

**Local Authority Rising Bollard User Group
(LARBUG)**

**RISING BOLLARD SYSTEMS
DESIGN, USE AND OPERATIONAL
GUIDE**

INTRODUCTION

Many Local Transport Plans include measures to restrict and control traffic in city centres, to promote and improve public transport and to provide an enhanced environment for pedestrians. Whilst Traffic Regulation Orders have been introduced in many town and city centres to achieve these aims, many fail to meet their objectives through lack of enforcement. Many drivers are all too prepared to ignore any manner of access restriction when their personal needs require. The increasing pressures on the Police means that in many areas, enforcing access controls remains a low priority. Therefore, many highway authorities are looking for other ways of enforcing access restrictions including physical methods of enforcement such as rising bollards.

Whilst rising bollard systems can provide a reliable and flexible way of controlling vehicle access, the potential benefits need to be considered against the costs of system installation and perhaps more importantly, the costs of managing such systems.

Managing the safe operation and public relations aspects of rising bollards can also be a challenge that needs to be taken into account when considering the use of rising bollard technology. The advice given in this guide may also be applicable to other forms of physical barrier used on the highway including rising steps or rising arms.

LARBUG

The Local Authority Rising Bollard User Group (LARBUG) has been established as a forum for highway authorities to share experience of rising bollard systems and to develop improved designs and procedures in partnership with bollard system manufacturers. Consultants working on behalf of highway authorities are welcomed to group meetings.

LARBUG has a website (www.risingbollards.org.uk) which provides contact details and information on the Group.

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Some rising bollard schemes are operated and monitored through traffic signals technology. For details of the Traffic Control User Group (TCUG) some of whose membership has an interest in rising bollard technology, please contact:

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CONTENTS

	<u>Section</u>	<u>Page</u>
1	Background	
2	Legality and Authorisation	
3	Bollard System Specification	
4	Risk Assessment and Safety Audit	
5	Basic System Components	
6	Site Layout Issues	
7	Rising Bollard Operation	
8	Operational Issues	
9	Failure Modes and Emergency Operation	
10	Signing	
11	Authorised Users	
12	Management and Monitoring	
13	Maintenance and Repair	
14	Bollard System Commissioning	
15	Applications and Site Studies	
16	Government Contacts	
17	Glossary	

SECTION 1: BACKGROUND

- 1.1 The first actively used rising bollard system used on the highway in United Kingdom is believed to be that installed by Cambridgeshire County Council in the historic centre pedestrian zone in Cambridge. This system was installed in July 1992 to control motor vehicle access during the hours of pedestrianisation. In the wake of the Cambridge system, rising bollards were installed in several city and town centre pedestrian zone areas.
- 1.2 In 1997 the Department of Transport published a Traffic Advisory Leaflet (04/97) which gave guidance on the use of rising bollards on the highway. This guidance was based on fairly limited experience but since this time, rising bollards have become a more common traffic management tool with their use extended to include bus gates and through route and residential road closures. This guide aims to build on the initial advice given in Traffic Advisory Leaflet 04/97, to explore operational and design issues and to show examples of rising bollard system application.

Image: traffic advisory leaflet

SECTION 2: LEGALITY AND AUTHORISATION

2.1 Legality

- 2.1.1 Initially, questions were asked over the legality of using rising bollards on the highway. Traffic Advisory Leaflet 04/97 clarified the situation. Rising bollards can be used to enforce Traffic Regulation Orders (TROs) that are time related or restrict access to particular classes of traffic. Other applications include controlling or regulating motor vehicle access to pedestrianised or restricted areas, and ensuring that other road users do not use selective road closures such as bus gates. The use of rising bollards solely as a tool for reducing or maintaining lower vehicle speeds or in conjunction with conventional traffic signals is not recommended.
- 2.1.2 Traffic Advisory Leaflet 04/97 states “Bollards and other obstructions under Sections 92 (outside London) and 94 (London) of the Road Traffic Regulation Act 1984 (RTRA) may include obstructions of any description whatsoever. These may be either fixed or moveable and may be placed so as to prevent the passage of vehicles at all times or at certain times only. It follows from this that rising bollards are lawful as movable obstructions if they prevent the passage of vehicles where this is prohibited by a traffic order. In Scotland, Section 28 of the Roads (Scotland) Act 1984 applies. The Highways Act 1980, section 66(2) enables fixed bollards to be erected on the edge of a footway for the protection of pedestrians. This could include protecting the footway from pavement parking so as to safeguard pedestrians.”

2.2 Authorisation

- 2.2.1 Rising bollard systems should have a method of directing authorised users when to proceed when negotiating a bollard controlled access point. It is recommended that all bollard installations provide "indicators" advising authorised road users of the bollard status i.e. whether the bollard is fully retracted, fully raised or in the process of lowering or raising (see section 5: Basic System Components and Section 10: Signing). However, no indicators for this use are prescribed in the Traffic Signs Regulations and General Directions 2001. Therefore, if indicators are used, they require authorisation by the Department for Transport or by the appropriate national authority.
- 2.2.2 Current advice from the Department for Transport states that authorisation will only be given to indicators, variable message signs (VMS) or other information or related control devices if they are of a type approved by the Secretary of State. Both type approval and site approval will be necessary for any indicators.

SECTION 3: BOLLARD SYSTEM SPECIFICATION

3.1 Specification

- 3.1.1 This Guide does not attempt to explore in any detail the mechanical or electrical aspects of rising bollard system design and manufacture. The Department for Transport, through the Highways Agency, has developed a technical specification for rising bollard systems (HA: TR 2207A Specification for rising bollard control systems).

SECTION 4: RISK ASSESSMENT AND SAFETY AUDIT

4.1 Risk Assessment

- 4.1.1 When considering the use and design of rising bollard systems, highway authorities and bollard manufacturers should undertake a joint risk assessment process initiated by the manufacturer's product risk assessment to ensure that the system design and layout achieves an appropriate level of safety for all users without undermining its purpose.
- 4.1.2 Later sections of this guide will explore layout designs, safety systems, operational aspects and the key issue of managing tailgating vehicles. By their very nature, rising bollards, like automatic level crossing barriers, traffic signals and low structures across the highway, can represent a risk to road users if they proceed without due care and attention. Whilst bollard systems should be made as safe as possible for both authorised and unauthorised road users, a balance needs to be achieved to ensure that bollard systems serve their purpose.
- 4.1.3 A rising bollard system that is designed to restrict or regulate access, which incorporates excessive safety features, may result in any road user being able to gain access, which would undermine the purpose of installing the rising bollards.
- 4.1.4 LARBUG has developed a generic risk assessment that may be useful to Local Authorities as a guide in developing their own site-specific risk assessment (See Appendix A).

4.2 Safety Audit

- 4.2.1 Safety audit procedures should be followed when developing and designing schemes using rising bollards. As experience of rising bollard systems is still relatively limited, it may be appropriate for the audit team to include someone with experience of rising bollards. LARBUG members may be able to offer some support in this process (see LARBUG contact details).

SECTION 5: BASIC SYSTEM COMPONENTS

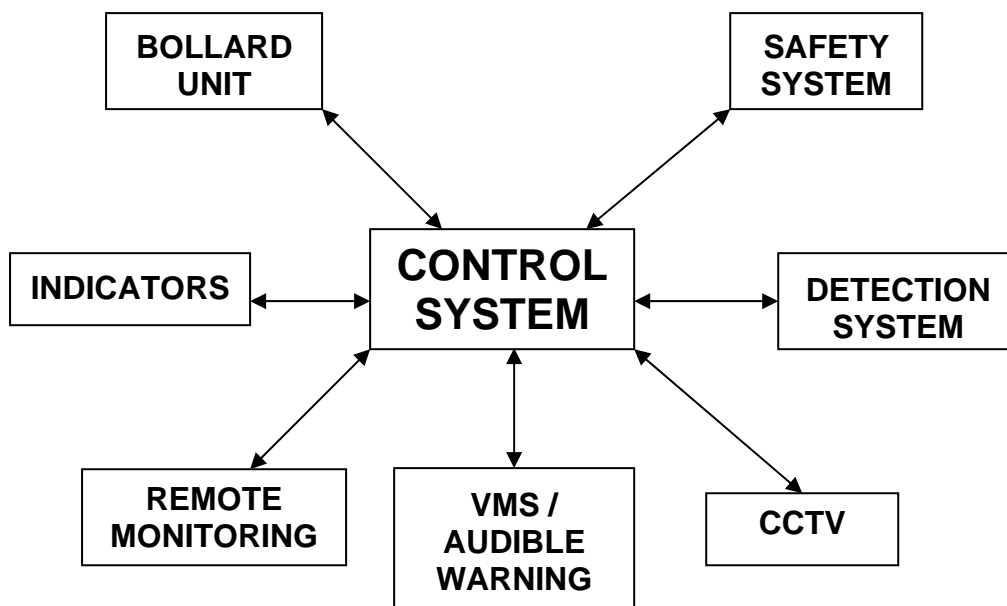
5.1 Components

5.1.1 Rising bollard systems generally consist of five main component parts:

- one or more rising bollard units to physically control access
- a safety system around the bollards
- a method of detection on the approach to detect authorised vehicles
- indicators to advise drivers of authorised vehicles of the bollard status
- a control system to co-ordinate these elements

5.1.2 Additional optional components could include:

- CCTV system
- remote monitoring and control system
- VMS / Audible warning systems



5.2 Rising bollard units

- 5.2.1 These usually take the form of a steel cylinder with a central ram to drive the cylinder up and down as required. Rams are usually hydraulically or pneumatically powered, although most systems now use hydraulic power. The cylinder is usually housed within an outer metal casing installed within the road construction with the top lip level with the finished road surface. Bollard manufacturers offer a range of colour finishes to the cylinder and some provide a plastic outer sleeve over the metal cylinder that can be changed if the finish is damaged. Reflective markings should be provided on bollards to make them more conspicuous during the hours of darkness. This can be achieved by using reflective tape that can be changed easily if damaged or vandalised.
- 5.2.2 Bollard units should be installed so that the bollard rises vertically. On roads with a heavy camber or cross fall some resurfacing around the bollard unit may be necessary to avoid surface water ponding around the unit. A separate flange collar should be provided over and fixed to the outer bollard unit casing to act as a guide as the bollard rises and lowers. The gap between the cylinder and the casing should prevent the ingress of stones and other debris into the unit, or prevent injury to pedestrians, cyclists and engineers undertaking repairs or maintenance.
- 5.2.3 The outer casing should be fitted with a drainage outlet near the base. If ground conditions require, the outlet should be connected to the highway surface water system or to a soakaway to ensure adequate drainage. In some circumstances it may be sufficient to surround the outer casing with gravel around the bottom third to allow any rainwater to percolate into the surrounding ground. Connections to drainage systems may not be desirable in areas prone to flooding as the surcharging of the drainage system could lead to backflow filling the bollard unit, resulting in the bollard system going into fault.
- 5.2.4 It is important to assess at an early stage that adequate depth is available in the highway, clear of public utility apparatus, to install a bollard unit. NSRWA notices (Form N) should be served at an early stage to ascertain the location of apparatus and the digging of trial holes to confirm the exact location of the bollard unit is recommended.
- 5.2.5 Bollards are generally powered hydraulically or pneumatically although hydraulic power is currently the favoured option by most highway authorities. The power unit should be located close to the bollard units as long hydraulic or pneumatic hose runs place greater loading on the power unit and can reduce the speed of bollard operation. To reduce the amount of street furniture, power units can be housed in the same street cabinet as the control system that coordinates bollard system operation. Power units can be housed in underground chambers to avoid clutter on street but this option is not recommended as it creates additional health and safety problems during maintenance and repair as well as providing a poor environment for mechanical operation.

- 5.2.6 To assist the bollard manufacturer in designing the power unit, information should be provided on the expected number and frequency of authorised vehicles allowing for any possible future increase.
- 5.2.7 Ducting should be provided between the power unit and each bollard unit to house hose connections. All duct runs should be provided with adequate inspection chambers to allow for regular and routine inspection, maintenance and repair. Sharp bends in ducting runs must be avoided to prevent wear and tear of hoses that can experience movement as power is transmitted to raise and lower bollards. When the ducting is installed accurate measurements of hose runs should be taken to allow the bollard manufacturer to produce hose runs of appropriate lengths. Any hoses cut too long can cause problems during installation when they may become bent unnecessarily to fit in duct runs, which can result in additional wear and tear.
- 5.2.8 Each bollard unit should be fitted with suitable switches to monitor the movement of the bollard. A switch should be provided at the top and bottom of the bollard unit to confirm when the bollard is in the fully retracted and fully raised positions. These switches should be connected direct to the system control system via duct runs.
- 5.2.9 The number of bollard units will depend on the width of the closure point. Obviously the greater the number of bollards, the greater the size of the power unit to be housed on street. The width of the closure point needs to take into account the size of vehicles to be allowed access. Attention should be given to the requirements of the emergency services, particularly the fire and rescue services. Bollard manufacturers should ensure that where more than one bollard is used, the speed of operation of each bollard is synchronised.

Image: rising bollard

5.3 Safety system

- 5.3.1 To minimise the risk of conflict between a bollard when rising and a vehicle, an inductive safety loop should be provided around the bollard units to the bollard manufacturer's recommendations. When the bollard is about to rise or is in the process of rising and a vehicle is detected by the safety loop, the system should hold down or reverse the bollard and return in to the down position until such time as the loop no longer detects the presence of a vehicle. The sensitivity of the safety loop should be set to detect pedal and motorcycles, wheelchairs, prams and buggies if site conditions dictate. This is considered the minimum safety requirement for sites where the number of authorised vehicles permitted access is small and where the risk of tailgating by other vehicles is low.
- 5.3.2 If there are site difficulties in providing a safety loop around the bollard, perhaps because of the ironwork in the carriageway, safety loops could be provided either side to detect the presence of vehicles close to the bollard. However, this arrangement may not provide detection of a cyclist or wheelchair or pushchair user approaching from the side as the bollard rises. This aspect

would need to be addressed by the layout of the site if this loop arrangement were to be adopted.

- 5.3.3 Vehicles with trailers can be a particular problem and safety loop sensitivity needs to be set so that they are not recognised as two separate vehicles to avoid the bollards rising between the vehicle and trailer. If this vehicle combination is likely to be permitted access, this should be brought to the attention of the bollard system designer and manufacturer.
- 5.3.4 At sites where traffic flow is higher and the risk of tailgating greater, consideration should be given to providing additional inductive safety loops on the approach to the rising bollard units to extend the zone of detection of the safety loop system. However, a balance needs to be struck. If the zone of detection is too great, this will make it easy for unauthorised vehicles to tailgate authorised vehicles through the bollards, thereby undermining their purpose. This aspect of layout design should be considered carefully with bollard manufacturers as part of the risk assessment process. It may be appropriate to provide a series of safety loops on the approach and vary the number connected in light of operational experience. It is important that the distance between individual safety loops is not greater than a typical car length to avoid detection being lost as the vehicle passes from one loop to another. Highway authorities will need to decide where the balance is struck having regard to individual site circumstances, the risk of conflict between tailgaters and the bollards and the risk posed to other highway users by vehicles gaining illegal access.
- 5.3.5 Where the layout provides a single traffic lane for use in both directions, safety loops should be provided on both approaches. The number of safety loops will be dictated by the space available between the bollards and the point of detection.

Image: loop layout

5.4 Detection system

- 5.4.1 Various detection systems are currently used to activate rising bollards. These include:
- Vehicle mounted transponders (electronic tags)
 - Swipe and proximity cards
 - Tokens
 - Keys
 - Remote controls (including cctv)
 - Key pads
 - Intercoms
 - Vehicle registration plate recognition cameras
 - Inductive loop (free access / exit) / queue loop

The selection of the detection system will depend on site layout and the types and number of users given authorised access.

- 5.4.2 For bollard systems where large numbers of a particular class of vehicle are regularly permitted access such as bus gates, the use of transponders is often the most appropriate form of detection system to use. Once the transponder is fitted, this can give fully automatic access through the rising bollards. Transponders should be fitted in accordance with manufacturer's instructions, which should be issued to the user at the same time as the transponder.
- 5.4.3 Whilst transponders can be read by above ground antenna fitted to some form of street furniture such as a lamp column or sign assembly, this is often not a practical arrangement as they are not as position sensitive as ground based systems. The most common form of transponder detection systems use antenna loops cut into the road surface. Ground based systems are much less prone to damage or vandalism, which can be an important factor, particularly where bollard systems operate in remote locations.
- 5.4.4 Transponders can be encrypted with codes to allow groups or individual vehicles to be identified as they use the system. This can allow controls to be placed on classes of vehicle or individual vehicles to prescribe the times and number of occasions that access is permitted. For example, in pedestrianised areas, access for loading vehicles could be restricted to certain periods of the day to avoid the busiest pedestrian periods. Coding can also be useful if 'black listing' is to be used so that the bollard system can prevent particular transponders from activating the rising bollards if required for any reason for any particular period. Black listing can be used to discipline authorised users to follow the procedures set out when using bollard systems
- 5.4.5 Road surface based antennas offer far more flexibility when designing site layouts but some sites can be prone to interference from locally generated electrical 'noise'. Electric mains and telecommunication equipment in the road near to road surface antenna can often be a source of interference. It is recommended that a site test be undertaken by the bollard system manufacturers early in the design process to identify any interference problems and to allow the precise location of the antennas to be established.
- 5.4.6 Some vehicles with magnetic equipment, such as fire tenders with front mounted winches, have experienced interference problems. Any vehicles of this type may require testing at the site to prove the reliability of transponder detection
- 5.4.7 The use of transponder-based systems is extending across the UK with various highway authorities developing their own transponder codes. Some bus companies that operate services across highway authority boundaries, where different bollard systems are in use, are now experiencing problems. Fitting more than one transponder to a bus can cause interference resulting in neither transponder being read correctly by the relevant bollard system. This can be a particular problem at bus gate bollard systems.
- 5.4.8 When considering the use of rising bollard systems to allow bus access, highway authorities should consider carefully the type of transponder to be

used and how it should be coded. Bus companies and neighbouring authorities may need to be consulted to ensure that buses have access through all the rising bollard systems on their routes. Many traffic signal based bus priority systems also use transponder technology.

- 5.4.9 A national protocol for transponder encryption would address this issue and the Traffic Control User Group (TCUG) is considering this issue with traffic signal companies, some of whom are also involved in the development and installation of rising bollard systems. Highway authorities using or considering the use of transponder based access control systems are encouraged to discuss transponder-coding issues with TCUG and LARBUG (see LARBUG contact details).
- 5.4.10 Vehicle registration plate recognition cameras are another way of achieving fully automatic vehicle detection. This has the advantage of avoiding the fitting of transponders but the performance of such systems in some situations and under some conditions may not guarantee the high levels of detection required for access control.
- 5.4.11 Bollard systems can provide selective access at certain times of the day but allow access for all users at other times. During the period when access is available to all users, an inductive loop can be used as an automatic means of detection. However, it must be remembered that rising bollards are recommended as an enforcement tool for Traffic Regulation Orders and their use when no such restriction exists or operates may be inappropriate. Bollard systems using variable access regimes can be confusing for drivers and particular attention needs to be given to how these arrangements are signed. This is covered in Section 10: Signing. An inductive loop also offers an easy way of providing egress for all users at a bollard controlled exit point from an area where access may be controlled to some degree.
- 5.4.12 For bollard systems that control access to pedestrianised or restricted areas, the number of vehicles permitted access is generally lower and detection systems that require manual operation can be more appropriate. Where authorised users are using private vehicles, the use of a card, key, key pad, token or intercom is often more attractive than having to fit a transponder to the vehicle. Manually operated systems offer more flexibility for users, particularly if they use more than one vehicle but it also increases the risk of abuse if authorised users allow unauthorised users the use of their card, key etc. The balance of flexibility against abuse needs to be considered when selecting which system to use.
- 5.4.13 The layout of manually operated systems needs to allow a driver of an authorised vehicle to be able to approach the street furniture housing a card reader, lock, key pad or intercom to operate it. Some bollard system manufacturers house the detection system on the side of a street cabinet housing the power unit and control system, to minimise street clutter. Manual detection systems can be more prone to vandalism, particularly swipe card or key based systems. This also needs to be taken into account.

- 5.4.14 Where access is permitted for drivers with mobility impairment, manually operated systems can be less user friendly and a transponder based system to give fully automatic detection can be more attractive. Some emergency services find manually operated systems that require the use of a card, key, token or security code for a keypad, difficult to administer. Dual detection rising bollard systems using both manually operated and transponder based detection have been developed which can give disabled drivers a choice and allow emergency service vehicles to use transponders.
- 5.4.15 Global Positioning Systems (GPS) can be used to track authorised vehicles to trigger the lowering of rising bollards when they reach a fixed point immediately prior to the bollards. However, such systems would need to be sufficiently accurate to avoid a bollard being lowered too early or not being lowered at all. GPS as a form of detection should only be considered if a very high level of accuracy could be guaranteed.

Image:detection loop

Image: pole mounted detection

5.5 Indicators

- 5.5.1 Whilst variable message signs can be used to indicate the status of rising bollards, the most common form of indicator used is a red-green indicator. Two-aspect vehicular traffic signals are not prescribed for use on public roads and therefore site and type approval would be required for each rising bollard site.
- 5.5.2 Conventional three-aspect traffic signals should only be used in accordance with Traffic Signs Regulations and General Directions (TSRGD) or the Pedestrian Crossing Regulations. Traffic Advisory Leaflet 04/97 states “Established practices of traffic control using traffic signals do not control separate vehicles; streams of vehicles are controlled with drivers able to see the signals from a significant distance. Rising bollards are normally used to control individual vehicles in that they are raised each time a vehicle has passed over them. The requirement, therefore, is for short range signalling and the standard form of traffic signals should not be used with rising bollards.”
- 5.5.3 Indicators should be positioned so as to be easily visible to the driver of the authorised vehicle gaining access. However, care should be taken to avoid the drivers of following vehicles being able to see the indicators. This will help to avoid following vehicles from tailgating and coming into conflict with the bollards as they rise following the passage of the authorised vehicle.
- 5.5.4 Traffic Advisory Leaflet 04/97 illustrates a design for a sign to explain how red-green bollard indicators operate that the Department for Transport would consider authorising in appropriate cases. Whilst this sign gives instruction on how to proceed through the rising bollard system, its use could be confusing to drivers. On the approach to the bollard system, drivers may have passed traffic signs that indicate some form of prohibition of access only then to encounter a sign that advises on how they should proceed through the rising bollards. The

pros and cons of using the indicator sign need to be considered by individual highway authorities when designing rising bollard systems.

- 5.5.5 Rising bollards can be used to enforce traffic orders that prohibit traffic other than for the purposes of gaining access to properties within a restricted area road or street, i.e. to prevent through traffic. In these cases there could be many one-off users of the rising bollards. The use of the indicator sign is considered more appropriate in these circumstances (see Section 10: Signing).
- 5.5.6 Automatic audible indication of the bollard status is not recommended as the only way of advising drivers as this could discriminate against those with a hearing impairment. There are also questions over how reliable such a system would be at sites with high background noise levels. Any automatic audible indication must avoid confusion with the audible signal used at pedestrian crossings.
- 5.5.7 Intercom systems can be used to communicate to drivers when to proceed but operating costs can be relatively high, as they may require staff to operate them on demand. Intercom systems are more popular at off-highway sites as a way of confirming that access will be permitted and are generally used in conjunction with red-green indicators.

Image: indicator pole

5.6 Control system

- 5.6.1 The operation of the bollard units, the safety and detection systems and the indicators are co-ordinated by a control system. This guide does not attempt to describe or explain the operation of control systems but bollard manufacturers should be required to confirm that all components are fit for purpose and satisfy all relevant electrical and mechanical standards.
- 5.6.2 Control systems are generally housed on street in a cabinet, which should be fit for purpose and satisfy all relevant standards of design and operation. Street cabinets can also house the power unit for the rising bollard units and as such the bollard manufacturer should ensure that the environment within the cabinet is suitable for the equipment it houses.
- 5.6.3 It may be possible to obtain the various bollard system components from various sources but it is strongly recommended that bollard systems be purchased from one source placing the responsibility for co-ordination of the various elements with one party. The authorisation process for the system indicators will also be easier if one system manufacturer is involved.
- 5.6.4 The control system safety design shall conform to EN 954-1 Category 3 or above and to The Supply of Machinery (Safety) Regulations 1992 (SI 1992/3073) as amended by the Supply of Machinery (Safety) (Amendment) Regulations 1994 (SI 1994/2063). As these regulations all apply to rising bollards, the complete system has to conform to them, and any other regulations that may be deemed applicable, by law under the CE regulations.

Image: street cabinet

SECTION 6: SITE LAYOUT ISSUES

The design for each rising bollard system should take into account the particular physical constraints of the site but there are other factors which should be considered.

6.1 Location

- 6.1.1 If possible, rising bollards should be located a reasonable distance from junctions, traffic signals and pedestrian crossings. This is particularly important where there are likely to be a high number of authorised vehicles and possible queuing on the approach to the bollards. Sufficient road space should be available to accommodate any queues to avoid obstructing junctions and crossing points.
- 6.1.2 When used to enforce access restrictions, rising bollards can significantly reduce traffic levels but the noise and vibration associated with authorised vehicles stopping and restarting when passing through any rising bollard closure point can adversely affect neighbouring residential properties. Where rising bollards are likely to be used by relatively larger numbers of vehicles, the location of the closure point should avoid proximity to households. Similarly, whilst reduced traffic levels can improve air quality, the increased occurrence of vehicle acceleration and deceleration can locally offset the gains in overall air quality.
- 6.1.3 Drivers can mistakenly assume that if rising bollards are not operating, the access restrictions they enforce do not apply, despite the presence of mandatory traffic signs. Locating rising bollards so that they are not visible from the route that unauthorised traffic should use, helps to minimise contravention levels during periods when rising bollards may not be operating.

6.2 Turning point

- 6.2.1 Consideration should be given to a turning point prior to the rising bollards where unauthorised vehicles can turn round if they reach the bollard restriction point in error. In practice, this may be difficult to achieve and some form of mandatory or prohibitory signing at a junction or turning point further back from the bollard site should be considered to deflect unauthorised vehicles before the physical restriction.

Image: turning point

6.3 Road widths

- 6.3.1 The width of the rising bollard access point needs to accommodate the types of authorised vehicles permitted access. Particular attention should be paid to the requirements of the Fire and Rescue service who will probably require access through most rising bollard systems. A minimum desirable traffic lane width of

3.1 metres is recommended where the rising bollard layout creates a pinch point width restriction. If the width constraint affects a longer length of highway, this may need to be increased taking into account the road alignment. The number of rising bollards used is a local design issue but a maximum clearance of 1.45 metres between bollards should prevent the passage of most cars.

6.4 Pedestrians

- 6.4.1 Rising bollards can represent a potential hazard to pedestrians, particularly in areas of high pedestrian density. Whilst bollard safety systems should minimise the risk to pedestrians walking in close proximity to bollards as they rise, it may be appropriate to design the layout to physically control or restrict pedestrian access in the immediate vicinity of the rising bollards by the careful location of street furniture or by the provision of pedestrian barriers or suitable pedestrian deterrent paving. Other street furniture such as seating and cycle racks may also achieve a similar result. If there are particular problems at the site with potential pedestrian-bollard conflicts, the use of an audible warning when the bollards are rising and lowering might be appropriate.

6.5 Parking

- 6.5.1 Vehicles parked in proximity to rising bollard systems can affect the operation of safety loops or prevent or obstruct the passage and detection of authorised vehicles. Consideration should be given to parking controls to prohibit or restrict parking during the periods of bollard operation.

6.6 Traffic islands

- 6.6.1 Installing rising bollards on one side of a traffic island to control access in one direction but leaving the other side physically unrestricted for traffic in the other direction may result in unauthorised traffic, bypassing the bollards by driving the wrong side of the traffic island, conflicting with oncoming traffic. This potential hazard should be considered as part of the risk assessment process. The use of long traffic islands with clear signing may be sufficient to address this issue.

Image: traffic island

6.7 Proximity to crossing points

- 6.7.1 Rising bollards can require extensive signing and associated street furniture which can distract drivers if located close to signalised pedestrian crossing points or conventional traffic signals. However, the options for locating rising bollards are often limited, particularly in city or town centres. If rising bollards are located near a formal crossing or conventional traffic signals, it is important to consider how the two systems should be linked to co-ordinate their operation.

- 6.7.2 Experience of this type of arrangement is limited. Owing to site constraints, the rising bollard site in Emmanuel Road in Cambridge is located close to a pelican crossing with the two systems linked to ensure that rising bollards do not lower when the pelican crossing pedestrian stage is running. Similarly, the pedestrian stage is inhibited if the rising bollards are in the process of lowering. Experience at this site suggests that if rising bollards have to be located close to a signalised pedestrian crossing, the closer the two systems are, the better the co-ordination to reduce the risk of conflict between pedestrians and authorised vehicles. (see Site Study 4).
- 6.7.3 Locating zebra crossings close to rising bollards is not recommended. Pedestrian priority at zebra crossings can result in authorised vehicles pausing over the bollards when held up by pedestrians crossing. Whilst the rising bollard system should be designed to allow for this, it is not perceived by drivers as a comfortable position in which to wait.

6.8 **Pedal cyclists**

- 6.8.1 Wherever possible and practical, pedal cyclists should be physically segregated from rising bollards by the provision of cycle lanes to allow rising bollards to be bypassed. However, at sites where pedal cycle numbers are small and where adequate room does not exist for cycle lanes, suitable signing should be provided to advise pedal cyclists of the presence of rising bollards. Consideration should be given to providing cycle deterrent paving in the immediate vicinity of the rising bollards to encourage cyclists to ride either side.
- 6.8.2 Where there are high numbers of cycles, consideration should be given to the provision of segregated cycle lanes with a Traffic Regulation Order to prohibit cycling in the authorised motor vehicle lane.

Image: cycle lanes

6.9 **Vehicle detection point**

- 6.9.1 The location of an automatic detection point for authorised vehicles, relative to the rising bollards, needs careful consideration. If the distance is too great, drivers have a tendency to creep forward before the bollards are fully lowered and the indicator has changed to direct the driver to proceed. If, for some reason, the bollards do not fully retract, the driver may be too far forward to see if any part of a bollard remains out of the ground and to see if the indicator has changed to green. This is less of a problem with manual detection as drivers are generally required to stop to physically operate the detection system.
- 6.9.2 If the point of detection is too close, drivers may not be able to see if the bollards are fully retracted. Whilst drivers should always be guided by the traffic indicators when deciding when to proceed, it is natural for a driver to want to see the bollards fully lowered.

- 6.9.3 It is recommended that authorised vehicles be required to stop at a prescribed point where the vehicle is intended to be detected. Consideration should be given to providing STOP markings on the road to ensure vehicles stop at the optimum position to be detected. However, at sites where the number of authorised users and frequency of use is small, this may not be necessary. TSRGD does not prescribe the use of these road markings for this purpose and therefore authorisation would be required. A narrower 100 mm. version of the prescribed stop line (TSRGD sign 1001) with the option of a smaller 1200 mm. depth version of the prescribed STOP marking (TSRGD sign 1022) is recommended, which will require authorisation. Stop markings may not be appropriate in environmentally sensitive areas and other ways of indicating where authorised drivers should stop to be detected may need to be considered (See Section 10: Signing - Stop Signs).
- 6.9.4 'STOP' markings may not be appropriate at bollard systems that operate for only part of the time. An alternative marking or reference point should be provided which is made known to authorised users. A kerbside marking or a 100 mm. broken transverse line similar to TSRGD sign 1003.1 may be appropriate.
- 6.9.5 Locating detection systems in advance of rising bollards to avoid authorised vehicles stopping is not recommended. Drivers could become use to bollards dropping to allow vehicle speeds to be maintained. A failure to detect the vehicle could risk a high-speed impact with the bollards. This arrangement would also increase the risk of high speed tailgating incidents.
- 6.9.6 Where a bi-directional system uses a single traffic lane with automatic detection on both approaches, the layout needs to ensure that authorised vehicles, having passed through the rising bollard, do not get detected on the opposite approach. Providing a traffic island on each approach to segregate opposing traffic flows at the detection points is one method of addressing this potential problem.

Image: stop line

6.10 Egress points

- 6.10.1 If rising bollards are used to control access to a particular area, such as a pedestrian or restricted zone, consideration should be given to how egress as well as access is controlled. This is particularly important where the access controls operate only part-time. Physically controlling access and egress at all entry and exit points could make it difficult for unauthorised vehicles that have gained access outside the access-restricted period, to leave the area in an emergency.
- 6.10.2 Having an uncontrolled exit point with entry prohibited by No Entry signs, provides a solution but this can lead to unauthorised users driving the wrong way through No Entry signs to gain access during restricted periods. Using a 'free exit' bollard system where the rising bollards drop for any exiting vehicle, using an inductive loop for detection, is another option but this is not

recommended for busy sites where tailgating incidents can be a particular problem.

6.11 **Equipment Cabinets**

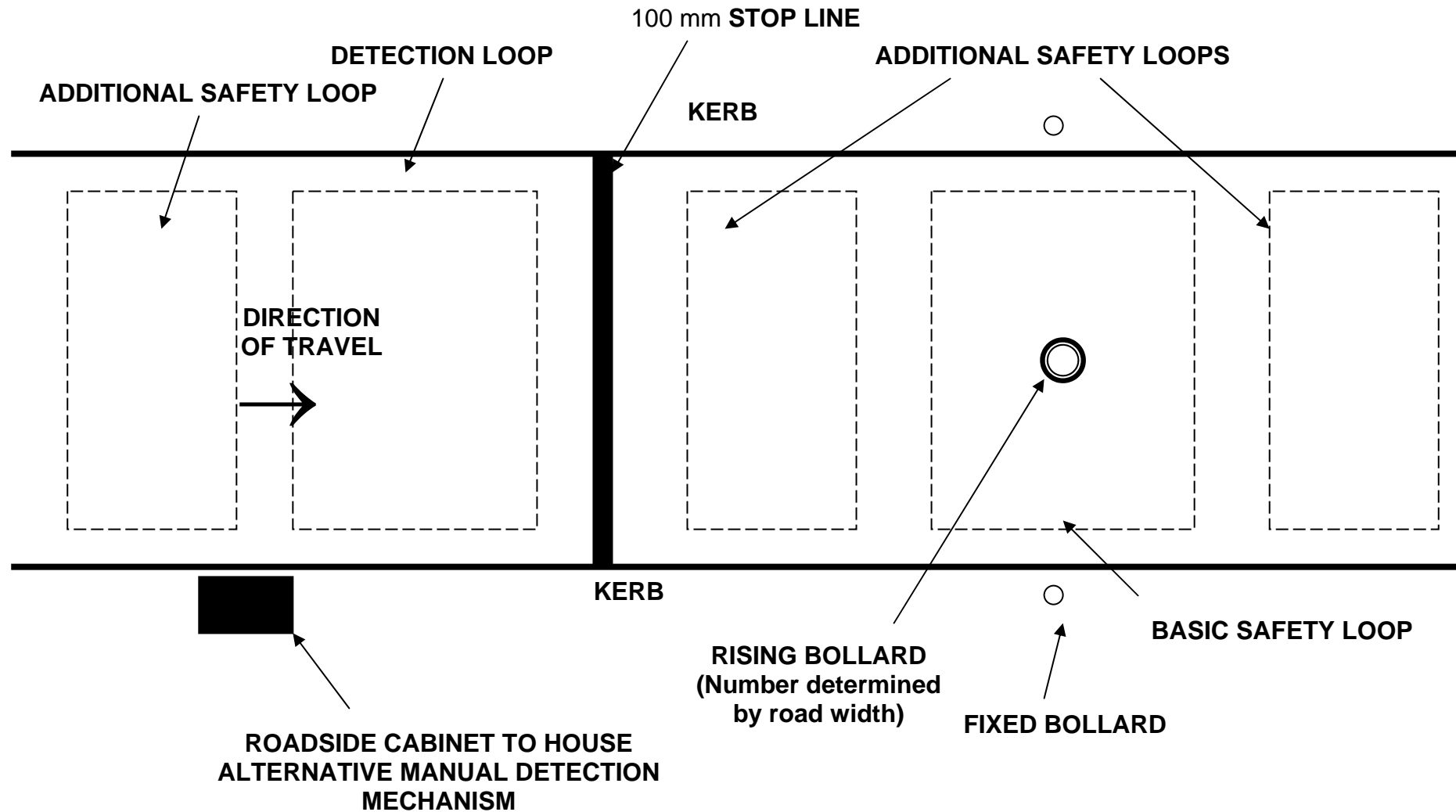
6.11.1 Many rising bollard systems use a street cabinet to house equipment. These should be located so as to allow easy access for system operation and maintenance and to minimise the risk of damage from motor vehicles. This can be a particular problem for cabinets that house traffic indicators and need to be clearly visible to authorised users operating the rising bollards. Locating static bollards around the cabinet could reduce any impact from motor vehicles. If placed on a footway, cabinets should be located so as to minimise the effect on pedestrian movements.

6.12 **Typical design layouts**

6.12.1 Layout No. 1 shows a typical layout for a one-way rising bollard system with automatic and manually operated detection systems. Layout No. 2 shows a typical layout for a bi-directional rising bollard system with automatic detection using a single traffic lane. Layout No. 3 shows a typical layout for a bi-directional rising bollard system with automatic detection with a traffic lane for each direction.

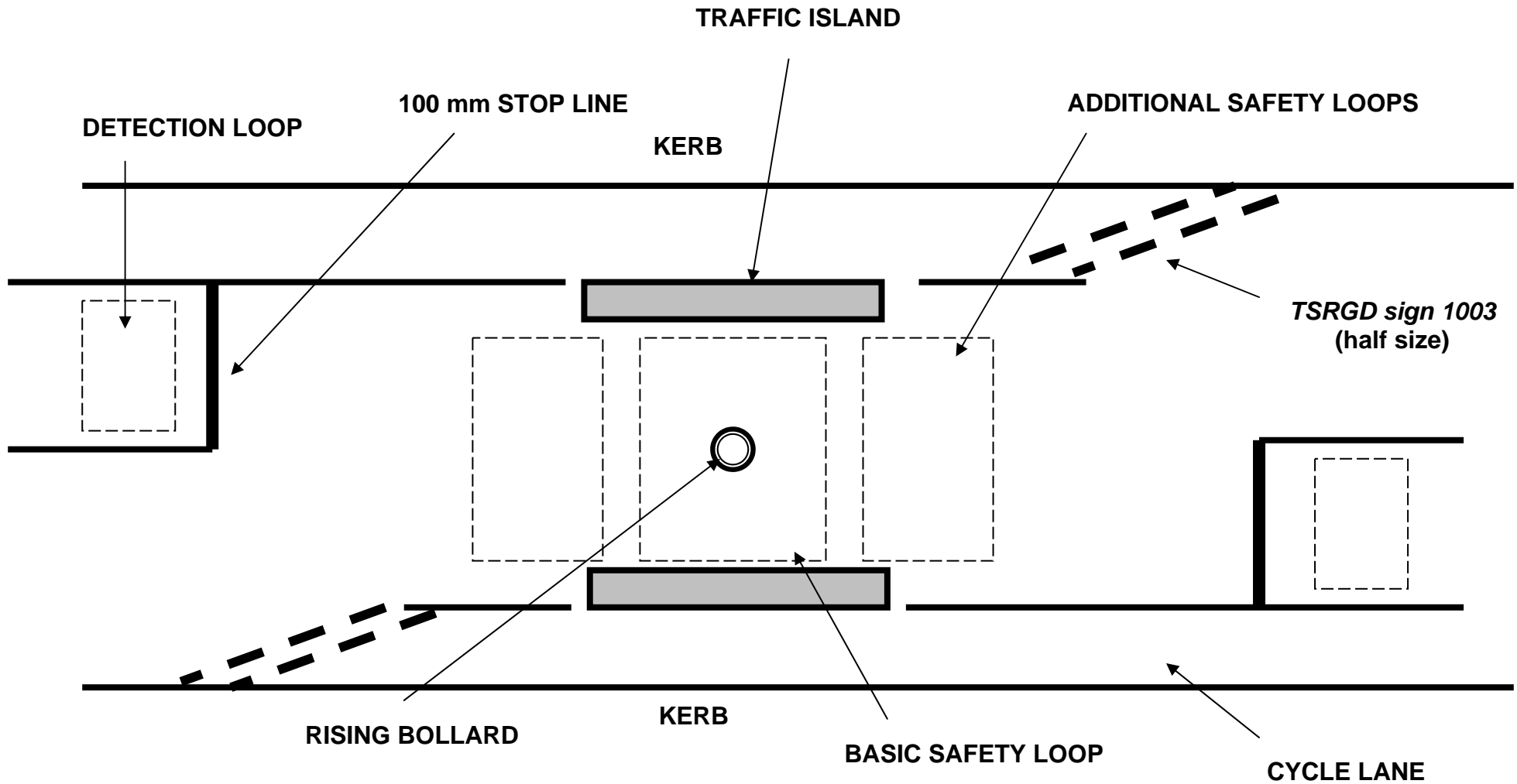
6.12.2 Safety loops can interfere with road surface antenna if placed in close proximity. Therefore, site tests are recommended involving the laying of test loops and antenna to check performance before confirming the design layout.

LAYOUT No. 1: One-way rising bollard system with automatic and manually operated detection system



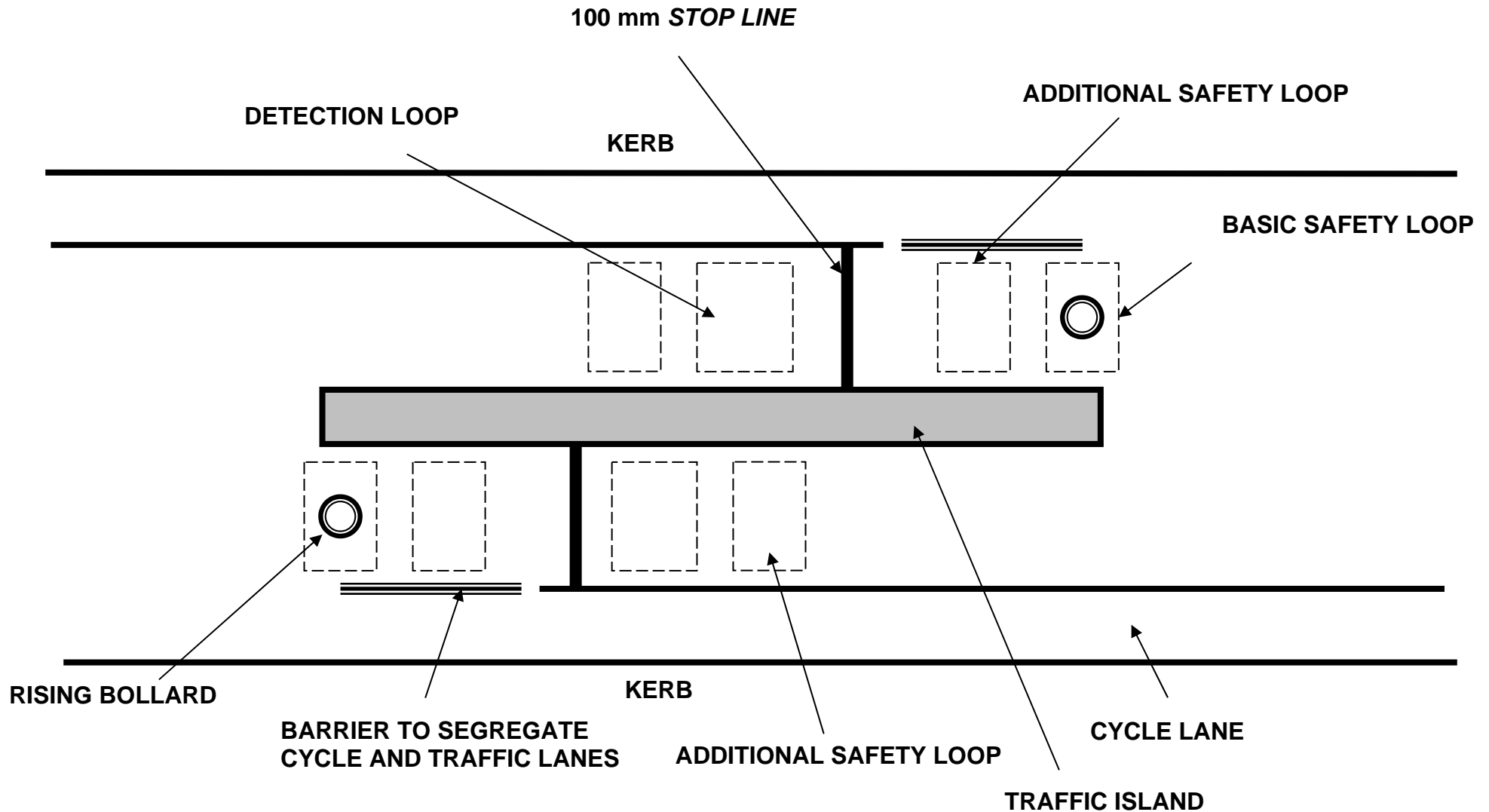
NOT TO SCALE

LAYOUT No. 2: Bi-directional rising bollard system with automatic detection using a single traffic lane



NOT TO SCALE

LAYOUT No. 3: bi-directional rising bollard system with automatic detection with a traffic lane for each direction



NOT TO SCALE

SECTION 7: RISING BOLLARD OPERATION

7.1 Basic Procedure

Rising bollard operation generally involves the following basic procedure:

1 An authorised vehicle approaches the rising bollard and is detected by an automatic or manually operated detection system

It is recommended that the vehicle is required to stop at a prescribed point where the vehicle is intended to be detected. Consideration should be given to STOP markings to ensure drivers stop at the optimum position for the vehicle to be detected. TSRGD does not prescribe any road marking for this purpose and therefore authorisation would be required (see Section 6: Site Layout Issues - Vehicle Detection Point).

At this stage the system indicator will be showing a red indicator or other similar indication by VMS.

2 Upon successful detection of the vehicle, the control system lowers the rising bollard

At this stage the system indicator will continue to show a red indicator or similar VMS indication.

3 When the full retraction of the bollard is confirmed by the bollard switches, the indicator will change to display a green indicator or similar VMS indication

Upon seeing a green indicator, the driver can then proceed.

4 As the authorised vehicle proceeds and is detected by the safety loop system, the traffic indicator changes back to red

5 When the vehicle has been detected passing over all the safety loops, in the correct order, if the safety loops are sequenced, and has cleared all safety loops, the bollard will then rise

If, during the raising of the bollard, another vehicle is detected by the safety loop system, the bollard will reverse to go down again until such time as the safety loops no longer detect a vehicle. Once the safety loops are clear of any vehicle, the bollard will then be raised once again.

If, for any reason, a vehicle is required to stop on the safety loop system, the bollard will be held in the down position until such time as the safety loops are no longer detecting a vehicle.

6 Once the raising of the bollard is completed and confirmed by the bollard switches, the system is then ready to respond to the next authorised user

Where a queue of authorised vehicles could be expected, it may be appropriate to configure the bollard system so that if another authorised vehicle is recognised by the control system as the bollard is rising, the bollard would be lowered again before it is fully raised. Once the bollard is fully retracted, as confirmed by the bollard switches, the indicator would change to green to indicate that the next authorised vehicle may proceed. This reduces the time taken to allow access for each authorised user.

7.2 Bi-directional systems

7.2.1 With rising bollard systems that allow authorised users in both directions, using a single traffic lane, the same basic operational protocol should be used but the control system will need to prioritise which authorised user is permitted access first. The control system should be able to validate and store a demand from each direction and identify the direction from which it came. The simplest way to prioritise demand when authorised users approach from both directions is on a first come, first served basis, however, it could be configured to give priority to any emergency service vehicle. Safety loops will need to be sequenced to allow the bollard system to identify in which direction a vehicle has passed through.

Image: bi-directional system

7.3 Start up arrangements

7.3.1 Many rising bollard systems operate 24 hours a day and as such do not require a start up procedure other than when a repair or maintenance is undertaken. In these circumstances the attending personnel would restart the systems following visual checks for approaching traffic. However, many bollard sites operate for only part of the day and week and therefore regular start up arrangements are required.

7.3.2 A timer can be used to switch on bollard systems automatically at a pre-determined time. However, even with warning devices on the approaches such as variable message signs, wig-wag type warning signs or vehicle detection loops to delay the switch on if a vehicle is detected on the approach, this arrangement is generally not recommended. Automatic switch on or start up from a remote site would avoid the need for attendance on site but is only recommended where cctv is installed to provide a clear view of the bollard site and the approaches or at sites where the highway layout ensures vehicle approach speeds are very low. Automatic start up arrangements would require very careful consideration during the risk assessment. The costs involved in providing an automatic start up method would need to be compared with the running costs associated with on site manual switch on and balanced against the relative risks for each start up method.

7.3.3 Attendance on site to switch on bollard systems gives an opportunity to undertake routine monitoring which is considered an important aspect of managing rising bollard systems on the highway. This is considered in Section 12: Management and Monitoring.

SECTION 8: OPERATIONAL ISSUES

8.1 Tailgating

- 8.1.1 Tailgating is the most frequent problem associated with rising bollard operation. Drivers of unauthorised vehicles, who fail to be aware that rising bollards are in operation, can follow behind authorised vehicles. Once the authorised vehicle clears the safety loop system, the lowered bollard will then start to rise, possibly bringing it into conflict with any tailgating unauthorised vehicle or even an authorised vehicle, whose driver does not wait until a green indicator is displayed.
- 8.1.2 To minimise the risk of tailgating, careful consideration should be given to the location and amount of signing necessary to draw driver attention to the presence of rising bollards. At sites with high numbers of authorised users, where the risk of tailgating is greater, the use of interactive or wig-wag style signing should be considered. Department for Transport authorisation should be sought as required (see Section 10: Signing).
- 8.1.3 Careful consideration should also be given to the layout of the safety loop system to achieve the right balance between the safety of tailgating drivers and the need to control the level of unauthorised access. Making it too easy for unauthorised vehicles to gain access, may avoid tailgating incidents but may also undermine the purpose of operating rising bollards (see Section 5: Basic System Components).
- 8.1.4 Rising bollard systems should be well publicised to ensure local drivers are aware of their operation on the highway.

8.2 Vehicles reversing

- 8.2.1 Where automatic detection is used, authorised users will, from time to time, fail to be detected as they pull up to the detection point. This may then require the vehicle to reverse to allow the vehicle to be detected. Authorised users should be instructed to leave adequate room for an authorised vehicle in front to reverse if required.

8.3 Vehicle speeds

- 8.3.1 The reduced traffic levels achieved by rising bollard enforcement can result in increased speeds of those vehicles with authorised access. This can be a particular problem in pedestrianised areas where the benefits achieved by reliable access control can be undermined by fewer but faster vehicles. Granting access to authorised vehicles can, in some cases, be made conditional. Setting a maximum speed limit for authorised users can allow their access to be revoked if users are found to be exceeding the speed limit. Similarly, in pedestrianised areas, authorised users can be required to give way

to pedestrians at all times with access revoked if authorised users fail to observe pedestrian priority (see Site Study 1: Cambridge Historic Centre Pedestrian Zone). Traffic calming measures could also address any problems with increased vehicle speeds, although the costs need to be carefully weighed against the scale of the speeding problem.

8.4 Pedal Cycles

8.4.1 Safety loop systems should be sufficiently sensitive to retract or hold down a bollard if a pedal cyclist rides close to it as it is rising or about to rise.

8.4.2 Once lowered by the detection of an authorised vehicle, rising bollards are only raised again by the passage of a motor vehicle across the safety loops. Safety loops can mistake a group of cyclists as a motor vehicle. If a group of cyclists rides into the space between an authorised vehicle and lowered bollards, this can trigger the raising of the bollard before the authorised vehicle passes through the closure point. It may be necessary to provide a physical barrier to prevent cycle access to the space between the detection point and the rising bollards to address this problem but it should be recognised that this potential problem is only likely at sites with significant levels of pedal cycles.

Image: cycle barrier

8.5 Pedestrians

8.5.1 At some locations pedestrians may be using the highway in the vicinity of rising bollards. To minimise the risk of injury, the pressure in the hydraulic or pneumatic system powering the bollards should be adjusted so that the weight of a pedestrian standing on a bollard should be sufficient to prevent the bollard from rising. At some sites this has led to problems with pedestrians deliberately standing on bollards to cause the system to go into fault, resulting in it switching itself off. Again, a balance needs to be struck when considering these potentially conflicting problems. Consideration could also be given to an audible warning for pedestrians when the bollards are in motion (See Section 6: Site Layout Issues – Pedestrians) .

8.6 Detection system interference

8.6.1 Multiple road surface antenna (loops), operating in the same area, can experience and cause interference that can impair the detection read range of transponders. Bollard manufacturers need to ensure that systems are linked to synchronise the technology to avoid interference and maximise the detection system read range.

8.7 **Operational hours**

- 8.7.1 If used to enforce access restrictions, rising bollards should operate throughout the whole period that the restrictions apply. Only operating rising bollards during part of the restricted period could confuse drivers who may then consider that the access restriction only applies when and if the rising bollards are in operation. This could exacerbate any problems of tailgating if rising bollards come into operation during, rather than at the start of a restricted period.

SECTION 9: FAILURE MODES AND EMERGENCY OPERATION

9.1 Failure modes

- 9.1.1 As with any system, rising bollards will not always operate correctly on all occasions. Bollard systems should fail to a safe state with the bollards fully retracted. In the event of a power failure, the control system should allow the bollards to drop under gravity to ensure that access is maintained. When a bollard system goes into fault, any traffic indicators should also switch off. Similarly, variable message signs being used as an indicator should also switch off or change to show a blank face. If, for any reason, the bollards fall to lower when the system goes into fault, the red indicators should remain on. However, any mandatory signing for the Traffic Regulation Order being enforced should be maintained during the times of operation irrespective of whether the rising bollards are operating or not.
- 9.1.2 With two-way systems that provide a separate traffic lane for each direction, if the rising bollards in one traffic lane fail for whatever reason, the bollards in the other traffic lane should also go into fault unless each lane is controlled at by bollards during differing time periods. This will avoid unauthorised vehicles attempting to use the wrong traffic lane to bypass the bollard system. If the bollards in each traffic lane are independent systems, suitable linking should be provided to allow both to go into fault simultaneously.

9.3 Emergency operation

- 9.3.1 Vehicle detection systems are also liable to fault and backup arrangements need to be considered for the emergency services. The most common backup system involves the provision of a locked manual operation panel similar to that provided at all traffic signal controllers. Keys should be issued so that in the event of a bollard system failing to respond to an emergency service vehicle, the driver can open a panel to access manual operating switches. The emergency services should be encouraged to ensure that the manual panel is locked after use to avoid others manually operating the bollards. In emergencies, this may not be practical and in these circumstances the emergency services should be encouraged at the earliest opportunity to inform whoever manages the bollard system that the manual panel is unlocked to enable action to secure it as soon as possible.
- 9.3.2 Accidents or incidents may cause damage that prevents a bollard being unable to retract to the normal fault state. The bollard control system should be capable of monitoring the status of the bollards as they rise and lower to detect if this state occurs. This should then trigger a fault message by modem, radio or hard wire link to effect emergency repairs.
- 9.3.3 Bollard systems can be fitted with a dial up facilities to allow them to be switched off remotely. This may be useful at more remote sites. Combining a

dial up facility with cctv coverage would allow effective management of system faults.

Image: emergency panel

SECTION 10: SIGNING

The provision of clear signing to satisfy Department for Transport requirements is key to successful rising bollard operation. Given the willingness of some drivers to ignore access restrictions, clear and effective warning signing are required to minimise the risk of conflict between rising bollards and unauthorised vehicles. The extent and type of the signing provided should reflect the exact nature and timing of the access restriction and the traffic levels at the site. Signing aspects need to be given careful consideration at an early stage as part of the risk assessment process.

There are five elements to signing for rising bollards; advanced information signs to direct unauthorised drivers to alternative routes to avoid rising bollards, advance warning signs to indicate the use of rising bollards and the nature of the traffic restriction ahead, mandatory signing to allow the traffic restriction to be enforced and to permit the use of rising bollards, signing to direct authorised vehicles to stop and, if required, an information sign at the rising bollards to direct authorised users how to proceed through the rising bollards.

10.1 Advance information signs

10.1.1 These could take the form of map type or stack type direction signs that incorporate a mandatory prohibition sign, indicating the nature of the traffic restriction being enforced by rising bollards, along with a warning sign (TSRGD sign 562) with a supplementary plate indicating rising bollards. An alternative could involve the use of a No Through Road sign (TSRGD sign 816) with a supplementary plate indicating those vehicles exempt from the traffic restriction rather than using a mandatory prohibition sign.

10.2 Advance warning signs

10.2.1 TSRGD does not prescribe a specific warning sign for rising bollards. It is recommended that TSRGD sign 562 with a "Rising bollards" supplementary plate is used but authorisation is required for each site. A distance plate or direction arrow could be included if required (TSRGD sign 573). This type of sign can be combined with a sign to indicate the nature of the traffic regulation order that the rising bollards are enforcing.

Image: warning sign

10.3 Mandatory signs

10.3.1 The mandatory signs provided at the rising bollard closure point should conform with TSRGD to allow rising bollards to be used as an enforcement tool. For access restrictions TSRGD signs 617 and 619 are the most commonly used. However, some highway authorities have used No Entry signs TSRGD 616 with a supplementary plate to indicate those classes of motor vehicles exempt from the access restriction. No Entry signs are perhaps more readily recognised and

more widely understood than other access restriction signs but TSRGD does not prescribe their use for signing many of the access restrictions that rising bollards are being used to enforce and, therefore, authorisation is required for each site.

- 10.3.2 Pedal cycle access should be segregated wherever possible if No Entry signs are proposed as Department for Transport advise indicates that any authorisation for such signs would not include pedal cycles (See Section 6: Site Layout Issues – Pedal Cycles). At some rising bollard sites, changing from prohibition of motor vehicles signs (TSRGD sign 619) to No Entry signs (TSRGD 616) has helped reduce the incidents of tailgating accidents involving unauthorised vehicles.
- 10.3.3 An alternative approach for bus gates controlled by rising bollards is the use of TSRGD sign 953.

Image: mandatory sign

10.4 Stop signs

- 10.4.1 Authorised vehicles should be required to stop to allow drivers to check the indicator prior to passing through rising bollards. A special 100 mm. wide stop line and 1200 mm. depth STOP road marking to TSRGD signs 601.1 and 1002.1 can be used to indicate the point at which to stop (see Section 6 Site Layout Issues – Vehicle Detection Point). TSRGD does not prescribe their use for this purpose and authorisation should be sought from the Department for Transport.
- 10.4.2 At sites where rising bollards are operated part time, the use of a stop line and STOP marking may be confusing for drivers when the bollards are not operating. A variable message sign to display a STOP sign (TSRGD sign 601.1) when the bollard operates could address this but alternatively a 100 mm. broken transverse road marking similar to TSRGD sign 1003.1 could be used to indicate the point where authorised vehicles should stop to check the indicator.

10.5 Traffic indicator sign

- 10.5.1 Traffic advisory leaflet 4/97 indicates a sign to inform drivers how to pass through rising bollards. The sign should be erected in close proximity to the traffic indicator to which it refers.
- 10.5.2 Whilst the sign gives useful information about when to proceed through the bollards there is a concern that it gives a mixed message to unauthorised drivers who could see a sign advising how the bollards operate whilst at the same time seeing mandatory signing that indicates that they are prohibited from passing through the bollards. Locating the advisory leaflet sign in close proximity to the traffic indicators to avoid drivers seeing the sign on the approach to the bollards may address this problem.

- 10.5.3 Rising bollards could be used to enforce one-way street or “except for access” traffic regulation orders. Potential, this could involve all types and classes of road users operating the rising bollards. In these circumstances where there may be large numbers of ‘one-off’ or ‘first time’ users, the use of the traffic advisory leaflet sign both in proximity to the traffic indicators and on the approach to the rising bollards is recommended.
- 10.5.4 Where rising bollards are used to enforce traffic regulation orders which only allow access for limited types and classes of road user and where the users regularly gain access, such as at bus gates or permit controlled pedestrian zones, it may not be necessary to use the traffic advisory leaflet sign.

Image: indicator sign

10.6 Extent of signing

- 10.6.1 The amount and extent of signing to be provided will depend on site layout and the level of use. At lightly trafficked sites, where the number of authorised vehicles is low and where traffic is mainly local to the area, signing may be more localised. Similarly, if rising bollards are installed at established road closures, to permit access for selected vehicles, limited signing may be appropriate.
- 10.6.2 Where rising bollards are installed on routes without previous access restrictions, which may have been used by through traffic, extensive signage may be necessary to convey a clear warning to drivers, at least initially.
- 10.6.3 Where rising bollards are to be used in environmentally sensitive areas the desire to avoid creating visual intrusion from extensive signing should not undermine safety. It may be appropriate to install extensive signing initially and then reduce the amount over a period of time as the use of rising bollards becomes established.

10.7 Interactive and Wig-wag signing

- 10.7.1 At busy rising bollard sites where access restrictions have been introduced on routes that previously had significant volumes of through traffic, consideration should be given to the use of interactive signs to highlight the presence of rising bollards. Approaching vehicles could trigger the interactive sign to display a suitable warning message. An alternative would be to use fixed signing with wig-wag signals triggered by approaching traffic to reinforce the warning. In both cases site authorisation should be sought from the Department for Transport. Wig-wag signing may be best located at a suitable turning point where unauthorised drivers have an opportunity to re-route to avoid the rising bollard.

- 10.7.2 Any wig-wag style signing should only use amber lenses. Wig-wag signs should not be located near to any traffic signals or signalled crossing point where the flashing amber signal could be misleading to drivers.
- 10.7.3 Interactive and wig-wag style signing can be visually intrusive and particular care should be taken when identifying sign locations in environmentally sensitive or residential areas.

Image: wig-wag sign

SECTION 11: AUTHORISED USERS

Authorising access through rising bollard systems requires careful management with adequate training being given before any authorised user is permitted to operate rising bollards. Without this, there is a risk that authorised users may come into conflict with rising bollards, possibly resulting in litigation.

11.1 Authorisation process

11.1.1 A formal authorisation process is recommended for all authorised users with clear instructions being issued on how and how not to use rising bollard systems. A written record should be kept for each authorised user confirming that training has been given.

11.1.2 Clear and simple instructions should be formally issued to all authorised users. Where access is authorised for regular users, drivers should have few problems using rising bollards, given clear operating instructions. However, operational management becomes more difficult when authorised access is granted for a particular purpose or need such as for loading and unloading vehicles, where the drivers may change regularly.

11.2 Training

11.2.1 It may be appropriate for the authorisation process to involve actual on-site training with the bollard system but if there are a large number of authorised users, such as with city centre bus gates where large numbers of buses and taxis may be allowed access, the use of a training video may be appropriate.

11.2.2 The training for authorised users should give clear and simple step-by-step instructions on how to proceed and should explain the basic safety measures employed to prevent damage to either rising bollards or authorised vehicles. The instructions should reflect the type of detection methods used to identify authorised vehicles. This will give authorised users confidence when they start using the system

11.2.3 It is particularly important to ensure the emergency services are trained to operate rising bollards. Like any technology, rising bollards can be subject to system failures and a backup method of gaining access is advisable for the emergency services (see Section 9: Failure Modes and Emergency Operation).

11.3 Transponders

11.3.1 If a transponder based detection system is being used, the manufacturer's recommendations on vehicle fitting should be issued along with the transponder.

SECTION 12: MANAGEMENT AND MONITORING

12.1 Day to day management

- 12.1.1 Effective management is considered vital to the credibility of rising bollard systems, which can be open to criticism if not managed efficiently. Some early systems lacked effective management, resulting in long periods of non-operation thereby undermining confidence and bringing their use and suitability into question. Regular non-operation exacerbates problems of contravention as drivers may soon ignore restrictions without bollard enforcement. It also increases the risk of tailgating incidents when bollard operations resume.
- 12.1.2 A management structure should be established so that authorised users problems and questions from the public can be dealt with effectively. Requests for one-off, temporary or emergency access through rising bollards will inevitably arise on a day to day basis that will require managing. Ensuring faults are attended to quickly and routine maintenance is undertaken should form part of the management role.
- 12.1.3 When considering the use of rising bollards, highway authorities need to take into account not only the costs associated with the installation of bollards but also year on year management costs. Bollard management can be dovetailed with other highway operations to reduce costs.

12.2 Inspection

- 12.2.1 Like other highway operations, bollard systems should be regularly inspected and records kept to monitor performance, check safety and provide evidence in any possible litigation.
- 12.2.2 The staff resources and the frequency of checks should reflect the level of use of each particular rising bollard site. For busy sites it is recommended that sites be checked frequently to confirm and record the basic operation of the system. At sites where few vehicles are permitted access, less frequent checks may be more appropriate. The frequency of checks is a matter of judgement for each highway authority. Bollard operating checks via automatic monitoring or cctv systems may provide an alternative to on-site checks. Site checks should also include signing, particularly if interactive, variable message or wig-wag style warning signs are used.

12.3 CCTV

- 12.3.1 Consideration should be given to providing cctv at rising bollard sites. At busy, urban sites, the risks of tailgating are greater and cctv monitoring can be useful to monitor operations and provide evidence in any cases of litigation arising from tailgating incidents.

- 12.3.2 At more remote sites or in some residential areas where there may be a greater risk of vandalism, cctv should be considered. However, highway authorities will need to judge the benefits against the installation and running costs for cctv. Experience suggests that the benefits can outweigh the costs, particularly at busy sites where tailgating and the subsequent risk of litigation may be a problem.
- 12.3.3 Cameras should, if possible, be capable of identifying vehicle registration plates and viewing the bollard indicators as vehicles pass through. Video footage can often be particularly useful in resolving disputes if authorised or unauthorised vehicles strike rising bollards. Suitable arrangements need to be made for the storage of camera images to ensure compliance with the Data Protection Act.
- 12.3.4 Camera systems linked to video recorders housed on site can reduce the high costs often associated with camera communication links to remote sites. However, video tapes require changing regularly but it may be possible to co-ordinate this with site inspection visits. Camera systems now exist that can capture images only when triggered by particular events. Triggering camera operation when a bollard is rising and the safety system is also detecting the presence of a vehicle can be a useful way of capturing tailgating incidents.
- 12.3.5 Linking rising bollard systems to traffic signal remote monitoring systems may also be possible which can allow early identification of system faults. Rising bollard and traffic signal manufacturers should be consulted on the compatibility of each system.

Image: cctv

SECTION 13: MAINTENANCE AND REPAIR

13.1 Maintenance Arrangements

- 13.1.1 Regular maintenance is vital in securing reliable rising bollard operations and highway authorities should ensure that appropriate arrangements are made to undertake routine maintenance. The frequency of maintenance needs to reflect the level of use and arrangements should be adapted in the light of experience.
- 13.1.2 Maintenance arrangements should also consider the need for emergency repairs to avoid, in the worst case, access being denied for any length of time if a rising bollard fails to fully retract, if damaged.
- 13.1.3 Only suitably trained personnel should be permitted to work on rising bollards. Some highway authorities have made local arrangements for emergency repairs to avoid any lengthy delays when bollard manufacturer's engineers travel to site. In these circumstances local engineers should be trained and approved by the relevant bollard manufacturer before they are permitted to work on a bollard system.
- 13.1.4 To reduce maintenance contract costs, neighbouring highway authorities could consider joint contract arrangements. As well as reducing costs it may allow bollard manufacturers to develop more locally based maintenance teams. Local storage of spare parts will allow any operational down time to be minimised. The availability of a spare bollard unit may allow a damaged unit to be removed and a new unit connected quickly to allow operations to recommence while the damaged unit is taken off site for repair and then eventual reuse.
- 13.1.5 Record sheets should be kept of all routine maintenance and repair work as part of the monitoring process. This will allow the identification of repetitive faults for feedback to the manufacturers to facilitate design improvements.

13.2 Contacts

- 13.2 Highway authorities should ensure that clear contact arrangements are in place. This is considered particularly important for the Police, outside of normal office hours, as they are likely to be who the public contact in any emergency. Consideration should be given to providing emergency contact details on site.

13.3 Safety

- 13.3.1 Method statements should be agreed with maintenance engineers to ensure that safe methods of working are followed when maintenance or repair work is undertaken. Whilst these may be generic in nature, the particular requirements of each site layout should be considered.

SECTION 14: BOLLARD SYSTEM COMMISSIONING

14.1 Site commissioning

- 14.1.1 Careful consideration should be given to how rising bollard systems are installed and then commissioned. Where well-established road closures are being adapted to allow greater access, for authorised users, traffic management and commissioning is generally not a particular problem. However, where new bollard enforced access restrictions are being introduced on routes where traffic generally has access, installation and commissioning can be problematic. A formal commissioning process with appropriate documentation should be undertaken before a highway authority adopts a rising bollard system. This should involve a joint manufacturer-highway authority presence on site to test all aspects of the operation.

14.2 On-site testing

- 14.2.1 Road closures could be considered to allow safe conditions for installation, but the commissioning process requires each element of the system to be checked in operation. Whilst bollard system manufacturers should undertake as much testing as possible at the factory, some on-site testing with authorised users may be necessary before a system is accepted. It is recommended that bollard system manufacturers be required to monitor the on-site operation for a suitable period to ensure that all aspects of the system are working correctly and are properly co-ordinated.

14.3 Risk Assessment

- 14.3.1 A risk assessment for on-site testing should be carried out by the highway authority with the manufacturer and suitable numbers of staff provided on site to monitor the safe testing of all system aspects. The costs involved should be allowed for in the tendering process.

14.4 Post commissioning monitoring

- 14.4.1 Once commissioned it is important that rising bollard systems are monitored closely during the first few weeks of operation to assess the need for any operational or layout changes. Feedback should be sought from authorised users and other highway users including cyclists and pedestrians. Any changes should be made and assessed before the final safety audit is undertaken. Particular attention should be given to safety loop operation, the detection system and signing issues.

SECTION 15: BOLLARD SITE INDEX

LARBUG maintains an index of some rising bollard systems on the highway. The index gives details for sites including:

- location
- type of application
- hours of operation
- traffic regulation order
- installation date
- system manufacturer
- inspection and maintenance regimes
- Local Authority contacts

The index is available via the LARBUG website (www.risingbollards.org.uk).

SECTION 15: APPLICATIONS AND SITE STUDIES

Pedestrianised Areas

Many of the early rising bollard systems were installed to enforce access restrictions in pedestrianised streets and zones or other similar traffic restricted areas.

Many systems operate for part of the day and/or week to ensure effective enforcement of access controls during the busiest pedestrian periods.

See Site Studies 1-3

Bus gates

With many highway authorities promoting the use of public transport as an alternative to car dependency, bus gates are becoming an increasingly common use of rising bollard enforcement.

Many sites permit access for taxis as well as buses and as such the numbers of authorised vehicles is generally much higher. When introduced on routes previously used by all traffic, tailgating can be a particular problem, at least initially. Clear signing is a key requirement in these situations.

See Site Studies 4-6

Congestion control closures

As congestion builds in many towns and cities, drivers seek alternative routes to bypass delays which may be inappropriate. Rising bollards can be used to control vehicular access on alternative routes at peak periods. If appropriate, the rising bollards can be turned off during off peak periods, when through traffic is not a problem, to minimise inconvenience for local residents, shops and businesses. Legislation now exists to allow Local Authorities to levy road charges to reduce congestion. Rising bollards can be used to enforce congestion charging mechanisms.

See Site Studies 7 & 8

Site Study 1: Cambridgeshire County Council

Location	Historic Centre Pedestrian Zone, Cambridge
Contact	Richard Preston Environment and Transport Department Cambridgeshire County Council Castle Court Shire Hall Cambridge CB3 0AP Tel: 01223 717780 Email: richard.preston@cambridgeshire.gov.uk
System details	2 bollard systems located in St. John's Street and Senate House Hill The St. John's Street site consists of twin rising bollards on a one-way street operated by either car reader or transponder with a 2 aspect traffic indicator and acts as the main entrance to the pedestrian zone area The Senate House Hill site consists of a single rising bollard operated by either car reader or transponder with a 2 aspect traffic indicator and acts as an exit point for authorised users
Period of bollard operation	St. John's Street: 10 am to 4 pm, Monday to Saturday Senate House Hill: at all times with egress allowed for authorised users only between 10 am and 4 pm, Monday to Saturday
Traffic regulation order	Motor vehicle access prohibited between 10 am and 4 pm, Monday to Saturday except for emergency services and authorised users Access prohibited between 8.30 am - 10 am and 4 pm - 6.30 pm, Monday to Saturday except for buses, taxis, disabled badge holders and for the purposes of access to properties within the pedestrian zone area
Authorised users	Between 10 am and 4 pm, Monday to Saturday <ul style="list-style-type: none">• 250 disabled badge holders• 40 University/College staff with off-street parking who work at other sites during the day• 15 security and postal delivery vehicles• 4 residents• 1 free shuttle bus service <p>Authorised users required to observe a 10 mph speed limit and to give way to pedestrians at all times</p>
Start of operation	August 1992

Signing details	St. John's Street: pedestrian zone sign (TSRGD sign 618.3 variant) with warning sign (TSRGD sign 562) with "Rising bollards" supplementary plate Senate House Hill: access restriction sign (TSRGD sign 619 variant) with warning sign (TSRGD sign 562) with "Rising bollards" supplementary plate
CCTV	Not covered specifically by separate cameras but can be monitored by existing city centre security system
Inspection regime	Daily inspection by City Centre Access Team
Maintenance arrangements	Maintenance contract with manufacturer to achieve minimum 85% system operation throughout the year

Image: St. John's Street

Site Study 2: Stockport Metropolitan Borough Council

Location	Bridge Street / Great Underbank, Stockport
Contact	Tim Collins Environment & Economic Development Division Stockport Metropolitan Borough Council Hygarth House 103 Wellington Road South Stockport SK1 3TT Tel: 0161 474 4869 Email: timothy.collins@stockport.gov.uk
System details	2 bollard systems located at either end of the site, each consisting of twin rising bollards operated by car reader with 2 aspect traffic signal indicators
Period of bollard operation	At all times
Traffic regulation order	Motor vehicle access prohibited between 10.30 am and 4 pm except for emergency services, maintenance vehicles and authorised users Entry for access only at all other times
Authorised users	Highway maintenance vehicle (card reader access) Police vehicles (transponder and card reader access) Fire appliances (card reader access) Ambulances (code for combination padlock on manual control panel) Access cards available on request with a deposit if above criteria met Bollards allow entry and exit for all vehicles outside pedestrianisation period
Start of operation	March 2002
Signing details	Pedestrian zone sign (TSRGD sign 618.3 variant) Bollard warning and information sign design based on Traffic Advisory Leaflet
CCTV	Not covered specifically by separate cameras but can be monitored by existing town centre security system Reviewing need for dedicated cameras
Inspection regime	Town wardens Council Direct Services staff

Maintenance
arrangements

First call-out: Stockport Direct Services (Direct Labour
Organisation) staff trained by ATG Access (system
supplier)
Second call-out: ATG Access

Image: Stockport

Site Study 3: Calderdale Metropolitan Borough Council

Location	Halifax Town Centre: conservation area shopping precinct (£1 million highway refurbishment during 2001 aided by Heritage Lottery Fund)
Contact	Richard Binks Calderdale MBC Engineering Services Northgate House Northgate Halifax HX1 1UN Tel: 01422 392927 Email: richard.binks@calderdale.gov.uk
System details	<p>6 bollard systems - 5 twin & 1 triple bollard installations, sited at entries / exits to pedestrian precinct</p> <p>Access by contacting cctv operator via on site Telguard intercom post (also incorporating 2 aspect traffic indicator) Bollards remotely used by cctv operator telephoning the 6 individual Telguard sites</p> <p>Swipe card facility installed but not used due to success of cctv link, manual override keys in use as backup</p> <p>Manual retractable bollards in line with automatic bollards as further backup</p>
Period of bollard operation	Bollards rise at 9.30 am with 'free exit' until 10 am allowing traders vehicles to clear precinct 10 am – 4 pm, authorised users only At 4 pm bollards drop until following day's cycle
Traffic regulation order	No vehicles except authorised users Loading only 4 pm – 9.30 am every day No waiting at any time
Authorised users	10 am – 4 pm <ul style="list-style-type: none">• Emergency Services• Refuse collection• Statutory undertakers• Royal Mail• Bullion delivery• Emergency egress for private parking within precinct• Shop refurbishment / repair contractors• Any authorised by a Police Officer

Start of operation	May 2002
Signing details	Pedestrian Zone sign 618.3 incorporated into hoop sign format, requiring DfT authorisation Separate bollard warning information sign, in hoop format Intercom information plate on intercom post
CCTV	3 town centre security cameras used covering all 6 sites, 1 new camera installed to ensure full coverage of all bollard sites Additional fee paid to cctv monitoring agency to operate bollard system
Inspection regime	Fortnightly inspection by council officer, main fault / incident information reliant upon reports from cctv operator Parking wardens assist with fault clearance (manual override)
Maintenance arrangements	Service agreement with manufacturer: annual service & 24 working hour notice repair call out facility

Image: Halifax

Site Study 4: Cambridgeshire County Council

Location	Emmanuel Road, Cambridge
Contact	Richard Preston Environment and Transport Department Cambridgeshire County Council Castle Court Shire Hall Cambridge CB3 0AP Tel: 01223 717780 Email: richard.preston@cambridgeshire.gov.uk
System details	Bi-directional system with a traffic lane for each direction with one rising bollard in northbound lane and twin rising bollards in southbound lane Both lanes operated by vehicle transponder Segregated cycle lane provided in each direction System linked to pelican crossing located close to bollard system on south approach Pelican crossing pedestrian stage inhibited when southbound lane bollards are lowered Southbound lane bollards inhibited when pelican crossing pedestrian stage running
Period of bollard operation	At all times
Traffic regulation order	Driving of motor vehicles prohibited at all times except for authorised users Cycling prohibited except in cycle lanes
Authorised users	<ul style="list-style-type: none">• 250 buses• 195 hackney carriages*• 400 licensed private hire cars* <p>* Only hackney carriage and hire cars licensed by Cambridge City Council, South Cambridgeshire District Council and District Councils neighbouring South Cambridgeshire eligible for authorised status</p>
Start of operation	August 1999
Signing details	No entry signs (TSRGD sign 616) with warning signs (TSRGD sign 562) with "Rising bollards" supplementary plate No Through Road signs (TSRGD 816) with warning signs (TSRGD sign 562) with "Rising bollards" supplementary plate provided on both approaches to the closure point

CCTV	Camera provided for each traffic lane connected to video cassette recorders housed in street cabinet giving 24 hour recorded footage (tapes changed every other day)
Inspection regime	Daily inspection by City Centre Access Team
Maintenance arrangements	Maintenance contract with manufacturer to achieve minimum 85% system operation throughout the year

Image: Emmanuel Road

Site Study 5: Cheshire County Council

Location	City Centre Busgate, Frodsham Street, Chester.
Contact	Kay Hallas Engineering Service Cheshire County Council Backford Hall Chester CH1 6EA
System details	1 VP700 bollard system located in Frodsham Street. The site consists of twin rising bollards on a busy bus lane operated by either transponder or autotag.
Period of bollard operation	Permanent operation.
Traffic regulation order	Motor Vehicle access prohibited at all times except emergency services, street cleaning vehicles and authorised users.
Authorised users	Local buses, hackney carriages licensed by Chester City Council and cyclists.
Start of operation	November 2002.
Signing details	Local Bus, Cycle, Taxis sign (TSRGD sign 953 variant). With only plate (TSRGD sign 953.2). Black on white warning signs authorised by DfT.
CCTV	Not covered specifically by a separate camera but can be monitored by existing CCTV.
Inspection regime	Inspected by CCC following fault reports.
Maintenance arrangements	3-year Maintenance agreement in place with manufacturer with next working day call out.

Image: Chester

Site Study 6: Buckinghamshire County Council

Location	Church Street, High Wycombe
Contact	Eric Meek Buckinghamshire County Council Transportation Division Wycombe Area Office Easton Street High Wycombe Bucks HP11 1NH
System details	<p>4 bollard system located in Church Street Bus Gate. The site consists of 2 pairs of bollards in a two-way bus gate operated by transponder with a 2 aspect traffic indicator Bollards can be remotely overridden through CCTV control room using a dedicated CCTV camera</p> <p>Site acts as an entry / exit for buses only for a pedestrian sensitive zone (not fully pedestrianised zone) Free exit for any vehicles that accidentally get into the zone</p>
Period of bollard operation	24 hours, 7 days a week
Traffic regulation order	Access prohibited to all vehicles other than buses and emergency vehicles
Authorised users	Buses and emergency vehicles
Start of operation	September 1999
Signing details	No Entry signs (TSRGD sign 616) with "Except buses" supplementary plate
CCTV	Dedicated camera plus roving town centre cameras
Inspection regime	Daily inspection by Area Technician
Maintenance arrangements	Platinum maintenance contract with manufacturer

Image: High Wycombe

Site Study 7: Lancashire County Council

Location	Butler Street, Preston
Contact	Larry Pope Environment Directorate Lancashire County Council Guild House Cross Street Preston PR1 8RD Tel: 01772 264491 Email: Larry.Pope@env.Lancscc.gov.uk
System details	<p>Single rising bollard system located in Butler Street, Preston</p> <p>System consists of a rising bollard which is operated when both the congestion loops on Butler Street give an output, indicating that the queues to a major shopping centre car park are about to encroach on to Fishergate which is the main route from the town centre</p>
Period of bollard operation	<p>At any time when traffic conditions are such that the congestion loops give an output indicating severe congestion</p> <p>When operated the bollard will remain in the raised position for a minimum of one hour</p>
Traffic regulation order	<p>The order provides that any vehicle proceeding in Butler Street in a southbound direction, with the intention of entering the Fishergate Centre car park will be prevented from doing so, when the car park is closed, by a bollard, which is adjacent to the southernmost point of the Railway Station Forecourt</p> <p>When the bollard is raised, a No Entry sign will be displayed to prevent access to the car park at times of high usage</p>
Authorised users	Emergency vehicles only
Start of operation	January 2002
Signing details	<p>Butler Street: 2 secret signs (TSRGD sign 616) and 2 signs TSRGD 562 with "Rising bollard" supplementary plate</p> <p>Fishergate: 1 LED variable message sign, which displays "CLOSED"</p> <p>Corporation Street: 1 LED variable message sign, which displays "CLOSED"</p>

CCTV	2 cctv cameras monitoring both the bollard and Butler Street, with monitoring facilities at the Fishergate shopping Centre and Lancashire County Council's UTC control room, with automatic recording facilities
Inspection regime	Monthly inspections by Lancashire County Council technicians
Maintenance arrangements	Maintenance contract with traffic signal maintenance contractor

Butler Street Operational Note

The bollard is operated manually by security staff from the Fishergate Centre. A cctv monitor has been installed in the Fishergate Centre Control Room. Audible warning facilities and warning lights have also been provided in the Fishergate Centre.

1. When the first congestion loop "A" on Butler Street becomes activated an amber lamp will be illuminated, this is to inform/warn the staff in the Fishergate Centre of the current highway status.
 - The output from this loop will automatically activate the cctv which will start to record all activities on Butler Street, including the congestion loops and bollard equipment, the monitoring facilities are housed in the UTMC control centre Winckley House
 - The cctv monitor is always active in the Fishergate Centre control room
2. If the congestion becomes so bad that the second congestion loop "B" becomes activated the audible unit will sound in the Fishergate Centre and a Red Lamp will be illuminated.
The audible unit has to be cancelled manually by a push button.

The output from the congestion loop "B" will automatically trigger the following sequence of events:

- The legends displayed by the two (VMS) variable message signs, one on Corporation Street and one on Fishergate will display the legend "CLOSED" referring to the Butler Street entrance
- Lower section of the secret signs will display the rising bollard warning symbol

At this stage the bollard should be raised manually by opening the small side door on the bollard cabinet, then turn and hold the AUTO/DOWN UP switch to the UP position. (This switch will self-centre when the bollard has been raised). The bollard will only operate when both amber and red lights are illuminated.

(This will then set off the following sequence of events described below).

3. When the bollard is activated Traffic Indicator's (Red/Green) (100mm lenses) near to the rising bollard will change from green to red and at the same time twin wig-wags (amber flashing lights) will start to flash. This will also trigger secret signs (top half) to be displayed (No Entry) the bottom half of the sign as detailed above will also remain in the active state.
 - There is a short time delay before the bollard is raised, to enable the secret signs, wig-wags and traffic indicator's to be displayed.
 - When the bollard is being raised an audible warning will automatically sound to warn any pedestrians in the vicinity of the rising bollard.
4. The bollard will remain in the raised position for a minimum period of 1hour.
5. The bollard will lower automatically after one hour and the variable message signs, and secret signs will automatically return to an inactive state.
6. Fixed signs have been erected to advise drivers of the (recommended route) to the Fishergate Centre. And Town Centre car parks
7. For fault monitoring the bollard equipment, congestion loops, secret signs and variable message signs have been connected to a remote monitoring computer system in the UTMC control room at Winckley House, via a BT line and a Siemens (OMU) outstation monitoring unit) This records all activities of the on-site equipment.

At the first sign of any emergency situation at the Fishergate centre the bollard (SHOULD IT BE IN THE RAISED POSITION WILL BE LOWERED) to the down position until the incident has been cleared, and the all clear has been given.

Emergency arrangements: The red emergency button inside the bollard cabinet to be pressed in all emergency situations. This will lower the bollard immediately. Two keys to operate the system have been issued to security staff.

Image: Preston

Site Study 8: Durham County Council

Location	Durham City Road User Charge Scheme, Historic Peninsula
Contact	John McGargill Environment and Technical Services Department Durham County Council County Hall Durham DH1 5UQ Tel 0191 3834635 Email: john.mcgargill@durham.gov.uk
System details	Single bollard located in the exit carriageway of Saddler Street at entrance to Durham Market Place and Historic Peninsula The site consists of an automatic bollard linked to a payment machine in the centre of the carriageway operated by means of either :- £2 cash payment Presentation of a single use exemption card Presentation of a multi use exemption card Vehicle transponder Operated remotely from the NCP Parking Office Used by approximately 300 vehicles per day
Period of bollard operation	Monday to Saturday 10 am to 4 pm
Traffic regulation order	Road User Charge Order under the Transport Act 2000 No Entry (to prohibit exit through entrance side) Loading and Waiting restrictions in Market Place and Saddler Street
Authorised users	2 shuttle bus services Holders of exemption cards or transponder devices Residents of charging area Employees of Durham Cathedral Employees of Durham University Disabled persons in possession of an exemption card Postal and bullion vehicles Site linked to NCP Parking Office via Telguard Intercom system
Start of operation	1 st October 2002

Signing details	Road User Charge Zone signs (Non prescribed) Warning Signs: TSRGD sign 562 Supplementary Plate : 'Rising Bollard' Special authorised signs
CCTV	3 cameras 1. recording bollard position 2. recording approach 3. recording adjacent entrance area to controlled zone Cameras monitored from NCP Parking Office
Inspection regime	Daily 10 am, 12 noon and 4 pm
Maintenance arrangements	Through contractor NCP Ltd. 1st line maintenance by contractor

Image: Durham

SECTION 16: GOVERNMENT CONTACTS

Equipment specifications and approval:

Mr Richard Privett
Highways Agency
2 The Square
Temple Quay
Bristol
BS1 6HA
Tel: ??????????CHECK
Email: richard.privett@highways.gsi.gov. uk

For sign authorisations:

In England
Kitty Vernon
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????????????? CHECK

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In Scotland
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Email: Iain.gardiner@scotland,gsai.gov.uk

In Northern Ireland

SECTION 17: GLOSSARY

Antenna	Aerial to detect and communicate with electronic tags (transponders) to activate the lowering of rising bollards
Authorised user	A person, group or organisation given permission to gain access or egress through rising bollards
Bus gate	Rising bollard system to restrict access to buses and other forms of public transport
CCTV	Closed circuit television
Detection system	System to detect and validate demands to lower a rising bollard
Indicators	Signal or sign to indicate the positional status of a bollard
LARBUG	Local Authority Rising Bollard User Group: a group of Local Authorities whose remit is to encourage standard designs and operation amongst users and bollard companies and to develop best practice
RTRA	Road Traffic Regulation Act
Safety system	System to detect the presence of vehicles at or on the approach to a rising bollard
Tailgating	Unauthorised vehicles following authorised vehicles through a rising bollard
TCUG	Traffic Control User Group:
Traffic regulation order	An traffic order enforceable by law made under the Road Traffic Regulation Act to restrict or prohibit the use of a road by vehicular traffic
Transponder	An electronic tag fitted to a vehicle to activate the lowering of rising bollards to permit access or egress
TSRGD	Traffic Signs Regulations and General Directions: a Statutory Instrument approved by Parliament that prescribes the types of traffic signs permitted on the public highway and their uses
Wig-wags	Twin alternating flashing light units

RISING BOLLARD SYSTEMS GENERIC RISK ASSESSMENT

Activity and/or Workplace: RISING BOLLARD SYSTEMS ON THE PUBLIC HIGHWAY				Directorate/Section/Team:
Activity	Description of potential hazard	Possible outcome / injury	Risk before precautions/ controls	Minimise Risk By (describe precautions/controls):
Bollard rising	Motor vehicle hitting rising / lowering bollard	Consistent with sudden arresting of vehicle		<ul style="list-style-type: none"> • Safety loops around and prior to bollard • Signal indicators in advance of bollard to direct drivers when to proceed • Mandatory and warning signs to restrict access to authorised users • Retro-reflective bands on bollard • Authorised users to under take formal training before being allowed use of the system
Bollard rising	Pedal cycle hitting rising / lowering bollard	Falling injuries		<ul style="list-style-type: none"> • Safety loops around and prior to bollard with sensitivity set to detect pedal cycles • Signal indicators in advance of bollard to direct drivers when to proceed • Mandatory and warning signs to restrict access to for pedal cycles • Retro-reflective bands on bollard • Alternative route provided for pedal cycles to avoid bollard
Bollard rising	Pedestrians standing on rising bollard	Falling injuries		<ul style="list-style-type: none"> • Bollard to be pressure induced to stop upward movement when pressure is applied on top

Bollard rising	Pedestrians walking into rising bollard	Falling injuries, damage to shin etc		<ul style="list-style-type: none"> • Site layout to discourage pedestrian movement near bollard • Bollard to be fully flush with road surface when fully lowered • Warning signs to advise of rising bollard operation • Safety loops around and prior to bollard with sensitivity set to detect push chairs, buggies • Use of street furniture to deflect pedestrians away from bollard • Bollard to be pressure induced to stop upward movement when pressure is applied on top
Pedestrian	Person sitting on bollard	Falling injuries		<ul style="list-style-type: none"> • Warning signs to advise of rising bollard operation • Site layout to discourage pedestrian movement near bollard
Entry to control equipment	Pedestrian, maintenance team	Electrocution		<ul style="list-style-type: none"> • Control box to be properly sealed to deter entry. • Low voltage supplies should be used for card readers, signals and audible warning • Access keys issued only to trained staff
Access by Emergency services	Delays to response times			<ul style="list-style-type: none"> • Transponders and / or swipe cards issued to meet needs of emergency services • Emergency panel fitted with keys issued to meet needs of emergency services to allow manual lowering of bollard

Assessed by:

Name:

Signature:

Job title:

Date:

Date last reviewed: