

Appendix G – Complementary Measures

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G1 HIGH OCCUPANCY VEHICLE LANES

G1.1 WHAT IS A HOV LANE?

High Occupancy Vehicle (HOV) lanes are traffic lanes where use is restricted to those vehicles carrying two or more passengers. These lanes might be segregated from the main carriageway in some way (physically or by road markings) and may also be open to public transport vehicles, motorbikes and other modes.



G1.2 HOV LANES IN BRITAIN

High occupancy vehicle lanes have been in existence since the 1960's in the US with the first high occupancy vehicle lane at on Shirley Highway (I-395) to the Pentagon.

In Britain the first high occupancy vehicle lane opened in May 1998 on a two kilometre stretch of the A647 Stanningley Road in Leeds.

The Highways Agency in their 'Preliminary Analysis of Potential Sites for HOV Lanes on Trunk Roads in England'¹ examined eight motorway sites for the implementation of HOV lanes. The purpose of the study was to determine if such lanes were feasible and to rank those sites which were found to be feasible. Four of the sites were rejected and the remaining four were taken forward for a feasibility study that was undertaken on behalf of the Highways Agency by KBR².

The four motorway sections pre-selected by the Highways Agency were generally all on radial routes used by commuters to major cities: -

- M3 junctions 2-3;
- M61 junctions 6 – 3;
- M62 junctions 25 – 27; and
- M1 junctions 13 – 17 (Not a radial route).

As part of the 'High Occupancy Vehicle Lanes Feasibility Study', investigations were carried out into the potential introduction of AM peak inbound HOV lanes at all four locations.

The KBR study examined the implementation of a HOV lane on a widened dual four lane motorway layout.

¹ Preliminary Analysis of Potential Sites for HOV lanes on Trunk Roads in England, Highways Agency, 2004

² High Occupancy Vehicle Lanes Feasibility Study, Kellogg, Brown & Root/Highways Agency, 2004

The preferred option is to introduce the HOV lane as an ‘open access’ (non-segregated) peak period off side running lane. It was recommended that HOV lanes should generally start approximately 0.5 kilometres before the on slip node of the initial junction, they would then be continuous until their end approximately 0.5 kilometres after the off slip node of the terminal junction. The argument for this solution would that it would separate the potential conflicting movements of slip road and HOV lane transitions and ensure they take place at different locations along the motorway mainline.

The incremental costs of introducing HOV lanes during widening compared to introduction of HOV lane schemes on an existing motorway are relatively low, as much of the temporary traffic management and roadside equipment enhancement costs would be already included in the widening schemes. Introduction of HOV lanes during widening would help to ‘lock in’ the benefits of the increased road capacity. The M62 scheme was forecast to be the best of the four studied in economic terms and it was suggested that it is taken forward for further study. M62 junctions 25 – 27 is part of the SWYMBUS network and will be examined as part of that study.

G1.3 RECENT DEVELOPMENTS

More recently significant progress has been made in taking the HOV concept forward in Britain. In March 2006, the Department for Transport (DfT) announced that the UK’s first car sharing lane will be introduced on the M606/M62, expected to be operational in 2007. This lane will cater for the left turning movement from the M606 to the eastbound M62 and will allow High Occupancy Vehicles to bypass congestion at this location.



In addition, the DfT had already announced that the “M1 HOV” pilot scheme will be included as part of the widening of the M1 motorway between Junctions 7 and 10. This will include a HOV lane running in both directions between the junctions. If successful, the lanes will be extended northwards to Junctions 13 as part of the next package of widening.

G1.4 KEY ISSUES

Extensive research has been undertaken into high occupancy vehicle lanes with the vast majority of this research being undertaken in the US. Over 45 years of operation a number of lessons have been learned from HOVs in the US. This section presents issues that should be considered when implementing a HOV lane. These issues have been defined from an extensive review of current literature on the subject that is listed in a bibliography H.1.11 and are as follows: -

- What can we learn from experience elsewhere?
- What guidance/best practice has been established?
- What do we need to consider prior to implementation?
- What is there to learn from previous implementation and marketing of HOV lanes?
- What operational issues do we need to take into account?
- What are the monitoring and consultation issues?
- Is there anything else to consider?

G1.5 WHAT CAN WE LEARN FROM EXPERIENCE ELSEWHERE?

UK Experience

Within the UK there are currently three sections of high occupancy vehicle lanes in operation, these are as follows: -

- A647 Stanningley Road (Leeds);
- A4174 Avon Ring Road (Hambrook, South Gloucestershire); and
- A370 Long Ashton Bypass (Long Ashton, North Somerset).

The A647 has been in operation since 1998 and as a result of its success, Leeds City Council is now planning to introduce HOV lanes on the proposed East Leeds Link Road.

The feasibility of HOV lanes on motorways has been examined with four sites undergoing detailed examination including: -

M3 junctions 2 – 3;

M1 junctions 13 – 7;

M61 junctions 6 – 3; and

M62 junctions 25 – 27.

As a result of this study it is planned to introduce a HOV lane on the M1 junctions 7-10 (12.5 kilometres) when that section of the motorway is widened in 2008. If this scheme proves successful the HOV lane could be extended as far as junction 13 (Milton Keynes) when that section of the M1 is widened in 2011 (23.75 kilometres).

A further study entitled 'M62 Junctions 25 – 27 HOV lane – Preliminary Feasibility Study – First Draft' concluded that it is clear that a HOV lane could potentially hold significant benefits for the widened fourth lane of the M62 eastbound between J25 and J27. In contrast, dedicating one lane of a three lane M62 for HOV use only does not appear to be feasible, since the remaining two non HOV lanes are likely to be significantly over capacity, regardless of the degree of car sharing in the network.

US Experience

In the US HOV lanes have been in operation since the 1960's. Currently, there are 22 cities with HOV lanes with more than 2000 HOV lane miles across 120 HOV lanes in operation in the US.

The vast majority of these HOV lanes have been successful but it is interesting to note that two HOV lanes in New Jersey were closed for not meeting the desired transport objectives.

High Occupancy Toll (HOT) lanes have also been used in the US where single occupancy drivers can pay a toll to use the HOV lane when there is available capacity.

G1.6 WHAT GUIDANCE/BEST PRACTICE HAS BEEN ESTABLISHED?

On behalf of the Highways Agency, WS Atkins issued 'Draft Guidelines on Designated Lanes'. The guidance set out how to identify and develop options, detail on scheme design and signing, integration with other transport measures, how to monitor and evaluate the scheme and how to involve the public and media. This guidance should be evaluated for its applicability and should be further developed to ensure that HOV lanes are implemented according to best practice.

G1.7 WHAT DO WE NEED TO CONSIDER PRIOR TO IMPLEMENTATION?

Goals Objectives

A variety of goals/objectives have been set for HOV lanes worldwide, many of which may be applicable to HOV lanes implemented across South and West Yorkshire.

Goals/objectives set include: -

- Provide travel time savings and a more reliable trip times to HOVs;

- Provide safe travel options for HOVs without unduly affecting the safety of general purpose vehicles;
- Reduce overall vehicular congestion and motorist delay by encouraging greater HOV use through car pooling;
- Increase overall efficiency of the system by allowing HOVs to bypass congestion on lanes designed for their use;
- Improve air quality by decreasing emissions;
- Reduce vehicle trips, vehicle miles travelled (VMT);
- Maintaining mobility;
- Promoting transit and ridesharing;
- Providing travel options to meet user needs;
- Generating revenue to offset capital and operating expenses; and
- Minimise impacts to other traffic in the corridor and on parallel facilities.

It is vital that great care is taken to set the goals/objectives as inappropriately set goals/objectives can lead to the negative portrayal of a HOV lane as occurred in New Jersey.

Criteria

A number of studies defined criteria that would lead to a success of a HOV lane. These include: -

- Radial corridor into a major city;
- Serve long dispersed trips orientated to major activity centres;
- A regional population of at least 1.5 million;
- Population/employment densities;
- Travel volumes;
- Congestion levels;
- Overall travel time savings;
- Legislative direction, policy support and a lead agency with a strong project champion;
- Cooperation with other involved agencies, and support from government agencies are important factors during the planning and operating phases of a project; and
- Publicly accepted HOV lanes include high levels of bus service, travel time savings of at least 1 to 1.5 minutes a mile, improved trip reliability, adequate enforcement, public information programs, and supporting transit and ridesharing facilities, services, and policies.

To determine the best strategy for HOV and how it could be applied in the UK we must also understand the potential benefits and disbenefits of its introduction. These will include: -

- Journey time changes for HOV's compared to single occupancy vehicles;
- Change in average car occupancy;
- Change in total volume of vehicles (as a result of changes in car occupancy);
- Benefit to cost ratios;
- Impact on operations of local roads;
- Impact on air quality; and
- Impact on road safety.

G1.8 WHAT IS THERE TO LEARN FROM PREVIOUS IMPLEMENTATION AND MARKETING?

Implementation

Of particular interest to the possible implementation of HOV lanes on the M90 is a conclusion from HOV Facility Development that HOV lanes which take existing road capacity are harder to implement than new lanes that are implemented as HOV lanes. HOV lanes implemented on existing carriageways are seen as taking capacity away, whilst new capacity HOV lanes are not taking capacity away from all users, as capacity was not there in the first place.

Issues to consider for the implementation of HOV lanes include: -

- Lane friction (reduction in speed in HOV lane due to general purpose lane congestion);
- Speed differential between HOV lane and general purpose lane;
- Congestion at the end point of HOV facilities, when HOV vehicles merge with general purpose lanes;
- Affect of incidents/adverse weather; and
- Geometric constraints of roadways such as hills and curves.

Marketing

Within the literature reviewed, marketing has been identified as a key element in the successful implementation of a HOV lane. Marketing has been used to: -

- Advertise the opening of HOV lanes;
- Educate drivers in the use of HOV lanes;
- Promote immediate use of HOV lanes;

- Create awareness of support facilities; and
- Provide updated accounts of HOV lane time savings and usage.
- Key aspects to consider include: -
- Motorists find the name HOV confusing;
- People over estimate the violation rate; and
- Marketing efforts must continue after the HOV lane has opened.

What operational issues do we need to take into account?

Four elements of managing and operating HOV lanes are: -

- Operating Hours;
- Safety;
- Enforcement; and
- Operating Hours.

HOV lanes can either operate on a full time or part time/peak period basis. Full time operation was shown to have the following benefits: -

- Signing and delineation are simpler;
- Violation rates tend to be lower and enforcement easier;
- There is less motorist confusion concerning operational hours;
- Accidents are less likely to affect HOV operation; and
- There are greater car occupancy levels all day.

Part time peak period operation is shown to have the following benefits: -

- Avoid public perception that the HOV lane is underutilised (the “empty lane syndrome”) during off peak periods;
- Lane closures during off peak for maintenance creates less congestion due to the availability of the additional lane; and
- Part time HOV facilities provide optimum use of all lanes during off peak periods, particularly for construction and maintenance purposes.

Other points of interest include:

Average number of people in each car is higher than what was expected in off peak period especially weekends;

HOV lane use is higher in the PM peaks than the AM peaks especially during the summer months.

Safety

A number of factors associated with HOV lanes could lead to safety problems:

- Ingress/egress difficulty;
- Vehicles illegally crossing the buffer;
- Speed differential; and
- Reduced inside shoulder width.

It is vital that these factors are examined so that they may be mitigated, as far as possible, in the scheme design.

Enforcement

It has been identified that one of the critical elements of implementing a successful HOV lane is enforcement. Without proper enforcement of the HOV lane occupancy requirements, the operational effectiveness and efficiency, along with public acceptance suffer.

US experience identified that recommended intensive enforcement is necessary only for the first three months (or less) of the operation of a new HOV facility. After that point, the level of effort should revert to routine enforcement.

Currently enforcement is a manual operation and there are no means of automating the occupancy enforcement of HOV lane occupancy.

It can be concluded that given existing conditions a HOV lane would have to be manually enforced until technology is further developed.

G1.9 WHAT ARE THE MONITORING AND CONSULTATION ISSUES?

Consultation

Consultation has been used as a key way of monitoring whether the public perceive a scheme to be a success or otherwise. Aspects of consultation have included asking: -

- Why people use the facility?
- Whether people are in agreement with HOV lanes?
- How high people perceive violation rates to be?
- Whether respondents felt that HOV lanes were being fully utilised?
- Why people car pool?
- Why people do not car pool?
- Whether HOV lanes are a fair use of taxpayer's money?

- Whether work place incentives would encourage users to car share?

Monitoring

It has been suggested that HOV lanes can take years to reach their full potential and therefore extensive monitoring needs to be undertaken on a regular basis as HOV lanes can evolve over time.

Items that could be monitored include:

- Traffic volumes;
- Vehicle proportions;
- Link capacity;
- Vehicle occupancy;
- Person throughput;
- Junction capacity;
- Queue length;
- Journey time and journey time reliability;
- Lane utilisation;
- Enforcement/violation rates;
- Public opinion,
- Accident analysis;
- Air quality; and
- Noise.

Monitoring should not only take place on the HOV lane route but also on adjacent routes/radials to examine their impact on re routing.

G1.10 ARE THERE ANY FURTHER CONSIDERATIONS?

There are still areas of HOV lanes that require further research to be undertaken. Of particular interest to the implementation of HOV lanes on the M90/A90 are: -

- Lane Separation; and
- Entry and Exit to HOV lanes.

With respect to lane separation, there is an option to use road markings or physical barriers to separate the HOV lane from the rest of the traffic. This may be beneficial in that safety could be improved and lane friction may be reduced or removed. However, this would require more road space than a non-separated option. There are also a number of alternatives available for the traffic management at the beginning and end of HOV lanes depending on the precise make-up of traffic and the aims and objectives of each individual HOV

lane. There is also the issue of whether vehicles would be allowed to enter or leave the lane at any point along its length. This may be desirable to make use of the entire capacity of the motorway but could not occur if the HOV lane was separated from the rest of the carriageway in some way.

G1.11 HOV LANE – LITERATURE REVIEW - BIBLIOGRAPHY

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ACTIVE TRAFFIC MANAGEMENT (ATM)

G1.12 WHAT IS ACTIVE TRAFFIC MANAGEMENT?

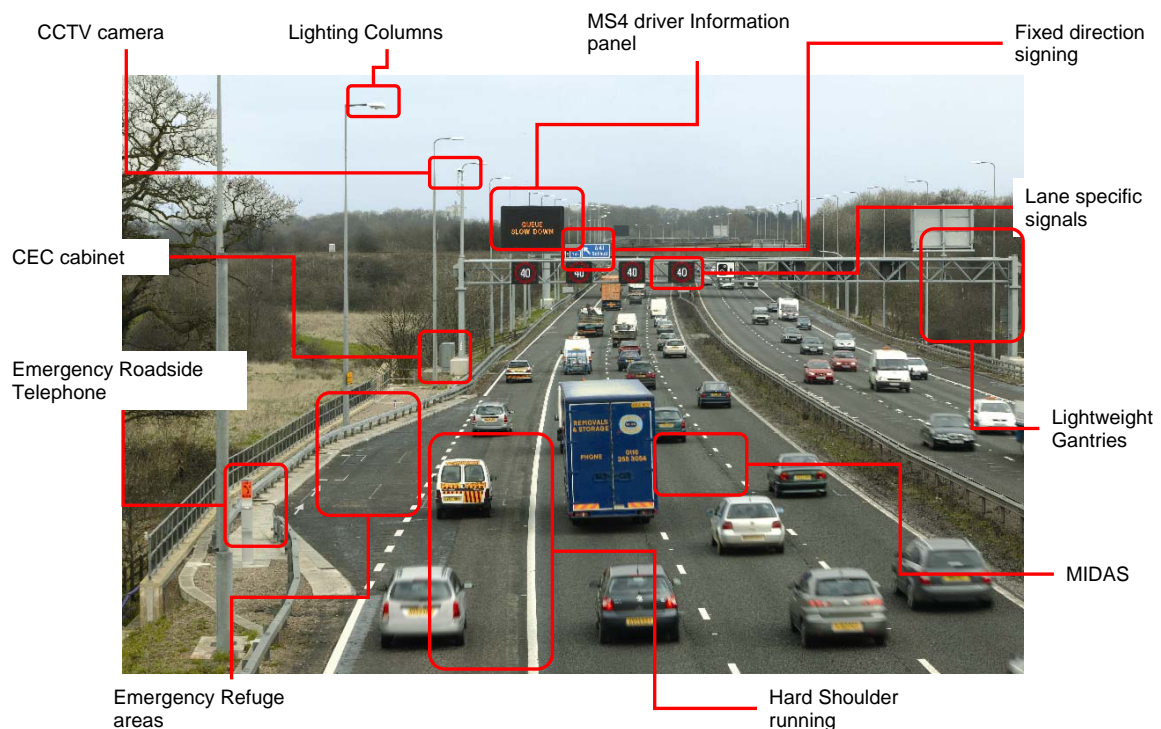
Active Traffic Management is a new pilot motorway scheme that has been put in place on the M42, junction 3a to 7, to the South-East of Birmingham. The scheme combines a number of new technologies and existing motorway features to provide:-

- Reliable journey times;
- Reduced congestion;
- Enhanced information to drivers; and
- Improved response times to incidents.

G1.13 WHAT TECHNOLOGY IS USED IN ATM?

Figure G.1 below shows the numerous features that are required to control traffic on the M42 ATM pilot project. The

Figure G1: – Features of ATM Pilot Project on the M42



G1.14 HOW ATM OPERATES

Signs and signals on the M42 ATM scheme inform drivers of traffic conditions ahead, speed limits and the availability of lanes. The position and sequence of the signals ensures that drivers have time to see and understand the signal and to make a manoeuvre.

During high volumes of traffic, speed limit signals show a mandatory speed limit across the carriageway. The speed and availability of lanes is controlled so that the traffic is able to flow more smoothly, reducing congestion. In the unlikely event of an incident, the signals can also be used to control traffic around the incident.

To help protect incident scenes and queuing traffic, when in use, all signals are mandatory and are enforced.

When this stretch of the M42 is not congested and there are no incidents, all normal motorway rules apply.

Figure G2: - Normal Motorway Conditions:



Photograph courtesy of Highways Agency

- No congestion or incident
- No speed limits shown on signals
- National speed limits apply
- Hard shoulder only for emergency and breakdown
- Use emergency refuge areas in an emergency for added safety

If there is congestion or an incident Active Traffic Management will manage the traffic to ease congestion:

Figure G3: - Active Traffic Management without hard shoulder running:



Photograph courtesy of Highways Agency

- Incident or congestion ahead
- Speed limit signals are set and must be obeyed
- Driver information signs provide necessary information for road users
- Red cross over hard shoulder means do not use this lane, except in an emergency or breakdown
- Use emergency refuge areas in an emergency or breakdown for added safety

In the case of severe congestion, or incident the hard shoulder may be opened to traffic under controlled conditions:

Figure G4: - Active Traffic Management with hard shoulder running:



Photograph courtesy of Highways Agency

- Incident or congestion ahead

- Speed limit signals are set and must be obeyed
- Driver information signs provide necessary information for road users
- Hard shoulder used as a lane for all vehicles between junctions
- Do not stop on the hard shoulder
- Use emergency refuge areas in an emergency or breakdown for added safety

G1.15 RESULTS OF THE PILOT PROJECT

Early results of the pilot scheme have been favourable among most drivers questioned as part of the Highways Agency post-scheme opening evaluation. Although it is still relatively early in the assessment process (the scheme started – September 06) drivers have seen the benefits of the scheme, particularly during periods of heavy traffic or following an incident.

A key element of the research has been to understand driver perception/understanding of the use of the signing, particularly as traffic conditions change and speed limits are introduced and ultimately the activation and use of the hard shoulder as a fourth running lane. Monitoring will continue during the pilot period prior to final assessment of the overall success of the project.

BUS PRIORITY & NETWORK DEVELOPMENT

G1.16 BUS PRIORITY

Bus Priority measures were introduced by City of Edinburgh Council on the east bound A90 approaching Barnton roundabout. These enabled buses to avoid the worst of the delays arising particularly in the morning peak through the provision of bus lanes and queue management system. This scheme is considered to be working well and is achieving its objectives.

Further Bus Priority measures could be introduced both within the southern bridgehead area and also in Fife. On the south side outbound (or bridge bound) measures can be introduced which would complement the A90 eastbound measures described above. These would facilitate the flow of buses towards the bridge (and perhaps across it) and would be particularly helpful during the evening peak periods. These measures could include:

- bus lanes;
- bus pre-signals;
- bus boarders;
- bus contra-flow lanes;

- bus only roads;
- bus priority at existing signals;
- bus bypass at junctions (an example of which is shown in Figure G.5); and
- bus gates.

Figure G5: - An Example of a Bus Bypass at a Major Interchange



Within the Fife Bridgehead area a comprehensive bus priority network could be introduced linking the centres of Dunfermline and Rosyth with the M90/A90 corridor. These would be aimed at improving reliability and journey times for existing services and would encourage public transport operators to introduce new services from Fife to Edinburgh and West Lothian. The Fife network could be integrated with the proposed M90/A90 HOV scheme described above to produce an efficient “people movement” corridor across the Forth.

A detailed analysis of the possible bus priority measures on both sides of the Firth have been undertaken and are reported in the SITCoS Report³. The possible introduction of these measures, would it is hoped consolidate the patronage levels and over time increase the number of passengers using

³ Queensferry SEStran Integrated Transport Corridor Study, SEStran, 2004

cross-Forth bus services. In turn this could lead to the increase in scheduled services and expansion of the bus network on both sides of the Firth as demand for new destinations and routes hopefully materialised.

PARK AND CHOOSE

G1.17 PARK & CHOOSE SITES

Park and Choose Sites are a natural extension of the already well established Park and Ride sites. Instead of being particularly focussed on providing interchange with a single particular mode, Park and Choose sites allow the onward journey to be made by a choice of modes. For example the Park and Choose site could be serviced by rail and bus services. Bus services could consist of a mix of feeder services, serving the local catchment, and express services linking population centres.

Park and Choose sites would also provide locations where car sharing can take place. Drivers would meet, leave one or more cars parked, and then continue their journey taking advantage of the HOV lanes. SEStran's recently launched website "TripshareSEStran.com" allows people looking for car sharing opportunities from their local area to their regular destination. This could easily be adapted to offer the trip-sharing opportunities from one of the potential Park and Choose locations. The big advantage of this approach is that should a trip sharer not be able to return with the allocated driver they have an alternative mode back to the site via either bus or rail.

Park and Choose sites are currently being considered at Halbeath, Rosyth, Inverkeithing, Ferrytoll and Dalgety Bay. The expected modes to be provided at these sites and the necessary improvements required are listed below:

- Halbeath (Bus, Park and Choose) and would need work to develop a completely new site;
- Rosyth (Rail, Bus, Park and Choose) and would need additional parking spaces and improved road access and passenger waiting facilities;
- Inverkeithing (Rail, Bus, Park and Choose) and would need increased car parking and improved access and passenger waiting facilities;
- Ferrytoll (Bus, Park and Choose) would need more parking spaces; and
- Dalgety Bay (Rail, Bus, Park and Choose) would need more parking spaces and improved access and passenger waiting facilities.

The combination of the increased options for drivers through the new Park & Choose sites together with improvements to the bus network journey times as a result of potential bus priority would, it is hoped lead to increasing use of these facilities. Over time this could contribute to reducing the levels of single occupancy vehicles crossing the Firth of Forth.