TECHNICAL MEMORANDUM CH2MHILL®

Bognor High Street

Commentary on Proposed Use of Rising Bollards for Access Restriction

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Introduction

West Sussex County Council (WSCC) has commissioned CH2MHill to investigate the potential for installing automatic rising bollards at key locations in Bognor town centre to restrict vehicular access to the pedestrianised section of the High Street. This will complement current designs for creation of a "shared space" along the High Street and reflects concerns raised as to the potential violation of this shared space by unauthorised vehicles.

Under the proposed scheme, access to the High Street will be given to buses. Delivery vehicles will also be allowed access during certain hours for loading/unloading. Blue badge holders currently have access but under the proposed scheme this will no longer be available. Shop-owners and shop workers using the dedicated off-street parking facilities at the rear of the shops will also be given access. All other vehicles, except emergency and other essential Council services, will be excluded.

Scope of Work

This note provides the following information:

- An examination of the advantages and disadvantages of rising bollards, including practical/operational limitations;
- Feedback from UK local authorities currently using, or having used, rising bollards in similar situations as that envisaged for Bognor High Street;
- An indication of the likely costs for purchase and operation of rising bollards at the proposed locations; and
- A brief outline of potential alternative solutions that would mitigate against contraventions of the access restrictions.

Overview of Rising Bollards

Rising bollards have been installed across the UK by many local authorities. They are intended to provide a physical barrier to access for unauthorised vehicles. They are commonly used to secure sensitive areas from attack or to enforce traffic regulation orders in restricting access to particular classes of traffic (e.g. buses, taxis) and/or to certain times of the day (e.g. for goods deliveries).

Rising bollards generally use an electric or hydraulic mechanism installed under the carriageway to raise and lower the bollard, either manually or automatically in response to a trigger from the driver or vehicle. A cabinet is located nearby at the roadside, which contains all of the control and communication equipment needed to raise and lower the bollard and to enable remote monitoring of bollard operation by the local authority (or other delegated authority) as well as providing for remote lowering/raising of the bollard. Figure 1 below shows a typical installation.

Figure 1 Example of a rising bollard installation and schematic of typical layout

Bollard operation can be initiated by one of the following methods:

- a push button or key-operated trigger in the adjacent bollard control cabinet. This can be set to temporarily or permanently raise or lower the bollard;
- a key fob/access card whereby the driver of the vehicle requiring access inserts the fob/card into, or swipes it across, an adjacent roadside receiver;
- a key pad whereby the driver of the vehicle requiring access enters a PIN into a key pad located at the roadside;
- a “tag-and-beacon” method, where a transmitter tag is located in or on the vehicle. When a vehicle equipped with a tag approaches the bollard the tag communicates with a roadside beacon, which initiates lowering of the bollard; or
- other highway approved detection systems, e.g. above ground detector, ANPR camera.

In addition to the bollard and roadside control cabinet, other infrastructure is also required, including:

- Red/green warning lights, positioned in such a way as to clearly indicate to drivers when they should stop and when it is safe to proceed. These lights must have DfT Type Approval for use on the highway;
- Inductive loop or other such detectors to identify when a vehicle is above the bollard, in order that the bollard will not rise when a vehicle is over the bollard (whether moving or stationary);
- Static signing, in accordance with the Traffic Signs Regulations and General Directions (TSRGD) to inform approaching vehicles of the access restrictions, the presence of the rising bollards and to instruct drivers on what action needs to be taken.

It is also recommended to include CCTV cameras at the rising bollard locations, for the following reasons:

- Provides visual confirmation to local authority staff of the continuing operation of the bollards;
- Highlights any issues with the bollards, e.g. bollard jammed in raised/lowered position; and
- Provides evidence in the event of any damage to vehicles and/or bollards, which can be used to support any legal challenge, whether by the local authority or the vehicle owner.

Advantages of Using Rising Bollards

The key advantage of a rising bollard is that, in an environment with a "gateway" access point to an area that requires access restriction, the bollard provides a physical restriction to access from vehicles and is thus self-enforcing. It provides a very clear statement to drivers of the access restriction so there is no ambiguity as to whether a driver should proceed. Unauthorised vehicles are incapable of proceeding therefore there should be no need to manually enforce the restriction.

Another advantage of a rising bollard against other physical measures such as barriers is that a bollard, being constructed to withstand vehicle impact, is extremely vandal-resistant so there is usually no requirement to replace equipment as a result of vandalism unless as a result of deliberate impact from a vehicle.

Disadvantages of Using Rising Bollards

There are various problems associated with the use of rising bollards, the extent of which is generally in proportion to the level of demand by authorised vehicles. In theory these problems should not occur with robustly-designed and properly installed and maintained bollards but in practice problems occur to varying degrees depending upon the use to which the bollards are put.

Technical Issues

The mechanical nature of the devices together with the environment in which they are used and the demands placed on them through frequent use leads to operational problems. Feedback from the three authorities that were consulted for this study made reference to the following problems:

1. **Bollard jams in the upright position** – while this may be fairly simple to rectify, it does require attendance of an operative at site, usually either a member of local authority staff or the bollard supplier. While the bollard is in this position, all vehicles requiring access are disrupted and may be required to take an alternative route, if one exists. This can be particularly problematic where frequent access is needed by bus and taxi services.

2. **Bollard jams in the lowered position** – this is particularly problematic from a repair perspective as it is difficult to gain access to the bollard to repair it when it is under the carriageway. Unlike a jam in the upright position, a jammed bollard in the lowered position does not present any restriction to authorised – or indeed unauthorised – vehicles. However, repair will require access to the carriageway and this inevitably requires a carriageway closure. To minimise disruption this would probably need to be carried out overnight, which usually carries additional expense to the local authority.

3. **Inductive loop detector fails** – the inductive loop is a safety feature to prevent the bollard rising when a vehicle is passing. The loop is buried under the carriageway, is subject to repeated mechanical stress from passing vehicles and is thus susceptible to failure. When a loop fails, it

makes the bollard unusable and thus it remains in the lowered position until the loop is repaired. As for (2) above, this doesn't present an access restriction but it does require closure of the carriageway to repair the loop, which can cause disruption unless repaired overnight.

4. **Failure of card/tag** – this has occurred amongst those authorities that were consulted although it was not seen as a major problem as replacement cards can be readily available from the local authority. There is usually a telephone number at site for a driver unable to access to contact a member of local authority staff to obtain a replacement card, although this may not be available immediately.

5. **Failure of remote monitoring/control system** – this is usually either the failure of the site system to recognise a problem or failure of the communications system to relay a fault to a central point. In such cases problems are often only discovered by the authority following a call from a member of the public, or when CEOs or police become aware of them.

Public/Press Perception

One of the primary issues with rising bollards is not one of a technical or operational nature but is that of public perception of them as a potentially dangerous and excessive means to enforce a restriction. Vehicles – both authorised and unauthorised - becoming caught on rising bollards is now a less common occurrence than it used to be due to proper regard to the design of the access points along with improved reliability of equipment. Nonetheless, rising bollards remain a regular feature of local and national press stories. Claims have been made of serious, and even fatal, injuries caused by rising bollards. It would appear that most cases of cars striking or being struck by rising bollards are due to driver error, but regardless of this news items are usually of an anti-rising bollard (and thus anti-authority) nature.

Loss of access for authorised vehicles such as buses, shop owners and delivery vehicles due to bollard failure is likely to cause friction between the local authority and these users. This could potentially lead to claims against the authority for the negative impact upon the trade of those affected, or at least give rise to questions from these users as to the need for rising bollards.

Operations and Maintenance

Notwithstanding the public perception of these devices, they can incur a significant operations and maintenance burden upon the authority, with the additional staff resourcing requirement that this entails. Staff may need to be available at least during times of bollard operation to respond to problems, particularly those causing access problems and/or involving damaged vehicles. Immediate response is often needed to allow authorised vehicles to gain access and to avoid any delays.

The alternative to this is to set up arrangements with the bollard supply for highly-responsive maintenance and on-site support services. One of the authorities consulted for this review had delegated the maintenance and support response to the bollard supplier although the authority retained responsibility for management of the access cards. The supplier was required to provide a means for rapid detection and response to any problems. Clearly this would be at a cost to the local authority, although they were not willing to provide information as to this cost.

The authority is also required to set up and maintain a permit system for those vehicles allowed access. Again, this will have a resource burden to record and track usage of all issued cards/tags, notwithstanding the ongoing cost of purchasing and distributing new cards/tags. This database of users will need to be kept up-to-date and cards/tags rescinded where the user no longer needs, or is

entitled to, access. The administrative resource required to do this depends to a large extent on the number of authorised users and thus the pool of cards/tags issued, but in any case the time required to do this should not be underestimated.

Legal Challenges

The Department for Transport issued Traffic Advisory Leaflet 4/97 provides guidance on the implementation and operation of rising bollards (attached here as Appendix A). One key requirement outlined in this note is for the bollard system to be incapable of rising under a vehicle. However, there have been many publicised cases of bollards rising under vehicles and striking them. Regardless of whether a vehicle is authorised to access the restricted area, if the bollard rises under it then by definition this contradicts TAL 4/97 and thus leaves the authority open to challenge.

Although the legality of rising bollards has been questioned, there has never been any general legal challenge to their legitimacy and, given the widespread presence of such devices across the UK, it appears to have been generally accepted as a means of access restriction. Nonetheless, legal challenges have been made against individual authorities by drivers of vehicles damaged by bollards on the basis that the presence and purpose of a particular rising bollard was unclear or that it did not operate as it should. Some of these challenges have been successful.

Any damage to vehicles may therefore require the authority to engage in legal action, either as defendant (if the vehicle owner believes the authority is at fault) or as plaintiff (if compensation is sought from the driver for bollard repair). Either way, this could tie-up considerable staff time – and cost - in dealing with these activities.

Design Issues

It is clear that careful design of a rising bollard scheme, including a full design risk assessment, is an essential prerequisite for a robust rising bollard scheme. There is significant potential for visual intrusion and obstruction to other users of the space given the amount of signing and warning lighting required to ensure that motorists are given as much advance warning as possible of the bollards and who is, and is not, allowed access. As stated earlier in this note, this requires a number of static signs and red/green warning lights as well as a roadside control cabinet and a plinth/unit/keypad to enable identification of authorised vehicles. This will inevitably impact upon the amount of “street clutter” and potentially restrict pedestrian access. Another typical example of a rising bollard installation is given in Figure 2 below, which demonstrates the amount of infrastructure needed to ensure compliance and to mitigate against driver error/non-compliance.

Figure 2 Illustration of infrastructure required for a rising bollard installation

Estimated Costs for Installation and Operation

In May 2013 CH2MHill investigated costs for installing rising bollards at another location in West Sussex, on behalf of WSCC. This was a design concept for a single bollard at a bus gate, which was not adopted. However, a quotation was provided by a leading UK supplier of rising bollards and a breakdown of costs is provided below (to the nearest £'000). All prices quoted are per item:

£16,000 for the bollard and associated in-road and roadside equipment (excluding signing)

£3,000 for installation

£5,000 for a tag-based reading unit

£6,000 for remote monitoring/remote control system

Thus the total installation cost per bollard is around **£30,000.** Note that this excludes any cost for static signing (see below).

In addition, a cost of £32 was quoted for each in-vehicle tag. In Bognor it is expected that buses, emergency services, delivery vehicles and other selected users (e.g. shop-owners) will have access. Most of these users have vehicle fleets and it is likely that most if not all of these fleets will require tags to ensure that all fleet vehicles can be operated. It is thus possible that up to 500 tags may be needed, which would cost **£16,000**. This would apply regardless of the number of bollards installed.

Maintenance and support charges were quoted by the supplier at around **£425 per year** for each bollard. However, it should be noted that this is only understood to be for preventative maintenance and thus excludes call-out charges for repair to damaged equipment. Examination of the case studies later in this report demonstrates that a comprehensive preventative and reactive

maintenance regime is critical to the successful operation of rising bollards. Costs for maintenance that require the supplier to provide a rapid-response 24/7 maintenance and support service are not known but they will inevitably be much higher than the above figure.

Given the current design for the Bognor High Street shared space scheme, it is likely that four rising bollards will be required at the following three sites:

- York Road at the junction with Belmont Street;
- High Street at the junction with Sussex Street; and
- High Street at the junction with Bedford Street – this will probably require two rising bollards as the road is too wide for a single bollard to prevent vehicular access.

The twin-bollard layout on Bedford Street site would cost less than £60,000 (i.e. £30,000 per bollard) as only one set of roadside equipment (including tag reader) is needed. A general assumption has therefore been made that the cost to supply and install the second bollard and its associated control equipment would be half that of the first bollard, i.e. £9,500 rather than £19,000. Only one tag reader and remote monitoring system would also be needed at this site.

The cost of suitable static signing to warn drivers of the presence of the bollards also needs to be allowed for. It is assumed that this will be around £1,000 per site for supply and installation, which would mean a total cost for signing provision of **£3,000** (note that only one set of signing is required for the two bollards on Bedford Street).

Based on these assumptions, the total estimated cost for installation of four bollards at three sites, with tag-based detection for up to 500 vehicles and remote monitoring/control of bollard operation, is **£118,500** with a maintenance cost of **£1,700 per year** (4 x £425).

Assuming a 20% contingency for cost increases, variation in costs between suppliers and other unknown factors, an allowance should be made for supply and installation at a total cost of around **£142,000**.

A full breakdown of the above costs is provided in Appendix A to this report.

Review of Local Authority Operation of Rising Bollards

As previously stated, rising bollards are used by many local authorities across the UK so this review is by no means exhaustive. It has been limited to those already in operation by WSCC and to two other authorities from whom information was readily available. Given that rising bollards are considered by many authorities as a highly-sensitive public issue, the names of the two other authorities consulted have not been included in this note.

General Perception

From a brief internet-based review of local authority rising bollard operation, the rate of success of rising bollards in towns and cities across the UK seems to vary considerably. A common factor with all such installations seems to be that mechanical problems do occur regularly, especially where vehicular access - and thus bollard operation - is frequent. The general level of operational success lies in the funding and staff resource dedicated to responding quickly to these problems. However, in some cases, local authorities do not appear to have the budget or the staff availability to do this.

Case Study No.1

The first of the local authorities that was contacted is located in the West Midlands. They currently have several automatic rising bollards controlling access to a pedestrianised section of the High Street and Market Square in a medium-sized market town (population approx. 22,000).

The bollards have been in place since 2004. Buses or taxis do not require access to any of the restricted areas so authorisation is mainly for delivery vehicles. There is also a small parking area in Market Square for blue badge holders and others with a particular need for access. Swipe cards are used by those wishing to gain access to the High Street and Market Square.

The authority has experienced serious problems with the bollards almost from the day that they were installed, and they continue to have problems with them. The initial problems were with failure of the inductive loops used to identify the presence of vehicles. These loops were installed under block pavers and regularly failed. Subsequently the authority has had to change virtually every component of the rising bollard system several times over due to mechanical/electrical failure.

They also stated that it was common for a motorist to deliberately or accidentally bump into the bollards. Even if this was done gently, it would usually result in damage to the post. Even minor damage would produce a slight deformation resulting in the post jamming either in the upright position, thus restricting access to authorised vehicles, or in the lowered position. In the latter case it has proved very difficult to raise again as the post is flush-mounted to the road/footway surface.

The authority once had a dial-up connection to each post to enable remote operation. A motorist without a swipe card requiring access - or one whose card didn't work - would be able to call the assigned telephone number and the bollard would be lowered by remote control (assuming the driver was authorised to gain access). However, this required a local authority officer to be available at all times to answer calls and this was not sustainable, so the service was withdrawn.

There is also no remote monitoring of the bollard so the authority only gets to know when a problem has occurred if a member of the public or a local shop-owner notifies them. This then requires the relevant officer to immediately go to site to address the problem.

The authority is now in the process of removing all of the rising bollards and is replacing them with static bollards in locations where vehicular access for deliveries is no longer required. In summary, their experience with rising bollards has been a very negative one and on this basis they strongly advise against using them if other options are available.

Case Study No.2

The second local authority that was consulted is in the south of England. They have installed three pairs of rising bollards in a medium-sized town (population approx. 39,000) to restrict vehicular access to the pedestrianised shopping area. They have also installed a single bollard at a bus gate in a similarly-sized town (population approx. 22,000). Both installations have been in place since 2006.

The first of these locations uses the bollards from 10am to 5pm to restrict access to all traffic except for emergency services and other essential services, e.g. security vehicles. The bus gate location allows buses-only throughout the day.

In both cases, access is granted using specially-configured swipe cards or in-vehicle tags. The bollard supplier provides full maintenance of the bollards and arranges the supply and configuration of the access cards.

At the primary location, the daily monitoring in terms of dropping-down of the bollards at 5pm and raising them at 10am is done via manual intervention by Civil Enforcement Officers, who open the bollard control cabinet at each location and turn a switch to either raise or lower them.

Day-to-day card issuing and collecting is done by the authority's in-house Traffic Services team. Only the sourcing and technical configuration of the cards is done by the system supplier when the authority wishes to purchase a new batch of cards when stocks run low, or if a faulty card is returned. The supplier's maintenance representative visits the sites with the batch of new cards to verify that they work with the barriers prior to issuing to the authority.

The view of this local authority is that the rising bollards are performing well, particularly since October 2011. Prior to this, buses and taxis were granted access at the first of the above locations but these services were then re-routed away from the centre for reasons unconnected with the bollard operation. This reduced daily demand on the bollards by around 40 vehicles per day, which reduced the load on them and resulted in fewer problems.

Rare issues have occurred with drivers missing or misreading signs and striking the bollards, leading to damage and the need for repair. Similarly, rare issues have occurred with access cards not working or having expired. The bus gate bollard has also failed on a few occasions (reasons were not supplied).

The authority confirmed that all bollards are still in place and operational and are likely to remain so for the foreseeable future. The general view is that the bollards have worked better with there being fewer traffic movements after October 2011 so the level of demand from authorised vehicles would appear to be an issue for consideration.

Case Study No.3 (Crawley)

WSCC staff were consulted in relation to an existing rising bollard in Crawley[1]. A single bollard has been in operation since 2007 on Coachman's Drive/Winfield Way between Anglesey Close and Southgate roundabout north of the Crawley Town football stadium. It is situated at a single-lane (i.e. bi-directional) bus gate, operating in conjunction with traffic signals to allow buses in either direction to pass through while restricting access to all other vehicles. Access is provided by a tag fitted to each bus, which lowers the bollard when the bus approaches. The system was provided by ATG Access Limited, one of the UK's leading suppliers of rising bollards.

The exact frequency of bus services at this location was not determined during discussion with WSCC staff but examination of bus timetables shows that buses in either direction use the bus gate (and thus the bollard) every few minutes during the day, so it is clear that they are frequently used.

Consultation with WSCC revealed that during the first few years of operation the bollard performed very poorly, with almost every component needing regular replacement as faults appeared. This caused considerable problems for the Council and for bus operators as the road needed to be closed for the duration of repairs. The persistent problems culminated in discussions with the supplier regarding a complete revision of the maintenance arrangements for the bollard. Agreement was reached on a suitable preventative and responsive maintenance regime. As a result, performance has been much improved and there have been relatively few problems since. Occasionally the

[1] Google Streetview link to the Crawley site - https://maps.google.co.uk/maps?q=Coachmans+Drive,+Crawley&hl=en&ll=51.099931,-0.197251&spn=0.002796,0.004823&sll=52.8382,-2.327815&sspn=10.974582,19.753418&oq=coachmans&hnear=Coachmans+Dr,+Crawley+RH11,+United+Kingdom&t=h&z=18&layer=c&cbll=51.099931,-0.197251&panoid=bX8FBIRLskNc3JSRoGmMMQ&cbp=12,66.9,,0,8.81

bollard will jam in the upright or lowered position, requiring a site visit by WSCC staff or the supplier to resolve. However, this does not seem to have created any major problems for the bus operators.

It is understood that WSCC plans to continue operating this bollard and is confident that no major problems will occur as long as the current regime of regular maintenance and support continues.

General Conclusions from the Local Authority Feedback

The installations from the all three case studies have been in place for a similar length of time. However, there's a marked contrast in the degree of success of each operation, leading to very different views on the effectiveness and value of the bollards. The second case study appears to have a similar or even greater level of demand upon bollard operation than the first but it has nonetheless been much less prone to problems. This could be due to several factors (e.g. different supplier, more robust/professional installation, different installation environment) but one clear difference is that the second authority tasked the supplier with monitoring the bollards and keeping them operating whereas the first seems to have taken more responsibility for this. A similar approach was eventually adopted in the case of the Crawley bollard, which seems to have resolved the previous problems. Although maintenance costs were not provided by any of the three authorities, the extensive maintenance programmes will most likely have cost the second authority, and WSCC in Crawley, a significant sum in maintenance fees from the supplier. However, this will be mitigated by the authority not having staff regularly tied-up in responding to and repairing faults. Clearly the maintenance aspect, and in particular the need to place the emphasis for this on the supplier, is a critical element for consideration in any potential installation for Bognor.

Alternative Options to Rising Bollards

There are several possible alternatives to rising bollards including:

- Rising-arm barriers;
- Automatic Number Plate Recognition (ANPR) cameras; and
- "Manual" enforcement, i.e. CEO and/or police presence.

The pros and cons of each of these options are discussed below along with a comparison with rising bollards.

Rising-Arm Barriers

These are installed, and operate, in a similar fashion to that of rising bollards. However, the physical restriction is a barrier above the carriageway rather than a bollard within it. The advantages over rising bollards are:

- generally less prone to failure;
- simpler and less costly to maintain as most of the equipment (except inductive loops and cabling) is above the carriageway;
- no need for working in - and thus closure of - the carriageway to effect a repair (except for inductive loop repair) so minimal disruption to traffic while the repair is taking place;
- a more visually obvious restriction and thus less likely to involve motorists striking them or attempting to drive through them;

- in addition to inductive loops to identify the presence of vehicles, sensors in the barrier arm can detect when the descending arm is about to strike a vehicle and immediately raise it to avoid a collision with the vehicle (or, indeed, a passing pedestrian); and
- less likely to cause major damage to vehicles in the unlikely event that the barrier does lower onto a vehicle. This means that the vehicle can be moved more quickly from the carriageway, thus minimising delay to other vehicles needing to gain access.

The disadvantages of rising-arm barriers are:

- more visually and physically intrusive as it offers a permanent barrier across the whole of the carriageway – this may be an issue given the proposed High Street scheme with the emphasis on pedestrian priority;
- despite the presence of sensors in the barrier arm there remains the risk of the arm striking a pedestrian walking under the barrier as it descends. It may therefore be sensible to segregate the area around the barrier from the general pedestrian flow. However, this would introduce additional infrastructure, with further segregation and visual intrusion;
- the barrier arm is highly vulnerable to vandalism and, while straightforward to replace, does represent a significant maintenance burden; and
- requires the same supporting infrastructure (signing, warning lights, sensors) as rising bollards.

ANPR Cameras

WSCC currently has a civil enforcement operation in place in Bognor, which is delegated to Arun District Council. In this case it would be feasible to introduce ANPR cameras to enforce the access restrictions and issue Penalty Charge Notices (PCNs) to those motorists contravening the restriction.

ANPR enforcement would comprise one or more cameras capable of automatically detecting the Vehicle Registration Mark (VRM's, i.e. "number plates") of a vehicle passing through the restriction. This would immediately be checked on–site by the system against a known list of authorised vehicles ("whitelist"). Any vehicle not listed would be immediately flagged to a central control (commonly the local authority's CCTV operations room). The control facility would receive a "data package" from the camera comprising a video clip of the vehicle contravening the restriction and it's VRM together with other relevant information (e.g. camera location, time and date of contravention). Each package would be checked by an operator and, if deemed to be a contravention, a PCN would be issued in a similar manner to those issued for parking contraventions.

The advantages of using ANPR enforcement are:

- Less visually or physically intrusive than either barriers or bollards as it does not involve a physical restriction in the carriageway;
- Less roadside infrastructure required – no need for card/tag reader or keypad; no requirement for carriageway excavation to install equipment; no red/green warning lights; no control cabinet - the cameras are usually self-contained units mounted on existing street lighting or other such column, they use 3G mobile phone for communications and just need a mains power supply from the column;
- Very low maintenance overhead – there are no mechanical parts in the camera to fail;
- No potential for physical contact between the camera and a passing vehicle and thus no requirement for replacement and repair and consequently no likelihood of reparation claims

from motorists for damage to vehicles (or claims from the local authority for damage to cameras);

- marginally more susceptible to vandalism than rising bollards (although in practice very few ANPR cameras are vandalised); cameras are also far less vulnerable to vandalism than rising-arm barriers;
- No requirement to issue or replace cards/tags – all that is required is the VRM of the authorised vehicle, which can easily be added to or removed from the system; and
- the revenue from issuing of PCNs will provide for a return on capital investment and enable funding for ongoing operations (all camera enforcement systems known to CH2MHill have, within a very short period, generated sufficient revenue to cover installation and continue to provide sufficient funds to maintain the service).

Disadvantages of ANPR camera enforcement are:

- requires significantly more back office infrastructure (e.g. video review PC, data storage facility) than for rising bollards/barriers;
- requires additional staff resource to review and process the continuous in-flow of contraventions (it is unlikely that contraventions will cease unless a physical barrier option is adopted). However, this resource can usually be accommodated within the authority's existing civil enforcement operation; any further resource that may be required can usually be funded with the additional PCN revenue generated; and
- generally treated with suspicion by press and public alike as a revenue-generating activity for the local authority, so it may generate negative publicity for WSCC;

If WSCC has no desire for a full enforcement regime then it would be possible to engage in a "soft enforcement" activity whereby contraventions are recorded as described above. However, instead of issuing PCNs, the identified motorists are sent requests not to contravene the restrictions in future. The request could be accompanied by an explanation as to why the restrictions are in place. This approach would clearly not generate any revenue to support the ongoing operation of the system or the additional resource needed to issue the requests. However, it may provide for a more positive relationship with press and public.

One variation on the above "soft" approach would be to use the VRM data obtained in order to identify "repeat offenders" and/or times of day/days of week when most contraventions occur. CEO or police presence in the High Street could then be targeted at these times to enforce the restriction (whether or not that involves the issuing of PCNs).

Manual Enforcement by CEOs

This approach remains largely unchanged from the current operational scenario whereby Civil Enforcement Officers (CEOs) patrol Bognor High Street to enforce regulations governing parking. Although currently only the police has powers to enforce moving traffic offences in the High Street, the new proposals include the provision of signing that identifies waiting restrictions. This should enable the CEO's under their current remit to issue PCNs to any motorist that accesses the High Street and stops for any reason, e.g. to pick-up/drop-off passenger(s).

One major advantage of a manual enforcement approach is that no additional infrastructure is required on-street so there would be no installation or ongoing costs for equipment operation/maintenance, no visual intrusion and no potential for delays to vehicles when problems arise or when maintenance is required. The lack of a physical barrier such as bollards - and the surrounding visual intrusion of signing, lighting, etc. - is also less likely to raise public sensitivities or

objections to the High Street access restrictions and no likelihood of adverse public or press reaction if operational problems with the bollards arise or vehicle collisions with bollards occur. It would also avoid the need for the procurement and distribution of tags/cards to each authorised user, assuming that tags/cards are the chosen method of access (they are the most common method currently in use).

The main disadvantage of manual enforcement is the need for additional or diverted CEO resource to ensure that the High Street is adequately patrolled. Also, even with regular patrols it is inevitable that contraventions will occur without penalty at times when CEOs are not patrolling the High Street or are otherwise occupied. The lack of a physical restriction such as bollards, along with the relevant warning signs, lights, etc. may also lessen the deterrent effect, although suitable signing would still need to be in place to notify drivers of the High Street access restrictions. It should be noted, however, that the additional financial burden in terms of additional CEO resource requirement is likely to be partially, or even fully, mitigated through the revenue accrued from payment of PCNs by those motorists charged with contravening the regulations.

Appendix A

Breakdown of Cost Estimates for Rising Bollards on Bognor High Street

Item	*Location:* Unit Cost	York Rd	Sussex St	Bedford St *Bollard #1*	Bedford St *Bollard #2*	Back Office
Bollard incl. detection/control	£16,000	£16,000	£16,000	£16,000	£8,000	
Installation	£3,000	£3,000	£3,000	£3,000	£1,500	
Tag reader	£5,000	£5,000	£5,000	£5,000		
Remote monitoring/control	£6,000	£6,000	£6,000	£6,000		
Static signing	£1,000	£1,000	£1,000	£1,000		
Tags (for 500)	£16,000					£16,000
	Subtotal	**£31,000**	**£31,000**	**£40,500**		**£16,000**
					Estimated total cost for all sites =	**£118,500**
					Total incl. 20% contingency =	**£142,200**

Table 1 Breakdown of estimated costs for supply and installation of rising bollards

Notes:

1. The above costs (excluding static signing) were obtained from a major UK supplier of rising bollards in May 2013 as part of a conceptual design for a bus lane undertaken by CH2M HILL for a residential road in Chichester, which included a rising bollard. Note that these costs may have increased since May 2013.

2. Costs for bollard roadside equipment and installation have been reduced for Bedford Street as two sets of this equipment are unlikely to be needed to operate two bollards at this site. An assumption has been made that the second bollard will be half the cost to supply and install than that of the first bollard.

3. Tag readers, remote monitoring and static signing are related to the site and not the number of bollards at the site, hence why only one set of this equipment is needed at Bedford Street.

4. A contingency sum of 20% has been allowed above for potential variances between supplier costs and other unknown factors.