

Controlled Motorways | M25



October 2006

Introduction - The Highways Agency's network

The Highways Agency is responsible for maintaining, operating and improving a strategic road network of about 9,400 km (5,841 miles) of motorways and trunk roads in England ('the network'). This network carries a third of all road traffic and two-thirds of all freight traffic, totalling around 153 billion kilometres travelled each year. The Agency is an Executive Agency of the Department for Transport.

The Agency priorities are to:

- Continue to maintain the network in good condition to ensure that it is safe and available to use
- Maximise performance from the existing network
- Improve the network where necessary

Effective operation of the network involves traffic management schemes. Controlled Motorways systems are designed to manage the increasing demands on our networks, to keep people moving in a safe environment.

This pamphlet has been produced to provide an explanation to drivers who regularly use the Controlled Motorways section of M25 of how the system works and why it is needed.

The M25

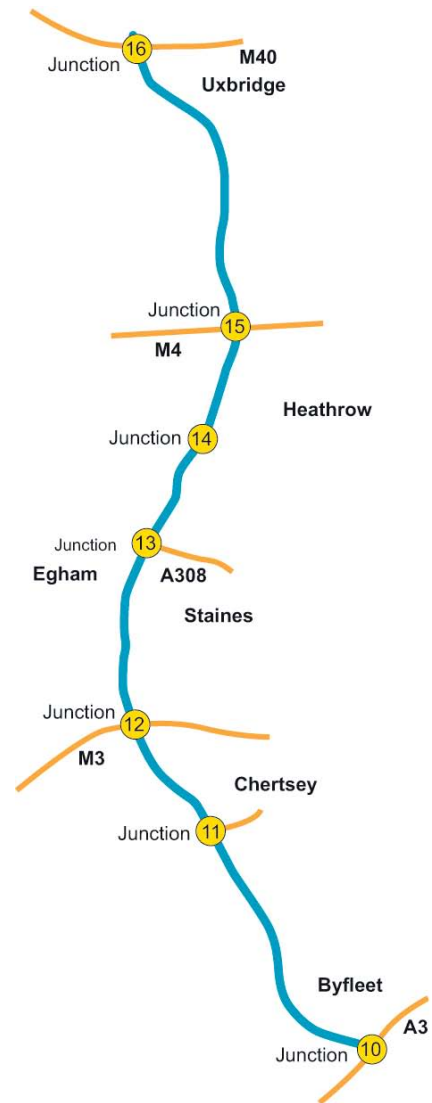
The western section of the M25 is one of the busiest sections of motorway in Europe carrying in excess of 200,000 vehicles per day. To help manage this, a variable speed limit and incident detection control system has been operational on this section since 1995.

The controlled section is fully instrumented with loop detectors that collect real-time traffic data such as vehicle count, speed and traffic density. Signal gantries automatically display mandatory speed limits in response to this traffic data. Variable Message signs on the motorway also display text information to drivers to give advance warning of conditions ahead.

This part of the M25 is a critical part of the national motorway network. It connects the many radial motorways and trunk roads serving London and provides a bypass for through traffic.

The original section of Controlled Motorways in place between the M3 and M4 (Junctions 12 to 15) had four lanes running in each direction and three lanes through each junction. It was designed in the mid 1990's to carry 100,000 vehicles a day. However, the busiest section between Junctions 13 and 14 already carries 200,000 vehicles a day. With traffic continuing to grow, it was recognised that congestion would increase, with traffic diverting onto local roads, unless further capacity was provided for the future.

Therefore, a decision was taken to widen the M25 to five lanes between Junctions 12 and 14, and to six lanes between Junctions 14 and 15. The widening also incorporated four lanes through Junctions 13 and 14, and new link roads to Heathrow Terminal 5. The Controlled Motorways technology on the section was upgraded at the same time. This work began on site in January 2004 and opened ahead of schedule in December 2005.



Why do we need Controlled Motorways?

Traffic demand on the M25 typically increases by 2% each year and we need to manage this demand effectively to help keep the motorway flowing. To achieve this safely, we need to smooth the traffic flows/speeds to maximise the motorway's potential. The speed control system on the M25 creates an environment to minimise the risk of flow breakdown (where traffic can become stationary on the motorway), reduce accidents as a result of flow breakdown and produce more reliable journey times.

Many years of research have enabled the Agency to develop techniques and systems to achieve effective traffic control and these systems are constantly monitored and adjusted to maximise benefits and operational reliability.

As the traffic demand increases, inevitably we must expect the signals to be on more often and for longer periods. The signals and message signs can also be manually set by the Police or Agency staff to complement or override automatic settings.



The Signal Controls

- *There are two reasons for automatic signal and message sign settings*

Signals set for Congestion

These are set in response to the number of vehicles per minute passing over the loop detectors – the traffic demand. As demand increases so does the risk of flow breakdown and accidents. At carefully calculated thresholds, the signals are set to reduce the speed of traffic, smooth the flow, reduce the potential for flow breakdown and create a safer environment for the current traffic conditions. Initially, 60mph signals are displayed on the gantries and then as the traffic demand increases further, 50mph signals are displayed.

Drivers may not realise why these signals are set, and this is understandable as there may be no apparent reason for the settings. However, the system is detecting high traffic demand and is using the signals to prevent the congestion from deteriorating into flow breakdown. This makes the journey smoother and safer for all.

Signals set for Incidents

These are set when the system detects very slow moving or stationary traffic over a loop detector. The signals provide warnings to protect queueing traffic and produce a safer driving environment. When a queue is detected, the system rapidly sets signals to 40mph limits in the immediate area and 60mph limits leading into this, to give advance warning to drivers alerting them to reduce their speed. If the signal gantries are quite close together, the advance signals will be set to 50mph limits. Message signs are also set with appropriate text to support this situation.

Incident settings are designed to protect stationary/slow moving vehicles and the back of queues that can result from these. The incident detection system also works alongside the congestion system to control the speed of traffic in congested areas where flow breakdown has already happened.

The signals can also be set manually, for example when maintenance works are being carried out. The signals are used to aid the management of lane closures.

Message Signs

At regular intervals on the motorway there are message signs giving text information to give more details to the driver about the situation ahead and these reflect the signal activity. Examples of the automatic messages are 'CONGESTION STAY IN LANE', 'QUEUE AHEAD' or 'QUEUE AFTER NEXT JUNCTION'. Other messages such as 'OBSTRUCTION' can be set manually by the Police or Agency staff.

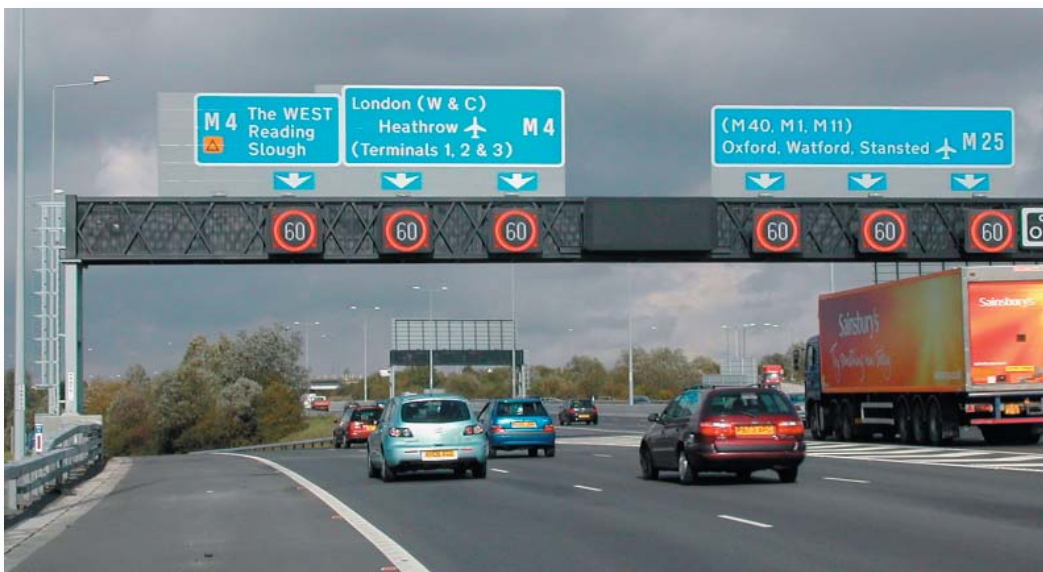
The Whole Picture

The whole system is dynamic and responds minute by minute to the current conditions anywhere on the controlled section. The whole section is linked together to enable staged and smooth changes to the signals throughout your journey.

Timing - why are the signals on so long?

The signal system is intelligent and prevents the signals changing the limits displayed or switching the signals 'on and off' too quickly. This gives drivers time to respond and ensures the signals are not confusing.

Once the signals are on, timing delays are introduced to stop signals switching off prematurely. Studies have shown that after heavy congestion has occurred, it is vital to control the recovery of traffic speeds and let the traffic flow recover safely. This minimises the risk of further flow breakdown or traffic incidents re-occurring.

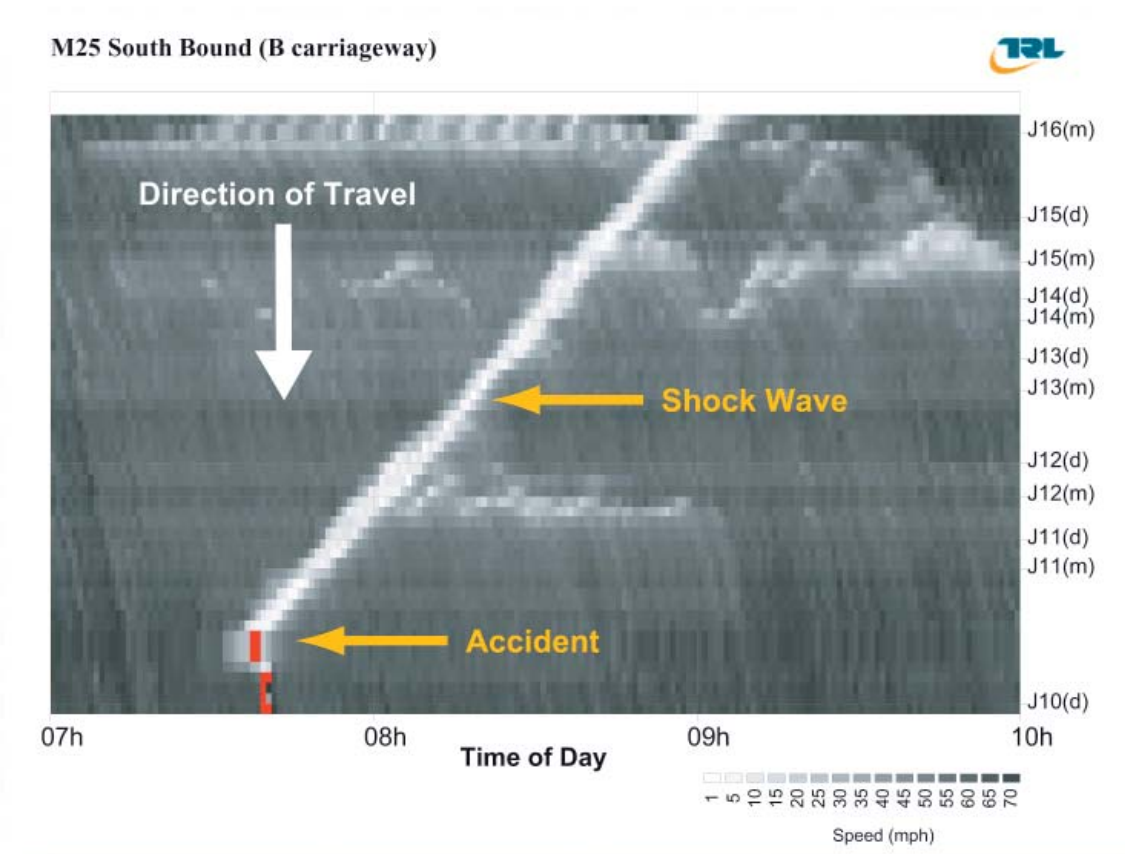


The Monitoring

Traffic analysis tools allow traffic engineers to pinpoint areas on the motorway that have recurrent congestion, which enables the development of new strategies and solutions. Being able to see the whole motorway provides an understanding of the mechanisms that cannot be seen from a single driver's perspective.

The example plot below shows time in hours on the horizontal axis and the junctions (distance) marked on the vertical axis. The background on this plot, black to white, represents traffic speed. Slow speeds are in white, fast speeds are in black. This plot is for the southbound carriageway, so traffic flows from Junction 16 to Junction 10, from the top to the bottom of the plot.

An accident occurred on the M25 near junction 10 (at the bottom of the plot). Although it only took a few minutes to clear the accident, its effects were felt an hour and a half later by drivers at junction 16. The slowing of speeds is shown as the diagonal white line (a shockwave). The driver at junction 16 will never see what caused the incident or even know when or where it occurred, but it still presents the same hazard to that driver in the form of a shockwave of reduced speeds which can lead to heavy braking and increased risk of accidents.



What can cause a shockwave?

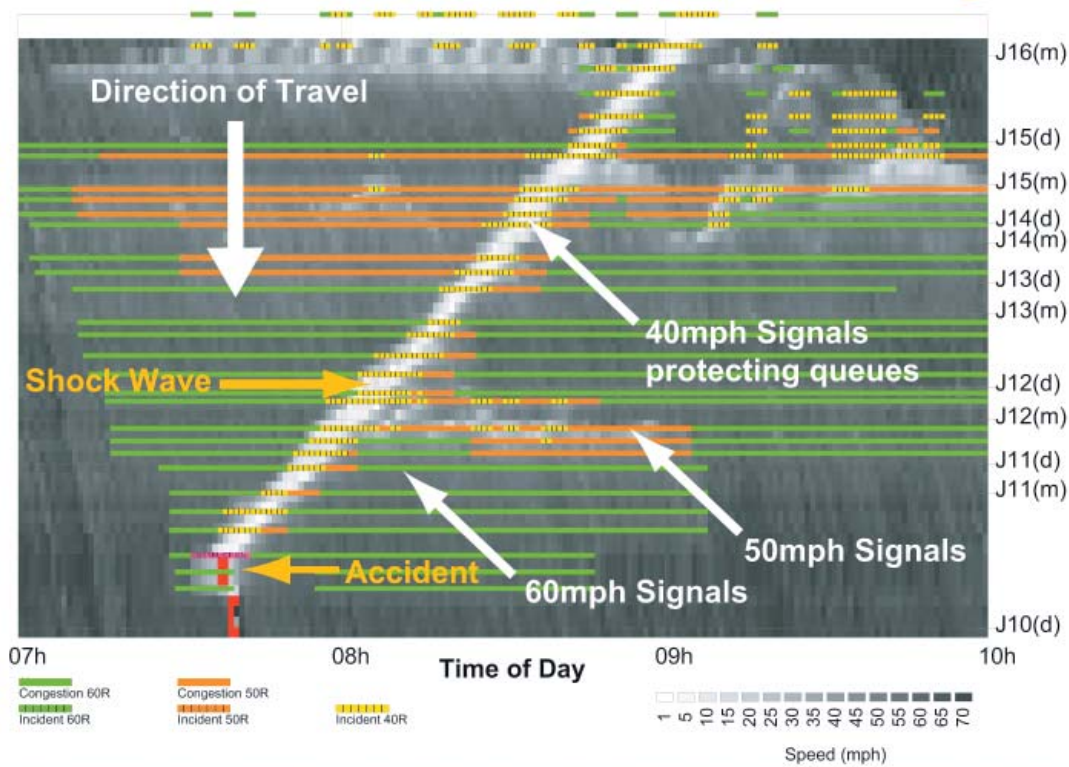
Drivers experiencing a shockwave find that they suddenly have to slow down, then a few moments later they can speed up again. The causes of this 'stop-start' driving are varied, some are due to incidents, some are due to traffic conditions (e.g. merging at a junction), some are due to the physical layout of the road, and others appear to have no cause.

Studies have shown that a shockwave occurs when the density of the traffic reaches a critical level. Unstable traffic speeds combined with sudden braking creates a shockwave which travels back through the traffic at about 12mph.

The Signal Controls

This second plot of the same shockwave shows the signal activity overlaid and the system in operation with the 40mph signal limits (yellow on the plot) protecting the back of the queues produced by the shockwave.

M25 South Bound (B carriageway)



Speed Enforcement

It is essential to the operation of Controlled Motorways that there is compliance with the mandatory speed limits that are set. Speed cameras are used to enforce the displayed speed limit. The enforcement system operates on all lanes of the motorway and enforces the speed limits that vary with the traffic conditions. The signals confirm to the enforcement system the actual speed limit being displayed at the precise time of an offence.

Your Journey - Time and Space

When travelling through the M25 controlled section with the signals displaying 60, 50 or 40 mph speed limits, a driver may be unaware of whether the signals are set due to high demand on that part of the motorway or whether there is an incident, queue on the main carriageway, or perhaps a queue on an exit slip affecting the main carriageway. The congestion and incident control systems work together to provide the best advice to the driver and the message sign text is provided to give additional information on the situation ahead.

When a 40mph signal is displayed, it is usually due to an incident, a resulting queue or congestion that has resulted in flow breakdown. Depending on the event, and how long it was since it occurred, drivers may never see what caused it, especially if they have queued in a long tailback of traffic. The 40mph settings can also be as a result of slow-moving 'traffic management vehicles' at night, in this case the signals warn drivers of potential hazards ahead.

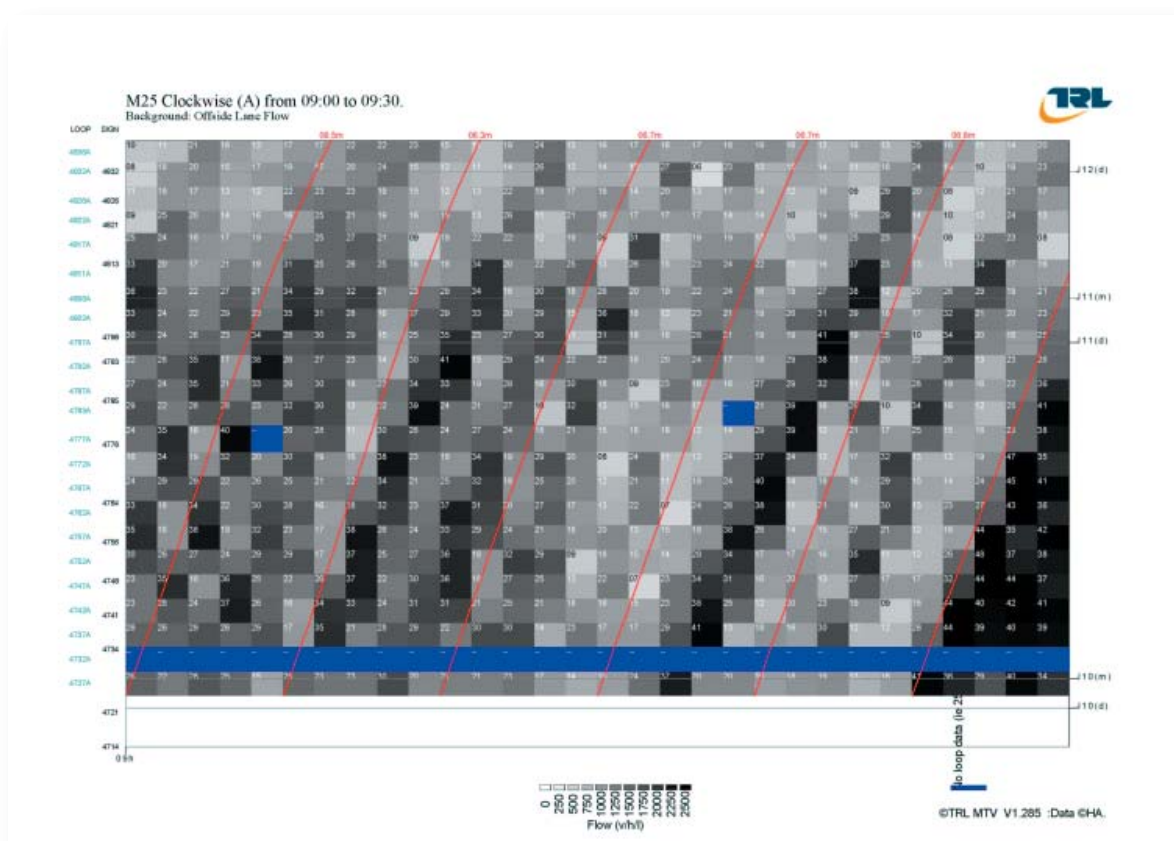
Sometimes, it is possible to see what appears to be an unusual sequence of signals on the gantries. This can be caused by a combination of travelling speed and the system controls responding to a change in the traffic conditions.

Frequently Asked Questions

Why do I see 60mph limits set when there appear to be low flows of traffic and the traffic is moving freely?

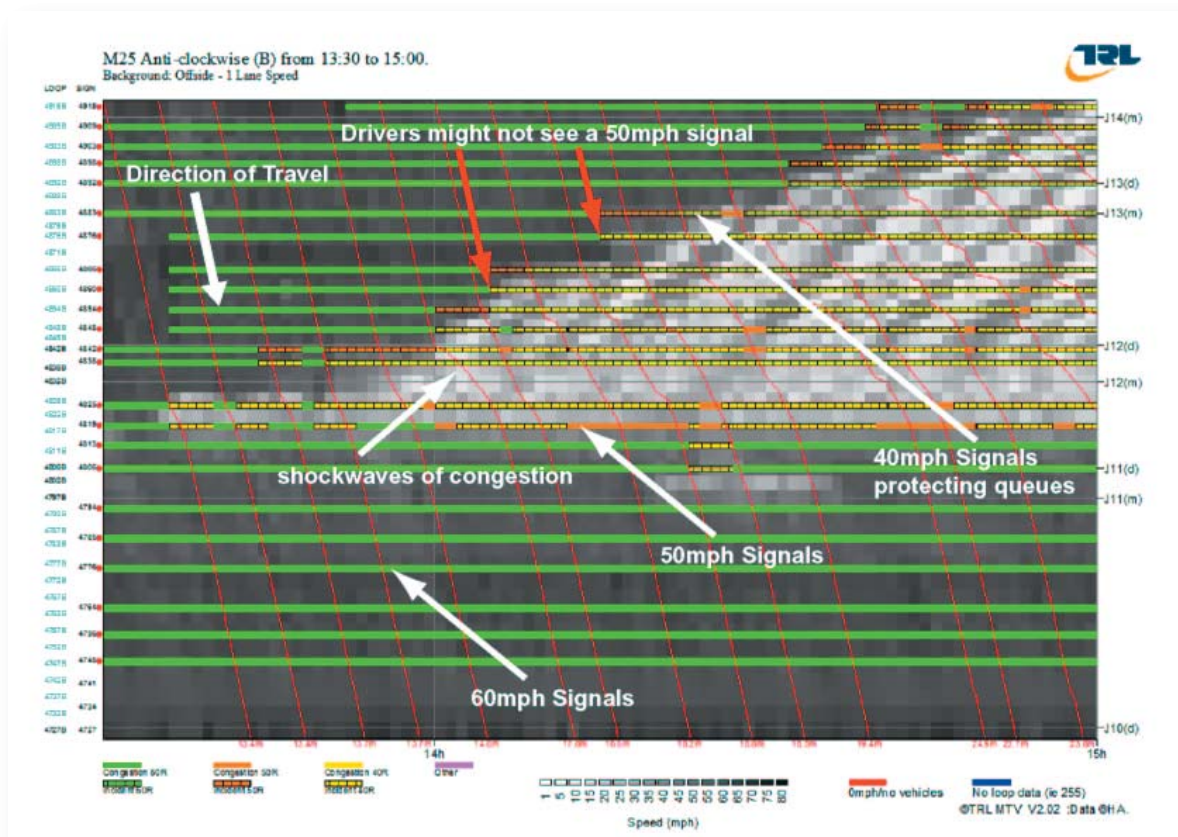
Traffic often travels along the motorway in 'platoons'. Drivers travelling between these platoons may not be able to see the congested traffic in front or behind. By the use of variable speed limits, traffic is prevented from catching up with the platoons in front of them, thereby keeping the platoons apart and stopping the moving queue from growing. This reduces the potential for flow breakdown to occur (when traffic can be brought to a standstill).

The traffic plot below shows the platooning effect. This plot is for the northbound carriageway, so traffic flows from Junction 10 to Junction 12, from the bottom to the top of the plot. The numbers and shading in each cell show the flows per minute in the offside lane. The red lines represent typical journeys through the section. The plot shows how vehicles can travel between the platoons, with drivers only seeing low flows, despite high overall flows on the motorway.



Why are 40mph limits often followed by sections of heavy congestion?

The incident controls are in operation and the system is protecting the backs of the queues as the vehicles move from shockwave to shockwave. When a 40mph limit is set, a speed limit of 60mph or 50mph is also set upstream to warn of the queue ahead. If drivers see a 40mph signal become set as they approach a gantry, this means that a queue has formed ahead. The following plot shows how the signals typically react to a queue, and how drivers can see different signal settings according to their time of travel.



Why do I see 40mph limits (or lower) overnight, with no apparent cause?

Roadworks are often carried out late at night and in the early hours of the morning. The signals are used to support the laying out and removal of the traffic cones, as this is a dangerous activity. Occasionally, drivers can encounter signals just before the cones are laid out, or just after they are removed.

Why do I see what appear to be inappropriate signals and messages on the gantries?

The system is responding to a real event that is happening at that moment, further ahead of the driver. It is possible that by the time the driver arrives at the location of the event, there is no apparent cause, and the traffic conditions have resolved themselves.

For More Information

Write to: M25 Team
Room 4A
Highways Agency
Federated House
London Road
Dorking
RH4 1SZ

Telephone: Highways Agency Information Line (HAIL): **08457 50 40 30**

E-mail: odarea5@highways.gsi.gov.uk

Visit: **www.highways.gov.uk** for Real Time Traffic Information

Contacting the Highways Agency

For Highways Agency Information Line (HAIL) is

08457 50 40 30

This number is for motorists who require information

For real time traffic information, call the

Traffic England Helpline on

08700 660 115

(calls from BT landline to 0845 numbers cost no more than 4p per minute. Mobile calls usually cost more)

Safe driving at roadworks



During 2005, five workers were killed and 12 seriously injured in the course of their work on Highways Agency roads. This was the worst year for 5 years.

For the safety of all road users and roadworkers, drivers approaching roadworks are advised to:

- Keep within the speed limit – it is there for your safety.
- Get into the correct lane in good time – don't keep switching.
- Concentrate on the road ahead, not the roadworks.
- Be alert for works' traffic leaving or entering roadworks.
- Keep a safe distance – there could be queues in front.
- Observe all signs – they are there to help you.

Remember that tiredness can kill. Take regular breaks from driving.