

# HOV LANE INFO SHEET



## ISSUE 6 - JUNE 2002 UPDATE

This revision:

General update starts from 'Improvements to the HOV Lane Scheme';

Surveys planned for September 2002;

Future improvements identified.

### A647 HIGH OCCUPANCY VEHICLE (HOV) LANE



While the primary aim of the Leeds Transport Strategy is to provide attractive alternatives to the car, Leeds City Council felt there was scope to encourage car sharing in the immediate future.

The identified target was to provide the majority of peak period Leeds-bound people, whether travelling by bus or through car sharing, with priority. Traffic flow reduction was not a target, although, if car sharing became more popular, traffic flows might be expected to reduce.

At 0700 on Monday 11th May 1998, Leeds became the first Authority in Britain to open a priority lane for car sharing vehicles. Indeed, the Stanningley Road High Occupancy Vehicle (HOV) lane is the first such scheme on an urban road in Europe.

The demonstration has proved that a combined bus, cycle and HOV lane in an innovative urban application, as opposed to the more typical, inter-urban (i.e. motorway) application, is achievable. After encouraging results and just eighteen months, on Monday, 8th November 1999, Leeds City Council sealed the experimental traffic regulation order making the HOV lane permanent.

At the start of the demonstration, Leeds City Council was a lead member of a European consortium formed to research methods of Increasing Car Occupancy (**ICARO**). This two year European project included site demonstrations such as the Leeds HOV lane, computer simulations and a study of the car sharing institutional and cultural frameworks in nine European countries. The ICARO project has recently been completed and further details can be found on the ICARO web page: [www.boku.ac.at/verkehr/icaro1.htm](http://www.boku.ac.at/verkehr/icaro1.htm).



## A647, Stanningley Road



The A647, Stanningley Road was chosen initially because Leeds City Council was already considering bus improvement measures and had data indicating that 30% of existing cars already carried 2 or more occupants. Indeed, after the inclusion of buses, one-third of all vehicles carried two-thirds of all people in the morning peak period. The corollary being that two-thirds of vehicles had only the single driver occupant, a poor use of valuable highway space. The intention of the Leeds HOV scheme, therefore, was to provide priority for the majority of people travelling towards Leeds on the A647 in the peak periods.

The A647 is a dual carriageway lending itself to becoming one lane for high occupancy vehicles (HOVs) and one lane for all purpose traffic. There was regular peak period congestion and, with no public transport priority measures, all those taking the bus were also caught in the congestion. The traffic flow in 1997 was approximately 2000 vehicles travelling into Leeds in the morning peak hour (0730 to 0830). Elements of the journey which could take nearer 3 minutes, regularly took over 10 minutes.

Prior to the introduction of the HOV lane a total of 3645 people were recorded travelling into Leeds on the A647 during the morning peak hour. 2225 of these travelled in buses or cars with 2 or more occupants. These people would benefit directly from the priority of an HOV lane and experience reduced journey times. In the same period, 1420 single occupant drivers would be expected to suffer some additional delay whilst alongside the HOV lane.

### High Occupancy Vehicle Lane - Design

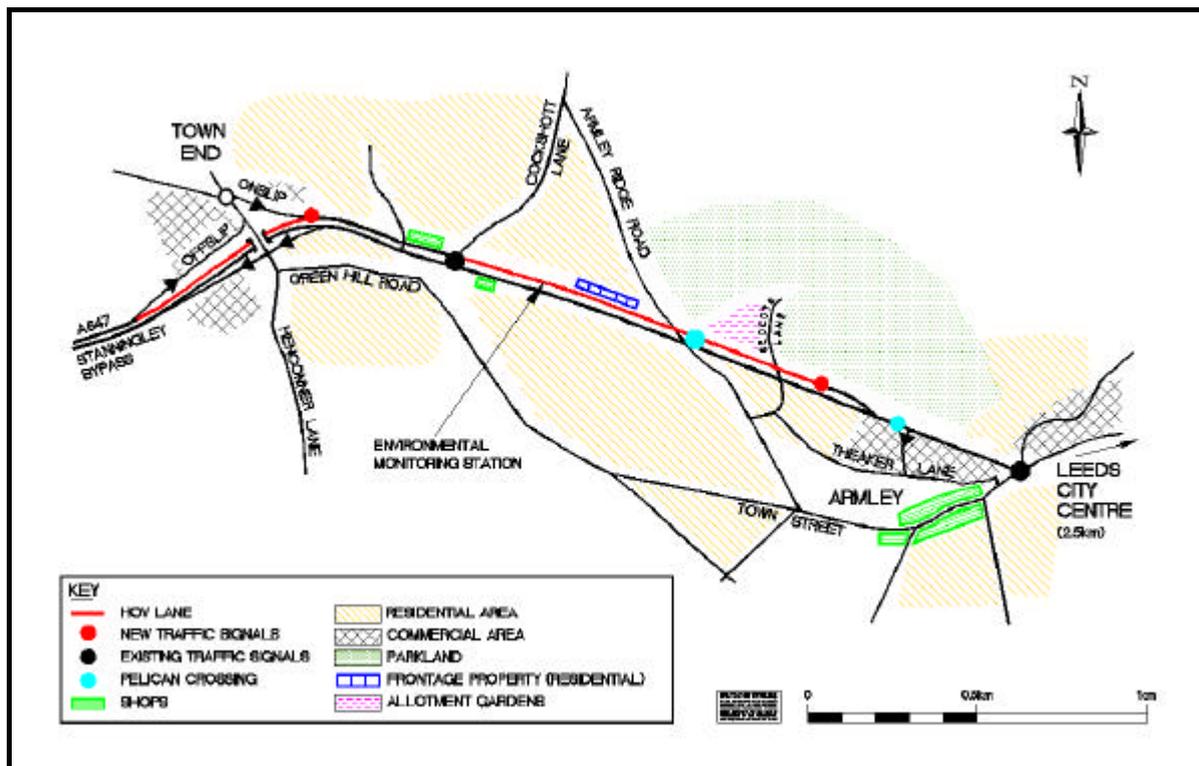
A number of design parameters were initially decided upon.

- The lane would be available to buses, coaches, motorcycles, pedal cycles and vehicles carrying 2 or more people. Goods vehicles over 7½T would be excluded however many the occupants, as they could interfere with the optimum working of the lane.
- The lane would operate during peak periods only. All day measures were discounted due to the problems securing all day enforcement.
- The occupancy level would be set at 2 or more occupants. HOV lane studies in other cities indicated that lack of use, the empty lane syndrome, was an acknowledged reason for some HOV lane failures. In Leeds, a lower limit of 2 occupants would provide a lane usage of 30% (700 vehicles per hour), a reasonable level of operation.
- ICARO's 2 year time scale precluded land purchase and the scheme would be restricted to land owned by Leeds City Council.
- The HOV lane would be the inside lane, nearest the kerb. This would allow buses to continue servicing existing bus stops. To prevent HOVs being delayed by boarding passengers, bus lay-bys would be provided.
- The legality of enacting an HOV lane under existing legislation had been confirmed prior to the start of the ICARO project. The Road Traffic Regulation Act (1984) authorises local authorities to introduce experimental traffic regulation orders (TROs) for schemes out of the ordinary and without prior public consultation. The Leeds HOV lane was without UK precedent and Leeds City Council used the Act to implement the preferred HOV scheme within the 2 year project timescale. Clearly, the Council were conscious of potential public objections and sought to minimise these wherever possible. Whilst there was no formal public consultation exercise, consultations were held with politicians, the emergency services, public transport bodies, cycling groups, disabled community groups, motoring organisations and local community groups. This process remains on-going.



- Enforcement of the HOV lane was an early consideration. With the potential for abuse, Leeds City Council considered that near continuous enforcement would be required and that manual enforcement was most appropriate. The police operation would involve more than the standard provision and the Police Authority and Leeds City Council entered a partnership agreement to secure the necessary resources. The need for enforcement and the associated costs were the main reasons for choosing a peak period HOV lane, rather than an all day scheme.

Against this background, highway officers drew up a scheme which was thought to have a reasonable chance of success and which minimised potential objections.



## High Occupancy Vehicle Lane - Scheme

The HOV lane concept is most easily described as a bus lane open to cars with two or more occupants.

The chosen scheme consists of an inbound only HOV lane operating towards Leeds in both the morning and evening peak periods (0700 -1000, 1600 - 1900, Monday to Friday).

The main features are:



- an inbound HOV lane utilising the existing nearside lane of the dual carriageway of the A647 Stanningley Road. To accommodate 3 side roads and a parade of shops, the HOV lane is in 2 sections (0.4km and 1.1km) over 2km of highway.
  - bus measures such as half width bus lay-bys, new shelters with lighting and timetables on both sides of the carriageway and which extend beyond the HOV lane.
  - pedestrian improvements such as new footways and new crossing facilities.
  - 3 km of new cycle measures.
  - community benefits, through restraint measures on a known rat-run.
  - safety measures, such as a speed camera and guard rail.
- general highway improvements beyond the HOV lane to provide further benefits for all highway users.



### Improvements to the High Occupancy Vehicle Lane Scheme

The HOV lane has evolved since opening on 11 May 1998, largely in response to monitoring but also as a result of on-going consultation with residents, police officers and bus operators.

- Parking restrictions were relaxed outside properties 26-56 Stanningley Road in response to residents' concerns (October 1998).
- Traffic signal operations are continually assessed and amended where necessary. In January 1999, the traffic signal cycle time was changed from 90 to 45 seconds in response to perceived delay felt by HOV drivers. This interrupted the established traffic signal 'green' wave but improved perception of delay. Also in January, a new loop detector was activated in the HOV lane to provide further priority for HOVs under certain conditions.
- Some traffic signs have been amended, removed or additional ones added.
- The pedestrian crossing facility at Armley Park has been made more efficient through conversion to a puffin, reducing vehicle delay whilst protecting pedestrian demands.
- There have been white-lining amendments.
- An additional police enforcement lay-by was created on the surplus carriageway at the old Henconner Road on-slip.
- A hard-standing area has been created beside the new speed enforcement camera on the first length of HOV lane.
- Additional drop kerbs have been placed to the northern footway to complete a route along Stanningley Road from Armley Ridge Road to Ledgard Way.
- A new pedestrian refuge on A647, Armley Road has been added which also serves to impede an illegal right turn.
- Fixed time period traffic signals at the end of the HOV lane were enhanced in Autumn 2000. The signals were given the capability to detect queues over a more extensive area, both upstream and downstream, and apply different plans. They were also given the capability to switch themselves on and off during the set operational hours rather than operate within a fixed time frame envelope (0740 start and 0900 finish). This greatly improved efficiency and protected priority for HOVs.

Since 1999, there have also been other changes to the highway infrastructure in the study area.



- Pedestrian refuges have been constructed on Hill Top Road, a parallel minor route to the south of the A647, as part of the West Leeds Boys High School housing development.
- There have been substantial changes on a parallel major arterial route to the north of the A647, the A65 Kirkstall Road at Cardigan Fields.
- The signalling at Armley Gyratory was extended in 2002, changing traffic patterns, particularly on the A647. Armley Gyratory is the busiest junction in Leeds and is located at the end of the A647.

### Future Improvements to the High Occupancy Vehicle Lane Scheme

Following final surveys in September 2002, the HOV lane scheme will be evaluated. This will take into account the efficiency of the network and a number of other issues raised by the public.

### Results

The HOV lane was last evaluated in May/June 1999. Since then there have been spot checks on usage, particularly on violation rates. The September 2002 surveys will be undertaken over the same study area (5km by 3km) as before, from the A65, Kirkstall Road to the north to the A6110 Outer Ring Road to the south and from Swinnow Road to the west to the A62 Gelderd Road to the east.

'Before' surveys were undertaken in May/June 1997 and 'after' surveys periodically throughout the experiment. The most recent surveys were completed in May/June 1999.

The results to date were summarised at the time under the following headings:

- morning peak traffic flows
- evening peak traffic flows
- occupancy
- journey times
- queue lengths
- accident analysis
- police enforcement
- public attitudes/driver behaviour

**Morning Peak Traffic Flows** - The initial origin-destination surveys undertaken had identified that a high proportion of the A647 Stanningley Road traffic was longer distance (33% of non-HOV car traffic originated in Bradford) and would have the capability to use alternative but still appropriate routes, or change mode. Immediately after opening there was significant driver avoidance of the A647 - traffic flows went down 20%.

By 1999, that traffic flows on the A647 had returned to 1997 levels both in the peak hour and over the 3 hour operational period. A natural consequence of this is that there is little in the way of extra rat-running on the surrounding network. Heavy commercial vehicles (HCV) movements have also returned to normal. In the early stages, diversion of HCVs was a concern and one only overcome by temporary signing amendments.

Other user groups appear to have benefited from the experiment. Scheduled bus services, motorcyclists and cyclists have all increased slightly over the three hour morning peak.

**Evening Peak Traffic Flows** - Three hour evening peak traffic flows, which began 14% lower than the morning peak, fell 10% when the scheme was first introduced. At these lower levels the initial difficulties with the priority signals were more obvious and an unsignalled merge was introduced. Despite free flow conditions, evening peak traffic levels only surpassed 'before' levels in June 1999 and now commonly reach 1997 morning peak levels. On occasions, evening peak traffic levels are now greater than the morning peak. This indicates that there is a case for reintroducing the evening peak signals which remain the preferred method of providing HOV priority.



**Occupancy** - Limited roadside interviews in July 1998 and February 1999 had identified the formation of new car pools. Indeed, 26% of HOV interviews were apparently new car pools and cited the HOV lane as the reason for forming them. However, this high number appears to be a result of natural travel pattern evolution rather than a direct consequence of the HOV lane. Many transport planners recognise that in any six month period as much as 10% of the traffic can change without the need for infrastructure changes. Hence, new car pools form but others cease. This appears to be the case here because the latest survey results show that HOV numbers are virtually unchanged across the 4 inbound occupancy sites.

On the A647 specifically, HOVs have increased by 55 vehicles (5%) over the 3 hour morning peak. This indicates that non-HOVs on the A647 have exchanged places with HOVs on other routes. The figures also show a higher proportion of HOVs are now travelling in the morning peak hour (an additional 105), perhaps because this is their preferred time and their journey is more predictable. Interestingly, there have also been small increases in 3, 4, and 5+ occupancy vehicles.

The average car occupancy rate for Leeds is 1.3 persons per car and the commencement level for the A647 in May 1997 was 1.35. By September 1998, surveys showed that this had increased to 1.41 persons per car, mostly by traffic transfers. By June 1999, A647 car occupancy had reached 1.43.

With regard to bus occupancy, the two bus operators who operate the vast majority of services on the A647 reported a slight increase in bus patronage 5 months after the scheme was introduced. There have been no further patronage surveys, although public service vehicle counts have shown there are more morning peak hour scheduled buses running in 1999 (33) than in 1997 (20). Bus operators have also reported consequential service improvements across Leeds arising from the time gains on the A647.

Evening peak occupancy was not counted in June 1999 because the prediction was that traffic flows would remain low. However, June 1999 automatic traffic counts proved that flows have returned and are now in excess of 1997 levels.

**Journey-times** - In August 1998, morning peak HOV journey time savings were reported as 2½ minutes for a 5km trip from the Leeds Outer Ring Road to the Inner Ring Road. In September 1998 this saving had increased to 3½ minutes and by June 1999 the time saving was 4 minutes. The increase in time gain has been mainly due to traffic signal improvements identified earlier. Independent verification came from bus operator FirstGroup in 1998, when they reported that their standard scheduled services were showing time gains of 3½ minutes.

Non-HOV journey times in 1999 have also shown further recent improvements, culminating in the present 1½ minute saving. This saving increases the previous advantage of the A647 over the alternative and inappropriate routes through residential areas. This result supports the traffic figures which also indicate no additional rat-running. Two A647 journey time graphs are attached at the end of this Info Sheet.



There is presently no discernible time benefit for HOVs in the evening peak period. However, included in the HOV lane scheme were improvements to reduce evening peak rat running in Armley. At the A647/Ledgard Way junction, the right turn capacity out of Ledgard Way was increased by extending the filter time in May 1998. Over 100 extra vehicles each hour are now able to turn right here than did previously, benefiting Armley Town Street.

**Queue Lengths** - The scheme has affected how and where vehicles queue. By giving priority to HOVs, two queues of equal length have been transformed into a long queue in the non-HOV lane and a short queue in the HOV lane. There is no evidence of non-HOV queues extending as far as the Outer Ring Road but they do regularly reach Cockshott Lane.

**Accident Analysis** – The downward accident trend identified in the first ten months has continued and now shows a 30% reduction in casualties over the 3 years since opening.



The A647/Armley Ridge Road junction remains a site for concern. The existence of the HOV lane and associated markings has affected driver behaviour at the junction. In December 2000 a speed camera was moved to the junction from another part of the scheme and the whole site continues to be monitored to determine whether further road safety works may be required.

**Police Enforcement and Violations** – While regular police enforcement by motorcycle proved effective during the opening year, on 11th May 1999 the police agreement was amended to random policing. Sometimes by patrol car, sometimes by beat officers at the traffic signals.

Initially, the HOV lane policing policy resulted in low lane violation levels of typically 2% for cars in the morning peak hour. More recent figures in 2002 suggest that the rate fluctuates between 10% and 2%, reducing to less than 6% when expressed across both lanes. The policing agreement will continue for the present and will be evaluated in 2003/4 following the outcome of a 3 year research project into occupancy detection by camera.

**Public attitudes/driver behaviour** – The initial study included roadside interviews and a household survey and showed that the existence of the HOV lane had encouraged people to car share. The ICARO Report contains more detail of the roadside interviews and also includes the results of a telephone attitudinal survey. Further roadside interviews were conducted on 24th February 1999 and showed increased support for the lane from HOV drivers, up from 55% to 66%. This low percentage support from HOV drivers is interesting as these drivers would be expected to rate the scheme much higher. During the interviews, which drivers completed themselves in the presence of an interviewer, a number were asked why they were not supporting the HOV lane. The feedback was that these drivers were not consistent HOV drivers and alternated between HOV and non-HOV. Accordingly, their answers were a reflection of their other, non-HOV journeys.

## Environmental Results



Three pollutants provide the best indication of air quality in relation to general road traffic air pollution. These are carbon monoxide, nitrogen dioxide and particulate matter and data on each was collected from the new A647 environmental monitoring station both 'before' and 'after' the introduction of the HOV lane. In addition, nitrogen dioxide was monitored at fifteen additional sites located in the HOV lane study area.

Nitrogen dioxide results at the time indicated that there has been little change in air quality on the A647 or adjoining routes as a result of the HOV lane operation. Carbon monoxide monitoring adjacent to the HOV lane did indicate a slight improvement in air quality for both the morning and evening peak periods. A more noticeable improvement in air quality adjacent to the HOV lane was achieved with regard to particulate matter.

Air quality changes have been directly compared with central Leeds air quality data. This comparison indicates that most of the study area's air quality improvements have resulted from reduced vehicle emissions and not through favourable weather conditions i.e. increased dispersion leading to improved air quality.

'Before' and 'after' road traffic noise emissions were also recorded at the environmental monitoring station. Noise levels indicated then that there had been a noticeable noise reduction coinciding with both the morning and evening periods of HOV lane operation.

## Conclusions

In conclusion, the HOV demonstration has continued to provide journey-time benefits for HOVs. Bus operators have welcomed reductions in their journey-times and reported a slight morning peak increase in bus patronage along the A647, Stanningley Road in 1999. The demonstration has also raised the profile of energy conservation and there are indications of new car pools having been formed. The improvements undertaken since September 1999 are expected to show further time gains for buses and other HOVs gains.

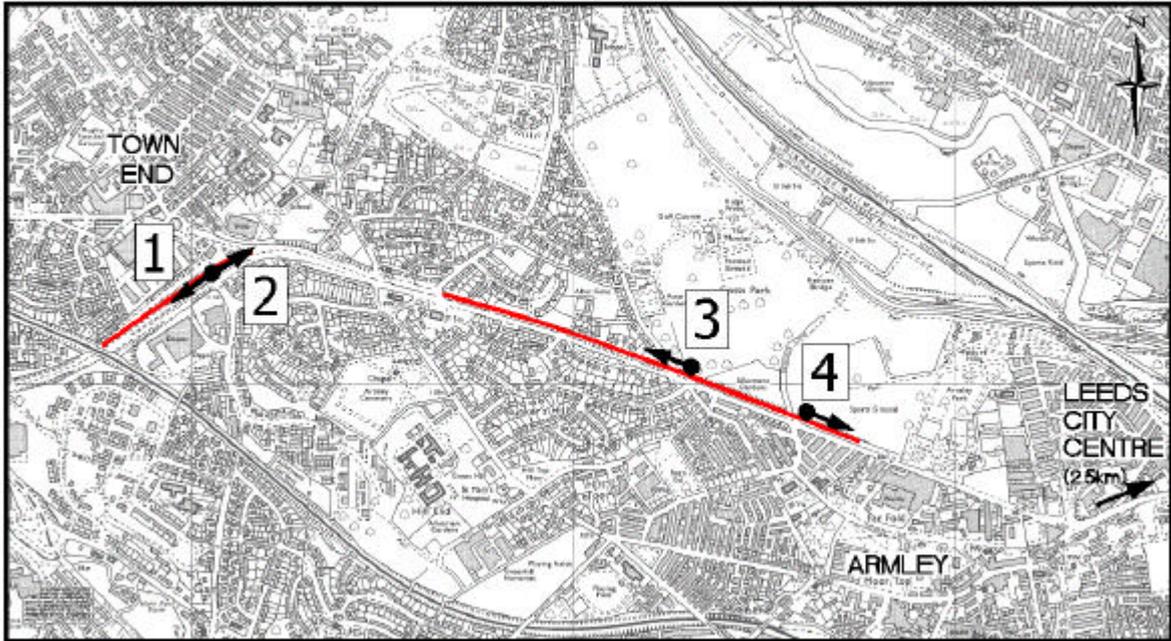
## Further Information

There is a publicity leaflet 'Priority Lane for High Occupancy Vehicles' available from Leeds City Council, Department of Highways and Transportation, Ring Road, Middleton, Leeds LS10 4AX. The leaflet can also be found on Leeds City Council's web page.

The results of the ICARO project were presented at a conference in Leeds on Monday 22nd March 1999. Delegates received a copy of the ICARO manual, designed to assist professional transport planners when considering car share schemes. This Manual is available from the above address for 25ecu + p&p (approximately £22:00). Information will be presented in various formats: there will be a CD-ROM, video, brochure, report and manual. Further details can be found on the ICARO web page:

- [www.boku.ac.at/verkehr/icaro1.htm](http://www.boku.ac.at/verkehr/icaro1.htm)

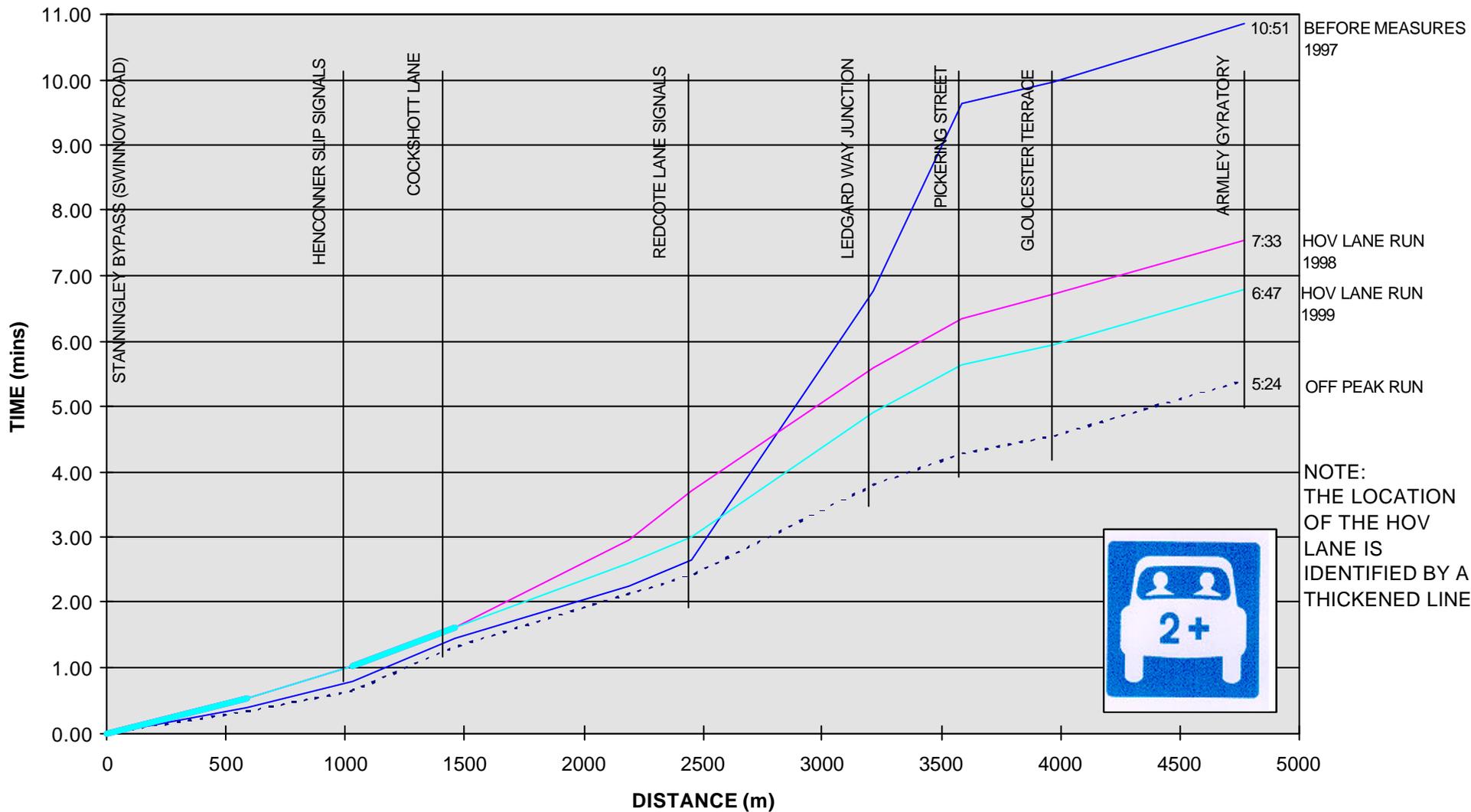
There is also a Local Transport Plan web-site at: [www.westyorkshire-ltp.co.uk](http://www.westyorkshire-ltp.co.uk)



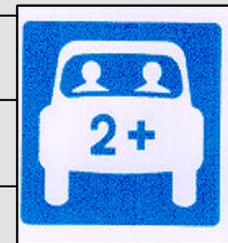
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### A647, HOV LANE JOURNEY TIMES (AM PEAK)



NOTE:  
THE LOCATION  
OF THE HOV  
LANE IS  
IDENTIFIED BY A  
THICKENED LINE



## A647 NON-HOV LANE JOURNEY TIMES (AM PEAK)

