From 1st October 2008 the Railways and Other Guided Systems (Safety) regulations (ROGS) became effective. These require the Operator to self certify the safe operation of the system in place of ORR.

Ultimately it would be for Stagecoach Metrolink Ltd to determine whether they will be prepared to accept and manage the risks associated with bicycles on the trams and will need to be consulted if GMPTE, as the Promoter of Metrolink, wish to pursue this policy.

2 The Carriage of Bicycles on Trams and Associated Hazards

A Department for Transport (DfT) / Countryside Agency Report[2] quotes potential demand for bicycles as around 4% of seating capacity for heavy rail vehicles but it is market specific, notably in tourist areas. It states that;

- provision should include for larger types of bicycle including tandems and bicycles with trailers which are sometimes used by disabled cyclists and families; and that
- in order to avoid bicycles falling over and causing an obstruction to passengers or staff, it is important that bicycles are secured in their storage area by wheel clips or restraining straps.

2.1 Possible Options for Bicycle Storage on a Tram

A bicycle within the saloon environment of a tram introduces objects that are hazardous to passengers, e.g. sharp points such as handlebars and pedals, and a key issue identified by the HMRI is the need to adequately secure bicycles during transit. There are three basic options:

1. Bicycle hand held by the cyclist.
2. Bicycle secured to the internal walls of the tram via straps.
3. Bicycle stored in a rack (horizontal, inclined or vertical arrangement).

A segregated storage area for bicycles through the use of racks, as found on some heavy rail vehicles, provides the means of minimising the risks associated with passenger / bicycle interaction within the heavy rail environment. However, the designation of such space for bicycles on a tram is not considered practical, as a result of space constraints, meaning bicycles would have to share space with other passengers including wheelchairs and those with pushchairs. Having regard to the different types of bicycle then tandems and bicycles with trailers would pose additional problems in terms of the space required. It is not considered practical to cater for these types of bicycle.

No provision for the storage of bicycles exists on the existing T68 and T68A trams. To provide a designated space for securing a bicycle to the internal wall of the tram the space currently designated for wheelchairs would need to be modified. While it would be possible to modify T68 type trams to provide for cycle storage we are not aware of plans to do so as part of GMPTE's imminent refurbishment programme for these trams. The options for storage locations on T68A trams were considered in the Nottingham University Study[3] and are shown in Figure 2.1. Only options B1 and F1, or possibly D1, are likely to be practicable but further studies would be required to confirm this. Such modifications are likely to require seats to be removed from each car.

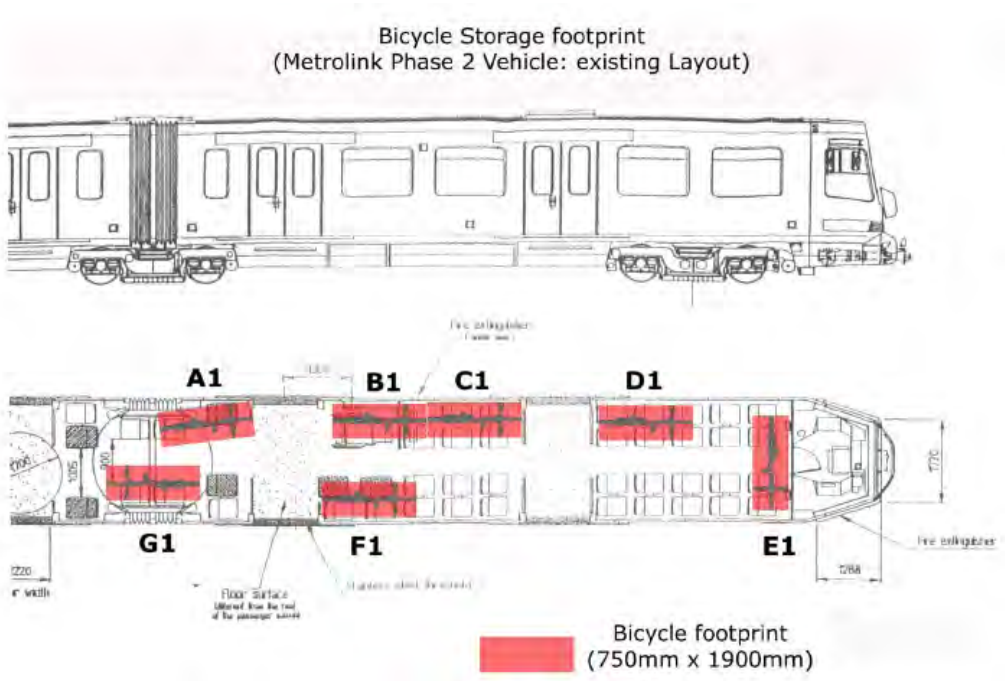

Figure 2.1: Bicycle Storage Options for T68A Trams (Nottingham University Study)

The interior layout of the M5000 trams, which are being supplied by Bombardier Transportation for the Phase 1 & 2 Capacity Enhancements and Phase 3A, have been designed to accommodate the storage of a bicycle in the passenger saloon. The wheelchair spaces (one per car) which are located between the central door and perch seats are intended to be used for pushchairs and buggies when not occupied by a wheelchair. Alternatively a bicycle could be stored in this location and restrained with straps fitted to the interior wall. The possible location of the bicycle position for M5000 tram is shown in Figure 2.2. This would limit the number of bicycles that can be securely restrained during transit at any one time on a single tram to two, at the loss of wheelchair provision.

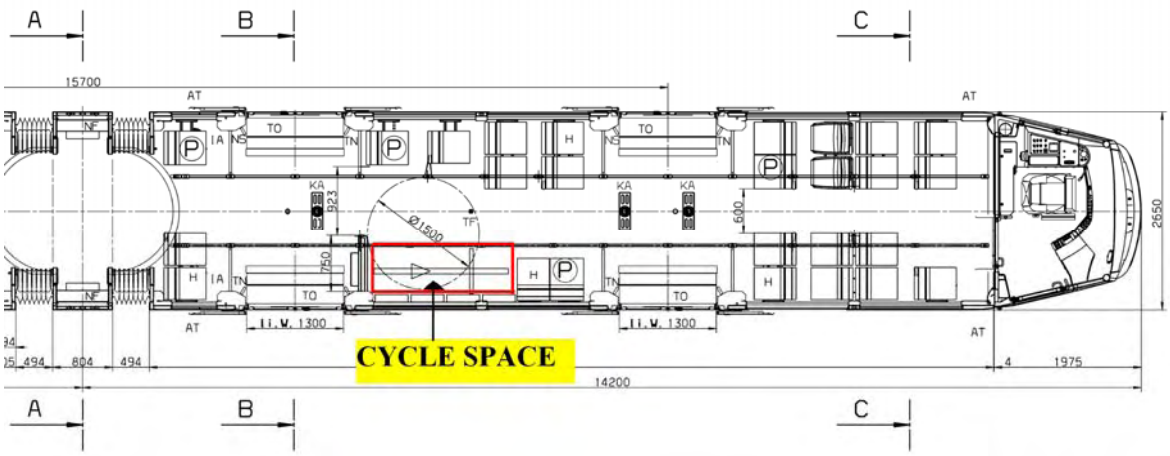

Figure 2.2: Possible Bicycle Storage Location for M5000 Trams

2.2 Hazards Associated with the Carriage of Bicycles on Trams

A risk assessment has been carried out to identify the key hazards associated with the carriage of bicycles on trams, the persons at risk and the consequence or impact of the risk should it occur, which is summarised in table 2.1 below.

Table 2.1: Risk Assessment for the Carriage of Bicycles on Trams

Hazard	Persons at Risk	Consequence / Impact	Risk Level [1]
01 Cyclist riding along the access ramps and or platform.	Cyclist / Other passengers	Injury to cyclist through: – collision with stop furniture – cyclist falling off platform possibly in front of a moving tram Injury, possibly serious, to cyclist and other passengers through collision of cyclist with passengers.	Low / Medium
02 Cyclist (dismounted) falls off platform whilst waiting for tram.	Cyclist	Injury to cyclists. Risk not considered significantly greater than that for other passengers.	Low
03 Bicycle strikes a passenger whilst the cyclist is boarding / alighting the tram.	Passengers	Injury to passenger which is likely be minor in nature but high in frequency of occurrence. Other impacts could include soiled / damage clothing.	Low / Medium
04 Cyclist becomes trapped in the door when boarding / alighting the tram.	Cyclist	Injury to cyclist which is likely be minor in nature. M5000 trams will be fitted with obstruction detectors. Other impacts include extended dwell times and damage to the bike and or tram.	Low
05 Bicycle stored in designated space within the saloon and secured properly, where viable.	Passengers (inc. Cyclist)	Injury to passengers as a result of falling on the bike, particularly during tram acceleration and braking. Injuries could be relatively serious. Other impacts could include soiled / damage clothing and the designated bike storage space is likely to coincide with that designated for other priority users creating the potential for conflict and or delay to journey times.	Medium / High
06 Bicycle not correctly stored in designated space within the saloon e.g. held by cyclist.	Passengers (inc. Cyclist)	Injury to passengers as a result of falling on the bike and or the bike falling on passengers, particularly during tram acceleration and braking. Injuries could be relatively serious and without the bicycle properly restrained such incidents could involve a greater number of passengers. The presence of the bike may also hinder egress from the tram during an emergency situation, with passengers being temporarily trapped. In addition, the bicycle may cause damage to the tram saloon interior.	High
07 Conflict resulting from enforcement of rules of carriage i.e. number of bicycles, storage method, priority rules	Passengers & Operational Staff	Abuse and or physical injury as a result of violence.	Low

1. The risk level is based upon the anticipated severity of the risk and the likelihood of it occurring.

Light rail systems, by the nature of the function they fulfil i.e. providing frequent, high capacity and fast urban public transport services, often result in a significant number of standing passengers within the saloon sections of the tram. In addition to this, their operational characteristics differ somewhat to heavy rail services, which are intended to primarily provide for longer distance inter-urban travel.

Passenger injury through collision with a bicycle whilst the bicycle is manoeuvred on to and off a tram is likely to result in a high frequency of minor injuries. However, of particular concern in the issue of carriage of bicycles on trams is the acceleration and deceleration rates experienced by light rail passengers. These are generally higher than those experienced by heavy rail passengers and as a result, passengers aboard a tram are much more susceptible to jerk. The saloon environment of a tram is specifically designed to address this issue e.g. provision of grab rails to provide passengers with a means of steadying themselves and rounded edges to saloon furniture e.g. seats to minimise puncture type injuries.

Trams also operate on a line of sight basis within the highway environment and interface with other users e.g. road vehicles and pedestrians. It is noted that Metrolink Phase 3A is being constructed for line of sight operation and it is GMPTE's intention to convert the segregated section of the Altrincham and Bury lines, which are currently operated using traditional heavy rail block signalling, to line of sight operation. This mode of operation and the nature of the highway environment in particular, increases the potential for the need to use emergency braking (to avoid hazards) which has very high rates of deceleration, approximately 2.5 times those of normal service braking. During these events standing passengers are more prone to stumbling or in extreme cases falling.

Given the presence of standing passengers and the potential for them to stumble and or fall onto a bicycle the potential for injury to occur is high and if the bicycle were not secured properly it would also fall, possibly affecting a greater number of passengers. Even if a bicycle were secured against the internal wall of the tram:

- when stored on two wheels the handlebars would be at the head height of a child; and
- if stored in the vertical position the handlebars would be at the head height of an adult.

Both of these scenarios create a risk of injury to the head and eyes of the passengers. The nature of the Metrolink system which has high operating speeds over significant lengths (than generally found on other UK light rail systems) compounds the consequence of passengers colliding with part of a bicycle particularly during deceleration (braking), be that service or emergency.

2.2.1 Possible Measures to Mitigate Risks

The hazards identified in Table 2.1 will always exist if the carriage of bicycles were permitted and not completely segregated from other passengers. The carriage of bicycles on trams should therefore only be permitted if the risks can be reduced to an acceptable level. There are a number of measures that could be implemented which may achieve this. However, the only way to reduce the risk to zero is by continuing the existing bicycle carriage policy.

(i) The Stop Environment

The environment in and around the Metrolink stop would need to be modified such that it was safe for the cyclists, passengers and other pedestrians in the vicinity of the stop and engendered, as far as reasonably practicable, a culture whereby cyclist dismounted when accessing the stop platforms to minimise the potential for conflict with other passengers.

Modifications would be required to infrastructure over the whole network including steps, ramps, lifts and platforms with regard to the layout of platform furniture. Appropriate regulations would need to be developed and the Metrolink By-laws amended. Around the stop signage would be required for the following;

- To identify where cyclists have to dismount before entering the stop;
- To enforce that riding of bicycles on the platform is prohibited;
- To indicate when the carriage of bicycles on trams is permitted, what type of bicycle is permitted (e.g. excludes tandems) and how they must be stored during transit, what the charge is (if any), which trams allow the carriage of cycles (if applicable), and where to wait on the platform; and
- To indicate the level of priority cyclists have over other passengers, with particular regard to wheelchair users and those passengers with pushchairs and buggies, and the process by which these priorities will be applied.

A report prepared by GMPTE[4] sets out the changes that would need to be considered to ensure that the system remains safe for all users including cyclists. Some of the existing parts of the network, particularly in the city centre, may be difficult to adapt as they are already congested and space for expansion is not easily available.

The GMPTE report should be seen as a ‘starting point’ for more detailed investigation of facilities throughout the network or those parts of it where bicycles could be permitted. It may then be necessary to prohibit cycles from certain parts of the network, for example city centre on-street stops, owing to the high number of ordinary passenger movements. This may be achieved by restricting the times during which bicycles can / cannot be carried on trams to where passenger numbers are low.

Management / Implementation of Mitigation Measures

The ways in which these measures could be enforced include the use of CCTV at the stops and instruction over the Public Address (PA) system and by revenue protection staff, public safety officers and or the Police when they are present on the stop. However, there is no readily available information to quantify how effective these measures would be in engendering conformance to the Regulations.

(ii) The Tram Environment

As already stated, the introduction of a bicycle into the passenger saloon creates additional hazards for passengers. A segregated area for the storage of bicycles during transit is not considered practical as it would have a detrimental impact on the passenger capacity of the tram. Therefore controlling the method of storage during transit and minimising the number of passengers exposed to the hazards are the only practical means of reducing the level of risk.

Permitting cyclists to hold their bicycles during transit exposes passengers to the increased risk of injury and introduces additional risks associated with egress from the tram during an emergency situation. Therefore such a means of securing the bicycle during transit may only be acceptable in situations where passenger numbers are low and generally seated.

To mitigate the risks further bicycles should preferably be stored in a designated position, most probably against the interior wall in the same space allocated for other priority users and properly secured. This would therefore:

- Limit the number of bicycles that could be carried on a single tram at any one time. Given the possible arrangement for the M5000 tram the number of securely stored bicycles on any single tram would be limited to two. Whilst this would reduce the extent of the hazard it would not alter the potential consequences should the hazard occur. As a result the level of the risk would be reduced but not fully mitigated.

- Create an interaction between cyclists and other priority users that would need to be carefully managed through the application of an appropriate policy embedded in amended Metrolink By-laws. The operational practical aspects of this are discussed further in Section 3.1.1.

As with the stop environment, signage would be required on the outside and within the tram to:

- Identify the times during which the carriage of bicycles would be permitted;

- Identify which doors of the tram are to be used for boarding and alighting with a bicycle;

- Identify the type and how many bicycles can be carried at any particular time;

- Identify the location in which bicycles are to be stowed and the requirement to use the restraining measures provided; and

- Indicate the priority levels of different users and the means by which they would be applied.

To reduce the level of the risk, in terms of the likelihood of its occurrence, then it would be necessary to minimise the number of passengers exposed to the hazard by restricting the time periods during which the carriage of bicycles would be permitted. Trams on the Altrincham and Bury lines are operating at capacity in the morning and evening peak periods, particularly between 08.00 and 09.00 and 17.00 and 18.00. It has been accepted by GMPTA that if the carriage of bicycles on trams were to be permitted this would exclude the peak periods when demand levels are high and trams heavily loaded, particularly in the inbound direction in the morning and the outbound direction in the evening.

The levels of demand by day of the week are indicated in Table 2.2 which shows the average total daily ticket sales for September 2008 by day of the week. It can be seen that the highest level is on Fridays and Saturdays which are higher than most weekdays. Sunday use is only about half that of the other days.

Table 2.2: Metrolink ticket sales by day of week for September 2008[A]

Day	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Total daily ticket sales	17,488	17,815	19,161	18,615	20,728	19,878	8,978
Percentage of weekly total	14.30%	14.5%	15.6%	15.2%	16.9%	16.2%	7.3%

Therefore time periods to which the carriage of bicycles could be restricted may include:

- Sundays only;
- Off-peak periods (weekday and Saturday).

However, even during these periods trams can be heavily loaded, varying considerably over sections of the different lines, and often with a significant number of passengers standing. In addition, the reduced service frequency during these periods and on a Sunday compressed time period for travel demand can compound the potential for trams to be heavily loaded. Through the expansion of the Metrolink Network with the Phase 1 and 2 Capacity Enhancement projects and the construction of Phase 3A GMPTE it is inevitable that growth in passenger numbers, not just during the peak periods but across the operational day, will occur. Whilst some cyclists would not board already busy off-peak / weekend trams, some may, and problems could arise during the course of a journey as the number of passengers aboard a tram increases. (It is noted that Merseyrail heavy rail services allow bicycles on all trains and find that at peak times the demands on space are largely self regulating with cyclists avoiding taking their bicycles on trains during the busiest periods).

Trams also operate at capacity for special events including football and cricket matches at Old Trafford, major events at the Arena at Victoria station and other major attractions in the city. The weeks preceding Christmas are also heavily loaded throughout the operational day. Special events introduce the need for varying restrictions and additional complexity in the application and enforcement of regulations.

[A] Note that the figures in Table 1 exclude those travelling using a season ticket or under a concession.

The exact point at which the risk would be reduced to an acceptable level is difficult to define. It probably lies close to the situation where the number of passengers aboard the tram is not substantially greater than the seated capacity of the tram, thereby minimising the number of passengers standing, which would also assist with driver enforcement of the regulations associated with bicycle carriage.

Such levels of usage are not uniform by time of day across the various lines, and the Phase 3 extensions will complicate matters further. For example, whilst outbound services on the Bury Line may be lightly loaded after 19:00 hrs, inbound services from Altrincham are not. The application of varying restrictions would lead to confusion and difficulties in enforcement. A detailed assessment of passenger loadings by line, direction, day of week and time would be required to determine if there were suitable common time periods. This may be at the extremities of the operational day where the benefit to cyclists would be questionable.

An assessment by analysis of ticket sales alone and number of vehicles operating on the network would not be sufficiently robust owing, as the information provided for such a study is not directional and does not account for the large numbers of passengers travelling by season ticket or concession. However, an initial assessment of ticket sales by hour and total number of vehicles operating on the network for Sundays during September 2008 indicated that the average number of passengers aboard a tram during 10:00 – 14:00 was close to (within 10%) or above the seated capacity of an M5000 tram.

Management / Implementation of Mitigation Measures

Should trams continue to be operated by the driver alone without further dedicated personnel on each tram (for example through the introduction of conductors) then the driver will be responsible for enforcing the rules of bicycle carriage. A driver's ability to enforce carriage rules, and hence minimise the passengers' exposure to the hazards, will largely depend on their ability to observe on board conditions through the use of external cameras and internal mirrors. This will be driven by the level of passenger loadings but the visibility of activity in the second car and the second tram on a double unit may be very restricted. The practicality and ability of drivers to robustly enforce carriage rules, i.e. storage and numbers, is questionable.

In addition, the driver would be responsible for determining during the course of a journey whether it is safe to either allow a bicycle to be brought on to a tram or for a bicycle to remain aboard a tram. Even with guidance, judgements are likely to vary considerably between drivers and enforcement of requests to leave the tram could be problematic with the potential to increase delays at stops and conflict between the driver and passenger.

It is therefore likely that to adequately manage the risks associated with the carriage of bicycles on trams further dedicated personnel (e.g. a conductor) on each tram will be required. This is likely to result in additional operational costs, although this may be offset in whole or part by re-deploying / re-training existing revenue protection staff. However, we are not aware of plans for Metrolink to introduce such staff,

3 Operational Issues Arising from the Carriage of Bicycles

The demand for the carriage of bicycles on trams in the Manchester area is not known. However, there are a number of operational practicalities that would need to be resolved.

3.1 Interaction with Other Users

3.1.1 Priority Users

Should the carriage of bicycles be permitted then it is likely that the space designated for bicycle storage during transit would share the same space allocated for other priority users i.e. wheelchair users and those with pushchairs / buggies or luggage.

At present wheelchair users have priority use of the space that is designated for them. If pushchairs or buggies are already occupying this space they are expected to move to allow access for a wheelchair. During most off-peak times there is adequate space to accommodate wheelchair users and pushchairs or buggies. The use of this space for storing a bicycle during transit would complicate the situation which would need to be carefully managed through the application of an appropriate policy embedded in amended Metrolink By-laws.

Clear signing to indicate the hierarchy amongst priority users would be essential. Cyclists would likely have the lowest priority, although their interaction with passengers with pushchairs / buggies is likely to be similar to that with wheelchair users.

Difficulties would arise if the space is already occupied by a bicycle and a wheelchair user then wishes to board. Should the cyclist be requested to leave the tram and wait for the next one or the wheelchair user asked to wait for the next tram? Service delays would be inevitable whilst the situation was resolved.

If trams continue to be operated by the driver alone then in the event of any dispute they would have to resolve the situation, firstly through the use of the onboard Public Address (PA) system. In extreme cases the driver may be tempted to leave the cab to resolve an incident which would result in significantly extended dwell times and could not be considered acceptable practice.

It is noted that on double unit trams, only the spaces in the first tram are currently fully accessible to priority users at all stops, owing to the existing configuration of the Mosley Street and St Peters Square stops, signing and platform markings across the network are configured to indicate this. Whilst this raises the possibility of segregating priority users and cyclists with bicycles on double unit trams, it is understood that GMPTE intend to modify the layouts of the aforementioned stops in the near future thereby providing access for priority users to the second tram. In addition, double unit trams are operated during the peak periods when passenger loadings are at their highest which maximises the level of the risks associated with the carriage of bicycles on trams as identified in Section 2.2.

3.1.2 All Passengers

Carrying a bicycle on and off a tram will require an interaction with other passengers, both at the stop and those standing in the tram saloon. In addition to the potential for injury to passengers, other impacts such as soiled and or damage to clothing through contact with parts of the bike are possible and could be particularly prevalent given the Manchester climate. This may lead to passenger disputes and claims and potentially deter passengers from using the service.

3.2 Number of Bicycles

Given the proposed internal arrangement of the M5000 tram the maximum number of securely restrained bicycles that could be carried on any single tram would be limited to two, one in each car. Clear signage and marking on the platforms where cyclists wishing to take a bicycle on a tram should wait will be required.

In limiting the number of bicycles that could be carried on a single tram this would create difficulties for cyclists travelling together or for families e.g. a parent with children. Service delays could occur whilst cyclists assess whether the bicycle spaces in each car are in use. Cyclists travelling together may also be tempted to try and board together which would result in service delays whilst rules of carriage are enforced. As noted in Section 2.2.1 the driver's ability to adequately observe on board conditions including the correct use of bicycle restraint systems is questionable.

However, it should be noted that even in cities with extensive light rail networks, where the carriage of bicycles is permitted, demand in practice is fairly low most of the time, again making it easier to manage potential conflicts. Only at weekends with finer weather are substantial numbers of passengers with bicycles more likely.

3.3 Mixed Tram Fleet

All services are currently operated by T68 type trams (including T68A and T68M). The internal layouts are similar although there are some detailed differences in the seating layout and wheelchair spaces. At present there is no space suitable for secure storage of bicycles. The internal layout of M5000 trams will be different and as noted in Section 2.1 the wheelchair space would be capable of being used to securely store a bicycle.

The first consignment of M5000 trams, for enhancing existing service capacity, will be delivered during 2009, and as a result from autumn 2009 there will be two significantly different types of tram in service, one which does not have bicycle provision and one which could. We understand that GMPTE's imminent refurbishment programme for the existing fleet, which will include changes to the livery to make the entire fleet look similar, does not include for modifications to the internal layout of the T68 / T68A trams to provide bicycle storage.

The allocation of trams to services has not yet been finalised but it is likely that at least for the first two or three years (before the commencement of services on Phase 3A), trams of both types will be used on most parts of the network. If bicycles were only permitted on one type of tram it would be difficult for a cyclist to know when a tram of that type would arrive. Again this could result in enforcement issues that would need to be resolved at the stop resulting in service delays. To overcome this, apart from modifying the internal layout of the existing T68 / T68A trams such that they would be capable of carrying a secured bicycle, it would be necessary to restrict the carriage of bicycles to routes exclusively served by the new M5000 trams. However, this is unlikely to be adopted as a result of the restrictions that would be imposed on the Operator to manage delivery of services and tram maintenance.

3.4 Stop Dwell Times and Journey Time

Passengers are attracted to light rail because of the competitive and reliable journey times offered. Extended dwell times increase the overall journey times and impact on service reliability.

3.4.1 Existing Dwell Times

Existing dwell times are generally in the region of 15 seconds for lightly used stops, 20 seconds for average stop use and 30 seconds for central area stops. At very busy city centre stops at peak times, dwell times can extend up to 60 seconds or more.

3.4.2 Possible Impact on Dwell Time at Stops due to Bicycle Carriage

A survey of the time it would take for a cyclist to board and alight a tram with a bicycle in various conditions has not been undertaken as part of this study. However, research undertaken by Nottingham University[3] of cyclists boarding and lighting trams in both Europe and North America indicated that the physical act of boarding and alighting a tram with a bicycle can be undertaken without causing significant additional delay.

Despite this, of particular concern is the additional time that would be needed to allow a cyclist to secure the bicycle with any restraint system such that the bicycle is “safe” in transit, or in the case of alighting remove the restraints. The level of passenger loading will be a factor that affects the time this would take.

Evidence from other studies[4] suggests that if bicycle use is low, no more than one bicycle per journey, the impact on dwell time is likely to be very small if the tram is not already heavily loaded. However, as the number of bicycles carried on any particular journey increases then the impact on dwell time, and hence journey time, will increase and if tram loadings are high, as can occur in off-peak periods (in addition to the peak periods), it would be difficult for a cyclist to board without causing significant delays and disruption to other passengers.

The need to monitor that restraint systems are being properly used would also be a further area where increases in stop dwell time could occur.

In addition, as noted in Sections 2.2.1, 3.1, 3.2 and 3.3 extended dwell times could result from:

- The need for cyclists to determine whether the bicycle spaces are in use and resolve issues arising from cyclists travelling together;
- Resolve issues arising from the application of priority users regulations;
- Resolve issues arising from the mixed tram fleet; and
- The need to assess, with reference to passenger loading, whether it is safe for a bicycle to board or remain aboard a tram.

Without a better understanding as to the level of demand for the carriage of bicycles on Metrolink and the effect the issues raised above would have on dwell times it is difficult to predict the overall impact on journey time and service reliability that would occur. There may be no significant increase in dwell times in off-peak periods if bicycles are permitted. However this could change if several cyclists wished to board at one time, if a cyclist attempted to board a tram with a high number of standing passengers, or intervention was required to resolve an incident.

It is noted that as the network is expanded and the operation becomes more complex the impact of extended dwell times would be more profound on overall service reliability. It will be important to minimise the potential for dwell times to be extended beyond what has been allowed for in the operational planning.

3.5 Tram Capacity

3.5.1 Existing Tram Capacities

(i) Ansaldo T68 Trams

The existing T68 trams have a maximum capacity of 201 passengers comprising 82 seated and 119 standing. There are two wheelchair spaces (one per car) which if occupied reduce the total capacity by 6 passengers to 195. The existing T68A trams have a maximum capacity of 196 passengers comprising 82 seated and 114 standing. Again there are two wheelchair spaces which if occupied reduce the total capacity by 6 passengers to 190.

(ii) Bombardier M5000 Trams

The M5000 trams will have a maximum capacity of 206 passengers comprising 52 seated (8 of which will be designated as priority seats), 8 perch seats and 146 standing. There are two wheelchair spaces (one per car) which if occupied reduce the total capacity by 6 passengers to 198. As noted in Section 2.1 the internal layout of the passenger saloon has been designed to permit a bicycle to be stored in the wheelchair space should it not be occupied by another priority user.

3.5.2 Effect of Bicycles on Capacity

One wheelchair occupies the space of 3 standing passengers, based on a loading of 4 passengers per square metre. A bicycle stored on its wheels would occupy a floor area approximately 1.80m x 0.75m, which is equal to 1.35m². This is equivalent to 6 standing passengers (when rounded up) at 4 passengers per square metre. For every tram carrying a bicycle, the capacity would therefore be reduced by 5 i.e. -6 normal passengers + 1 cyclist.

A comparison of capacities for each tram type and for wheelchair and combined wheelchair and bicycle use is given in 3.1.

Table 3.1: Capacities for each Tram Type with Wheelchair and Bicycle Occupancy

	T68	T68 with 2 wheelchairs	T 68 with 1 bicycle and 1 wheelchair	T68A	T68A with 2 wheelchairs	T68A with 1 cycle and 1 wheelchair	M5000	M5000 with 2 wheelchairs	M5000 with 1 cycle and 1 wheelchair
Seats [1]	82	82	78	82	82	80	52	52	52
Priority (incl. in seats)	-	-	-	-	-	-	8	8	8
Fold down seats (T68/T68A) / Perch seats(M5000) [2]	4	2	2	4	0	0	8	6	4
Standing	119	113	110	114	108	105	146	140	137
Wheelchair & User	0	2	1	0	2	1	0	2	1
Bicycle & Cyclist	0	0	1	0	0	1	0	0	1
Total	201	197	190	196	192	187	206	200	195

1. The internal layout of T68 and T68A trams would need to be modified to accommodate a bicycle, which is likely to require seats to be removed from each car.

2. Fold down seats not included in capacity totals as they affect standing capacity.

The total capacity reduction is around 2.5% for the carriage of a single bicycle and around 5% for the carriage of two bicycles. However, the effect of bicycle carriage on capacity is largely academic as it is not suggested that it would be permitted when trams are heavily loaded.

4 Other LRT Systems in UK and Europe

4.1 UK LRT Systems

None of the existing LRT systems in the UK permit bicycles to be carried at any time including off-peak periods. Some very limited experience exists for special events.

4.1.1 Sheffield Supertram

The original specification for the trams did include space for a bicycle to be carried in the low floor sections but a policy change before the system started operation meant that they have not been used for this purpose and are only used for wheelchairs or pushchairs and buggies.

Cycles are not permitted on trams but a special arrangement was made with 'Pedal Pushers', the Sheffield Cycle Campaign, to allow cycles on a special tram for a specified journey. These were operated on about four occasions in autumn 2007 with up to 20 cycles on each tram. This arrangement has since been made permanent and a 'cycle special' tram is operated with driver only (no conductor) on the last Sunday in the month between Cathedral and Halfway. A cycling group co-ordinator organises participants; ordinary passengers are not permitted on these journeys. No problems have been reported with this operation. For the 'cycle special' tram a fare of £5 per person return was charged initially but this was changed to a charge of £150 per round tram trip although we understand this may be increased to £200 or £250 in the near future. It is believed that the cycling organisation have obtained some funding to support the charge.

One suggestion from the cycling organisations is to have one section of the tram for the public and one for the cyclists on a normal service tram. Stagecoach Supertram and the Passenger Transport Executive (PTE) were reported to be considering this option but it has not been taken further. Stagecoach Supertram are sympathetic to the needs of cyclists and have a regular cycling liaison group. However, we understand that they would object to bicycles on normal service trams.

4.1.2 Nottingham Express Transit (NET)

It is understood that the Promoters of NET and the existing operator of NET Line One consider the carriage of bicycles on the NET system raises safety and operational issues. Trams currently operating on NET Line One, which are understood will also run on the NET Phase Two routes are narrower than Metrolink trams, 2.4m as opposed to 2.65m. They do not include facilities for securing bicycles and it is seen that unsecured bicycles would create an unacceptable risk of injury to passengers and fouling / damage to clothing. Secure facilities would also create a problem, particularly with passenger capacity, comfort and operational efficiency, especially as usage on Line One has demonstrated that the system is well used for most periods in the day. In addition, to the driver there are conductors aboard all trams who need the space to move around the passenger saloon to undertake revenue collection duties.

4.1.3 Docklands Light Rail (DLR)

Cycles are not permitted on normal DLR services but special arrangements are made for specific cycling events. Prior to the London Triathlon, competitors are permitted to use the DLR to take their bicycles to the race venue near the Poplar stop. It should be noted that DLR vehicles are not equipped with track brakes.

4.1.4 Other UK Systems

None of the other UK light rail systems have permitted bicycles to be carried including the Blackpool Tramway, Tyne and Wear Metro, Midland Metro and London Tramlink (Croydon). The option has been discussed by a number of authorities including Transport for London (TfL) but no changes to existing policies have been made. The proposed tram schemes for South Hampshire and Liverpool made provision for cycles on trams but neither of these schemes have been progressed, both having their funding cancelled by the Department for Transport (DfT).

The Operator of the new tram system under construction for Edinburgh, Transport Edinburgh Limited (TEL), published a report in 2007 ruling out carriage of cycles on trams for safety reasons. But in November 2008 it was announced that 'there were now plans for trials in 2012 or 2013, once the trams are in place and reliable passenger numbers have been established.' TEL's spokesman, Alastair Richards, said 'We are committed to off-peak trials as soon as usage reaches a steady state with sufficient experience built up and a quick system for retention of bicycles has been devised and approved for trials in public operation'.

The new trams for the Blackpool tram system will not have any designated spaces for bicycles.

4.2 European LRT Systems

The majority of tram systems in European cities do not permit carriage of cycles. In Gothenburg bicycles were prohibited because it was considered that pedals and handlebars could cause damage and injury and there would be a risk of bicycle chain oil fouling the garments of other passengers[5]. The Antwerp authorities were opposed to carrying cycles because it would degrade commercial speeds and passenger comfort, both features which passengers sought in survey responses[5].

The Nottingham University Report[3] states that "there are a number of European systems which allow bicycle carriage although they tend to be low floor systems. This reduces the number of ramps and allows adjacent footways to become part of the platform, thus increasing space and reducing potential conflicts." It concludes that "there are no overseas systems with physical layouts which match those in Manchester. It is therefore difficult to learn any lessons from them in terms of infrastructure changes." The report includes a brief description of bicycle facilities on trams in Basel, Hannover, Strasbourg and Zurich.

A survey in 1998[5] reported that bicycles were permitted on trams in Amsterdam, Basel, Berne, Bonn, Bremen, Cologne, Darmstadt, Halle, Karlsruhe, Leipzig, Strasbourg, Stuttgart and Zurich. About half these allowed cycles at any time and half at off-peak times only. In addition, cycles were permitted at weekends only in Bochum-Gelsenkirchen and Essen. A total of 28 networks from over 400 worldwide permitted cycle carriage.

In some cities the number of cycles that are permitted on a tram is restricted to one, two or occasionally four as in Karlsruhe.

4.3 Comparison of Metrolink with Other LRT Systems

4.3.1 UK LRT Systems

A comparison of Metrolink with other UK light rail systems is shown in Table 5.1 below. Edinburgh tram has been included although it will not open until 2011. In concept Metrolink most closely resembles Tyne and Wear Metro and Croydon Tramlink as both were based on converted suburban rail lines with new central area links. Also, all three systems have track brakes. However it differs from Tyne and Wear Metro in having street running cross city links in place of tunnels and differs from Croydon Tramlink in having high floor rather than low floor trams. Metrolink is the only UK light rail system with high floor trams and high platforms with street running.

Metrolink is one of three systems, Tyne and Wear Metro and Croydon Tramlink being the others) which have no staff on board who would be able to supervise bicycle users other than the driver. All the other systems have a conductor or in the case of DLR a train captain.

None of the UK systems allow carriage of bicycles on service trams. DLR and Sheffield Supertram have allowed bicycles for specific events on limited occasions.

Table 5.1 also shows some statistical comparisons. The character of the systems is indicated by the average stop spacing which is over 1 km for Tyne and Wear, DLR and Metrolink as they are predominantly segregated systems on railway alignments. The remaining systems have stop spacing mainly between 600m and 800m indicating their predominantly tramway characteristics.

An indication of passenger density is given by passenger kilometres per route kilometre. It can be seen that DLR has the highest value at 5.93 million passenger km/route km, as may be expected given the density of the population and area served, but Metrolink is the second highest with 5.52 million passenger km/route km, ahead of Croydon Tramlink with 5.05 million passenger km/route km.

Another measure of a tram system is passenger kilometres per tram kilometre which gives average tram occupancy. Again DLR has the highest value at 74.2 passenger kms per tram km, Croydon Tramlink is second with 56.6 and Metrolink close behind with 55.3. Tyne and Wear Metro is slightly lower at 53.9.

These measures indicate that Metrolink has high tram loadings, similar to those on DLR, Croydon and Tyne and Wear Metro.

Table 4.1: Comparative data for UK Light Rail Systems

	Blackpool Tramway	Tyne & Wear Metro	Docklands Light Railway	**Manchester Metrolink**	Sheffield Supertram	Midland Metro	London Tramlink (Croydon)	Nottingham Express Transit	Edinburgh Tram
Year open	1885	1980	1987	**1992**	1994	1999	2000	2004	2011
Route length (km)	18	78	55	**38**	29	20	28	14	18
No. stops	61	60	39	**37**	48	23	39	23	22
No. Trams	78	90	98	**32**	25	16	24	15	27
No. Staff	106	673	484	**329**	258	162	216	185	-
No. Passengers. 07/08 (m)	2.9	39.8	66.6	**20.0**	14.8	4.8	27.2	10.2	-
Passenger. km 07/08 (m)	8.7	312.8	326.4	**210.0**	44.4	50.5	141.4	44.0	-
Power supply	600v DC OLE	1500v DC OLE	750v DC 3rd rail	**750v DC OLE**	750v DC OLE	750v DC OLE	750v DC OLE	750v DC OLE	750v DC OLE
Rolling stock type	mixed	6 axle artic.	6 axle artic.	**6 axle artic.**	8 axle artic.	6 axle artic.	6 axle artic.	6 axle artic.	6 axle artic.
Multiple unit operation	Yes	Yes	Yes	**Yes**	No	No	No	No	No
Floor height	High**	High	High	**High**	Low	Low	Low	Low	Low
Platform height	Low/none	High	High	**High**	Low	Low	Low	Low	Low
Street running	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Wheelchair accessible	No*	Yes	Yes	**Yes**	Yes	Yes	Yes	Yes	Yes
Crew	Driver Conductor	Driver	Train captain	**Driver**	Driver Conductor	Driver Conductor	Driver	Driver Conductor	Driver Conductor
Cycles permitted	No	No	No	**No**	No	No	No	No	No
Owner	Blackpool Council	TWPTE	TfL	**GMPTE**	SYPTE	WMPTE	TfL	Nottingham City/County	Edinburgh City

	Blackpool Tramway	Tyne & Wear Metro	Docklands Light Railway	**Manchester Metrolink**	Sheffield Supertram	Midland Metro	London Tramlink (Croydon)	Nottingham Express Transit	Edinburgh Tram
Operator	Blackpool Transport Services Ltd	TWMetro	Serco Docklands	**Stagecoach**	Stagecoach	National Express	TfL	Transdev	Transdev
Average stop spacing, (m)	295	1,300	1,410	**1,130**	605	870	720	610	820
No. trams per route km	4.3	1.2	1.8	**0.8**	0.9	0.8	0.9	1.1	1.5
No. staff per tram	1.4	7.5	4.9	**10.3**	10.3	10.1	9.0	12.3	-
Passenger kms per route km, m.	0.48	4.01	5.93	**5.52**	1.53	2.53	5.05	3.14	-
Vehicle km, m.	0.9	5.8	4.4	**3.8**	2.4	1.6	2.5	1.2	-
Passenger kms per vehicle kms	9.7	53.9	74.2	**55.3**	18.5	31.6	56.6	36.7	

Notes

*Yes from 2012. ** Low from 2012

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4.3.2 European LRT Systems

Four existing European LRT systems have been compared with Manchester Metrolink, all of which run on 1435 mm gauge as the Metrolink system. These four modern tram networks allow the carriage of bicycles on their rolling stock, with variations on the time of day the bicycles can be transported and the charge for doing so, where applicable.

(i) Strasbourg

The Strasbourg CTS system in France was officially opened in 1994. To date it comprises of 5 lines, operating a length of approximately 55 km. This system uses a combination of Bombardier and Alstom manufactured rolling stock, which are all 100% low floor trams, in combination with low level platforms. The network runs largely segregated from other modes of transport along paved and grassed corridors where possible. The network runs at grade for its majority, with interaction between pedestrians and the vehicles in a similar manner to the city centre running of Metrolink. The operators' policy with regard to the carriage of bicycles is that they are allowed to travel on the trams for free, but only during off-peak periods. The bikes also have to be stowed in the rear-most carriage of the tram. It is understood that the reason for this policy on only carrying the bikes in the rear carriage is to reduce the conflict between cyclists and pedestrians during boarding and alighting.

It is difficult to draw any direct comparisons between the Strasbourg and Metrolink systems due to the differences in rolling stock and high/low floor platforms. It should be noted however that the policy of transporting the bikes in the rear carriage only would allow a degree of separation between users whilst waiting on the platform, and also during boarding and alighting. It is anticipated that as a result this would reduce the risk of delay to the dwell time at the stop. It is also considered that this policy would help separate cyclists and wheelchair users, reducing the possible conflict with regard to allocated space on the trams. However this would not be practicable on Metrolink trams because of the constraints arising from the door positions and internal layout and consequential impact on tram capacity.

The limitation of the application of this policy on the Metrolink network is the current rolling stock. The existing Ansaldo T68/T68A trams and the forthcoming Bombardier M5000 trams have similar door positions, in the respect that they have four sets of doors in total down each side of the tram, and neither have doors directly behind the drivers cab. The rolling stock of the Strasbourg system has a set of doors on both sides directly behind the drivers cab, as can be seen in Figure 4.1. It is these sets of doors at the rear which are used by the cyclists on the Strasbourg system. Using the rear most doors on the T68/T68A and M5000 trams would create a significant conflict between cyclists and passengers as it is these doors which access the rear quarter section of seats and one of the central quarter section of seats, representing a significant proportion of the seating and standing positions on the tram. Amending the policy so the cyclists use the rear most central set of doors would reduce the conflict between pedestrians and cyclists, but by no means eliminate it. This in turn would result in the cyclists and wheelchair users having to share the same space on the trams near to the articulation (subject to no internal refitting of the trams), which can lead to delays and conflicts at tram stops. This policy would also result in the paths of cyclists and pedestrians having to cross whilst approaching and leaving the platform.

Figure 4.1: Strasbourg Bombardier Flexity Outlook

(ii) Stuttgart

The Stuttgarter Straßenbahnen AG is the operator for the Light Rail network in Stuttgart where tram operation started in 1868. The narrow gauge tram system (1000 mm) has been gradually replaced by the European gauge (1435 mm) light rail system from 1975, and it is the gauge system which will be compared to Metrolink in this report. This system comprises 14 lines with a total length of approximately 213 km. The rolling stock used is 164 No. DT8 trams, which are manufactured by the partnership of Adtranz (now Bombardier) and Siemens and are 100% high floor construction. These trams are permanently coupled pairs of 4 axle bogie cars rather than 6 axle articulated cars found on other systems including Metrolink.

The last narrow gauge line was replaced in December 2007 and current operations are based entirely on the standard gauge modern system which operates the high floor trams, operating from high level platforms. Narrow gauge trams have been retained on two lines which are run as tourist / leisure routes with low platforms. As such there are sections of the network where the infrastructure still caters for both gauges of tram and also for low and high level access. The network runs along segregated corridors for approximately three quarters of its total length. In the city centre, large sections of the alignment run in tunnels to avoid conflict with other modes of transport

The carriage of bicycles on the Stuttgart network is allowed free of charge, however they are not permitted between 06:00 to 08:30 and 16:00 to 18:30, Monday to Friday on the majority of the network. We have been unable to obtain information as to any restrictions with regard to the location of storage of the bicycles on the trams or the access onto / off the trams.

In Stuttgart there has also been a large investment in improving the cycling access, the facilities and storage of cycles at the tram stops. This provides cyclists with an option to store their bicycles for picking up on a return journey in the event that they intend to travel during peak hours or if they are refused entry. It is felt that this is a key factor to providing a system which is practical for use by cyclists, and the presence of the cycling facilities at the stations reinforces to the pedestrians that the network is in support of the carriage of bicycles on their trams. This in turn will encourage the use of bicycles, but also help to promote an environmentally friendly image for the operator and owner of the network, which in current climates is significantly beneficial.

It is possible to draw some comparisons between the Stuttgart and Metrolink networks. They both operate high floor, high level access systems, and the length of route and number of stops is comparable to the Metrolink network once Phase 3A extensions are in operation. The layout of the trams is also similar, in particular the arrangement of the doors, as can be seen in Figure 4.2.

Figure 4.2: Stuttgart DT8 Class 10 Tram

This shows that it is feasible to operate a bicycle carriage system on a high level platform / high floor tram network such as Metrolink, however a more detailed study of the Stuttgart system would be required to analyse the patronage, frequency of service and general operator perception of the scheme before it could be said that it is suitable to carry bicycles on Metrolink. Consideration must also be given to the social environment of the catchment area and whether this policy would lead to increased vandalism and abuse of the system. This is a network dependent issue and cannot be resolved or analysed from comparison with other networks.

(iii) Cologne (Köln)

The Cologne tram network is operated by Cologne Transport Holdings Ltd, and has been operational since 1968. Cologne has a vast network of public transport, and the tram system is seen as a crucial component of travel within the city centre district. The network comprises 11 lines, covering a length of approximately 191km. This is largely segregated but with some sections of shared street running. In densely populated areas of the city centre the alignment runs underground. Through the history of the network there has been a multitude of rolling stock used, but current operations utilise a combination of Bombardier K4000, K4500 and K5000 trams. The 11 lines are split between high level platforms/trams and low level platforms/trams. The K4000 and K4500 trams are 70% low floor trams (of which there are 193 combined) and the K5000 are a 100% high floor tram (of which there are 74 operating on the network).

The policy with regard to the transportation of bicycles on trams is that they are permitted. On the trams there are specific areas which are marked for use by bicycles. The conditions of carriage are that there must be available space for the bike on the tram, and priority is given to passengers with prams and wheelchairs. There are restrictions to when bicycles can be transported, and this varies from line to line and access can be withdrawn in the circumstance of special occasions such as sporting events. The tram staff can refuse access at any point even if there is space available. Passengers must pay an additional charge to transport a bicycle, however it is free to some season ticket holders and students during particular time periods. **A heavily emphasised condition of carriage on the network is that the cyclist is responsible for any damage to the tram or injury/damage caused to any other passenger**. The operator is protected from any claim arising as a result of the carriage of bicycles. It must be noted that it may not be possible to enforce this disclaimer on a UK network such as Metrolink under UK law.

Figure 4.3: Cologne Bombardier K4500 (left) and Bombardier K5000 (right)

The operation of the K5000 trams on the Cologne network again demonstrates that it is possible to transport bicycles on a high level platform/high floor tram network similar to Metrolink. The Metrolink M5000 tram is a slightly modified version of the K5000. The constraints on this system are large however, with heavy restrictions on the time of use, an additional charge for carriage of the bicycles, the responsibility of damage/injury lying with the cyclist and that the cyclist has the lowest level of priority of all users. It is felt that these factors combined together will not actively promote the use of bicycle carriage on the tram network, and as a result the cost and effort invested into providing a cycling system may be greater than the return through cyclist patronage.

(iv) Basel

The Basel tram network consists of 12 lines running through Basel town centre and the surrounding suburbs. It covers a distance of approximately 86 km, and the network operates on a low level platform configuration. This network is largely street running or through pedestrian areas.

Basel's tram network is operated by two companies, who operate on separate lines although sharing tracks in the city centre. Baselland Transport AG (BLT) run 3 lines, with their distinctive yellow and orange livery trams and Basler Verkehrs-Betriebe (BVB) run 9 lines with their green vehicles. The vehicles of each operator are fully compatible, and in times of vehicle shortages it has been known for vehicles to be mixed along routes. There is a wide range of vehicles used across the network, including the manufacturers Duwag, Schindler and the more recently acquired Siemens Combino as seen in Figure 4.4. The vehicles are low level access, high level trams i.e. the passenger climbs steps on the vehicles when entering (except in low floor centre sections). The exception to this is the Siemens Combino trams which are 100% low floor. To allow access for wheelchair users, passengers with prams and cyclists, the older rolling stock of the network have been retrofitted with low floor central units as can be seen on the BLT tram in Figure 4.4.

Figure 4.4: Basel Schindler tram in BLT livery (left) and Siemens Combino tram in BVB livery (right)

The policy of the network for the transportation of bicycles is that they are permitted, but not within peak hours. There is a charge for carrying the cycles, and as per the Cologne network the cyclists have the lowest priority in the event that wheelchair users and passengers with prams wish to use the tram. On the older rolling stock the cycles must be carried in the retrofitted central units, where there is space for 16 bikes. These central units however are shared with all other pedestrians, and are apparently well favoured by elderly passengers. It is unclear where bicycles must be carried on the Siemens Combino trams, but it is understood that they are allowed, with the same restrictions and prices as the high floor trams.

It is difficult to draw comparisons between the Basel network and Metrolink due to it being a low floor network with a mixture of rolling stock, new and old. A large proportion of the trams are still not compliant with the equivalent of the UK Disability Discrimination Act (DDA) regulations, and this system demonstrates as an extreme the cost implications associated with retrofitting of trams. A point which can be drawn from this network however is that it is possible to run a bicycle carriage system where there is a wide range of rolling stock. Without any cyclist patronage figures it is however difficult to know whether this system is widely used by cyclists or whether the restrictions on time, the additional cost, the low level priority or the fact that the next tram to arrive at the platform may not be fitted with the appropriate compartment for them to travel in puts off a lot of people from transporting their bikes on this network.

5 Cost of Repairs to Trams and Claims

5.1 Types of Damage and Repairs

Damage to trams is most likely to occur to interior panels or fitments from impact by pedals or handlebars. This would probably be confined to minor scratches in the majority of cases.

Injury to passengers could occur from impacts with pedals, handlebars or other parts of the bicycle, for example brake levers and handle bars, being at eye level of children, damaging their eyes or head. Damage to garments could arise from contact with greasy bicycle chains or muddy wheels.

5.2 Costs of Repairs

It is difficult to estimate the cost of repairs to trams resulting from damage caused by bicycles on the tram as there is little UK experience and no readily available information from Euopean systems on which to base any estimates. Costs will vary considerably according to the extent and nature of the damage but are likely to be small in most cases, perhaps in the range £100 to £500 per incident. If there were, say, one incident per month then the annual cost would be in the range £1,200 to £6,000.

The risk of damage and consequent repair costs could be reduced if consideration was given to protecting any vulnerable tram parts, for example by fitting aluminium sheeting to the side walls where cycles would be stored. Some examples can be found on heavy rail units.

5.3 Costs of Claims

As for repair costs, estimating potential claims costs is difficult without any UK experience on which to base estimates. It has been suggested that claims would be small, perhaps in the order of £500 to £2,000 per incident but these figures could be significantly higher if any serious injury was caused. It should be noted that from the information obtained from systems where cycles are permitted on trams, none have reported any safety issues or referred to any claims resulting from bicycle carriage.

In Section 4.3.2(iii) it was reported that in Cologne, it is a condition of carriage of bicycles that the cyclist is responsible for any damage to the tram, or injury or damage caused to any other passenger; the operator is protected from any claim arising from the carriage of bicycles. However this approach may not be applicable in the UK due to differences between UK and European law.

6 Conclusions

At present, under the current Metrolink By-laws, bicycles are not permitted at any time on any part of the Metrolink network (including both stops and trams) unless they are folded and fully encased.

GMPTE continue to receive representations from cycling groups to permit the carriage of bicycles on trams. However, the demand for the carriage of bicycles on trams in the Manchester area is not known.

The current demand for the carriage of bicycles on the Oldham and Rochdale line, where trams will replace the existing trains that do carry bicycles, is unknown but from initial inquires with Northern Rail it is believed to be low. It may be appropriate to conduct a survey on the current demand levels, running from now to the closure of the train route in autumn 2009.

The HMRI, now part of the ORR, have raised no objection in principle to the carriage of bicycles on trams but would look to the relevant duty holders to manage risks.

Under ROGS the Operator is responsible for certifying the safe operation of the system. Therefore, it would be for Stagecoach Metrolink Ltd to determine whether they will be prepared to accept and manage the risks associated with bicycles on the trams and will need to be consulted if GMPTE, as the Promoter of Metrolink, wish to pursue this policy.

6.1 Safety Issues of Bicycles on Trams

A bicycle within the saloon environment of a tram introduces objects that are hazardous to passengers, e.g. sharp points such as handlebars and pedals. A high frequency of minor passenger injuries could occur through collision with bicycles whilst they are manoeuvred on to and off a tram (subject to bicycle usage).

Of particular concern to the issue of the carriage of bicycles is the higher acceleration and deceleration rates of trams (compared to trains) which make standing passengers, which can be significant in number, more prone to jerk. The saloon environment of a tram is specifically designed to address this issue e.g. provision of grab rails to provide passengers with a means of steadying themselves. However, with a bicycle within the saloon environment there is an increased risk of injury to a passenger from falling into or against part of a bicycle. The level of risk is worsened when coupled with the highway environment in which trams often operate as this can result in the need for drivers to use emergency braking, which has very high rates of deceleration.

It is also noted that the carriage of bicycles on trams would create risks for other passengers in and around the stop environment, such as a mounted cyclist colliding with another passenger, when entering or leaving the stop.

6.2 Possible Measures to Mitigate Risks

There are a number of measures that could be implemented to reduce the level of risk to passengers.

6.2.1 Storage of a Bicycle

A bicycle could be adequately secured during transit to minimise the extent of the hazard it presents to other passengers. The layout of the new M5000 trams could readily incorporate such features but the layout of the exiting T68 / T68A trams would require significant modification,

The most viable option would be against the internal walls using straps as a restraint system within the space shared with other priority users i.e. wheelchair users and those with pushchairs and buggies. Whilst this would limit the number of bicycles carried on any single tram to a maximum of two (one in each car) and reduce the level of the risk it would not fully mitigate the risks.

6.2.2 Restrictions in Time of Carriage

To significantly reduce the level of the risk, in terms of the likelihood of its occurrence, then it would be necessary to minimise the number of passengers exposed to the hazards by restricting the time periods during which the carriage of bicycles would be permitted. Metrolink trams can be heavily loaded at all times during the operational day, not just during the peak periods, with a significant number of standing passengers. Growth in passenger numbers is inevitable with the expansion of the network, not just during the peak periods but across the operational day.

The exact point at which the risk would be reduced to an acceptable level is difficult to define. It probably lies close to the situation where the number of passengers aboard the tram is not substantially greater than the seated capacity of the tram, thereby minimising the number of passengers standing. Such levels of usage are not uniform by time of day across the various lines, and the Phase 3 extensions will complicate matters further. The application of varying restrictions would lead to confusion and difficulties in enforcement. A detailed assessment of passenger loadings by line, direction, day of week and time would be required to determine if there were suitable common time periods. This may only be at the extremities of the operational day where the benefit to cyclists would be questionable.

6.2.3 Ability to Manage Risks Effectively

Should trams continue to be operated by the driver alone, then they would be responsible for:

- Implementing the rules of carriage i.e. storage and numbers. However, their ability to adequately observe on board conditions through the use of external and internal cameras / mirrors is questionable.

- Determining during the course of a journey whether it is safe to either allow a bicycle to be brought on to a tram or for a bicycle to remain aboard a tram. Again the

practicality of this is questionable with judgements between drivers likely to vary considerably.

It is therefore likely that to adequately manage the risks, further dedicated personnel on each tram may be required.

Measures are available for managing the risks that arise in and around the stop environment through the modification of infrastructure and provision of clear signage. Enforcement would be available through the use of CCTV and the PA system or revenue protection staff / public safety officers when present on the stop.

6.3 Operational Issues

The carriage of bicycles aboard a tram would raise a number of operational issues.

- It is likely that bicycle storage space would share the same space as that allocated for other priority users. The use of this space by a bicycle during transit would therefore complicate the situation with regard to the hierarchy of priority with potential for difficulties if the space is already occupied by a bicycle and a wheelchair user then wishes to board. Should the cyclist be requested to leave the tram and wait for the next one or the wheelchair user asked to wait for the next tram?

- It is likely that the owing to the possible means of securely restraining a bicycle during transit that the number of bikes that could be carried aboard a single tram would be two. This would create difficulties for cyclist travelling together e.g. parents with children.

- From the autumn of 2009 there will be two types of tram in service i.e. the existing T68 / T68A trams which have no provision for the carriage of bicycles and the new M5000 trams which could accommodate bicycles. As the entire fleet will eventually carry the same livery it will be difficult for cyclists to know when a tram of the correct type will arrive. The allocation of one type of tram to a particular route is unlikely owing to operational restrictions this would impose on the Operator.

- Research by others has indicated that the physical act of boarding and alighting a tram with a bicycle can be undertaken without causing significant additional delay. However, extended dwell times could result from:
    - The additional time needed to allow a cyclist to secure the bicycle with any restraint system and for the driver to monitor their correct use. The level of passenger loading will be a factor that affects the time it would take;
    - Resolving issues arising from the application of priority user regulations;
    - Resolving issues arising from the mixed tram fleet; and
    - The need to assess, with reference to passenger loading, whether it is safe for a bicycle to board a tram or remain aboard a tram.

  Without a better understanding as to the level of demand for the carriage of bicycles on trams and the effect the issues raised above would have on dwell times it is difficult to predict the overall impact on journey time and service reliability that would occur. However, as the network is expanded and the operation becomes more complex the impact of extended dwell times would be more profound on overall service reliability.

6.4 Evidence from Other Systems

- No UK light rail systems permit cycles to be carried at any time aboard normal passenger services, principally as a result of the reasons identified above. Cycles are or have been carried by special arrangement for specific events on Sheffield Supertram and DLR.
- The majority of light rail systems in Europe do not permit cycles to be carried but a number do permit cycles at weekends, during off peak periods or in a few cases at any time. The most relevant for comparison with Metrolink are Cologne and Stuttgart as both have high floor vehicles and high platforms and networks similar in scale to Metrolink in its extended Phase 3 configuration.
- For systems which permit cycles on trams there does not appear to be any publicly available evidence of adverse impacts on safety or operations. Specific discussions with Operators would be required. This was outside the scope of this study.

6.5 Costs of Repairs and Claims

- There is little evidence on which to base any estimates of costs of tram repairs resulting from damage caused by bicycles on trams but the risks are likely to be small and repair costs low, perhaps in the region of £1,200 to £6,000 per annum.
- There is little evidence on which to base any estimates of costs of claims resulting from injury or damage to clothing resulting from bicycle carriage on trams but the risks are likely to be small and claim costs low, perhaps in the region of £5,000 to £10,000 per annum. Claims for any serious injuries e.g. those that could arise as a result of the need to perform emergency braking could increase these figures substantially.

6.6 Overall Summary

This report sets out the extent of problems that may arise if the carriage of bicycles aboard trams were to be permitted. Such a policy should only be implemented if the risks can be reduced to an acceptable level.

Limiting the time periods during which bicycles could be carried is the key mitigation measure. However, as a result of heavy loadings during the majority of the operational day it is likely that bicycle carriage would need to be restricted to the extremities of the operational day. This would provide little benefit to cyclists.

Even with this restriction in place, it is likely that additional personnel aboard each tram will be required to assist the driver in enforcing the rules of carriage and managing the operational practicalities that arise. However, we are not aware of plans for Metrolink to introduce such staff, which is likely to result in substantial additional operational costs. Although, these may be offset in part by re-deploying / re-training existing revenue protection staff.

To make provision for cyclists, and particularly those commuting, it may be more appropriate to make adequate provision for secure bicycle storage at tram stops rather than their carriage on trams. This will require capital expenditure but may in part be recovered through increases in revenue, and the option of a daily usage charge.

Appendix A HMRI (now ORR) Letter to GMPTE dated 20 May 2003

8322296

HSE
Health & Safety Executive

HM Principal Inspector of Railways : Mr David Keay

Tom Beamon
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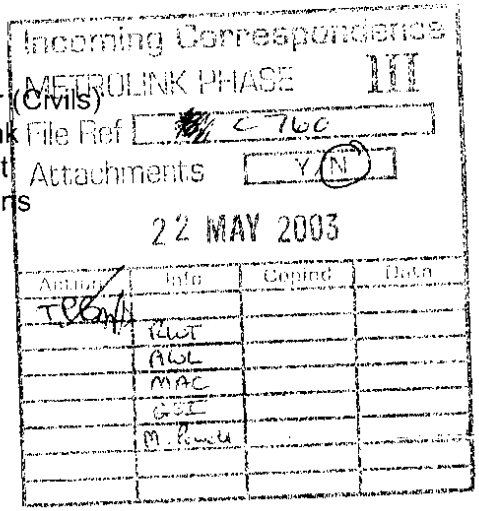

Your Ref: TPB/AWC/C760/8320981

Our Ref: MLKGen/PR 113588

Date: 20 May 2003

Dear Sir

RE: METROLINK PHASE III: CARRIAGE OF CYCLES ON TRAMS

I note your recent letter, referenced above, and your efforts to review the impact of allowing the carriage of cycles on the Metrolink system.

The view of HM Railway Inspectorate with respect to the carriage of cycles on trams is that in concept we have no objection to the carriage of cycles on trams. As with all aspects of any tram operation we look to the relevant dutyholders to manage risks associated with their undertaking so far as reasonably practicable.

With specific reference to the carriage of cycles on trams our view remains that cycles should be adequately secured during transit but we accept that this may include being held by the user. This approach is not uncommon across Europe.

The issue of security of cycles during transit or maintaining escape/evacuation routes in emergencies extends, of course, to other items of luggage and will require careful consideration for the route to the Airport.

The current guidance for tram stop design should not prevent access for cyclists to the stop and I believe that 2m ramp widths with cyclist dismount signs would represent an acceptable proposal. I share your view that hoop chicanes are to be avoided as they may restrict access for mobility impaired passengers. The directional changes found in compliant ramps combined with the appropriate approach angle to the platform should provide suitable mitigation.

Should you wish to discuss the matter further please do not hesitate to contact me.

Yours faithfully

C P Carr
HM Inspector of Railways

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Appendix B References

The reports detailed below have been reviewed as part of this study and relevant information extracted.

Specific References

[1] Metrolink Phase 3 Cycles on Trams Report of Further Consultation. April 2003.

[2] Bicycle and Rail, A Good Practice Guide. The Countryside Agency and DfT. August 2004.

[3] Nottingham University research project: Bike Access on Light Rapid Transit. February 2003

[4] Implications on Metrolink Infrastructure from Allowing Carriage of Cycles On Board Trams. Jan 2003.

[5] The Interaction of Cyclists and Rapid Transit Systems. MVA for DETR. June 1998.

General References

[6] The Interaction of Cyclists and Manchester Metrolink Phase 3 (MMP3).

[7] Sheffield Cycle Campaign: Report on Supertram Cyclists Specials. December 2007.

[8] Patronage and Monthly Ticket Sales data. GMPTE. Sept 2007 to Sept 2008.

[9] Bombardier M5000 specification drawings: “BB57_01_01_2” and “LV-939-0124”.

[10] French Metro & Tramway Systems Talk. Graham Jellett, August 2007.

[11] Greater Manchester Transportation Unit (GMTU): Transport Statistics 2006 and Draft 2008.

[12] Swedish National Road and Transport Research Institute: Making Tracks – Light Rail in England and France. March 2002.

[13] Greater Manchester Local Transport Plan (GMLTP2) – 2006/7 to 2010/11.

[14] Carriage of Cycles on Trams – TTK Report. October 2008.