

**Traffic Systems  
and Signing**

**MCH 1352  
Issue D  
February 2002**

# **Technical Guide to SCOOT Loop Siting**

© Crown Copyright 2002

Applications to reproduce this material should be made to The Controller of Her  
Majesty's Stationery Office  
First published 2000

Printed and published by the Highways Agency



*(This page is intentionally left blank.)*

**REGISTRATION OF AMENDMENTS**

<b>Amend No</b>	<b>Page No</b>	<b>Signature &amp; Date of Incorporation of Amendments</b>	<b>Amend No</b>	<b>Page No</b>	<b>Signature &amp; Date of Incorporation of Amendments</b>

*(This page is intentionally left blank.)*

**MCH 1352D**

**Contents**

**Chapter**

- 1 Introduction
- 2 Loop Dimensions
- 3 Number Of Loops
- 4 General Siting Requirements
- 5 Loop Siting, Particular Cases
- 6 Links Where Loops May Not Be Required
- 7 History

*(This page is intentionally left blank.)*

# 1 INTRODUCTION

## Scope

1.1 This technical guide gives information on the siting and dimensions of loops used for general vehicle detection in centrally controlled traffic signal systems running under the adaptive control system SCOOT (Split, Cycle and Offset Optimisation Technique). The information presented is intended for guidance rather than strict observance. The final choice of loop configuration will depend very much on the conditions encountered on site. For further information on the siting of SCOOT loops, contact:

Traffic Systems and Signing Division  
Highways Agency  
Temple Quay House  
2 The Square  
BRISTOL  
BS1 6HA  
England.

1.2 Guidance on the positioning of loops used for selective vehicle detection for bus priority under SCOOT is outside the scope of this document.

1.3 The previous issue of this document (Issue C) has been updated to cover new facilities introduced into SCOOT. The document now makes reference to bus priority (SCOOT version 3.1), stopline loops and reduced detection modelling (both SCOOT version 4.2).

### General

1.4 In the current implementation of SCOOT systems, information on traffic behaviour is obtained from inductive loop vehicle detectors which measure vehicle occupancy. Information from detectors is transmitted by the on-street equipment to the central computer. The SCOOT traffic model and optimisers use this information to calculate signal timings to achieve the best overall compromise for co-ordination along all links in the SCOOT area.

1.5 As a general rule, each separately signalled traffic stream should be provided with one or more SCOOT loops positioned at the upstream end of the link. In some instances, however, it may be possible to avoid the installation of a SCOOT loop through the use of existing stop line detection or by using the reduced detection modelling facility. Both facilities provide the opportunity for cost savings but entail a compromise in the operation of SCOOT compared with a system fully equipped with SCOOT loops.

1.6 Before starting to site SCOOT loops it is necessary to identify the separate traffic streams in the SCOOT controlled network. A survey of the road layout and traffic behaviour is then required to determine provisional locations for loops, feeder cables and associated ducting. The survey may also determine any links where SCOOT loops are not required.

1.7 If loop based Selective Vehicle Detection (SVD) is to be provided for bus priority, then the siting requirements of the SVD loops should be considered before final SCOOT loop siting. In some instances there may be locations where the selected position for both the SCOOT loop and SVD loop are similar. It is advisable in these circumstances to adhere to a minimum gap between the loop cable runs in either system. This situation may however provide opportunities for sharing the same ducting to accommodate feeder cables for both the SCOOT loop and SVD loop. For advice on the specific requirements of SVD loops, contact with the suppliers of SVD equipment is recommended.

1.8 Before a final decision is made on the position of a SCOOT loop, each loop site should be observed during both peak and off-peak periods. For different sites it is recommended that the proposed loop position be chalked on the carriageway or marked with a spray paint. In this way the percentage vehicles which miss the loop or the number of vehicles which clip the loop can be easily determined and the optimum site chosen. The aim is to detect at least 85% to 90% of vehicles that cross the downstream stop line. It may be that some traffic management measures are required to improve lane discipline.

## 2 LOOP DIMENSIONS

2.1 The length of SCOOT loops in the direction of travel is fixed at 2m. This is a compromise between a loop being short enough to detect gaps in the traffic stream and long enough to detect stationary vehicles in a queue.

2.2 The following loop dimensions are based upon the loop having 3 buried turns.

2.3 The width of the loop is dependent on site conditions and should not be less than 1.2m. In the past 1m width has been the generally accepted minimum. It may be possible to use this width in extreme cases but experience has shown that 1.2m should be the minimum. Factors affecting the width are:

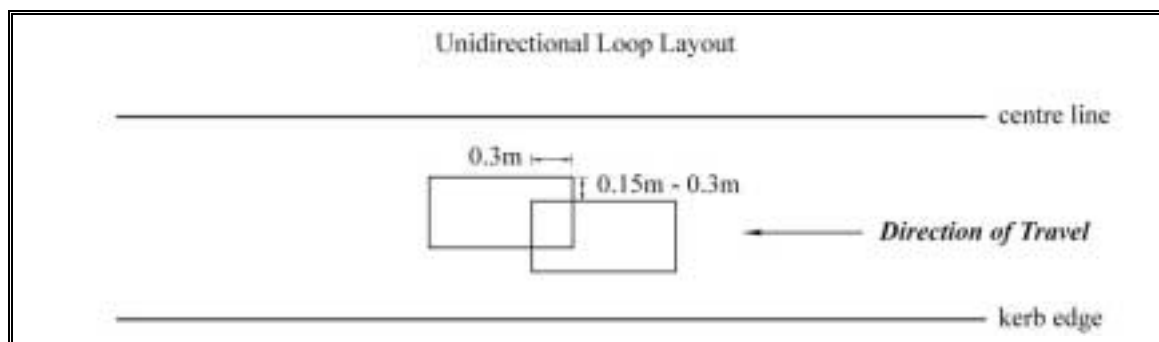
i) The offside edge of the loop should be approximately 1m from the centre line of the road to reduce the probability of detecting vehicles straddling the centre line. The centre line is taken to be the line least occupied by vehicles in either direction and may not coincide with the marked centre line.

ii) The loop should be sited where the risk of parking over it is minimal. Experience has shown that double yellow lines are an insufficient safeguard and unless other physical deterrents to parking exist (e.g. guardrail), it is recommended the nearside edge of the loop be located 2.5m from the kerb.

iii) Areas covered by yellow boxes or "KEEP CLEAR" marking should be avoided. Under queuing conditions, loops in these areas will not give the correct occupancy indication.

iv) In the case of multi-lane links where more than one loop is provided, the gap between two adjacent detectors on a link should be approximately 2.0m (based on the width of an average vehicle) so as to balance under-counting and over-counting errors.

v) Where carriageway width is restricted, the minimum 1.2m wide loop may still be clipped by oncoming traffic. Where this problem is expected unidirectional loops should be considered. The recommended layout of these loops is shown in Figure 2.1.



**Figure 2.1**  
Unidirectional Loop Layout

### 3 NUMBER OF LOOPS

3.1 It is important that the loop accurately detects vehicles entering the link.

3.2 Generally one loop can detect traffic in 1 or 2 lanes. Therefore, one loop is required if the link has one or two lanes, two loops if the link has three or four lanes, and three loops if the link has more than four lanes. However, in some situations a  $2n-1$  loop configuration may prove worthwhile installing where the 'standard' one or two loops are considered impracticable.

3.3 This array should be highlighted in the works specification as a considered option. The system supplier may wish to comment when the loops are being finally surveyed prior to installation.

## 4 GENERAL SITING REQUIREMENTS

4.1 The cost of cabling to the loops is a significant item in the SCOOT detection system. This is particularly true of entries to the system, where lengths of cable greater than 150 metres may be required to the nearest Outstation Transmission Unit (OTU). It is tempting therefore to reduce cable lengths to achieve cost savings. The temptation should be resisted until the initial design is completed, when an overall review should be made to reduce costs if possible. In practice, the cost of feeders is a relatively small component of the overall system cost and the effects of reducing standards may degrade the performance of the whole system.

4.2 In general, one loop for each link is required, normally located at the entry to the link (Figure 4.1). This conveniently reduces cabling costs between the loop and Outstation Transmission Unit. Loops are not installed where a traffic stream is to be given a permanent fixed length stage or where the signals are not directly controlled by SCOOT (e.g. Pelican crossing on a fixed offset from an adjacent SCOOT junction).

4.3 The loops should be positioned in such a way that free flow conditions can be achieved over the loop, by both straight-ahead vehicles and those which have turned into the link. The mean speed of vehicles over the loop should be within  $\pm 20\%$  of the mean free running speed along the link. As a guide, the distance indicated on Diagram 1 may be 10-20 metres. Usually this can be achieved by observation rather than measurement. It is important to have a journey time from the loop to its associated stop line as recommended at 4.6. A double check for the loop position is to stand at the stop line and check where the traffic comes from. At least 85% - 90% of traffic passing the stop line should have crossed the detector.

4.4 One of the functions of the SCOOT program is to detect and take action to reduce the queue on a link when the upstream junction is likely to be blocked. Once congestion occurs the detector invariably becomes fully occupied. Under these circumstances SCOOT cannot consider undetected vehicles forming the rear of the queue. The congestion logic is invoked once the detector has been occupied for more than 4 seconds. So that the system can recognise an exceptionally long queue, the detector should be sited far enough upstream to be beyond the normally expected back of the queue on that link.

4.5 Problems have arisen where a filter causes congestion and where the dedicated filter lane merges with the main through route (upstream of the stop line). An exit filter loop has limited reaction to the queue whereas a loop in the filter lane will respond to congestion and has a quicker reaction. Careful loop siting between the typical end of queue position and the point where lanes merge, but where lane discipline is good, should enable SCOOT to see the queue and react before the main through route is seriously affected.

4.6 The SCOOT program should be allowed sufficient time to predict stop line arrivals. This means that the loop should be sited so that the journey time from loop to stop line under free-flow conditions is no less than 6 seconds and typically 8-15 seconds. In some cases it will not be possible to achieve the minimum 6 seconds and in such cases the SCOOT model will be less accurate when optimising splits. Entry links into the system are discussed separately in 5.4.

4.7 Unsignalled side roads to the link should be taken into account if they contribute or remove more than 10% of the total traffic on the link, in the long or short term. The loop should be positioned downstream of such roads. This may conflict with the above requirements, and is discussed further in Chapter 5 Loop Siting, Particular Cases.

4.8 Care should be taken to minimise the risk of vehicles travelling in the opposite direction crossing the loop. This often occurs near bus stops or at any situation where opposing traffic may at times be forced to the wrong side of the road. Uni-directional loops should be considered in these circumstances.

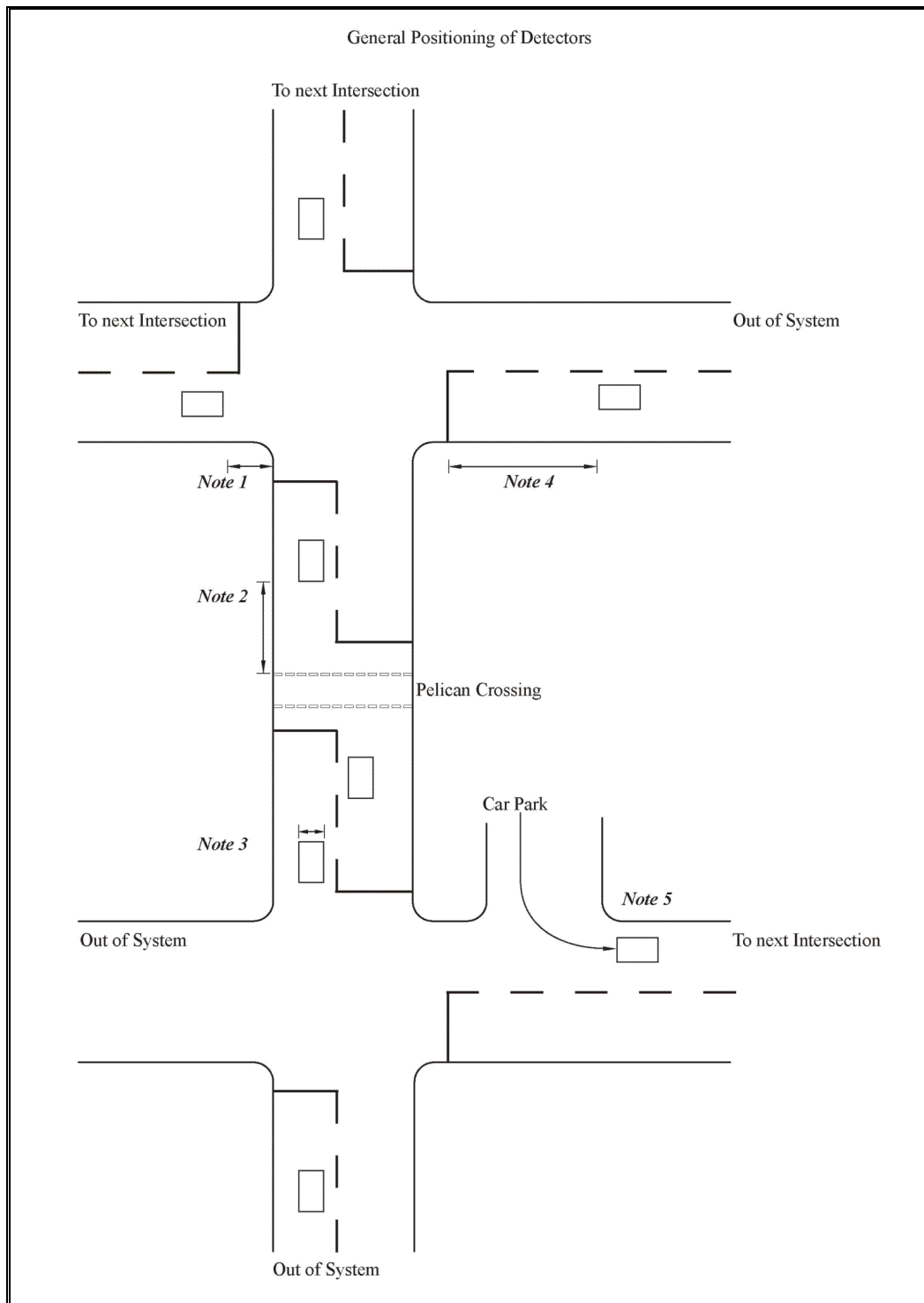
4.9 Wherever possible, avoid locations where short term disruptions to traffic are likely because of parking, e.g. builders yard entrances, cash and carry store accesses, laundrette's, regular but unscheduled vehicle calls such as security vehicles near banks, etc. Bus stops can also cause disruption. See 5.3.

4.10 Consideration should also be given to the location of the detector units which control the SCOOT loops. Normally these may be mounted in or adjacent to the OTU which sends the SCOOT data back to the instation. However, if the cable length between a loop and its detector unit is greater than 150m then the detector unit should be mounted in a remote housing closer to the loop.

4.11 TR 0100 details the functional requirements of detection equipment for SCOOT. There is normally no requirement to detect two-wheeled vehicles and in general they are ignored during validation. As such the 150m separation between detector unit and loop should be the limit for a minimum 1.2m width loop.

4.12 However, it may be possible to detect vehicles beyond 150m although this must be treated with a fair degree of caution. Loop size relative to feeder length, detector unit sensitivity setting and the number of loop turns buried in the road will all have an increasing affect on how well the detection system operates. The aim should be a mid-range sensitivity setting with the standard 3 loop turns, otherwise problems of failing to detect or incorrectly detecting vehicles in an adjacent lane could result.

4.13 If problems are anticipated where the 150m distance is to be exceeded then advice should be sought from TSS Division.



**NOTE 1:** For distance refer to 4.1

**NOTE 2:** For distance refer to 4.1

**NOTE 3:** For distance refer to 2.3

**NOTE 4:** For distance refer to 5.4

**NOTE 5:** For distance refer to 4.4

**Figure 4.1**  
General Positioning of Detectors

## 5 LOOP SITING, PARTICULAR CASES

5.1 The particular cases discussed below are intended to cover most situations where the general requirements given in Chapter 4 General Siting Requirements cannot be fully met. Inevitably situations will arise where the techniques described in this guide do not provide a complete solution. In such cases advice may be sought from TSS Division.

### Side Roads Close to the Downstream Junction

5.2 If a side road carrying a significant volume of traffic, i.e. greater than 10% of the total on the link, is close to the downstream end of the link it will generally be impossible to satisfy the general requirements given in Chapter 4 General Siting Requirements. In this case a detailed analysis should first be made of the side road traffic flow figures (16 hours count) to assess the real extent of the problem. Inevitably the solution will be a compromise. It may be preferable to ignore the effect of the side road flow and accept a less efficient SCOOT model, which then may be compensated for to some extent by tuning parameter values during calibration. Generally SCOOT can cope with consistent side road interference. One solution may be as detailed in 5.12.

### Bus Stops

5.3 If practicable, SCOOT loops should be installed downstream of a bus stop to avoid queuing on the loop. The loop should be installed far enough downstream of the bus stop so that vehicles passing the bus will still pass over the loop and will be travelling at  $\pm 20\%$  of the mean link speed, whether a bus is at the stop or not.

### Entry Links

5.4 The journey time requirements of 4.6 apply to entry links as well as normal links. In the case of entry links there is usually no convenient up-stream OTU, and the journey time requirements of 4.6 may result in long lengths of cable between the loop and the OTU. In practice the loop may be sited about 80 to 100 metres from the stop line. This distance may be reduced if speeds are low or increased for high speed roads or those with persistent heavy queuing.

### Right Turning Traffic

5.5 When right turning traffic is controlled by a green arrow a detector is needed to provide a measure of demand. If right turning lanes are prominently marked well ahead of the junction, lane discipline is usually well observed and if the general requirements of Chapter 4 General Siting Requirements can be met, then the Authority is advised to site the detector loop upstream of the junction (position L1 in Figure 5.1). Even if a compromise has to be made, an upstream detector has a better response from SCOOT by means of a better measurement of congestion, and exit blocking; and retains the full green split control.

5.6 An extra right turn detector can be used in a dedicated right turn lane even though all traffic has previously crossed the normal upstream detector. If the loop is within about 20 metres of the stop line then it can operate as a stop line loop (position L2 in Figure 5.1), controlling only the green split, with the offset either controlled from the upstream loop or fixed by an offset bias.

5.7 If the loop cannot be located upstream, it must be located downstream and designated an exit loop. Exit loop detection for right turn traffic provides acceptable SCOOT traffic modelling but has a reduced green split control. It is inferior to upstream detection because the length of queue is unknown and the number of vehicles using the green arrow can only be measured one cycle in arrears. However, this loop position has an advantage which may influence its use with green filters. It measures traffic that uses the filter and ignores traffic accepting gaps in the previous stage. Thus when the right turn traffic is opposed by a low flow, the effects of gap acceptance are taken into account and the filter is controlled only by the non-gapping traffic.

5.8 If an entry loop for the next downstream link is to be provided it may also be used as the right turn exit loop (position L4 in Figure 5.1), obviating the need for a specific right turn loop. Where no such entry loop is present, the exit loop may be positioned immediately downstream of the right turn stop line (position L3 in Figure 5.1). This latter position can provide for better control because the journey time measured from the start of the green arrow to traffic passing over the loop is usually more consistent.

5.9 When the right turning traffic is dominant (say 50%), it may be preferable to use the normal upstream detector to control the length of right turn stage. The parallel straight on traffic will need less time than the right turning traffic and can be ignored. As these conditions change by time of day, the SCOOT model may need to be changed to suit different conditions. For example a link may operate with normal filter control using an exit loop in off peak, low flow conditions, but in the peaks the dominant right turn movement will be controlled by the upstream detector loop.

### Left Turning Traffic

5.10 Where a left turn movement at traffic signals is catered for by an unsignalled slip road, it is generally undesirable that the turning traffic should influence the stage green time given to that approach. If the left turners have already separated from other traffic in the vicinity of the loop, then the loop may be positioned so that they are not counted. Otherwise all traffic on the link should be counted and the left turners compensated for by tuning parameter values during calibration.

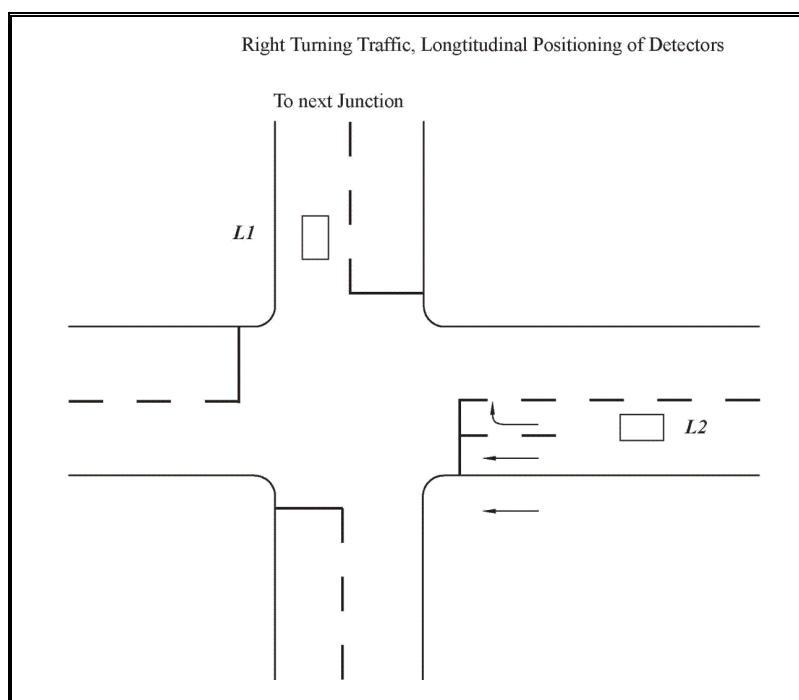
The above may also apply at junctions where a left filter arrow is provided.

### Junctions close together

5.11 Where two junctions are so close together that it would be clearly impracticable to locate loops between them, then the two junctions may be regarded as one SCOOT Node, and loop provided accordingly. Alternatively two nodes may be retained with dummy links without detectors between the nodes, using biases to fix the offsets.

### Converging and diverging traffic movements

5.12 Where more than one traffic stream approaches a stop line from converging links which cannot be monitored by one loop, then two loops may be used, one on each approach. The same applies if traffic leaving a stop line splits and takes two different routes. In both cases the journey time from the loops to the stop line must be the same. It would be wise to discuss the layout with the system supplier before the loops are cut.



**Figure 5.1**

Right Turning Traffic, Longitudinal Positioning of Detectors

#### NOTE

- i) L1 counts the right turning traffic during the right turn stage.
- ii) It may also be used to count total traffic for the next junction.

## 6 LINKS WHERE LOOPS MAY NOT BE REQUIRED

6.1 Omitting SCOOT loops from suitable links in the network can reduce the costs of ducting and loop installation and maintenance. These savings will be greater on links where ducting is provided solely for SCOOT loop feeders than where ducts are shared with SVD systems. In most cases, the omission of the SCOOT loop entails a compromise in the operation of SCOOT.

### Entry Links

6.2 Where the first or last node at the edge of a SCOOT network is a Pelican, or stand alone Puffin or Toucan crossing, there is normally no requirement for a SCOOT loop on the entry link. This is because in this situation the entry link does not contribute to split or offset optimisation, and pedestrian crossings do not usually set the region cycle time. In situations where queuing takes place on the entry link beyond a signalised crossing there may be some benefit in positioning a loop upstream of the typical back of queue position.

6.3 On less important entry links where the green time rarely if ever increases beyond the minimum set in the controller, the SCOOT loop could be omitted without affecting the efficiency of SCOOT control.

### Stop Line Loops

6.4 Where traffic lanes are equipped with stop line loops, it may be possible to make use of them for SCOOT control, even though they are not in the recommended position. This applies only where the loop covers only one lane. The control provided from a stop line loop will be inferior to that obtained by using loops in the standard position. In particular, offset optimisation is not possible. Stop line loops may be suitable for SCOOT control on some entry links at less critical nodes, where compromises in SCOOT optimisation are acceptable.

### Reduced SCOOT

6.5 The reduced SCOOT facility produces synthetic cyclic flow profiles for links not equipped with a SCOOT loop. The synthetic profile is estimated from the discharge profile of upstream links. Estimating flows from an upstream link is most likely to be successful on radial routes and one-way systems with small turning proportions at the junctions. Simple merges between two flows of traffic may also be suitable candidates.

## 7 HISTORY

Approval of this document for publication is given by the undersigned:

Issue A            March 1983  
Issue B            July 1984  
Issue C            August 1989  
Issue D            February 2002

Traffic Control Systems & Lighting  
Zone 2/16E  
Temple Quay House  
2 The Square  
Temple Quay  
Bristol  
BS1 6HA



M.J. SMITH  
Team Manager  
Traffic Control Systems & Lighting