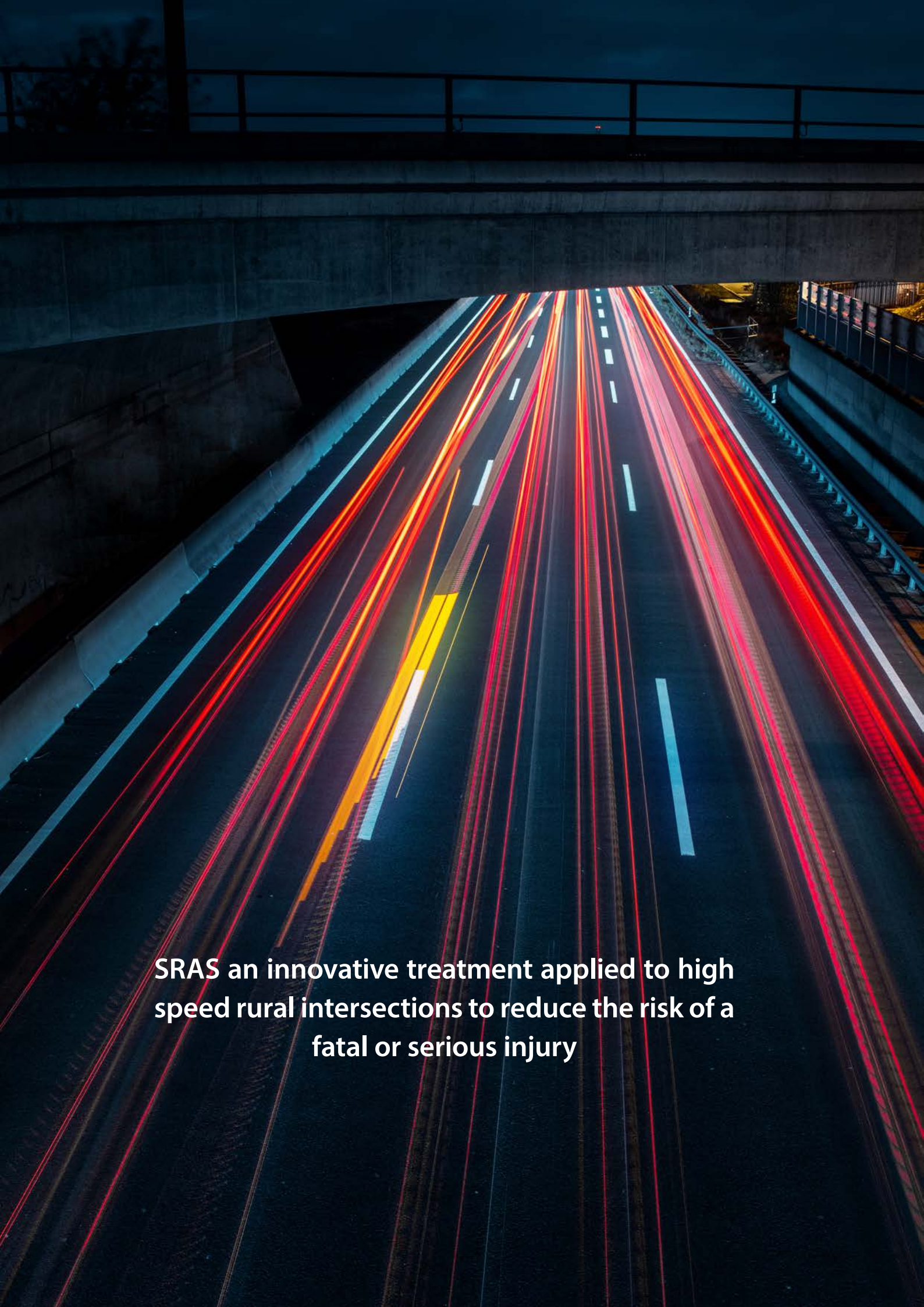
TRAFFIC TECHNOLOGIES

SRAS

Side Road Activated Speed

Locations of ESLS and Side Road Detection



SRAS an innovative treatment applied to high speed rural intersections to reduce the risk of a fatal or serious injury

INTRODUCTION

Side Road Activated Speeds (SRAS) is an innovative treatment applied to high speed rural intersections to reduce the risk of a fatal or serious injury.

'The Safe System Principle' of collision speeds note that the survivability of a side impact crash dramatically decreases when a vehicle impacts another vehicle at speeds greater than 50km/h.

Vehicles travelling on a Side Road that are approaching an intersection with a Major Road trigger a detector which activates a temporary speed reduction on the Main Road for a short period of time, using **Electronic Speed Limit Signs (ESLS)**.

The ESLS reduces the speed on the Main Road from the designated speed down to the side road activated, speed level. This speed reduction on the Main Road allows vehicles travelling on the Main Road to react and brake, so that if a crash occurred at the intersection between a vehicle on the Main Road and a vehicle on the Side Road, the vehicle on the Main Road would be travelling at a reduced speed at the point of impact, therefore reducing the possibility of a fatal or serious injury.

Image 1: Side Road Detector

SRARS Control Box and Solar Panel

ESLS Sited on Main Road

The location of the ESLS and the Side Road detection point is critical to ensuring that vehicles travelling on the Main Road are able to react, reduce their speed to the ESLS speed and brake to a collision speed of 50km/h or less.

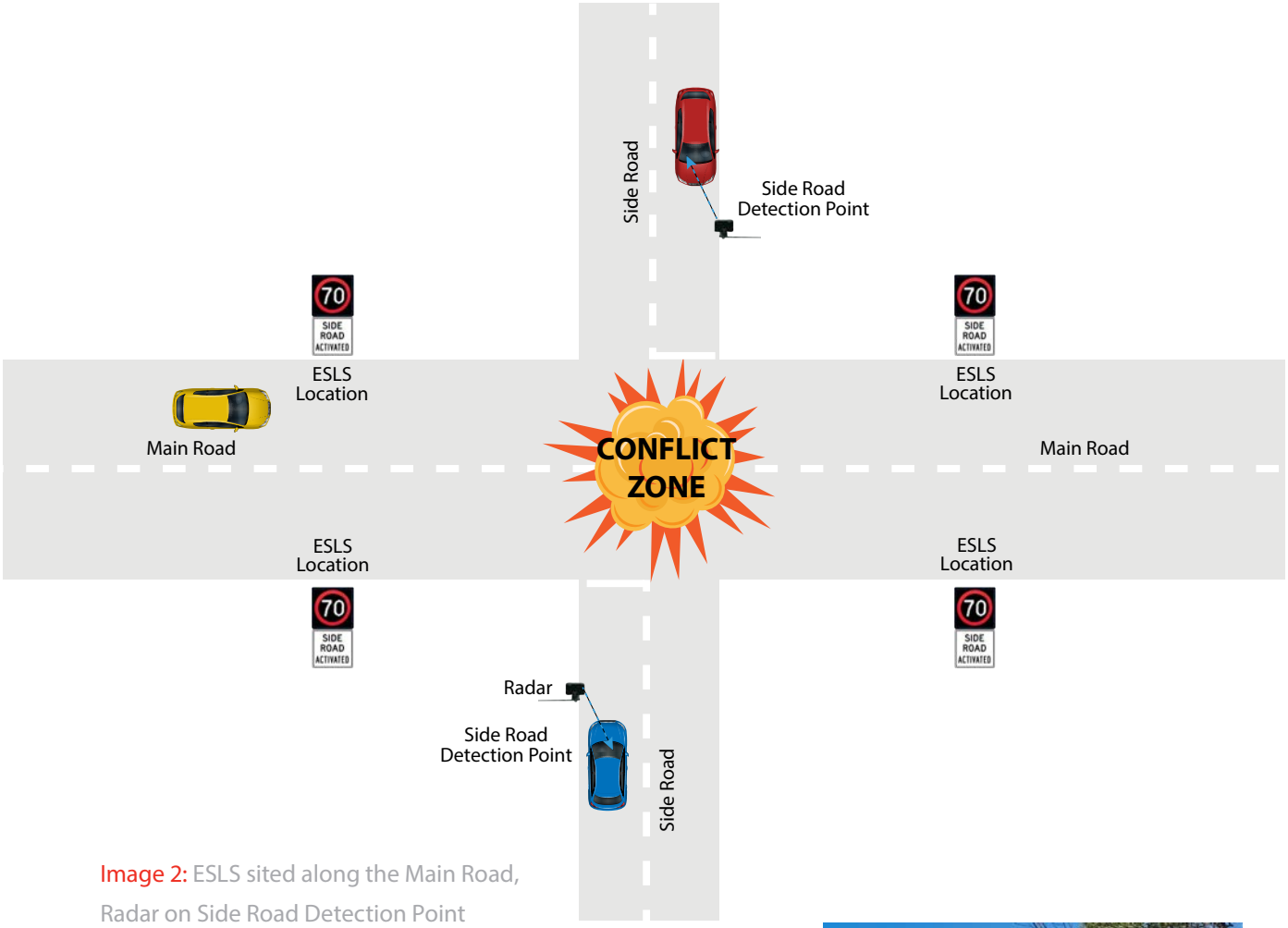


Image 2: ESLS sited along the Main Road, Radar on Side Road Detection Point

A critical case scenario occurs when the travel time of a vehicle on the Main Road is the same as the travel time of a vehicle on the Side Road to reach the conflict zone.

The location of the Side Road detection point is determined by the critical case scenario. Two seconds of travel time is added to the Side Road travel time to allow for variability of speed and provide an increased safety factor. The critical case scenario is therefore determined when the travel time on the Main Road from the ESLS location to the conflict point is the same as the travel time from the detection point with +2 seconds of added travel.

Detector Distances from the Intersection

The steps for determining the locations of the ESLS and Side Road detectors are determined in two parts A & B

A : Determine the ESLS Location on the **Main Road (D1)**

- Select location of ESLS signs based on the posted speed of the Main Road and site context constraints. Start with the selecting the **"Preferred Location"** distances **(from Table 1)** from the intersection.
- If the "Preferred Location" distances are not suitable due to site conditions, then the **"Desirable Location"** distances **(from Table 2)** should be used.
- If the "Desirable Location" is not suitable due to site conditions, then select the **"Constrained Location"** distances **(from Table 3)**.

B: Determine the **Side Road (D2)** Detection Location

- Select the corresponding Side Road detection location based on the posted speed of the Side Road and in the same 'location' category in A (above).
- The posted speed of the Side Road may be different for each leg. Select the distances for different Side Road posted speeds from the same 'location' category as selected in A (above).
- If the location of the Side Road detection is not suitable based on the location of the ESLS selected in A (above), then select a different ESLS location that results in a more suitable location of the Side Road detection.

The three location options provide designers with flexibility to determine appropriate locations due to the specific site conditions and constraints. The values in Tables 1, 2 and 3 all have adequate factors of safety and ESLS and detectors may be placed ±5m from the values in the tables provided overleaf.

Table 1. Preferred Locations of ESLS on Main Road and Side Road Detectors

Preferred location of ESLS signs on the Main Road assumes 4 seconds of travel in between the initial slowing down to the ESLS posted speed and reacting to a vehicle at the intersection. (See Step D PAGE 9)

	Preferred Location			
	MAIN ROAD		SIDE ROAD	
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)(d_2)
110km/h posted Speed on Main Road	110km/h	348m	110km/h	320m
			100km/h	307m
			90km/h	290m
			80km/h	270m
			70km/h	247m
			60km/h	221m
			50km/h	192m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
100km/h posted Speed on Main Road	100km/h	296m	110km/h	290m
			100km/h	279m
			90km/h	265m
			80km/h	248m
			70km/h	228m
			60km/h	204m
			50km/h	178m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
90km/h posted Speed on Main Road	90km/h	259m	110km/h	256m
			100km/h	249m
			90km/h	238m
			80km/h	223m
			70km/h	206m
			60km/h	186m
			50km/h	163m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
80km/h posted Speed on Main Road	80km/h	226m	110km/h	223m
			100km/h	218m
			90km/h	210m
			80km/h	199m
			70km/h	185m
			60km/h	168m
			50km/h	147m

Table 1 Preferred Locations of ESLS on Main Road and Side Road Detectors

Table 2. Locations of ESLS and Side Road Detectors

Preferred location of ESLS signs on the Main Road assumes 2 seconds of travel in between the initial slowing down to the ESLS posted speed and reacting to a vehicle at the intersection. (See Step D PAGE 9)

	Desirable Location			
	MAIN ROAD		SIDE ROAD	
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
110km/h posted Speed on Main Road	110km/h	303m	110km/h	259m
			100km/h	251m
			90km/h	240m
			80km/h	226m
			70km/h	208m
			60km/h	139m
			50km/h	164m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
100km/h posted Speed on Main Road	100km/h	257m	110km/h	229m
			100km/h	224m
			90km/h	215m
			80km/h	203m
			70km/h	189m
			60km/h	171m
			50km/h	150m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
90km/h posted Speed on Main Road	90km/h	221m	110km/h	195m
			100km/h	193m
			90km/h	188m
			80km/h	179m
			70km/h	167m
			60km/h	153m
			50km/h	135m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
80km/h posted Speed on Main Road	80km/h	187m	110km/h	174m
			100km/h	162m
			90km/h	160m
			80km/h	155m
			70km/h	146m
			60km/h	134m
			50km/h	120m

Table 2 Desired Locations of ESLS on Main Road and Side Road Detectors

Table 3. Constrained Locations of ESLS and Side Road Detectors

Location of ESLS signs on the Main Road assumes no distance of travel in between the initial slowing down to the ESLS posted speed and reacting to a vehicle at the intersection. (See Step D PAGE 9)

	Constrained Location			
	MAIN ROAD		SIDE ROAD	
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
110km/h posted Speed on Main Road	110km/h	259m	110km/h	198m
			100km/h	196m
			90km/h	190m
			80km/h	181m
			70km/h	169m
			60km/h	154m
			50km/h	136m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
100km/h posted Speed on Main Road	100km/h	218m	110km/h	177m
			100km/h	168m
			90km/h	165m
			80km/h	159m
			70km/h	150m
			60km/h	138m
			50km/h	122m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
90km/h posted Speed on Main Road	90km/h	182m	110km/h	160m
			100km/h	146m
			90km/h	138m
			80km/h	135m
			70km/h	128m
			60km/h	119m
			50km/h	107m
	Main Road Posted Speed	Distance from Intersection to ESLS (D1)	Side Road Posted Speed	Distance from Intersection to Detector (D2)
80km/h posted Speed on Main Road	80km/h	148m	110km/h	144m
			100km/h	131m
			90km/h	118m
			80km/h	122m
			70km/h	107m
			60km/h	101m
			50km/h	92m

Table 3. Constrained Locations of ESLS on Main Road and Side Road Detectors

Determining Location of ESLS and Side Road Detection

Determining the locations of the ESLS and Side Road detection is outlined below in 5 Steps, A-E;

A Calculate the distance it takes for a vehicle travelling on the Main Road at the posted speed to slow down to the ESLS speed, react to a vehicle at the intersection and brake, so that if there is a collision the vehicle on the Main Road is travelling at 50km/h or less.

B Convert the distance the vehicle travelled in Step (A) into equivalent travel time.

C The critical case scenario is where a vehicle travelling on the Side Road reaches the detector triggering the speed reduction at the same time as a vehicle travelling on the Main Road is located just before the ESLS (see image 2).

D The Side Road detection location is set based on the critical case scenario from Step C with an added +2 seconds of time for a factor of safety to allow for variation in travel speeds on the Main Road and Side Road.

E The distance from the intersection to the Side Road detection point is the sum of the braking distance required to stop at the intersection from the Side Road posted speed + the addition distance travelled at the Side Road posted speed.

ELECTRONIC SPEED LIMIT SIGNS (ESLS) LOCATION

The locations of the ESLS signs on the Main Road is determined by the distance it takes for a vehicle travelling at the posted speed to slow down to the ESLS speed, react to a vehicle at the intersection and brake, so that if there is a collision the vehicle on the Main Road is travelling at 50km/h or less.

Calculating for the distance/time travelled for a vehicle on the Main Road can be calculated by dividing the distance/time into the following Steps 1-5 page 10.

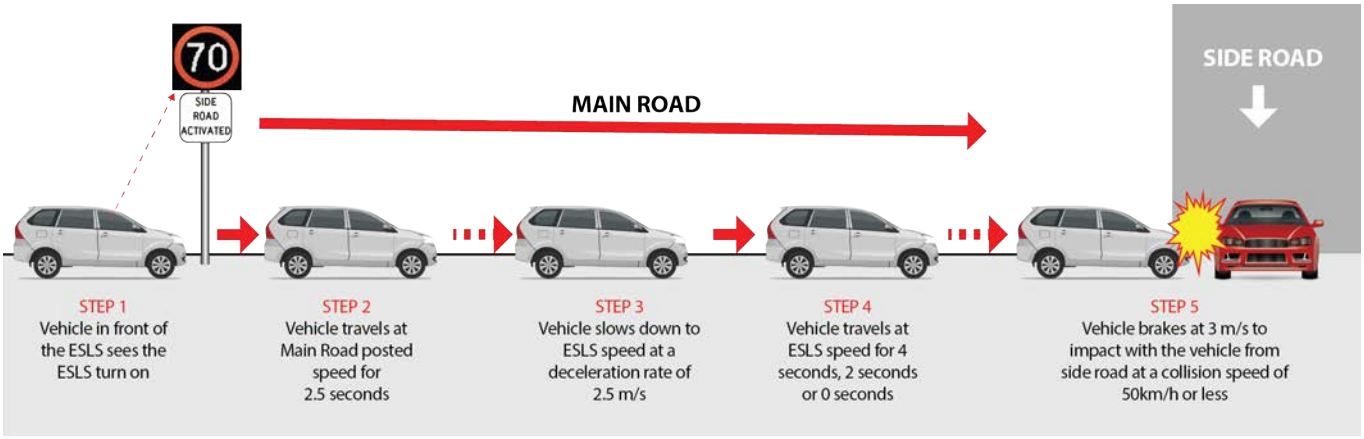


Image 3: Calculating for the distance/time travelled for a vehicle on the Main Road can be calculated by dividing the distance/time into 5 Steps.

1 A vehicle travelling on the Main Road at the posted speed **just before** the ESLS sees the ESLS come on with the reduced speed (either 80km/h for a Main Road posted speed of 110km/h or 70km/h for a Main Road posted speed of 100km/h or 90km/h or 80km/h).

2 The vehicle reacts to the ESLS after a period of 2.5 seconds *(a 2.5 second reaction time has been used based on Austroads Guide to Road Design Part 3 Table 5.2)* while travelling at the Main Road posted speed.

3 The vehicle slows down from the posted speed to the ESLS speed at a deceleration rate of 2.5m/s *(this has been assumed from Austroads Guide to Road Design Part 4A Section 5.2.2).*

4 The vehicle travels *(4s of travel is assumed for the "Preferred Location" distances in Table 2.1, 2s of travel is assumed for the "Desirable Location" distances in Table 2.2, and 0s of travel for the "constrained Locations" in Table 2.3.)* for a distance at the ESLS speed, sees a vehicle at the intersection and travels an additional distance while reacting to the vehicle at the intersection *(a 2 second reaction time from Austroads Guide to Road Design Part 3 Table 5.2 has been assumed as the driver is already driving in an alert condition in a rural area).*

5 The vehicle then brakes at a deceleration rate of 3m/s *(Austroads Guide to Road Design Part 3 Commentary 12)* from the ESLS speed to the collision speed of 50km/h. The deceleration distance was calculated using the SUVAT equation.

Calculations for ESLS Locations on the Main Road

			Reacting to ESLS Sign	Slowing Down to ESLS Speed	Travel at ESLS Speed and Reacting to Vehicle at Intersection	Braking		
Option	Main Road Posted Speed	ESLS Speed	Distance Travelled / Time Travelled	Distance Travelled / Time Travelled	Distance Travelled / Time Travelled	Distance Travelled / Time Travelled	Total Distance	Total Time
110 (1)	110km/h	80km/h	76.38m / 2.5s	87.91m / 3.3s	44.44m / 2.0s	50.13m / 2.8s	258.86m	10.6s
110 (2)	110km/h	80km/h	76.38m / 2.5s	87.91m / 3.3s	88.88m / 4.0s (2.0s travel + 2.0s reaction time)	50.13m / 2.8s	303.3m	12.6s
110 (3)	110km/h	80km/h	76.38m / 2.5s	87.91m / 3.3s	133.32m / 6.0s (4.0s travel + 2.0s reaction time)	50.13m / 2.8s	347.74m	14.6s
100 (1)	100km/h	70km/h	69.45m / 2.5s	78.76m / 3.3s	38.88m / 2.0s	30.83m / 1.8s	217.92m	9.6s
100 (2)	100km/h	70km/h	69.45m / 2.5s	78.76m / 3.3s	77.76m / 4.0s (2.0s travel + 2.0s reaction time)	30.83m / 1.8s	256.8m	11.6s
100 (3)	100km/h	70km/h	69.45m / 2.5s	78.76m / 3.3s	116.64m / 6.0s (4.0s travel + 2.0s reaction time)	30.83m / 1.8s	295.68m	13.6s
90 (1)	90km/h	70km/h	62.5m / 2.5s	49.42m / 3.3s	38.88m / 2.0s	30.83m / 1.8s	181.63m	8.5s
90 (2)	90km/h	70km/h	62.5m / 2.5s	49.42m / 3.3s	77.76m / 4.0s (2.0s travel + 2.0s reaction time)	30.83m / 1.8s	220.51m	10.5s
90 (3)	90km/h	70km/h	62.5m / 2.5s	49.42m / 3.3s	116.64m / 6.0s (4.0s travel + 2.0s reaction time)	30.83m / 1.8s	259.39m	12.5s
80 (1)	80km/h	70km/h	55.55m / 2.5s	23.16m / 1.1s	38.88m / 2.0s	30.83m / 1.8s	148.42m	7.4s
80 (2)	80km/h	70km/h	55.55m / 2.5s	23.16m / 1.1s	77.76m / 4.0s (2.0s travel + 2.0s reaction time)	30.83m / 1.8s	187.3m	9.4s
80 (3)	90km/h	70km/h	55.55m / 2.5s	23.16m / 1.1s	116.64m / 6.0s (4.0s travel + 2.0s reaction time)	30.83m / 1.8s	226.18m	11.4s

Side Road Detection Point Locations

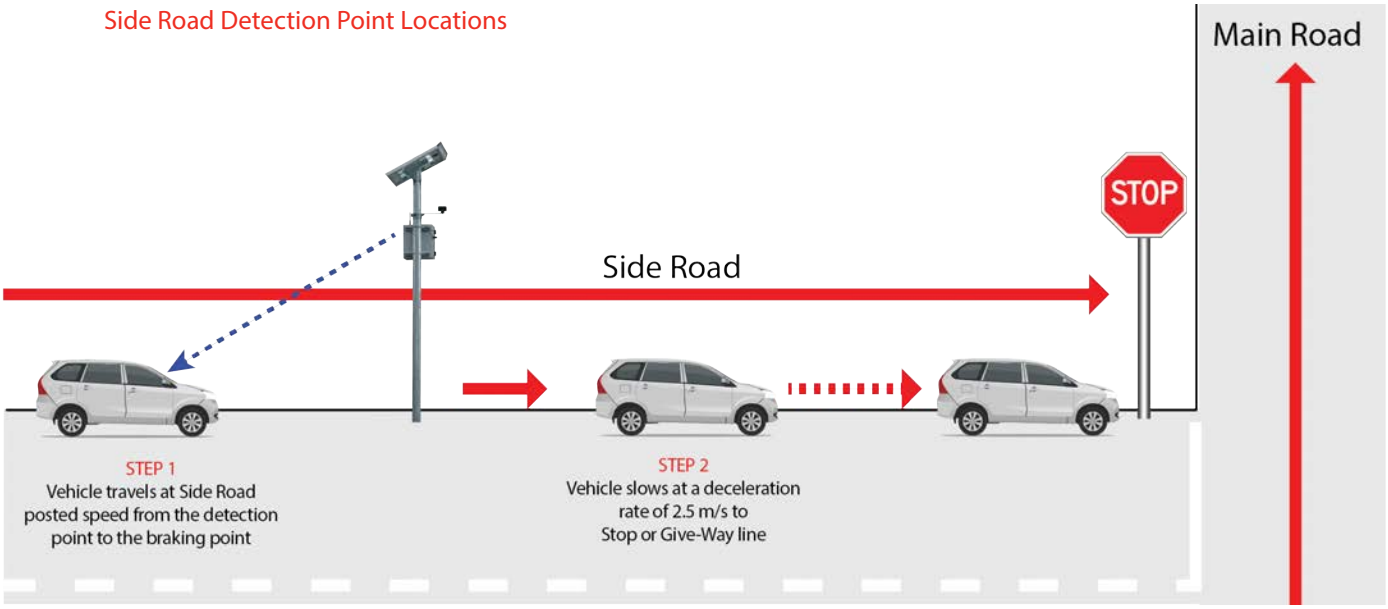


Image 4: Steps 1 & 2

Calculating the placement of Side Road detection is based on the critical case scenario where a vehicle travelling on the Side Road reaches the detection point triggering the speed reduction at the same time as a vehicle travelling on the Main Road is located just before the ESLS.

The travel distance and travel time for a vehicle approaching the intersection from the Side Road can be derived by the following steps.

1. Travel from the detection point on the Side Road to the point where the vehicle will start braking in order to stop at the intersection.

2. Brake from the posted speed on the Side Road at a deceleration rate of 2.5 m/s to a stationary position at the intersection.

The travel time for undertaking these two steps has already been determined from the critical case scenario calculated in Electronic Speed Limit Signs (ESLS) Location (Page 9). Once this braking distance has been calculated, it can be converted into braking time.

This will determine the time that it takes for a vehicle to brake from the posted speed to a stationary position at the intersection. The total travel time on the Side Road, from the detector to the intersection must equal to the total travel time from the ESLS on the Main Road to the intersection plus an additional +2 seconds. +2 seconds have been added to the travel time to allow for variations in speed for the Side Road and Main Road and to add an extra factor of safety.

Calculations for Side Road Detector Locations

Option	Main Road Posted Speed	Side Road Posted Speed	Minimum Travel Time to Side Road from Detector to Intersection (Based on the Location of ESLS on Main Road)	Travel to Detector from Braking	Braking Distance or Braking Time	Stopped at Intersection	Total Distance from Intersection to Detector
110(1)	110km/h	110km/h	12.6s	11.61m	186.66m/12.22s	N/A	198.27m
		100km/h	12.6s	41.39m	154.35m/11.11s	N/A	195.74m
		90km/h	12.6s	65m	125m/10.00s	N/A	190m
		80km/h	12.6s	82.44m	98.75m/8.89s	N/A	181.19m
		70km/h	12.6s	93.70m	75.58m/7.78s	N/A	169.28m
		60km/h	12.6s	98.85m	55.56m/6.67s	N/A	154.41m
		50km/h	12.6s	97.79m	38.58m/5.56s	N/A	136.37m
110(2)	110km/h	110km/h	14.6s	72.71m	186.66m/12.22s	N/A	259.37m
		100km/h	14.6s	96.95m	154.35m/11.11s	N/A	251.3m
		90km/h	14.6s	115m	125m/10.00s	N/A	240m
		80km/h	14.6s	126.88m	98.75m/8.89s	N/A	225.63m
		70km/h	14.6s	132.58m	75.58m/7.78s	N/A	208.16m
		60km/h	14.6s	132.19m	55.56m/6.67s	N/A	138.86m
		50km/h	14.6s	125.57m	38.58m/5.56s	N/A	164.15m
110(3)	110km/h	110km/h	16.6s	133.81m	186.66m/12.22s	N/A	320.47m
		100km/h	16.6s	152.51m	154.35m/11.11s	N/A	306.86m
		90km/h	16.6s	165m	125m/10.00s	N/A	290m
		80km/h	16.6s	171.32m	98.75m/8.89s	N/A	270.07m
		70km/h	16.6s	171.46m	75.58m/7.78s	N/A	247.04m
		60km/h	16.6s	165.53m	55.56m/6.67s	N/A	221.09m
		50km/h	16.6s	153.35m	38.58m/5.56s	N/A	191.93m
100(1)	100km/h	110km/h	11.6s	N/A	186.66m/12.22s	N/A	177.19m
		100km/h	11.6s	13.61m	154.35m/11.11s	N/A	167.96m
		90km/h	11.6s	40m	125m/10.00s	N/A	165m
		80km/h	11.6s	60.22m	98.75m/8.89s	N/A	158.97m
		70km/h	11.6s	74.26m	75.58m/7.78s	N/A	149.84m
		60km/h	11.6s	82.18m	55.56m/6.67s	N/A	137.74m
		50km/h	11.6s	83.90m	38.58m/5.56s	N/A	122.48m
110(2)	100km/h	110km/h	13.6s	42.16m	186.66m/12.22s	N/A	228.82m
		100km/h	13.6s	69.17m	154.35m/11.11s	N/A	223.52m
		90km/h	13.6s	90m	125m/10.00s	N/A	215m
		80km/h	13.6s	104.66m	98.75m/8.89s	N/A	203.41m
		70km/h	13.6s	113.14m	75.58m/7.78s	N/A	188.72m
		60km/h	13.6s	115.52m	55.56m/6.67s	N/A	171.08m
		50km/h	13.6s	111.68m	38.58m/5.56s	N/A	150.26m
110(3)	100km/h	110km/h	15.6s	103.26m	186.66m/12.22s	N/A	289.92m
		100km/h	15.6s	124.73m	154.35m/11.11s	N/A	279.08m
		90km/h	15.6s	140m	125m/10.00s	N/A	265m
		80km/h	15.6s	149.10m	98.75m/8.89s	N/A	247.85m
		70km/h	15.6s	152.02m	75.58m/7.78s	N/A	227.6m
		60km/h	15.6s	148.86m	55.56m/6.67s	N/A	204.42m
		50km/h	15.6s	139.46m	38.58m/5.56s	N/A	178.04m

Calculations for Side Road Detector Locations cont...

Option	Main Road Posted Speed	Side Road Posted Speed	Minimum Travel Time to Side Road from Detector to Intersection (Based on the Location of ESLS on Main Road)	Travel to Detector from Braking	Braking Distance or Braking Time	Stopped at Intersection	Total Distance from Intersection to Detector
90(1)	90km/h	110km/h	10.5s	N/A	186.66m/12.22s	N/A	160.39m
		100km/h	10.5s	N/A	154.35m/11.11s	N/A	145.88m
		90km/h	10.5s	12.5m	125m/10.00s	N/A	137.5m
		80km/h	10.5s	35.77m	98.75m/8.89s	N/A	134.52m
		70km/h	10.5s	52.88m	75.58m/7.78s	N/A	128.46m
		60km/h	10.5s	63.85m	55.56m/6.67s	N/A	119.41m
		50km/h	10.5s	68.62m	38.58m/5.56s	N/A	107.2m
90(2)	90km/h	110km/h	12.5s	8.55m	186.66m/12.22s	N/A	195.21m
		100km/h	12.5s	38.61m	154.35m/11.11s	N/A	192.96m
		90km/h	12.5s	62.5m	125m/10.00s	N/A	187.5m
		80km/h	12.5s	80.21m	98.75m/8.89s	N/A	178.96m
		70km/h	12.5s	91.76m	75.58m/7.78s	N/A	167.34m
		60km/h	12.5s	97.19m	55.56m/6.67s	N/A	152.75m
		50km/h	12.5s	96.40m	38.58m/5.56s	N/A	134.98m
90(3)	90km/h	110km/h	14.5s	69.65m	186.66m/12.22s	N/A	265.31m
		100km/h	14.5s	94.17m	154.35m/11.11s	N/A	248.52m
		90km/h	14.5s	112.5m	125m/10.00s	N/A	237.5m
		80km/h	14.5s	124.65m	98.75m/8.89s	N/A	223.4m
		70km/h	14.5s	130.64m	75.58m/7.78s	N/A	206.22m
		60km/h	14.5s	130.53m	55.56m/6.67s	N/A	186.09m
		50km/h	14.5s	124.18m	38.58m/5.56s	N/A	162.76m
80(1)	80km/h	110km/h	9.4s	N/A	186.66m/12.22s	N/A	143.58m
		100km/h	9.4s	N/A	154.35m/11.11s	N/A	130.59m
		90km/h	9.4s	N/A	125m/10.00s	N/A	117.5m
		80km/h	9.4s	23.49m	98.75m/8.89s	N/A	122.24m
		70km/h	9.4s	31.49m	75.58m/7.78s	N/A	107.07m
		60km/h	9.4s	45.51m	55.56m/6.67s	N/A	101.07m
		50km/h	9.4s	53.34m	38.58m/5.56s	N/A	91.92m
80(2)	80km/h	110km/h	11.4s	N/A	186.66m/12.22s	N/A	174.13m
		100km/h	11.4s	8.06m	154.35m/11.11s	N/A	162.41m
		90km/h	11.4s	35m	125m/10.00s	N/A	160m
		80km/h	11.4s	55.77m	98.75m/8.89s	N/A	154.52m
		70km/h	11.4s	70.37m	75.58m/7.78s	N/A	145.95m
		60km/h	11.4s	78.85m	55.56m/6.67s	N/A	134.41m
		50km/h	11.4s	81.12m	38.58m/5.56s	N/A	119.7m
80(3)	80km/h	110km/h	13.4s	36.03m	186.66m/12.22s	N/A	221.71m
		100km/h	13.4s	63.62m	154.35m/11.11s	N/A	217.97m
		90km/h	13.4s	85m	125m/10.00s	N/A	210m
		80km/h	13.4s	100.21m	98.75m/8.89s	N/A	198.96m
		70km/h	13.4s	109.25m	75.58m/7.78s	N/A	184.83m
		60km/h	13.4s	112.19m	55.56m/6.67s	N/A	167.75m
		50km/h	13.4s	108.90m	38.58m/5.56s	N/A	147.48m


70
SIDE
ROAD
C441
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LYNNES RD
Wonthaggi
70
SIDE
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ALDRIDGE

Aldridge Traffic Systems Pty Ltd

12 - 14 Leeds Street
Rhodes NSW 2138

www.trafficltd.com.au

NSW
P: +61 2 9736 3677
F: +61 2 9736 3391
e: info@trafficltd.com.au

VIC
P: +61 3 9430 0222
F: +61 3 9430 0244
e: info@trafficltd.com.au

SA
P: +61 8 8362 2385

e: info@trafficltd.com.au

NT
P: +61 8 8947 0733
F: +61 8 8947 0713
e: info@trafficltd.com.au

ACT
P: +61 2 6299 7922
F: +61 2 6299 7977
e: info@trafficltd.com.au

WA
P: +61 8 9248 1002
F: +61 8 9209 2288
e: info@trafficltd.com.au

QLD
P: +61 7 3266 1900
F: +61 7 3266 2244
e: info@trafficltd.com.au

TAS
P: +61 3 6273 1177
F: +61 3 6273 1759
e: info@trafficltd.com.au

UNITED KINGDOM
P: +44 (0) 1159 223 797
F: +44 (0) 1159 223 836
e: info@aldridgetraffic.co.uk