CPNI

Centre for the Protection of National Infrastructure

Public Realm Design Guide

Hostile Vehicle Mitigation

Third Edition

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Public Realm Design Guide

Hostile Vehicle Mitigation

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Foreword

CPNI is the UK government's National Technical Authority for physical and personnel protective security. Our role is to protect national security by helping to reduce the vulnerability of the national infrastructure to terrorism and other threats. We are accountable to the Director General of MI5.

CPNI products and advice extend out to support the protection of assets and people from terrorism: crowded places, Publicly Accessible Locations (PALs), temporary events and iconic sites. This is primarily done through the National Counter Terrorism Security Office (NaCTSO) and their network of Counter Terrorism Security Advisers. We also support selected security professional bodies to maximise our reach.

Typically, in terms of Hostile Vehicle Mitigation, focus is on protecting people and assets.

People – members of the public, visitors, customers, staff and contractors in the area that you are trying to protect.

Assets – buildings, contents, equipment and sensitive materials.

In recent years, more terrorist attacks have occurred in the public realm, with some involving the use of vehicles. A significant number of these attacks have directly targeted people. Consequently, the design of the public realm is an important factor in protecting both people and assets by stopping or delaying attacks. Creating and taking design opportunities to make them safer will help.

CPNI is continually developing physical security solutions and producing guidance to aid the planning, design and implementation of Hostile Vehicle Mitigation (HVM) schemes. Introducing HVM into the public realm is a significant challenge and must fulfil numerous requirements in order to integrate successfully, such as:

- Aesthetics
- Public Access
- Traffic Management
- Physical Constraints
- Health & Safety
- Cost
- Maintenance

CPNI encourages those responsible for the design of the public realm to consider the project requirements for protective security at the earliest possible design stage. There is a need to innovate and design integrated solutions that meet the functionality and aesthetic brief, and also protect sites vulnerable to vehicle attack.

This design guide provides the design community with a background to HVM, how to include it in the project process, key aspects such as stakeholder engagement and risk management, and blending protection into sites. It has been designed to be used within the whole of the United Kingdom, but does not exclude application in other countries.

Department for Transport

SUPPORTED BY
MAYOR OF LONDON

TRANSPORT FOR LONDON

NATIONAL COUNTER TERRORISM SECURITY OFFICE

RIBA Architecture.com

RTPI Royal Town Planning Institute

Landscape Institute
Inspiring great places

BPF

THE CROWN ESTATE

Endorsements

The production of this design guide has been guided by a number of organisations and professionals in close coordination with CPNI.

Consultation within a focussed Steering Group of industry professionals has been used to gain insight, experience and ideas to inform the development of the guidance.

The organisations shown below have endorsed this design guide and companies, organisations and individuals who contributed to the formation of this design guide are shown in the appendices.

Government:
Department for Transport
Mayor of London
National Counter Terrorism Security Office
Transport for London

Professional Bodies:
Landscape Institute
Royal Institute of British Architects
Royal Town Planning Institute

Real Estate:
British Property Federation
The Crown Estate

Contents

Introduction

This guide provides information and impetus to those responsible for integrating Hostile Vehicle Mitigation (HVM) into the public realm, in order to manage the threat from terrorist vehicle attacks.

It is important that our surroundings remain open and inclusive and that the addition of physical security measures designed to protect us are integrated and proportionate to the identified threat. The purpose of this guide is to assist the public realm design process and to encourage a positive and creative response to the challenges of counter-terrorism and protective security.

In recent years, terrorists have used a variety of attack methodologies (refer to CPNI ‘Recognising Terrorist Threat Guide’). Concentrating on vehicle threats, they use the Vehicle As a Weapon (VAW) to directly drive at targets to cause harm. They also use Vehicle Borne Improvised Explosive Devices (VBIEDs), known as vehicle bombs, to attack targets. Understanding these threats, the potential consequences and the intelligent application of HVM are the focus of this guide.

The design of the public realm must consider the application of HVM measures holistically, to ensure that the correct level of protection is provided without compromising the ability to create aesthetically pleasing and functional public spaces.

There is no “one size fits all” response to providing protection against hostile vehicles. Every place is unique and requires an informed and considered approach. Additional factors that will change over time and warrant consideration are the changing purpose of a place, evolving terrorist attack methodologies and the terrorist threat level[1].

1 Assessment of the level and nature of terrorist threat to the UK is made by the Joint Terrorism Analysis Centre (JTAC).

Part 1

Context

Vehicle-Borne Threats

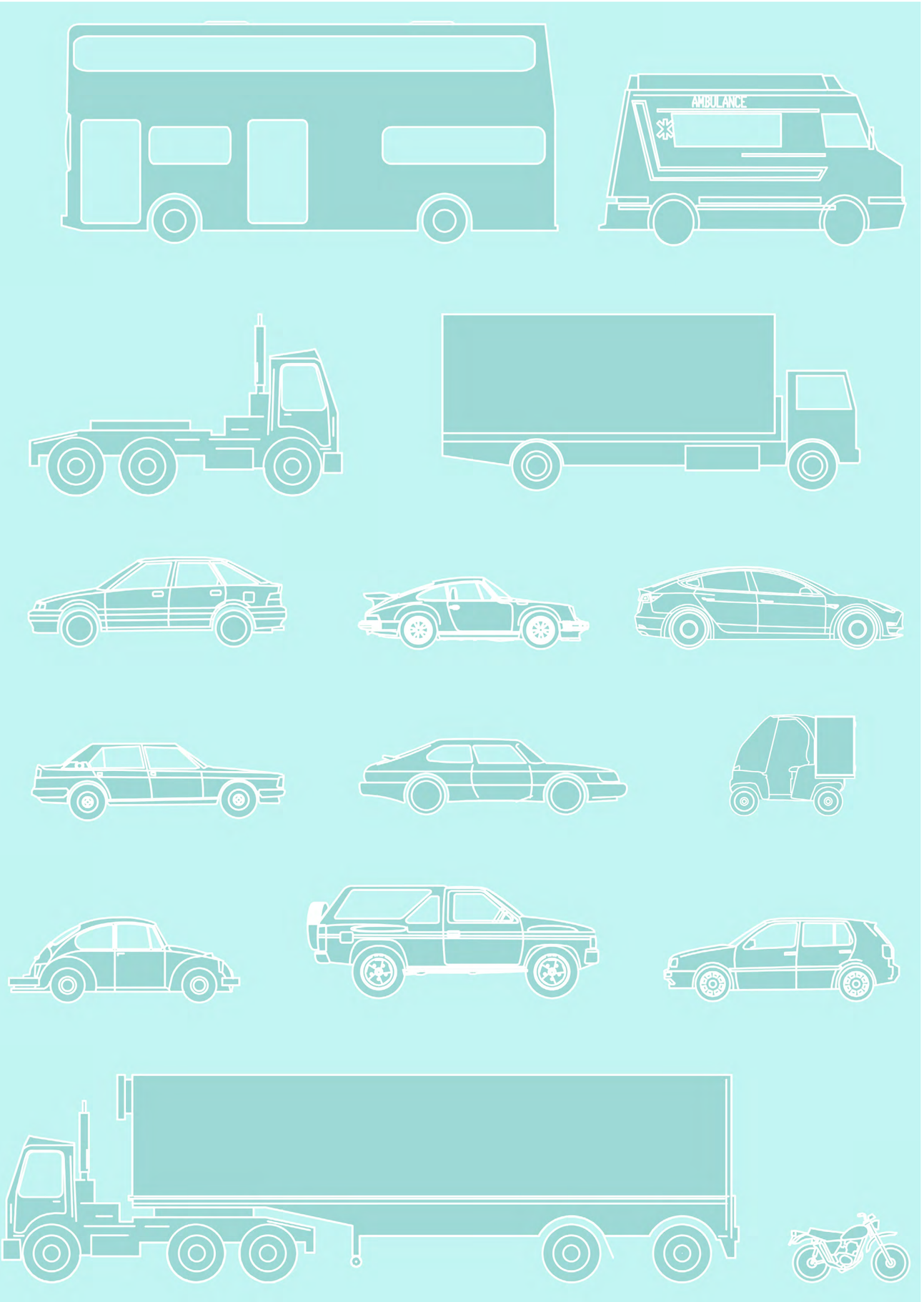
Methods of Vehicle-Borne Attack

7 Techniques of Terrorists

Every Metre Counts

What is Hostile Vehicle Mitigation (HVM)?

What are Vehicle Security Barriers (VSBs)?



Vehicle-Borne Threats

Hostile Vehicle Mitigation should be proportionate to threat

It is vital to have a clear understanding of possible attack types and threat vehicles in order to design proportionate protection.

Vehicle-borne threats range from vandalism to criminality (such as ram raiding) to terrorism. The attacker(s) may be opportunistic or determined to succeed. The attack may be spontaneous in nature, right through to well-planned operations, designed to exploit site vulnerabilities.

Using a vehicle in an attack continues to be attractive because they are:

- widely available
- low cost
- easy to use
- dynamic
- a protective shell for occupants

Additionally, they are able to carry:

- a large payload
- weapons
- several attackers

Depending on how a vehicle is used in an attack, the consequences could range from minor injuries sustained from a vehicle impact, through to significant loss of life and catastrophic damage to buildings, infrastructure and services.

Consideration should be given to the wide range of potential vehicles including small electric vehicles, motor bikes and cargo bikes.

Using a Vehicle As a Weapon (VAW) has the objective of causing serious injury and death to those struck by the vehicle. Previous VAW attacks suggest that, depending on the location and number of people in proximity, those injured or killed can range from one individual up to several hundred. The publicity and perceived success of VAW attacks has led to them being widely considered by terrorists, irrespective of belief.

Using a Vehicle-Borne Improvised Explosive Device (VBIED) has the objective of maximising structural damage to property and local infrastructure, inflicting widespread injuries and fatalities, and creating widespread disruption and publicity. The main causes of catastrophic structural damage and serious or fatal injury result both from the direct physical effects of an IED: high blast pressures and high-velocity fragmentation, leading to subsequent building collapse and flying or falling debris.

Specific methods employed by those with hostile intent to gain vehicular access to a public space to conduct a VAW or VBIED attack can be expected to develop over time and will continue to exploit any vulnerabilities within the physical environment. Consequently, the design of our public spaces should mitigate current threats and have the flexibility to adapt to evolving threats.

Methods of Vehicle-Borne Attack

'VAW' Vehicle As a Weapon[2]
'VBIED' Vehicle-Borne Improvised Explosive Device[2]
'MTA' Marauding Terrorist Attack[3]
'FAW' Fire As a Weapon[4]

VAW

There are three main types of vehicle-borne attack[2]:

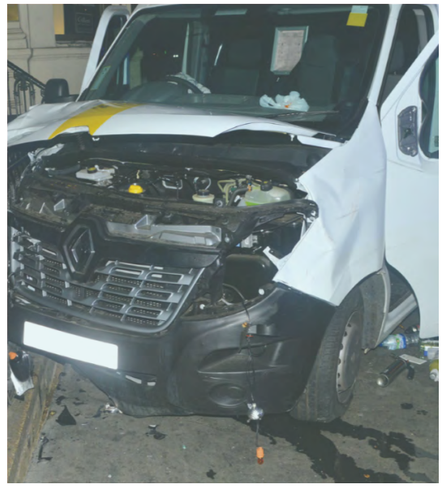
1. Vehicle As a Weapon (VAW)
Deliberately driving a vehicle at an individual or into crowds of people to cause harm; or deliberately driving a vehicle into infrastructure to damage or disrupt its operation. This may indirectly lead to harm to people or disruption to the operation of a site/ event, or more widely, critical services or supplies.

Driving a vehicle into crowds is regarded by terrorists as attractive because it is likely to cause multiple casualties, is low complexity, affordable, requires little planning and skill and is perceived as less likely to be detected in the planning phase.

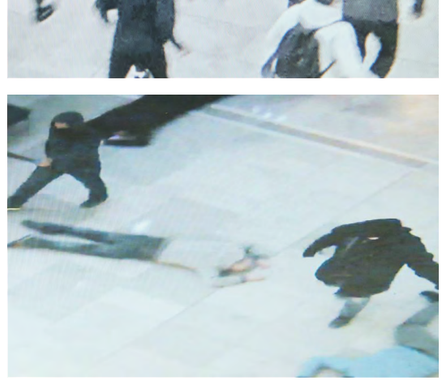
VBIED

2. Vehicle-Borne Improvised Explosive Device (VBIED)
Transporting a bomb to the attack target which when exploded may cause structural failure to buildings and mass human injury and fatality. Whilst more difficult to conduct, the damage from a VBIED can be extensive, with effects potentially reaching out several hundred metres.

VAW



MTA



3. Layered Attack
A combination of attack types. The vehicle may facilitate the delivery of armed attackers, either covertly or overtly; or be combined with a VBIED or VAW attack.

VAW attacks are often the first part of a Layered Attack. The attacks typically begin on public roads with little or no warning and are often followed by a Marauding Terrorist Attack (MTA) using bladed weapons, firearms or Fire As a Weapon (FAW).

Another instance of a layered attack is multiple vehicles being sequentially used to weaken and breach protection to conduct the attack.

2 www.cpni.gov.uk/hostile-vehicle-mitigation-0
3 www.cpni.gov.uk/marauding-terrorist-attacks-1
4 www.cpni.gov.uk/fire-weapon-0

7 Techniques of Terrorists

How vehicle-borne attacks manifest

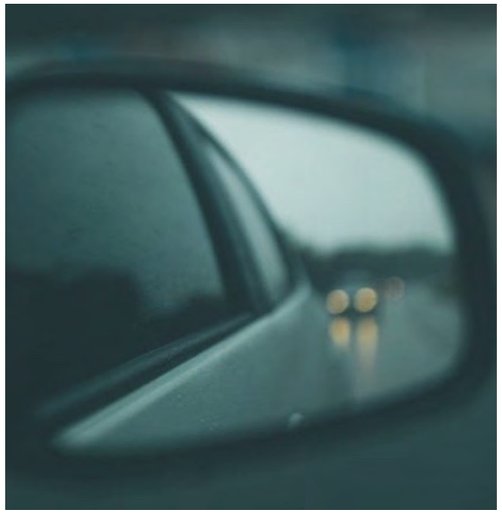
Several of these may be used in an attack (VAW, VBIED or Layered)

1 Parked

A vehicle may be parked close to a target or inside the perimeter of a site or event space. The vehicle may be parked legitimately, illegally or without the land-owner or event organiser's consent. It may be deliberately parked repeatedly to create familiarity.
The vehicle may be abandoned or remain occupied for a short or considerable amount of time prior to the time of attack.
Unsecured parked vehicles within or outside a protected area may be utilised by the attackers.

2 Encroachment

A hostile vehicle may be able to exploit gaps in:
• An urban/rural landscape or perimeter protection.
• Drive slowly through or over what is perceived to be a perimeter or series of obstructions.
• Closely tailgate a legitimate vehicle through a single layer Vehicle Access Control Point (VACP).

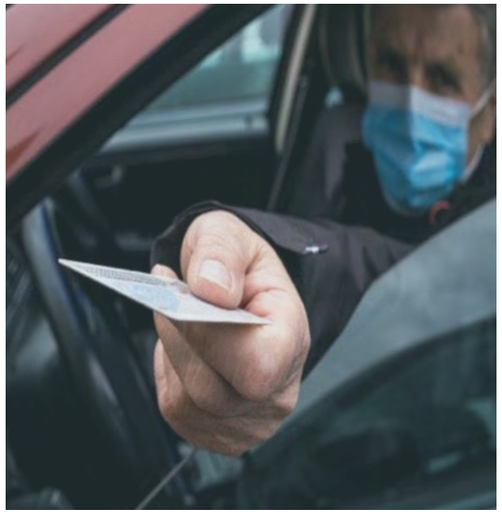


3 Penetrative

A vehicle may be used at low or high speed to weaken and/or breach through security measures. A penetrative attack could result in an Improvised Explosive Device (IED) detonating in or close to a target or a hostile vehicle entering a crowded place. Lower speed attacks may involve the vehicle being aggressively and repetitively rammed against security measures or other obstructions to gain access.

4 Deception

• Trojan Vehicle: The vehicle may be modified to replicate a legitimate vehicle. The vehicle may look familiar: make and model, registration number, livery.
• The occupant(s) of a vehicle may use pretence to gain site access. The occupants may lie, or use forged/ stolen documentation to gain access, use disguises to appear genuine or try to distract/confuse the security officer(s) to gain access.
• Unknowing mule: a legitimate driver unknowingly delivers a hidden IED, firearms, weapons and/or attackers into a protected area.



7 Techniques of Terrorists (continued)

How vehicle-borne attacks manifest

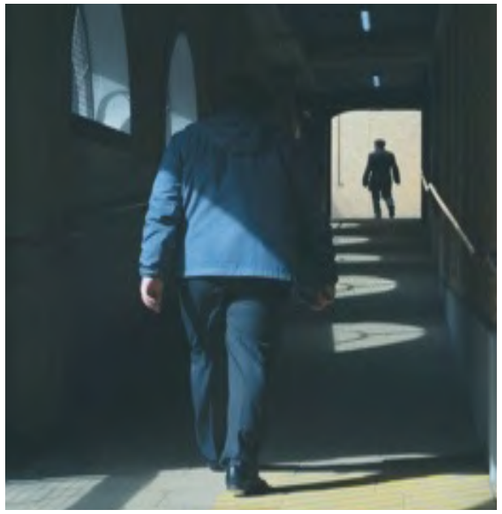
Several of these may be used in an attack (VAW, VBIED or Layered)

5 Duress/Coercion

A security officer at a Vehicle Access Control Point (VACP), a legitimate driver or other person could be forced to facilitate hostile access into a site. They or others known to them may be threatened with violence. They may be placed under undue influence through mental pressure e.g. bribery or blackmail.

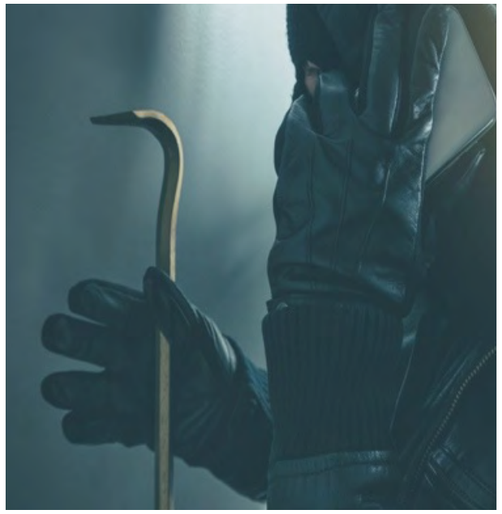
6 Insider

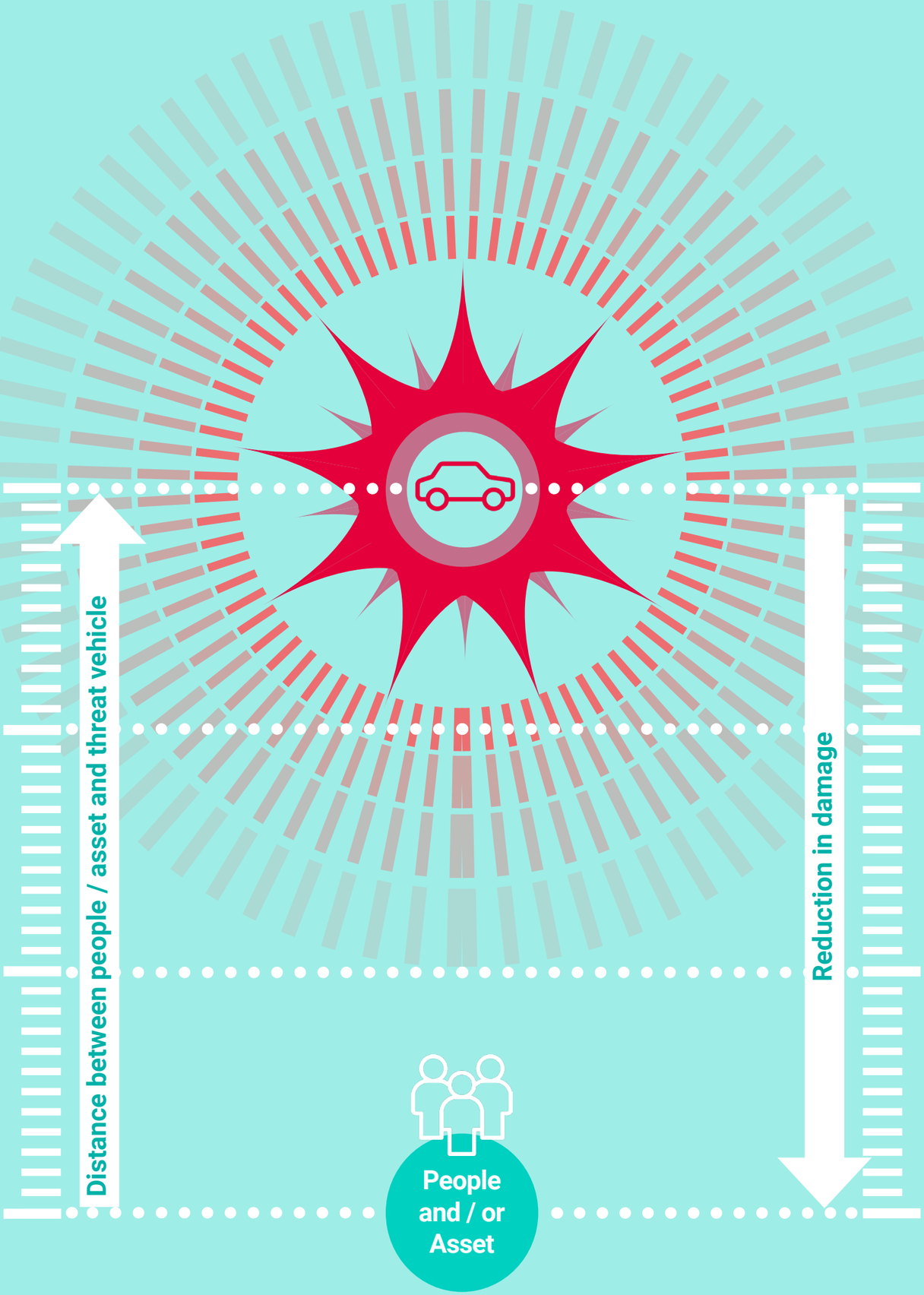
A person with legitimate access willingly facilitates an attack by operating the security measures locally or remotely, managing or issuing access rights or tampering with the security measures.



7 Tamper/Sabotage

With the intent of degrading security measures, these attacks facilitate hostile vehicle access at a later time and involve altering, weakening, or disabling a barrier and/or associated systems. Tampering is harder to detect and may occur gradually over time. Sabotage is more obvious and may facilitate a fast moving or imminent attack.





Every Metre Counts

The distance between people / asset and the threat vehicle is a significant factor in determining the damage sustained by them. Designing in more distance has clear benefits, depending on the type of threat.

Vehicle As a Weapon (VAW)
Ideally, a hostile vehicle should be prevented from reaching people. If that cannot be achieved, then detecting the vehicle breach as early as possible and minimising approach speeds could provide some benefit. These will give people more time to realise the threat and seek safety. Additionally, forcing the vehicle to travel slower by having HVM measures in place, such as chicanes, will increase the time people have to take evasive action.

Vehicle-Borne Improvised Explosive Device (VBIED)
Blast stand-off distance is a critically important factor in determining the extent of damage that can be caused by any VBIED. The ability to maximise this distance will always be site-specific, but early consideration in the design process will enable optimum solutions to be achieved. This can also include improving the blast resistance of a building.

Keeping a potential VBIED away from people or an asset limits the damage caused by blast effects. Adequate blast stand-off distance can be enforced through the use of HVM: physical barriers and effective traffic management.

If retrofitting HVM measures in an existing built environment, it may be difficult to maintain ideal stand-off distances, particularly in urban areas. Careful planning is required as every additional metre of stand-off will have a significant impact on blast mitigation. In more constrained sites, particular emphasis should be given to site or district-wide security, avoiding direct approach routes, managing maximum vehicle approach speeds and installing threshold HVM measures.

Asset
Typically, in terms of Hostile Vehicle Mitigation, focus is on protecting people and assets.

People - members of the public, visitors, customers, staff and contractors.

Assets – buildings, contents, equipment and sensitive materials.

What is HVM?

Hostile Vehicle Mitigation (HVM) is a protective security discipline focussing on reducing risks associated with vehicle-borne threats posed by terrorists and criminals.

HVM is a holistic approach to the protection of people from vehicle-borne threats encompassing a range of disciplines beyond simply installing physical barriers.

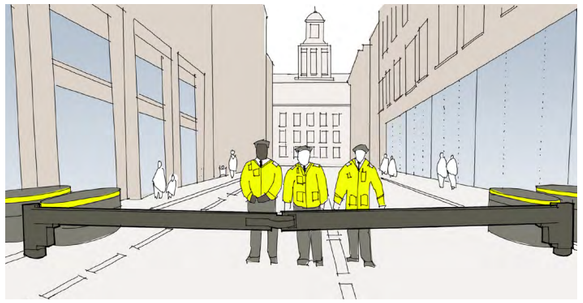
HVM is the effective delivery of measures that are informed by the threat, the consequences of an attack and the vulnerabilities of the Publicly Accessible Location (PAL) or asset to be protected.

The bases of HVM are:

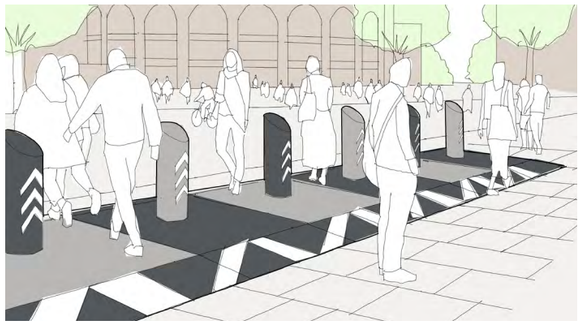
- security risk assessments,
- security planning,
- the design and the deployment of measures that complement the needs of the business, institution or venue.

Examples of Vehicle Security Barriers

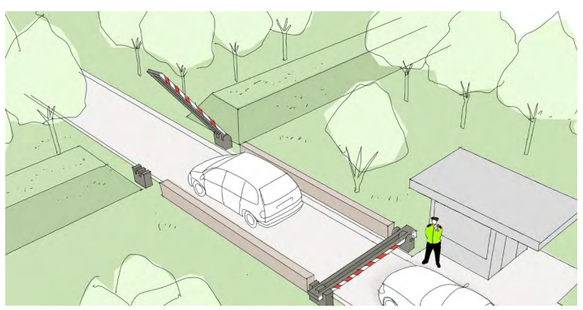
Active (redeployable swinging arm barrier)



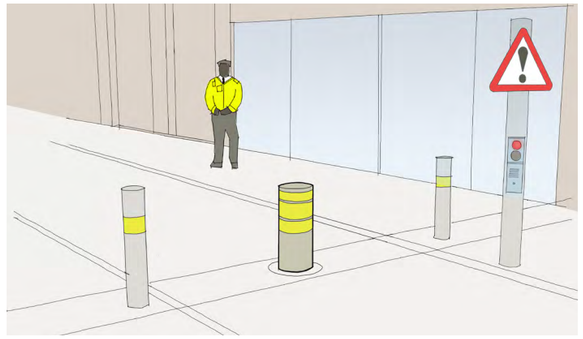
Passive (temporary)



Passive (earth bunds and walls) with Active (rising arm barrier)

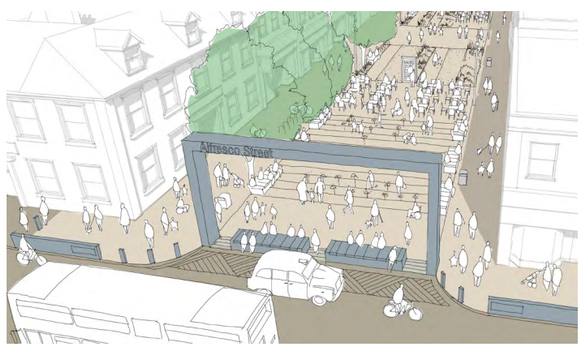


Active (rising bollard)



Passive (street furniture)

Passive (street furniture)



What are VSBs?

Vehicle Security Barriers (VSBs) can be passive (static), or active (operable). Active measures can be operated either at the gate or bollard, or remotely via CCTV. They are vulnerable to Duress and Deception techniques and therefore passive measures are preferred wherever possible.

Passive measures :
static barriers,
sculptural elements,
landform, water, walls, fences, berms, bunds, ditches, raised planters or street furniture.

Active measures :
blockers,
bollards,
gates,
can be rising, sliding, swinging or retracting and are operated manually or powered.

Part 2

Pre Design

Introduction to Risk

Assessing Risk

Stakeholder Engagement

Benefits of HVM

Introduction to Risk

Risk Ownership

A risk management approach to Hostile Vehicle Mitigation schemes is essential to the management and ownership of residual risk, and the development of a risk-based security strategy. Depending on what needs protecting, NaCTSO's risk management process for Publicly Accessible Locations (PALs) and CPNI's protective security risk management for critical assets will help the approach.

The public realm and PALs often have multiple uses and competing stakeholder needs, expectations and dependencies that allow residential buildings, businesses or enterprises to operate and/or thrive, whether they are located in the PAL or are adjacent and therefore potentially dependent on it.

Risk owners and other key stakeholders should be identified at the outset of a project and work on a common approach to develop a shared understanding of threats and of their needs in order that residual risks are reduced to **'as low as reasonably practicable'**.

Those accountable for security risks at a board/executive level should be fully sighted on the risks that they own, and the options explored by stakeholders to reduce the risks.

Public realm stakeholders and possible risk owners:

Assessing Risk

Balancing Competing Demands

Coupled with good governance, a systematic risks management process will help organisations explore options and opportunities to develop informed security strategies that deploy appropriate security measures whilst demonstrating whether the options and solutions are:

- **J**ustifiable
- **A**chievable
- **S**ustainable
- **P**ractical
- **A**ffordable
- **R**easonable

A systematic risk assessment process will allow risk owners and key stakeholders to identify:

- **threats** and how they may manifest themselves,
- **locations**, people or assets that are likely to be a target,
- **vulnerabilities** of those locations or assets and how those vulnerabilities may be exploited,
- initial and longer-term **consequences** of an attack on a location or asset e.g. loss of life or a service going offline,
- **stakeholders** at all corporate levels who will be responsible, accountable, consulted, and informed in the:
  - governance,
  - risks management process,
  - project delivery,
  - lifecycle operation and management of a scheme,
- **activities and needs** of the organisation(s), business(es) or enterprise(s),
- **mitigation options**,
- **risk tolerance levels** for risk acceptance, avoidance, reduction or transfer,
- **priority risks and issues** to address.

Risk assessments should be reviewed periodically as future development plans emerge, the use of the public realm changes and the threat will change with time. Producing a security Operational Requirement will help draw out many of the points listed above and will help identify potential security measures (e.g. vehicle security barriers).

> *"It is more cost effective to "design-in" protective security measures from the outset of a scheme, and, by engaging with all interested stakeholders, this process can ensure measures work together, do not displace vulnerabilities elsewhere in a new build, and offers wider business continuity and crime prevention benefits."*
> **Extract from CONTEST: The United Kingdom's Strategy for Countering Terrorism June 2018.**

Stakeholder Engagement

Stakeholder involvement will depend on a number of factors including, but not limited to the:

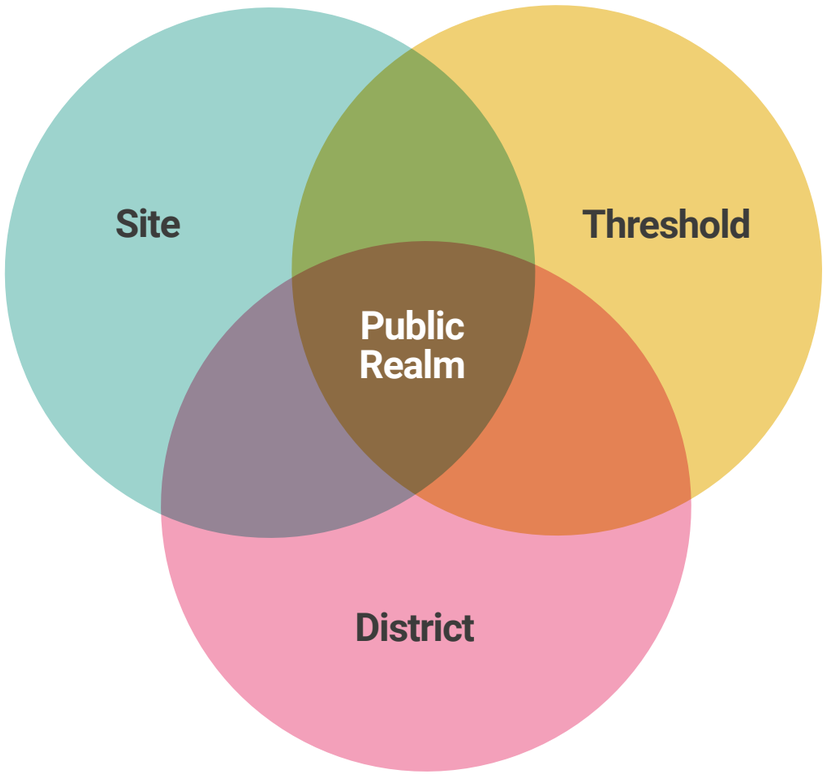
- scale of the project and the impact it has on the stakeholders, for example:
  - New development,
  - Existing development improvement,
  - HVM specific proposals,
- type of location requiring the measures,
- ownership of the location or asset,
- use and / or dependencies on the space,
- the project lifecycle stage and the roles of the stakeholders at each one of those stages, for example, whether they will be:
  - Responsible, those delivering tasks to meet the objective,
  - Accountable, those responsible for risk or signing off risk,
  - Consulted, those to be engaged to provide their opinion or expert advice,
  - Informed, those to be informed of objectives, progress, deliverables and other outcomes.
- The project plan should map out the job roles and individuals that need to be engaged, why, to what level of detail and expectations, when and what follow-on steps are required. Public consultation should only be carried out when a security and communications plan has been developed and agreed.

The project security plan should state which security related information (e.g. security risk assessments, operational requirement, standard operating procedure, performance technical specification) should be shared, with who, why and what the security handling requirements are. Security related information should not be placed in the public domain where it might be considered of value to adversaries.

Benefits of HVM

Over and above its intended security purpose, Hostile Vehicle Mitigation (including vehicle security barriers) can provide a number of benefits to an area when coupled with designing out crime and community safety measures, including:

- public reassurance,
- reducing anti-social behaviour and crime,
- reducing vehicle speeds,
- improvements to road safety,
- improvements to pedestrian safety,
- environmental improvements such as reduction in air and noise pollution by making changes to vehicular movement,
- opportunities for artistic features, messaging or advertising,
- functional benefits i.e. introduction of street furniture,
- improved public realm with widened footways,
- improved disabled access,
- opportunities to increase biodiversity through greening (e.g. planters),
- creating a sense of space and place,
- providing peace of mind to people and businesses.



Part 3

Design Response

Role of Design

What Makes a Place Secure?

Traffic Management

Reducing Speed

Design and Vehicle Security Barriers (VSBs)

Pedestrian Movement

Five Cs

Cycle Access

Role of Design

The opportunity exists for designers of the public realm to ensure that Hostile Vehicle Mitigation (HVM) measures are integrated seamlessly into the environment, providing proportionate security whilst also creating appealing and functional places for people. This section explores design thinking and technical information to demonstrate different approaches to these challenges.

Along with many other public realm design drivers, safety and security issues should be considered from the outset to ensure that HVM measures are woven successfully into the fabric of new proposals. As security becomes an increasingly significant factor, it is important that a holistic approach is taken to develop integrated strategies that provide appropriate and balanced responses, and avoid unintended consequences within the surrounding area.

In some instances, particularly within existing built environments, HVM measures will not have been considered at the outset and solutions may need to be retrofitted. Unless well thought through and designed, these solutions may provide less effective security, be more costly and have a negative visual impact.

Interventions will vary from a macro scale of site masterplanning to a micro scale of detailed physical restraints. Where conditions limit the possibilities for HVM, softer measures can also be effective. Some will be discreet and some may be overt, but generally the emphasis should be for preventative rather than deterrent measures. Every scenario will be different and solutions must always cater for site specific requirements.

In situations where the threat diminishes, options to remove HVM measures can be considered, if this would result in improvements to the public realm.

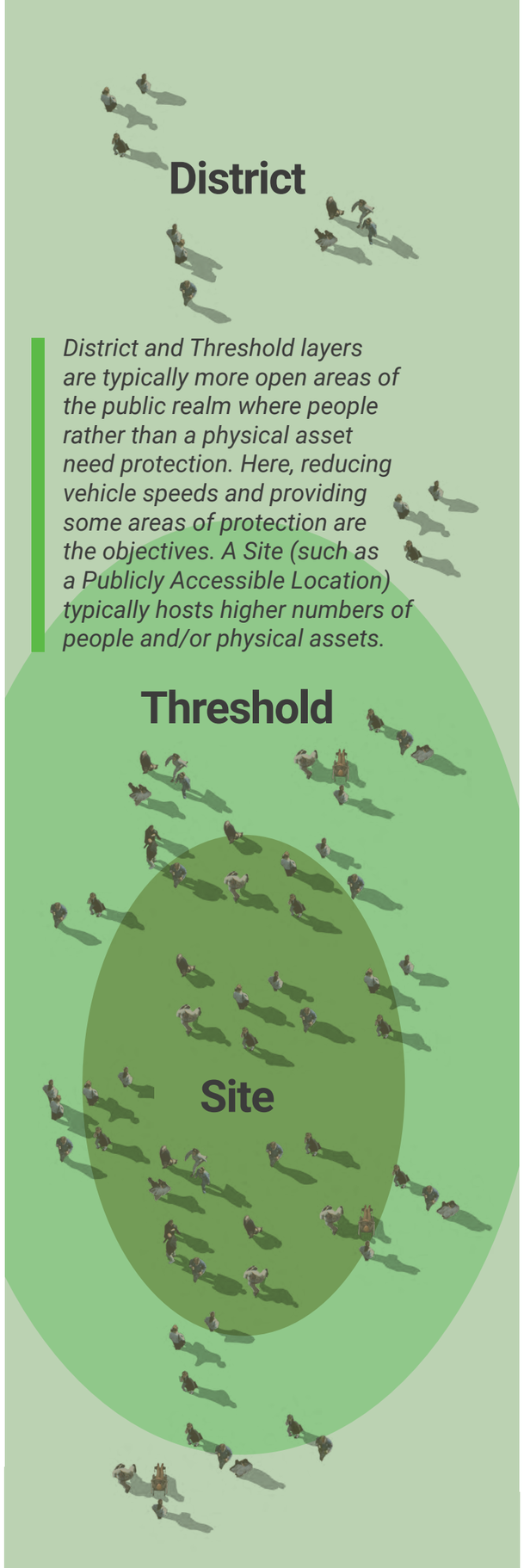
What Makes a Place Secure?

Holistic Security
As well as integrating HVM measures into the public realm, it is important to follow a holistic approach to overall security. Such an approach will acknowledge and respond to the interdependence of physical measures with electronic and procedural security measures (for example Intrusion Detection System [IDS] and Closed Circuit Television [CCTV] or search and screening and access control) to ensure that overall security is enhanced rather than compromised.

The level of threat in a public space may vary at different times of the day or year. Effective security design will recognise these fluctuations and schemes can be flexible using redeployable or contingency solutions at peak times of crowd density or during a special event.

Layered Approach
Successful security is most effective when implemented on a number of geographic layers. In terms of HVM, layers can feature access control and vehicle management on a **district** level, design of approach routes, further vehicle management and stand-off distances at the **threshold** level and finally, control of stand-off distances and secure **site** design to the immediate vicinity of populated areas and the asset.

Each of the layers will influence the context and approach to the integration of HVM measures (refer to the 'Five Cs").



District and Threshold layers are typically more open areas of the public realm where people rather than a physical asset need protection. Here, reducing vehicle speeds and providing some areas of protection are the objectives. A Site (such as a Publicly Accessible Location) typically hosts higher numbers of people and/or physical assets.

District
The wider site context - of varying scale but generally with multiple sites and land ownerships.

Outer level protection must include consideration of wider site planning, traffic management and access control. Protection of people and / or assets is most effective when it is possible to implement security over a wide area. Holistic and well-managed protection to an outer 'perimeter' will typically lessen the risk, but may impact onerously on legitimate traffic and daily operations. Potential costs for wider interventions may be offset by a reduced need for by a reduced need for protecting several individual Sites.

Threshold
This is typically the layer surrounding a Site. It can include multiple land ownerships.

It should be designed to control or prevent vehicular access; this will minimise opportunities for a Vehicle As a Weapon (VAW) attack on people here or within the Site.

Incorporating blast stand-off distance in the form of HVM measures here reduces blast effects on the Site in the event of a Vehicle-Borne Improvised Explosive Device (VBIED) attack, improving the outcome for people and assets within the Site if a VBIED detonates.

Site
The layer containing a higher number of people (e.g. a Publicly Accessible Location) and/or physical assets.

This is typically the last line of defence and must be designed to control or prevent vehicular site access. This layer of protection includes consideration of site planning, access control and traffic management but with more manageable on-site operational issues. With a particular emphasis on site planning it is possible to avoid direct vehicle approaches, reduce maximum hostile vehicle approach speeds and to create opportunities for increasing blast stand-off distances.

Given the high number of people and physical assets within the Site, it is very important to minimise opportunities for hostile vehicles. Preventing or severely limiting a Vehicle As a Weapon (VAW) is a priority, as is reducing the harm and damage from a Vehicle-Borne Improvised Explosive Device (VBIED) attack. Blast stand-off distance is therefore a priority consideration for this protective layer as well as the design, positioning and integration of HVM measures within the immediate context.

Typically, in terms of Hostile Vehicle Mitigation, focus is on protecting people and assets.

People – members of the public, visitors, customers, staff and contractors in the area that you are trying to protect.

Assets – buildings, contents, equipment and sensitive materials.

Worked examples of each protection scenario are shown on the 'Urban Scenarios' pages.

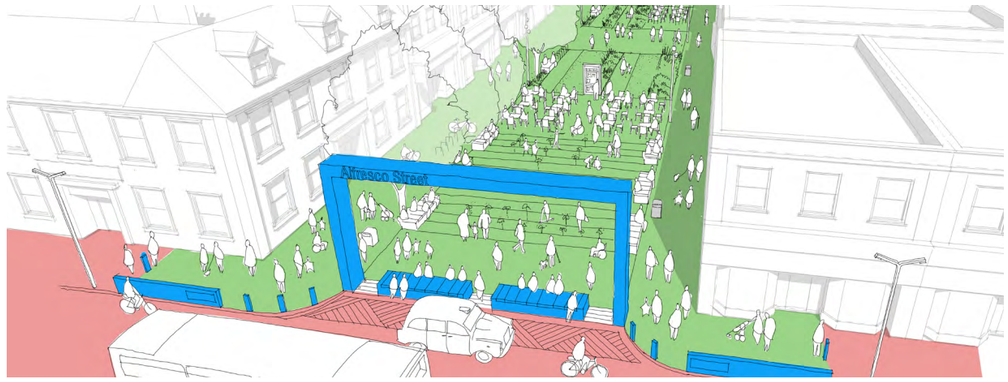
Traffic Management

The level of intervention should be proportionate to the assessed vehicle-borne threat and sympathetic to the day-to-day site operations such as servicing, deliveries and visitor drop-off. Ideally the application of traffic management should:

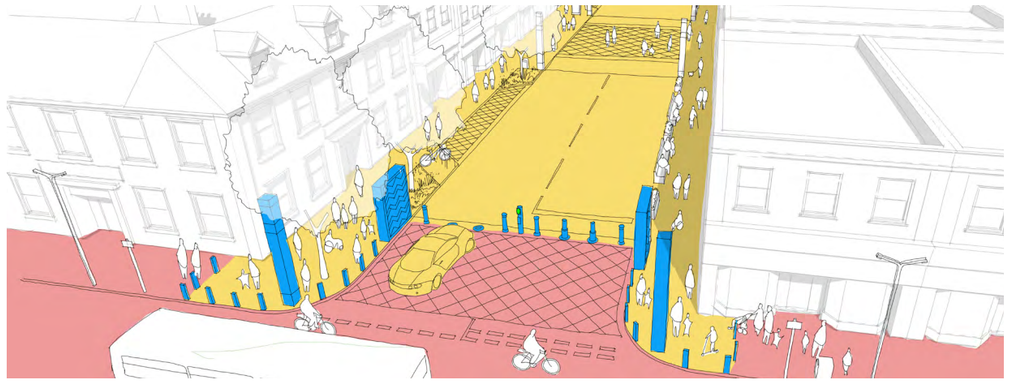
- provide proportionate protection to a PAL and the people within it, or a physical asset;
- create a safer environment for people, who may be the target of a Vehicle As a weapon (VAW) attack;
- create an enforceable blast stand-off;
- create a perimeter around a protected physical asset;
- minimise the amount of traffic requiring site access; and
- be in place when it is required for specific events or times.

No protection Reduced protection Full protection HVM

The following traffic management options can be utilised:

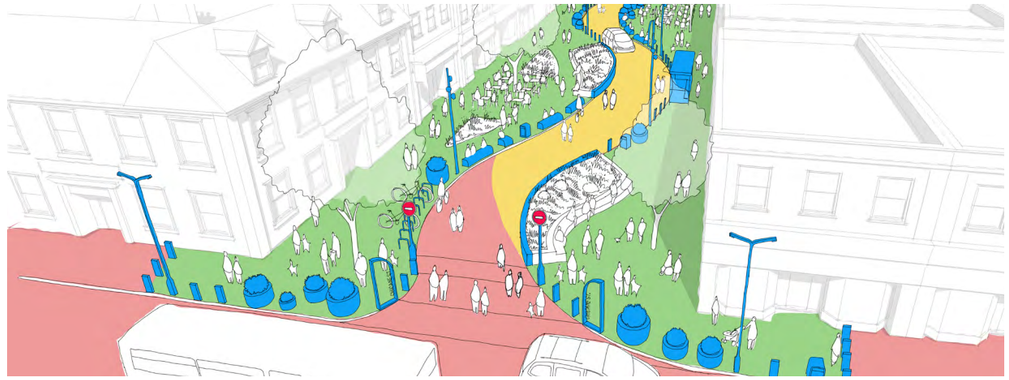


(a) Vehicle exclusion - In certain situations total vehicle exclusion enforced by Vehicle Security Barriers (VSBs) may be appropriate.



(b) Vehicle inclusion - In other instances, controlled access for authorised vehicles such as emergency services, utilities, deliveries, buses, residents and Blue Badge holders may need to be accommodated through a Vehicle Access Control Point (VACP) and should be carefully managed to avoid being defeated by hostiles.

(c) Temporary protection - Temporary or redeployable Vehicle Security Barriers (VSBs) may be employed at times of heightened threat or pre-planned special events. These barriers require specialist equipment to deploy, tend to be more visually intrusive and less permeable for pedestrians than permanent solutions.



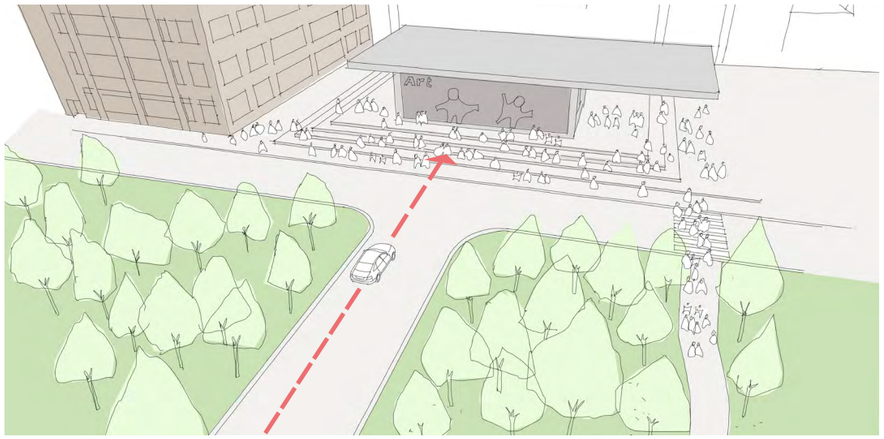
(d) Traffic calming methods - The application of horizontal deflections (e.g. bends and chicanes) that are enforced by VSBs will limit hostile vehicle speeds. Reducing hostile vehicle speeds significantly reduces the severity of a vehicle-borne attack with fewer casualties in a VAW attack on people and less damage from a penetrative vehicle impact on other assets. Reducing vehicle speeds can reduce the requirements and associated costs of HVM measures and provide more opportunities to deploy discreetly integrated protection.

Is an ATTRO needed? An Anti-Terrorism Traffic Regulation Order (ATTRO) can be made if vehicular and/or pedestrian traffic into, or along, a road needs to be temporarily or permanently restricted for counter-terrorism purposes. An ATTRO can only be initiated by the traffic authority on the recommendation of a Chief Officer of Police, typically advised by a police Counter Terrorism Security Adviser (CTSA) and specialists at the UK Government's Centre for the Protection of National Infrastructure (CPNI).

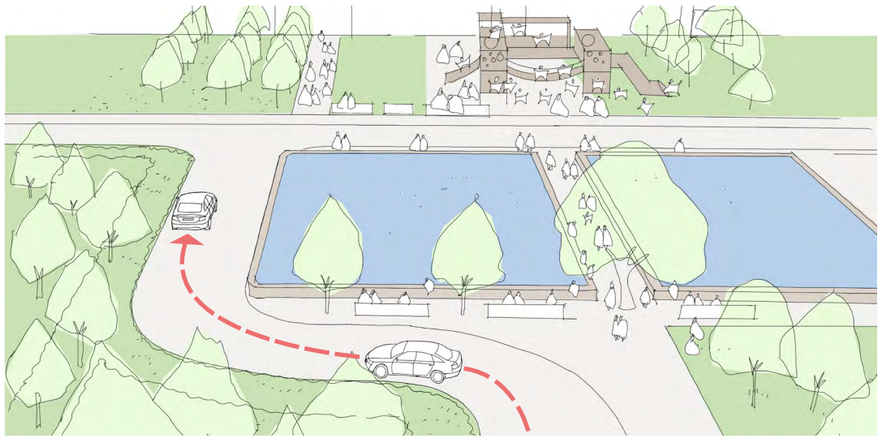
Reducing Speed

Increasing protection of people, Publicly Accessible Locations and physical assets

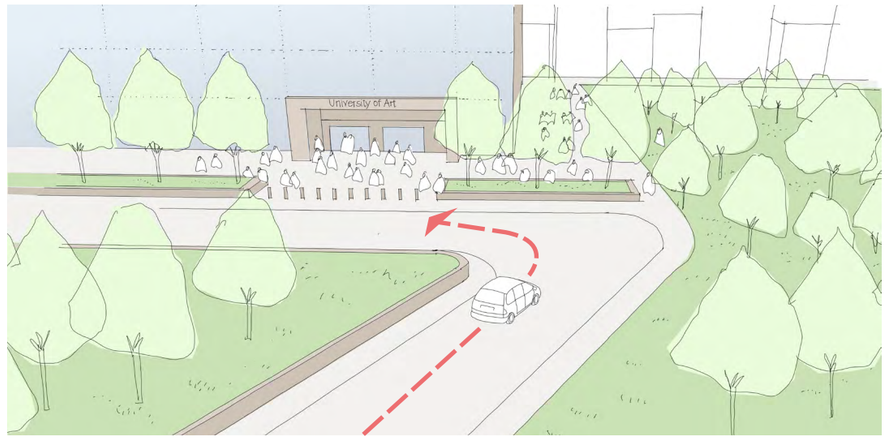
A small decrease in speed will ... → ...reduce the severity of impact and... → ...provide more opportunity for appealing preventative measures... → ...with blended designs that are less intrusive,... → ...and / or smaller and cheaper VSBs.



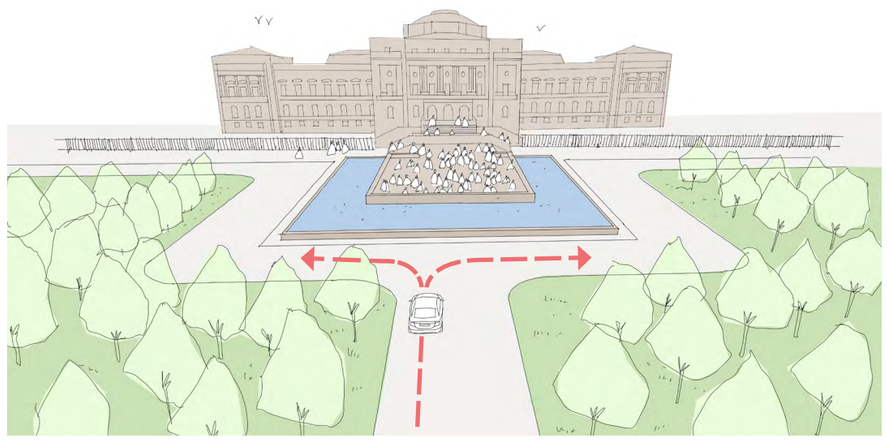
A direct approach route towards the target allows a hostile vehicle to build up speed on approach.



Chicanes and offset approaches reduce hostile vehicle approach speed.

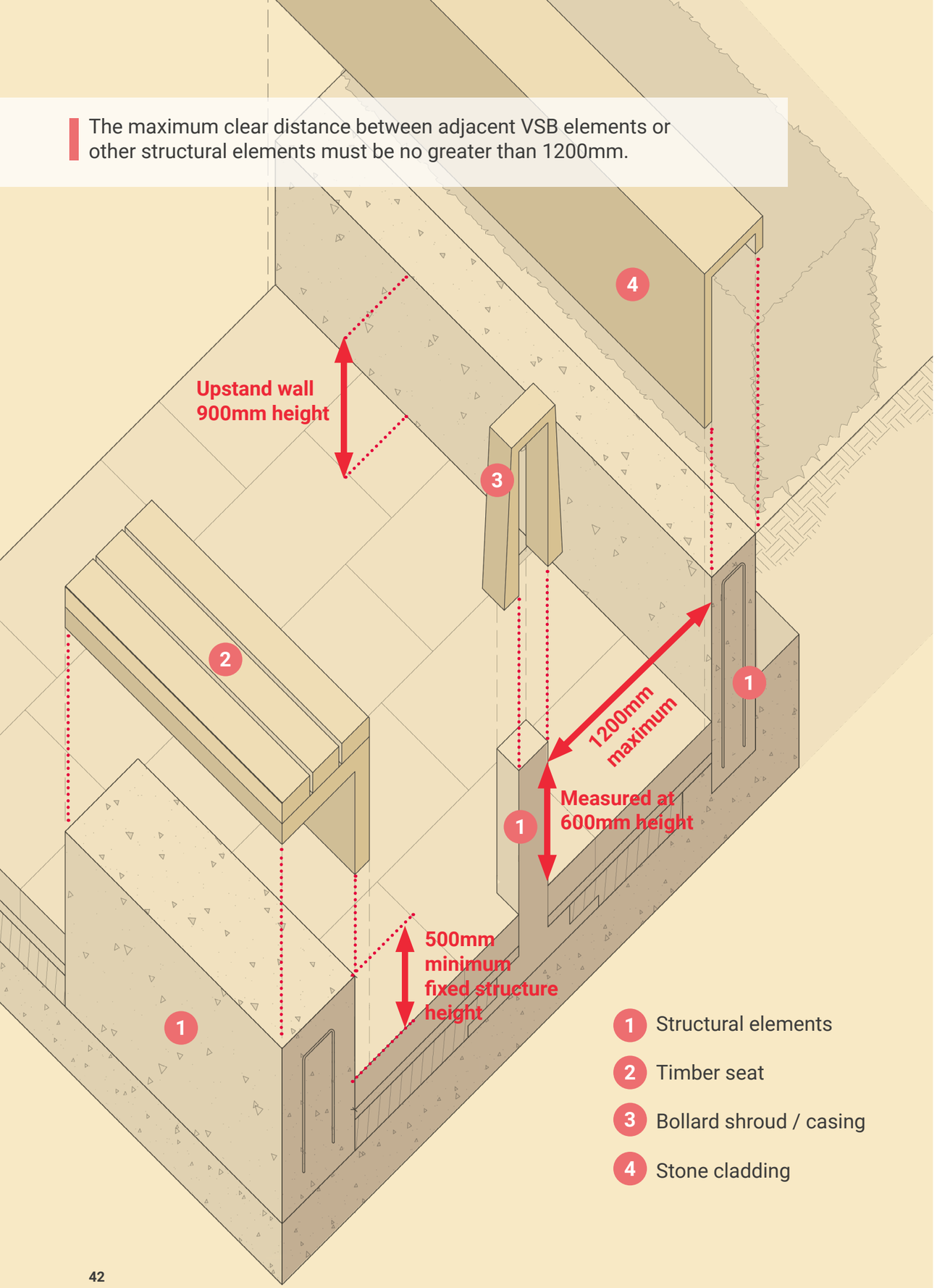


Moving a road or relocating a vulnerable location or asset, to create an indirect approach, will reduce the opportunity for a hostile vehicle.



Removing vehicle access removes the potential for using a vehicle as a weapon and establishes a stand-off distance from parked hostile vehicles.

The maximum clear distance between adjacent VSB elements or other structural elements must be no greater than 1200mm.



Design & Vehicle Security Barriers

Technical Requirements

The maximum clear distance between adjacent Vehicle Security Barrier (VSB) elements or other structural elements must be no greater than 1200mm. This dimension is designed to prevent encroachment of vehicles beyond the blast stand-off perimeter, whilst maintaining access for pedestrians, wheelchair users and pushchairs. The 1200mm clear dimension must be measured between structural elements at a height of 600mm above ground level. In practice, with shrouds and coverings on VSB cores, the final clear distance may be slightly reduced.

The minimum height for vertical fixed structures is 500mm. However increased heights should be sought to reduce potential vehicle ingress and introduce other benefits. For example, an increased height of 900mm or more will make the measure more conspicuous, assist the visually impaired and typically reduce the penetration of an impacting hostile vehicle.

All vertical elements selected to prevent vehicle access should be fit for purpose and successfully tested and rated to one of:

ISO 22343-1 (expected 2023)
ISO IWA 14-1

BSI PAS 68 or
CEN CWA 16221 (withdrawn)

Further advice for the application of these elements can be referenced to:

ISO 22343-2 (expected 2023)
ISO IWA 14-2
BSI PAS 69 or
CEN CWA 16221 (withdrawn)

Further information about these standards: the testing of VSBs and their application into the public realm, can be found on CPNI's HVM website page.

Pedestrian Movement

When considering the installation of Vehicle Security Barriers (VSB) in the public realm, designers should take a holistic approach to ensure an appropriate level of physical protection is provided whilst minimising any negative impact on pedestrian movement. Sites must accommodate movement safely and at the required level of comfort and convenience. The pedestrian characteristics and social context of the site should be considered to determine areas of risk, for example where VSBs will be installed in crowded places or adjacent to places that can generate high footfall such as a busy transport hub or event venue.

A number of tools and techniques are available to develop a comprehensive understanding of pedestrian flow. These include desk top surveys and field research to identify pedestrian desire lines, walking similar sites to gain first hand experience, observing existing pedestrian flow characteristics, collecting pedestrian flow data (e.g. through video surveys), simulation tests using validated computer software and trials to examine proposed modifications to the site.

In the context of this guide, the term 'pedestrians' is applied to all those permitted to use the footway.

The impact of VSBs on pedestrian movement will vary significantly depending on the size and orientation of the obstacles, the spacing between them, their visibility and the surrounding pedestrian flow characteristics.

Bollards are generally relatively slender installations in comparison with other street furniture – similar in circumference to street lights. The dimension and shape of other types of bollards (e.g. cubes, bell-shapes) are likely to have a greater impact on pedestrian flow. The scale of this impact should be a design consideration. For example, in free flowing pedestrian conditions, bollards spaced with 1200mm gaps between them (not accounting for shrouds/covers) and perpendicular to the flow will have, at most, a minor effect on pedestrian convenience. In these conditions, pedestrians are unlikely to change their direction and body position or reduce their walking speed.

In contrast, larger VSBs (such as benches, planters, gates, etc.) have an increased impact on pedestrian convenience as they greatly reduce the amount of usable space, create more potential for conflicts, and may require pedestrians to reroute and slow down. Compared with bollards, which primarily influence the behaviour of pedestrians located in the immediate vicinity, larger obstacles can impact the wider system (e.g. dividing the flow into two or more channels to navigate around the obstacle).

The presence of obstacles will increase crowd density. While this may have a minimal impact in low footfall and free-flowing conditions, the impact will be increased in high density, congested conditions such as crowded events or some emergency situations.

The guidance within the 'Inclusive Mobility: A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure (2021)' and the Equality Act 2010 should also be considered. For example, a visually impaired person using a long cane or with an assistance dog needs 1100mm width, whilst it is recommended a person using two sticks/crutches or a wheelchair user requires a 900mm width. Other design considerations may include the appearance of VSBs to improve visibility and accessibility.

In using this guidance it should be noted that the design of a VSB scheme must achieve a balance between multiple operational and security requirements.

Further reference:

- TAL 1/11 Vehicle security barriers within the streetscape, DfT & CPNI, April 2011 (amended October 2017)
- TAL 2/13 Bollards and Pedestrian Movement, DfT & CPNI, May 2013 (amended October 2017)
- TAL 1/16 The Influence of Bollards on Pedestrian Evacuation Flow, DfT & CPNI, November 2016 (amended October 2017)
- Inclusive Mobility: A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure (2021)

Five Cs

Capacity | **Comfort** | Convenience | Conflict | Context

Pedestrian movement parameters can be evaluated to investigate if, and how, any are influenced by the design of a physical environment that includes a VSB scheme.

Pedestrian movement is influenced by the following inter-related technical factors:

Capacity
Capacity is the **maximum flow** rate at which pedestrians can safely flow through a space during a defined period of time. Flow rate is measured in people per metre per minute (p/m/min). The capacity is calculated by multiplying the maximum flow rate by the usable width of the path.

Flow rates depend highly on context and can vary significantly. Industry guidance can provide an indication of appropriate rates to use in different types of spaces. For example, the following rates are typically used in normal conditions for footways, stations and sports grounds respectively:

- Pedestrian Comfort Guidance †: There will be restricted movement for all pedestrians when flow rates are over 35 p/m/min.
- Station Capacity Planning Guidance †† : 65 p/m/min (maximum one-way flow); 50 p/m/min (maximum bidirectional flow).
- Guide to Safety at Sports Grounds ††† : 82 p/m/min (maximum flow on a flat surface) and 66 p/m/min (maximum flow on a stepped surface).

It is apparent that these standards vary given different locations and scenarios. For an accurate assessment of flow conditions on an existing site, flow rates can be derived by collecting real data (e.g. footfall counts per minute).

Comfort
Comfort is defined as the amount of personal space available to pedestrians and the ability to move freely. This is affected by the available space and the pedestrian density, measured in people per square metre (p/m²).

When walking, as density increases constraining free movement, pedestrians feel less comfortable and their achievable walking speeds are reduced. In other circumstances (e.g. while queuing or dwelling), higher densities may not be deemed uncomfortable.

† Transport for London (TfL), 2019.
†† Network Rail (NR), 2016.
††† Department for Culture Media and Sport (DCMS), 2018.

Five Cs

Capacity | **Comfort** | **Convenience** | **Conflict** | Context

Comfort (continued)
Peak flow rates are typically achieved at densities of about 2 p/m² . After this point, the density reduces walking speed to such an extent that the flow begins to decrease. As pedestrian densities approach 4 p/m² (when the path is assumed to be saturated with people), flow will be significantly constrained with little pedestrian ability to move or change direction. For this reason, guidance documents typically quote a maximum density of 4 p/m² †††.

Convenience
Convenience is defined as the ability of a pedestrian to identify and follow their preferred route to their target at their favoured speed. A “desire line” describes a user's preferred route through a space. Following this route requires that the pedestrian has sufficient space to manage their local movement and position.

Context (for example, time pressure for commuters) will impact both the desire lines and favoured speed.

Actual routes taken can be measured in terms of pedestrian speed, distance travelled and the subsequent journey duration. A pedestrian would want to cover this distance in a speed that enables them to reach their target in a timely manner (i.e. to meet their objective).

Conflict
Conflict is defined as a discrete event that interrupts a pedestrian’s movement towards their target.

Conflicts can occur between a pedestrian and the physical environment (e.g. a bollard) or between two or more pedestrians. Conflicts can include collisions or behaviours necessary to avoid a collision such as stopping or sudden changes of direction.

Conflicts may hinder pedestrian movement (by reducing speeds or diverting them from their chosen path) and may lead to trips and falls, especially at high densities. Individual conflicts may also have a secondary effect on nearby pedestrians – affecting the overall flow along a path.

††† Department for Culture Media and Sport (DCMS), 2018.

Five Cs

Capacity | Comfort | Convenience | Conflict | **Context**

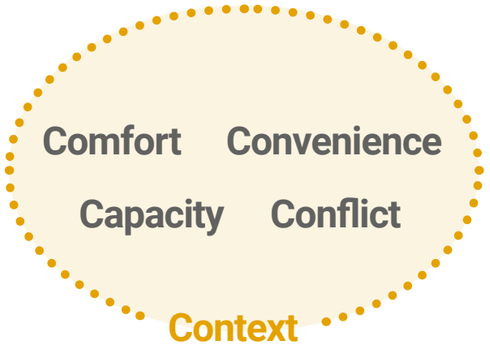
Context relates to the surrounding social, situational and demographic factors that influence pedestrian behaviour, their route choices and their movement between and around VSBs.

Several of these factors can increase density and reduce freedom of movement, impacting the other four Cs. For example:

- **demographic factors** (e.g. high proportion of social groups, children/elderly, those using mobility devices),
- **normative factors** (e.g. crowd intoxication, likelihood of disorder),
- **encumbrance levels** (e.g. high proportion of those with luggage or prams),
- **familiarity levels** (e.g. pedestrians unfamiliar with the area, those wayfinding),
- **VSB design use** (e.g. bollards with flat tops might encourage pedestrians to lean, deposit waste, or sit on them),
- **adjacent attractions** (e.g. that produce desire lines not perpendicular to the VSB or skew routes more heavily to one part of the design),
- **environmental factors** (e.g. low lighting, change in level or incline leading to the VSB),
- **surrounding urban features** (e.g. retail kiosks or newspaper vendors, decision points immediately beyond the VSB line, pedestrian crossings).

All populations will include pedestrians with different movement abilities. Designs should not compromise accessibility: all pedestrians should be able to be navigate the VSB measures safely during routine movement and emergency use (e.g. during an evacuation from a nearby structure).

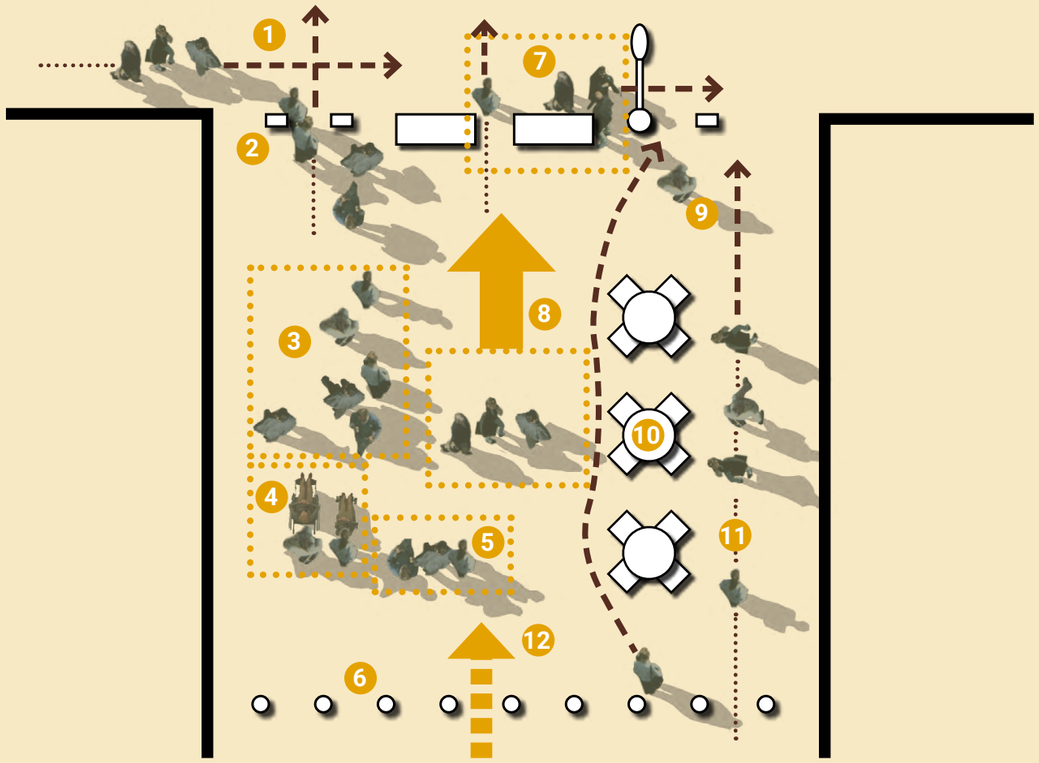
Designers should consider how the site context affects the other four Cs, identifying factors that might increase the impact of VSBs on pedestrian movement and seek mitigations where possible. For instance, the type of geographic layer in which the VSB is located will also shape the Context – i.e. the district, threshold or site (refer to ‘What Makes a Place Secure’).



Context provides the backdrop and can amplify the impact of the VSB on pedestrian movement and experience.

Glossary Diagram

In the context of this guide, the term ‘pedestrians’ is applied to all those permitted to use the footway.



1. **Crossflow**: Flows moving to reach different targets leading to desire lines crossing.
2. **VSB – Vehicle Security Barrier** : Not all measures are bollards and will have a different impact on flow.
3. **Comfort** is the amount of space available and the ability to move freely. This is affected by the occupiable space and the density (p/m²).
4. **People with Movement Devices (i.e. wheelchairs and push chairs)** move at different speeds and occupy different areas.
5. **Social Group**: People moving together – likely at the speed of slowest member.
6. **Bollard Array**: Designed to be permeable – passed through by people. Formed from a set of bollards that are relatively slender– similar in circumference to street lights.
7. **Conflict** is defined as a discrete event that interrupts a pedestrian’s movement towards their target.
8. **Flow**: Function of population density and walking speed.
9. **Walking Speed**: Pedestrians will have different maximum walking speeds based on their movement abilities and whether they are encumbered.
10. **Street furniture / obstacles.** Not necessarily designed to be permeable
11. A “**desire line**” is a user's preferred route. Convenience is defined as the ability of a pedestrian to identify and follow this route to their target at their favoured speed.
12. **Capacity** is the maximum flow rate at which pedestrians can safely flow through a space (p/m/min). It is calculated by multiplying the maximum flow rate by the usable width of the path.

Capacity

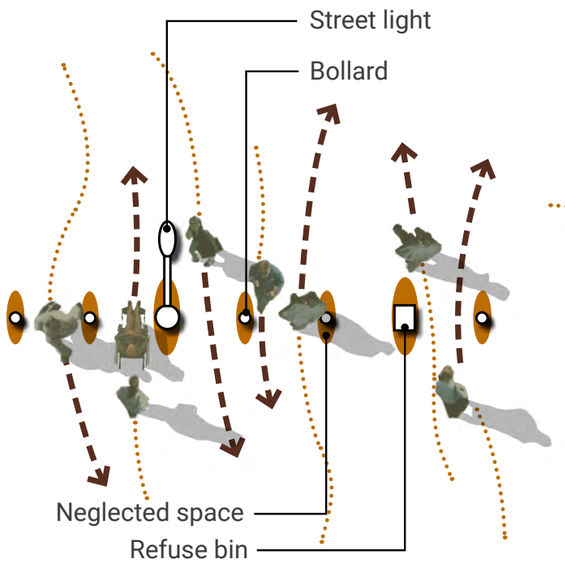
Flow Rate
Introducing obstacles into a path reduces the available width. This will reduce the capacity of the path (i.e. the maximum number of pedestrians that can pass through every minute).§

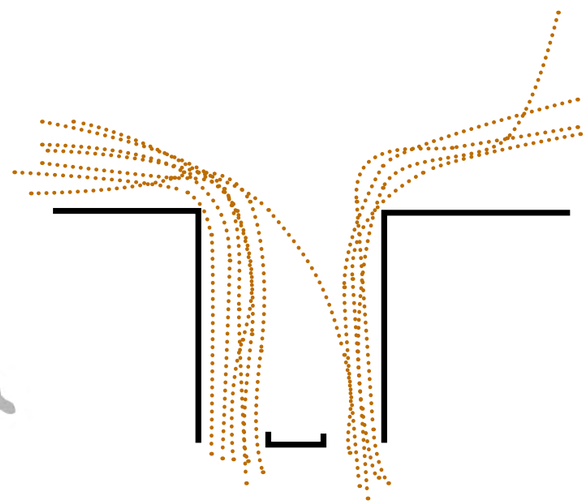
For example, placing a 2 metre wide bench across a 10 metre wide pathway would reduce the available width by 20%, lowering the capacity accordingly. However, evidence suggests that the arrangements of some obstacles (e.g. permeable bollard arrays) have a smaller impact on flow than if determined by their combined widths. In areas with low footfall, introducing obstacles may not have an impact on flow rates where there is still sufficient space for the number of pedestrians using the path.

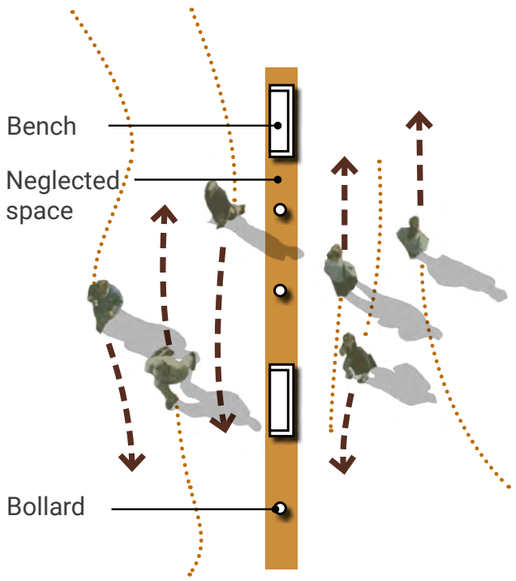
As footfall increases, at a certain point (when the number of arrivals is greater than the flow capacity across the path width), introducing obstacles will lower flow rates and may increase congestion.

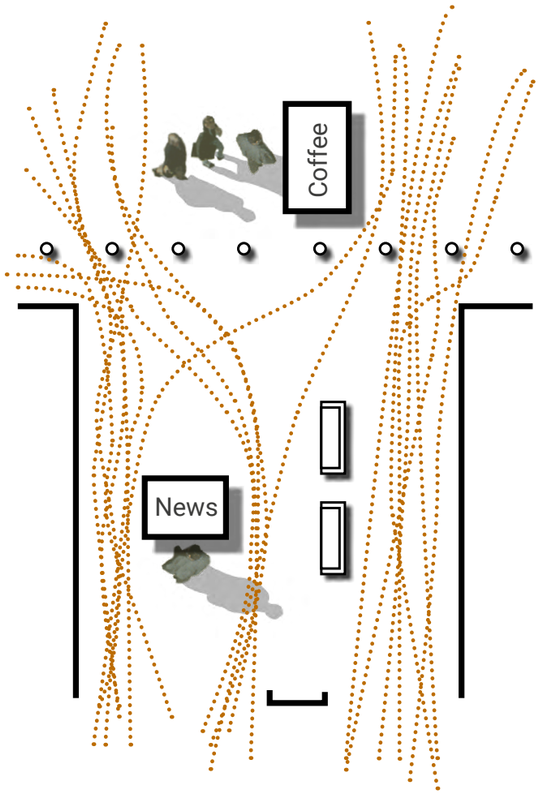
Flow Through Bollard Arrays
The impact on pedestrian flow can be minimised when a bollard array is perpendicular to the direction of movement.

Where bollards are arranged in other configurations, such as straight lines parallel to movement along a kerb edge, the bollards confine movement. Here, pedestrians will instead maintain a distance from the array (rather than passing through it), as they walk parallel to it and follow their









Comfort

Capacity (continued)
chosen path. In such cases, bollard arrays might help to shape the path adopted rather than affect movement rates.

Flow through bollard arrays (or any permeable VSB measures) will be affected by the presence of other flow behaviours (i.e. cross flows and merging flows).

Density
VSBs take up floorspace that might otherwise by occupied by pedestrians, effectively increasing the density by reducing the occupiable space. Designers should avoid placing VSBs where densities are already elevated (e.g. in narrowings, at intersections or where pedestrians are queuing or dwelling).

It is unlikely that pedestrians will be evenly distributed across a path. Local high densities within a flow may occur, particularly when there are large groups or encumbered pedestrians with luggage, mobility devices, or prams, for instance. Like flow, density can fluctuate over time, with waves of pedestrians arriving or departing an area at the same time.

As density increases, so the pedestrian's view ahead of them will be obscured. As such, pedestrians might have less prior warning of the upcoming VSB. This may lead to sudden changes in their path and increase the chance of conflicts especially if they are not familiar with the path.

§ Online resources are available that present experiments exploring flow characteristics: https://ped.fz-juelich.de/da/doku.php

Convenience

Route Choice
Route choice will affect the paths adopted by pedestrians and the flow patterns generated. The ability of a pedestrian to adopt their chosen route will be influenced by the layout of the space around the VSB and any attractions and services adjacent to the VSB (e.g. food kiosks, entrance gates, etc.).

Pedestrians choosing different routes can produce crossing/merging flows, amplifying the impact of VSBs (e.g. bollard arrays) on pedestrian flow and comfort.

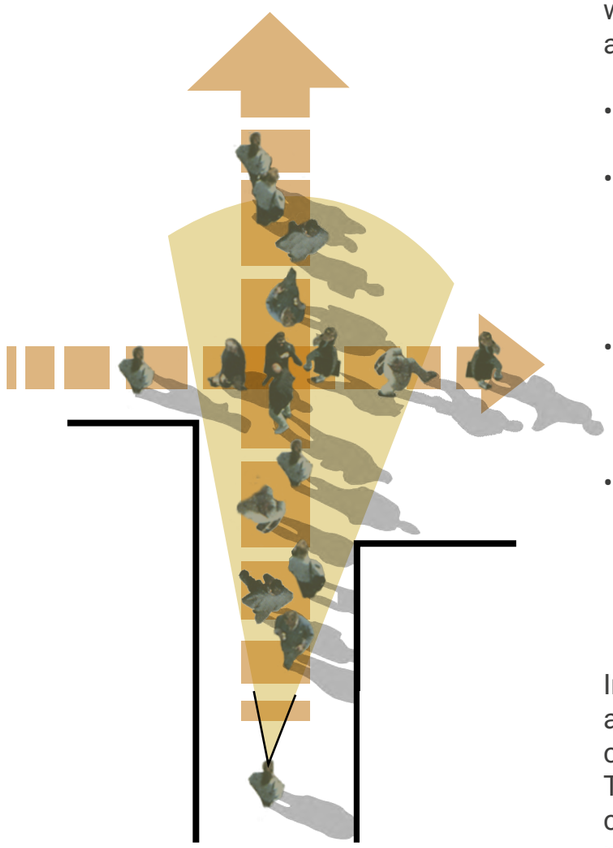
Speed
Pedestrians will have different maximum walking speeds based on their movement abilities and whether they are encumbered. Target speeds (the speeds pedestrians would chose to adopt) also depend on the situation (the Context), for instance social groups will tend to move at the speed of the slowest group member.

The speed of pedestrians in unidirectional flows reduces as crowd density increases above 1 p/m² – likely halting entirely beyond 4 p/m². §§,* In spaces with complex flow patterns the presence of VSBs might further reduce speeds as local densities increase. It is therefore better to avoid positioning VSBs where complex flow patterns are expected – or factor the possible reduction in speed into the VSB design where such a location is unavoidable.

Wayfinding and Visibility
The presence of permeable VSBs such as bollard arrays generally do not adversely affect pedestrian desire lines or wayfinding. However, larger obstacles may discourage pedestrians from using a particular route.

Visual perception will influence pedestrian awareness of upcoming obstacles (such as VSBs) and their need to account for them in their movement. Pedestrians with visual impairments or those who are unfamiliar with the space may only become aware of obstacles when close to them, increasing the chances of unplanned interactions (conflicts).

Visual perception becomes all the more challenging for pedestrians during high footfall, high density and spaces where views might be obscured. For crowded sites, the design of VSB schemes should consider ways to aid perception including their height, prominence, and colour in comparison to the surroundings.



Conflict

More conflicts are observed to take place where complex pedestrian flow conditions are present. For instance, where:

- Multiple pedestrian flows meet or cross,
- Restricted visibility between flows reduces time for negotiation between pedestrians and adjustment of speed and direction;
- Limited space increases pedestrian density, particularly where multiple flows interact;
- Stationary pedestrian activity occurs (e.g. localised queuing or waiting) or pedestrians leaning or sitting on the VSBs, impeding the movement of other pedestrians.

Introducing VSBs into environments where a combination of these conditions occur could increase the likelihood of conflict. The number and impact of these conflicts can be made worse by poor design of the physical environment.

§§ Fruin, JJ, Pedestrian Planning and Design, Metropolitan Association of Urban Designers and Environmental Planners, 1971.

* Gwynne, S.M.V. and Boyce,K.E., Engineering Data, SFPE Handbook of Fire Protection Engineering, 5th Edition, Hurley et al. (eds.), Springer, ,NY, 2016, pp2429-2551.

Cycle Access

To meet technical requirements, the distance between the structural elements of Vehicle Security Barriers (VSBs) must be no greater than 1200mm.

The minimum widths specified for cycle infrastructure design often exceeds 1200mm. Though not optimal, cycle routes can, by exception, accommodate 1200mm spacings and maintain cycle transit, albeit at slower and safer speeds.

Wherever possible, inclusive cycle strategies should be accommodated, meaning greater spacings to facilitate cycle flow. However, in locations assessed as being vulnerable to vehicle-borne attack, consideration should be given to reducing the spacing to 1200mm at vulnerable points; in this case, where a cycle route meets a location requiring protection.

Alternative access arrangements should be considered for wide/ adapted cycles that are close to, or exceed 1200mm; this will depend in part on the frequency of these cycles and existing alternative routes. Cycle transit requirements on public cycle highways/paths are quite distinct to those on privately owned sites, where ownership and management of the route is clearly defined.

Rational discussions should be held between stakeholders regarding security requirements, cycle access requirements, potential safety issues and risks, before a pragmatic decision is made.

Further reference :

Cycle Infrastructure Design', Local Transport Note 1/20 (July 2020).

Part 4

Inspiration

Design Inspiration

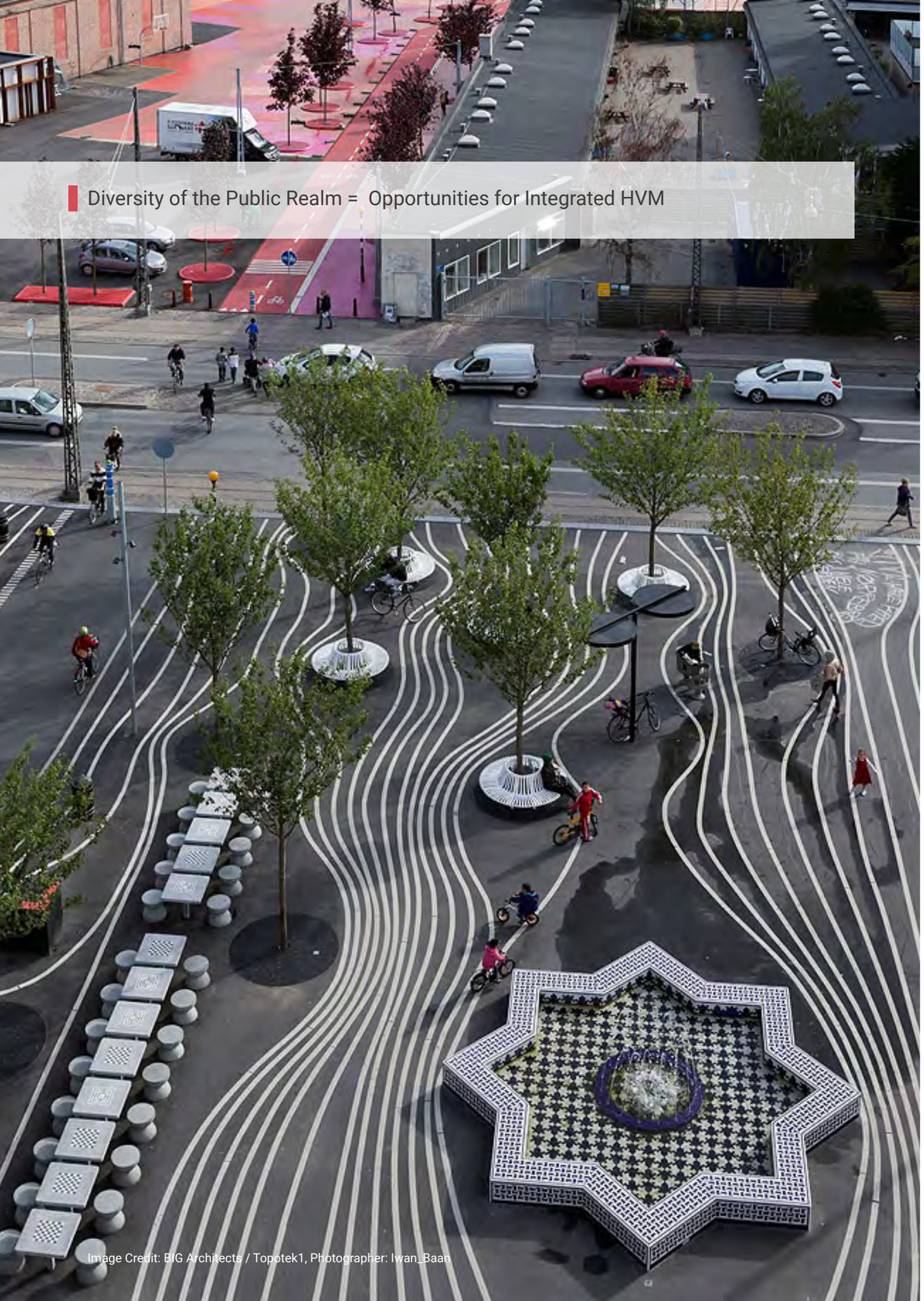


Image Credit: BIG Architects / Topotek1, Photographer: Iwan_Baan

Design Inspiration

6 Key Design Principles

Six key principles have been identified in delivering successfully integrated Hostile Vehicle Mitigation in the public realm. A site-specific approach is essential in delivering effective and appropriate measures.

- Consider forward planning and maintain design versatility during projects as threats evolve and targets change with time.
- Provide mitigation measures proportionate to the threats.
- Design to enhance the setting.
- Include multi-functional elements – consider the streetscape as a whole and the removal of clutter alongside the integration of HVM.
- Ensure an accessible and inclusive environment.
- Design with maintenance in mind.

Design Reference

The following pages illustrate a selection of elements, from public art to street furniture, which could be adapted and developed (in terms of structure and dimensions) to provide integrated HVM:

- Public art & culture
- Incidental street elements
- Water
- Play
- Seating
- Street furniture
- Topography & levels
- Walls, fences & boundaries
- Parklets, traffic calming & modal filters
- Urban greening
- Blended elements

Design Inspiration

Public Art & Culture | Incidental Street Elements

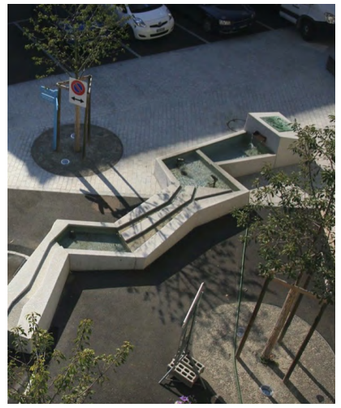
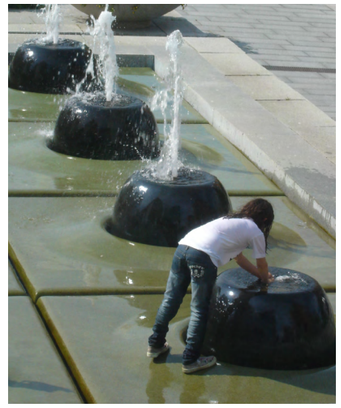
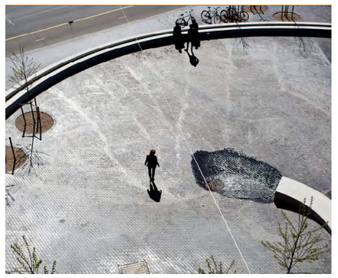




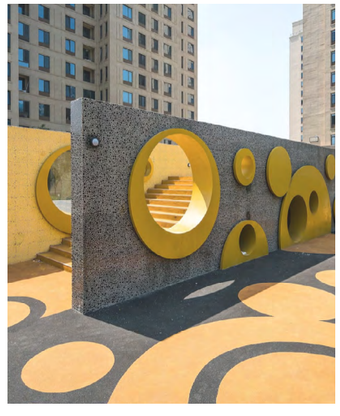


Elements illustrated could be adapted and developed (in terms of structure and dimensions) to provide integrated HVM.

Water | Play

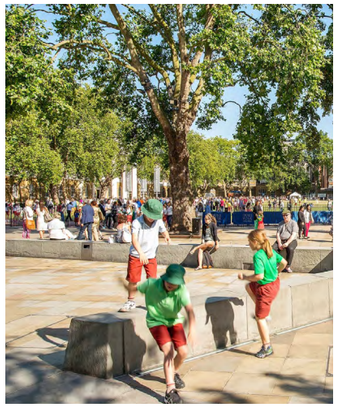


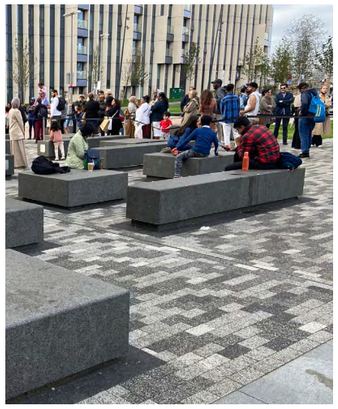



Elements illustrated could be adapted and developed (in terms of structure and dimensions) to provide integrated HVM.

Design Inspiration

Seating | Street Furniture



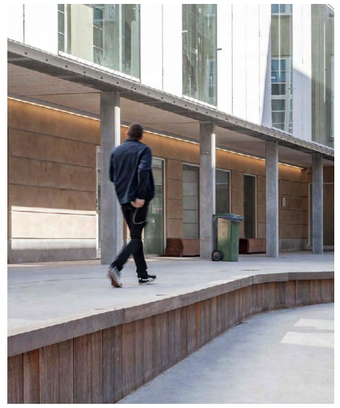
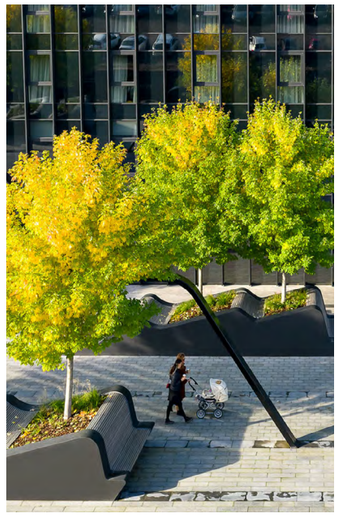



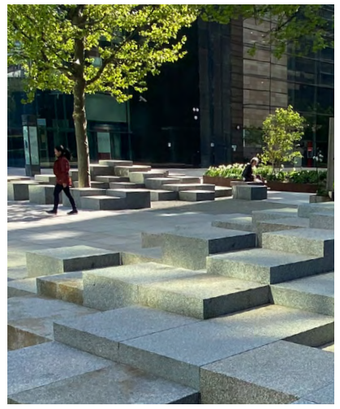


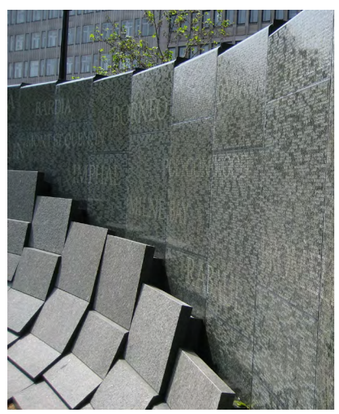

Elements illustrated could be adapted and developed (in terms of structure and dimensions) to provide integrated HVM.

Topography & Levels | Walls, Fences & Boundaries





Elements illustrated could be adapted and developed (in terms of structure and dimensions) to provide integrated HVM.

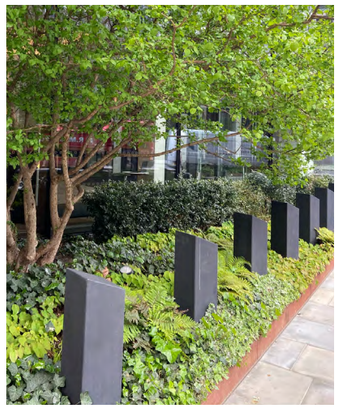
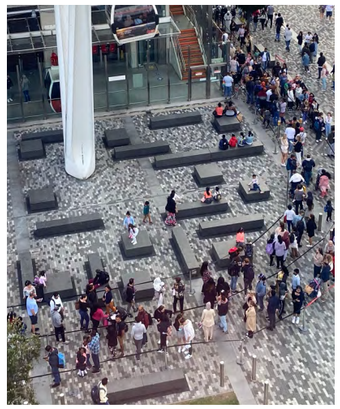
Design Inspiration

Urban Greening & SuDS | Parklets, Traffic Calming & Modal Filters




Elements illustrated could be adapted and developed (in terms of structure and dimensions) to provide integrated HVM.

Blended Elements





Elements illustrated could be adapted and developed (in terms of structure and dimensions) to provide integrated HVM.

Part 5

Urban Scenarios

The following section examines potential strategies and proposals for three urban scenarios, each with different requirements and constraints.

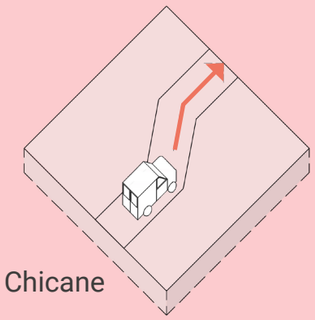
Designer's Toolkit

Scenario 1: District

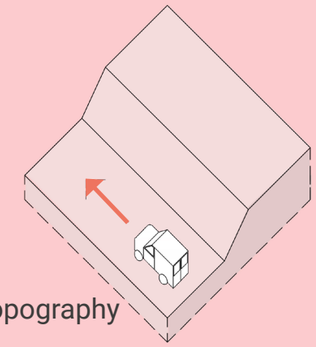
Scenario 2: Threshold

Scenario 3: Site

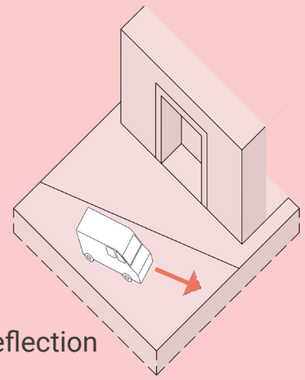
Design Principles:



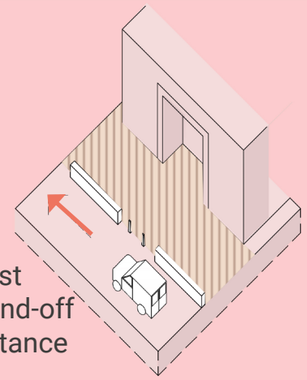
Chicane



Topography

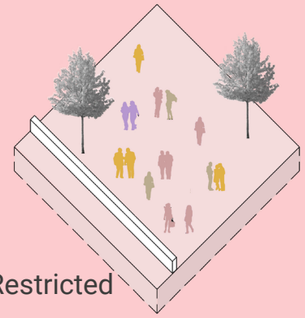


Deflection

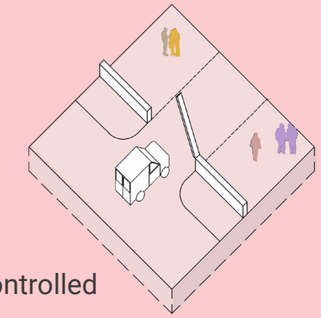


Blast Stand-off Distance

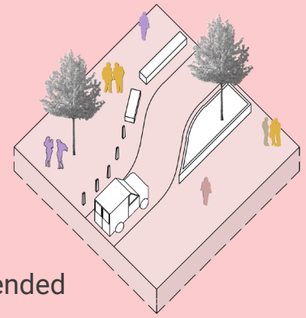
Access Principles:



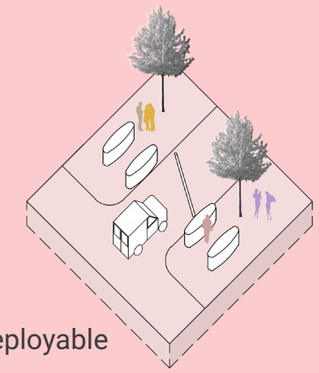
Restricted



Controlled



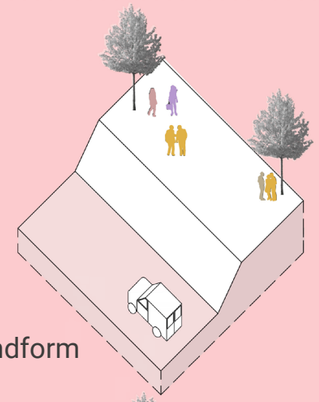
Blended



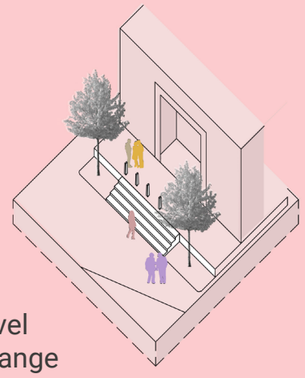
Deployable

Landscape Elements:

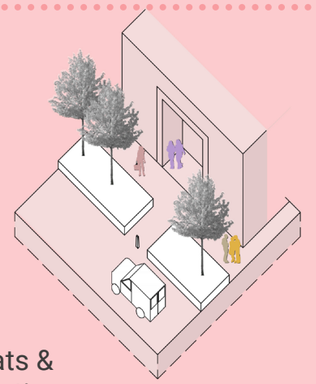
Street Furniture



Landform

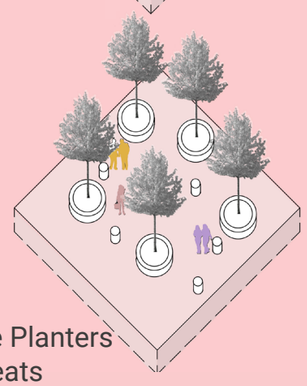


Level Change

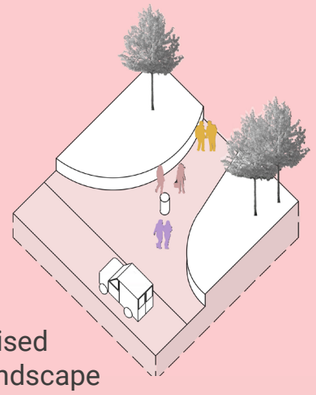


Seats & Planting

Blended Elements



Tree Planters & Seats



Raised Landscape

Public Art

Designer's Toolkit

The diagrams opposite illustrate a range of design tools available to public realm designers to address the threat of hostile vehicles.

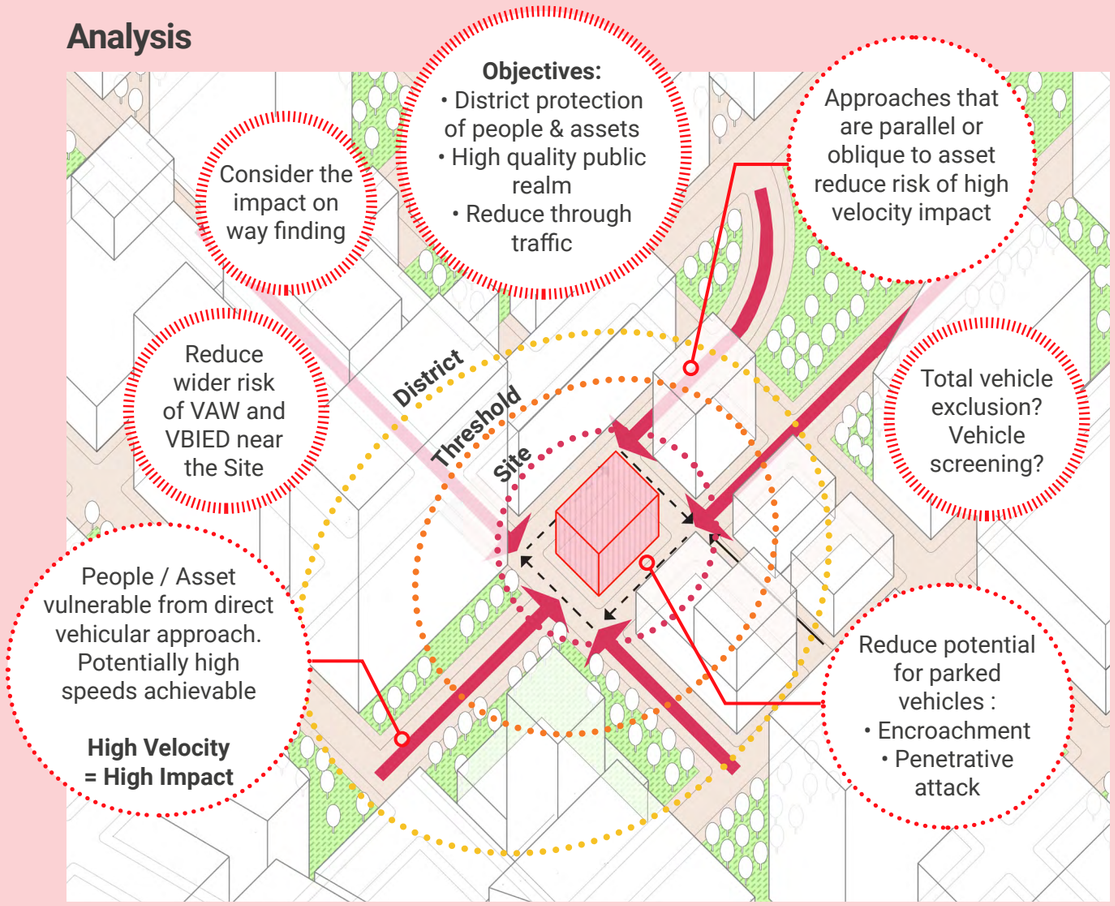
The list is not exhaustive and is intended to demonstrate principles that could be employed to incorporate HVM within the public realm.

For VSBs rated to recognised standards, refer to HVM chapters in CPNI's Catalogue of Security of Equipment.

Scenario 1: District

Includes opportunities to influence the District, Threshold and Site

Analysis



Opportunities

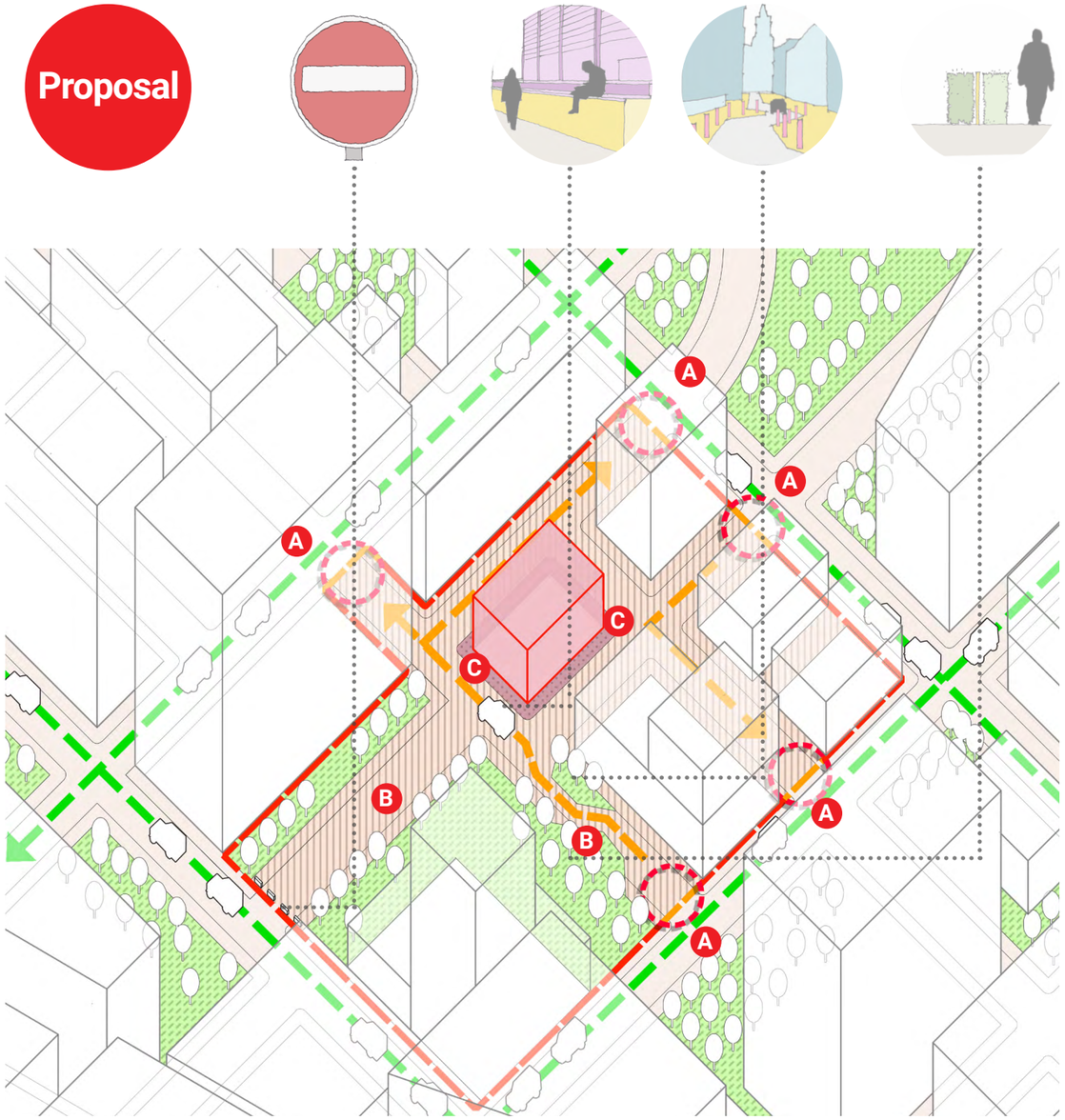
Site set within tight urban layout / streetscape may be a cluster of populated areas and assets, and therefore sensitive location.

Conduct site observation to assess Five Cs.
Risk from hostile vehicles:
- Either VBIED or VAW

At district level controls can be implemented at a range of scales for maximum effect including:
- Site planning
- Traffic management
- Access and control management

Reduce the ability, and therefore the risk, of a hostile vehicle accessing the area.

Understand existing way-finding through site observation



A **District** Consider: Vehicle screening , manual / automated systems, traffic management / vehicle exclusion.

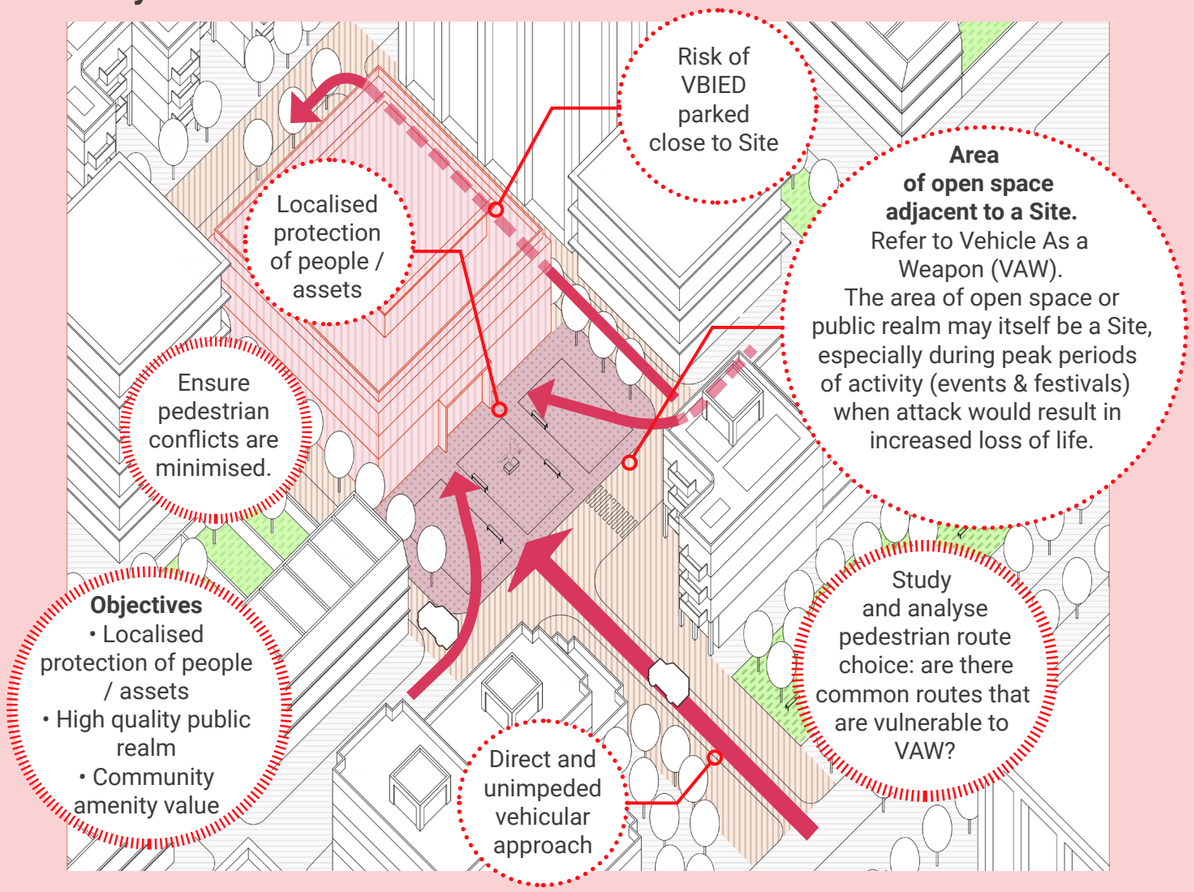
B **Threshold** Consider: Emergency access only, establish maximum stand-off distance in case district level controls are breached, chicanes to control vehicular approach speed to asset through public realm.

C **Site - 'Last Line Of Defence'**
Physical barriers integrated into public realm and building apron, may include: water, seating, furniture, sculpture or art feature, play elements. Consider: accessibility, pedestrian access and flow, aesthetics, physical constraints, costs, maintenance.

Scenario 2: Threshold

Includes opportunities to influence the Threshold and Site

Analysis



Opportunities

Controls can be implemented at both Threshold and Site levels.

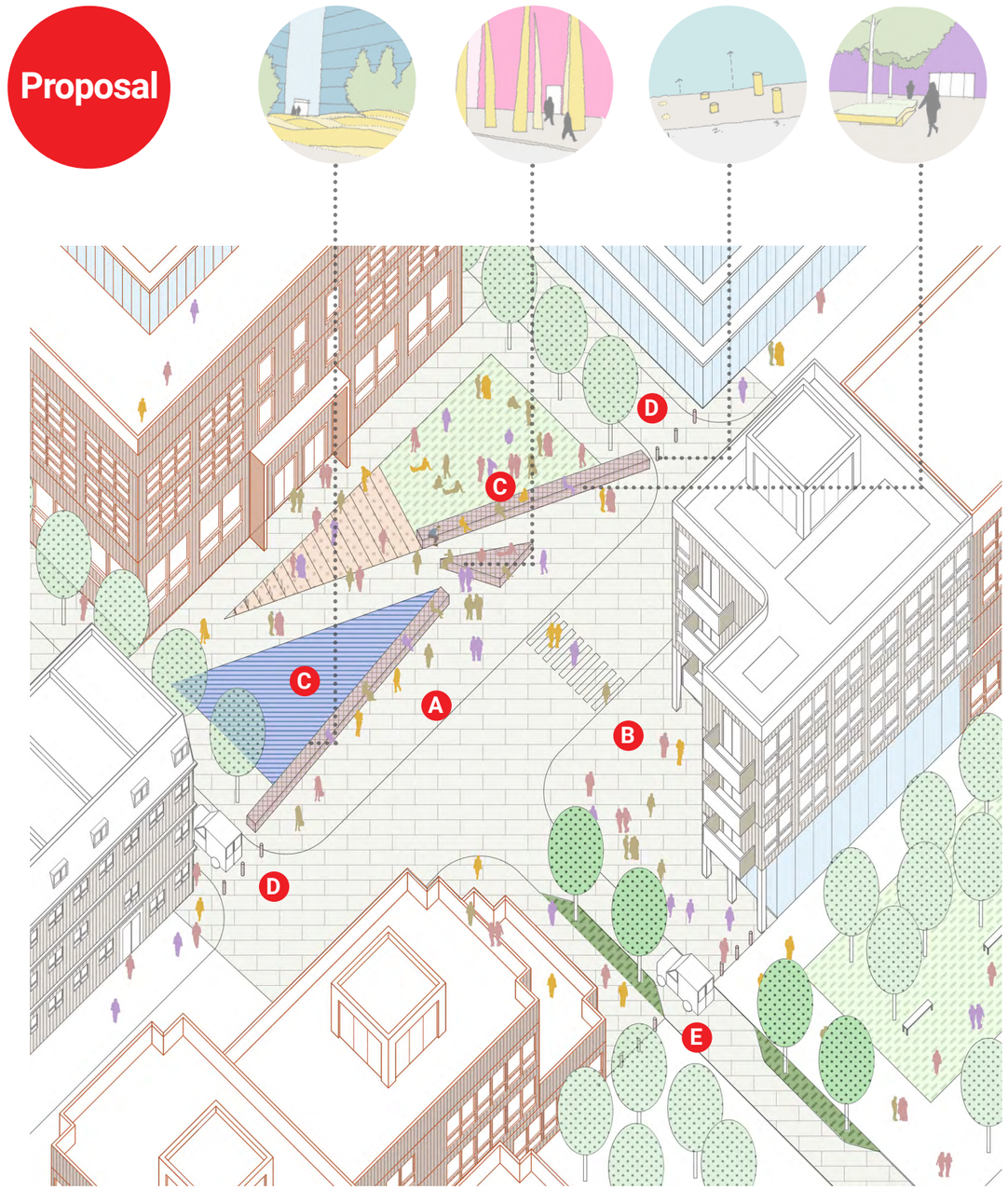
Reduce hostile vehicle approach speeds:
- Horizontal deflections
- Vertical elements (such as barriers)

Create opportunities for maximising stand-off distances:
- Elements integrated into the fabric of the public realm
- 'Dual / multi-purpose' barriers
- Holistic approach to security
- Integrated public realm design
- Consider existing desire lines and route choices

Available tools:
- Active barriers
- Passive barriers

Integrated design solutions could include use of:
- Multi-functional landscape features
- Raised soft landscape areas
- Water features and repositioned sculpture
- Chicanes with planting opportunities

Proposal

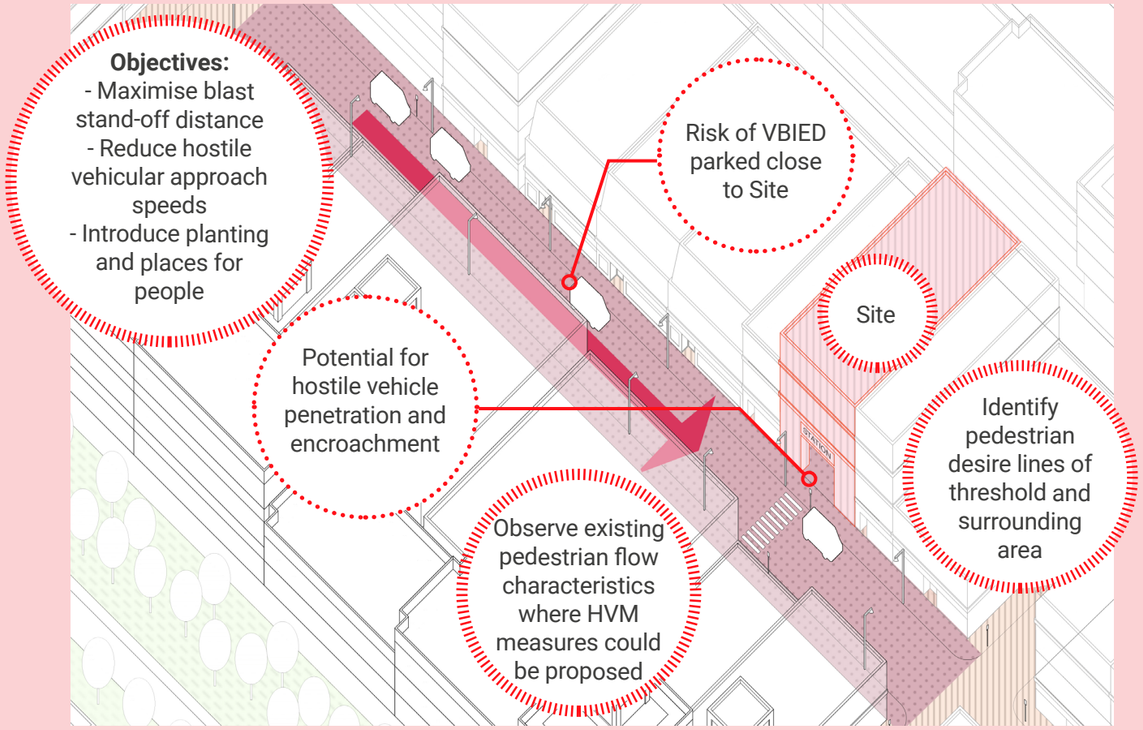


- **A** Maximise blast stand-off to minimise impact of a VBIED.
- **B** Consider desire lines and pedestrian flows.
- **C** Water features and landscape elements as potential HVM providing seating & play opportunities.
- **D** Active barriers provide opportunity to allow specific vehicles to be screened and access the Site, reducing the capability of hostile vehicles to access the curtilage of the Site. However, active barriers are more susceptible to deception and duress techniques.
- **E** Use of chicanes assists in reducing vehicle speeds, making it safer for people and lessening the impact on physical assets. Opportunity for wider environmental benefits such as new street tree planting and SuDS.

Scenario 3: Site

Includes opportunities to influence the Site

Analysis



Opportunities

Site set within tight urban grain.
This scenario looks at localised asset protection, where District and Threshold level controls are less favoured. Seek to reduce vehicle speeds, so that a hostile vehicle is a reduced threat to people and cannot impact with as much force.

Every Metre Counts: Maximise blast stand-off by keeping vehicles on the road. This has the added benefit of protecting pedestrians on the footway from a VAW attack.

'Last Line Of Defence':
- Restrict vehicular access
- Minimise effects of damage in VBIED attack

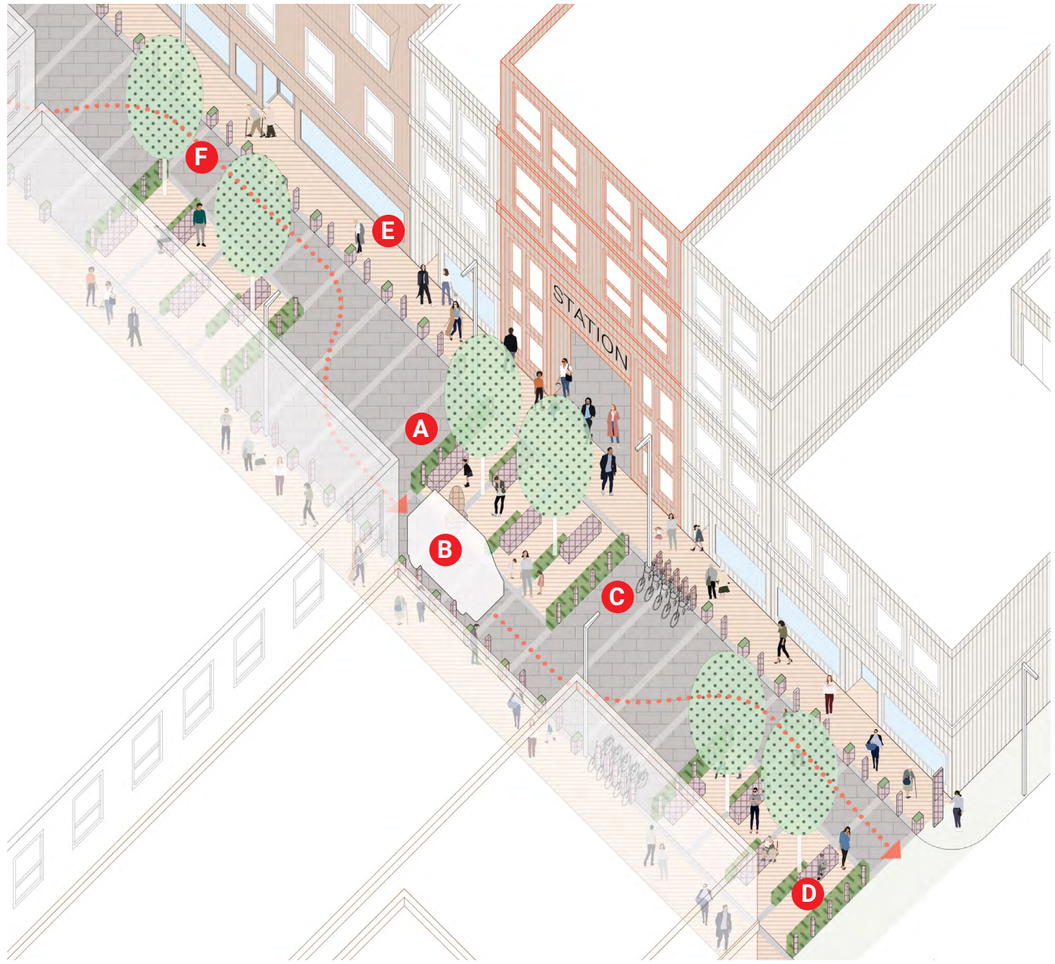
Walk similar sites with and without HVM measures to gain first-hand experience. Consider other factors: kiosks, newspaper vendors, cycle stands, etc that might impact on pedestrian flows when HVM measures are introduced.

Available Tools: Passive barriers

Integrated design solutions could provide additional benefits of:
Sculptures, signs, flexible play, seating areas & informal social interaction, areas of soft landscape and reduced stormwater discharge to the sewer, improved biodiversity and canopy cover, shade and shelter, topography and level changes, improved accessibility and inclusiveness, enhancement of air quality.

Maximum 1200mm gap between structural elements of barriers to prevent vehicular encroachment.

Proposal



- A Reduce/screen access to Site perimeter.
- B Maximise stand-off distances.
- C Include multi-functional elements.
- D Design to enhance the setting – improve the wider threshold.
- E Allow a flexible public realm with pedestrian permeability.
- F Integration of chicane creates opportunity for planting and protected spaces for people.

Part 6

Process

The Designer’s HVM Journey

The Designer's HVM Journey

For a definition of how security planning relates to the RIBA Plan of Work visit CPNI's Build it Secure and 'Security Overlay to the RIBA Plan of Work', RIBA & CPNI (due in 2022)

As with many aspects of public realm design, early consideration of opportunities and constraints in relation to HVM is a crucial part of producing an integrated and holistic security strategy. It is equally important that these considerations are carried throughout the design process to delivery on the ground.

A long term commitment is also required to monitor and maintain the effectiveness of integrated security measures to ensure that design solutions continue to perform their role both in HVM and in providing attractive places for all to enjoy. Particular issues for consideration at the various stages may include, but are not limited to, the following:

- Risk management of the threat to an acceptable level whilst delivering design excellence.
- The budgets afforded for the design and delivery of the proposals, and then management/maintenance in use after handover.
- Stakeholder identification and engagement to ensure proposals gain consensus and are achievable.

Assessing the threat
It is vital to understand if a vehicle attack is a realistic possibility.

- How could an attack occur at the District, Site or Threshold?
- What type of attack could it be?
- What locations might the attack occur at?
- What are the consequences of an attack?

Managing the risk
A balance will need to be reached between creating appealing and functional places, and protecting the people and physical assets from the threat. Pragmatic decisions are needed throughout the project process to satisfy both design and risk requirements.

Making stakeholders aware of the situation is key and understanding what level of risk they are willing to accept.

- Are they aware of the existing and/ or future level of risk?
- Are they comfortable with the risk or do they want to reduce it?
- To what level do they want to reduce the risk?
- What is their appetite for taking design opportunities that meet multiple needs?

Preparation and Briefing

Brief

- Assess the risk of threat to the site and its adjacent buildings having regard to the function and identity of the site, and if either will change.
- Seek advice from Police Counter Terrorism Security Advisers (CTSAs) and / or qualified security professionals to establish risks to be addressed.
- Consider liability of risk ownership and due diligence.
- Identify & engage with key stakeholders and risk owners.
- Establish a process for engagement and consultation, to continue until completion with all key stakeholders and representative groups including amenity and marginalised groups.
- Review requirements for security as an integral part of the design brief.
- Define a suitable study area beyond the site boundary.
- Define the scope of work and cost allowances for HVM consultancy services.

Feasibility studies

- Apply appropriate tools & techniques to understand vehicular movement.
- Apply appropriate tools & techniques to understand pedestrian movement.
- Trial pedestrian flows on site if possible, alongside a computer simulation to 'stress test' design layouts.
- Consider the strengths and weaknesses of computer modelling.
- Understand how the threat might be displaced to an adjacent location.
- Assess the possibility of security measures extending beyond the client's ownership boundary.
- Liaise with adjacent landowners to explore wider scale strategic security opportunities.
- Keep in mind that there will invariably be trade-offs, with interventions having the potential to impact neighbouring sites.
- Review planning implications as part of early design for any development affecting relevant assets for both site specific interventions and the wider area, including use of pre-application advice where appropriate.
- Explore options for asset re-location to mitigate the threat.

Site information

- Undertake site observation work and other assessment methods.
- Walk the site to gain first-hand experience as a user – consider desire lines.
- Research current/proposed building/highways developments in the immediate context.

Consider

- Who takes the lead, who contributes at each stage, and who signs off on a project-by-project basis.
- The Principal Designer's duties under CDM 2015 ('to identify and eliminate foreseeable Health and Safety risks where possible, or take steps to reduce or control those risks') to include risks in relation to HVM.

Concept to Technical Design and Approvals

Design
- Ensure that strategic site planning & layout don't compromise security or opportunities for security.
- Develop proposals in the context of existing or proposed local security strategies and plans.
- Check that security measures are proportionate to the threat: is risk being managed sensibly?
- Ensure that feedback from consultation with all key stakeholders and representative groups is addressed.
- Consider Health and Safety implications.
- Apply a sympathetic approach to public realm function and appearance.
- Remember Four Cs – Capacity, Comfort, Convenience and Conflict, and the overarching 5th C – Context.
- Explore potential for multi-functional elements.
- Explore opportunities for play, arts and culture.
- Consider solutions with 'in-ground' planting to contribute to Sustainable Drainage Systems (SuDS) and / or urban greening.
- Ensure proposals are compatible with sustainability objectives.
- Designs to be successfully impact-tested and rated to a recognised standard or incorporate proven structural design.

Coordination
- Coordinate utilities with proposed Vehicle Security Barrier systems (VSBs) and required footings for HVM proposals.
- Consider basements and any other below ground constraints.
- Consider security in relation to operational issues.

Access & movement
- Ensure the design does not compromise accessibility or pedestrian flows.
- Avoid potential unintended consequences such as new attack targets or risks, conflicts between user groups, or erosion of quality of the environment.
- Clearly define boundaries to publicly accessible areas.
- Review opportunities for managing vehicular approach & access, including moving barriers.

Longevity
- Consider future flexibility and ability to adjust to evolving threats. Vehicular threats have changed over time and will continue to do so.
- Consider the adoption of proposals and potential implications of ongoing maintenance – design with maintenance in mind.

Costs
- Define construction costs for HVM measures.
- Check additional sources for HVM funding. Are there national or local Government initiatives?

Planning
- Engage with the Local Authority on site specific risks and risk management proposals.
- Set out clear safety objectives and rationale in the documents submitted with a planning application to ensure they are not compromised during the planning application process, for example if details are amended to deal with traffic, amenity or heritage considerations.
- Where security measures are incidental to the main proposal (for example a new build, change of use or extension/refurbishment/alteration) it will be even more important to ensure that safety objectives are embedded into the overall design approach to ensure they are not compromised and are bought to the attention of all relevant parties including design review panels, environmental assessors etc.

Procurement
- Identify and contact suitable contractors, and name or nominate specialist HVM measure subcontractors.
- Include the technical requirements for HVM measures in tender information or employer's requirements and review tender returns or contractors proposals, including any alternatives proposed to reduce costs, against HVM threat assessment.

Construction
- Ensure that HVM measures and their technical requirements are fully defined and coordinated within the construction documentation.

In Use

Management
- Consider preparation of a formal management plan, if one is not already part of the approval process.
- Coordinate the management plan with other local strategic plans.
- Fully inform management and operators of the site maintenance requirements.
- Consider/prepare contingency plans.

Review
- Implement continual assessment of HVM measures against current threats.
- Periodically review measures against changing threats or other varying circumstances.
- Has the function or identity of the site changed? Does this change the threat picture?

Part 7

Appendices

Appendix A

Further reference

Centre for the Protection of National Infrastructure (CPNI)
www.cpni.gov.uk
CPNI's role is to protect UK national security. We help to reduce the vulnerability of the UK to a variety of threats such as Terrorism, Espionage and Sabotage.

We provide advice on physical and personnel security. Most importantly, we explain how these components combine together and reinforce each other - and their relationship to the threat. CPNI's protective security advice is built on a combination of:

- what science tells us (our research and development programme)
- our understanding of the national security threat
- our experience and expertise
- effective relationships with private and public sector partners
- policy considerations.

We prioritise to whom we give advice through various mechanisms for example a sector approach for national infrastructure, a criticality scale and the 'Protect' objectives of CONTEST (UK's strategy for counter terrorism).

MI5
www.mi5.gov.uk
The Security Service (MI5) is responsible for protecting the UK against threats to national security.

Joint Terrorism Analysis Centre (JTAC)
www.mi5.gov.uk/joint-terrorism-analysis-centre
JTAC is a multi-departmental organisation that analyses and assesses all intelligence relating to international terrorism on behalf of the UK Government.

The National Counter Terrorism Security Office (NaCTSO)
www.gov.uk/government/organisations/national-counter-terrorism-security-office
NaCTSO is a police hosted unit that supports the 'protect and prepare' strands of the government's counter terrorism strategy.

NaCTSO supports the network of Counter Terrorism Security Advisors (CTSAs) who work within local police forces as officers and staff.

Counter Terrorism Security Advisers (CTSAs)
www.gov.uk/government/publications/counter-terrorism-support-for-businesses-and-communities/working-with-counter-terrorism-security-advisers

CTSAs are responsible for the provision of protective security advice to crowded places (areas where there may be large crowds who could be vulnerable to terrorist attack).

CTSAs also work with local authorities and businesses to identify and assess sites that may be vulnerable to terrorist attack. They advise them, and organisations and professional bodies, about counter terrorism protective security guidance that should be incorporated into their general crime prevention plans, advice and guidance

Home Office
Home Office - GOV.UK (www.gov.uk)
The Home Office is the lead government department for immigration and passports, drugs policy, crime, fire, counter-terrorism and police, and plays a fundamental role in the security and economic prosperity of the UK.

It is supported by 30 agencies and public bodies to deliver on key responsibilities, including keeping the United Kingdom safe from the threat of terrorism and ensuring people feel safe in their homes and communities. By working together with the police, security and intelligence agencies, the private and public sectors, civil society and international partners, we continue to ensure that the evolving terrorist threat does not undermine the very fabric of our society.

National Cyber Security Centre (NCSC)
www.ncsc.gov.uk/
Helping to make the UK the safest place to live and work online.

We support the most critical organisations in the UK, the wider public sector, industry, SMEs as well as the general public. When incidents do occur, we provide effective incident response to minimise harm to the UK, help with recovery, and learn lessons for the future.

Register of Security Engineers and Specialists (RSES)
www.rses.org.uk/
RSES has been established to promote excellence in the field of security engineering by providing a benchmark of professional quality against which its members have been independently assessed.

RSES is sponsored by the Centre for the Protection of National Infrastructure (CPNI) and is administered and operated by the Institution of Civil Engineers (ICE).

Department for Transport (DfT)
www.gov.uk/transport/transport-security
The Department for Transport (DfT) aims to protect people and transport infrastructure while allowing transport systems to operate efficiently and effectively. This is by managing the risk of terrorist attack on the UK's transport systems as part of the wider government counter-terrorism strategy.

Further reference (continued)

Secured by Design
www.securedbydesign.com
Official UK Police flagship initiative combining principles of 'designing out crime' with physical security.

Design Against Crime (DAC)
www.designagainstcrime.com
DAC is a practice-led design research project that emerged at Central Saint Martins College of Art and Design. The Centre's focus is based on the understanding that design thinking as well as design practice can and should address security issues without compromising functionality, other aspects of performance, or aesthetics.

Landscape Institute (LI)
www.landscapeinstitute.org
Royal Chartered body for landscape architects in the United Kingdom.

Royal Institute of British Architects (RIBA)
www.architecture.com
Professional association of architects in the United Kingdom.

Royal Town Planning Institute (RTPI)
www.rtpi.org.uk/
UK's leading planning body for spatial, sustainable and inclusive planning.

International Crime Prevention Through Environmental Design Association (CPTED)
www.cpted.net/
Crime Prevention Through Environmental Design (CPTED) is a multi-disciplinary approach of crime prevention that uses urban and architectural design and the management of built and natural environments.

Perimeter Security Suppliers Association (PSSA)
www.pssasecurity.org
The PSSA is the trade association for companies involved in the supply and installation of products designed to provide high levels of physical protection and intruder detection for sites and their external perimeters in all circumstances where terrorist or criminal attack is a perceived risk. The PSSA was formed with the encouragement of CPNI, with the shared objective to promote the use of high performance products and their professional installation.

Protect UK
www.protectuk.police.uk/
An information sharing platform to better inform businesses and the public on the threat, and the best practices to mitigate against it.

Protective security publications

- BS ISO 22343 Security and resilience -- Vehicle security barriers -- Part 1: Performance requirement, vehicle impact test method and performance rating, Publisher ISO, planned publication 2023
- BS ISO 22343-2 Security and resilience - Vehicle security barriers. Part 2: Application, Publisher ISO, planned publication 2023
- CONTEST - The United Kingdom's Strategy for Countering Terrorism, HM Government, June 2018
- Protect Duty. As of March 2022, the Home Office, on behalf of UK Government, responded to the Protect Duty consultation.
- CPNI Catalogue of Security Equipment (CSE) - Impact rated vehicle security barriers
- Guide to safety at Sports Grounds: Sixth edition. Department for Culture Media and Sport, 2018
- IWA 14-1:2013 Vehicle security barriers – Part 1: Performance requirement, vehicle impact test method and performance rating, ISO, 2013 (to be replaced by BS ISO 22343)
- IWA 14-2:2013 Vehicle security barriers – Part 2: Application, ISO, 2013 (to be replaced by BS ISO 22343)
- Managing Risk, Business Continuity, NaCTSO, 2020
- PAS 68:2013 Impact test specifications for vehicle security barrier systems, BSI, 2013 (to be replaced by BS ISO 22343)
- PAS 69:2013 Guidance for the selection, installation and use of vehicle security barrier systems, BSI, 2013 (to be replaced by BS ISO 22343)
- Pedestrian Comfort Guidance for London, Version 2. TfL, 2019
- Fruin, JJ, Pedestrian Planning and Design, Metropolitan Association of Urban Designers and Environmental Planners, 1971.
- Protecting Crowded Places: Design and Technical Issues, HM Government, Revised 2014
- TAL 1/11 Vehicle security barriers within the streetscape, DfT & CPNI, April 2011 (amended October 2017)

Protective security publications (continued)

- TAL 2/13 Bollards and Pedestrian Movement, DfT & CPNI, May 2013 (amended October 2017)
- TAL 1/16 The Influence of Bollards on Pedestrian Evacuation Flow, DfT & CPNI, November 2016 (amended October 2017)
- Vehicle Security Barriers at Sports Grounds, CPNI, planned publication 2022

Other publications

- Manual For Streets, third edition, DfT / CIHT, due in 2022
- 'Security Overlay to the RIBA Plan of Work', RIBA & CPNI (due in 2022)

Appendix B

Precedents

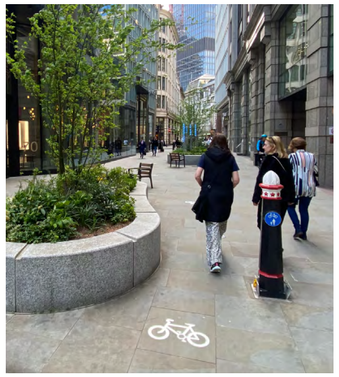
This section illustrates a range of HVM measures and potential HVM measures both in the UK and overseas. The images include a variety of developments from business districts to transport hubs as well as interventions that are part of existing built environments, both recent and historic. Not all elements illustrated are structural but could be adapted as required to become part of a HVM scheme.

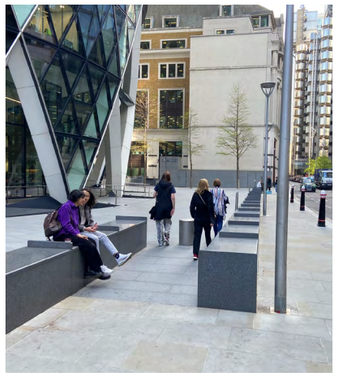
Precedents

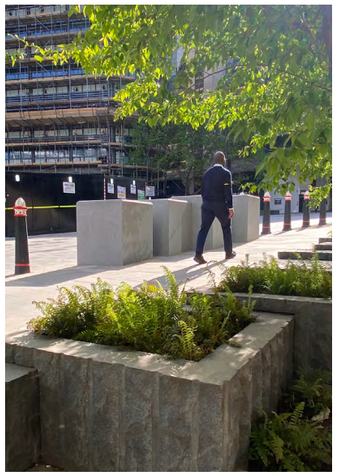
Business District

Queen Street, City of London

Leadenhall Market, City of London


St Mary Axe, City of London

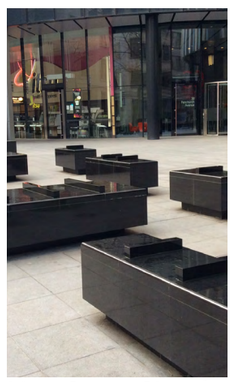

St Mary Axe, City of London


Stonecutter Street, City of London

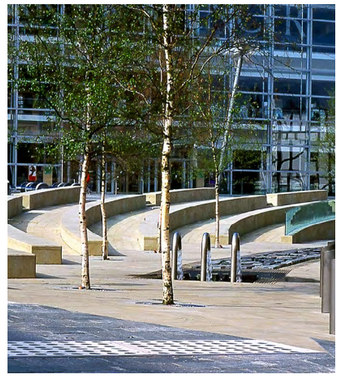

Fenchurch Street, City of London


Wall Street, New York

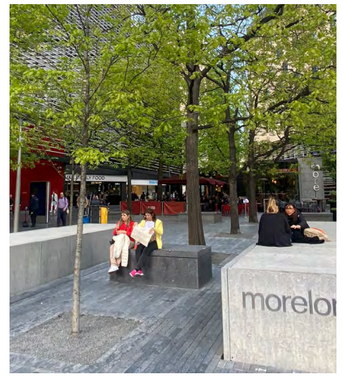

St Helens Square, City of London


Lime Street, City of London

Town & City Centre Streets & Squares


Exchange Square, Manchester


Stratford Upon Avon, Warwickshire



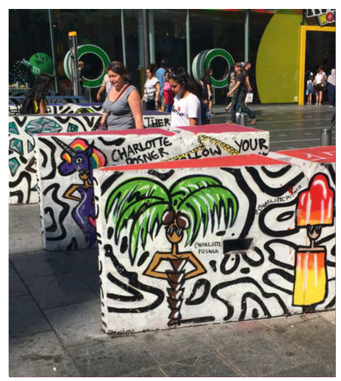
More London, London


Mitcham Lane, Wandsworth, London

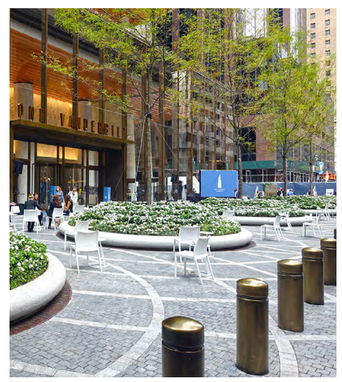

Times Square, New York


Windsor Town Centre, UK


Duke of York Square, London

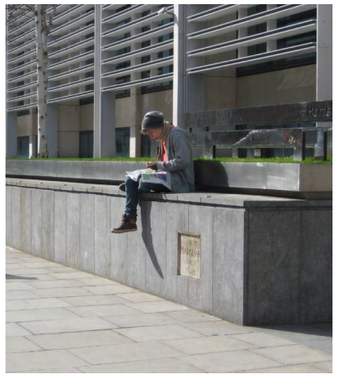


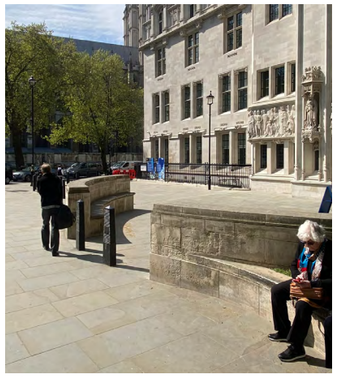
Leicester Square, Westminster, London


One Vanderbilt, New York

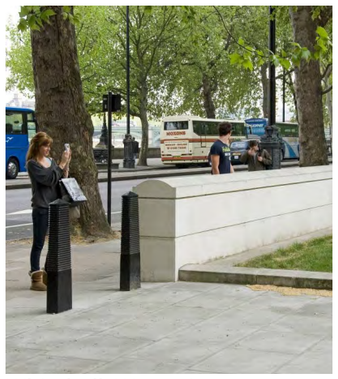
Precedents

Government and Public Buildings

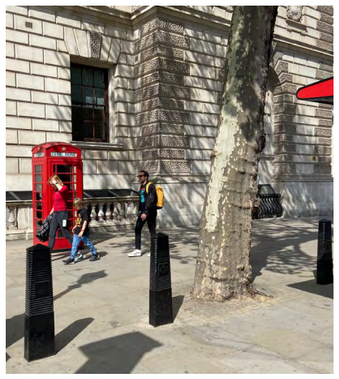

Home Office, Westminster, London


The Supreme Court, Westminster, London

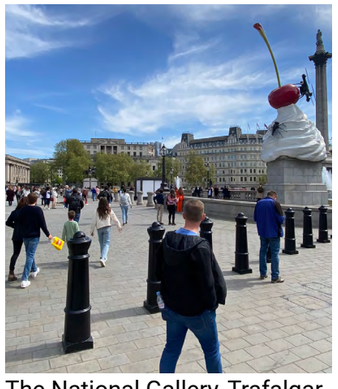

Scottish Parliament, Holyrood, Edinburgh


Whitehall, Westminster, London


American Embassy, Nine Elms, London


Whitehall, Westminster, London


St Paul’s Cathedral, London


The National Gallery, Trafalgar Square, London


Scottish Parliament, Holyrood, Edinburgh

Transport Hubs, Retail Streets & Squares


Slough Bus Station, Slough, UK

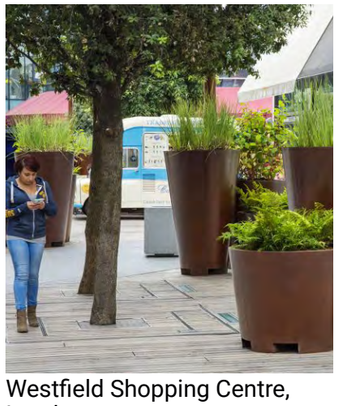

Kings Cross / St Pancras Station, London


Nova, Victoria, London

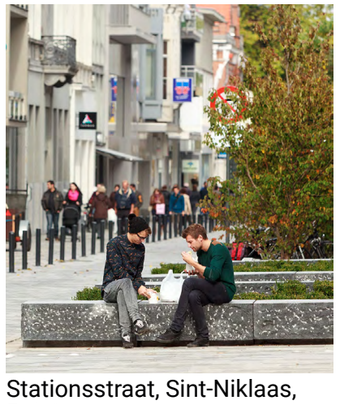

Kings Cross / St Pancras Station, London


Selfridges, London


Heathrow Airport, London, UK


Westfield Shopping Centre, London


Belfast Airport, Northern Ireland

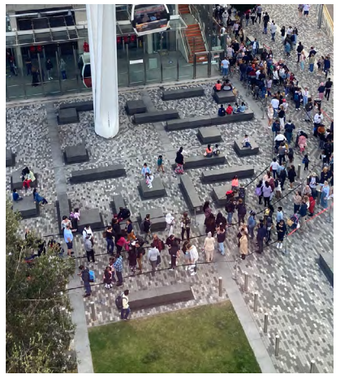

Stationsstraat, Sint-Niklaas, Belgium

Precedents

Visitor Attraction, Cultural & Leisure venues


Tower of London


Monument, City of London


Emirates Air Line, Greenwich Peninsula, London



London Eye, Southbank, London


Windsor Castle, Windsor, UK


Titanic Belfast, Northern Ireland

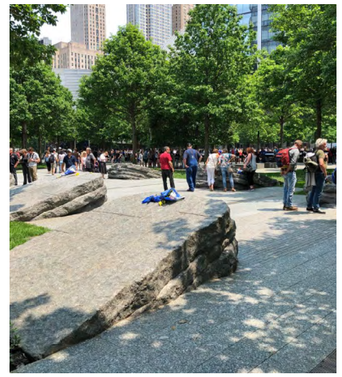

Wembley Stadium, London

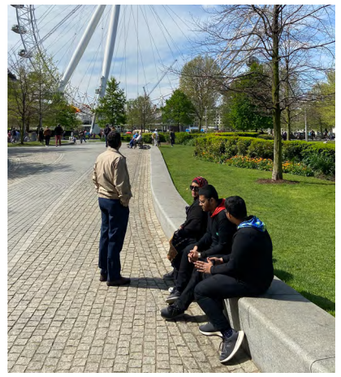

Covent Garden, London

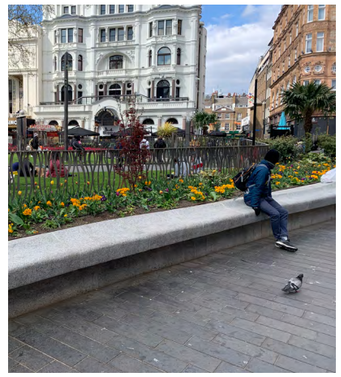
Gardens, Parks & Landform


Christchurch Gardens, Victoria, London


Seething Lane Gardens, City of London


9/11 Memorial Glade, New York


Jubilee Gardens, Southbank, London


Leicester Square, London

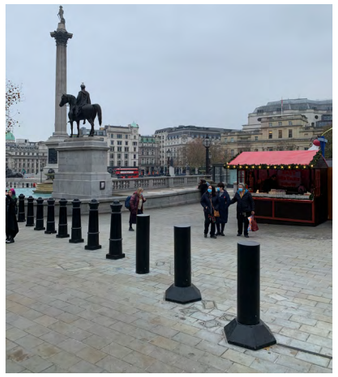

College Green, Westminster, London

Cathedral Gardens, Manchester


Festival Gardens, City of London

Precedents

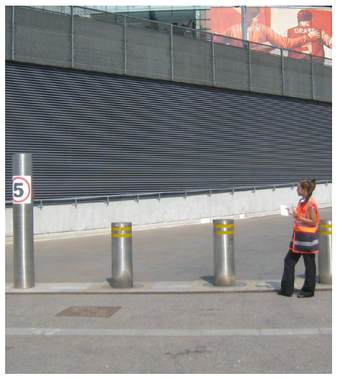
Active Measures & Vehicle Access Control Points

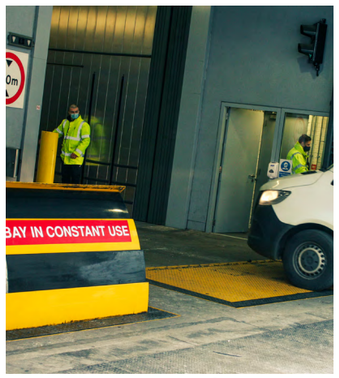

Trafalgar Square, London


Parliament Square, London

Scottish Parliament, Holyrood, Edinburgh


Houses of Parliament, Westminster, London


Emirates Stadium, London



Philpot Lane, City of London


Lime Street, City of London


Horse Guards Parade, Westminster


Shoe Lane, City of London

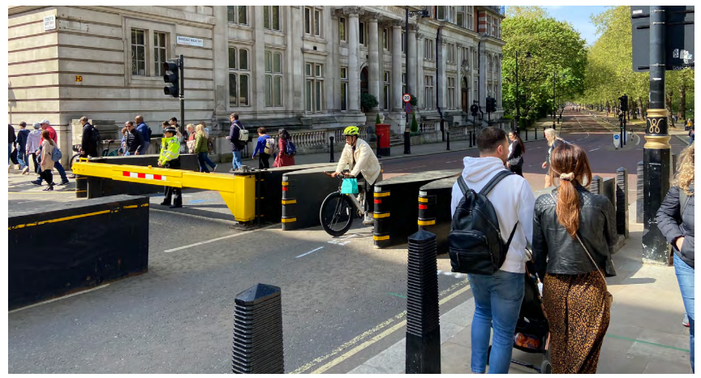
Redeployable Systems


Temporary installation, Victoria Embankment, Westminster


Temporary installation, Park Street, Westminster


Houses of Parliament, Westminster


Houses of Parliament, Westminster


Birdcage Walk, Westminster, London

Temporary installation, Victoria Square, Birmingham

Appendix B

Glossary

Typically, in terms of Hostile Vehicle Mitigation, focus is on protecting people and assets.
People – members of the public, visitors, customers, staff and contractors.
Assets – buildings, contents, equipment and sensitive materials.

Blast Stand-Off – Distance from the source of blast to the protected asset.

BSI – British Standards Institution.

CEN – European Committee for Standardisation.

CPNI – Centre for the Protection of National Infrastructure.

Curtilage – The area of land around a building or other structure.

CWA – CEN Workshop Agreement

Desire Line – A path representing the shortest or most easily navigated route between origin and destination.

District – A region or locality.

Enterprise – A business, institution or venue.

FAW – Fire As a Weapon.

HVM – Hostile Vehicle Mitigation.

IED – Improvised Explosive Device. An IED is a bomb fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy or incapacitate personnel or vehicles.

ISO – International Organisation for Standardisation

IWA – International Workshop Agreement.

Layered Approach – A multi-tiered approach to addressing the opportunities and challenges.

MTA – Marauding Terrorist Attack.

NCSC – National Cyber Security Centre

Operational Requirements – Process for identifying vulnerabilities, risks and measures to mitigate risks. Can be high level recommendations (e.g. a need for HVM) that encompass multiple areas of a site, and also more detailed, if focusing on a specific type of mitigation (e.g. Vehicle Access Control Point requirements).

PALs – Publicly Accessible Locations.

PAS – Publicly Available Specification.

PBIED – Person-Borne Improvised Explosive Device.

Pedestrian – In the context of this guide, this term is applied to all people that are permitted to use the footway.

Public Realm – The public realm incorporates all areas of a village, town or city to which the public has open access, which may include areas that are privately owned.

Streetscape – The street patterns, furnishings and landscape that form the built environment.

Urban Grain – Pattern (morphology) of streets, buildings and other features within an urban area.

VACP – Vehicle Access Control Point.

VAW – Vehicle As a Weapon.

VBIED – Vehicle-Borne Improvised Explosive Device.

VSB – Vehicle Security Barrier.

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Page 95, bottom right: Landezine / Sweco Belgium
Page 96, centre middle: MFD Group
Page 97, top right: New York Yimby / Michael Young
Page 97, centre middle: FM Conway
Page 97, bottom left: BDP
Page 98, top left and top middle: FM Conway

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