Technical note

ATKINS

Project:	A30 Brook Waters Vehicle Activated Signs (VAS)	**To:**	Dave Thomas, Wiltshire Council
Subject:	Feasibility Study	**From:**	Florence Ching , Atkins
Date:	30th April 2015	**cc:**	Kevin Bishop, Atkins

1. Introduction

There have been longstanding concerns, raised by the local community, regarding the dangers faced by opposing large vehicles using the A30 Brook Hill between the hamlets of Birdbush and Brook Waters. There have been instances when HGVs are being forced onto the opposite side of the road through the narrowing section, immediately east and west of the A30 Brook Hill/ Watercress Lane/ West End Lane crossroad, at Brook Waters.

Atkins Transportation was instructed by Wiltshire Council to undertake the feasibility study on behalf of South West Wiltshire Area Board and CATG (Community Area Transport Group) to investigate the feasibility of controlling traffic movements by means of Vehicle Activated Signs (VAS) to provide warning of oncoming uphill large vehicles.

2. Background

2.1 Location

The A30 is a single carriageway road and is the principal route between Shaftesbury and Salisbury. The A30 descends into the valley of the Ferne Brook at Brook Waters. Where this river crossing at Brook Waters is made, a four armed crossroads is formed with Milkwell and Donhead st Andrew to the north with a number of minor roads to the south.

The extent of A30 to be examined, for the provision of Vehicle Activated Sign, passes through the hamlets of Birdbush and Brook Waters for approximately 1km long as shown in the location plan below (see Figure 1).

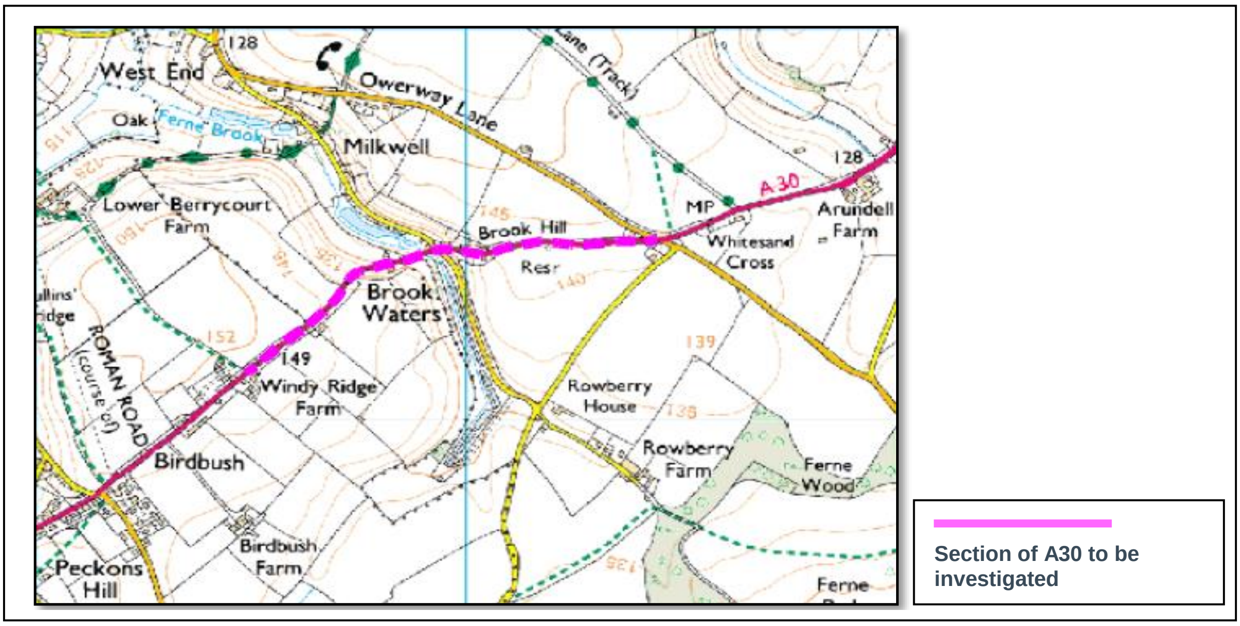


Figure 1. Location Plan

Plan Design Enable

2.2 Existing Layout

The A30 Brook Hill is a single carriageway road in a rural location with carriageway width ranging between 5m and 6m. The road is unlit and is subjected to 40mph speed limit.

A topographical survey was undertaken in January 2015 to obtain information including carriageway width, levels, road markings and other road furniture such as traffic signs. To the east of the crossroads, the road is narrow and twisting, the carriageway width reduces to a 4.9m near South View Cottages and Tree Tops Cottages where the road is restricted by a stone wall on one side and high hedges on the other. The centre line marking has been omitted along a 70m section. The absence of the centre line marking on rural roads below 5.5m in width, would inform drivers the road is not wide enough for opposing traffic to pass.

There are permanent static warning signs with high intensity yellow backing together with a supplementary plate, approximately 150m in advance of the affected site in both Eastbound and Westbound approach. This is accompanied by “SLOW” road markings and there are a further two sets of “SLOW” road markings after this. (Refer to Photo 1. Existing permanent static warning signs).

Photo 1. Existing permanent static warning signs

To the west of the crossroads, the road is generally wider with better visibility. The centre and edge of carriageway are delineated by road markings and there are two sets of ‘SLOW’ road markings on the eastbound approach to the crossroads.

The majority of the route has no footway or verges and there are high hedges approximately 1.5m to 2m high and stone walls on both side of the carriageway along most sections of the route.

2.3 Traffic Data & Speed Survey

Traffic flow and speed surveys were conducted between 10th March and 23rd March 2015 for two weeks. The traffic counter was located at A30 Donhead St Andrew, east of the study area.

Table 1 below shows the Annual Average Daily Traffic (AADT) and the Annual Average Weekday Traffic (AAWT) flow in a single direction (one-way).

Direction	AADT Flow	AAWT Flow	% HGV AADT	% HGV AAWT	85th Percentile Traffic Speed
Eastbound (To Salisbury)	2232	2112	6.1%	5.2%	45mph
Westbound (To Shaftesbury)	2213	2155	5.7%	4.7%	45mph

Table 1. Traffic Data and Speed Survey, March 2015

2.4 Collision Data

Table 2 below shows the collision data on the A30 Brook Hill over a 6 year period from January 2009 through December 201 4. There were a total of 5 collisions recorded during this period, all collisions were slight except for a fatality which was a single vehicle collision. Two of the collisions involved a large vehicle (>7.5Tonnes) and a car. At both incidents, the large vehicle was travelling downhill in the westbound direction, round the right hand bend through the narrowing section of the A30 Brook Hill whilst the car was negotiating through the bend and collided head on.

Drawing 5132282-ATK-7064-SD-DR-C-001 Accident Data in Appendix A illustrates the location and number of injury collisions over the past 6 years.

	Fatal	Serious	Slight	Total
Motor vehicles only (excluding 2-wheels)	0	0	3	3
2- Wheels	1	0	1	2
Total	1	0	4	5

Table 2. Accident Data between 2009 and 2014

2.5 Site Survey

A site visit was undertaken on 26th March 2015 to assess the existing driving condition for the extent of A30 affected. There is no provision of footway or verge for majority of the route so it was not possible to carry out the site visit on foot. The section of A30 affected was driven through and a video survey was recorded.

The DfT Traffic Advisory Leaflet 1/03 and Traffic Signs Manual Chapter 4 give recommendations about the circumstances when a vehicle activated signs should be used. It recommends that:

> *"Vehicle Activated Signs should not be considered until the fixed signing and road markings have been checked to ensure they comply fully with the guidance in terms of correct size, siting, visibility and condition."*

As discussed in Paragraph 2.2 above, based on information obtained from topographical survey, site observation and the accident data, it is suggested that a review of the existing signage and road markings can be carried out to the A30 west of the Brook Waters crossroads, to include additional warning signs before the implementation of a VAS is considered. This study will therefore focus on assessing the suitability of a VAS to the A30 Brook Hill, east of the Brook Waters crossroads.

Technical note

3. Technical and Design Considerations

The purpose for the provision of VAS is to alert traffic that a large vehicle is approaching in the opposite direction, by displaying a flashing message. The sign is activated when the approaching vehicle exceeds the threshold setting of the sign e.g. speed, height. This reduces the chances of two large vehicles from meeting in the narrowing section and reduces the possibility of collision between vehicles given the 40mph speed limit.

A sign will be placed in both directions in advance of the narrowing road and they will be connected by radio link, meaning that whichever way the large vehicle is coming from, the oncoming driver will always be warned.

The following sections detail the design criteria, site specific considerations and type of detection system options available.

3.1 Design Guidance

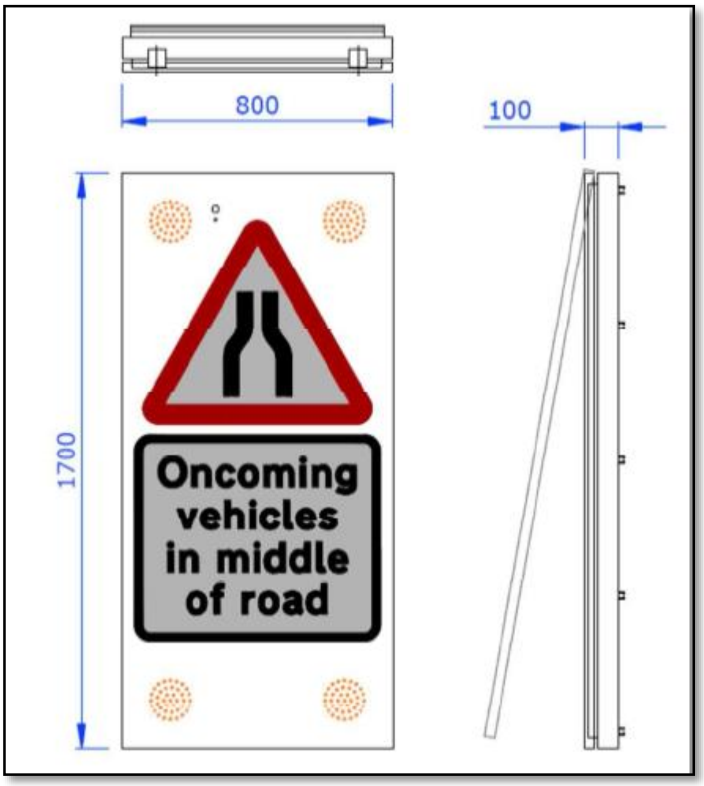
The following guidance has been taken into account during the design process:

- Traffic Advisory Leaflet TAL 1/03 – Vehicle Activated Signs (2003)
- Traffic Signs Regulations and General Directions 2002 (TSRGD 2002)
- The Traffic Signs Manual Chapter 4 (2013) – Warning Signs

3.2 Type of VAS to be used

The proposed VAS will have a 'Road Narrow' warning sign to Diag. 516 in the upper portion of the sign with a supplementary plate reading 'Oncoming vehicles in the middle of the road' to Diag. 575 in the bottom, like the existing static signs, in accordance with the Traffic Signs Manual Chapter 4 and TSRGD 2002.

The diagram below shows the proposed sign.



Technical note

Figure 2. Proposed VAS (Image provided by Swacro Traffic Ltd.)

3.3 Design Criteria

- Siting distance – The VAS shall meet the requirements of Appendix A in the Traffic Signs Manual Chapter 4 Warning Signs (2013) and subject to the 85th percentile speed. The 85th percentile is the speed at which up to 85 per cent of the traffic is travelling. For 85th percentile speed between 41mph to 50mph, the minimum clear visibility distance should be 75m and the distance of sign from the hazard should be between 110m and 180m.
- Visibility – Care should be taken to ensure that no substantial fixed obstructions obstruct the sightlines including road furniture such as traffic signs. The sign should be clearly visible to drivers, for a minimum of 3 second view. (On a 40mph road the minimum distance between the detection and the sign should be 53m.)
- Electrical Supply – VAS are powered by the nearest mains supply which is often via a street lighting column. Where a location lacks mains power or where mains power costs are prohibitive, solar and/or wind power is used.
- Sign location – Consideration should also be given to roadside vegetation and nearby homes and businesses as the light emitted from the signs can sometimes intrude.

3.4 Site Constraints

- The majority of the route has high hedges, approximately 1.5m to 2m high, on both side of the carriageway. Removal of the hedge maybe required to provide sufficient visibility to the signs. The hedge will have to be maintained to avoid obstruction to the signs.
- There are a couple of pubs and cottages immediately west of the A30 Brook Waters crossroads, which restricts the positioning of the signs and detection poles in the eastbound approach.
- Signs should be erected within the highway boundary.
- Solar or wind powered would not provide the amount of electricity required to support the sign and detector configuration. Also, solar power is not ideal in areas where high hedges are present. An equivalent of 8 no. of solar panels per site would be needed if the VAS are to be powered by solar energy. Street lighting is not available in the vicinity of the site. Electrical supply will have to be taken from the local electricity provider i.e. Southern and Scottish Energy.

3.5 Type of Vehicle Detection Systems

3.5.1 Option 1 - Over Height Vehicle Detection (OVD)

A pole is installed at either side of the road at each OVD detection point upstream of the length of narrow road. The signs are activated by radio link from the detection point. Figure 2 shows an overview of the configuration

When a vehicle passess through the detection point, the controller differentiates the vehicle size and sends a signal to the sign at the opposite end of the zone (or both signs) to activate it until the zone is cleared. The sign flashing ambers will illuminate to warn traffic approaching from the other direction of a hazard ahead. The on time for the sign displays is set in the sign controller. In the event of more than one large vehicle entering the zone, activations are 'stacked' in the controller to ensure the system is not disabled before all vehicles have cleared the zone.

The system has various failure modes, continuing to work until only one beam remains. Once both beams have failed, the sign will constantly display the flashing amber wigwags as a final warning.

A similar system was deployed at Kingway Railway Bridge on the A429 Chippenham Road, Corston in 2009 to warn large vechicles of the low bridge ahead.

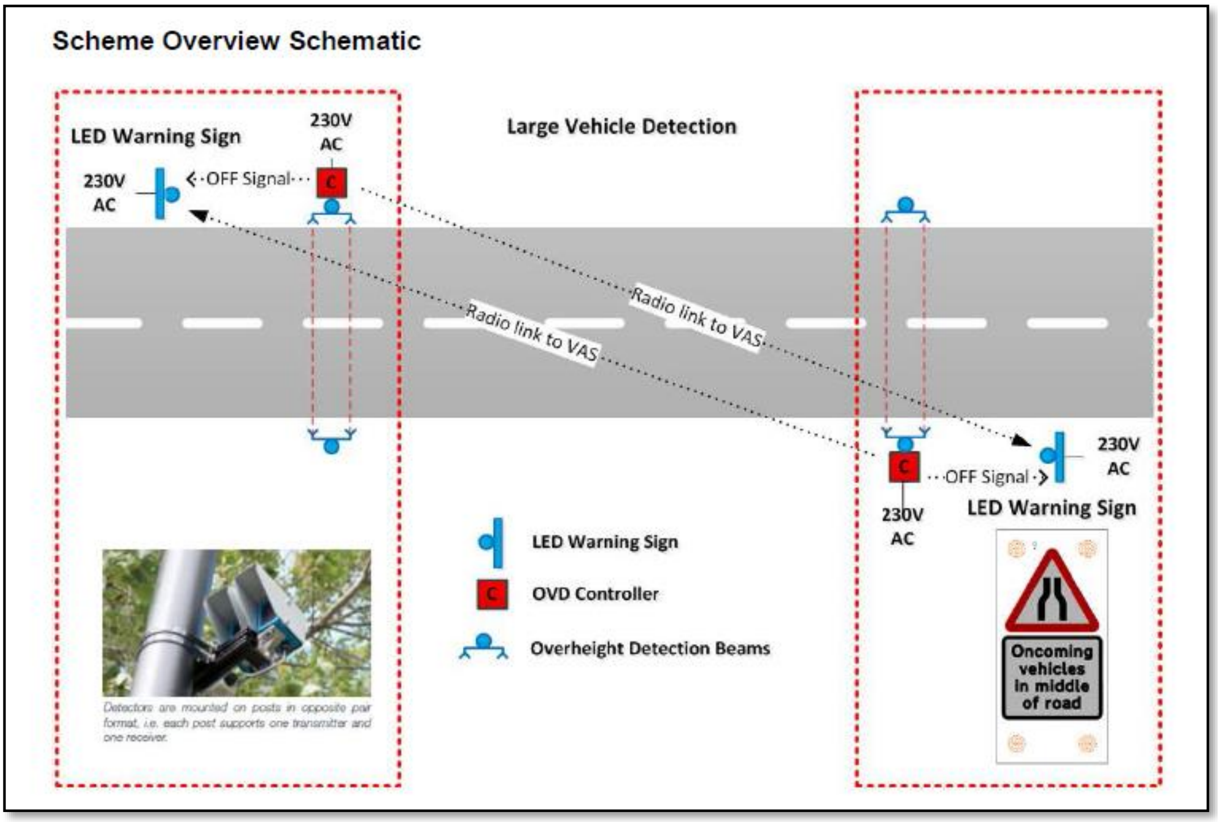


Figure.3. An overview of OVD System (Image provided by SwarcoTraffic Ltd.)

Pros –

- The detectors are adjustable and can be mounted at any height on the pole to suit the type of vehicle to be detected.
- The detector poles and signs are erected in close proximity to reduce land use and disruption to traffic during installtion.
- Distances across the overall zone, i.e. the area capturing detection and signage, can be large as radio link is used for communication links;
- Radio link between signs and detectors meaning no ducting involved.

Cons –

- The detection pole can be high (e.g. up to 5m in height above ground) and can be visually instrusive in rural location.
- The detection pole could be misaligned in the event of high wind.

3.5.2 Option 2 – Underground Loop Detection

The VAS are activated when a vehicle passes over a detection loop in the carriageway. A similar configuration was implemented on A360 Church Street, West Lavington in 2008. When a vehicle travelling westbound passes over a loop at the eastern end of the narrow section, this triggers the westbound sign to display the upper sign portion (Road Narrows) and via the link cables, triggers the eastbound sign on the western end of the narrow section to display the lower sign portion (Oncoming vehicle in the middle of road). The system also works in reverse. The message is displayed for approximately 20 seconds after the loop detector demand, the time it takes on average to negotiate the narrowing.

There have been issues with the maintenance of the link cables, between the signs, that are required to trigger the sign from the opposite end of the narrow section by underground loop detectors. It was not possible to maintain or repair a damaged loop that was directly cut into the road and full replacement was needed.

The use of radio link (wireless transmission) will prevent the need of laying extensive cables and ducts in the carriageway, and hence reduces the chances of being damaged by road works such as by the utility and or communication companies cutting through them as they install or maintain their own services.

The traditional detection loop detects all kind of vehicles, i.e. the signs are activated each time a vehicle passes over the loop. When traffic flow is high, the messages in the sign can be permanently displayed. The constant activation will reduce its impact on drivers.

Axle classifier is available that permits the detection of vehicle axles and axle spacing. However, this system has not been deployed in Wiltshire and a trial for this new initiative is recommended prior to implementation.

Pros –

- Experience from previous projects within Wiltshire, have the relevant knowledge on how the system works.
- Generally reliable in many applications and locations.

Cons –

- The loops will be destroyed by ‘planing out’ during resurfacing works. Lesson learnt in A360 West Lavington VMS;
- If the slots are not deep enough, the backfill is more likely to come away, exposing the loop cable, which will result in the cable being worn and broken;
- Deterioration of the carriageway, breakup of the surface will result in the loops becoming exposed and damaged;
- Road temperature – hot sunny days, cooler evenings and cold sub-zero winter days/ nights can affect the cables.
- Maintenance and replacement of cables require full road closure, results in disruption to the traffic flows.

Technical note

3.5.3 Cost Estimate

Items	Cost	
	Option 1	Option 2
Supply and install VAS signs & posts (2 no.)	£11,000	£11,000
Supply OVD detection kit (2 no.)	£9,000	
Supply and install detector post set (4 no.)	£3,000	
Ducting for VAS		£8,000
Slot cutting and cabling		£2,000
Install and commission system	£2,000	£2,000
Electricity Supply	£10,000	£10,000
Sub-Total	£35,000	£33,000
Design Fee	£3,000	£3,000
Site Supervision Fee	£3,000	£3,000
Traffic Management	£5,000	£8,000
Routine Sign Inspection and Maintanence *Note: - The VAS suppliers will provide a guarantee against equipment or component failure for 12 months, this does not cover routine maintenance such as foliage clearance, vehicle impact or vandalism.	£2,000	£5,000
Contigency (18%)	£8,640	£8,820
Total	**£54,640**	**£57,820**

3.6 Signs and Detectors Location

Drawing 5132282-ATK-7064-SD-DR-C-002 Signs and Detectors Location Plan in Appendix A shows the proposed locations for the signs and detectors.

These sites have been chosen to ensure adequate visibility of the sign is achieved without obstructing lines of sight for general traffic, access to equipment locations where necessary as well as avoiding difficult traffic queuing outside residences in the village.

The overall distance across the scheme is as shown at approximately 350m, which should mean that the communication between sites is at an optimum working range.

4. Conclusions

The issues for A30 Brook Hill is the lack of carriageway width to accommodate two large vehicles passing each other. This as a result forces HGV into the opposite side of the road. A number of collisions have occurred at Brook Hill which are partially attributed to the highway alignment (see drawing 001).

Any modification to the existing road layout would not be practical given the restraints of narrow carriageway width and buildings close to the carriageway.

The provision of Vehicle Activated Signs will be an appropriate remedial measure to address the issues at A30 Brook Hill. There has been research undertaken nationally and in other Counties to evaluate the relation between the configuration of the sign and their impact on driver behavior and sign efficiency. The results show that VAS appear to be very effective in reducing speeds and there is also an apparent reduction in the number of collisions occurring.

The VAS would offer benefit to drivers if they are positioned and operated correctly. The activation of the signs and the flashing amber light enhance drivers' awareness of the upcoming hazard i.e. narrow roads and the approaching vehicle in the opposite side of the road, in order to reduce the conflict between large vehicles.

Both configurations operate by means of detecting the presence of vehicles. Option 1 – Over Height Detection will be able to distinguish all large vehicles so long as the sensors are mounted at an appropriate height that capture vehicles that are higher than the threshold setting i.e. 3m for HGVs. The installation of this detection system does not require lengthy excavation and laying of ducting and cabling, hence reducing the chances of them being damaged and shorten the time needed when traffic management is in place, in comparison to Option 2 – Underground Loop Detection. Loop detection can be reliable if they are well maintained but for the reasons discussed in Section 3.5.2 they can be unreliable. The initial cost for the installation and supply of the signs and detections is similar for both options. However, on-going maintenance and replacement of the underground loops can create lifespan issues, based on previous experience on A360 West Lavington VMS scheme. The Over Height Detection transmits data by wireless radio communication meaning the transmission is not restricted by the geometry of the road and buildings in the surrounding area. In light of the reasons discussed above, Option 1 – Over Height Detection is the recommended option. The cost of Option 1 is estimated to be £55k.

Monitoring should be undertaken following the installation to assess its impact on collision and speed. A safety audit should also be undertaken prior and after the VAS is installed to ensure it meets the appropriate highway safety standards.

Technical note

APPENDIX A – DRAWINGS

- 5132282-ATK-7064-SD-DR-C-001 Accident Data
- 5132282-ATK-7064-SD-DR-C-002 Signs and Detectors Location Plan