INTERIM ADVICE NOTE 103/08

Advice Regarding the Assessment of Sites for Ramp Metering

Summary
This document provides advice on identifying on-slip locations that are likely to be suitable for the implementation of ramp metering.

Instructions for Use
This document supersedes and replaces IAN 66/05 ‘Guidance for the Selection of Sites for Ramp Metering’.

Interim Advice

Table of Contents

Interim Advice

1. Introduction

Standards vs. Advice

This Interim Advice Note (IAN) provides advice upon the selection of suitable sites for the installation of ramp metering. It draws on the experience gained to date from the recent roll out of 30 ramp metering schemes. The advice is directed primarily at motorways, though it may be equally applicable in many respects to all purpose dual carriageway trunk roads.

Outline

Ramp metering is a technique that manages traffic joining a motorway to reduce congestion caused by over utilisation. Ramp metering reduces congestion by maintaining a maximum throughput in the vicinity of the merge point.

Relationship

This document updates and replaces IAN 66/05 'Advice Regarding the Assessment of Sites for Ramp Metering' using experience from the installation and operation of 30 ramp metering sites. Details of ramp metering principles, design, installation and operation can be found in other Highways Agency documents as detailed in the references, section 5 of this note.

Implementation

The two main factors affecting the feasibility of a site for ramp metering are the traffic characteristics and the physical characteristics. This IAN details the ideal and acceptable traffic characteristics where ramp metering would be a suitable solution. It also gives advice on the impact of various physical characteristics which need to be considered and mitigated against at the design stage.

Economic benefit calculations for a proposed ramp metering scheme should be based on delay reductions of between five and ten percent depending on how well the site traffic conditions meet the requirements detailed in this IAN.

Interim Advice

2. Criteria for the Installation of Ramp Metering

The criteria for assessing the suitability of a site for ramp metering relates to both the traffic and physical characteristics of the site. These criteria are set out in the following paragraphs and have been derived from experience gained with existing ramp metering schemes on the motorway network.

Traffic Characteristics:

The fundamental purpose of ramp metering is to improve an existing traffic congestion problem. Sites that may be suitable for ramp metering should show flow breakdown on the main line carriageway where speeds drop below 50kph (30mph) on a regular basis for a significant period of time causing an appreciable amount of vehicle delay. The minimum delay requirements can be seen in Table 1 on page 6.

For a standard ramp metering system to be effective, the congestion must be caused by merging traffic or excessive demand downstream of the merge.

Ramp metering will only be effective if the congestion problem:

- Is a result of merging traffic or the resulting downstream flow;
- Is a regular occurrence; and,
- Is for a significant duration or length.

Ramp metering has been found to be particularly effective to manage the following traffic characteristics:

- Merging traffic interfering with mainline traffic;
- Traffic joining from the on-slip conflicting with traffic leaving the main carriageway at a major downstream junction;
- Temporary peaks in joining traffic resulting in congestion;
- On-slips fed by signalised junctions causing large platoons of merging traffic;
- High on-slip flows overloading merge capacity;
- On-slips affected by shockwaves and flow breakdown from downstream; or,
- Queuing traffic is already a feature of the on-slip during peak periods.

Slip road traffic flow should be high enough for it to have an impact on the main carriageway traffic. Ideally a minimum slip road flow of 400 veh/lane/hr is suggested based on experience to date, however lower flows could be acceptable if it is evident that it could be contributing to a congestion problem.

Conversely, there is a practical maximum flow that can be achieved over the ramp metering stop line. If the maximum recommended slip road flows are exceeded, the installation of ramp metering will lead to excessive queuing on the slip road and therefore it would be inadvisable.

A suggested maximum on-slip flow is 900 veh/lane/hr, although ramp metering can work with flows up to 1250 veh/lane/hr depending on factors such as the length of the slip road, percentage HGV and gradient of the on-slip. If the flows are above 900 veh/lane/hr but below 1250 veh/lane/hr, then reference should be made to the 'MCH 2470 - Ramp Metering Technical Design Guidelines' to establish if operation at the higher flow is feasible. Alternatively consideration should be given to re-modelling the slip road. For example, increasing the number of lanes would improve storage capacity and reduce the maximum flow through the signals per lane.

During the installation of the ramp metering system, queue length detectors need to be installed between the slip road entrance and the ramp metering stop line to monitor and control the slip road queues. Figure 1 on page 6 shows the layout of a typical ramp metering

installation.

Ideally speed, flow and occupancy data is required at 500m intervals in the vicinity of the junction in order to:

- Identify and assess the cause, quantity, scale and location of the traffic problem;
- Control the algorithm and signals for ramp metering; and,
- Monitor the performance of the ramp metering.

The traffic problem at the merge location should be assessed over a number of days (excluding school holidays, special events and adverse weather conditions) by collecting and analysing data at one minute intervals (if possible) and also by making observations of traffic behaviour on site.

A good example of the type of detection required comes from the Motorway Incident Detection and Automatic Signalling (MIDAS) system. This includes the installation of inductive loops at nominal 500m intervals and provides average values of speed, flow and occupancy each minute.

If a standard MIDAS detection system is present, the infrastructure must be deemed to be sufficiently robust with minimum malfunctioning loops (e.g. it is essential that working loops exist upstream of the back of the queue, upstream of the merge area and downstream of the bottleneck). All of these loops must be set to traffic counting, this allows the data to be collected.

The current ramp metering system cannot function without an existing MIDAS installation, therefore if suitable traffic detection does not exist at a site, route managers should assess the suitability of their site for its installation prior to any implementation of ramp metering. If there is no MIDAS present, then a limited MIDAS installation would need to be installed.

If a site is to be considered for ramp metering where MIDAS is not present, then alternative sources of data need to be sought in order to assess flows, quantify congestion and identify the cause of congestion. These are the sources of data suggested;-

- Flows can be obtained from the Highways Agency Traffic Information System (HATRIS) which can be accessed on the internet at: http://trads.hatris.co.uk/. It is good practice to select data from a neutral month and use five day averages.
- Serious 'stop start' congestion can be identified by the presence of traffic travelling at below 50kph. It is possible to assess the number of hours a link is travelling at below 50kph per year from TrafficMaster™. This can be obtained from the Highways Agency National Intelligence Unit (NIU). Although it is not as accurate as MIDAS data, a suitable indication of sufficiently high levels of congestion is 100 hours per year as an average between the upstream and downstream links of the junction.
- In order to identify the exact cause of congestion and to validate the congestion data without MIDAS, it will be necessary to rely on the local knowledge of route managers and their staff who are familiar with the causes of congestion and the traffic patterns on the road during the peak periods.

Schemes for immediate implementation should be based on current data with no adjustment for traffic growth, however, future traffic growth could be considered where, for example, a future development is expected in the vicinity of the junction.

Withdrawn

Summary of Criteria

Table 1 summarises the criteria set out above.

Parameter	Minimum Value		Maximum Value	
	Ideal	Acceptable	Ideal	Acceptable
Annual delay at speeds below 50kph (30mph).	10,000 Vehicle Hours Delay	100 Hours	No Maximum Value	
Downstream mainline flows per lane (vph)	1,500	Appreciable based on local knowledge	No Maximum Value	
Slip road flows per lane (vph)	400	300	900	1,250
Slip road flow as percentage of downstream flow (%)	10	5	30	50

Table 1 – Criteria for Ramp Metering Application.

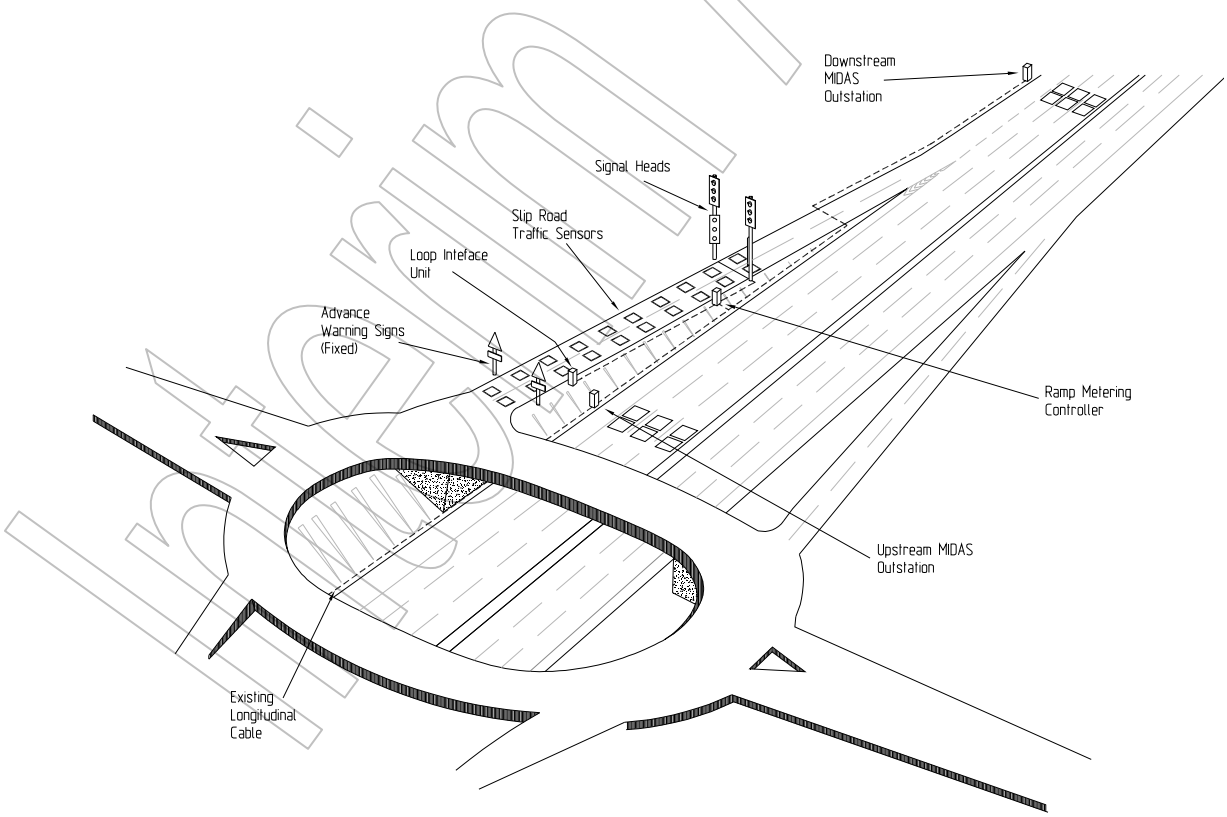

Figure 1 – Diagram of Typical Ramp Metering Site

Physical Characteristics

This advice is based on current experience of junction layouts that are common on the network. These sites generally use long, straight, two lane slip roads with long tapered merges on to three lane main carriageways. However it is not only these types of junction that cause the types of congestion that ramp metering can address.

Sites which have any of the following characteristics are less ideal, but ramp metering can still provide a benefit:

- Lane gain from slip road;
- Ghost Island;
- Two or four lane carriageways; or,
- Curved on-slip.

These sites will need additional design consideration to ensure that the best metering strategy can be applied

There are no individual physical characteristics that rule out a site for selection completely. The main consideration is the practicality of locating the stop line safely. Specifically, sufficient sight lines to the stop line and queue control area are required to account for the high approach speeds.

It has been found that sites which have the following characteristics can benefit greatly from ramp metering if the site is well designed and the correct metering strategy can be applied:

- Short or sub-standard merge areas;
- Where a bottleneck exists downstream on the main carriageway such as a bend or a gradient; and,
- Two lane on-slips which have been artificially reduced to one lane in an attempt to restrict joining traffic.

In cases where these characteristics occur, they should be considered carefully and a judgement made as to whether they will affect the operation of the system, its ability to handle traffic flow or cause serious safety issues. Any of these characteristics must be noted and if the site is still considered suitable, be passed on and highlighted to the scheme designers so that mitigation of any potential problems can form part of the early design stage.

With ramp metering in operation, the slip road should satisfy two requirements:

- There should be sufficient distance between the stop line (when ramp metering is implemented) and the main carriageway for vehicles to accelerate to the desired operational speed; and,
- It should be able to store a sufficient number of vehicles so that, when vehicles are queuing, vehicles do not back up beyond the entrance to the slip road.

Assessment of the desired operational speed, queuing capacity requirements and stop line placement is part of the design process. These areas are defined in the design guidelines (MCH 2470 - Ramp Metering Technical Design Guidelines). These consider a number of factors at the site including, platoon size, number of HGVs, vehicle acceleration and gradient.

Interim Advice

3. Withdrawal Conditions

This IAN gives advice on the best practice for selecting sites which are feasible for ramp metering based on the understanding gained through the installation and operation of 30 ramp metering sites. Further advice will be given in future based on further developments of the current ramp metering system and experience gained in additional ramp metering installations such as those part of the Ramp Metering Implementation Project.

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5. References

Ramp Metering Technical Design Guidelines	MCH 2470
Ramp Metering Installation Guidelines	MCH 2471
Ramp Metering Configuration Setup and Management Guidelines	MCH 2472
Ramp Metering Calibration Guidelines	MCH 2473
Ramp Metering Operational Procedures	MCH 2474
Ramp Metering Maintenance Handover Procedures	MCH 2475

Interim Advice