Road Restraints Part 2

A ***crash*** course into road restraint systems

Chris Clarke

- Differing standards for differing applications
- Strategic Road Network, DMRB & the RRRAP
- Local Road Network, local authority guidance & the LARA
- Pedestrian Guardrail assessments

Safety Moment

Low Sun

- Driving in winter the sun is lower in the sky
- This can cause glare, impacting forward visibility

Mitigations:

- Keep sunglasses to hand
- Clean your windscreen
- Use your sun visor
- Slow down
- Keep distance

Introduction to Road Restraint Systems (RRS)

Why are RRS required:

- To prevent vehicles from impacting with or entering roadside hazards.
- To prevent vehicles crossing from one carriageway to another.
- To absorb some of the energy from the impact cause by an errant vehicle striking it.
- To redirect the vehicle along the line of the barrier to prevent it from turning around, turning over or re-entering the stream of traffic.

When / where do we provide a Vehicle Restraint System (VRS)?

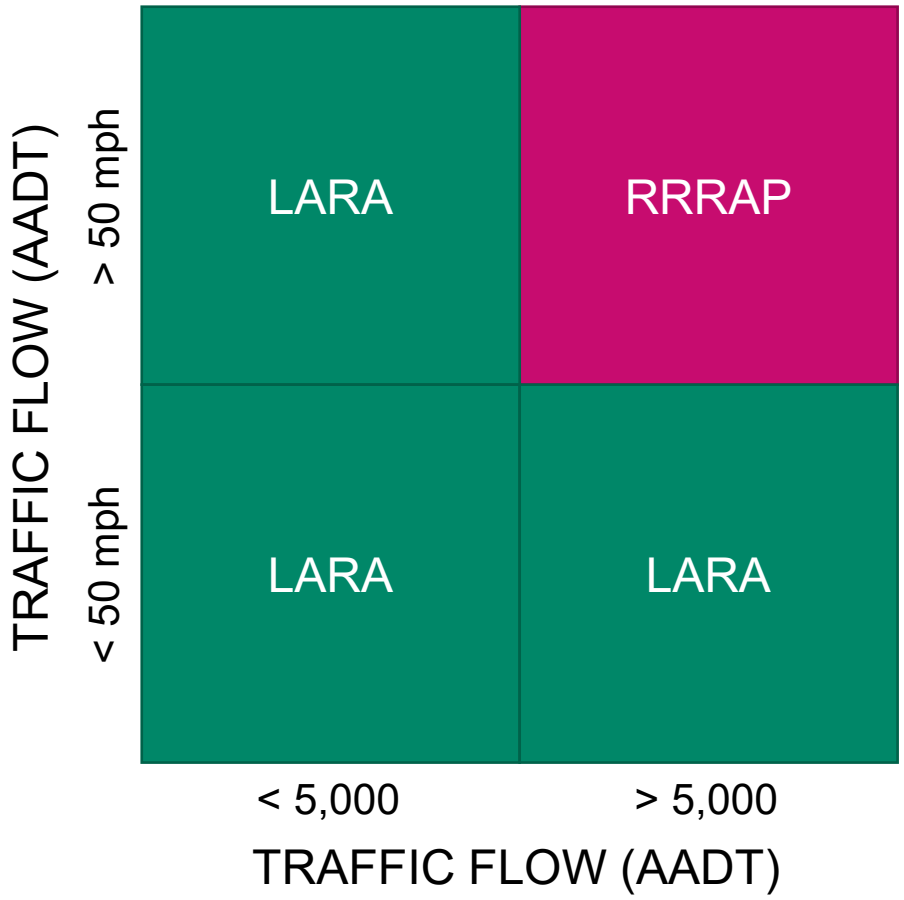
There are two main sources of information relating to the provision of VRS:

- The Design Manual for Roads and Bridges (DMRB) CD 377 Requirements for Road Restraint Systems
- The Department for Transport Design & Maintenance Guidance for Local Authority Roads Provision of Road Restraint Systems on Local Authority Roads (produced by the Roads Liaison Group, part of the CIHT)

Both documents require a detailed risk assessment to be undertaken to ascertain the need for a VRS.

- DMRB requires a Road Restraint Risk Assessment Process (RRRAP) to be carried out
- Local Authority Guidance requires a Local Authority Risk Assessment (LARA) to be carried out.

Different situations = Different assessments



CD 377 & the RRRAP

Used when: speed limit is greater than 50 mph and two way AADT is greater than 5,000, and:

- on all new roads;
- on schemes where the highway cross-section is being altered permanently;
- whenever the RRS at the end of its serviceable life and needs replacing;
- whenever a hazard is introduced and/or moved, and/or modified;
- whenever there is a change in risk at or near the edge of the carriageway;
- whenever a RRS needs to be dismantled (other than where localised sections need to be removed to gain access), e.g. during planned maintenance schemes.

CD 377 & the RRRAP

Due to factors such as the complexity and variability of hazards and their locations, traffic speed limits, road layouts, alignments, and variability of traffic incident data there may be situations where a RRRAP is not appropriate for direct assessment, such as at:

- central reserves
- roundabouts
- junction areas or lay-bys

There may also be a situation where a road with a flow of less than 5,000 AADT / speed limit of less than 50 mph impacts an APTR or motorway that requires an assessment, e.g. a road bridge over a major road.

Appendix A of CD 377 provides guidance on the assessments to carry out dependant on the situation, whether a RRRAP, GG 104 or LARA is required,.

How The RRRAP works

Risk is assessed by looking at a combination of **likelihood** and **consequences** and is expressed in equivalent fatalities per 100 million vehicle km. 1 fatal = 10 serious = 100 slight injuries

Likelihood is the **probability of a vehicle leaving the road** (based on road type, local factors such as alignment, traffic flow and type, collision history, junction location) and the **probability of errant vehicle reaching object** (impacted by hazard location, topography, speed and type of vehicle, etc)

Consequence is the **effect on occupants of an errant vehicle if it reaches the hazard** (impacted by speed of errant vehicle, aggressiveness of hazard, % LGV / MGVs) and the **effect on others** (users of an adjacent road, railway or building)

Total risk = risk to vehicle occupants in cars + risk to LGVs +Risk to MGVs + Risk to others

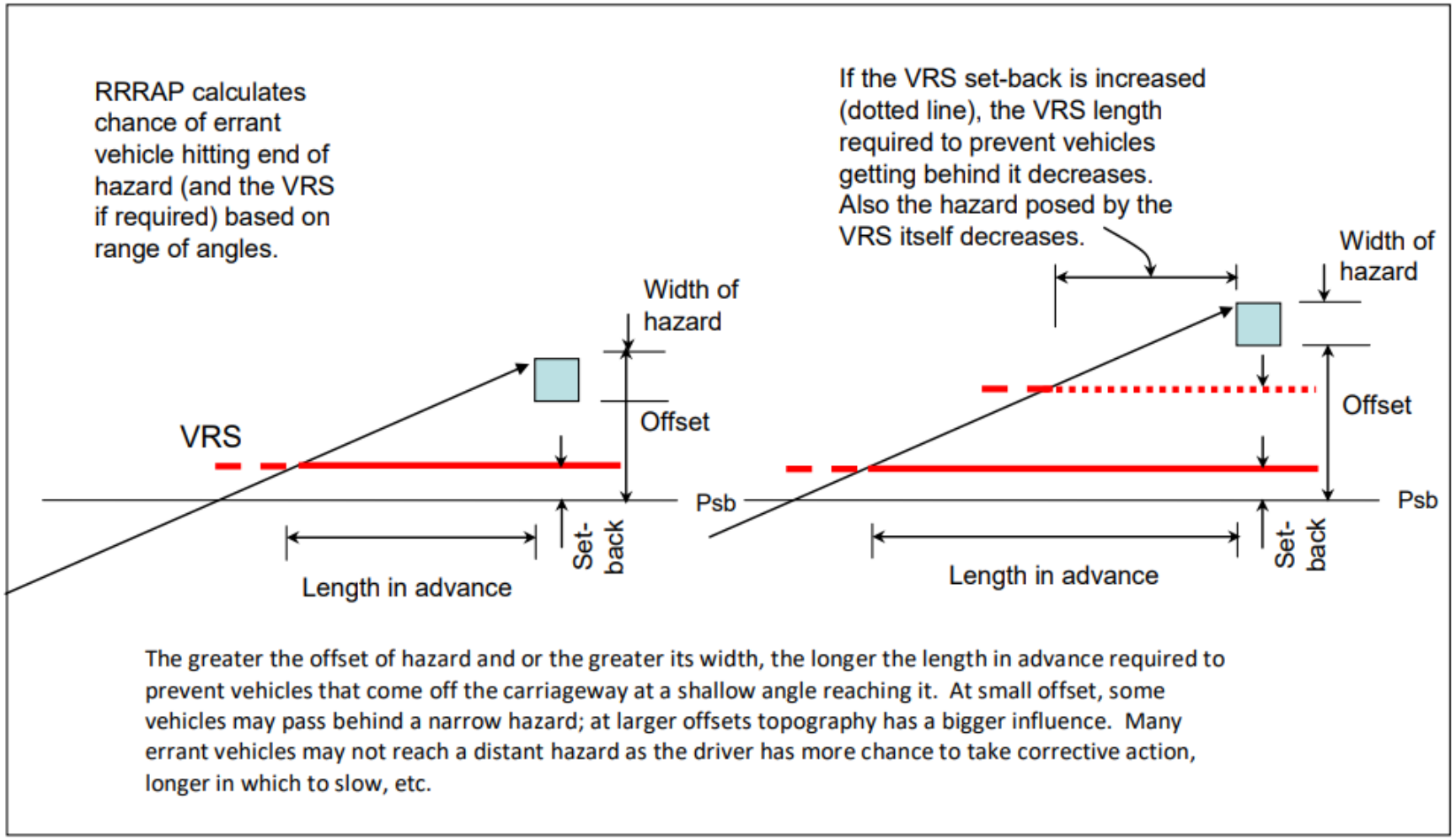
How The RRRAP works

Collision frequency is non-linear; the risk per vehicle changes with flow.

At low flows the risk per vehicle is high, but the benefit / cost of providing a barrier will be low. At higher flows, the risk per vehicle is lower but, because overall there will be more collisions than on a low flow road, the benefit / cost is higher.

The thresholds used in the RRRAP are also curved. They are set such that the need for a VRS is independent of the flow on the road. The risk posed by a hazard with a high aggressiveness may be unacceptable at a range of traffic flows or offsets from the carriageway

How The RRRAP works



The greater the offset of hazard and or the greater its width, the longer the length in advance required to prevent vehicles that come off the carriageway at a shallow angle reaching it. At small offset, some vehicles may pass behind a narrow hazard; at larger offsets topography has a bigger influence. Many errant vehicles may not reach a distant hazard as the driver has more chance to take corrective action, longer in which to slow, etc.

What you need to carry out a RRRAP

- Traffic flow data (AADT, HGV percentage)
- A site visit
- Specific hazard locations (from topographical survey, site measurements or design data)
- Facility to extract 3D information for earthworks slopes (spot levels or X sections)
- A RRRAP account (contact your organisations super user)

Carrying Out the RRRAP

- Always refer to the User Guide, it is very useful
- Fill out common details

Record Details	
Record Name	A40 Access to Witney: northbound diverge offside
Is this record related to Highways England funded work?	No
Project Name	A40 Access to Witney
Description	

Basic Details	
Project ID or PIN	60611611
Highway Authority	Oxfordshire County Council
Designer Company Name	Aecom (Highways) Newcastle upon Tyne
Designer Reference	
Contract Type	
Contract Sub-Type	
Region	Oxfordshire
Country	England

Reason for Design is associated with	
New section of road	Yes
Widening existing carriageway	No
Upgrade/improvement to existing carriageway	No
Downgrade existing carriageway	No
Replacement of existing restraint	No
New restraint on existing road	No
Temporary works	No
Road furniture/equipment improvement	No
Assess existing parapet	No
Other Details	

Details relating to particular section covered by assessment		
Class and Standard		
Road classification	All Purpose Road	
Road number	[illegible]	
Road name		
Road sub-type e.g. D2	Single	
Road location e.g. Urban	Rural	
To current geometric standards?	Yes	
Location	**From**	**To**
Junction Name	A40	B4022
Junction No		
Marker Post		
Section label		
Chainage of section(m)	220.0	565.0
Section/Direction being assessed	[illegible]	
Near side or offside verge, or wide central reserve being assessed	O/S Verge	
Does road have full-width (i.e. to standard) nearside hardshoulder or hardstrip?	N/A	
Are Environmental considerations likely to influence provision?	No	

Traffic Information	
Permanent speed limit (mph)	60
Temporary Mandatory Speed Limit (HS[illegible])	N/A
AADT (2-way unless motorway link or [illegible]lip)	6797
% Large Vehicles	8.5
% Medium Vehicles	15.4
Model accident frequency (Nearside)	0.021
Model accident frequency (Offside)	0.015

Scheme Duration & Barrier Costs		
	Start Year	2023
	Use Default VRS Lifetime (20 years)?	Yes
	Use the default Discount (i.e. inflation) Rate of 3.0% over the VRS lifetime?	Yes
?	Use default safety barrier and parapet costs?	Yes

Carrying Out the RRRAP

Barrier costs

- I tend to stick to default unless I have a reason not to
- Guidance is provided within the RRRAP on how to deviate
- Useful if you know a scheme will be costly, e.g. a parapet improvement that required bridge strengthening, or barrier on an embankment requiring special foundations.

Carrying Out the RRRAP

Inputting hazards

600, 1100, and hard shoulder/ hard strip and verge details are required to run the tool.

All other hazards present should be recorded

RRRAP provides useful guidance for each hazard and each field, click: (?)

Hazards Overview

Edit Category Configuration | Key to Colour Coding

Overview, by category, of the hazards present in the length of road verge (or central reserve) being assessed.
You must edit the category configuration above to be able to calculate risk for hazards (see help for more details).

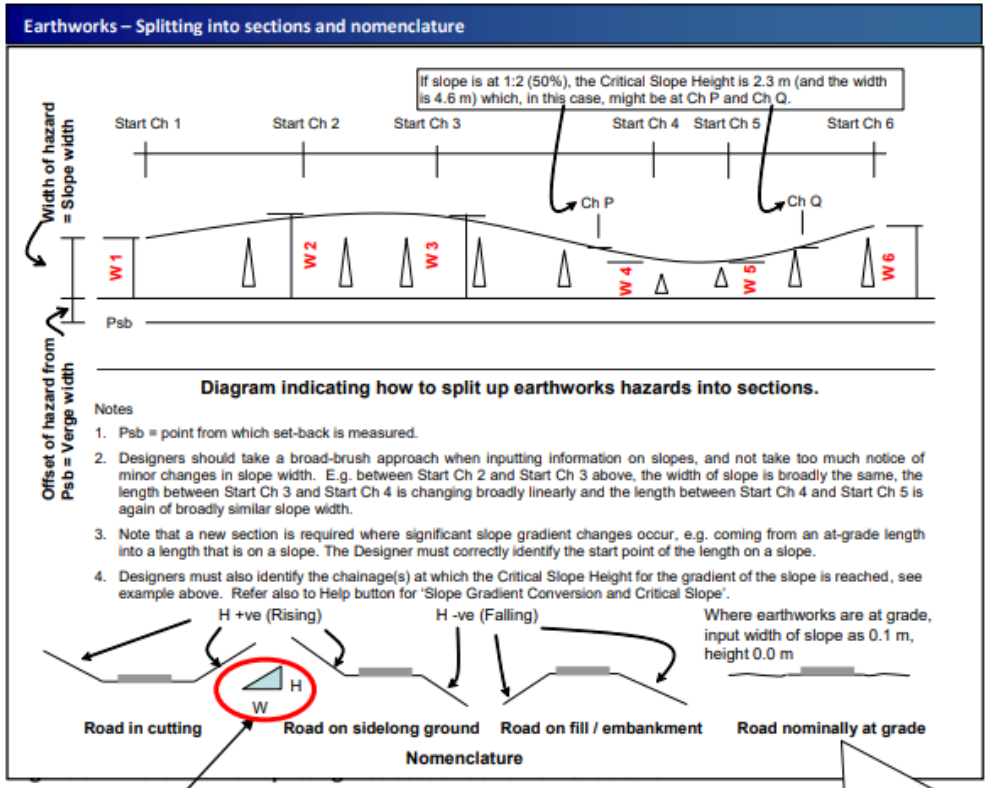
Hazard Category	Data Req'd	No. of Hazards entered	Hazard Category	Data Req'd	No. of Hazards entered
300 Fencing	No		1600 Piles and Retaining Walls	No	
400 Parapets	No		1700 1800 Structural Concrete and Steel	No	
500 Drainage Features	No		2500 Special Structures	No	
600 Earthworks	Yes	13	Telegraph Poles/Pylons	Yes	1
1100 Kerbs and Edge of Pavement Details	Yes	2	Trees	No	
1200 Traffic Signs or Signals	Yes	4	Water	No	
1300 Road Lighting Columns	No		Hardshoulder / hardstrip width & Verge width details	Yes	4
1500 Motorway Communications (above ground)	No				

Hazards where Others could be affected	Data Req'd	No of Hazards entered
Railway	No	
Road	No	
Public building, sports or playground, or other place where significant numbers of people congregate	No	
Chemical or Fuel Installation	No	

Carrying Out the RRRAP

Critical Height of earthworks

- Generally take a broad brush stroke to inputting earthworks.
- The critical height must be also recorded
- High embankment slopes relative to their slope may have a higher severity in the event of a vehicle travelling down the embankment
- Steep earthwork slopes when the road is in cutting may present a risk of overturning or re-entering the carriageway if an errant vehicle travels up the slope (particularly on steep slopes)



Slope conversion H : W	Slope conversion %	Critical slope height
Steeper than 1 : 1		1.0 m or higher
1 : 1	100	1.0 m
1 : 1.25	80	1.2 m
1 : 1.5	66.7	1.6 m
1 : 1.67	60	1.8 m
1 : 2	50	2.3 m
1 : 2.5	40	3.4 m
1 : 2.75	36	4.0 m
1 : 3	33	6.0 m
1 : 3.5	28.6	7.0 m
1 : 4	25	9.0 m
Shallower than 1 : 4		None

The nomenclature is important. The RRRAP calculates the gradient based earthworks inputs of width and height.

See sections 8.4.7 and 8.4.8 for advice on inputs where earthworks change to/from a slope or go from > or < critical slope height (see help above). In this example had for instance the gradient ref 0600.0001 been -50% rather than -25%, then the RRRAP would have indicated VRS is required from ch 5100 all the way to ch 5200, whereas in practice if there had been an entry where the critical height of 2.3 m for a 50% gradient occurred, say at ch 5150, the RRRAP would have indicated that VRS was only required to ch 5150.

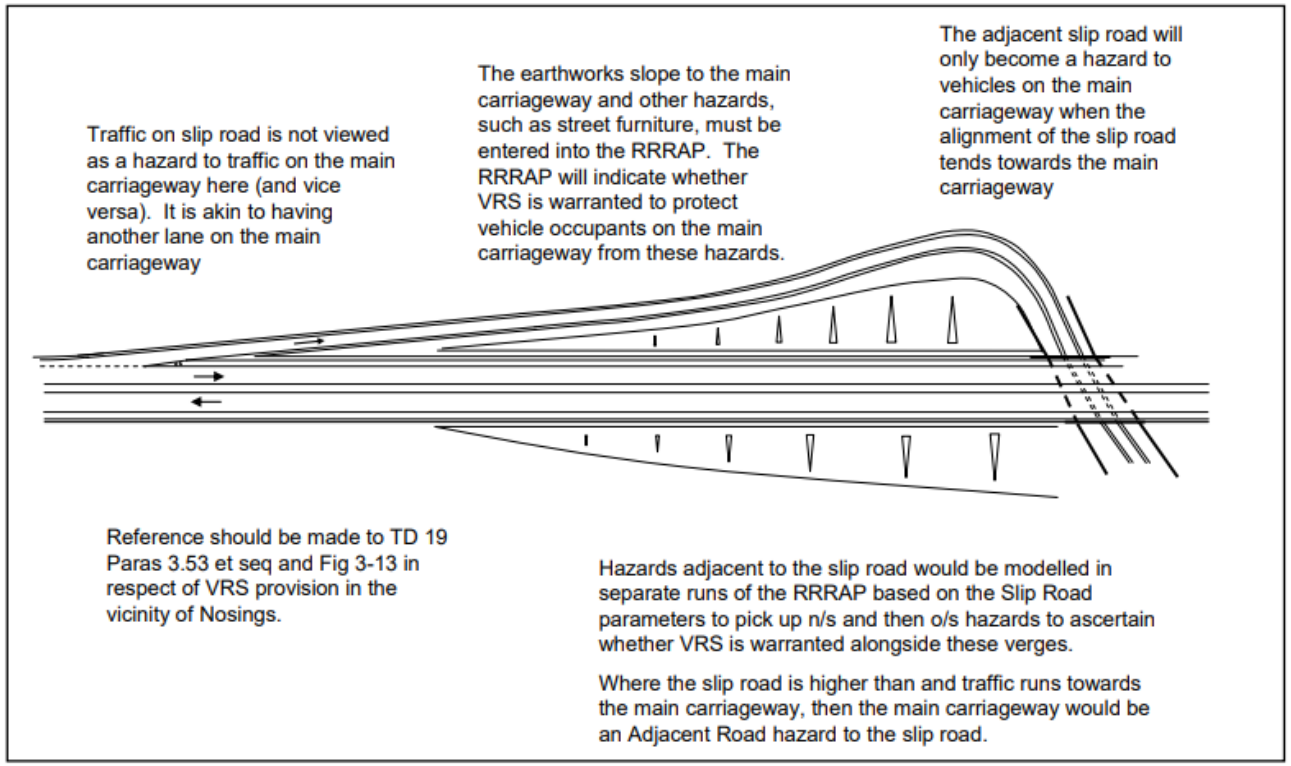
Id number	Earthworks profile	Start chainage of profile	Offset of hazard from PSB	Width of slope	Overall Height slope	Ave gradient of Slope %
0600.0001	Falling at 25%	5100.0	1.5	28.0	-7.0	-25.0
0600.0002	Nominally at Grade	5200.0	1.5	1.0	0.0	0.0

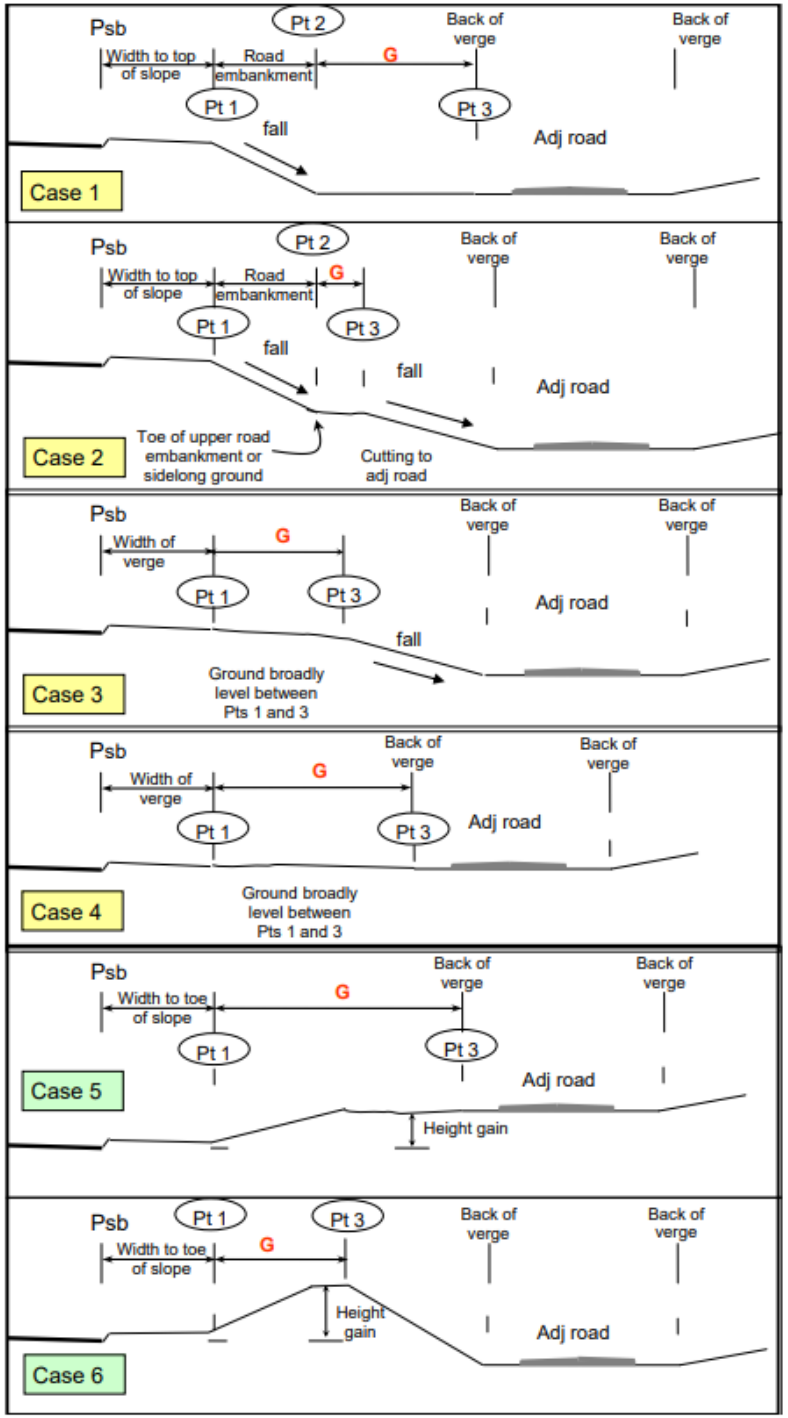
It is important to identify **all** points at which the critical height for the particular gradient are reached – see section 8.4.8, otherwise VRS may not start and end at correct points

Figure 8-12 Earthworks – Slope Gradient and Critical Height

Carrying Out the RRRAP

Adjacent Roads should be inputted when roads are adjacent and there is a level difference between them





In Cases 1 to 4 where G <= 15 m offset to road becomes offset to Pt 1. (PNR = Pt 1).

Where G> 15 m offset to road becomes offset to Pt 3. (PNR = Pt 3).

In Cases 5 and 6 where G<= 15m, offset to road (PNR) becomes closer of offset to Pt 3 and Pt 1 + 4x height gain.

Where height gain > 2.5 m and or G > 15 m no need to assess; add note in the hazard 'Comment' field to confirm this is the case.

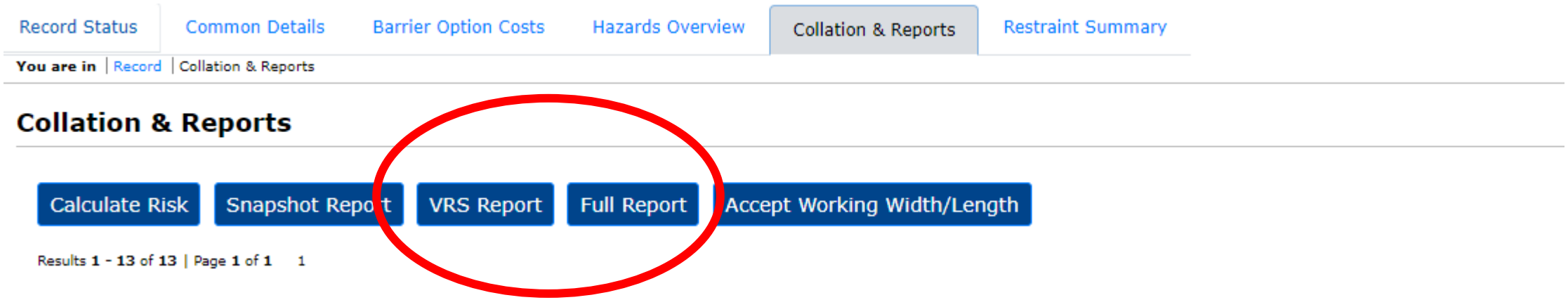
RRRAP Outputs

Risk	Hazard Details						Risk Levels		VRS Lengths (m)		VRS Details & Containment		
Output detailed results?	i	Id	Nature of Hazard	Start chainage	End chainage	Offset(s) from Psb	Is risk without VRS acc-eptable?	Level of risk with optimum length VRS	Min Length VRS in advance	Min Length VRS beyond	VRS working width class	VRS	Parapet
☐	i	0600.0001	Nominally at Grade	221.0	231.0	0.06					W2		
☐	i	0600.0002	Nominally at Grade	231.0	250.0	0.006					W2		
☐	i	0600.0004	Falling at 30%	250.0	272.0	1.5	Yes						N/A
☐	i	0600.0015	Falling at 33.3%	272.0	333.0	2.6	Yes						N/A
☐	i	0600.0007	Falling at 33.3%	333.0	393.0	3.0	Yes						N/A
☐	i	0600.0008	Falling at 33.5%	393.0	433.0	2.9	Yes						N/A
☐	i	0600.0009	Falling at 34.3%	433.0	454.0	2.9	Yes						N/A
☐	i	0600.0016	Falling at 32.3%	454.0	490.0	4.6	Yes						N/A
☐	i	8200.0001	Adjacent Road Single	470.0	570.0	17.5 / 36.0	Yes						N/A
☐	i	0600.0010	Falling at 47.3%	490.0	510.0	2.5	Yes						N/A
☐	i	0600.0014	Falling at 44.4%	510.0	520.0	2.75	No	Acceptable	45		W2	N2	N/A
☐	i	0600.0013	Falling at 43.2%	520.0	540.0	2.65	No	Acceptable	44				
☐	i	0600.0011	Falling at 44.2%	540.0	570.0	2.5	No	Acceptable	43		W2	N2	N/A

Alternative WW/VRS setback's available i.e W6

RRRAP Outputs

- Don’t forget to generate reports for records of hazards assessed.
- Can be useful for external checks on assessments



- Carry out the design of the VRS utilising the design considerations from the previous presentaion

Local Authority Guidance and the LARA

- Guidance published in 2011
- In 2009 half of UK fatalities involved vehicles leaving the carriageway
- Guidance came about as DMRB guidance would overestimate the risk and over specify the requirement for a VRS
- This would not represent good value for money

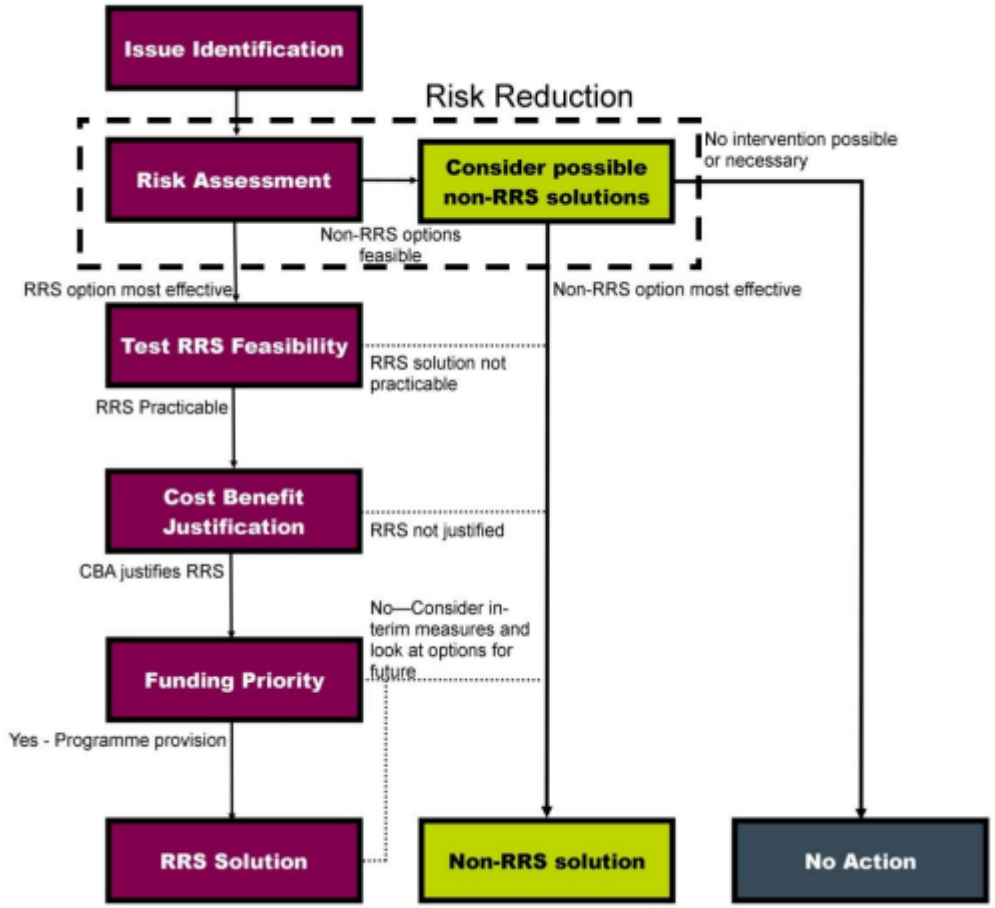
- Guidance is not a prescriptive set of standards like DMRB
- Designed to be adapted by local highway authorities to create a pragmatic system for decision making to help them make best use of the finite resources available to them.

Local Authority Guidance and the LARA

Data that informed the RRRAP:

- Is from a large number of routes that share a large number of common features. Local highway authority routes are much more diverse and a huge variety of circumstances exist.
- Is for routes that have a substantially better road alignment.
- Is from routes that have other safety features that would not typically be present on local highway authority routes. E.g. Motorway Incident Detection and Automatic Signalling

Local Authority Guidance and the LARA



Local Authority Guidance and the LARA

CATEGORY	RISK LEVEL	OUTCOMES
Higher Priority Site	Risk cannot be accepted save in extraordinary circumstances.	Where the risk assessment has defined a site as Higher Priority the installation of a RRS is justified in terms of the level of risk. Further consideration is then required to determine if the site meets the other appraisal criteria. Even at high risk sites non-RRS interventions may reduce the risk to a level where a RRS can be omitted.
Medium Priority Site	Intervention may be required to introduce control measures to drive residual risk towards the Lower Priority Site category. The residual risk can be tolerated only if further risk reduction is impracticable or requires action that is grossly disproportionate to the reduction in risk achieved.	Where the risk evaluation has identified a site as Medium Priority a RRS may be justified however a non-RRS approach to reducing the risk may prove sufficient to negate the need for a RRS. If suitable effective measures cannot be introduced then the appraisal process would normally continue in order to consider the other criteria.
Lower Priority Site	Level of risk regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	Where the risk evaluation identifies a site that is lower priority further appraisal is not required and the level of risk does not normally support installation of a RRS. Simple low cost measures that could reduce the risk can still be considered.

LARA Method A: Collision Assessment

Only suitable for existing roads where collision data is available.

- Local roads can vary greatly, detailed risk data may not be available for every variation of road
- It is possible to use national data to guide the risk assessment process.
- The appropriate average KSI collision rate for each type of road may represent a suitable intervention level that could highlight where further investigation is required.

LARA Method A: Collision assessment

Object Hit	Fatal	Serious	Slight	All	KSI	KSI %
None	366	5,733	23,733	29,832	6,099	20.4
Road sign or traffic signal	14	102	508	624	116	18.6
Lamp post	31	218	920	1,169	249	21.3
Telegraph Pole/Electricity pole	7	51	232	290	58	20.0
Tree	32	216	562	810	248	30.6
Bus stop or shelter	3	17	75	95	20	21.1
Crash barrier	8	48	317	373	56	15.0
Submerged	1	1	3	5	2	40.0
Entered ditch	6	27	156	189	33	17.5
Other permanent objects	64	496	2,087	2,647	560	21.2
Not known	0	1	0	1	1	100.0
Total	**532**	**6,910**	**28,593**	**36,035**	**7,442**	**20.7**

Built up roads (excluding motorways)

Object Hit	Fatal	Serious	Slight	All	KSI	KSI %
None	95	977	3,089	4,161	1,072	25.8
Road sign or traffic signal	18	121	486	625	139	22.2
Lamp post	9	65	283	357	74	20.7
Telegraph Pole/Electricity pole	7	53	251	311	60	19.3
Tree	132	543	1,482	2,157	675	31.3
Bus stop or shelter	0	2	8	10	2	20.0
Crash barrier	22	118	715	855	140	16.4
Submerged	2	4	13	19	6	31.6
Entered ditch	20	247	1,191	1,458	267	18.3
Other permanent objects	66	470	2,161	2,697	536	19.9
Not known	95	977	3,089	4,161	1,072	25.8
Total	**371**	**2600**	**9679**	**12,650**	**2,971**	**23.5**

Non-built up roads

Object Hit	Fatal	Serious	Slight	All	KSI	KSI %
None	10	68	297	375	78	20.8
Road sign or traffic signal	3	11	32	46	14	30.4
Lamp post	1	10	28	39	11	28.2
Telegraph Pole/Electricity pole	0	0	2	2	0	0.0
Tree	11	32	93	136	43	31.6
Bus stop or shelter	0	0	0	0	0	-
Crash barrier	16	103	689	808	119	14.7
Submerged	0	0	0	0	0	-
Entered ditch	5	13	48	66	18	27.3
Other permanent objects	2	26	111	139	28	20.1
Not known	10	68	297	375	78	20.8
Total	**48**	**263**	**1,300**	**1,611**	**311**	**19.3**

Motorways

Object Hit	Fatal	Serious	Slight	All	KSI	KSI %
None	471	6,778	27,119	34,368	7,249	21.1
Road sign or traffic signal	35	234	1,026	1,295	269	20.8
Lamp post	41	293	1,231	1,565	334	21.3
Telegraph Pole/Electricity pole	14	104	485	603	118	19.6
Tree	175	791	2,137	3,103	966	31.1
Bus stop or shelter	3	19	83	105	22	21.0
Crash barrier	46	269	1,721	2,036	315	15.5
Submerged	3	5	16	24	8	33.3
Entered ditch	31	287	1,395	1,713	318	18.6
Other permanent objects	132	992	4,359	5,483	1,124	20.5
Not known	0	1	0	1	1	100.0
Total	**951**	**9,773**	**39,572**	**50,296**	**10,724**	**21.3**

All Roads

Table 3.2[3] - Reported single vehicle accidents: by objects hit off carriageway: built up and non-built up roads and severity 2009. (Note – 'None' in the above tables indicates the injury occurred despite not hitting a physical object, the injury may have occurred by the vehicle encountering an embankment or cutting)

LARA Method B: Network Rail Methodology

Only suitable where there is a road – rail interface.

Refer to: Managing the accidental obstruction of the railway by road vehicles.

Published by DfT, most recently updated in 2020.

Used for:

- Road bridges over railways
- Roads running alongside railways
- Cul-de-sacs ending at railways.

- Usually as highway engineers we just think of overbridges and very high containment barriers, but this is useful in more complex areas.

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LARA Method C: Risk Scoring

Method A (Collision Assessment) may not be suitable in a number of instances:

- On new roads.
- On improved roads: where the nature of the layout has changed sufficiently to make reference to historic collision data a poor indicator of future performance.
- Where collision data is not available.

Assessment made up of 4 factors:

- Location factor
- Layout factor
- Collision factor
- Consequential factor

LARA Method C: Risk Scoring

Factor	Priority Rank	Enter 'Y' where applicable (One entry per section)	Risk Factor Score
Location	All other roads		0
	Rural U & B roads and urban C roads		1
	Rural A roads and urban B roads	Y	3
	Urban A Roads		6
Layout (pt. 1)	Straight alignment and/or complies with TD9	Y	0
	One step below desirable minimum R with superelevation of 5%		1
	Two steps below desirable minimum R with superelevation of 5%		2
	Three steps below desirable minimum R with superelevation of 5%		3
	Four steps below desirable minimum R with superelevation of 5%		4
	Five steps below desirable minimum R with superelevation of 5%		5
Layout (pt. 2)	No reason for lane changing/manoeuvres.	Y	0
	Some potential for lane changing, overtaking, positioning manoeuvres or avoiding action.		2
	High likelihood of lane changing, overtaking, positioning manoeuvres or avoiding action.		3
Collision Factor (Pt 1)	Individual spot hazard		0
	Series of individual hazards less than 50m apart or a longitudinal hazard that might be reached.	Y	1
	Longitudinal Hazard that is highly likely to be reached resulting in harm or a spot hazard downstream of a feature which may guide the vehicle towards the hazard.		2
Collision Factor (Pt 2)	Percentage of KSI for primary hazard < 20%		0
	Percentage of KSI for primary hazard 20 -30%	Y	1
	Percentage of KSI for primary hazard >30%		2

Factor	Priority Rank	Enter 'Y' where applicable (One entry per section)	Risk Factor Score
Consequential Factor (Pt 1)	No secondary events likely.		0
	When damaged or collapsed the feature could give rise to the risk of secondary vehicular accidents.	Y	1
Consequential Factor (Pt 2)	No impact on network availability.	Y	0
	If hazardous feature was damaged or collapsed this could give rise to network disruption for more than one day.		1
Consequential Factor (Pt 3)	No significant cost implications.		0
	Significant cost of repair or replacement following collision.	Y	1
		Total Score	**7**
		Priority	**Low**

0-8 = Low priority site
9-13 = Medium priority site
14+ = High priority site

LARA Method C: Risk Scoring

Drawing Reference: N/A

AECOM Imagine it. Delivered.		Date: 27/07/2022	Prepared By: CC	Checked By: MH	Approved By: KT		
Hazard No.	**Hazard**	**Location**	**Approximate Chainage**	**Score**	**Classification**	**Comments**	**VRS proposed for this feature**
H59	Signals at crossing	Relief road, eb, ns	430, 840	7	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H60	Signals at crossing	Relief road, wb, ns	430, 840	7	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H61-H66 have been removed from the assessment as the crossings they were located by are not signalised, therefore the hazard is not present.							
H67	Earthworks slope	Relief road, wb, ns	320 - 380	5	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H71	Earthworks slope	Relief road, eb, ns	760 - 920	5	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H72	Earthworks slope	Relief road, wb, ns	1170 - 1290	5	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H73	Earthworks slope	Relief road, eb, ns	1300 - 1560	7	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H77	Chevron Sign	Roundabout A	Northern Chevron	10	Medium	This has been classified as a medium priority site for protection by VRS, the predominant reason is because of the sharp radius (measure between entry and exit arms), and thus the layout factor is greater. Despite this it is not practical to provide VRS for these chevrons as the VRS is unlikely to perform appropriately at the angles an errant vehicle is likely to hit the barrier, therefore a non VRS approach to reducing the risk may be appropriate.	No VRS A non VRS measure to reduce the risk will be to ensure that traffic chevrons are mounted on passively safe posts at appropriate mounting heights with appropriate post spacing.
H78	Chevron Sign	Roundabout A	Eastern Chevron	8	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H79	Chevron Sign	Roundabout A	Western Chevron	10	Medium	This has been classified as a medium priority site for protection by VRS, the predominant reason is because of the sharp radius (measure between entry and exit arms), and thus the layout factor is greater. Despite this it is not practical to provide VRS for these chevrons as the VRS is unlikely to perform appropriately at the angles an errant vehicle is likely to hit the barrier, therefore a non VRS approach to reducing the risk may be appropriate.	No VRS A non VRS measure to reduce the risk will be to ensure that traffic chevrons are mounted on passively safe posts at appropriate mounting heights with appropriate post spacing.
H92-94	Single post sign 008	Refuge island	160, 240, 1540	7	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS
H95	Single post sign 008	Refuge island	1320	7	Low	The level of risk is regarded as generally acceptable. Further effort to reduce risk is not likely to be required as resources to reduce risk would be grossly disproportionate to the risk reduction achieved.	No VRS

Purpose of Assessments, what do they actually say?

- Assessments only show whether the installation of a VRS is justified to reduce the risk to a road user.
- If a VRS is not required, it doesn’t necessarily mean that there is no risk to a road user
- Is there a residual risk and could other interventions reduce the risk e.g. passively safe road furniture, trief kerbs, removal of hazard outright?
- Some things may be raised within Road Safety Audits or design reviews

Pedestrian Guardrail Assessment

- **NOT** a restraint system
- Only used to influence pedestrian movements
- Can ‘trap’ pedestrians that cross on a desire line within the carriageway
- Can narrow footways
- Can narrow crossings
- Can cause tunnel vision for drivers
- Presents a crushing hazard

Pedestrian Guardrail Assessment

- TfL began removing significant lengths of guardrail in 2011 and reviewed collision data 3 years before and after, published in 2017

- KSI collisions reduced by 53% and 47% for pedestrians and all users.
- Influence the movement pattern of pedestrians particularly at crossings

- Current practice is not to provide PGR unless there is a specific reason to do so

Pedestrian Guardrail Assessment

You may have areas where you may have a reason to consider providing guardrail

- E.g. if there is a footway in close proximity to a junction that may be on a bend where pedestrian visibility is poor
- If there is a pedestrian desire line to cross the road at a potentially unsafe location then it may be appropriate to guide pedestrians to more appropriate crossing location.

How do you ensure that there are no other interventions and all other impacts have been considered?

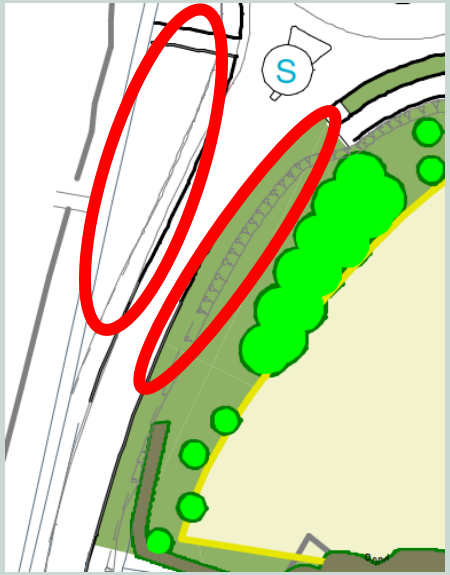
Pedestrian Guardrail Assessment

We can carry out an assessment that considers:

- Pedestrian desire lines
- Potential impact of PGR on pedestrian movements
- Constraints in the area
- Are there alternative measures that could also influence pedestrian movements:

  - Speed limit reduction;
  - traffic calming;
  - relocation of a crossing to better fit pedestrian desire lines;
  - installation of a new crossing at a desired location;
  - installation of bollards;
  - footway widening
  - buffer zones between footways and the road
  - birds mouth fencing; and
  - planting.

Pedestrian Guardrail Assessment

Example site 1		
Desire lines & anticipated usage:	Any NMU travelling north on Station Road will likely use the western footway, if they wish to cross the road to then travel east on the Relief Road, the most direct path will be crossing the road diagonally before they reach the crossing to avoid the link between the crossing and the existing western footway, which may be seen as a diversion (this also applies to users wishing to travel south). However, the western footway is separated from the edge of the road by a grass verge and small embankment and the southern footway of the Relief Road terminates at the designated crossing area where there is grass verge to the south. Due to this it is considered that the number of pedestrians who either start or end the crossing movement outside of the designated crossing area, will be limited, with the majority of users crossing within the designated crossing area. The number of pedestrians that may utilise the crossing is not known.	
Width constraint:	There is no width constraint for users travelling northbound on the western footway. There is no width constraint for users travelling souths / west on the southern footway.	
Visibility impact and alignment of the road:	Travelling northbound the road is on a smooth shallow curve, motorists are likely to have good visibility to anyone crossing at an inappropriate location, and any guardrail could be positioned as to not impact visibility. Travelling southbound the road is just on the exit of a roundabout, motorists may have less time to react to pedestrians crossing at inappropriate locations. Any guardrail could be positioned as to not impact visibility.	
Decision for provision of PGR:	The provision of PGR may be disproportionate to the risk reduction achieved. A length of birds mouth fencing on each side of the road may deter any undesired crossing movements and encourage NMUs to cross at the desired location. Provision of a deterrent on one side of the road may create a barrier that could 'trap' NMUs in the road that have attempted to cross to / from an inappropriate location. However, due to the location and extents of the footway, along with the grassed area separating the footway and the carriageway it is not anticipated that any measures to guide NMU movements will be required.	

Thank you.

Any questions

AECOM

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