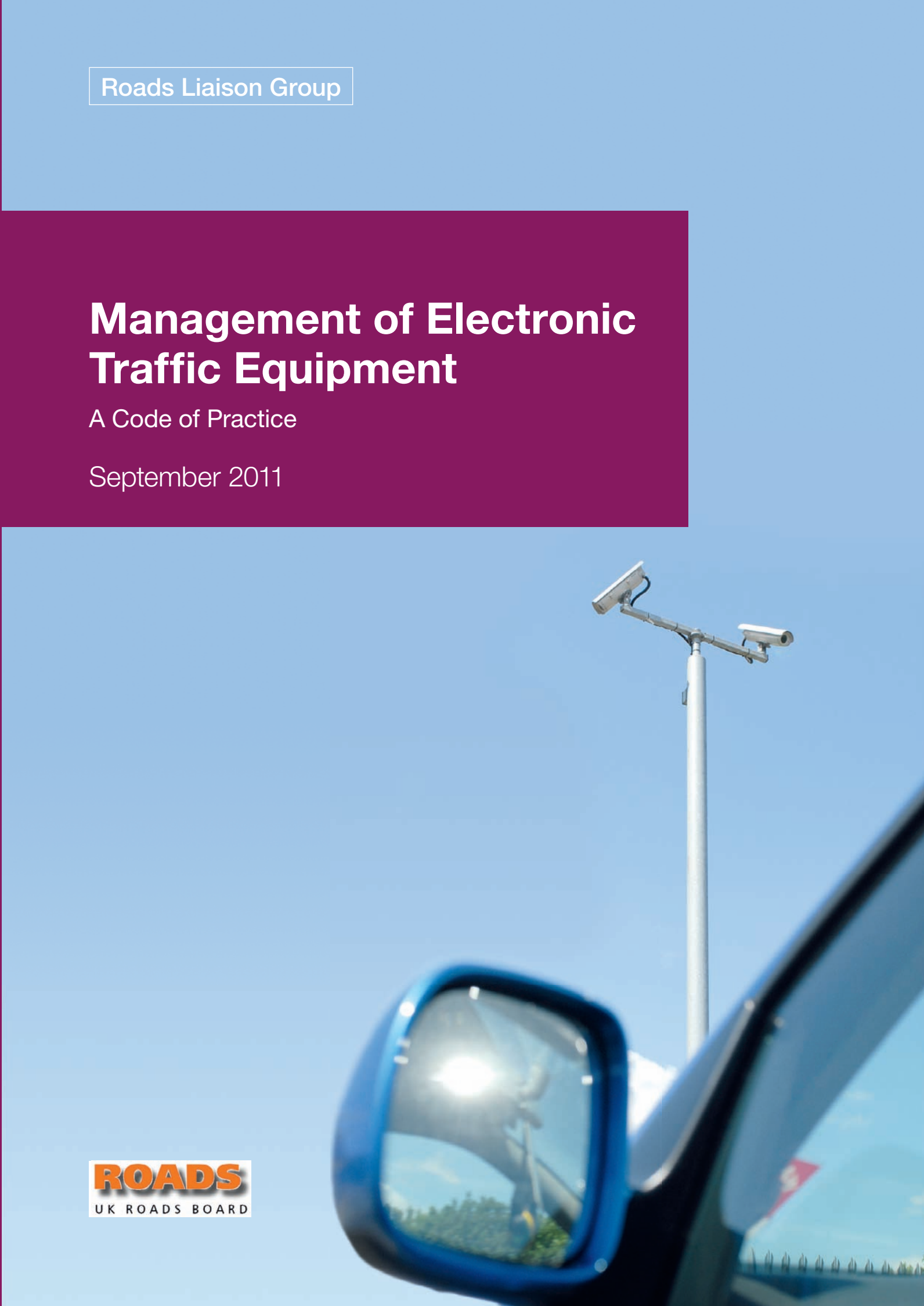
Roads Liaison Group

Management of Electronic Traffic Equipment

A Code of Practice

September 2011



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Contents

Foreword

Within the United Kingdom, the continuing growth of technology in the highways sector has enabled local authorities to manage in a more informed way their highway networks and the traffic using them, leading to improvements in congestion control and carbon reduction. The success of the implementation of technology varies from authority to authority and, with the development of new technology continuing apace, this Code of Practice has been developed to provide consistent guidance on the management of the maintenance of traffic control systems.

While the installation of this new technology is important, what is equally important is to manage the maintenance of equipment to ensure that effective performance can continue for the whole life cycle of each and every asset.

Each local authority assumes responsibility for its own assets but until now there has been little guidance available on how to effectively manage the maintenance of this technology; this has led to varying standards of maintenance within the UK from authority to authority. This Code of Practice is the first document within the UK written specifically for local authorities which publishes good practice obtained from their experts on how to effectively maintain these assets.

The UK has so far under invested in the maintenance of electronic equipment, and there is an increasing deficit of requirements year on year. Funding for refurbishment programmes varies greatly from authority to authority, with some operating an effective maintenance regime, replacing equipment on a rolling fifteen to twenty year programme, while other authorities do not have a replacement programme in place at all. Maintenance programmes should be developed and managed in line with the practical advice contained within this Code to ensure that the available funding is spent effectively.

This document has been promoted by the UK Roads Liaison Group and funded by the Department for Transport. I am pleased to recommend this publication as an important document for local authorities that own and operate electronic traffic equipment on their network. The maintenance of these assets is something that we cannot afford to overlook; by following the good advice and recommendations contained within this Code, we can avoid a future where assets have to be switched off or removed, and we can continue to enable users of the network to travel on less congested roads and to make informed decisions relating to their journey.

Leicestershire CC

Matthew Lugg
Chair – UK Roads Board

Executive Summary

This Code of Practice aims to provide local authorities with guidance in an ever changing environment to create a strong foundation for a positive and lasting maintenance policy for electronic traffic equipment. Adoption of the recommendations will help achieve the delivery of high quality services. Whilst the Code is specifically written for the local authority sector, the principles may be applicable to maintenance arrangements outside this sector.

The Code establishes a series of good practice policies and procedures for the management of maintenance of fixed location electronic traffic equipment and has the principles of asset management at its core. Authorities should develop an Implementation Plan, looking at short, medium and long term scenarios in order to provide the public with a network of optimised equipment.

The Code addresses the whole life cycle of the assets. Designers should take account of maintenance requirements during the design process, and costing issues should be addressed prior to implementation, helping to ensure that authorities understand the true whole life cost of providing new assets.

The Implementation Plan is critical to the successful implementation of the recommendations made by the Code. The emphasis should switch as far as possible from a reactive to a preventative approach to maintenance planning, with programmes for preventative maintenance and asset refurbishment or renewal, all within the framework of the asset management plan.

The Code gives detailed guidance on the maintenance requirements of all types of fixed electronic traffic equipment. It also advises on options for maintenance contracts and for procurement of power and telecommunications services so that each authority can select those that are most appropriate for their own requirements, taking into account the full range of services that will be required.

The recommendations of this Code are not mandatory on authorities. The key asset management principle of focusing on user needs and expectations in the design and delivery of service implies that authorities should have reasonable discretion in the adoption of this Code.

The Code is based on the assumption that available funding for maintenance will provide some flexibility for authorities to pursue a regime of assessment and rational planning of programmes and priorities. Where this is not the case, statutory obligations for network safety will need to take precedence.

Recommendations – These are made throughout the Code in highlighted boxes and also summarised in Appendix A.

Glossary of Terms

The Code uses a number of acronyms and other terminology, the full description of which shall be found alongside the first reference to that acronym within the text. For ease of reference, a full list of the acronyms that the Code uses is found below.

ANPR	Automatic Number Plate Recognition
BLC	Bulk Lamp Change
BT	British Telecom
Cattle crossing	Stand alone crossing facility using 2-aspect wig-wag signals, provided to allow cattle to be herded across the carriageway
CCTV	Closed Circuit Television
CDM	Construction (Design and Management) Regulations
CPG	Car Park Guidance
CSP	Communication Service Provider
DFM	Detector Fault Monitoring
DMRB	Design Manual for Roads and Bridges
DNO	Distribution Network Operator (for example telephone or electricity suppliers)
EAC	Estimated Annual Consumption
ELV	Extra Low Voltage
EM	Equivalent Meter
EMS	Electronic Message Sign
EU	European Union
Equestrian crossing	Stand alone crossing facility using near sided or far sided aspects and demand units provided to allow ridden horses to cross the carriageway
FMS	Fault Management System
GIS	Geographic Information System
GPS	Global Positioning System
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications

IEEE	Institution of Electrical and Electronics Engineers
Instation	Office based PC (personal computer) used for management of systems and on-street assets
IP	Internet Protocol
IT	Information Technology
ITS	Intelligent Transport Systems
JCT	Joint Contracts Tribunal
KPI	Key Performance Indicator
LED	Light Emitting Diode
LPI	Local Performance Indicator
LTN	Local Transport Note
Maintenance inspections	Any form of inspection relating to the maintenance regime, normally preventative maintenance inspections however also including reactive maintenance inspections as appropriate
MPRS	Metering Point Registration Service
MVD	Microwave Vehicle Detector
NI	National Indicators
NICEIC	National Inspection Council for Electrical Installation Contracting
NJUG	National Joint Utilities Group
NRSWA	New Roads and Street Works Act
OJEU	Official Journal of the European Union
OMU	Outstation Monitoring unit
Outstation	Site based electronic equipment, associated with an asset, which allows data to be transmitted between the site asset and the instation for the purposes of control and/or monitoring of an asset. The unit can be either a separate unit or form part of the equipment itself as an integral unit.
PE	Photo Electric
PECU Array	Photo Electric Cell Array Unit
Pedestrian crossing	Crossing facility incorporated into a signalised junction
Pelican crossing	Stand alone pedestrian crossing facility using far-side pedestrian aspects. Features include a flashing green man and a flashing amber to vehicles.

Puffin crossing	Stand alone pedestrian crossing facility using nearside pedestrian demand units, on-crossing and kerbside detection for pedestrians
PI	Performance Indicator
PSTN	Public Switched Telephone network
Routine maintenance	Regular inspections and works undertaken to ensure continuing operation of the asset
RMS	Remote Monitoring System
RTC	Road Traffic Collision
RTPI	Real Time Passenger Information
SIM	Subscriber Identity Module
TAL	Traffic Advisory Leaflet
Toucan crossing	Stand alone crossing facility using either near sided or far sided aspects or demand units, provided to allow cyclists and pedestrians to cross the carriageway
TRL	Transport Research Laboratory
TRO	Traffic Regulation Order
TSRGD	Traffic Signs Regulations and General Directions
TUPE	Transfer of Undertakings (Protection of Employment) Regulations
Type Approval	Home Office approval of equipment for use on the UK road network
UKRLG	UK Roads Liaison Group
UMSC	Unmetered Supplies Certificate
UMSO	Unmetered Supplier Operator
UTC	Urban Traffic Control
UTMC	Urban Traffic Management and Control
VAS	Vehicle Activated Sign
VMS	Variable Message Sign

Note: A list of documents and websites referenced within the Code is provided as Appendix C. Throughout the Code, the reference to a document is indicated using the number shown in parentheses after each document, e.g. *Code of Practice on Transport Infrastructure Assets: Guidance to support Asset Management, Financial Management and Reporting* (5).

Section 1
Introduction

1.1 THE TRAFFIC MANAGEMENT CONTEXT

The need for effective traffic management

1.1.1 The effective operation of the highway network is critical to economic prosperity and social inclusion. The operation and provision of facilities and services are based on the ability to move easily around the highway network, whether this is for the provision of food or the effective operation of businesses, schools and hospitals.

1.1.2 Networks are becoming increasingly congested, and the need for maintenance of the network and the provision of information to road users is greater than ever before. Traffic congestion affects all road users, causing increased journey times and a consequential cost to the economy. The impact on the environment from congestion is also significant, contributing to increased carbon dioxide emissions and climate change.

1.1.3 With the need to manage increasing traffic volumes and to keep traffic moving, the use of electronic traffic equipment has an important role to play in the effective management of the network.

Traffic control and monitoring infrastructure

1.1.4 Traffic management measures, such as traffic control and monitoring equipment, may be used to affect the behaviour of those using the network to achieve a number of objectives, including the reduction of congestion.

1.1.5 The use of traffic control and monitoring infrastructure is an effective way of managing current and future traffic. In many cases, it provides an environmentally acceptable solution to reducing congestion when compared with constructing improvements to the network, such as carriageway widening. Hence, the prevalence of such infrastructure is increasing and set to continue rising as technology finds new and more effective methods of dealing with traffic issues.

The need for maintenance

1.1.6 This Code provides guidance for establishing and managing an effective maintenance regime to ensure that all traffic control and monitoring infrastructure performs to the required standards.

1.1.7 There are many reasons why fully commissioned equipment might cease to work, including poor design, poor installation procedures, vandalism, other third party damage, age, poor maintenance, malfunction of equipment or obsolescence. As with all technology, what is considered to be “cutting edge” now will become obsolete at some time in the future. The whole life cycle of equipment being installed today might typically be fifteen years, with some equipment needing to be replaced sooner owing to obsolescence.

1.1.8 Failure of electronic traffic equipment might pose serious risks to the use of the network, including:

- management of traffic is not effective, with increased risk of congestion;
- safety of road users might be compromised; and
- information passed to the public might be incorrect.

1.1.9 As a worst case scenario, the failure of equipment might endanger the travelling public and place the authority at risk of litigation if the problem is not dealt with effectively. Congestion caused by the poor maintenance of an asset might increase gradually over a number of years. Without the appropriate monitoring processes in place, this might go unnoticed and often be attributed to growth in traffic in the area, rather than understanding the underlying cause and dealing with the actual issue.

1.1.10 To ensure the effective performance of electronic traffic equipment, there is a clear need for a regime for maintenance. This includes both reactive and preventative maintenance activities, as these are described in Sections 3 and 4 of this Code.

Value for money and performance management

1.1.11 There is an inherent expectation that all parties involved in managing the network will seek ways to improve the service to meet the needs of the users. The introduction of new technologies should be based on demonstrating value for money, taking into consideration whole life costs, including initial capital costs, operational costs, maintenance, energy use, and potential service and performance improvements.

1.1.12 Many authorities use performance indicators (PIs) to measure the effectiveness of delivering the complete service and to provide a baseline from which improvements can be measured. This should be done in the context of developing a performance management framework for the wider highway service.

> **Recommendation 1** – All parties involved in delivering the service should seek ways to improve the service to meet the customers' needs. New equipment, processes and strategies should have identifiable tangible benefits, but cost should not be the only consideration.

Legal obligations and duties

1.1.13 Authorities have certain legal obligations with which they need to comply and which might, on occasion, be the subject of claims or legal action by those seeking to establish non-compliance; in such cases, the contents of this Code may be considered to be a relevant consideration. Where authorities elect in the light of local circumstances to adopt policies, procedures or standards different from those identified by the Code or other advice, it is essential that these differences are identified, the reasoning captured, and the alternative approach approved as appropriate by the authority. There are legal obligations relating

to serviceability, some associated with the duty for network management and others relating to sustainability from environmental legislation. In such cases, this Code reflects the statutory position and provides guidance on application.

Traffic Management Act

1.1.14 The Traffic Management Act (1) was introduced in England and Wales in 2004 to tackle congestion and disruption on the highway network. The Act places a duty on local traffic authorities to ensure the expeditious movement of traffic on their road network and those networks of surrounding authorities. The Act gives authorities additional tools to better manage parking policies, traffic enforcement and the co-ordination of street works. The Act states that local traffic authorities shall make appropriate arrangements for performing the network management duty, including the appointment of a Traffic Manager.

1.1.15 In Scotland the Transport (Scotland) Act (2) requires the appointment of a Road Works Commissioner who has responsibility for monitoring the road network.

Steering Group/Atkins Project Team

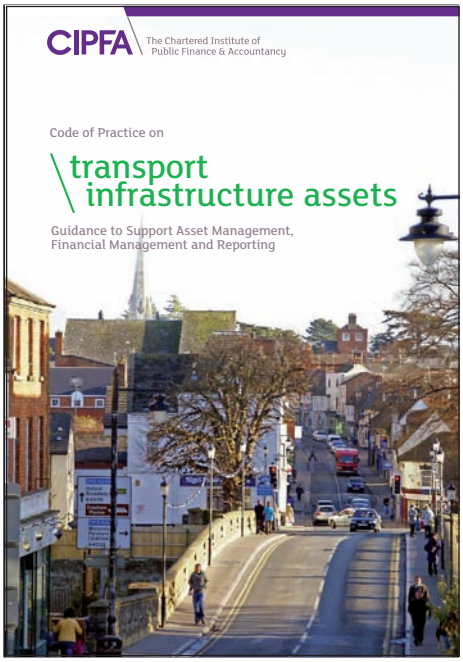
1.2 THE ASSET MANAGEMENT CONTEXT

Asset management principles

1.2.1 This Code is based on the principles of asset management and therefore seeks to promote value for money and continuous improvement within the core objectives of highway maintenance, to deliver a safe, serviceable and sustainable network, taking into consideration user needs. These objectives are described in *Well-maintained Highways* (3). The management of electronic traffic equipment should follow the same core objectives.

1.2.2 It is widely recognised that implementing an asset management approach can assist authorities in ensuring efficient use of resources in delivering the highway service, as well as supporting the development of a framework for providing documentary evidence for decisions made, improving transparency and accountability. Guidance on the use of asset management is given in the *Framework for Highway Asset Management* (4) to facilitate the meaningful exchange of knowledge and experience on the subject. The framework was published in June 2004 and will be revised in the near future. Further advice in relation to the financial management and reporting now required on relation to the management of highway assets is given in the CIPFA 2010 publication

entitled *Code of Practice on Transport Infrastructure Assets: Guidance to support Asset Management, Financial Management and Reporting* (5). Other guidance is also available in PAS 55-1:2008 (6).



1.2.3 Most authorities in England have started to implement asset management for their highway assets, with many benefits. Similar principles may be applied to the management of electronic traffic equipment.

Data (inventory and condition)

1.2.4 Accurate and reliable data on electronic traffic equipment is essential to ensure that appropriate investment decisions on maintenance requirements are made. Inventory data should include asset type, relevant attributes and location. Where appropriate, information should also be provided on current condition, date of last inspection, last maintenance action etc. This data should be stored in a format that is easily accessible to authorities and their contractors.

1.2.5 Consideration should also be given to the information that is needed to meet the requirements of Whole of Government Accounts in reporting asset value for relevant equipment.

1.2.6 Most authorities use Information Technology (IT) systems for the management of their data. Effective use of such systems may support authorities in defending third party claims by providing reliable information that can be used as a legal defence.

Serviceability (current and future)

1.2.7 Determining appropriate service levels for each asset type is a fundamental requirement of asset management. When determining these service levels, authorities should consider the requirements of the users of the network, the importance of maintaining reliability, ensuring availability, achieving integrity and enhancing condition. These service levels should be set out in the authority's policy for each asset type.

Life cycle planning

1.2.8 In order to deliver value over the whole life cycle of the asset, authorities should make investment decisions based on life cycle planning where practicable. In doing this, the costs should take account of: installation, operation, maintenance, asset renewal, energy consumption and decommissioning. It is important that life cycle costs are calculated as part of the design process in order that due consideration can be given to the maintenance aspect prior to installation.

1.2.9 The use of life cycle planning can help authorities optimise investment over the asset life by identifying in advance the optimal time when refurbishments will need to be undertaken. Planning refurbishments in accordance with the anticipated life of the asset will help to minimise the number of faults that the asset develops during its life. Maintenance interventions should be planned when the number of faults will be expected to rise, owing to wear and tear of the components.

1.2.10 By using a life cycle approach authorities should be able to prepare long term maintenance programmes for their assets. They will be able to prioritise their preventative maintenance activity to meet their service levels and other network requirements. Proactive planning will also enable these activities to be combined with other activities, either by asset type or by location, minimising the impact of maintenance activities on road users.

Risk and reliability

1.2.11 Reliability of the asset is crucial to both the authority and users of the network. The authority needs to manage the risk associated with reliability so that, when faults do appear, they can be treated as genuine and fixed within a reasonable timeframe. Authorities may wish to consider maintenance strategies that are preventative and risk based, taking into account asset criticality and condition.

1.2.12 The importance of risk management as a component of asset management is now widely recognised, both at the strategic level to inform decisions on investment and priority, and at the operational level to improve regimes of defect inspection and repair.

1.2.13 In recent years there has been an increase in users pursuing claims against authorities where injury or damage has occurred and they consider there has been a failure on the part of the authority to maintain the asset to the required standards. In light of this trend, the need is stressed throughout this Code for authorities to establish and publish clear strategies and policies, and maintain consistent detailed regimes of inspection, repair, recording and monitoring.

1.2.14 The legislation relating to corporate manslaughter has been used in cases involving various aspects of highways maintenance and is an understandable cause for concern. Compliance with this Code, along with obtaining clear approval from Members for policies and programmes, particularly with regard to any deviations from the Code, should be considered the best approach.

1.2.15 The issue of litigation is dealt with more fully in *Well-maintained Highways* (3). Further guidance for handling risk and liability claims can be found in *Highway Risk and Liability Claims* (7).

Technology advances

1.2.16 Technological changes and improvements are and will continue to be integral features in the field of electronic traffic equipment. It is the acceleration of innovation that is enabling authorities to find solutions to issues that several years ago could not have been addressed. Authorities should, as far as possible, ensure when establishing effective maintenance regimes that they also take steps to future proof their assets and the systems operating them.

> **Recommendation 2** – Authorities should seek to future proof systems and processes as far as is practicable.

1.3 TOWARDS SUSTAINABLE MAINTENANCE

Sustainable approach

1.3.1 Ensuring a sustainable approach is a core objective of highway maintenance and therefore of this Code.

1.3.2 Each authority should develop their maintenance regime based on sustainable principles. The adoption of good practice in the management of electronic traffic equipment will assist in reducing journey times, congestion and exhaust emissions, including carbon dioxide.

Recycling and re-use

1.3.3 Where possible, authorities should increase the use of recycling and re-use of equipment within their maintenance regime. Whilst recycling of equipment might not be the direct responsibility of the authorities, they should establish the percentage of equipment that is recycled and should also consider this aspect during the preparation of maintenance contracts, along with incentivisation where appropriate.

1.3.4 The re-use of equipment will help to reduce landfill but is also likely to reduce the cost to the authority when equipment needs to be replaced. If it is not possible to re-use equipment, the authority should seek to ensure that, wherever possible, equipment is recycled.

> **Recommendation 3** – Where possible, authorities should aim to increase the use of recycling and re-use of equipment within their maintenance regime.

Energy

1.3.5 The cost of energy and the drive to reduce carbon emissions has recently led to a number of innovative approaches for the provision of power for electronic traffic equipment. The use of renewable energy, such as solar power, should be considered as part of the design process wherever possible, providing the authority with both financial and environmental benefits.

1.3.6 The use of solar power is desirable but within the UK is not as widespread as possible. Authorities should consider the positive effects of the use of solar technology as part of their approach to life cycle planning, taking account of potential cost savings. Authorities should take into account the issue of reliability of supply; therefore solar power should not be used for safety critical applications.

1.3.7 The need for reducing energy consumption has driven many developments in technology in recent years, such as use of Extra Low Voltage (ELV) equipment.

> **Recommendation 4** – Authorities should consider the use of low energy (e.g. ELV) equipment as the norm, especially for new or renovated sites.

1.4 OBJECTIVES OF THE CODE

1.4.1 The objectives of this code are to:

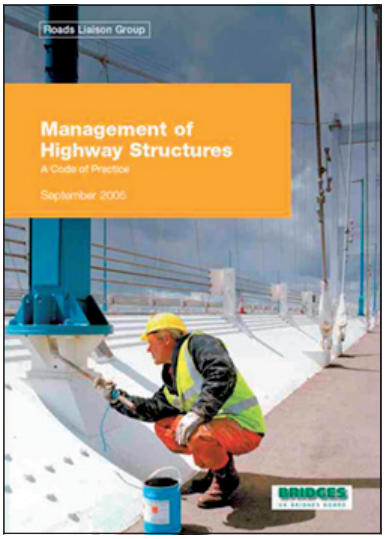
- **Encourage the adoption of asset management principles** – to promote a holistic and life cycle approach in decision making for maintenance of electronic traffic equipment.
- **Encourage the development and regular review of policies** – once an authority has established an approach for dealing with its maintenance requirements on the basis of this Code, it is good practice to review the approach on a regular basis.
- **Encourage focus on the needs of users and communities** – policies for the maintenance of electronic traffic equipment should have the needs of users and communities at their heart.
- **Encourage the adoption of good practice and a consistent approach** – this Code is written as a guidance document to assist authorities improve the maintenance practices they employ for their electronic traffic equipment. Good practice has been captured from authorities throughout the UK and has been used to inform the Code, in order that a level of consistency and harmonisation across all authorities is developed, whilst still allowing flexibility for local variations to be applied as appropriate.
- **Promote risk assessment** – the Code encourages the assessment of risk in the determination of local technical and operational standards, rectification of defects arising from safety and serviceability inspections, and investment opportunities.
- **Promote efficiency** – the Code shares established good practice to enable authorities to follow proven efficient methods of working, thus making improvements in areas that might not be operating at optimised efficiency levels at present.
- **Encourage integration with highway maintenance** – this Code seeks to encourage authorities to consider the maintenance of electronic traffic equipment in the context of the wider asset management and highway maintenance requirements.

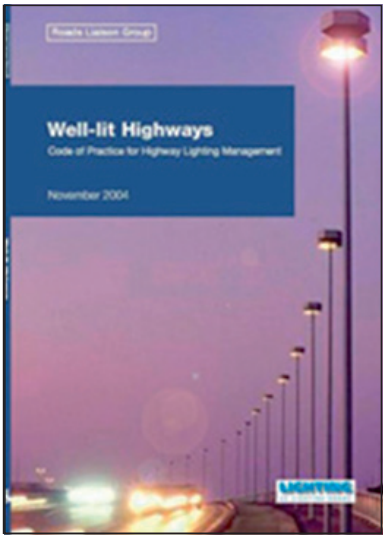
- **Encourage innovation** – the Code seeks to encourage continuing innovation in the effective maintenance of electronic traffic equipment and encourages the development of interaction among various stakeholders from different areas to discuss good practice principles established as a result of such innovation.

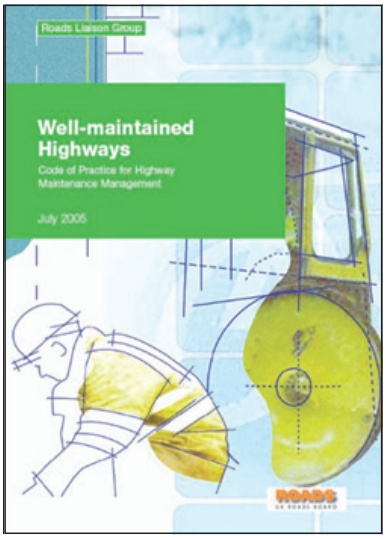
1.5 SCOPE OF THE CODE

General

1.5.1 The Code provides guidance on the planning and management of the maintenance of electronic traffic equipment within the context of good practice and performance improvement. It is not intended as a detailed technical reference for all aspects of maintenance or to repeat technical guidance available elsewhere.







1.5.2 The UK Roads Liaison Group (UKRLG) has published the following three Codes of Practice,

- *Well-lit Highways* (8);
- *Well-maintained Highways* (3); and
- *Management of Highway Structures* (9).

1.5.3 This Code is written to sit alongside the other three Codes, as demonstrated in the guidance hierarchy structure shown in Figure 1.1.

Technologies covered by the Code

1.5.4 This Code covers most technologies that are included in the term electronic traffic equipment and the following technologies are dealt with in detail:

- **traffic signals** – including junctions and shuttle working scenarios under traffic signal control;
- **crossing signals** – including any non-motorised traffic controlled by signals, for example pedestrian, Toucan and equestrian crossings;

- **signals other** – including cattle crossings, School Crossing Patrol flashing amber warning signs and wig-wags as commonly situated outside emergency service stations;
- **interactive and timing activated signs** – including vehicle activated signs;
- **variable message signs** – including dot matrix, Light Emitting Diode (LED) type and standard text prism signs, and signs for car park management systems;
- **road safety cameras** – including red light, average speed and fixed point speed cameras;
- **real time passenger information systems** – the fixed location elements of the system only (i.e. the information signs);
- **traffic monitoring equipment** – including vehicle count sites, classified count sites, traffic flow data collection sites and Automatic Number Plate Recognition cameras;
- **rising bollards** – including rising steps and barriers;
- **CCTV cameras** – including only fixed location cameras; and
- **over-height vehicle detection systems** – including detection control and integrated signs.

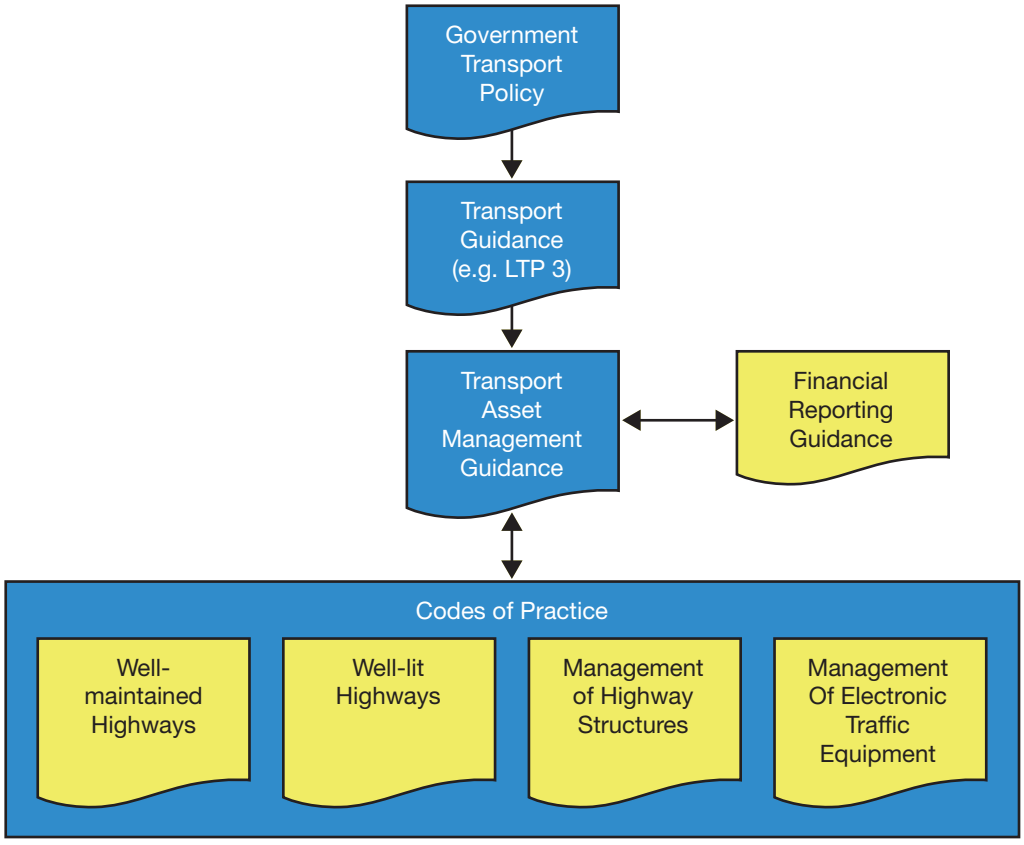


Figure 1.1: Guidance hierarchy structure

Equipment not covered by the Code

1.5.5 The following items are not covered in this Code:

- **any mobile infrastructure** – only permanent and fixed infrastructure is covered by the Code;
- **tunnel management systems** – every tunnel system is unique; however, some of the elements used within a tunnel management system are covered by the Code;
- **infrastructure placed exclusively within the motorway and trunk road network** – reference should be made to guidance produced by the Highways Agency and others; where infrastructure is located at the point where the trunk road network meets the local authority network, it is in the interests of the public that the two authorities liaise with each other to provide the optimum service level;
- **tidal flow systems** – these systems are bespoke and any authority considering deploying them should consider the maintenance requirements as part of the design, producing their own guidance document as appropriate; parts of this Code may be relevant with regard to certain technologies used within a tidal flow system;
- **road user charging systems** – these systems are bespoke and any authority considering deploying them should consider the maintenance requirements as part of the design, producing their own guidance document as appropriate; parts of this Code may be relevant with regard to certain technologies used within a road user charging system;
- **railway and tramway interaction** – interaction between the road network and tramway systems should be considered separately by the authority, taking into account the bespoke nature of the interaction and users of both systems; and
- **dedicated telephone communication systems** – these systems are limited within local authority networks; their nature is that they are bespoke, based upon the needs of the individual authority. Any authority with its own telephone communication system should ensure that they have in place their own guidance document which details the maintenance procedures and policies for this equipment.

Recommendation 5 – If authorities own assets containing other technologies that are not covered by this Code, they should ensure that a guidance document is in place to be used by their staff.

1.6 USE OF THE CODE

1.6.1 It is recognised that parts of the guidance and information contained in this Code might become out of date with time, while some of the recommendations might need to be reviewed and updated in the light of experience and new knowledge. It is intended that the Code will be revised and enhanced from time to time as necessary, therefore Complementary Guidance will be issued periodically to keep it relevant to current good practice.

1.6.2 Where Complementary Guidance is issued, it will refer to the section of the Code that it is intended to replace, and this will supersede any previously issued guidance contained within this Code. It is the users' responsibility to ensure that they are familiar with all Complementary Guidance. Should the Code be required to provide guidance to resolve conflicts of opinion, the latest version of the Code, including all Complementary Guidance, should be referred to.

1.6.3 The full suite of UKRLG Codes of Practice, including this Code and any Complementary Guidance, is available to download from the UKRLG website: www.ukroadsliaisongroup.org/liaison/practice.htm

1.7 IMPLEMENTATION OF THE CODE

Identification of gaps in current practice

1.7.1 Authorities should review policies and practices at regular intervals in line with this Code and its Complementary Guidance. Should the authorities decide not to implement a particular recommendation of the Code, variations should be dealt with as described below. Users should undertake a full review of current practice within their organisations.

1.7.2 Once the current practices have been reviewed and are fully understood, authorities should identify any gaps where the current procedure does not reflect the recommendations in this Code and that have not been varied by agreed local practices. Areas should be identified which are not covered at all by current practices as well as those that are not covered in sufficient detail.

1.7.3 From this gap analysis, authorities should develop action plans for implementation. Each Implementation Plan should address all items identified below.

1.7.4 Any variations from the recommendations given in this Code should be clearly recorded within the Implementation Plan and in any appropriate policy or service standard documents, including reasons given for the variation.

1.7.5 The Code does not suggest a timescale or specific order of implementation. It is the responsibility of authorities to identify an appropriate timeframe and order in which to implement any new procedures, whilst giving due consideration to any other wider agendas as appropriate.

1.7.6 Development of the Implementation Plan should be treated as a formal project with agreed milestones, resources and budgets.

Recommendation 6 – Where authorities elect to adopt policies, procedures or standards different from those suggested by the code, it is essential for these to be identified, together with the reasoning for such differences, and approved as appropriate by the authority.

Recommendation 7 – Once an authority has established procedures for dealing with its maintenance requirements, the procedures should be reviewed on a regular basis to ensure that they are still fit for purpose and in accordance with any updated regulations or guidance.

Recommendation 8 – Authorities should undertake a full review of current practices, followed by an assessment of the differences between current practice and the recommendations set out by the Code. Once the gaps are identified, clear plans should be established on how they are to be addressed.

Recommendation 9 – The authority should develop an Implementation Plan, in accordance with the recommendations of this Code. The development of this plan should be treated as a formal project, with agreed milestones, resources and budgets in order to ensure that the optimum outcome is achieved.

Qualified personnel (including training policy)

1.7.7 The Implementation Plan should address resources and skills required for its delivery. There should be a requirement for at least one member of the maintenance team (preferably the Team Leader) to fully understand the Implementation Plan and the implication of this on the practices to be undertaken by the team.

1.7.8 All those staff involved in managing electronic traffic equipment should have appropriate experience, skills, training and equipment to perform their duties. Monitoring of all these issues should be co-ordinated to ensure appropriate levels of competence and delivery. Ongoing training should support changes in technology, materials and procedures.

1.7.9 All personnel should have a thorough understanding of personal and task-related risks, together with an awareness of the available range of actions and options.

1.7.10 If an authority does not currently have the required experience, there are several options that should be considered:

- recruitment of experienced resources;
- training of existing staff through formal courses or on the job training;
- training of existing resources through partnering approaches with other authorities or partner organisations; and
- outsourcing.

Recommendation 10 – Authorities should ensure that suitably trained staff are in place to undertake the management of maintenance of electronic traffic equipment.

Management of data and other information

1.7.11 Assets that might exist outside the context of physical infrastructure include drawings, databases, inventories, inspection records, test certificates and designs that hold valuable information about the equipment installed and its intended use. When setting up a management system, links to this data should be considered for ease of operation.

1.7.12 All authorities should develop and operate detailed management systems for their data and other information. These systems will assist in the effective management of the assets in accordance with each authority's defined maintenance strategy, to enable appropriate risk assessment strategies to be formulated, and to facilitate the purchase of electricity for unmetered equipment. Fault and repair histories, together with the results of inspections and electrical and structural testing, should be included to allow the monitoring of the condition of the assets and to determine future asset replacement programmes. These details will enable maintenance requirements to be established and provide supporting information for capital and revenue bids.

1.7.13 A properly maintained asset management system will hold information that can be used effectively and efficiently on all aspects of the service. Planning and recording of preventative maintenance of the asset is a crucial element of any system and this is dealt with in more detail in Section 4.

1.7.14 It is important to have information and data about the progress and operation of the service, including items such as:

- analysis of trends;
- recurring faults;
- specific component failure;
- response times; and
- geographical trends.

Recommendation 11 – Detailed asset management systems should be put in place.

Setting performance measures and targets

1.7.15 In order to understand whether delivery of the service is effective, authorities may consider setting a number of performance measures and targets. These should be clear, concise and challenging, as well as providing a framework under which an authority is able to deliver year on year improvements, and prove to all stakeholders that this makes a real difference to the service they receive on the network.

1.7.16 There are various service improvement groups that facilitate exchange of good practice. Authorities should consider membership of such groups, because they provide an appropriate forum for benchmarking, as well as development of new ideas.

1.7.17 Further information regarding key performance indicators is included in Section 2.4, with further details contained in Appendix B.

Recommendation 12 – Performance indicators should be used to measure authority and contractor effectiveness in delivering the service and to provide a baseline from which improvements can be measured.

Financial plans

1.7.18 It is recognised that funding is not always available, so Implementation Plans should contain a staged approach as described below:

Stage 1 – Short term measures to provide an operational setup that can manage day to day activities

1.7.19 As part of the Implementation Plan, the authority should as a minimum provide funding for what should be one-off costs of establishing or updating the system in accordance with the guidance provided in this Code. Such implementation may include: updating the library of design records for each asset, rectifying any issues within the set-up of remote monitoring and fault management systems, and any other items that the authority feel do not currently conform to this Code. The short term funding should also cover rectification of any urgent legal and safety critical issues that might be discovered as part of the implementation process and should preferably be based on a worst case scenario.

Stage 2 – Medium term measures to maintain on an ongoing basis

1.7.20 In Stage 2, authorities should ensure that, after the rectification of issues raised under Stage 1, funding is secured to adequately maintain the current assets on an ongoing basis for a fifteen year whole life cycle for each of the assets. Stage 2 may overlap with Stage 1, depending on availability of funds.

Stage 3 – Long term measures to cover a whole life cycle approach

1.7.21 In Stage 3, authorities should develop an action plan to ensure that funding is available for life cycle maintenance of current and future installations.

1.7.22 The authority should define its own life cycle targets, based on good practice, taking into account the useful life of each of the assets to the time when maintenance of the asset is likely to become too problematic and replacement will become necessary. The authority should seek to define replacement of the asset after a set number of years and will need to ensure that sufficient funding is in place in a separate refurbishment budget to meet this target.

> **Recommendation 13** – Authorities should provide financial plans for maintenance that detail their priorities as well as clear direction on how the maintenance operations will be managed in the short, medium and long term.

Prioritisation of needs

1.7.23 The authority, as part of their Implementation Plan, should clearly state the priorities for their organisation and how they intend to deal with the issues for the short, medium and long term. Paragraphs 1.7.18–22 demonstrate a clear framework for the prioritisation of needs for developing an effective maintenance regime, and the authority should consider employing such a plan. However, it is the responsibility of the individual authority to clearly set their own priorities, dependent upon their own needs, and those of the road users within their own network.

1.7.24 Authorities should not proceed with a plan that has no reasonable expectation of providing for the long term sustainability of their systems with reasonable life expectancy. Should sufficient funding not be available, those accountable should be informed of the need to reduce their expectations to the funding levels available.

Systems to process and manage faults

1.7.25 The authority should ensure that an adequate system exists to process and manage faults.

1.7.26 If an electronic system is to be used (which is desirable), the authority should ensure that each asset is set up correctly within the system database and that it is able to communicate correctly with the instation terminal. Failure to ensure that the system is working correctly will result in faults remaining unreported and therefore un-repaired, consequently leading to greater risk to members of the public and the authority, inaccurate Key Performance Indicators (KPIs) and poor performance of the asset on the network.

1.7.27 Where electronic systems are not in place to process and manage faults, the authority should ensure that they put in place a manually operated system to provide an adequate fault management process. This should be included in the Implementation Plan.

Recommendation 14 – Authorities should ensure that adequate systems are in place to process and manage faults.

Preventative and reactive maintenance

1.7.28 This Code describes the maintenance of electronic traffic equipment as reactive and preventative.

1.7.29 Reactive maintenance relates to issues that occur as a result of a fault somewhere within the system. Such faults could include: detectors broken as part of carriageway resurfacing, infrastructure breaking down owing to wear and tear or unintended interaction with the general public, such as collisions as part of a road traffic accident, vandalism or graffiti.

1.7.30 Preventative maintenance refers to items that are required to be dealt with on a regular basis. Examples of this might include bulk lamp changes at traffic signals, tree trimming regimes or time clock changes as a result of British Summer Time changes.

1.7.31 The Code provides in depth guidance for both reactive and preventative maintenance for all fixed location assets on local authority networks.

Appropriate systems for the asset

1.7.32 In the UK the size of authorities varies greatly. It is recognised therefore that a different approach will need to be adopted by authorities with many assets to be maintained and the very small authorities with very few assets requiring maintenance. However, all authorities (regardless of their size) should establish and implement a process for maintaining their assets and systems that is fit for purpose.

Section 2
Policy and Provision of Service

2.1 LEGAL POWERS, DUTIES AND OTHER GUIDANCE

2.1.1 There is a general duty of care on highway and traffic authorities to "secure the expeditious, convenient and safe movement of vehicular and other traffic (including pedestrians)". This is set out in Section 122 of the Road Traffic Regulation Act 1984 (10). Proper maintenance of traffic control systems has a part to play in meeting this duty.

2.1.2 All traffic control systems (including traffic signals and their control equipment) used on public highways must meet the requirements of:

- Traffic Management Act 2004 (1), Section 2 (England and Wales only);
- Disability Discrimination Act 2005 (11);
- Traffic Signs Regulations and General Directions (TSRGD) 2002 (12);
- Traffic Signs Regulations (Northern Ireland) 1997 (13);
- Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997 (14);
- Zebra, Pelican and Puffin Pedestrian Crossings Regulations (Northern Ireland) 2006 (15); and
- Traffic Signs (Welsh and English Language Provisions) Regulations and General Directions 1985 (16).

2.1.3 Under Section 64 of the Road Traffic Regulation Act 1984 (10), all traffic signal displays, road markings, vehicle activated signs and variable message signs are considered "traffic signs" in legal terms and must comply with the Traffic Signs Regulations and General Directions 2002 (12). Section 65 of the Act gives authorities the power to place traffic signs.

2.1.4 Section 23 of the Road Traffic Regulation Act 1984 (10) gives highway and traffic authorities the powers to place pedestrian crossings. This applies only to Zebra, Pelican and Puffin crossings, as set out in the Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997 (14). Toucan and equestrian crossings are covered by the TSRGD.

2.1.5 Direction 56 of the TSRGD contains a requirement that all control equipment for signs and signals, including the content of all instructions stored in or executable by it, must be of a type approved in writing by the Secretary of State. In practice the Type Approval process is managed by the Highways Agency. Advice on this is given in TD 7/07: *Statutory Approval of Control Equipment* (17).

2.1.6 TD24/97: *All Purpose Trunk Road Inspection and Maintenance of Traffic Signals and Associated Equipment* (18) specifies the inspection requirements and maintenance procedures for traffic signal equipment that each maintaining

authority should consider carrying out. It is considered to be good practice that this document also be applied, wherever possible and appropriate, to any maintenance regime associated with other specialist traffic control and monitoring related equipment. This document also specifies the need for records to be kept and monitoring undertaken to ensure that up to date information is kept for all sites. This is particularly important, as each maintaining authority will be able to carry out the necessary risk management for each site based on the fault records and site information. Note that while use of TD 24/97 is only mandatory on trunk roads, local authorities may also find it useful as good practice guidance.

2.1.7 TA 84/06: *Code of Practice for Traffic Control and Information Systems for All-Purpose Roads* (19) provides a framework for all maintaining authorities to follow with regards to the whole life cycle of traffic control and information systems. This includes a section detailing the operation and maintenance requirements which expands on the requirements set out in TD24/97.

2.1.8 As part of maintaining traffic control systems, there is a duty of the maintaining authority to take all reasonable steps to ensure the safety of maintenance personnel and the public. TD24/97, while specifically relating to trunk roads, is an important document for local authorities which summarises the statutory requirements for road safety and electrical safety that should be integrated within the maintenance authority's specifications and procedures. These procedures should ensure that site operatives are familiar with and apply the good practice necessary to safeguard safety. Such legislation and guidance includes:

- Construction (Design and Management) (CDM) Regulations 2007 (20);
- Health and Safety at Work etc. Act 1974 (21);
- Traffic Signs Manual Chapter 8 (22);
- BS7671:2008 *Requirements for Electrical Installations* (IEEE Wiring Regulations, Seventeenth Edition) (23);
- Electricity at Work Regulations 1989 (24); and
- Electricity at Work Regulations (Northern Ireland) (25) 1991.

2.1.9 The Health and Safety at Work etc. Act 1974 (21), together with the Management of Health and Safety at Work Regulations (Amendment) 2006 (26), and the CDM Regulations 2007 (20) set out the requirements for authorities to carry out work in a safe manner and establish arrangements for the management of construction works.

2.1.10 In Northern Ireland the equivalent legislation is the Management of Health and Safety at Work Regulations 1992 (27) and the Construction (Design and Management) Regulations 1997 (Northern Ireland) (28).

2.1.11 The New Roads and Street Works Act 1991 (NRSWA) (29) is an enabling act setting out the duties of authorities to co-ordinate and regulate works carried out on the highway. For maintenance of traffic control systems, each maintaining authority has a duty to liaise with the appropriate NRSWA co-ordinator.

2.2 MANAGEMENT OF MAINTENANCE

Strategy

2.2.1 All items of electronic traffic equipment require inspection and maintenance to ensure that they: are safe, operate correctly, continue to provide the designed performance, and that the length of their life cycles is maximised. Maintenance can be divided into two aspects:

- **reactive** – where failures of equipment are recorded and the equipment is repaired or replaced (see Section 3);
- **preventative** – a process of maintenance carried out on a cyclical basis to help reduce or eliminate failures and to ensure the system is operating at its intended design outputs (see Section 4).

2.2.2 A service management strategy, covering the structure of the organisation, details of the service provision and the targets to be achieved, should be implemented. The targets should be related to the defined policies of each authority. Without clearly defined targets, it will be difficult to assess how successfully the service has been delivered.

Management and operation systems

Approach

2.2.3 The management of the asset, energy and maintenance activities is best organised using dedicated software specifically designed to handle electronic traffic equipment. A comprehensive package will include: equipment inventories, work instructions and monitoring, scheduling of cyclical activities, energy calculations and financial control. Digital mapping, with links to the asset database, should also be incorporated and should be used to record highway

power supplies, cable records and feeder pillar locations. Other information, such as new works plans, photographs, design drawings and risk assessments, can also be incorporated if required.

2.2.4 Without access to computerised data and records of work carried out, the reporting of key information and the production of KPIs will be very difficult. Management information and data analysis of failure modes, response times and expenditure provide the opportunity to plan for the future whilst controlling the present.

Fault Management Systems

2.2.5 Fault Management Systems (FMS) are designed to pass reported faults to maintenance contractors with minimum human intervention. The authority should seek to establish an effective system whereby faults received on Remote Monitoring Systems (RMS) and Urban Traffic Control (UTC) are capable of being directly transferred to FMSs with appropriate instructions to the maintenance contractors, which will allow them to repair the fault.

Recommendation 15 – Authorities should establish effective systems for the transfer of faults from UTC and RMS to an appropriate FMS, with instructions to the maintenance contractor providing enough detail to allow the effective repair of the fault.

Competence of staff

2.2.6 The competence of staff should be addressed within the Implementation Plan as discussed in paragraphs 1.7.7–10. This section provides further information on Sector Scheme Accreditation, health and safety, and environmental awareness requirements.

Sector Scheme Accreditation

2.2.7 The National Highways Sector Schemes have been gradually introduced to the highways industry, with the first schemes commencing in 2002 and many others being added since. Each scheme is a bespoke integrated management scheme within an ISO 9001:2000 framework.

2.2.8 The schemes are designed to:

- provide an industry benchmark;
- ensure that all processes are planned;
- provide a basis for continuous improvement;
- focus on quality as an objective;
- reduce overall costs for the authority and supplier;
- provide and maintain a properly trained and competent workforce;
- involve all sides of the industry in scheme ownership within a partnership framework;

- ensure that Certification Bodies use auditors with technical knowledge and experience of the sector concerned; and

- promote confidence in quality management systems by provision of a robust, transparent system.

2.2.9 The Highways Agency requires the registration of operatives under the Sector Scheme. Authorities may wish to consider the accreditation of appropriate operatives under the Sector Scheme as good practice. When awarding maintenance contracts, it is good practice for the authority to seek assurance that all successful tenderers are able to prove competence through the registration of operatives on the Sector Scheme.

2.2.10 Further information regarding Sector Scheme registration can be obtained by visiting the following website:

www.bsigroup.com/en/BSI-UK/Assessment-and-Certification-services/Management-systems/Standards-and-Schemes/Highway-Sector-Schemes/

Health and safety

2.2.11 Authorities and contractors must ensure that they comply with the latest health and safety requirements. Authorities' maintenance providers must be fully trained in all issues of health and safety, relating to risks that a contractor might be exposed to in the course of their duties. Exposure to risks is an everyday occurrence for a maintenance provider; however, it is the way in which these risks are recognised and mitigated that will ultimately limit exposu

Environmental awareness

2.2.12 As a minimum, all authorities should comply with relevant legislation regarding the environment. Many authorities may choose to consider additional environmental training for their staff, to enhance their understanding and make appropriate considerations in the delivery of the service.

2.3 DESIGN AND INSTALLATION FOR MAINTENANCE

Design overview

2.3.1 Any new design should take full account of the maintenance requirements of the asset following implementation. Appropriate design decisions should be made which will lead to minimised maintenance requirements for the site and a reduced impact upon the network. Unnecessary maintenance requirements, such as road closures and diversions for loop cutting, should be designed out where possible. If for any reason it is not possible to design out maintenance issues, then these should be clearly identified at the design stage.

> **Recommendation 16** – Designers should take account of the whole life cycle of the asset, including installation, maintenance and decommissioning, during the design stage.

Materials

Selection

2.3.2 When selecting materials and components for an asset, the designer needs to take account of many factors. First and foremost is that the asset should be able to achieve its set objectives. There is often more than one way of achieving this, and other factors should also be taken into consideration.

2.3.3 Selection of materials and components at the design stage should take into account the ease and cost of maintenance. Designers should seek to mitigate risks associated with both installation and maintenance at the point of source, and this mitigation should also be extended to the use of suitable materials and components.

2.3.4 Authorities should consider a number of issues before proceeding to the installation phase:

- Does the asset in its proposed state achieve its objectives, while meeting all relevant safety and legal requirements?
- Are there any cost effective changes that could be made without compromising the usefulness or safety of the asset?
- How easy will the asset be to maintain?
- Are there any cost effective changes that could be made to make maintenance of the asset less risky and less costly?
- Is a specialist supplier required for any of the components?
- If a specialist supplier is required, what will happen if they go out of business?
- Are there likely to be any significant issues when decommissioning is required? Can these be reduced by redesigning any aspects?

2.3.5 It is also the responsibility of both the designer and approving authority to ensure that adequate measures are put in place to minimise the effect on the environment. The environment can be affected in many different ways, but some of the considerations that should be kept in mind are detailed below:

- use of materials in keeping with the local environment;
- reduce waste material wherever possible;
- minimise landfill requirements by recycling; and
- re-use old equipment where appropriate;

Installation

2.3.6 Where possible, authorities should seek to specify materials with the installation process in mind. Where possible, materials should be used that will mitigate against as many installation risks as possible. These risks will include health and safety issues such as the amount of time that a maintenance contractor is required to work at height or the length of time that a contractor might be required to work in the carriageway; or they may include other risks such as the amount of waste material that is generated during installation, or the use of equipment that is out of keeping with the local environment.

2.3.7 Well chosen materials for use in the installation process can make a significant difference to the cost and complexity of maintaining that system in the future. For example, specifying pole retention sockets at a traffic signal junction means that, should the pole be knocked down in a road traffic accident, a new pole could be installed for minimal cost and disruption, thus restoring the asset to full working order.

Maintenance

2.3.8 When falling under the maintenance operation, an asset is likely to remain in a fixed state until it is decommissioned, simply being maintained or repaired when required. The authority should continually review the configuration of the asset throughout its life cycle and make sensible amendments at a time when maintenance is required.

2.3.9 For example, inductive loops might be damaged or destroyed during resurfacing of the carriageway. In this situation, it might be cost effective to commission a speed survey on the road to investigate whether Microwave Vehicle Detectors (MVDs) could safely be deployed instead of inductive loops. If possible, replacement with above ground technology will not only make installation more cost effective but will reduce the risk of damage in the future.

2.3.10 As technology improves, it might be possible to improve the maintainability of an asset through the use of new innovative products, in a way which was not possible when the asset was originally designed. Authorities should take advantage of such technology wherever reasonably practicable, as long as the benefits justify the costs.

2.3.11 Making changes such as this will have a positive effect on the KPIs that the authority sets, and will help towards achieving a year on year improvement.

Design

CDM requirements

2.3.12 Following its initial introduction in 1994, the CDM Regulations were revised in 2007. The revised Regulations are intended to make it easier for those involved in construction projects to comply with their health and safety obligations. Further information may be downloaded from the following website.

www.hse.gov.uk/construction/cdm.htm

2.3.13 All parties involved in the design, installation and maintenance of a scheme should be aware of their duties under the CDM Regulations and should undertake their responsibilities fully.

Risk assessment

2.3.14 The designer should ensure that a full risk assessment is undertaken for each new asset. The risk assessment should take into account the design and installation process and pay special regard to any risks that might become an issue within the maintenance and decommissioning phases in the life cycle of the asset. An example of a maintenance risk that might be able to be designed out with careful consideration is the requirement for a lane closure in order to access street furniture or wiring.

2.3.15 The designer should seek to mitigate as many of the risks as is practicable. It is recognised that not all risks can be designed out, so the designer should ensure that, where it is not possible to completely eliminate a risk, efforts are made to reduce the impact or likelihood of the risk occurring.

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2.3.16 The designer should retain the risk assessment document within the design pack and a copy of this should be passed to the maintenance department to be kept within their records. The maintenance provider should review the site risk assessments periodically to ensure that they are still appropriate for the asset and surrounding environment. Should site conditions change for any reason during the maintenance phase, it will be the responsibility of the maintenance provider to update the risk assessment accordingly.

2.3.17 If a visit to the site is required by another contractor, it is the responsibility of the maintenance provider to ensure that that contractor is aware of the risk assessment and any special measures that should be taken, prior to its staff attending site.

2.3.18 Those staff should undertake their own risk assessment, when they first get to the site, to ensure that the working environment will be safe for the workforce and members of the public while works are being undertaken. If they observe that the risk assessment is inappropriate for the site, it will be their responsibility to feed back appropriate comments to the maintenance provider within a reasonable timescale, to minimise the risk to any future visitor to the site. The maintenance provider should ensure that the risk assessment is updated with any comments received within a reasonable timescale and before any future site visits are undertaken.

2.3.19 In addition to the above risk assessments, risks should be assessed for the overall maintenance operation, for example reviewing the risks of not undertaking preventative maintenance inspections and actions and mitigating those risks as appropriate.

Health and Safety File

2.3.20 The Health and Safety File should be compiled by the CDM Co-ordinator as part of the design phase and should contain all of the design information for CDM notifiable projects. The Health and Safety File should be retained by the owner of the asset and used during the maintenance of that asset.

2.3.21 The Health and Safety File should be made available for the maintenance provider by the asset owner. It is imperative that the file is updated as appropriate, should site conditions change for any reason.

Installation, commissioning and handover

Quality of installation

2.3.22 Authorities should ensure that they are aware of the quality of work that contractors are likely to undertake and seek reliable references from previous employers before entering into any contractual agreement.

2.3.23 When assessing tenders for installation work, authorities should not simply look to accept the lowest price, but should seek to build in assurances of the quality of the work to be undertaken.

2.3.24 The quality of the installation will have a direct effect upon the future costs of maintaining the asset, as the higher the quality of the installation, the more cost effective maintenance for that asset is likely to be.

Site supervision

2.3.25 Site supervision during the installation procedure should be undertaken whenever necessary to ensure that the work meets the appropriate quality and standard. Site supervision ensures assurance on the quality of installation provided by different companies and on the compliance with appropriate electrical standards. It also provides assurance to the maintenance contractor that the installation has been undertaken competently.

2.3.26 Adopting an approach of undertaking site supervision will give authorities the opportunity to rectify issues at the point of source, rather than discovering them down the line when they might be more difficult, time consuming and expensive to resolve.

As-built records

2.3.27 From time to time authorities will receive requests for statutory undertakers' notices for new works.

2.3.28 Records should be kept as part of the installation process as to the location of all equipment relating to the asset, both above and below ground.

2.3.29 Production of as-built drawings is a recognised way of recording accurate site information and to detail any differences between the original site design drawings and the installed asset.

2.3.30 A good record of the locations of all underground apparatus will reduce the risk of future damage to the asset and minimise the risk of injury to operatives digging within the vicinity of the asset, for which the authority will be liable.

Commissioning and acceptance

2.3.31 Each authority may wish to have its own commissioning, factory acceptance and site acceptance procedures, including checklists and approved personnel lists for all asset types.

2.3.32 The procedures should be clearly documented such that, in the event of a claim, the authority is able to clearly demonstrate that an asset has been site acceptance tested by a competent person. Example forms for commissioning equipment are included in Appendix D.

2.3.33 Records should be retained of every site acceptance test, whether completed satisfactorily or not, and these should be passed to the authority when the asset is formally handed over from the installation phase, to be kept within the maintenance records.

Handover to maintenance procedures

2.3.34 Authorities should ensure that an adequate handover procedure to their maintenance department is in place following the site acceptance of the asset.

2.3.35 The handover procedure should include acceptance and agreement of both the designer and an agreed signatory for the maintenance department that the asset has been appropriately installed and commissioned. Until such time as the formal document is signed, the asset should remain the responsibility of the designer to ensure that all outstanding installation issues are resolved to the satisfaction of the maintenance department signatory. An example form for the handover of the asset from the designer to the maintenance team is included in Appendix D.

2.3.36 Should faults occur post commissioning but before the asset is passed into maintenance, it will remain the responsibility of the designer to ensure that these faults are rectified. It is good practice for the authority to insist that the maintenance provider is present at the site acceptance test to sign the installation off as appropriate, for handover to the maintenance department.

Trees

Design: effect of trees

2.3.37 The effect of trees on the performance of the asset should be considered at the design stage and care should be taken to minimise the need for unnecessary pruning and damage to the trees throughout the expected life cycle of the asset. Account should be taken of the inevitable growth in height and spread of the tree, and help and advice sought from an arboriculturist as appropriate at the design stage.

2.3.38 Care should be taken to avoid unnecessary damage to roots and branches when erecting or removing assets or excavating cable trenches. See National Joint Utilities Group (NJUG) *Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees* (30) for further details.

Maintenance regime requirements

2.3.39 Suitable arrangements for monitoring any interference with the performance of the asset and for pruning should be included within the asset maintenance records. Only minor pruning of branches up to 50mm in diameter should be carried out by maintenance personnel. More extensive pruning should be carried out by qualified operatives under the supervision of an arboriculturist. For further information refer to BS 3998:1989 *Recommendations for Tree Work* (31).

Maintenance factors

Design for maintenance

2.3.40 The designer should ensure that the requirements of maintenance are incorporated within the design; this can best be achieved by liaising with the maintenance provider during the design.

2.3.41 Around the UK there are many examples of poor design practices, where little consideration has been given to the maintenance of the asset.

2.3.42 The designer should look to design out or reduce the risks that occur during maintenance activities. The designer should also ensure that access to the asset is made as simple as possible, for example by providing a parking bay for maintenance personnel or by placing a controller cabinet away from objects that will hinder access to it.

Specification of products requiring reduced maintenance

2.3.43 The designer should always think about specifying components that will reduce the maintenance requirement. A good example of this is to provide above ground detection instead of inductive loops at a traffic signal controlled junction, where there is scope for making such a decision.

2.3.44 The designer should assess the maintainability of the specified components and determine whether this is the most cost effective way of providing the required technology at the given location, over the whole life cycle of the asset.

Use of energy efficient equipment/products

2.3.45 The designer should specify energy efficient components wherever possible, for the reasons discussed in paragraphs 2.3.52–60.

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Decommissioning

Procedures

2.3.46 Authorities should ensure that they have their own procedures relating to the decommissioning of an asset.

2.3.47 Each authority should prepare in advance a site specific plan for decommissioning, including appropriate risk assessments and any relevant information retained from the design file, and should inform all stakeholders of the details and reasons for the proposed decommissioning. Other appropriate information that could be included within this liaison are agreed timescales and expected outcomes following the removal of the asset.

2.3.48 The decommissioning process should be carefully managed, with any work undertaken monitored and signed off as complete by a competent person on behalf of the authority. Careful management of the scheme will minimise the risk of claims from members of the public from trip hazards left in footways or through injury caused through the absence of the asset.

2.3.49 The authority should retain a copy of the documentation produced as evidence in the event of a claim.

Records

2.3.50 All records relating to the asset, including designs, risk assessments and maintenance records, should be kept for a minimum period, normally seven years, following the decommissioning of the asset. This will help to protect the authority from possible personal injury claims. The authority may wish to retain records for longer than seven years at its discretion.

Waste disposal

2.3.51 Following the decommissioning of an asset, the authority should consider waste disposal, as discussed in paragraphs 2.3.52–60. Contractors should also share responsibility with regards to recycling.

Environmental factors

Use of energy efficient equipment/products

2.3.52 Authorities should specify and source the use of energy efficient products wherever possible. Technology is moving forward rapidly and new products are being introduced to the market on a regular basis. Many of these products reduce energy consumption. This supports the reduction of carbon emissions as well as reducing electricity costs. Low voltage equipment reduces the risk of electric shock to operatives.

2.3.53 Examples of the type of energy efficient technology currently available include ELV equipment and LED technology – however, this is by no means exhaustive and it is recognised that, following the publication of this Code, the market will continue to develop in this area.

2.3.54 Innovative low energy technology should be considered for use by authorities as it becomes available, in order to support the reduction of their carbon footprint and contribute towards the Government carbon reduction targets. Appendix G provides a case study provided by Newcastle City Council which shows the energy and cost savings that they experienced when they trialled the use of ELV equipment.

2.3.55 In addition to the use of low energy products, authorities should consider the use of alternative energy sources such as solar power, wherever practicable.

Waste disposal

2.3.56 Authorities should ensure that they and their contractors minimise waste materials during design, installation, maintenance and decommissioning.

2.3.57 Examples of waste materials that could be generated during these processes include protective packaging containing new products, batteries that require changing and lamps replaced during preventative maintenance.

2.3.58 Authorities should always seek to re-use any items where possible. Should this not be practicable for any reason, recycling should be adopted and considered before sending waste to landfill.

Energy reduction measures

2.3.59 A number of authorities have recently begun to implement energy saving measures such as switching off street lighting during the middle of the night. Authorities should consider the environmental and financial benefits and risks of implementing similar measures for the switching off of non safety critical assets, such as variable message signs (VMS), overnight. A consultation process identifying the benefits, negative impacts and risks associated with switching off assets should be undertaken before any such actions are taken. This should be documented and retained by authorities.

2.3.60 However, changes such as these could have detrimental effects on the life cycle of the equipment and introduce additional safety risks at the location. In addition, the cost savings and carbon benefits of switching off these assets might be minimal, as the internal heater might need to remain in operation at all times, for example.

2.4 PERFORMANCE MANAGEMENT

Improving performance

2.4.1 Knowledge of, and comparison with, other authorities might lead to changes in the way the service is delivered. It is always good practice to review the service being provided on a regular basis, giving due consideration to the potential benefits and improvements that might be achievable.

2.4.2 Regardless of these external influences, there is an inherent expectation that all parties involved in delivery will seek ways to improve the service, to meet the customers' needs. The introduction of new techniques, new equipment and new management strategies should have identifiable beneficial outcomes, which should be monitored to ensure that the perceived benefits have been achieved and if not, understand the reasons why.

2.4.3 Cost implications should be recognised but savings or increases in expenditure should not be the sole consideration.

2.4.4 KPIs should be used to measure the performance of the authority and the maintenance provider in delivering the complete service, and to provide a baseline from which improvements can be measured. The items listed in paragraphs 2.4.5–8 that are to be reported annually should be monitored continuously, so that corrective action and improvement can be taken as soon as required.

Performance reporting

2.4.5 Authorities should report actual performance against their service policy statement annually. The report should include both National Indicators (NIs) and Local Performance Indicators (LPIs), and may also include other relevant statistics.

2.4.6 There are two main functions of the indicators:

1. to provide internal management information to monitor and control service delivery. It is not expected that this information will normally be published unless it is considered advantageous to do so; and

2. to provide performance information to be made available in the public domain.

Table 2.1: Examples of useful indicators for performance reporting

Indicators for internal management review	Indicators for public performance reporting
The average time to identify a fault	The total number of faults identified by: • the authority patrol • automated fault detection • public reporting
The number of actual patrols completed	The percentage of assets working as planned
The average time from identification of the fault to the issue of instruction for repair (this is a measure of the management of works identification and the authority's effectiveness)	The total number of failed or faulty Distribution Network Operator (DNO) service connections
The length of time from instruction to completion of the repair.	The total number and cost of incidents of: • vandalism/wilful damage • vehicular impact
The percentage of return visits (this provides a measure of the effectiveness of repairs undertaken by the maintenance provider)	
The number of call outs to emergency repairs	
The DNO's performance, time from instruction to completion	

2.4.7 The main difference between the two reporting types in Table 2.1 is that it is useful for the public to be able to see some statistical data in order to develop an understanding and appreciation of the service provided. When information is gathered for internal reporting, this data is more likely to be used for monitoring the performance of all parties involved in the contract.

2.4.8 In addition to the above, Government might require other PIs, which, if needed, should be included in the annual report produced by the authority.

Recommendation 17 – Annually, authorities should report actual performance in complying with their service policy statement, including National and Local Performance Indicators as appropriate.

Managing compliments, complaints, comments and claims

2.4.9 Customer care will normally be integrated into an authority's overall policy for response to compliments, complaints and comments. For this purpose, it is useful to distinguish between (a) reports of equipment not working or where it is considered to be operating incorrectly and (b) complaints where a previous report appears not to have been rectified. The former should be treated as a fault and dealt with accordingly, whereas the latter should be classified appropriately as a complaint or comment under the authority's customer care procedure.

2.4.10 Potential claims against an authority should be dealt with in full by the authority. Any action which may lead to a contractor being liable for a potential claim should be dealt with by the authority that is responsible for the scheme. Any claim against the contractor should be issued by the authority, within the terms of the contract.

Section 3
Reactive Maintenance

3.1 INTRODUCTION

3.1.1 This section provides guidance for the reactive maintenance of electronic traffic equipment. Historic maintenance contracts, under which many authorities maintain their asset, concentrate on reactive maintenance of equipment, simplified as “fixing the problems as they occur”.

3.1.2 Reactive maintenance is an important element of a maintenance operation, as it provides an immediate response to faults/issues that have occurred at a particular asset or within associated systems such as Urban Traffic Management and Control (UTMC) and reduces the negative impact on the travelling public.

3.1.3 Reactive maintenance requires contracts to be drawn up between the authorities and maintenance contractors, which should contain expected deliverables and contractual performance criteria such as response times to faults.

3.1.4 The authority should ensure that the maintenance contractor has sufficient processes in place to complete the maintenance procedures identified by the contract. Specific areas on which the authority might want to seek evidence from the contractor at the time of tendering include:

- processes to effectively manage repairs;
- assurance of the availability of spare equipment for emergency works; and
- likely availability of operatives for works to meet response times and other contract deadlines.

Recommendation 18 – Authorities should satisfy themselves that maintenance contractors have satisfactory procedures in place to provide an effective maintenance service, as required by the contract.

Steering Group/Atkins Project Team

3.2 MAINTENANCE PROCESSES FOR ALL ASSETS

Fault monitoring, reporting and management processes

Fault monitoring and reporting

3.2.1 Procedures for fault monitoring and reporting were initially developed for early traffic control assets such as traffic signals and have evolved over a number of years, taking into account operational experience and technological advancement.

3.2.2 There are many well defined principles of maintenance that can be applied to the wider field of electronic traffic equipment. Many of these principles are generic in their nature, such that they will apply to any types of asset that are covered by this Code. This section deals with these generic processes, with any exceptions identified on an asset by asset basis later in the Code.

3.2.3 Electronic traffic equipment faults are identified in three ways:

1. **Maintenance inspections** – The contractor identifies an electrical or structural issue through the planned inspection process. Once any issues are identified, the repair might be carried out immediately if appropriate or, should advanced works be required, then the issue should be logged on inspection documentation or reported by the contractor via the authority's fault reporting process.

2. **Remote Monitoring Systems** – A RMS monitors the operation of the asset continuously, using communication links between the asset and the fault reporting centre. Some systems can be configured to automatically raise faults with the contractor and therefore there is little or no human intervention required. Recommendations on what RMSs should monitor are detailed in TD24/97 (18); however, the failures detectable for each asset type will depend upon the asset's functionality.

3. **Third party reports** – Fault reports from third parties can be an invaluable way of providing additional information to the maintenance process. Usually, third party reports are likely to be obtained from one of the following sources:

- the public;
- police; and
- highway inspectors.

3.2.4 In order to ensure that third party reports can be effectively received, the authority should take steps to ensure that stakeholders can obtain the appropriate contact details of the authority's maintenance department. This can be achieved using media such as controller cabinet stickers, websites, the local press and radio. This list is not exhaustive, and the authority should develop its own procedures regarding how and where to advertise appropriate details.

3.2.5 The reporting of faults defined in 1 and 3 above will inadvertently raise issues that are outside of the normal definition of a fault, such as tree issues or disagreement on the operation of traffic signals. The authority should have a process in place to assess and manage these issues, which will help ensure that the correct response is taken.

3.2.6 Once a fault is identified, the report to the maintenance contractor can be provided in a number of ways, depending upon the contract and size of the asset. However, in every case there is a minimum level of information required in order to ensure that an efficient repair can be undertaken. This information is shown in Table 3.1.

Table 3.1 – Minimum information required for fault repo

Minimum information required	Details
Date/time	Date/time fault occurred and date/time fault issued to contractor
Location	Address of asset and specific asset reference (for example the signal controller reference number)
Fault details	What equipment is faulty? For example, a lamp fault or leaning pole. These details should also provide the specific location of the fault, for example the pole number and/or the road name and direction of the flow of traffic.
Fault priority and response time	Contractor's required response time for urgent and non urgent faults
Equipment details	Provide details about the asset, for example the traffic signal controller type or lamp details
Reported	Name and contact details of the reporter
Comments	Specific information relating to the site, for example repeat visits required, fault history or specific requests made

Fault management processes

3.2.7 Managing the fault after it has been reported is as important as the initial reporting procedure.

3.2.8 The type of fault reported will require one of a number of possible actions including:

- contacting third parties (for example the police or local bus companies);
- ensuring the contractor attends the fault and fixes it within the required time period; and
- ensuring that the fault is repaired during the first visit.

3.2.9 This Code does not specify how an authority documents the specific management actions, as the basic information will be the same, whether put through a Fault Management System (FMS) or kept on a spreadsheet.

3.2.10 However, the authority should have a defined process in place that will ensure the fault is properly managed from the time that the initial report of failure is received to the completion of the final repair. An example process is shown in Figure 3.1.

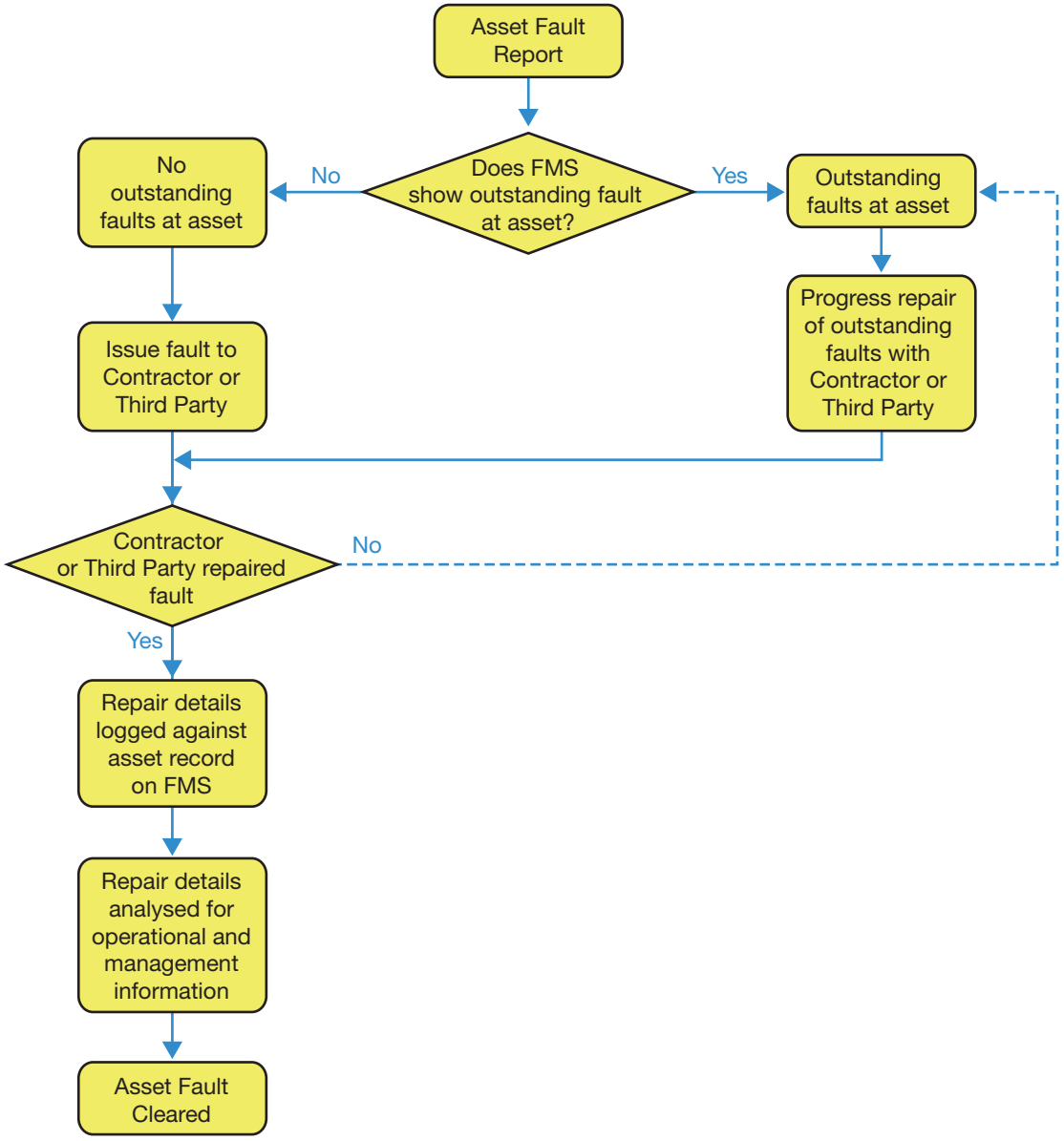

Figure 3.1: Typical flow chart detailing the reporting and management process for maintenance

Fault prioritisation and response times

3.2.11 Different types of faults require different levels of response, depending on the effect the fault can have on the highway network and the risk to third parties. The levels of response should be detailed in the authority's maintenance contract and should contain the following information:

- **Fault priority level** – Urgent/non urgent/chargeable – details the priority of different types of faults – see Table 3.2 for examples.
- **Fault response time** – Number of contract hours allowed to "Attend" or "Attend and fix" a fault. This will be dependent on contract conditions; however, this will ensure the contractor is responding as the authority has specified.
- **Contract hours** – The period(s) of time when the contract is valid (for example 7 days a week 08:00 to 18:00). The contract hours define when the response times are valid. For example, if a fault is raised at 16:00 and the contract hours previously detailed are valid, the response time will stop counting down at 18:00 and will resume the next day from 08:00.
- **Overall system availability** – The percentage of time that the system is available to be operational during the hours of the contract.

3.2.12 Fault types should be categorised at different priority levels – for example, safety issues should take priority over communication issues. The authority should define within the maintenance contract which type of faults should be fixed as urgent and which faults should be non-urgent. Authorities should adopt a risk based approach for this decision making.

3.2.13 Table 3.2 details some sample priority types and examples of contract hours for the differing types of faults.

Table 3.2: Sample fault priorities and response times

Fault types	Priority	Response time
Not working – Lamps off/all out/supply fail	Urgent	4 contract hours
Emergency repairs – Road Traffic Collisions (RTCs)/ vandalism	Urgent	4 contract hours
Lamp – Safety critical	Urgent	4 contract hours
Structural – Safety critical	Urgent	4 contract hours
Communication – British Telecom (BT), Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS) etc.	Non-urgent	9 contract hours
Detection – Carriageway and above ground	Non-urgent	9 contract hours
Lamp – Non safety critical	Non-urgent	9 contract hours
Structural – Non safety critical	Non-urgent	9 contract hours
Chargeable works – Those recharged to third parties, e.g. motorists who have caused damage	Chargeable	Depends on type and severity of fault (as categories above)

Emergency service

3.2.14 For emergency reporting and repairs, authorities should seek to implement local procedures, to deal with these issues in a way which is appropriate for their networks.

3.2.15 One approach might be that an authority ensures that a facility to report emergency situations and works 24 hours a day, seven days a week is operational and available for the receipt of third party reports. This service might be run by the authority and will call upon the contractor to attend site immediately as required.

3.2.16 The contractor's response is likely to be an "Out of contract hours" service provided to deal with emergency repairs to the asset, for example a traffic signal pole that has been knocked down by a RTC. In such a circumstance, the maintenance contractor will attend site to assist the authority by making the traffic signal equipment safe to the public.

3.2.17 The service level provided by the contractor will depend on the requirements specified by the contract.

Persistent non-performance

3.2.18 Persistent non-performance can be detrimental to the public perception of the quality of the service. This might be a result of long delays before repairs are completed. The causes are various and might include:

- poor quality of workmanship;
- breaches of health and safety processes;
- persistent failure to meet defined response times;
- obsolete equipment/lack of spare equipment;
- delays in assessment and managing of work; and
- lack of inventory data.

3.2.19 Where issues of under-performance are identified, a technical review should be undertaken with the aim to provide an improved performance in the future.

3.2.20 An agreed improvement plan should be developed detailing the action(s) to be taken, deadlines for implementation and ways of measuring success. If the issue has contractual implications, then the contractor should be formally notified, by means specified in the contract. This should include a copy of the improvement plan.

3.2.21 The authority should ensure that a procedure is in place to deal with continued poor contractor performance. The termination of the contract will remain the last option available to authorities and should only be considered if earlier efforts to improve performance fail. Authorities should ensure that all efforts to bring the contractor in line with the performance levels documented in the contract are recorded, to ensure that, in the event of the contract being terminated, they have good records to counteract any challenge to the termination.

3.2.22 Termination of a contract should be a last resort, as the cost of retendering a contract is high and there is an issue regarding who will deal with faults that occur in the period between the old contract being terminated and any new contract commencing.

On site activities

3.2.23 It is important to ensure that the contractor has an efficient fault diagnosis process for site works and has the capability to make appropriate decisions with regard to repairs and replacement components. The contractor should be competent to ensure that the asset is restored to full working order, is mechanically safe and is left in a functioning state as intended.

3.2.24 Adequate time should be allowed for authorities' inspectors to undertake any necessary testing, to ensure that the repair has been effective. Unsuccessful repairs that lead to further visits are detrimental to service delivery, wasteful of resources and have a negative impact upon the authority's carbon footprint.

3.2.25 Whilst the contractor is on site, the authority should seek to instruct them to undertake an asset health check by visually inspecting the asset to identify any other optical/mechanical/electrical defects. Any defects found should either be repaired immediately or reported via the maintenance procedure for future work. Minor repairs and adjustments might best be undertaken before leaving the site, either with or without agreement of the authority. The authority and contractor should establish the extent and scope of works that can be undertaken without reference back to the authority as part of the contract. Some works might require authorisation to proceed; other works might require further management, assessment and scheduling into a works programme.

3.2.26 Other issues for consideration during the maintenance inspection include:

- cleaning;
- obstruction by tree foliage; and
- risk assessment updates.

3.2.27 Where there are doubts as to the accuracy and completeness of the inventory, a check during the inspection should be considered, in order to provide any missing information.

Completion of fault records

3.2.28 All faults that have been raised should be given a fault record, which should include details such as description of the work involved, when it was carried out and the party undertaking the work.

3.2.29 This information should be recorded as part of the fault management process in case future reference is required, for items such as defending claims from the public and identifying future maintenance requirements. Table 3.3 provides a list of the minimum information required on each fault record.

Table 3.3: Completed fault report information

Minimum information required	Activity
Job reference	Record a unique job reference – to be allocated by the contractor or the authority
Date/time	Record the date and time the fault was issued Record the date and time the fault was cleared or attended by the contractor
Location	Record the address of the asset and any specific asset reference
Fault details	Record what fault has been identified, what work was carried out and what equipment was used to repair the fault
Fault priority and response time	Record the contractor's required response (i.e. urgent or non-urgent) and what the actual response time was
Equipment details	Record the actual asset details, for example the traffic signal controller type or lamp details
Engineer	Who attended the fault and carried out the repair
Comments	Record any other issues identified on site by the engineer. If the fault was not fully repaired, provide the details of any follow up action required to complete the repair.

Unsuccessful or incomplete work

3.2.30 If the contractor is unable to make a repair, or for some reason the repair was unsuccessful, the contractor should be required to re-attend site to carry out an effective repair within a revised and shortened response time. Authorities should ensure that the issue of time-frames for re-attendance for unsuccessful or incomplete work is detailed within maintenance contracts.

3.2.31 Contractors should investigate the cause of unsuccessful or incomplete repairs. This will ensure continuous improvement in their own performance level, as well as ensuring that the repair of the asset can be undertaken effectively at the next visit.

Verification

3.2.32 The contractor should provide supervision to monitor works, ensuring repairs are completed satisfactorily in accordance with the contract and internal method statements and procedures.

3.2.33 Authorities should ensure that repairs meet the specified requirements. This can be done in two ways:

- implement a system of random and regular site audits to examine completed work on site and the associated data; and
- verify via the RMS systems that faulty equipment has been fully repaired and is operational, utilising the contractor's personnel whilst they are still at site.

3.2.34 Authorities should use both methods to ensure that the service provided by the contractor meets expectations and the contract conditions.

Compatibility of equipment

3.2.35 Care is required in the choice of replacement components or assemblies following the identification of faults on existing assets. With an increasing number of manufacturers, caution has to be exercised when looking to replace equipment, to ensure that performance of the asset is not affected and the replacement component performs as required.

3.2.36 Additional complications are introduced by new technology, such as ELV controllers, which might not be compatible between manufacturers.

3.2.37 The contractor will need to discuss with the authority potential issues such as the likely compatibility of components, prior to undertaking any work.

3.2.38 UTMC systems are designed to allow different applications used within modern traffic management systems to communicate and share information with each other. This allows data from multiple sources, for example Automatic Number Plate Recognition (ANPR) cameras, VMSs, car park guidance systems and traffic signals, to be operated from a single central console or database.

3.2.39 The purpose of UTMC is to maximise the network capacity of the highway by creating a more robust and intelligent network management operation, to meet the current and future road user requirements.

Poles and furniture faults – knockdowns, vandalism

3.2.40 Faults identified on poles or street furniture can be as a result of a number of circumstances, for example RTCs, vandalism or wear and tear, and will require varying actions:

- **RTC fault** – Generally this type of fault requires an emergency response and action by the contractor, where the furniture could either cause an obstruction on the carriageway or an electrical hazard;
- **Vandalism fault** – This type of fault response will vary depending on the amount of damage caused and the location of the asset; and
- **Wear and tear** – These types of faults are normally identified through structural inspection and testing undertaken during preventative maintenance inspections or normal fault attendance. The degree of wear and tear identified will dictate the required urgency of the action to be undertaken.

3.2.41 When replacing damaged poles or other street furniture, a plan of action should be agreed between an authority and contractor, taking into account the following:

- Does the pole or street furniture need to be replaced or can the equipment be located on other existing furniture? This might reduce the risk of needing similar repair works in the future. Care should be taken to ensure that the existing furniture which is to be used to re-locate assets is capable of accommodating the equipment safely (i.e. the foundations are adequate and the equipment is able to be made electrically safe). In addition, the authority will need to consider how electrical cables (if required) can be run to the new location.
- What type of asset does the furniture relate to and is the replacement of the asset a priority? For example, a traffic signal pole might take priority over a vehicle activated sign pole as it is likely to be safety critical.
- What is the pole or street furniture location and what is the effect on the highway? For example, is traffic management required for the repair and does the work need to be undertaken at night.

- Electrical connection – Can the pole or street furniture be electrically isolated allowing safe working or should the whole asset be switched off? The authority should put an appropriate design process in place to ensure that all assets are electrically safe. Consideration should be taken as to whether electrical work is to be allowed during the hours of darkness as the risk of incorrect connections being made due to the difficulty associated with determining correct colours, is likely to be increased.

- What is the type of pole or street furniture and how this is installed in the ground? A tall pole (greater than 6 metres) concreted in ground, for example, will require additional time, working space and traffic management, whereas a passively safe pole installed in a pole retention socket will potentially reduce time, working space, traffic management and the need for working at height.

- Does the existing site layout meet current health and safety requirements and current design practice? If not, can the replacement of the damaged pole be used to bring an out of date site in line with current practices? In addition, should the pole be relocated in order to avoid similar instances of damage occurring in the future? (This might be especially relevant if the damage relates to signal poles being damaged in RTCs.)

Distribution Network Operator (DNO) service failures

3.2.42 DNO service failures and faults identified and confirmed by the contractor should be issued to the DNO. The response times will depend on local standards and performance agreements, service level agreement or similar arrangements. Authorities should have systems in place to monitor the progress of the works.

3.2.43 Within the procedures, an authority should be able to assess the consequence of the continued loss of electrical supply and, if necessary, accelerate repairs.

3.2.44 The local performance agreement or contract should detail the procedures to be followed by both parties when:

- placing orders;

- making request for emergency attendance;

- notifying faulty service connections and/or cut-outs; and

- notifying the completion of repairs to faulty service connections and/or cut-outs.

3.2.45 When an authority informs the DNO of any fault, notification details should include the following information:

1. An accurate location of the equipment involved including:

    - postcode;

    - asset number;

    - location, road name and, position, i.e. side of, rear of, outside house number, etc.;

- a map of the area (minimum size 1:1250 with the apparatus highlighted); and
- Ordnance Survey co-ordinates or Geographic Information System (GIS) co-ordinates.

2. A description of the work involved and the number of points involved;

3. The priority of the work (see Table 3.2); and

4. The type of work.

The DNO will normally repair at its own cost the following:

a) Faulty services including services with:

- no current;
- low voltage;
- loss of neutral connection; and
- high earth loop impedance.

b) Faulty cut-outs including those:

- suitable only for fuses that can be rewired;
- without an insulated shroud to the live incoming terminal;
- where the shroud to the live incoming terminal can be removed without the use of a tool; and
- cut-outs that are unsafe due to deterioration, e.g. with tracking or breakdown of insulation or burnt or corroded contacts and terminals.

3.2.46 In accordance with the unmetered connection agreement entered into with the DNO, the authority is responsible for providing a safe enclosure for the DNO's equipment. Further details regarding unmetered supplies can be obtained from the Elexon website at the link below:

www.elexon.co.uk/participating/unmeteredSupplies.aspx

3.2.47 Authorites will normally be required to meet the cost of:

- making safe service cut-outs following damage (including vandalism or damage);
- permanent disconnection;
- temporary disconnection; and
- reconnection after make safe or temporary disconnection.

3.2.48 Emergencies should be informed to the DNO immediately when an authority becomes aware of them. Response times for attending these faults will vary depending on local service agreements agreed between the DNOs and authorities. Authorities should endeavour to negotiate in the local service agreement the appropriate response times for their asset. The times are from receipt of notice of either the service or equipment being faulty. See Table 3.4 for examples of DNO response times.

Table 3.4: Example response times for DNO service failures

Activity	Response time
Emergency attendance – for example an exposed live cable	Less than 2 hours
High priority fault – for example, urgent attendance required for strategic or safety reasons such as a dangerous traffic signal junction/crossing or area of public order concern	Maximum response time allowed is 10 working days
Single fault on equipment – fault on equipment classed as low priority	Maximum response time allowed is 20 working days
Multiple faults on equipment – faults on equipment classed as low priority	Maximum response time allowed is 20 working days

Communication faults

3.2.49 Standard practice for the design and installation of most assets includes the provision of a telecommunications line to the RMS instation. There are a number of types of telecommunication including:

- PSTN – Public Switched Telephone Network;
- Private Wire Circuit;
- GSM – Global System for Mobile Communications;
- GPRS – General Packet Radio Service;
- Broadband Internet Protocol (IP) Addressed Circuits;

- Wireless; and
- Fibre Optic Cable.

3.2.50 Each communication type is provided by a Communication Service Provider (CSP). If faults occur with the communication to site, the following generic fault reporting process should be followed:

- Report the fault to the maintenance contractor in order to eliminate the possibility of the fault occurring within an authority's remote monitoring equipment, in the Outstation Monitoring Unit (OMU) for example. Once the equipment has been checked, there is more certainty that the fault lies with the service provided by CSP.
- Report a fault to the CSP using the agreed process under the local service agreement between the authority and CSP.
- If the fault is rectified by the CSP, then the fault should be closed down on the FMS. If further investigation is required, the authority should continue to manage the fault closely, obtaining regular updates from the CSP.
- If the fault requires both the CSP and the contractor to attend site together this should be arranged using the fault management process.

3.2.51 Response times for repairs will be different from authority to authority, as they are dependent on the local service level agreement between the authority and the CSP.

3.2.52 Typical communication issues include:

- **PSTN** – Issues can relate to no communications, noise on the telephone line and swapped lines meaning communications with a non-authority telephone line. All of these issues will be reported to the CSP following the above reporting process.
- **Private Wire Circuit** – Issues can relate to no communications, noise on the telephone line and swapped lines meaning communications with a non authority telephone line. All of these issues will be reported to the CSP following the above reporting process.
- **GSM** – Issues can relate to loss of service in the area, leading to no communications and that only a restoration of the service will restore communications. Low usage of a specific GSM number can lead to it dropping off the GSM network for some CSPs. To rectify this fault, the GSM number will require re-initialisation on to the network, and this can be carried out by the CSP or sometimes by placing the Subscriber Identity Module (SIM) card into a mobile phone and carrying out call or web functions.
- **GPRS** – Issues are typically the same as experienced with GSM communication.
- **Broadband IP Addressed Circuits** – Issues can relate to reduction of speed on the broadband line, affecting performance of large packets of information, such as Closed Circuit Television (CCTV) images. A

lack of communications can be due to a fault on the PSTN line that the broadband line is associated with, and the same reporting process should be followed to report the fault to the CSP.

- **Wireless** – Loss of wireless communications can relate to a number of issues, including the loss of repeater equipment or access points that are required to carry the wireless signal. Loss of signal can occur owing to any number of reasons, including vandalised or stolen antenna, for example. Further problems could be experienced with deterioration of the cable owing to the environment as systems use Category 5 (CAT-5) cables to connect equipment.

- **Fibre Optic Cable –** Issues can relate to reduction of performance on the cable, affecting packets of information, such as UTC data and CCTV images. Loss of communication might be due to a fault on the cable, and the same reporting process should be followed to report the fault to the CSP.

3.2.53 Equipment can also develop communication problems owing to issues such as faulty modem equipment or wear and tear on cable and communication sockets. These issues should be investigated by the maintenance contractor and resolved under the local agreement.

3.3 TRAFFIC SIGNALS AND CROSSING SIGNALS

Introduction

3.3.1 This section refers to the following types of signal assets:

- traffic signal junctions; and

- traffic signal controlled crossing – Pelican, Puffin, Toucan, and equestrian.

3.3.2 Reactive maintenance processes which are specific to the assets listed above are detailed in the following paragraphs.

Lamps off or all out – risks and how to reduce them

3.3.3 A common fault in traffic signal equipment is the report of lamps off or all out. This type of fault can be related to internal equipment issues, power supply failures in the local area or third party works requiring the traffic signals to be switched off. Guidance on this is provided in the Traffic Systems Group's *Guidance Note 2 – Traffic Signal Failure Procedures* (32).

3.3.4 This type of fault should be prioritised as an urgent fault (see paragraphs 3.2.11–13) owing to the effects on the travelling public and possible safety issues relating to users of the highway.

3.3.5 An urgent response to this type of fault reduces the risks; however, there are other actions that should be considered, including the following:

- place "Out of Order" signs on each approach to the traffic signals. This practice varies across local authorities, with advice given in Section 8 of Chapter 4 of the Traffic Signs Manual (22); and

- advertise the information that the traffic signals are not operational through the use of real time media such as radio broadcasts.

3.3.6 With a comprehensive fault management process in place, the above actions can be achieved efficiently and will assist in reducing the period of time when associated risks are present.

Detector faults – carriageway loops, overhead detectors and push button units

3.3.7 Traffic signals operate by using detection equipment such as inductive loops or MVDs to detect vehicles and other road users and inputting demands to the controller accordingly. Detection equipment should be monitored by the Detector Fault Monitoring (DFM) facility available in all traffic signal controllers. Controllers must be of a type approved in accordance with direction 56 of TSRGD, and comply with the relevant Highways Agency specification TR 2500 A: *Specification for Traffic Signal Controller* (33).

3.3.8 The DFM facility ensures detection is operating as designed and flags up detectors that have faults, either a permanent detect or a permanent non-detect output. The DFM facility logs a fault in the traffic signal controller's fault log, which can be identified through one of the processes detailed in paragraphs 3.2.1–10.

3.3.9 There are different types of detection equipment currently used at traffic signals and crossing signals for different reasons and applications. When these detectors become faulty, they can have differing effects on the operation of the signals. These types of equipment, a summary of the common faults associated and example actions that can be taken are listed in Table 3.5.

Table 3.5: Detection equipment types, faults and actions			
Detection equipment	**Fault type**	**Effect on the network**	**Action**
Vehicle carriageway loop	DFM permanent non-detect. Fault due to low traffic flow on one approach to traffic signals.	Failure to detect vehicles on low flow routes will result in them not getting green time at the signals.	Check loops operation, reset fault log and DFM and increase the DFM non-detect period for this approach if recurring fault.
Vehicle carriageway loop	DFM permanent detect. Fault normally caused by damage to the detector and its fail state being configured to permanently detect.	Will result in an inefficient use of the cycle time, through false demands being called. This might increase congestion in the network.	Check loop cable and the impedance value. Possible re-cut of loop in alternative location or after carriageway repaired.
Vehicle carriageway loop	Carriageway worn and loop cable exposed and damaged.	Will result in an inefficient use of the cycle time, through false demands being called. This might increase congestion in the network.	Check loop cable and the impedance value. Possible re-cut of loop in alternative location or after carriageway repaired.
Above ground vehicle detector	Detector vandalised and out of alignment, causing a DFM permanent non-detect.	Failure to detect vehicles on low flow routes will result in their not getting green time at the signals.	Re-align detector and check operation. Reset fault log and DFM.
Above ground pedestrian detector	DFM permanent detect. Fault due to dirty fascia.	Will result in an inefficient use of the cycle time, through false demands being called. This might increase congestion in the network.	Clean detectors fascia and check other detectors at site for same fault. Check operation. Reset fault log and DFM.
Pedestrian push button unit	DFM permanent detect. Fault caused by vandalism.	Will result in an inefficient use of the cycle time, through false demands being called. This might increase congestion in the network.	Check push button unit operation, replace if necessary. Install anti vandal push button units if common fault. Reset fault log and DFM.
Pedestrian push button unit	DFM permanent non-detect. Fault caused by low flow of non-motorised users over holiday period.	Will result in an inefficient use of the cycle time, through false demands being called. This might increase congestion in the network.	Check push button unit operation, reset fault log and DFM. Increase DFM non-detect period for this detector if recurring fault.

3.3.10 These examples are just some of the faults that can occur with detection equipment and each will require a different response from the contractor. It is recognised that there might be other types of detection available on the market that might need to be treated in different ways.

3.3.11 Response times for detection faults as previously mentioned in paragraphs 3.2.11–13 will vary – for example, a DFM permanent detect on a push button unit causing a crossing signal asset to cycle constantly between traffic and non-motorised users will be a high priority and therefore urgent.

3.3.12 The DFM facility is also available in certain manufacturers' RMS outstation units and can be used as an alternative or back up facility to the traffic signal controller. These DFM faults will be reported to the RMS instation in the same way as the traffic signal controller identified faults.

3.3.13 Detection equipment should be maintained in line with the manufacturer's instructions. It will be the responsibility of the contractor to ensure that this occurs.

Lamp faults

3.3.14 Traffic signals and crossing signals use different lamp types for different operations. Faults should be prioritised, reported and managed based on each operation:

- **Red lamp faults** – This type of fault should be processed as an urgent fault, owing to the potential safety risks to users at traffic signals and crossing signals whilst a red lamp has failed. Further importance should be given to second red lamp faults, where in some circumstances this type of fault either extinguishes all lamps at the site or inhibits the pedestrian crossing facilities from being used.

- **Unspecified lamp faults** – These faults should be processed as a lower priority fault.

- **Wait lamp faults** – This type of fault is generally reported by third parties or through maintenance inspections and should be considered (with reasonable thought) to be treated as a lower priority fault.

- **Box signs lamp faults** – These lamps, normally small fluorescent tubes located behind regulatory sign fascias, are visually difficult to identify if working during daylight hours. Faults on these lamp types are normally reported through RMSs for this reason. This type of fault should be processed as a lower priority fault.

3.3.15 If a lamp fault occurs on a traffic signal head located on a tall pole (greater than 6 metres), it might be beneficial that replacement of all lamps on this pole should be undertaken at the same time, owing to the cost and health and safety implications of undertaking such work. Undertaking work in this way will save time and money and will reduce the risk of future lamp faults, thereby reducing the likelihood of network disruption.

3.3.16 Lamp faults are identified by the lamp monitoring facility located in the traffic signal controller, or the RMS outstation unit, or an external lamp monitoring unit. Lamp currents or loads are monitored by this facility and, once a reduction in these values is identified, a fault is reported.

3.3.17 The contractor should ensure that all lamp currents or loads are re-learnt following the repair of the lamp fault and that all lamps are working correctly. This guarantees that the currents or loads that the lamp monitoring unit is monitoring are correct and false reports of lamp faults are avoided.

3.3.18 Persistent lamp faults can occur on occasion. With an effective fault management process in place, persistent faults should be easily identified and rectified. Normally, it is the responsibility of the maintenance contractor to identify the reasons behind the persistent fault and also to put in place repairs to remedy the situation. Example reasons for persistent lamp faults include:

- badly manufactured batches of lamps;
- faulty lamp holders; and
- loose wire connection in a circuit.

3.3.19 LED lamp technology is being installed widely throughout the traffic signal industry, owing to the many benefits this technology provides. These benefits include an increased life cycle for the lamp and reduced power usage. However, benefits are only fully realised when a whole site is ELV. Faults will still occur with this technology, and they should be processed in the same way as standard lamp faults.

Out of alignment heads

3.3.20 Traffic signal and crossing signal heads can be moved out of their normal alignment for a number of reasons, including:

- vandalism;
- weather – strong winds; and
- vehicle damage.

3.3.21 Out of alignment faults should be dealt with as an urgent fault, as safety issues caused by a signal head facing the wrong direction could be serious, especially if the head faces traffic approaching from a conflicting direction.

3.3.22 If the same fault occurs on more than one occasion, preventative measures should be investigated by the contractor and agreed by the authority. An example of preventative measures could be an anti-vandal locking mechanism for signal heads to prevent deliberate movement out of alignment faults, or relocating a signal head away from the carriageway to reduce the likelihood of vehicle damage.

Operational and timing issues

3.3.23 This type of fault is often reported by third parties. It relates to the signals not operating as designed or how third parties perceive they should operate. This type of fault can be difficult to investigate and resolve, especially if the details reported are vague or the information is second or third hand.

3.3.24 An initial investigation through a RMS system or via a site visit should be undertaken to establish whether the third party report is accurate. If this results in faults being identified, the fault should be reported to the contractor using the

FMS. If the investigation does not reveal any operational issues, the fault should be logged within the FMS but not sent to the contractor. By logging faults in this way, repeat occurrences can be cross-referenced and the issues investigated fully.

3.3.25 Any fault relating to signal timings should be thoroughly investigated, and it is the responsibility of the authority to ensure that timings are in line with advice and local policy. Safety critical timing amendments, such as intergreens or minimum green timings, should be made permanent within the controller as soon as possible after their identification. Non safety critical timings, such as maximum green times, can be amended as temporary data in the signal controller and made permanent at a later date, with the details of the temporary data being stored within the site controller as well as in the office. The authority should be aware that this carries a risk of repeat work needing to be carried out, should the controller lose that information for any reason.

3.3.26 If unforeseen operational issues occur, for example damage to detector loops caused by resurfacing, authorities should ensure that planned works that will affect the operation of the signals are carried out at the same time as the remedial/damage repairs.

Push button units – audibles and tactile signals

3.3.27 Push button units at signal sites might have audible units, rotating tactile cones, or both, installed, which provide an indication to visually impaired pedestrians that it is safe to start crossing.

3.3.28 Historically, faults within these units have only been identifiable through maintenance inspections or by third party reports. Realising the importance of these facilities, a number of manufacturers are providing the ability to monitor these units using RMSs. It is anticipated that this trend will continue and lead to wider application of RMSs in the future.

3.3.29 The most common faults experienced with audible units include a permanent audible output, a warbling audible output, or no audible output. The most common faults experienced with rotating tactile cones include the unit burning out owing to wear and tear or seizing of the unit motor.

3.3.30 As these facilities are provided primarily for the use of visually impaired pedestrians, this code recommends that any faults reported are categorised as urgent.

3.4 TRAFFIC SIGNALS OTHER

Introduction

3.4.1 This section refers to other traffic signals, including:

- cattle crossings;
- emergency services wig-wag signals; and
- School Crossing Patrol flashing amber warning signs.

3.4.2 For faults at these assets that relate to lamps off or all out, lamps, out of alignments and operational and timing issues please refer to Section 3.3.

3.4.3 Further design, installation and maintenance advice on these types of asset should be sought from other references including the DfT Traffic Advisory Leaflet 01/08 *Wig-wag Signals* (34).

3.4.4 This section does not cover wig-wag signals used at level crossings and tramways, even though there is an interaction between highway and rail users.

Cattle crossings

3.4.5 These are crossing signals designed to warn road users that cattle are likely to be crossing the road ahead and that they should be prepared to stop if necessary. They use modified traffic signal heads and key operated units.

3.4.6 Advice on the design and installation of cattle crossings is given in the DfT Traffic Advisory Leaflet 01/08 *Wig-wag Signals* (34) and TA 56/87 *Hazardous Cattle Crossings: Use of Flashing Amber Lamps* (35).

3.4.7 The combined sign and signal for cattle crossing is prescribed in Regulation 51 of the TSRGD and in diagram 4005 in Schedule 9 to the Regulations, Light Signals for Pedestrians and Animal Crossings (36).

3.4.8 For detection faults at this type of asset please refer to Section 3.3. It is advised that this detector is not configured in the DFM facility, as they are not likely to be used very often; this will ensure permanent non-detect faults are not reported back to RMS.

Wig-wag signals

3.4.9 Advice on the design and installation of wig-wag signals is given in the DfT Traffic Advisory Leaflet (TAL) 01/08 *Wig-wag Signals* (34). The signal is prescribed in Regulation 39 of the TSRGD and in diagram 3014 in Schedule 8 to the Regulations, Light Signals for the Control of Vehicular Traffic (37).

3.4.10 “Wig-wag signals are used to control road traffic at level crossings, swing or lifting bridges, tunnels, airfields or in the vicinity of premises used regularly by fire, police or ambulance service vehicles.” (TAL 01/08)

3.4.11 This Code concentrates on the emergency service wig-wag signals and further clarification for the installation and maintaining of other wig-wag systems can be found in:

- TR 2513 *Performance Specification for Wig-wag Signal Control Equipment* (38);
- MCX 0084 *Signal-Standard Traffic (Wig-wag)* (39); and
- Part 1 of TAL 01/06 *General Principles of Traffic Control by Traffic Signals* (40).

3.4.12 By their nature, wig-wag signals are often provided in remote and high risk locations, and will require the same priority response to faults as traffic or crossing signals. These sites should be connected to a RMS system in order to ensure faults are reported and repaired efficiently, in conjunction with TAL 01/06.

3.4.13 Some wig-wag system equipment, such as control panels, signal heads and communication equipment, are located within adjacent emergency service stations. Access to such equipment should be agreed with the emergency services before contractor visits are undertaken. This agreement could be reached on an individual visit basis or a "capture all" agreement.

School Crossing Patrol flashing amber warning signs

3.4.14 This type of signal is designed to warn highway users of school children crossing in the road ahead. Signals are likely to be installed at locations outside schools, school crossing patrol points or un-manned "disabled children" crossing points, and must be accompanied by traffic signs using diagrams 545, 547.1 or 547.7 of TSRGD (12).

3.4.15 The signals will normally operate on a pre-configured timetable and will flash for a defined period at certain times of the day.

3.4.16 Flashing amber lamps for use at school crossing patrol points are prescribed in Regulation 50 of the TSRGD and in diagram 4004 in Schedule 9 to the Regulations, Light Signals for Pedestrians and Animal Crossings.

3.4.17 Further information on the installation of this equipment is included in Local Transport Note 1/98 *The Installation of Traffic Signals and Associated Equipment* (41).

3.4.18 An increasing number of authorities are choosing to install solar powered versions of these signals, owing to the environmental benefits and ease of installation. One consideration that the authority should be aware of is the different type of maintenance that might be required for solar powered assets. This type of unit could develop battery charging faults, which might relate to a number of issues such as worn batteries, damaged solar panels, cabling issues or even limited daylight exposure caused by location or foliage issues. The contractor should carry out maintenance tasks in line with the manufacturer's guidance and liaise with the manufacturer if required.

3.4.19 To reduce the risk of location or foliage issues with solar powered assets, the authority and/or contractor should liaise with the manufacturer and gain the benefit of their experience. Some manufacturers offer a free design service and free after care warranty, which is something that the authority should take into account when installing assets of this type.

3.5 INTERACTIVE SIGNS

Introduction

3.5.1 This section covers interactive signs, such as Vehicle Activated Sign (VAS) equipment installed as part of a network of signs or one off local installations. This guidance within this section is also applicable to time activated signs. Authorities install interactive signs on the highway as part of road safety schemes where conventional signing has to be enhanced or is considered ineffective. Common uses of interactive signs include reducing the speed limit at certain times of the day or warning highway users of an imminent risk ahead.

3.5.2 Interactive signs are ordinarily the Electronic Message Sign (EMS) type, where activation by timetable or vehicle detection (above ground detector, inductive loop or other method) displays a prominent warning sign and optional accompanying message. Examples of interactive signs installed and operated by authorities include:

- individual sign and pole located on the entrance to a village where the speed limit changes from national speed limit to 30mph – the sign has an above ground speed vehicle detector located on top of the sign and has been configured to flash the sign to diagram 670 of the Traffic Sign Regulations and General Directions 2002 (12) "30mph" each time a vehicle is identified travelling above the configured trigger speed; and

- four signs located outside a school on a main road, where there are two signs on each approach, either side of the carriageway. A Traffic Regulation Order (TRO) exists where the speed limit outside the school reduces from 40mph to 30mph depending on time of day. The signs display the sign to diagram 670 "30mph" at configured times, i.e. morning drop-off and afternoon pick-up. Outside these times the sign displays the sign to diagram 670 "40mph" using the above ground speed vehicle detectors to detect vehicles travelling above the configured trigger speed.

3.5.3 The above examples are indicative of the use for which interactive signs can be employed, therefore this is not an exhaustive list.

3.5.4 For further information and guidance on VASs refer to the following documents:

- Traffic Advisory Leaflet (TAL) 01/03 *Vehicle Activated Signs* (42); and

- TRL Report 548 *Vehicle Activated Signs – A Large Scale Evaluation* (43).

Authorities should also refer to the interactive sign manufacturer's guidelines.

3.6 EQUIPMENT SPECIFIC ISSUES

3.6.1 A number of issues relating to the reactive maintenance of interactive signs are covered in more detail under Section 3.7. Inductive loop detection and above ground detector issues are covered under paragraphs 3.3.7–13 of this Code.

3.6.2 Above ground detectors used on interactive signs are installed either as an integral part of the asset or as a complementary stand alone component; there are different considerations for maintenance with both types of installation. The location of an integral above ground detector within an asset can increase the likelihood of access issues, whereas stand alone above ground detectors can be prone to vandalism and adverse weather. Different manufacturers tend to utilise a range of above ground detectors, some of which are commonly available and others which are not; this can lead to unavailability of the correct spare parts when required. The manufacturer's guidelines should be followed to reduce these issues and to carry out efficient repairs.

3.6.3 An increasing number of authorities are choosing to install solar powered versions of these signs, owing to the environmental benefits and ease of installation; related considerations are discussed in paragraphs 3.4.14–19.

3.6.4 Other renewable energy, such as wind power, is also being harnessed for use with interactive signs. With this type of unit there might be a risk to recharging because of a lack of wind. This might be down to the asset being in an inappropriate location, as well as other issues similar to these already covered by solar panel maintenance. The contractor should carry out maintenance of the wind generator and associated equipment in line with the manufacturer's guidelines and liaise with the manufacturer where necessary.

3.6.5 Operational issues, with regard to interactive signs, might be caused by a system failure with the sign controller, corrupt configuration or timetable (for example where the time of day is incorrect or timetable data is lost). Should these issues occur, liaison will be required between the contractor and the authority, referring to the manufacturer's guidelines if required.

3.7 VARIABLE MESSAGE SIGNS

Introduction

3.7.1 The use of UTMC systems and intelligent transport systems (ITS) equipment (including VMSs) enables authorities to provide information to the travelling public in greater quantities and with increased accuracy compared to fixed message signs. VMS allow prescribed or authorised messages to be displayed to users of the highway, informing of incidents on the network, forthcoming events, weather information and journey times. As traffic signs are safety related, they should have fault monitoring equipment associated with them.

3.7.2 VMSs are generally available in two types: the older style use pre-defined messages on rotating plank signs, and the current and more adaptable EMSs, which are able to display any number of pre-approved messages by illuminating specific LEDs within the sign face. Both types are in use by authorities and have different considerations with regard to maintenance.

3.7.3 During the design process, whilst deciding upon the location of a VMS, safe access to the equipment for future maintenance should be a key consideration. The nature of a VMS is that they are normally located adjacent to a live carriageway, with the maintainable components located at height. The risks associated with such locations should be assessed by authorities and contractors before any maintenance tasks are undertaken.

3.7.4 Authorities should, where possible, aim to install a VMS that can be monitored via a UTMC system. Where this is done, faults can be reported on a number of issues, including lamp failure. VMSs do not have to be associated with a UTMC system, as they can be operated independently; however, some of the benefits might be more difficult to obtain if manual intervention is required.

3.7.5 For further information and guidance on VMSs refer to Traffic Regulation TR 2517A *Performance Specification for Electromechanical Variable Message Signs* (44) and the manufacturer's guidelines.

Equipment specific issues

3.7.6 VMSs will vary in size, depending upon aspects such as the speed of the road. Authorities may wish to impose a policy which says that larger signs should be attended by more than one person, as often there are access issues – for

example, the access door might be too large for one person to lift. The authority and contractor should identify these equipment types before carrying out any maintenance activities and agree appropriate processes.

3.7.7 VMS maintenance activities in adverse weather conditions, such as strong winds, will need to be assessed by the authority, as there is the potential for damage to the sign door and internal mechanisms from strong gusts and from atmospheric moisture encroaching in normally sealed cabinets or equipment areas.

3.7.8 VMSs, like other electronic traffic equipment, should have heaters and thermostats installed within the sign to ensure a consistent temperature is achieved, allowing internal equipment to operate efficiently during adverse temperatures. Providing a consistent temperature will help to ensure that the life of the asset is maintained in line with the manufacturer's guidelines and the equipment operates as required.

3.7.9 Flasher units are permitted as prescribed in TSRGD or where an authorisation for a non-prescribed message specifically permits them. These units might be installed on the VMS to enhance the message displayed. They can develop faults over time, including lamp failures or other operational faults. These units should be maintained by the contractor in line with the manufacturer's guidelines.

EMS – LED type

3.7.10 There are a number of manufacturers of VMS equipment, and the components used will vary among manufacturers. The majority of lamp faults reported on VMSs relate to a proportion of LEDs having failed within the sign face. To repair LED failures, spare components should be fitted by the contractor in line with the manufacturer's guidance; ordinarily this will require the replacement of banks or strings of LEDs as opposed to individual LEDs.

3.7.11 Faults can occur with dimming facilities on most VMS types. Dimming faults will normally be identified by the sign reporting the fault to the VMS instation or UTMC system or by highway users reporting that the sign display is too bright. The contractor should investigate the reported fault and, once a full repair is complete, dimming tests should be carried out to ensure the facility is fully operational (Figure 3.2).

3.7.12 Dimming issues can arise from a VMS being installed too close to a tree and overhanging foliage, which can affect the photo electric (PE) cell on top of the sign. The function of the PE cell is to determine changes in daylight and, if this is shadowed by a tree, the VMS will function in the "dim" mode rather than "normal" mode. Actions should be taken to trim the foliage if this issue becomes a regular occurrence.

3.7.13 Following completion of the repair work, the authority should ensure the contractor communicates with the VMS instation operator, clarifying whether the fault has been fully repaired by carrying out instation checks, such as setting various test messages on the sign.

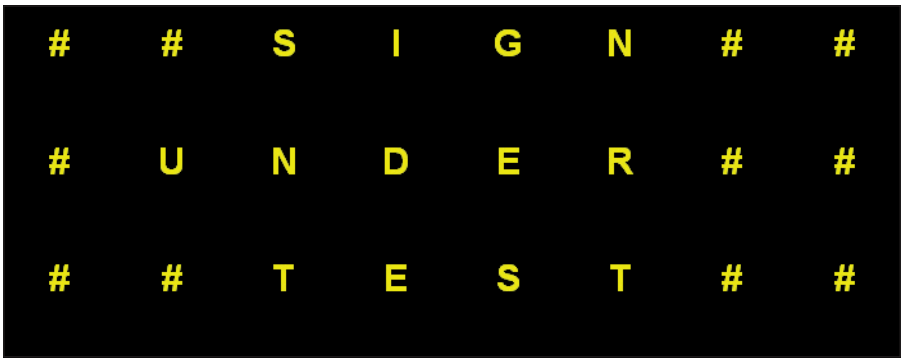

Figure 3.2: Test message which could be used on a 3 x 8 size LED type VMS

Limited function signs – rotating plank type and prism

3.7.14 This type of VMS is prone to mechanical faults that can lead the sign to show incorrect messages or stick between messages. The preventative maintenance inspections should include works to minimise this risk and be agreed by the authority and contractor. The contractor for reactive maintenance activities will need to ensure spare mechanical components and suitable lubrication are available in order that satisfactory maintenance can be achieved.

3.7.15 Wear and tear of mechanical components, including gears, connection rods and motors, is increased by exposure to the elements and continual sign changes.

3.7.16 Limit switches define the position the sign plank rotates to, allowing the correct message to be displayed to highway users. These switches can cause operational issues detailed above if not maintained in line with the manufacturer's guidelines and can be subject to wear and tear owing to continual sign changes.

3.8 FIXED ENFORCEMENT/ROAD SAFETY CAMERAS

Introduction

3.8.1 Road safety cameras were installed by most authorities as a result of the National Safety Camera Programme, which was rolled out across the country in 2002. Many authorities operate and maintain cameras under a Safety Camera Partnership, and this partnership works within Department for Transport rules and guidelines for safety camera enforcement. Other authorities operate and maintain safety cameras under a Road Safety Partnership, where the emphasis is on road safety and other road safety schemes are implemented alongside the installation of safety cameras.

3.8.2 Fixed enforcement/road safety cameras are designed to be installed by authorities at locations on the highways network where road safety or enforcement issues have been identified. There are three common types of camera:

- **speed camera** – assists with enforcing the set speed limit of the road; these can be fixed cameras or average speed cameras;
- **red light camera** – installed primarily at traffic signal junctions where red light jumping has been identified as a road safety issue; and

- **bus gate/lane camera** (might not be associated with safety camera partnerships) – equipment enforces usage of bus bane or bus gate by authorised vehicles.

3.8.3 The Road Traffic Offenders Act 1988 (45) states that safety cameras used to enforce compliance with speed limits must be "type approved" by the Secretary of State before evidence from them can be used in court. For further information and guidance on safety cameras please refer to the following advice on the Home Office website: www.homeoffice.gov.uk/

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3.8.4 The Type Approval of some safety camera equipment states that certain tasks can only be carried out by the manufacturer of the equipment and therefore imposes a restriction on who can maintain the equipment. In certain circumstances external contractors carry out maintenance tasks on safety cameras, and then to comply with the Type Approval the manufacturer has to re-commission the equipment. Authorities should ensure that local agreements with contractors do not contravene the terms and conditions of their asset's Type Approval, as this could lead to prosecutions becoming invalid.

3.8.5 Developing technology is leading to authorities using digital equipment and digital enforcement cameras. This technology provides clearer pictures and allows evidence to be transmitted over encrypted communications links which reduces the need to attend assets on the street.

3.8.6 Authorities and contractors should refer to the following guidance for further information on safety cameras DfT Circular 01/2007 *Use of Speed and Red-Light Cameras for Traffic Enforcement: Guidance on Deployment, Visibility and Signing* (46). Authorities and contractors should also refer to the camera manufacturer's guidelines.

Equipment specific issues

3.8.7 Vandalism of equipment is one of the common faults experienced with safety cameras and the authority should ensure that the contractor has the required training and competency to be able to fully repair the equipment that has been damaged. An urgent response to this type of fault is required by the contractor to complete a number of tasks including:

- making safe damaged equipment – covering over cosmetic damage or removing equipment that has been structurally damaged;
- disconnection from the mains supply if it is unsafe; and
- recovering the enforcement equipment and any evidence that might be retained within it. Information within equipment could provide information on the third party responsible for the damage.

3.8.8 Red light enforcement cameras operate in conjunction with traffic signals, which in the majority of circumstances are owned and operated by the same authority. Permission might have to be sought before maintenance tasks can be undertaken if specialist contractors are required or if the equipment belongs to another authority.

3.8.9 Red light enforcement cameras detect vehicles by using carriageway inductive loop detectors, which are installed either side of the traffic signals stop line. Maintenance issues relating to these detectors include wear and tear in the carriageway and damage by third parties. Where loops are damaged, they will need to be completely repaired before the site is fully operational again.

3.8.10 There are issues regarding red light enforcement cameras being able to monitor the red aspects of LED traffic signals. It is therefore not currently possible to install LED signal heads at sites where enforcement cameras are required.

3.8.11 Safety cameras are not normally monitored by RMS systems and therefore will need regular inspection to identify maintenance issues. This inspection can be carried out during the regular enforcement collection visits to the safety cameras. Some authorities carry out monitoring of their safety cameras using internal or external CCTV cameras; however, this practice is not widespread. The use of CCTV cameras for monitoring, especially internal equipment, could contravene the Type Approval and therefore authorities should seek guidance on this before implementing.

3.8.12 Average speed safety cameras use ANPR technology to identify the speed of an individual vehicle over a set distance. ANPR equipment and maintenance requirements are covered under Section 3.11.

3.8.13 Average speed safety cameras recently installed tend to be mounted on either tall poles or mast arm poles, which introduce their own risks for conducting maintenance activities; these risks should be investigated and documented prior to any tasks being undertaken. Mast arms in particular are regarded as structures rather than standard traffic signal poles. The contractor should also carry out further generic and site specific risk assessments prior to undertaking any maintenance activities. During maintenance, these assets should not be attended by a single engineer, owing to the risk of personal attack and other associated risks. Authorities should document their own policies with regard to this.

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3.9 REAL TIME PASSENGER INFORMATION SYSTEMS

Introduction

3.9.1 Real Time Passenger Information Systems (RTPIs) are normally installed by authorities in partnership with bus operators and other interested third parties. This document does not cover the on-board bus equipment but concentrates on the in shelter or on-street equipment.

3.9.2 RTPI systems primarily provide passengers with real time travel information, for example the anticipated pick-up time for a bus.

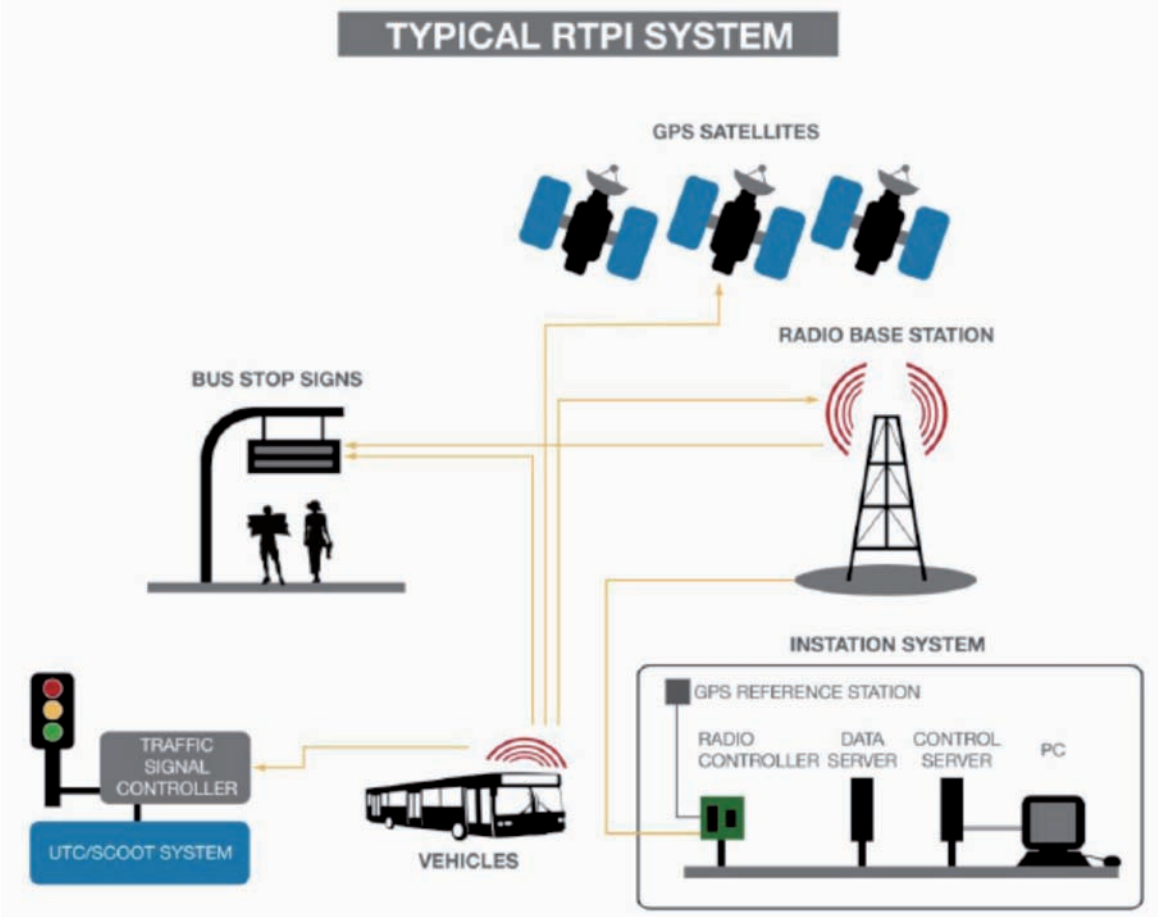

Figure 3.3: A typical RTPI system and its equipment components

3.9.3 Figure 3.3 shows how RTPI is communicated via a radio based system. Vehicles are tracked by Global Positioning System (GPS) satellites, sending updates on their GPS position and therefore expected arrival times to the instation systems and bus stop signs. The diagram also shows the capability of the system to utilise bus priority facilities at traffic signals.

3.9.4 RTPI systems are bespoke systems, and each authority will need to have in place local agreements with the manufacturer and the contractor on how best to operate and maintain the system. For further information and guidance on RTPI systems, authorities should refer to the manufacturer's guidelines.

Equipment specific issues

3.9.5 Vandalism of equipment is one of the common faults experienced with passenger information signs, as they are often placed in prominent urban locations. The authority should ensure that the contractor has the relevant training and competency to be able to fully repair the equipment that has been damaged. This damage ordinarily relates to the sign display, poles or furniture and communication equipment.

3.9.6 Specific types of RTPI signs communicate via radio communications, and the sign equipment associated with this can develop faults. Radio aerials are prone to damage from vandalism or adverse weather, and these faults can be identified through visual inspection or communication issues with the sign.

3.9.7 RTPI signs use display equipment such as LEDs to display the information to passengers. This display equipment can develop faults, such as LEDs failing, and these can be identified through either RMSs or regular visual checks.

Steering Group/Atkins Project Team

3.10 CAR PARK MANAGEMENT SYSTEMS

Introduction

3.10.1 Car park management systems, also sometimes referred to as Car Park Guidance (CPG) systems, are often installed by authorities. These systems provide parking information and guide highway users to parking facilities that have available spaces.

3.10.2 CPG systems can link into other UTMC systems to provide overall management of the network by the authority. The CPG system comprises a number of specific VMSs, which communicate to count units located at the entrances/exits of specific car parks. The count information is communicated to and from the instation using a communication medium, and then the VMSs are updated with the latest car park capacities. CPG systems do not have to be associated with a UTMC system, as they can be operated independently. However, some of the benefits might be more difficult to obtain if manual intervention is required.

3.10.3 Maintenance issues discussed within this Code relate to authority owned CPG systems and not privately owned systems installed in private car parks. However, some of the processes might be translated to these similar systems.

3.10.4 For further information and guidance on CPG systems please refer to Traffic Advisory Leaflet ITS 04/03 *Parking Guidance and Information* (47). Refer also to the individual CPG system's manufacturer's guidelines.

Equipment specific issues

3.10.5 For issues relating to reactive maintenance for VMSs, please refer to Section 3.7, as the majority of issues are covered there.

3.10.6 Important to the operation of a CPG system is the accuracy of the count information being received from the count units located at the access points to the car park. Inductive loop detectors in the carriageway surface are connected to count units, detecting vehicles that pass in and out of the car park access

point. Issues can arise from faulty count units or loop detectors where false information is displayed on the relevant VMSs, therefore requiring attendance by the contractor to identify and repair the issues.

3.10.7 Historically, count information faults have been difficult to identify, owing to the nature of the fault. Daily monitoring of the CPG system will reduce this problem. However, count faults could include intermittent faults and might relate to the following vehicle loop detectors that count vehicles out but not in, and vice versa. They might also not count at all or place a permanent demand on vehicle loop detectors counting in or out.

3.10.8 The contractor should, once a full repair is complete, with assistance from the authority determine the occupancy of the car park so that this can be reset on the instation and therefore the correct occupancy information is displayed on the relevant VMS.

3.11 TRAFFIC MONITORING EQUIPMENT

Introduction

3.11.1 There is an increasing demand for the provision of live network and traffic information to highway users using UTMC systems. One means of providing this information is to use traffic monitoring equipment to provide real time traffic data, including:

- weigh in motion;
- headway;
- classification;
- speed;
- height;
- length;
- journey times; and
- traffic pictures.

3.11.2 There are various types and manufacturers of traffic monitoring equipment, of which some of the types are listed below with a brief description:

- **Counters** – Equipment that is installed at key points on the network to provide count information. These can be installed as individual sites or ordinarily as part of an overall monitoring system linked to other UTMC systems. Vehicle detection is carried out using specific carriageway vehicle loop detectors linked back to the outstation in a static cabinet.
- **Classifiers** – Component normally integrated within counter equipment that classifies the types of vehicles using the network. Certain types are compatible with other UTMC systems and can provide, alongside counters, an overall picture of network performance. These units can sometimes utilise existing vehicle loop detectors for traffic signals, providing savings on installation, operation and maintenance costs.

- **ANPR cameras** – This type of equipment is used to identify vehicle journey times. Multiple cameras are installed on the network to monitor real time journey times on configured links between cameras. This journey time data can be then used in a number of ways, including sending it to a VMS to be displayed to highway users, or fed back into a UTMC system. Certain manufacturers' cameras can also capture images for real time display of road conditions and congestion in the area. This type of technology is also utilised in average speed cameras to calculate journey time over specific distance and therefore calculate the average speed.

- **Weigh in motion** – This facility is used by authorities to measure vehicle weight whilst the vehicle is on the move. This uses a bespoke system and is dependent on the application required by the authority. This technology is not covered in detail by this Code.

- **Over height vehicle detection** – This facility is used by authorities to identify over height vehicles on the network, for example on the approach to restricted access points such as a low headroom bridge. These systems are ordinarily bespoke equipment, and this technology is not covered in detail by this Code.

3.11.3 For further information and guidance on traffic monitoring equipment, authorities should refer to the manufacturer's guidelines.

Equipment specific issues

Counters and classifiers

3.11.4 Faults with inductive loops are ordinarily identified by the outstation unit located in a nearby cabinet. Faults are reported by the RMS or by regular checks on the equipment. The contractor should refer to the manufacturer's guidelines to be able to clearly diagnose the faulty equipment and carry out an effective repair.

3.11.5 An increasing number of authorities are choosing to install solar powered versions of this technology, owing to the environmental benefits and ease of installation; related considerations are discussed in paragraphs 3.4.14–19. The contractor should carry out maintenance tasks in line with the manufacturer's guidance and liaise with the manufacturer if required.

ANPR cameras

3.11.6 Vandalism of equipment is one of the common faults experienced with ANPR cameras. The authority should ensure that the contractor has the relevant training and competency to be able to fully repair any equipment that has been damaged.

3.11.7 Faults with ANPR cameras are historically difficult to identify via RMS systems. However, faulty cameras tend not to report any number plate matches and therefore manual daily monitoring of the ANPR system by the authority should be undertaken. Certain systems are able to report cameras automatically as faulty if no number plate matches are seen – however, others will require manual checking. Local procedures should be implemented by the authority to ensure ANPR faults are identified.

3.11.8 ANPR cameras with image capture capability should be checked regularly to ensure that this facility is functional. Issues identified should be reported to the contractor and the equipment attended and checked in line with the manufacturer's recommendations.

3.11.9 Contractors should carry out checks with the ANPR instation following repair of an ANPR camera. These checks should involve checking the alignment of the camera to identify if number plates are being correctly observed and recorded, ensuring consistent number plate reporting. If the equipment is capable of providing an image capture, the check should ensure that the equipment provides clear images of highway users and their number plates.

3.11.10 ANPR technology in average speed cameras will be subject to the same issues as detailed above. However, the maintenance of this equipment should be in line with the terms and conditions in the Type Approval for the equipment. Refer to Section 3.8 for further information.

3.12 RISING BOLLARDS

Introduction

3.12.1 Rising bollards have been in use since 1997 by authorities looking to enforce specific TROs such as access to restricted areas. Current thinking is for authorities to find alternative technology to enforce TROs because of the installation and maintenance difficulties experienced using rising bollards. Traffic Advisory Leaflet 4/97 *Rising Bollards* (48) details information on the approval required, planning considerations, indicators required and safety, which all should be considered when designing and installing rising bollar

Equipment specific issues

3.12.2 For faults at assets that relate to lamps, out of alignments and operational/ timings issues refer to Section 3.3.

3.12.3 Rising bollards are usually controlled by some form of vehicle detection such as vehicle transponders, carriageway loops or ANPR cameras. These detection types will lower the bollard as the vehicle approaches. To ensure this equipment continues to operate throughout its life period, the authority needs to ensure a clear maintenance process is in place.

- **Vehicle transponders** – The authority should ensure that faulty transponders are replaced as part of the maintenance process. A local agreement should be set up between the authority and the relevant vehicle fleet company for the issue of new transponders for new vehicles and the re-possession of transponders that are no longer required in out of service vehicles. The transponder units should be maintained by a contractor experienced in this type of equipment and always maintained in line with the manufacturer's guidelines.

- **Carriageway loops** – See Section 3.3 for further details on faults for this equipment. This type of detection is not able to detect specific vehicles and will normally be used in conjunction with CCTV cameras to ensure only valid vehicles are allowed access.

- **ANPR cameras** – These detectors are used alongside a list of authorised vehicles. A local agreement should be set up between the authority and the relevant vehicle fleet companies for the update of the list.

3.12.4 In each of the above cases, special consideration must be given to emergency vehicles. Authorities should have in place local agreements for such vehicles to have access to the restricted area.

3.12.5 In the case of a system failure or power failure, bollards should default to a safe state, ideally where the bollards are in the retracted position.

3.12.6 Rising bollards are generally considered to have a poor performance record when compared to other traffic signal and monitoring equipment. This is due to the nature of the equipment and associated behaviour from highway users. Vehicles colliding with bollards often cause significant damage, which leads to the need for repair and, with many of these systems being bespoke equipment, this can lead to long repair periods.

3.12.7 To minimise damage to bollards caused by vehicles, the following should be considered:

- **clear signage and lighting** – making highway users aware of bollards; and

- **civil engineering** – good ground works to ensure heavy vehicles passing over bollards do not cause damage.

3.12.8 Mechanical equipment faults should be investigated by trained and competent persons. The authority and contractor should agree in advance the maintenance process for this type of equipment and, if required, ensure the equipment is maintained by a specialist contractor.

3.12.9 Owing to the relatively high accident rate related to this equipment, a rigorous and robust post-accident inspection procedure should be in place. A lack of CCTV images might cause considerable costs to authorities in fighting claims.

3.13 CCTV CAMERAS

Introduction

3.13.1 CCTV cameras are becoming widely used for the monitoring of highway networks, identifying congestion hot spots and highway incidents. Specific maintenance contracts are normally agreed between the authority and the contractor relating to CCTV equipment, owing to the specialist nature of the equipment.

Equipment specific issues

3.13.2 Specific equipment faults which should be reported with an urgent response required are as follows:

- loss of picture from one or more cameras;

- picture quality so low that images are incomprehensible;

- loss of control from one or more cameras; and

- outstation equipment is damaged and in a dangerous condition.

3.13.3 Other faults should be defined as a non-urgent response. The urgent and non-urgent response times should be agreed locally, as discussed in paragraphs 3.2.11–13.

3.13.4 Reactive maintenance should be undertaken in line with the manufacturer's guidelines. Following the completion of the repair work, the authority should ensure the contractor communicates with the instation operators, clarifying whether the fault has been satisfactorily repaired by carrying out instation checks, such as zooming in on an object and ensuring that the camera focuses automatically.

Section 4
Preventative Maintenance

4.1 INTRODUCTION

4.1.1 Preventative maintenance refers to items that require to be dealt with on a cyclical basis, hence reducing the need for reactive maintenance. It provides the basis of a life cycle approach to the maintenance of electronic traffic equipment. Aspects of preventative maintenance include routine maintenance activities, as described in TD 24/97 *All-Purpose Trunk Roads Inspection and Maintenance of Traffic Signals and Associated Equipment* (18). A well-designed preventative maintenance programme will:

- help to prevent the performance of the installation falling below the designed level;
- identify any mechanical, structural, electrical or optical work necessary to maintain or increase the life of the installation;
- reduce the incidence of faults; and
- check that the installation is safe.

4.1.2 Preventative maintenance should be considered as an essential part of managing safety risks, ensuring serviceability and maintaining customer service.

4.1.3 Preventative maintenance will normally include the following generic activities:

- lamp inspection, maintenance and cleaning;
- visual inspection and minor repairs to electrical equipment and wiring;
- mechanical inspection and maintenance including door security;
- visual inspection of the structural condition of the asset, including supports and any attachments;
- programmed electrical inspection and testing;
- programmed structural testing;
- programmed group lamp replacement;
- programmed painting; and
- inventory data verification.

4.1.4 Further details on maintenance inspection requirements can be found in Chapter 2 of TD 24/97. This lists specifically the routine inspection requirements for traffic signals – however, some of these can be associated to other types of equipment. Authorities should define in their maintenance contract the

preventative maintenance inspection requirements of assets, carrying out periodic reviews to ensure either new or modified equipment is being inspected in line with current standards and the manufacturer's requirements.

4.1.5 Preventative maintenance programmes should be determined by taking account of all variables, including: lamp type, age and type of equipment, and statutory requirements such as electrical testing. Whilst it is desirable to carry out as many of these tasks as possible on a single visit, the competency and experience of the workforce might affect the range of work that can be completed at one time.

4.1.6 A careful assessment of the tasks and the qualification and experience of the maintenance operatives should be carried out to ensure maximum efficiency is achieved. If necessary, separate crews should be used for different tasks, to minimise delays and maximise productivity.

4.1.7 The recorded information and results of the maintenance inspections should be reviewed following completion to identify any follow up repairs or equipment issues, which can be programmed as preventative maintenance. The recorded information should be held in an appropriate maintenance system to ensure it is accessible to the correct staff, including the engineer supervising the maintenance contract and at the relevant location(s).

> **Recommendation 19** – Preventative maintenance should be treated as the key tool to successful implementation of the asset management plan, forestalling poor performance and failure of the installation.

4.2 MAINTENANCE INSPECTIONS

4.2.1 A regime of maintenance inspections is an integral part of a preventative maintenance. Their purpose is to detect operational failure and to identify physical or operational deterioration. Aspects of operational failure are discussed in Section 3 – Reactive Maintenance. Items to be covered during maintenance inspections include:

- equipment operation;
- electrical equipment, including both visual inspection and electrical testing;
- presence of relevant documentation;
- physical condition of equipment, including mechanical and electrical condition;
- physical condition of signs and road markings; and
- vegetation that could obscure assets.

4.2.2 Guidance given in TA 84/06: *Code of Practice for Traffic Control and Information Systems for All-Purpose Roads* (19) states that "complete inspections are required at least every twelve months, with specific items requiring inspections at intervals not greater than six months".

4.2.3 It is common practice for most inspections to be carried out by contractors.

4.3 MAINTENANCE PROCESSES FOR ALL ASSETS

Electrical inspection and testing

General

4.3.1 The Electricity at Work Regulations (24) state that "As may be necessary to prevent danger, all systems shall be maintained so as to prevent, so far as is reasonably practicable, such danger".

4.3.2 To demonstrate that an installation meets the necessary safety standards, electrical inspection and testing comparable to any other fixed equipment installation should be carried out. Electrical inspection and testing should be carried out at intervals of up to six years, in accordance with the requirements of BS 7671: *Requirements of Electrical Installations* (23).

4.3.3 The frequency of the electrical inspection and testing should be determined taking account of the following:

- the type of installation;
- the use and operation it is subject to;
- the frequency of maintenance;
- any external influences that exist; and
- past history of inspection and repair.

4.3.4 The co-ordination of electrical inspection and testing with other cyclic maintenance activities should be considered to help reduce disruption to the public; however, this might not be the most cost effective means of carrying out this operation, and separate personnel might be needed for this purpose.

4.3.5 TD 24/97 *All-Purpose Trunk Roads Inspection and Maintenance of Traffic Signals and Associated Equipment* (18) provides further details on electrical safety checks during preventative maintenance activities.

Visual inspection of electrical equipment

4.3.6 The condition of the electrical equipment and wiring should be visually checked at each preventative maintenance or repair visit and reported back to the authority. So far as reasonably practicable, the visual inspection should verify that the safety of persons, animals and property is not endangered.

4.3.7 The general visual condition of the installation should be noted on the inspection report. However, if any particular item causes concern, the problem should be detailed on a supporting schedule. Where appropriate, action should be taken to repair defects during the initial inspection to reduce the need for return visits.

4.3.8 During the visual inspection, any dangers should be identified that might arise during the testing procedure. The operative should take any necessary action and implement safety precautions. Where a problem is considered as dangerous, the item of equipment should be repaired immediately or taken out

of service by removing the main fuse from the supply termination until the fault has been rectified. Under no circumstances should an electrically dangerous item of equipment be left in operation.

4.3.9 Fuses or other circuit protection devices should be checked for correct type and value and, if necessary, replaced.

4.3.10 Failure to carry out an electrical inspection should be recorded in the operative's report. A record should be made of any departure from the regulations.

4.3.11 Operatives should be trained and competent to carry out visual inspections and recognise any potential dangers.

Electrical testing

4.3.12 Electrical testing should only be carried out by a competent person with sufficient training and experience to interpret the test results and identify any inherent problem within the installation. All test equipment should be suitable for the test intended, correctly calibrated and regularly certified. For further details on electrical competence, inspection and testing see Appendices E and F.

Electrical testing records

4.3.13 The results of periodic electrical inspection and testing should be recorded on an inspection certificate. Suitable test certificates specially designed for highway electrical installations are available from the National Inspection Council for Electrical Installation Contracting (NICEIC) at the website link below.

www.niceic.com

4.3.14 Records of electrical testing results should be kept throughout the life of the installation, enabling the condition of the equipment and the effectiveness of maintenance policies to be monitored. A management system should allow electrical test certificates to be linked to the specific individual item of equipment, thus meeting the demands of the regulations and providing an efficient maintenance system.

Structure inspection and assessment

Inspection and assessment of protective coatings

4.3.15 Traffic signal posts and other posts need to be protected from the effects of the weather, pollution and other elements. Steel posts in particular will quickly deteriorate if they are not provided with, as a minimum, a protective system such as hot dipped galvanising.

4.3.16 Further protection may also be given by the application of an additional protective system such as paint or powder coating. Posts manufactured from aluminium, stainless steel or composite materials generally require no additional protective coatings to be applied. To maximise the life of a post, any protective systems applied need to be maintained throughout its life.

4.3.17 In environmentally sensitive locations such as conservation areas, towns, and city centres, the application of additional protective coatings may be carried out to provide a more decorative and aesthetically pleasing finish to the posts,

as well as providing protection. The negative impact that poorly maintained posts can have on an area should be taken into account when determining maintenance and re-application of protective coating intervals.

4.3.18 The condition of protective systems, including the finish to aluminium, stainless steel or composite materials, should be inspected at each maintenance visit and a report on their condition submitted by the contractor to the authority. Maintenance operatives should be trained to recognise the different types of materials used in the manufacture of posts and the different types of protective systems applied, together with the potential defects and severity of the defects applicable to each.

4.3.19 Anti-vandal coatings that are applied to cabinets and posts should be maintained throughout the life of the asset and be inspected at each maintenance visit.

Protective coatings and application

4.3.20 Protective coatings such as decorative paint or anti-vandal coatings should be applied to asset furniture in situ by specifically trained and competent persons, normally from specialised external contractors. The authority and maintenance contractor should have the relevant risk assessments and method statements in place before this type of work is carried out, to ensure safety of the public and the environment.

4.3.21 Newly manufactured furniture should have the correct protective coatings specifically detailed for the asset, taking into account the material, its location and the surrounding environment to ensure the maximum life of the furniture is obtained.

Structural testing

4.3.22 Structural failures of corroded traffic signal posts have raised awareness of the increasing age of the asset and its deteriorating condition.

4.3.23 To help assess the structural condition, a visual inspection of each post should be carried out at every preventative maintenance or repair visit and a written report made by the contractor to the authority, stating the equipment's condition and any remedial works required.

4.3.24 Every time a post is removed from service, owing to accident damage or replacement, its condition should be inspected and analysed and the information recorded. The general condition of the unit, particularly the root section, will give an overall guide to the condition of other similar units in similar locations and of similar age. If a removed unit shows severe corrosion or other significant defects, it should prompt a thorough inspection of all units of the same or similar type.

4.3.25 Whilst visual inspections can provide a cost-effective means of assessing the general condition of the asset, they cannot identify internal or underground corrosion. The information determined from visual inspections should be recorded and used to develop further inspection and testing programmes as part of an overall assessment procedure for determining the condition of the asset.

4.3.26 An assessment of the structural condition of posts can be made by a number of methods. These methods vary from non-intrusive tests, such as ultrasonic testing at critical points on the unit, to “strength tests”, such as a full dynamic test, where a unit is subjected to a load equivalent to the maximum design load and its deflection at ground level recorded.

4.3.27 Non-intrusive tests do not give a direct measure of the structural strength of the unit tested; the data has to be analysed to provide an indication of structural strength. Strength tests should provide an actual measurement of the residual structural strength of post at the time of testing. Whatever tests are used, a detailed analysis of the result will be needed to maximise the value of the information obtained.

4.3.28 Structural testing should be carried out to a pre-determined programme. However, as most of the tests and in particular the strength tests need to be carried out by specialist contractors with the correct equipment and procedures, it is considered that this work should be programmed separately from other preventative maintenance activities.

Lamp change

Strategies

4.3.29 There are two main strategies for the replacement of lamp units:

- burn to extinction, under which each lamp unit is replaced on failure (addressed by reactive maintenance described in Section 3 of this Code); and
- Bulk Lamp Change (BLC) under which all lamps of a particular type in a particular area are replaced at the same pre-defined time, a typical preventative maintenance activity.

4.3.30 Owing to the legal requirements for the illumination of certain assets, including traffic and crossing signals, a bulk lamp replacement strategy should be adopted for the following assets:

- traffic and crossing signals;
- traffic signals other;
- interactive signs; and
- VMS – safety message type.

4.3.31 Lamp manufacturers are generally unable to provide accurate data of life expectancy of lamp units operated under field conditions, but can often supply limited data obtained under laboratory conditions.

4.3.32 With manufacturers designing new types of lamp units to be utilised within highways assets. including LED illumination, lamp replacement processes should be agreed in line with the type of lamp units fitted.

Burn to extinction

4.3.33 A burn to extinction lamp replacement policy maximises the life of the lamp. However, as individual lamp units have a varied life expectancy, it is impossible to assess the level of lumen depreciation that will occur throughout the installation. Few authorities will operate using a burn to extinction policy, as the cost of running a contract in this way is considerably more expensive and it is easy to change the lamps at a predetermined time during the periodic lens clean.

4.3.34 If this policy is implemented, then it will require the contractor to provide a higher amount of reactive maintenance, attending lamp units that have burnt out as and when, rather than carrying out preventative maintenance.

Bulk lamp change

4.3.35 It has traditionally been accepted that BLC is the most cost effective policy for the majority of lamp units used in the highway asset. BLC of lamp units helps to ensure that the system performance is maintained throughout the life of the installationLamp replacement periods depend on the type of lamp unit and the annual hours of operation, but lamp technology continues to improve and, to maximise the benefits from these improvements, group replacement intervals and cleaning intervals should be regularly reviewed. Records of the design criteria used should be kept, as this information will allow the effect of extending the replacement and/or cleaning intervals, to take account of improvements in lamp life and lumen depreciation, to be assessed.

4.3.36 BLC programmes should be organised so that a reasonably uniform workload is achieved every year. Lamps in new assets installed more than 12 months prior to the BLC programme of the immediate area should be included in the appropriate BLC programme.

4.3.37 Authorities should review as part of the BLC programme whether lamp units which have been replaced in the last two to three months should be replaced as part of the BLC. In doing so, they should determine whether there are any financial and environmental benefits in not replacing them. Ordinarily the contractor is attending site to replace other lamp units as part of the BLC and therefore the savings will be minimal. All lamp units should be run up after replacement to ensure they are working correctly within the specified asset.

4.3.38 As part of the BLC activities, and to provide efficiencies, cleaning of surfaces that protect the lamp units should be completed at the same time as the BLC, such as traffic signal lenses and VMS legend panels. Further details on these processes are provided in paragraphs 4.3.59–61.

4.3.39 TD 24/97 *All-Purpose Trunk Roads Inspection and Maintenance of Traffic Signals and Associated Equipment* (18) provides further details on BLC during the routine maintenance activities.

Mechanical inspections

4.3.40 Mechanical equipment which is a key part of the asset, such as a pneumatic arm on a plank type VMS, or a hinge on a cabinet door, should undergo inspections and, if necessary, works as part of the preventative maintenance process.

4.3.41 To ensure assets are secure from vandals and adverse weather damage, security locks/bolts on asset cabinets and poles should be inspected to ensure their effective operation is maintained throughout the life of the asset.

4.3.42 Should any works be required, they should be undertaken in line with the manufacturer's guidelines for the equipment. If the works to be undertaken are beyond the capability or competence of the contractor's employees, either training should be arranged or specialist contractors should be employed to complete this type of work. Details of all works undertaken should be recorded by the contractor.

Schedules and response times

Asset register

4.3.43 Equipment schedules provide an up to date list of the asset equipment which is held on the asset management system and which requires preventative maintenance inspections. The authority should agree equipment schedules with the maintenance contractor on an annual basis to ensure all new or modified assets are inspected and decommissioned sites are not. The asset register should detail such information as the unique asset reference, asset location (including roads and landmarks), the asset type and the asset equipment type.

4.3.44 Maintenance schedules should be programmed to geographical areas to allow the contractor to carry out inspections in an organised and efficient manner, thus reducing travel time, environmental emissions and cost to the authority.

4.3.45 Schedules can be used by the contractor to document the work carried out at each asset. However, specific inspection forms should be completed as part of the visit; this is detailed further in paragraphs 4.3.48–58 and Appendix D.

Response times

4.3.46 Maintenance contracts should specify the frequency of maintenance inspections. This will give the contractor a known and agreed timescale for completion of the inspection.

4.3.47 Maintenance inspections should be completed within 14 days either side of the agreed inspection date. This allows the contractor a period of four weeks within which the inspection should be completed.

Documentation/records

4.3.48 There are two types of asset documentation that should be recorded and maintained by the authority as part of their asset management process, as detailed below:

Inspection records

4.3.49 The contractor should provide, as part of the preventative maintenance process, a full record of works undertaken, including results of visual inspections, electrical tests and BLCs.

4.3.50 These documents should be recorded on the management system. Typical documents which should be provided by the contractor are:

- asset specific cyclical inspection form;
- electrical testing results form;
- structural testing results form;
- certification form (if asset type requires certification); and
- photos of site, including the specific risks identified.

Asset documentation

4.3.51 As part of the preventative maintenance regime, the contractor should undertake a periodic check of asset records for their accuracy against site location.

4.3.52 Typical documents that should be provided at site include:

- site drawing/layout;
- details of equipment configuration/wiring;
- operational settings;
- asset health and safety risks; and
- contractor engineer's log book detailing history of site works and other factors of importance.

4.3.53 Documentation that is missing or requires replacement owing to wear and tear should be noted by the contractor on the cyclical inspection form, allowing the authority to action and provide copies of the relevant documentation. The replacement of missing items should be actioned as soon as possible to allow the maintenance of the asset to continue in an effective and efficient manner.

4.3.54 TD 24/97: *All-Purpose Trunk Roads Inspection and Maintenance of Traffic Signals and Associated Equipment* (18) and TA 84/06: *Code of Practice for Traffic Control and Information Systems for All-Purpose Roads* (19) detail further information on documentation that should be available on site at the asset.

4.3.55 The authority should retain comprehensive records and documentation for each asset in its management system, and these should be accessible to those responsible for asset management as well as to the maintenance contractor.

4.3.56 The documentation that should be available in the maintenance file includes the following:

- documentation originating from the design file, including risk assessments, as-built drawings and statutory undertakers' drawings;
- preventative maintenance inspection records as detailed in paragraphs 4.3.48–58 and Appendix D;
- asset specific documentation as detailed in paragraphs 4.3.48–58; and
- asset fault history – records for the asset detailing faults/complaints for the previous five years (as detailed in TD24/97).

4.3.57 Asset documentation should be stored electronically by authorities in their management systems, for operational use, allowing easier access and distribution, with the original paper documents stored for reference or legal matters at an alternative location.

4.3.58 Asset specific documents and processes required should be agreed by the authority and contractor as part of the maintenance contract.

Cleaning procedures

4.3.59 Preventative maintenance processes should include a detailed cleaning process, as many elements of equipment used in the traffic control and monitoring function are sensitive to certain environments and locations.

4.3.60 The installation of new technologies, including advanced overhead detectors and solar panels, has led to the requirement for new maintenance processes. The authority and the contractor should review the current cleaning procedures and ensure these are up to date with the manufacturer's requirements.

4.3.61 Specific equipment cleaning requirements are described throughout Section 4 where relevant.

Safety

4.3.62 Safety requirements and concerns whilst carrying out preventative maintenance inspections, including Road Safety and Presence of Gas are documented in Chapter 4 of TD 24/97: *All-Purpose Trunk Roads Inspection and Maintenance of Traffic Signals and Associated Equipment* (18).

4.3.63 The contractor should have generic risk assessments in place detailing the identified risks for carrying out inspections, together with the measures which will either mitigate or remove these risks. These risk assessments should be documented in the maintenance files.

4.3.64 The authority should also retain site specific risk assessments relating to each asset. These site specific risks should be provided to the contractor prior to attendance at site. The contractor should review the risks before, during and after the visit and report back any issues to the authority.

4.3.65 An authority should have in place an internal procedure that details actions which should be taken when the presence of explosive or asphyxiating gas at an asset is identified. The maintenance contract should specify how the contractor tests for the presence of gas when working on an asset with confined spaces.

4.3.66 Vermin infestations in highway equipment are common, especially if the equipment in question has not been installed and sealed correctly. The authority should ensure that the contractor has risk assessments and method statements in place for dealing with vermin infestations, as there are significant risks involved, such as contracting Weil's disease.

4.3.67 Equipment should be properly sealed to minimise the risk of the intrusion of vermin, including sealing the bases of cabinets and poles, and blocking the end of cable duct runs. These actions should help to prevent equipment damage such as chewed cables and will minimise the risk of the spread of vermin throughout the assets equipment.

4.3.68 Assets located in either highly populated urban areas or rural countryside locations are most prone to the infestation of vermin, as they are located near natural vermin habitats. These assets should be identified separately within the inspection programme and the authority should consider whether it is necessary for specialist contractors to be brought in to undertake cleansing of the asset.

4.4 TRAFFIC SIGNALS AND CROSSING SIGNALS

Specific preventative maintenance tasks

Signal head visibility and alignment

4.4.1 The visibility of signal heads on all assets should be checked in accordance with the advice given in DfT Local Transport Note 2/95 *The Design of Pedestrian Crossings* (49). This involves identifying whether signal heads are visible and, if not, then precise reasons why, for example aspects such as foliage should be noted. Table 4.1 is taken from Local Transport Note (LTN) 2/95, which details visibility requirements.

Table 4.1: Required visibility of traffic signal heads

85 percentile approach speed (mph)	25	30	35	40	45	50
Desirable minimum visibility (metres)	50	65	80	100	125	150
Absolute minimum visibility (metres)	40	50	65	80	95	115

4.4.2 Foliage located within 1.5 metres of a signal head should be noted as part of the preventative maintenance, and instructions should be passed to the relevant contractor to undertake trimming in order to ensure that visibility of the head remains unobstructed. Further advice on visibility is given in Local Transport Note 1/98 *The Installation of Traffic Signals and Associated Equipment* (41).

Road markings

4.4.3 The authority should ensure that an inspection of road markings is carried out as a separate inspection or forms part of the preventative maintenance checks for traffic control assets. The condition of stop lines, pedestrian crossing studs, lane markings, hatching areas and directional arrows should all be inspected, and any worn or missing markings should be noted. *Well-maintained Highways* (3) and TD26/07 (52) provide further guidance in this area.

Street furniture

4.4.4 Some authorities, as part of their preventative maintenance, inspect items such as tactile paving, pedestrian guard railing, chambers, covers and kerb upstands to ensure the signal site as a complete entity has been inspected. The

authority should have in place a local agreement to ensure that these elements are inspected, if not under the traffic control preventative maintenance. *Well-maintained Highways* (3) gives further guidance in this area.

Alignment of above ground detection equipment

4.4.5 This equipment is vulnerable to vandalism and adverse weather conditions such as high winds. The alignment of these detector units should be checked as part of preventative maintenance. As part of this task, the connecting cables should be checked to ensure that they are satisfactorily secured.

Configuration

4.4.6 The traffic signal and crossing signal controller should be interrogated using the appropriate handset or terminal to ensure the following items are correctly set up within the controller's operational configuration:

- **time of day** – if this is incorrectly set, it can have a detrimental effect on the operation of the traffic signals or crossing signals;
- **date** – if this is incorrectly set, it can have a detrimental effect on the operation of the traffic signals or crossing signals;
- **British summer time dates** – if these are incorrectly set, this can affect the time of day settings;
- **faults** – any faults being reported by the signal controller;
- **crossing signals** – configured crossing timings should be checked against the approved timings to ensure that the site is operating within legal limits. It should be noted that some manufacturer's crossing signal controllers can revert to default settings following mains supply failure.

Furniture clean

4.4.7 Traffic signal poles and the traffic signal controller cabinet tend to attract unwanted attention in the form of graffiti, fly posters and other unauthorised signs. As part of the preventative maintenance, these should be either removed or identified for future rectification measures, such as specialist cleaning or the application of a protective coating.

Lens clean

4.4.8 The authority should ensure that the signal head lenses are cleaned on a periodic basis; it might make sense to do this as part of the BLC. Vehicle grime and the effects of varying weather conditions can cause a build-up of dirt on the lens, and this should be regularly cleaned so as not to restrict visibility of the signal lens. LED signal heads might not be included as part of the BLC programme owing to their increased life period – however, the authority and contractor should ensure that a similar process is in place to clean LED signal heads periodically.

Dimming facility

4.4.9 This equipment and facility should be checked by covering the dimming equipment, therefore simulating fading light, and the illumination of the lamps should decrease accordingly.

4.4.10 For further guidance and reference from traffic control users please refer to the TCUG *Guidance Note 1 – Inspection and Testing of Low Voltage Power Supplies and Cabling for Traffic Control Systems and Associated Equipment During Maintenance* (50).

4.4.11 Further tasks are described in Chapter 2 of TD 24/97 *All-Purpose Trunk Roads Inspection and Maintenance of Traffic Signals and Associated Equipment* (18).

4.5 OTHER TRAFFIC SIGNALS

Specific preventative maintenance tasks

4.5.1 Information relating to the following issues is provided in Section 4.4:

- signal head visibility and alignment;
- road markings;
- street furniture;
- alignment of above ground detection equipment;
- configuration;
- furniture clean;
- lens clean; and
- dimming facility.

School Crossing Patrol signs

4.5.2 The configuration for School Crossing Patrol flashing amber warning signs will require updating each school calendar year. This configuration update ensures that the unit operates on the correct days and not during school holidays or individual teacher training days. The amount of future configuration data that can be loaded will depend on the manufacturer – however, a minimum of one year and maximum of three years is typical. The authority should ensure a local process is in place with the contractor to carry out this timetable configuration update in line with the manufacturer's guidelines.

Alignment and cleaning of solar panels

4.5.3 The alignment of solar panels should be checked to ensure that optimum solar position is achieved, usually detailed in the manufacturer's guidelines. Correct alignment should reduce insufficient daylight and battery charging issues.

4.5.4 Solar panels should also be cleaned to reduce the risk of battery charging issues. Guidelines on how to clean the panels should be referred to before any cleaning is carried out, as use of the wrong cleaning materials could lead to the reduction of the operational life.

4.5.5 As part of their preventative maintenance, authorities should have in place a replacement programme for the solar panel equipment. Further guidance on life expectancy of this equipment should be sought from the relevant manufacturer.

Wig-wag control panels

4.5.6 Wig-wag control panels and associated control buttons should be tested to check the wig-wag operates as intended and there are no cable/wiring issues. The contractor should refer to the manufacturer's guidelines for further information on preventative maintenance.

4.5.7 The condition and alignment of associated warning signs should also be inspected. This is particularly important for the School Crossing Patrol flashing amber warning signs, as users of the network identify the possible risks by way of the warning signs and flashing units. Any defects should be noted and passed to the relevant persons for action.

4.6 INTERACTIVE SIGNS

General

4.6.1 Advice given in Traffic Advisory Leaflet (TAL) 01/03 *Vehicle Activated Signs* (42) relates to preventative maintenance being carried out every six months. However, authorities should have local service levels in place that best suit their own assets within their networks.

Specific preventative maintenance tasks

4.6.2 Information relating to the following issues is provided as indicated below:

- alignment of above ground detection equipment (Section 4.4);
- signing (Section 4.4); and
- alignment and cleaning of solar panels (Section 4.5).

4.6.3 The configuration and operation of interactive signs should be checked. The checks required will depend on the type of sign – however, the three main types of operation and the checks which should be carried out are detailed below:

- **Speed activation** – The detection equipment installed at site should be checked to ensure activation of the sign at the correct trigger speed. If above ground detection is used, then the alignment of this should also be checked. Any defects or repairs completed should be noted for the maintenance records.
- **Timetable activation** – Similar to the School Crossing Patrol flashing amber warning signs, these types of interactive signs require timetable updates periodically to ensure operation on the correct days. Operational checks should be carried out once these amendments have been made.

- **Inductive loop activation** – Physical checks on the inductive loop detection should be carried out to identify any wear and tear. The operation of the signs, via the pulsing of the inductive loops, should be checked and any defects or repairs completed should be noted for the maintenance records.

4.6.4 Any other approved timing values should also be checked as part of the preventative maintenance regime.

4.6.5 The sign fascia should be cleaned. Guidelines on how to clean the sign fascia should be referred to before any cleaning is carried out, as use of the wrong cleaning materials could lead to the reduction of operational life.

4.6.6 The visibility and the alignment of the signs should also checked. If foliage issues are observed, then any foliage within 1.5 metres of the sign should be noted as part of the preventative maintenance and instructions passed to the relevant contractor to trim.

4.6.7 During the maintenance inspection, a check of the operation and condition of the thermostat and heater should be carried out in line with the manufacturer's guidelines.

4.7 VARIABLE MESSAGE SIGNS

General

4.7.1 Advice given in the document Traffic Advisory Leaflet (TAL) 01/03 *Vehicle Activated Signs* (42) relates to VAS preventative maintenance being carried out every six months. However, authorities should have service levels in place that best suit the relevant assets installed on their networks.

Specific preventative maintenance tasks

4.7.2 Information relating to the following issues is provided as indicated below:

- visibility and alignment (Section 4.4);
- alignment and cleaning of solar panels (Section 4.5);
- fascia cleaning (Section 4.6); and
- thermostats and heaters (Section 4.6).

4.7.3 The rotating plank type of VMS will require a full inspection. The mechanical components of this type of equipment will require a check in line with the manufacturer's guidelines; however, typical tasks are component operational checks, lubrication/greasing of components and checking for wear and tear of components.

4.7.4 VMS doors and associated equipment require maintenance inspections to check any wear and tear, mechanical issues and lubrication/greasing of joints. This activity ensures that this equipment will continue to work as designed.

4.7.5 During the inspection the contractor should check to ensure the correct operation of the sign; this will be the case whether the sign is either mechanical or of the EMS type. The sign should be set to a number of operational states so the person carrying out the inspection can identify whether the sign is:

- rotating to the correct legend upon response (checking the operation of the limit switches); and
- illuminating the correct LEDs upon request.

4.7.6 Once all operational checks have been completed, the contractor should check that the sign is set back to the original operational settings.

4.8 FIXED ENFORCEMENT/ROAD SAFETY CAMERAS

General

4.8.1 Authorities and contractors should refer to DfT Circular 01/2007 *Use of Speed and Red-Light Cameras for Traffic Enforcement: Guidance on Deployment, Visibility and Signing* (46) for further information on safety cameras. Authorities and contractors should also refer to the cameras manufacturer's guidelines.

4.8.2 Certain type approved camera equipment requires preventative maintenance tasks to be carried out by the manufacturer, in order to ensure that the camera remains type approved and enforcements are still able to be prosecuted. This will restrict the authority' s choice of maintenance contractor for this type of equipment, and suitable agreements should be put in place to ensure the equipment remains type approved while in operation.

Specific preventative maintenance tasks

4.8.3 All doors, hinges, brackets and security systems used in the camera equipment will require preventative maintenance checks in line with manufacturer's guidelines. Some camera equipment is mounted on a counter weight operation, which allows the operator to carry out work at a safe level, rather than introducing risks by working at height. This counter weight equipment will require a thorough inspection to check that the system is still in a suitable

condition to support the camera equipment, and these checks should be carried out by a competent person and in line with the manufacturer's guidelines.

4.8.4 Certain camera equipment and sites will require a periodic calibration to ensure the continuing Type Approval for the asset. Ordinarily the calibration period for this type of equipment is annual; however, the calibration period will depend on details specified in the Type Approval for the asset or in DfT Circular 01/2007 (46).

4.8.5 Camera equipment might need to be removed from site and calibrated elsewhere by the manufacturer. This will mean that the camera will be out of service for a period of time, and authorities should consider whether contingency plans are needed to ensure continuing operation of the camera. This decision is likely to be influenced by a number of factors, including the safety improvements observed while the camera is in operation.

4.8.6 The authority should receive calibration certificates from the manufacturer, which should provide the start and end date of the calibrated period, serial numbers of the equipment calibrated and a signature from the manufacturer's engineer. These certificates should be filed in the asset maintenance records for future reference and possible enforcement appeals.

4.8.7 Further information on thermostats and heaters is included in paragraphs 4.6.2–7.

4.8.8 Lenses and optical components relating to the camera equipment should be periodically cleaned to ensure that the camera has sufficient visibility to capture pictures of offenders. Products and materials used for this cleansing should be used in accordance with the manufacturer's guidelines.

4.8.9 Associated with certain speed camera installations there are a series of secondary speed check markings, which are used as a visual aid to determine vehicle speeds. The authority should ensure as part of the preventative maintenance regime that these markings are still clearly visible such that they can be used to assist with prosecutions.

4.8.10 Preventative maintenance of red light enforcement cameras should include the inspection of the stop line associated with the camera. This check should ensure that the stop line is not worn and any defects noted are actioned by the authority in line with their local highway maintenance contracts.

4.8.11 A check of the carriageway surface and inductive loops associated with red light enforcement cameras should be included in the inspection. Defects should be noted and passed to the relevant party for action. This might include remedial works such as carriageway resurfacing or re-cutting of the loops.

4.8.12 Following the successful completion of the preventative maintenance activities, the camera equipment should be tested to ensure that it is operating as intended. The results should be recorded on the inspection paperwork.

4.8.13 In order to operate correctly, average speed cameras use ANPR equipment that is designed for installation on tall poles, allowing them greater visibility of the monitored lanes. The use of tall poles increases the risks associated with maintenance, and authorities should carry out specific risk assessments in order to reduce the potential risks where possible. To carry out preventative

maintenance tasks safely, additional traffic management and lane closures might be required. The authority should take account of any required closures during the initial planning and design stage.

Steering Group/Atkins Project Team

4.9 REAL TIME PASSENGER INFORMATION SYSTEMS

Specific preventative maintenance tasks

4.9.1 The fascia of the signs in bus shelters or on street should be checked periodically and cleaned with the appropriate products and materials, in line with the manufacturer's guidelines.

4.9.2 The signs should be checked for the failure of the illumination of LEDs. The contractor undertaking the checks should ask for the instation staff to set the sign to a test message, which should display each LED/element on the sign, allowing a check for faults. Alternatively, some manufacturers have a test facility on the sign, which can be implemented manually by the operative undertaking the inspection.

4.9.3 Sign door security and fixings should be checked, lubricated and defects noted for future action. Sign types vary, and each has a different number and types of mechanical component. The authority should check mechanical components in line with the manufacturer's guidance.

4.9.4 The housing of the sign should be inspected and defects noted for future action. Undetected defects of the sign housing could reduce the operational life of the housing and also cause aesthetic issues such as rust.

4.10 CAR PARK MANAGEMENT SYSTEMS

General

4.10.1 Preventative maintenance tasks should be carried out by competent persons with appropriate authorisation from relevant parties responsible for the upkeep of the car park where the management systems are installed. A local agreement should be in place between the car park owners and the authority relating to the required access for maintenance.

4.10.2 Specific risk assessments should be in place for each car park asset, listing the site specific risks and the proposed actions to either remove or mitigate these risks. These risk assessments should be in place before any maintenance tasks are carried out.

Specific preventative maintenance tasks

4.10.3 For relevant information on preventative maintenance tasks for VMSs that can be related to car park management signs refer to Section 4.7.

4.10.4 A car park management system might involve rising barrier equipment. Any mechanical components within such equipment should be inspected periodically in line with the manufacturer's guidance.

4.10.5 Car park cabinet door security and fixings should be checked, lubricated and defects noted for future action. The cabinet housing should also be inspected and defects noted for future action. Undetected defects in the cabinet could reduce its operational life and also cause other visible defects such as rust.

4.10.6 A check of the carriageway surface and inductive loops associated with the access points in the car park should be included as part of the inspection. Defects should be noted and passed to the relevant parties for action, which might include carriageway resurfacing or re-cutting the loops.

4.10.7 The contractor undertaking the inspection should be in contact with the car park system instation operator to carry out a check on the counting equipment and the occupancy values of the car park. This operational check will ensure that the reported occupancy values are correct and the counting equipment is functioning as designed. Special event and festive holiday timetables require

updating by the authority annually to ensure that the car park information displayed to highway users is correct. This task is carried out on the instation – however, the authority should treat this as part of the preventative maintenance process. These timetable changes should be noted in the asset maintenance records for future reference.

4.10.8 The routing of cabling for the car park management system varies from car park to car park and can sometime utilise metal casing attached to the car park structure. This casing should be inspected periodically to ensure the material has not been affected by the environment or damaged by third parties. Potential damage to casing could have an effect on the operation of the cable routed inside. Damaged cable should be identified through the electrical inspections carried out under BS 7671:2008 *Requirements for Electrical Installations* (23).

4.10.9 Associated directional and warning signs should be inspected as part of the process for identifying any defects in the alignment and condition of the signs. Defects should either be immediately actioned or noted for future remedial works.

4.11 TRAFFIC MONITORING EQUIPMENT

4.11.1 Information relating to the following issues is provided as indicated below:

- alignment and cleaning (paragraphs 4.5.1–7);
- alignment of above ground detection equipment (paragraphs 4.4.1–11) – this will relate primarily to over height vehicle detection systems; and
- thermostats and heaters (paragraphs 4.6.2–7).

4.11.2 ANPR equipment is vulnerable to vandalism and adverse weather conditions, therefore the alignment of these units should be checked. As part of this task the security of the connecting cables should be checked and secured as appropriate.

4.11.3 Lenses and optical components relating to ANPR cameras and over height equipment should be cleaned to ensure that the camera has sufficient visibility to capture pictures of offenders or detect over height vehicles. Products and materials used for cleaning should be used in line with the manufacturer's guidelines.

4.11.4 Foliage located within 1.5 metres of the units should be noted and instructions passed to the relevant parties to trim.

4.11.5 Poles and the associated cabinets often attract graffiti, fly posters and unauthorised signs. These should be either removed or identified for future action, such as specialist cleaning or the application of protective coatings.

4.11.6 A check of the carriageway surface and inductive loops associated with the monitoring equipment should be included in the inspections. Defects should be noted and passed to the relevant parties for action; these actions could include carriageway resurfacing or re-cutting the inductive loops.

4.11.7 The contractor undertaking the preventative maintenance tasks should carry out specific operational tasks, which will vary depending on the monitoring unit being inspected:

- **Weigh in motion** – Inspections to ensure the unit is measuring the correct data, for example the weight of the vehicle. If the outstation unit is connected to the RMS, then verification of the instation communications and a check of the data being reported should be undertaken. Operational checks should be carried out in line with local procedures and the manufacturer's guidelines.

- **Headway/classification/speed/count sites** – Inspections to ensure the unit is measuring the correct data, for example the class of vehicle or count numbers. If the outstation unit is connected to the RMS, then verification of the instation communications and a check of the data being reported should be undertaken. Operational checks should be carried out in line with local procedures and the manufacturer's guidelines.

- **Height** – Inspections to ensure the unit detectors are identifying over height vehicles correctly and the system actions the appropriate warnings, for example the VMS is displaying an appropriate information message. If the outstation unit is connected to the RMS, then verification of the instation communications and a check of the data being reported should be undertaken. Operational checks should be carried out in line with local procedures and the manufacturer's guidelines.

- **Journey times/traffic pictures** – ANPR equipment checks should ensure that vehicles are being detected and number plates recorded by the camera. This can be completed on site using a remote terminal plugged into the camera or via the RMS instation. If the outstation unit is connected to the RMS, then verification of the instation communications and a check of the data being reported should be undertaken. Operational checks should be carried out in line with local procedures and the manufacturer's guidelines.

4.11.8 To operate correctly, ANPR equipment and over height equipment are designed to be installed on tall poles, allowing them a greater visibility of the monitored lanes or over height vehicles. The use of tall poles increases the risks associated with maintenance, and authorities should carry out specific risk assessments to mitigate or remove these risks where possible. To undertake preventative maintenance tasks safely, additional traffic management and lane closures might be required. The authority should take into account these items during the initial planning and design stage.

4.11.9 Door security and fixings should be checked, lubricated and defects noted for future action. There are various types of monitoring equipment as detailed above, and the number of mechanical components found in different types will vary significantly. The authority should ensure that mechanical components are checked in line with the manufacturer's guidance.

4.11.10 The housing of the monitoring equipment cabinet should be inspected and defects noted for future action. Possible defects could reduce the operational life of the housing and also result in visible defects such as rust.

4.12 RISING BOLLARDS

Programming

4.12.1 The interval between preventative maintenance for rising bollards will vary, depending on how often the bollard is operated. If a bollard remains in the lowered position for the majority of the time, there is the likelihood that more significant damage could be caused by vehicles passing over it. In this situation, the authority should consider increasing the frequency of preventative maintenance.

Specific preventative maintenance tasks

4.12.2 Associated directional and warning signs should be inspected as part of the preventative maintenance process, identifying any defects in the alignment and condition of the signs. Defects should either be actioned or noted for future actions.

4.12.3 The control panel for the rising bollards, the warning indicators and associated control buttons should be tested to check that the rising bollards operate as designed and there are no cable and or wiring issues. The contractor should refer to the manufacturer's guidelines for further information on preventative maintenance.

4.12.4 Preventative maintenance tasks relating to CCTV equipment used to remotely monitor rising bollards are covered in Section 4.13.

4.12.5 A check of the carriageway surface and inductive loops associated with the monitoring equipment should be included in the inspection. Defects should be noted and passed to the relevant contractor for action; items such as carriageway resurfacing or re-cutting the inductive loops are examples of the type of remedial work that might be required.

4.12.6 Checks relating to the mechanical components should be carried out in accordance with the manufacturer's guidelines. This might require access to confined spaces, such as chambers or the bollards recess, and specific risk assessments should be agreed prior to any such maintenance tasks being undertaken.

4.12.7 To carry out certain preventative maintenance tasks safely, such as mechanical or operational testing, additional traffic management, lane closures and even diversions might be required. The authority should consider the need for these items during the initial planning and design stage.

4.12.8 Door security and fixings should be checked, lubricated and defects noted for future action. There are numerous types of rising bollard, and the number of mechanical components will also vary significantly between types. The authority should check mechanical components in line with the manufacturer's guidance.

4.12.9 The housing of the rising bollard control equipment is normally in cabinets or poles, which should be inspected as part of the preventative maintenance activities and defects noted for future action. Possible defects could reduce the operational life of the housing and also other visible defects such as rust.

4.12.10 Poles and the associated cabinets often attract graffiti, fly posters and unauthorised signs. These should be either removed or identified for future action, such as specialist cleaning or the application of protective coatings.

4.12.11 This equipment is vulnerable to vandalism and adverse weather conditions, and the alignment of these units should be checked. As part of this task, the security of the connecting cables should be checked and secured accordingly.

4.12.12 Refer to Section 4.11 for further details on the preventative maintenance tasks relating to ANPR equipment, which can be used to identify approved vehicles and allow access via the rising bollards.

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4.13 CCTV CAMERAS

General

4.13.1 The preventative maintenance tasks will include a complete overhaul, check and functional test of all outstation hardware in accordance with the manufacturer's guidelines. General preventative maintenance guidance can be found in MCH 1844 *NMCS Maintenance Instruction – Routine Maintenance CCTV Equipment* (51). This is a Highways Agency document; however, certain elements are relevant for CCTV equipment operated by local authorities.

4.13.2 There are aspects that should be addressed in a preventative maintenance programme relating to CCTV cameras, which are:

- instation equipment;
- outstation equipment; and
- transmission/communications equipment.

4.13.3 This section concentrates on the maintenance tasks relating primarily to the outstation equipment; however, it also details certain tasks relating to the other two aspects.

Specific preventative maintenance tasks

4.13.4 All lenses and screens should be thoroughly cleaned as per the manufacturer's guidelines. The use of abrasive material should be avoided when undertaking cleaning, and the authority should use only products and materials in accordance with the manufacturer's guidance.

4.13.5 A check of the operation and condition of the thermostat and heater should be carried out in line with the manufacturer's guidelines.

4.13.6 Certain CCTV cameras use wipers to keep the camera image clear in adverse weather conditions. These should be inspected and, if necessary, replaced.

4.13.7 The alignment and visibility of the CCTV camera should be checked with assistance from the instation system operator or via a remote terminal. Camera pan, tilt, visibility and rotational stoppers should be checked and reconfigured if required in order to ensure effective operation of the camera.

4.13.8 Visibility from the camera will need to be checked, and any objects obscuring the image should be noted and actioned appropriately. Foliage within 1.5 metres of the units should be noted and instructions passed to the relevant parties to trim.

4.13.9 The engineer responsible for carrying out the preventative maintenance activities should carry out relevant checks and tests in line with the manufacturer's guidelines. These tests could include image checks such as zoom, focus, iris and configured camera preset positions. However, specific tests should be determined based on guidance from the manufacturer.

4.13.10 To operate correctly, CCTV equipment is designed to be installed on tall poles, allowing the cameras better visibility of the network to be monitored. The use of tall poles increases the risks associated with maintenance, and authorities should carry out specific risk assessments in order to mitigate the risks where possible. To carry out preventative maintenance tasks safely, additional traffic management and lane closures might be required. The authority should take this into account during the initial planning and design stage.

4.13.11 All moving parts should be checked for wear and tear, then lubricated and greased in accordance with the manufacturer's guidance. CCTV camera mounting varies depending upon the age and manufacturer of the camera. To access the camera could involve using a mechanical winch mechanism or a counter weight mechanism, both of which will require checks in line with the manufacturer's guidance. Door security and fixings should be checked and lubricated, and defects actioned or noted for future action.

4.13.12 The housing of the CCTV control equipment can be installed in cabinets or the CCTV pole, and these should be inspected and defects noted for future action. Possible defects could reduce the operational life of the housing and also cause aesthetic issues such as rust.

4.13.13 Poles and the associated cabinets often attract graffiti, fly posters and unauthorised signs. These should be either removed or identified for future action, such as specialist cleaning or the application of protective coatings.

Section 5
Procurement

5.1 MAINTENANCE CONTRACTS

Introduction

5.1.1 The maintenance of electronic traffic equipment, by its nature, will consist of many individual small repairs being carried out to equipment spread over a wide geographical area and over a timeframe of a number of years.

5.1.2 Maintenance might consist of a simple individual replacement of a single component, such as a lamp or detector card, or might require a much more complex and costly repair, such as the complete replacement of a signal head or detector loop.

5.1.3 Maintenance contracts will usually need to cover both reactive and preventative maintenance operations (refer to paragraphs 4.2.1–2), and both of these should be identified and specified within an authority's maintenance contract.

5.1.4 Seeking a competitive contract is an important part of the process for an authority looking to achieve value for money. However, the quality of the service to be provided and the cost of the authority's staff when supervising the contractor should also be taken into account in an analysis of whether value for money is being obtained.

General considerations

5.1.5 A range of factors need to be taken into account when considering what form of contract should be adopted. These include:

- **scope** – whether the contract is only for maintaining existing assets or also for installing new equipment;
- **value** – what the likely annual contract turnover will be; a higher value could attract more and larger contractors to tender and allow them to reduce unit rates by spreading overheads; larger organisations might also have better technical resources;
- **duration** – longer contracts result in higher value (these are more attractive to contractors) and less frequent tendering and associated costs to authorities and contractors; however, there is a risk with a long term commitment if the contractor does not perform well;
- **knowledge** – the longer the contract, the greater the familiarity of the contractor's staff with the area, the authority and the assets;
- **Transfer of Undertakings (Protection of Employment) Regulations (TUPE)** – if there is an existing service provider, time needs to be allowed in the tender programme for TUPE issues to be resolved in conjunction with appointment of a new contractor;

- **European Union (EU) rules** – if a contract value exceeds current EU specified limits, the tender will be subject to the *Official Journal of European Union* (*OJEU*) process. Also EU rules dictate the maximum duration of contracts;

- **joint contracts with others** – the use of a contract by two or more authorities can produce economies and efficiencies by spreading tender and contract administration costs and allowing bigger contracts which are attractive to contractors, with potentially lower rates being tendered; the scope of contract and administrative issues will need to be agreed between the participating authorities;

- **performance criteria –** contracts should contain clear requirements for contractor performance in terms of both quality and cost, to allow overall value to be demonstrated (this is particularly important for larger/longer contracts); performance related bonus/penalty arrangements need to be carefully structured to ensure that the contractor does not focus on the financial outcome to the detriment of quality of service; and

- **resources –** the scale of contracts might be constrained by the resources available to administer and supervise them; resource limitations might be a reason to collaborate with another larger authority which could take the lead for the tendering and administration of a larger, more cost effective, contract.

Type of contracts

5.1.6 There are a number of types of contract that could be adopted, including:

- simple maintenance contract;

- contract for basic maintenance and the procurement of new equipment;

- performance contract;

- partnership contract; and

- framework contract.

5.1.7 In addition to the general considerations outlined in paragraph 5.1.5, each type of contract has particular advantages and disadvantages, as set out below.

Simple maintenance contract

5.1.8 This contract will be only for the provision of maintenance. The tender might be based upon an initial list of equipment, in order to enable a fair comparison of tenders. It is normal for the contract to be awarded for an agreed period of one or two years, with possible extensions up to five years, depending upon performance. Payment will be on the basis of a schedule of rates for the listed equipment items and/or lump sums for groups of activities.

5.1.9 It is good practice for an agreed method of amending the volume of equipment to be maintained (either up or down) to be included within the contract using a unit rate per item.

Advantages

- A short duration makes it easier to move to a new provider if the contractor performs poorly.

Disadvantages

- The potentially short duration of contract means that the contractor has contract visibility of a maximum of two years initially but often only one year, hence there is no incentive to optimise the performance of equipment.
- It requires some other form of procurement for new equipment, with the consequential tendering costs for the authority.
- Having two contractors can cause a conflict between the installation company and the maintenance company.
- The overall cost can be higher to the authority, as the contractor will have limited work to undertake, because no installation work is included. Staff utilisation therefore might not be optimised in order to generate efficiency and cost savings.
- Some duplication of administration by the authority and the contractor might occur.

Contract for basic maintenance and the procurement of new equipment

5.1.10 This is a more common contract option, where the contractor provides a schedule of rates for the maintenance activities, as for the simple maintenance contract. In addition, a schedule of rates for the provision of new equipment and activities is provided by the contractor. Authorities can predict the likely purchases for inclusion in the schedule of rates from either historic information or their own future predictions. The duration of this type of contract is similar to the simple maintenance contract.

Advantages

- Contractors have a greater interest in this type of contract because of the potential for increased revenue compared to a simple maintenance contract.
- There is more flexibility for the contractor to utilise staff resources.
- There is no conflict between separate maintenance and installation contractors.
- There is a cost saving in terms of reduced total tendering costs to the authority (one tender instead of two).

Disadvantages

- The potentially short duration of contract means that the contractor has contract visibility of a maximum of two years initially but often only one year, hence there is no incentive to optimise the performance of equipment.

- Some duplication of administration by the authority and the contractor might occur.

- New or replacement equipment has to be purchased through an agreed schedule of rates. This could result in the authority paying more for "one-off" items of equipment.

Performance contracts

5.1.11 Performance contracts include both maintenance and new installation works. These tend to have longer contract periods, generally of five years. As such, there is an incentive for the contractor to commit to performing well. The contractor is required to achieve a predetermined level of performance within a specified time period, normally related to KPIs for the overall service outcome, rather than individual activities. The performance of the contractor is usually monitored by the authority using information that the contractor supplies. The contractor will receive either bonuses or penalties based on achieving the performance criteria or not.

Advantages

- Higher quality of service can be achieved, as performance is closely specified.

- Contracts are more sought after by contractors owing to work continuity provided by the longer contract period

- Bonuses incentivise the contract and penalties deter poor quality performance.

- Contractors are required to take a longer term view of maintenance activities.

- Service levels are easily understood by authority members and the public, making it easier to demonstrate the quality of service.

Disadvantages

- Some duplication of administration by the authority and the contractor might occur.

- The relationship between the contractor and the authority can deteriorate over time because of disagreements, without an option to retender, unless there are grounds to terminate the contract.

Partnership contracts

5.1.12 This type of contract is where the authority and the contractor work together to bring improvement in the level of service to the end user and improved value and efficiency. To gain the full potential of a partnership a contract duration of at least five years is desirable.

5.1.13 There might be bonuses associated with the overall contract outcomes, where both organisations acknowledge the service benefits achieved; these generally relate to the entire service rather than individual actions and are normally of a higher strategic value to the authority. The service provided is normally monitored by the contractor in partnership with the authority, thus enabling greater efficiency and value.

5.1.14 The contract can extend outside the traditional maintenance work to include design and operations. The contract is normally performance based, priced on lump-sum fees for carrying out the routine works, and is measured against targets, through KPIs and audits, which trigger bonuses or penalties depending on results against the targets.

Advantages

- Allows a high quality service to be provided.

- Larger bonuses, which can be achieved depending upon the service outcome, can incentivise contractors to maximise their overall effort and improve their quality of service.

- Lower level of administration owing to shared resources.

- Focus on the overall service rather than individual cases, recognising the peaks and troughs that will occur in the workload, and the priority of the fault rather than pure attendance and repair times.

- Reduces potential for contractual conflict.

- The contractor takes greater involvement in the decision making process.

- Allows the authority to focus on strategy and service rather than delivery.

Disadvantages

- Requires the authority to have confidence in the parties to the partnership.

- It could lead to limitations in asset type installed depending on the experience of the partner.

Framework contracts

5.1.15 Framework contracts are an approach increasingly adopted to reduce the overhead costs associated with contract development and award. A number of suppliers are appointed. These contracts are most suitable for use by several authorities; this spreads development and administration costs further and gives contractors more incentive to tender because of the greater overall volume of work.

5.1.16 As financial assessments have been carried out at the tender stage, all task orders for work can be placed by agreeing costs. The option is available for secondary tendering between suppliers for some or all task orders. For the contracts to qualify as a framework, there should be prescribed rules for distributing orders between suppliers.

5.1.17 Framework contracts normally last for up to five years, but task orders for work can be issued under the contract right up to its expiry (subject to the authority's procurement rules).

Advantages

- Flexibility – the use of different contractors encourages competition and provides low prices and high quality.
- The single tender process reduces costs for both contractors and authorities.
- It can provide an opportunity to share the works across the suppliers – this can be useful if the authorities are generating high workloads.

Disadvantages

- EU rules regarding contract period can be viewed as being too short to encourage investment and development before re-procurement is required.

Contract documents

5.1.18 The available options for the provision of contract documents are:

- use a model document that might be amended to varying degrees;
- prepare a bespoke contract; and
- negotiate and then draw up a partnership agreement (contract).

5.1.19 Model contract documents that are currently available have been developed over time. These are predominantly for highway works maintenance contracts. Authorities will need to consider the use of these carefully, taking account of the extent of modification needed to meet their requirements as well as the resources and expertise available to prepare and later manage the contract.

5.1.20 Typical conditions of contract used include:

- Institution of Civil Engineers Conditions of Contract, 5th, 6th or 7th Editions;

- NEC3 (New Engineering Contract) Term Service Contract; and
- JCT (Joint Contracts Tribunal).

5.1.21 Typical specifications used include:

- Specification for Highway Works, adapted as necessary;
- model specifications; and
- purpose written specifications.

Inspection and monitoring of contracts

5.1.22 Authorities should ensure that sufficient suitably qualified and experienced staff are available to inspect, monitor and check the contractors' works. This will help to determine if the contractor is performing in accordance with the contract. The need for such staff might reduce in a partnership contract.

Inclusions in the contracts

5.1.23 When preparing contract documentation, authorities should be aware of the current condition of their assets and any existing problems that might require special treatment. It is normally preferable for contracts to include the provision of all materials, as this provides clarity of risk and responsibility in the event of failure.

5.1.24 Some authorities do not allow payment when the contractor reports "no fault found", hence the contractor will need to price in the risks involved.

Payment adjustments

5.1.25 It is important that a system to recompense authorities for the poor performance of contractors is included in any contract. This system should be related to the response times and other performance criteria defined in the contract.

5.1.26 Losses due to non-performance should be calculated to take account of the actual cost of the lost facility to the authority and might include factors such as the cost of energy or alternative arrangements for carrying out the work.

5.1.27 The level of risk being transferred to the contractor and the value to the authority should be considered when determining deductions for non-performance. The aim should be to incentivise the contractor to complete the works within the required period. Payment deductions against the contractor should not be set at a level that could be considered as punitive.

5.2 ELECTRICITY PROCUREMENT

Introduction

5.2.1 As part of the design stage, each authority or their representative will need to request a service from the local DNO. This request will normally take the form of a drawing specifying the location of the equipment, when power is to be connected, as well as the intended location of feeder pillars. Details of fuse rating required within the pillars should also be provided. The rating needs to take into account the necessary discrimination.

5.2.2 As part of the quotation process, the DNO might need additional information to be provided. Such information could include the hours of operation, the item type, and the method of earthing required within the pillar.

Trading arrangements

5.2.3 Under the current arrangements for unmetered supplies, the following two methods are available to authorities when purchasing energy:

- **non half-hourly** – the non-half hourly market requires the calculation of an Estimated Annual Consumption (EAC) by the Unmetered Supplier Operator (UMSO) at the DNO to enable the consumption to be settled through the balancing and settlement procedures; and

- **half-hourly** – the half-hourly market requires the electrical consumption of the network to be recorded at half-hourly intervals throughout the day. For unmetered supplies this is done by means of an Equivalent Meter (EM), which consists of two elements:

- The first is a Photo Electric Cell array Unit (PECU array), which logs the operating hours of the various types of photo electric cells in use. The PECU array is fitted with photo cells that are representative and proportionate to the authority's installation, such as thermal and electronic, together with their age profile. Care should be taken to ensure that as older thermal photocells are replaced on site those on the PECU array are also replaced so they remain representative.

- The second element of the EM is a software package known as "LAMP" or "Flare", which is in the ownership of the UMSO. This is used to download the operating hours data obtained from the PECU array(s) and to combine this with the authority's inventory data to calculate the consumption in kilowatt hours (kWh). The authority should appoint a Meter Administrator for this task. Elexon/Unmetered Supplier User Group holds a list of accredited Meter Administrators.

5.2.4 When deciding which purchasing arrangement to use, the authority should consider the following:

- Meter Administrator's costs and the cost of PECU array(s) are borne by the authority and will have to be absorbed into any savings made when trading on half-hourly contracts;

- it is widely accepted that half-hourly trading might not be cost effective for loads less than 100 kW; and

- half-hourly tariffs should where possible be fixed for the life of the contract.

Unmetered supplies certificates

5.2.5 Both trading methods require authorities to submit an accurate inventory to the UMSO for validation. There are appendices in *Balancing and Settlement Code of Procedure* BSCP520 (51) that show tables of approved equipment, charge codes with watt ratings and switching regime codes, which should be used by customers in their inventory data.

5.2.6 On validation of the inventory, the DNO will issue an Unmetered Supplies Certificate (UMSC), which should be made available to the prospective electricity supplier during the tender stage.

5.2.7 Currently, all unmetered loads can be considered for inclusion on the Unmetered Supplies Certificate. BSCP520 states that, provided the equipment has a predictable load and operating hours and is less than 500W, it can form part of an unmetered supplies arrangement. However, the UMSO has the discretion in certain circumstances to allow equipment to be connected without a meter if it does not comply with BSCP520 requirements.

5.2.8 When compiling an UMSC, the UMSO will consider metering for equipment with an installed load greater than 500W. This is particularly relevant for equipment fed via highway power supplies from a feeder pillar. These types of supply should be discussed with the DNO before the inventory is submitted and at the time the applications are being made for new supplies. As a general rule, equipment in use before April 1998 will retain its UMS status.

Agreements

5.2.9 The types of agreement that authorities might enter into are described below.

- **Connection agreement** – All customers are required to enter into a connection agreement with the DNO. This agreement sets out the terms and conditions under which a supply is taken from the DNO's network. The major part of the connection agreement will deal with the validation of the load connected to the network. It is essential that the inventory fairly represents the customer's connected load, as it can be subjected to audit by the UMSO. Any inaccuracies in the inventory could result in a factor being applied to the inventory to compensate for them. Power factor connection is one source of possible inaccuracy in measuring the electricity consumed. and the DNO have the right to apply a factor to compensate for low power if they can demonstrate that it is below the level specified in the agreement.

- **Meter Administrator's agreement** – The PECU array is normally located at the DNO's premises, but might be located anywhere suitable by agreement. The array is populated with 30 PECUs, which should be representative of those used within the authority's area. The PECU array is purchased by the authority and maintained by the appointed Meter Administrator.

- **Supply agreement** – The authority enters into a supply contract with its chosen supplier of electrical energy.

- **Metering Point Registration Service (MPRS)** – The supply contract inventory will be given a supply number (MPAN), which should be registered though the MPRS by the electricity supplier.

Emerging/sustainable technologies

5.2.10 Whenever alternative forms of power are being considered during the design stage for electronic traffic equipment, authorities will need to consider the risks of the equipment not having a permanent supply. For example, it might not be appropriate for equipment being utilised to address a safety related issue to have a non-permanent power source.

5.2.11 When the decision has been made to use a renewable energy source for particular equipment, consideration should be given at the design stage to the type of power generator product being installed, together with an indication as to the life expectancy of the product. As part of the ongoing maintenance, authorities will need to make provision for the supply and installation of replacement power generator parts as they become life expired.

5.3 TELECOMMUNICATIONS PROCUREMENT

Introduction

5.3.1 Remote access to an asset and continual monitoring of the equipment are standard requirements as part of the design and installation of electronic traffic equipment. These requirements should be achieved through the provision of a communications service to the equipment, of a type to be agreed by the authority during the design stage.

5.3.2 Each communication type is provided by a CSP. The authority will need to agree trading terms and conditions in advance of any connection being made, with the relevant CSP.

5.3.3 Types of communication currently available for use with electronic traffic equipment are as follows:

- **PSTN (Public Switched Telephone Network)** – Standard cabled telephonic technology used to provide a dial-up on demand service, where for example either the RMS instation can dial the asset or the asset can dial the instation as configured.

- **Private Wire Circuit** – A dedicated cabled circuit provided between two points which is continuously connected, allowing the user to have permanent communication with the asset with no interruptions.

- **GSM (Global System for Mobile Communications)** – A mobile communication service provided by CSPs, where communication is provided by a dial-up on demand SIM card service. The network coverage of the CSP will determine whether or not this technology can be installed at specific locations.

- **GPRS (General Packet Radio Service)** – Mobile communication service provided by CSPs, on the back of GSM technology (this is sometimes compared to broadband connection on a mobile network). This service is a continuous connection and allows assets to communication constantly.

- **Broadband Internet Protocol Addressed Circuits** – A broadband service provided over cabled telephonic technology. The service is a continuous connection, and speeds of the service can vary depending on the CSP and the service paid for. This type of communication allows a large amount of data to be sent and retrieved from the asset.

- **Wireless** – A communications service provided without wires, using technology initially developed for computer networks. This service is provided by specialist CSPs and will require additional equipment to be installed at the asset.

- **Fibre Optic Cable** – A communications service provided by the use of fibre optic cables, which can be used to transmit large volumes of data at high speeds. This service is provided by specialist CSPs and will require additional equipment to be installed at the asset.

5.3.4 When purchasing communication means from CSPs, authorities will be required to provide information to ensure the service is appropriate for the application. Standard information required will include two location addresses (line end point details), termination details, bill payer details and point of contact details in the event of any fault occurring.

Trading arrangements

5.3.5 Local trading arrangements should be agreed between authorities and the CSPs before any communication services are purchased or installed. The terms and conditions of these agreements should include timescales for installation, fault response, service types included in agreement, scope of works for installations, and liability.

5.3.6 In the majority of cases, trading arrangements could already exist between authorities and CSPs for other services provided to the authorities. Wherever possible, these should be utilised for the provision of communication services for electronic traffic equipment.

5.3.7 For further information on CSPs available and current regulations, please refer to the communication regulator's website, www.ofcom.org.uk/

Appendices

Appendix A
Recommendations

The following recommendations are made within the Code, in the sections referenced.

1. All parties involved in delivering the service should seek ways to improve the service to meet the customers' needs. New equipment, processes and strategies should have identifiable tangible benefits, but cost should not be the only consideration. (1.1)

2. Authorities should seek to future proof systems and processes as far as is practicable. (1.2)

3. Where possible, authorities should aim to increase the use of recycling and re-use of equipment within their maintenance regime. (1.3)

4. Authorities should consider the use of low energy (e.g. ELV) equipment as the norm, especially for new or renovated sites. (1.3)

5. If authorities own assets containing other technologies that are not covered by this Code, they should ensure that a guidance document is in place to be used by their staff. (1.5)

6. Where authorities elect to adopt policies, procedures or standards different from those suggested by the code, it is essential for these to be identified, together with the reasoning for such differences, and approved as appropriate by the authority. (1.7)

7. Once an authority has established procedures for dealing with its maintenance requirements, the procedures should be reviewed on a regular basis to ensure that they are still fit for purpose and in accordance with any updated regulations or guidance. (1.7)

8. Authorities should undertake a full review of current practices, followed by an assessment of the differences between current practice and the recommendations set out by the Code. Once the gaps are identified, clear plans should be established on how they are to be addressed. (1.7)

9 The authority should develop an Implementation Plan, in accordance with the recommendations of this Code, for the management of their maintenance. The development of this plan should be treated as a formal project, with agreed milestones, resources and budgets in order to ensure that the optimum outcome is achieved. (1.7)

10. Authorities should ensure that suitably trained staff are in place to undertake the management of maintenance of electronic traffic equipment. (1.7)

11. Detailed asset management systems should be put in place. (1.7)

12. Performance indicators should be used to measure authority and contractor effectiveness in delivering the service and to provide a baseline from which improvements can be measured. (1.7)

13. Authorities should provide financial plans for maintenance that detail their priorities as well as clear direction on how the maintenance operations will be managed in the short, medium and long term. (1.7)

14. Authorities should ensure that adequate systems are in place to process and manage faults. (1.7)

15. Authorities should establish effective systems for the transfer of faults from UTC and RMS to an appropriate FMS, with instructions to the maintenance contractor providing enough detail to allow the effective repair of the fault. (2.2)

16. Designers should take account of the whole life cycle of the asset, including installation, maintenance and decommissioning, during the design stage. (2.3)

17. Annually authorities should report actual performance in complying with their service policy statement, including National and Local Performance Indicators as appropriate. (2.4)

18. Authorities should satisfy themselves that maintenance contractors have satisfactory procedures in place to provide an effective maintenance service as required by the contract. (3.1)

19. Preventative maintenance should be treated as the key tool to successful implementation of the asset management plan, forestalling poor performance and failure of the installation. (4.1)

Appendix B
Example KPIs and Results Chart

B.1 EXAMPLE KPIS

	Design	Installation	Maintenance
1a Outturn cost within +/- 5% of latest agreed estimate for each commission (full bonus >80%, half bonus between 50 and 80%, no bonus less than 50%)	20%	15%	N/A
1b Outturn cost to be within +/- 2.5% for whole service	20%	15%	N/A
2a Agreed target dates met in at least 90% of cases	20%	20%	N/A
2b At least 95% to be less than 2 weeks behind agreed target date	20%	20%	N/A
3 Client feedback scores to average at least 3 weighted by scheme value	10%	20%	20%
4 System fault rates at least as good as previous year (prev. yr result)	N/A	N/A	25%
5 System uptimes to be at least 99% of total available	N/A	N/A	45%
6 Reduce congestion	3%	3%	3%
7 Improve road safety	2%	2%	2%
8 Better value for money	2%	2%	2%
9 Increased user satisfaction	2%	2%	2%
10 Reduce carbon	1%	1%	1%

B.2 RESULTS

	Design	Installation	Maintenance
1a Outturn cost within +/- 5% of latest agreed estimate for each commission (full bonus >80%, half bonus between 50 and 80%, no bonus less than 50%)	80%	80%	N/A
1b Outturn cost to be within +/- 2.5% for whole service	-1%	-2.9%	N/A
2a Agreed target dates met in at least 90% of cases	95%	91.67%	N/A
2b At least 95% to be less than 2 weeks behind agreed target date	20%	96.67%	N/A
3 Client feedback scores to average at least 3 weighted by scheme value	3.8	3.8	4
4 System fault rates at least as good as previous year (prev. yr result)	N/A	N/A	0.48 (0.55)
5 System uptimes to be at least 99% of total available	N/A	N/A	99.889%
6 Reduce congestion	50%	50%	50%
7 Improve road safety	100%	100%	100%
8 Better value for money	100%	100%	100%
9 Increased user satisfaction	0%	0%	0%
10 Reduce carbon	50%	50%	50%

Appendix C
Additional Useful Reading

C.1 DOCUMENTS REFERENCED IN THE CODE

1. Traffic Management Act 2004, Section 2 (England and Wales only). TSO.

2. Transport (Scotland) Act 2005. TSO.

3. UK Roads Liaison Group, 2005, *Well-maintained Highways*. TSO.

4. County Surveyors Society, 2004, *Framework for Highway Asset Management*. CSS.

5. Chartered Institute of Public Finance and Accountancy, 2010, *Code of Practice on Transport Infrastructure Assets: Guidance to support Asset Management, Financial Management and Reporting*. CIPFA.

6. British Standards Institution, 2008, PAS 55-1:2008 *Asset Management. Specification for the Optimized Management of Physical Assets.* BSI.

7. UK Roads Liaison Group, 2005, *Highway Risk and Liability Claims. A Practical Guide to Appendix C of The Roads Board Report.* UK RLG.

8. UK Roads Liaison Group, 2004, *Well-lit Highways*. TSO.

9. UK Roads Liaison Group, 2005, *Managment of Highway Structures*. TSO.

10. Road Traffic Regulation Act 1984. HMSO.

11. Disability Discrimination Act 2005. TSO.

12. Traffic Signs Regulations and General Directions (TSRGD) 2002. TSO.

13. Traffic Signs Regulations (Northern Ireland) 1997. TSO.

14. Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997. TSO.

15. Zebra, Pelican and Puffin Pedestrian Crossings Regulations (Northern Ireland) 2006. TSO.

16. Traffic Signs (Welsh and English Language Provisions) Regulations and General Directions 1985. HMSO.

17. Highways Agency, 2007, TD 7/07 *Statutory Approval of Control Equipment.* Design Manual for Roads And Bridges Vol. 8. TSO.

18. Highways Agency, 1997, TD 24/97 *All Purpose Trunk Road Inspection and Maintenance of Traffic Signals and Associated Equipment*. Design Manual for Roads And Bridges Vol. 8. TSO.

19. Highways Agency, 2006, TA 84/06 *Code of Practice for Traffic Control and Information Systems for All-Purpose Roads*. Design Manual for Roads And Bridges Vol. 8. TSO.

20. Construction (Design and Management) (CDM) Regulations 2007. TSO.

21. Health and Safety at Work etc. Act 1974. HMSO.

22. Department for Transport, 2009, Traffic Signs Manual Chapter 8 *Traffic Safety Measures and Signs for Road Works and Temporary Situations.* TSO.

23. British Standards Institution, 2008, BS 7671:2008 *Requirements for Electrical Installations* (IEEE Wiring Regulations, Seventeenth Edition). Institution of Engineering and Technology.

24. Electricity at Work Regulations 1989. HMSO.

25. Electricity at Work Regulations (Northern Ireland) 1991. HMSO.

26. Management of Health and Safety at Work Regulations (Amendment) 2006. TSO.

27. Management of Health and Safety at Work Regulations 1992. HMSO.

28. Construction (Design and Management) Regulations 1997 (Northern Ireland). TSO.

29. New Roads and Street Works Act 1991. HMSO.

30. National Joint Utilities Group, 2007, *Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees*. NJUG.

31. British Standards Institution, 1989, BS 3998:1989 *Recommendations for Tree Work.* BSI.

32. Traffic Systems Group, 2008, *Guidance Note 2 – Traffic Signal Failure Procedures*. TSG.

33. Highways Agency, 2005, TR 2500 A: *Specification for Traffic Signal Controller*. HA.

34. Department for Transport, 2008, Traffic Advisory Leaflet 01/08 *Wig-wag Signals*. DfT.

35. Highways Agency, 1987, TA 56/87 *Hazardous Cattle Crossings: Use of Flashing Amber Lamps*. Design Manual for Roads And Bridges Vol. 8. TSO.

36. Traffic Signs Regulations and General Directions 2002. Schedule 9, Light Signals for Pedestrian and Animal Crossings. TSO.

37. Traffic Signs Regulations and General Directions 2002. Schedule 8, Light Signals for Control of Vehicular Traffic. TSO.

38. Highways Agency, 2005, TR 2513 *Performance Specification for Wig Wag Signal Control Equipment*. HA.

39. Highways Agency, 1975, MCX 0084 *Signal-Standard Traffic (Wig Wag)*. HMSO.

40. Department for Transport, 2006, Traffic Advisory Leaflet 01/06 *General Principles of Traffic Control by Traffic Signals*. DfT.

41. Department for Transport, 1998, Local Transport Note 1/98 *The Installation of Traffic Signals and Associated Equipment*. TSO.

42. Department for Transport, 2003, Traffic Advisory Leaflet 01/03 *Vehicle Activated Signs.* DfT.

43. Winnett, MA, Wheeler, AH, 2003, TRL Report 548 *Vehicle Activated Signs – A Large Scale Evaluation*. TRL.

44. Highways Agency, 2005, TR 2517A: *Performance Specification for Electromechanical Variable Message Signs*. HA.

45. Road Traffic Offenders Act 1988. HMSO.

46. Department for Transport, 2007, Circular 01/2007 *Use of Speed and Red-Light Cameras for Traffic Enforcement: Guidance on Deployment, Visibility and Signing*. TSO.

47. Department for Transport, 2003, Traffic Advisory Leaflet ITS 04/03 *Parking Guidance and Information*. DfT.

48. Department for Transport, 1997, Traffic Advisory Leaflet 4/97 *Rising Bollards*. DfT.

49. Department for Transport, 1995, Local Transport Note 2/95 *The Design of Pedestrian Crossings*. HMSO.

50. Traffic Systems Group, 2003, *Guidance Note 1 – Inspection and Testing of Low Voltage Power Supplies and Cabling for Traffic Control Systems and Associated Equipment During Maintenance*. TSG.

51. Highways Agency, 2001, MCH 1844 *NMCS Maintenance Instruction – Routine Maintenance CCTV Equipment*. HA.

52. Elexon Limited, 2009, *Balancing and Settlement Code of Procedure BSCP520*. Elexon Limited.

C.2 WEBSITES REFERENCED WITHIN THE CODE

www.ukroadsliaisongroup.org/liaison/practice.htm

www.bsigroup.com/en/BSI-UK/Assessment-and-Certification-services/Management-systems/Standards-and-Schemes/Highway-Sector-Schemes/

www.hse.gov.uk/construction/cdm.htm

www.elexon.co.uk/participating/unmeteredSupplies.aspx

www.homeoffice.gov.uk/

www.ofcom.org.uk/

www.niceic.com

C.3 OTHER USEFUL SITES

www.dft.gov.uk/pgr/roads/tpm/tmaportal/

Appendix D
Example Forms

D.1 EXAMPLE 1 – ASSET INFORMATION FORM

SITE REFERENCE NUMBER: - ☐☐☐☐☐☐ / ☐☐

SITE LOCATION (ROAD NUMBERS/NAMES/TOWN): - ☐

DRAWING NUMBER ☐

INSTALLATION TYPE: - **(PLEASE TICK ONE)**
☐ JUNCTION ☐ PUFFIN ☐ PELICAN ☐ SCHOOL FLASHING WARNING
☐ JUNCTION WITH PUFFIN / ☐ TOUCAN ☐ (MICROTIMA) WIGWAG
☐ OTHER (PLEASE SPECIFY) ☐

☐ **CONSERVATION SITE**
☐ **SITE AFFECTED BY TREES**

COMMISSIONING (OR REMOVAL) DATE: - ☐☐☐ **(DD/MMM/YY)**

MONITORING/CONTROL: - ☐ UTC (inc. SCOOT) ☐ MOVA/RMS ☐ RMS ☐ NONE

TYPE OF WORKS: - **(PLEASE TICK ONE)** ☐ NEW INSTALLATION ☐ MODERNISATION/MODIFICATION ☐ EPROM CHANGE ☐ SITE REMOVAL

NUMBER OF CROSSING POINTS ☐

CONTROLLER

MANUFACTURER ☐

TYPE ☐

CABINET TYPE

JUNCTION ONLY: -
PART TIME YES / NO
NO. OF STAGES ☐
NO. OF PHASES ☐
NO. OF STREAMS ☐

☐ MINI PILLAR
☐ DIMMING
☐ SD LOOPS
☐ TRIPLE SD LOOPS
☐ SA LOOPS

NO. OF 4 CHANNEL DETECTORS USED ☐
NO. OF 2 CHANNEL DETECTORS USED ☐

☐ INTEGRAL LAMP MONITORING
☐ EXTERNAL LAMP MONITORING
RED LAMP MONITORING

TYPE OF UNIT(S): - (IF EXTERNAL) ☐ ☐

UTC

OTU TYPE ☐ TC12 ☐ INTEGRAL TC12 ☐ TC8

PRIVATE WIRE LINE TYPE ☐

PRIVATE WIRE CIRCUIT NO. ☐

STREET FURNITURE

SIGNAL HEADS	QUANTITY	**POLES**	QUANTITY
3 ASPECT RAG	☐	STANDARD (4m)	☐
3 ASPECT RA/GA (HI)	☐	TALL (> 4m)	☐
3 ASPECT RA/GA (FO)	☐	CRANKED/ SWAN NECK	☐
RED/GREEN MAN (FAR SIDE)	☐	SHORT (STUB)	☐
1 ASPECT GREEN ARROW (HI)	☐	DEMOUNTABLE (POLETECH)	☐
1 ASPECT GREEN ARROW (FO)	☐		
1 ASPECT CYCLE (TOUCAN)	☐	BOX SIGNS	☐
2 ASPECT WIGWAG WITH MICROTIMA	☐		
OTHER (SPECIFY)	☐		☐
			☐
			☐

PUSH BUTTONS

	QUANTITY
2 MAN (JUNCTION)	☐
3 MAN (PELICAN)	☐
TOUCAN	☐

PUFFIN/TOUCAN UNITS

	QUANTITY
COMBINED NEARSIDE/PUSHBUTTON	☐
SEPARATE NEARSIDE	☐
SEPARATE PUSH BUTTON	☐

RMS

☐ SIEMENS OMCU ☐ MONITRON OMCU

☐ SIEMENS OMCU/INTEGRAL MOVA

BT LINE NO. ☐ ☐

GSM LINE NO. ☐

GSM NETWORK ☐

TACTILES/AUDIBLES

TACTILE ROTATING CONES ☐ AUDIBLE UNITS ☐

ABOVE GROUND DETECTION

	QUANTITY		QUANTITY
MVD	☐	PED KERBSIDE	☐
IRD (STOPLINE)	☐	PED ON CROSSING	☐
		VIDEO PED KERBSIDE	☐

ADDITIONAL EQUIPMENT (NOT SPECIFIED ABOVE)

	QUANTITY
MANUFACTURER/DESCRIPTION ☐	☐
MANUFACTURER/DESCRIPTION ☐	☐
MANUFACTURER/DESCRIPTION ☐ ☐	☐

ELECTRICITY SUPPLY INFORMATION

☐ EDF SUPPLY ☐ OTHER SUPPLY ☐ ELI TEST CARRIED OUT BY SIGNAL CONTRACTOR ☐ ELI TEST CERTIFICATE

COMMENTS: **(HANDWRITTEN ONLY)**

EPROM

EPROM NUMBER: ☐ EPROM ISSUE NUMBER: ☐

☐ INITIAL EPROM ☐ MODIFIED EPROM ☐ CONFIGURATION DISCS SUBMITTED ☐ STANDARD CONFIGURATION

GENERAL SITE DATA

	NONE	PARTIAL	COMPLETE	ADDITIONAL NOTES
TACTILE PAVING				
DROPPED KERBS				
HIGH FRICTION SURFACING				
GUARD RAILING				

DATA SUBMITTED FOR HEALTH AND SAFETY FILE

☐ DATA SHEETS/TIMING DATA ☐ AS-BUILT DRAWING ☐ TM DRAWING

☐ APPROVED DRAWING ☐ CIVIL DRAWING (WHERE APPROPRAITE) ☐ DESIGNER ENVIRONMENTAL ASSESSMENT

☐ COPY OF OUTSTANDING ITEMS ☐ DESIGNER RISK ASSESSMENT ☐ SITE SPECIFIC H & S PLAN

☐ ELI TEST CERTIFICATE ☐ CABLE SCHEMATIC

ENGINEERS SIGNATURE:

PRINT NAME: DATE:

COMMENTS: **(HANDWRITTEN ONLY)**

OFFICE USE ONLY

☐ DATA SHEETS RECEIVED

☐ APPROVED DRAWING RECEIVED ☐ AS BUILT DRAWING ☐ CIVIL DRAWING RECEIVED

☐ ELI CERTIFICATE RECIEVED ☐ CABLE SCHEMATIC RECEIVED ☐ DESIGNER RISK ASSESSMENT

☐ PREFECT UPDATED ☐ MAINTENANCE FILE COMPLETE ☐ ADVISE ENERGY COSTS/ELECTRICITY SUPPLY

☐ RMS DATABASE UPDATED ☐ SITE CLEARED ☐ SERVICE DIRECTOR INFORMED

☐ TM DRAWING RECEIVED ☐ ASSET MANAGEMENT UPDATED ☐ DESIGNER ENVIRONMENTAL ASSESSMENT

☐ SITE SPECIFIC H & S PLAN

MAINTENANCE ENGINEERS SIGNATURE: DATE:

VERSION.8 **05/10/2005**

D.2 EXAMPLE 2 – ASSET COMMISSIONING FORM

COMMISSIONING CHECKLIST

LOCATION

SITE REF

DATE

The commissioning of Traffic Signals can be divided into three parts:

1 The EPROM test of the controller.

2 The checks that can be carried out before the controller is switched on.

3 The checks that can be carried out after the controller is switched on.

Part 1 should have been carried out in accordance with TR 2210A data sheets and is not covered in this document.

Part 2 can be carried out in the absence of the signal company engineer and it is suggested this is carried out before he arrives on site. One hour upwards should be allowed for this. It may be prudent to carry out this check a day or two before the date for commissioning at a complex junction.

Part 2 is in effect a pre-commissioning check.

NOTE: **Remotely Monitored Site** – Remember to print off OMCU Commissioning Sheet – MONITRON/SIEMENS.

UTC Site – Remember to print off the relevant OUT Details/Commissioning Sheet and Control Reply Sheet.

MOVA Site – Use this form in conjunction with the MOVA Commissioning Sheet.

PART 1 EPROM TEST

1 Has this been carried out by an approved engineer? ☐

2 Intergreen checked against approval drawing? ☐

3 Green conflicts checked? ☐

PART 2 ON SITE – CONTROLLER SWITCHED OFF

4 **(a)** Obtain an Earth Loop Impedance (ELI) test certificate for the installation. This should include impedance readings at the controller and at each signal pole with a Pass or Fail indication.

NOTE: **If no written evidence is available to show that the installation has a satisfactory ELI reading then the signals MUST BE LEFT OFF and isolated from the incoming mains supply.**

(b) Check that the correct fuse has been fitted to the electricity board cut-out in the mini pillar (60 Amp typical Junction Controller). ☐

(c) Check that a secondary 'double pole' cut-out and fuse have been fitted in the mini pillar (50 Amp ideally). This fuse must be smaller than the electricity board cut-out fuse and larger than the controller fuse. ☐

(d) Check that all earth connections have been made to the Main earth Terminal (MET) in the mini pillar and that the MET is connected to the neutral of the electricity Board's cut-out. ☐

(e) Check earth connections are in place from controller to the mini pillar MET. ☐

5 Check that a twin 13 Amp switched socket with RCD has been fitted on all new sites. Identify any with single sockets to the maintenance department. ☐

Layout

LEGAL **6** Has signal approval been issued? ☐

Signal Poles

At each signal pole position the following should be checked:

LEGAL **7** The location of the poles and associated equipment shall agree with the signal approval plan. ☐

LEGAL **8** Height of centre of amber lens signals above the pavement shall be 2.4m to 4.0m. The height may be limited to 2.65 to 3.1m as specified by ECC/SBS/TBC. It will be easier to measure to the bottom of the signal head body whereupon these measurements become 2.1 to 2.55m. ☐

LEGAL **9** Height of centre of amber lens above carriageway when fitted to a mast arm, catenaries etc. shall be 6.1 to 9.0m. ☐

LEGAL **10** Height to centre of a far-sided pedestrian signal head above pavement shall be 2.1 to 2.6m (measured to bottom of signal head body). ☐

LEGAL **11** Check that the correct visors are used at secondary and primary signal head locations. ☐

LEGAL **12** Check that sighting screens are bolted at the far corners. ☐

LEGAL **13** the arrangement of green arrow aspects within the signal heads and the direction shown by the green arrows should comply with the Traffic Signs Regulations and General Directions and all other relevant regulations. ☐

LEGAL **14** When a 4 in line signal head contains 2 green arrows and traffic may filter against a red signal the lower green arrow should appear as the filter. ☐

LEGAL **15** Signs to diagram 606 (white arrow on blue background) incorporated in signal head. Arrow may point in any directions through 180 degrees above the horizontal. ☐

LEGAL **16** All signs to diagram 606 mandatory, 612, 613, 614 prohibitory within the signal heads shall be internally illuminated at all times on independent circuits to the signal aspects. ☐

LEGAL **17** Ensure if Secret Signs are installed that they are only illuminated during configures hours of the day. See Section 57. ☐

18 Check clearance between signal heads and carriageway which should be 0.46m minimum. ☐

19 Signal poles to be firmly located. ☐

20 All signal poles shall be permanently reinstated. ☐

Associated Signs

LEGAL **21** Signs to diagram 543 (Traffic signals ahead), associated plates to diagram 5443.1, distance plates to diagram 572 or 573, diagram 616 (No entry) and associated exemption plate to diagram 620 must be directly lit during the hours of darkness if located within 50m of a street lamp forming part of a system of street lighting as defined in TSRGD. Alternatively, they may be lit during the hours that the street lamp is lit. They may also be reflectorised. Elsewhere, these signs must be reflectorised and may also be lit.

Note: Signs to diagram 543 may be used on the approach to a signal-controlled pedestrian crossing. Diagram 544, "Zebra crossing ahead", must not be used.

LEGAL **22** Signs to diagram 616 mandatory, 612, 613, 614 prohibitory,616 no entry, 620 exemptions buses and coaches and road markings to diagram 1046, no entry should be supported by an Act of Parliament, order, regulations bye-law or notice. (Not applicable to sign 612, 613 and 614 if supported by a green arrow on the same signal head.) ☐

Loop Detection

23 Check the positioning of detector loops. The measurements should be taken from the stop line to the nearest part of the loop to the kerb. With speed measuring loops the measurement is to the leading edge (on approach side) of the loop nearest the stop line. ☐

24 Check that all loop slots are backfilled to carriageway surface level. ☐

Markings

LEGAL	**25**	Pedestrian crossing studs must be within 10m of a traffic signal.	☐
LEGAL	**26**	The two rows of studs must not be less than 2.4m and no more than 5.0m apart for pedestrian crossings.	☐
LEGAL	**27**	Individual studs in a row should not be less than 0.25m and no more than 0.715m apart and a maximum of 1.3m from the kerb.	☐
LEGAL	**28**	Stop lines shall be 200mm wide in urban areas. 300mm wide stop lines shall be provided in rural areas, with speeds above 40 mph.	☐
LEGAL	**29**	Check that other road markings agree with the signal approval plan.	☐

Civil Works

30	Trenches shall be permanently reinstated with asphalt and any paving slabs re-laid where appropriate.	☐
31	Guard railing shall be in correct position and permanently reinstated.	☐
32	Dropped kerbs shall be provided at all pedestrian crossing points.	☐
33	Check Tactile Paving layout is in accordance with the signal approval plan.	☐
34	Any old road markings shall be removed.	☐
35	Check all Civil items on site to include in the as-built drawing and accurately note any variations from the signal approval drawing.	☐

Audible and Tactile Units

36	With the signals switched OFF using the switch on the manual panel (i.e. the controller is still cycling) the audibles or tactiles should NOT operate when the controller logic is green to any pedestrian phase or stage.	☐

Miscellaneous

37	Check that all signal and loop feeder cables are marked with their destination at both ends and in any junction boxes. Check 25% on a random basis for draw cords and cables.	☐
38	Check that draw cords have been left in ducts.	☐
39	Check that all poles have been numbered in accordance with the approval drawing.	☐

40 Check that the controller cabinet has been identified with its junction reference number (which should be visible from the carriageway). ☐

41 The controller base shall be sealed with a two-part epoxy resin. (**NOTE:** This must be done before or at the commissioning. If BT connections still to be made base seal must still be installed and then broken out at a later date.) ☐

PART 3 ON SITE – CONTROLLER SWITCHED ON

42 Acquire a 'Signal Installation Electrical test Certificate' stating that relevant tests have been carried out to prove that the electrical equipment is electrically safe. ☐

43 Switch lamps on and check that correct traffic movements take place in each stage. Be ready to switch lamps off if unexpected traffic movements take place and investigate accordingly. ☐

44 Check that all lamps on each approach are operating and in the correct sequence. ☐

45 Check that all far-sided/near-sided pedestrian aspects are working and in the correct sequence. ☐

Signal Head Alignment and Illumination

46 The primary signal heads shall be as follows:
On a high speed approach at a point 1.5m above the carriageway on the centre line 200m from the signals.
Otherwise, at a point 1.5m above the carriageway on the centre line 200m from the stop line. ☐

47 On each approach the height of the centre of the amber lens of each signal head above the carriageway shall be the same. ☐

48 The secondary signal heads should be angled towards a point 1.5m above the carriageway in the nearside channel of approach 25m from the stop line. ☐

49 Far-sided pedestrian signal heads should be directed to the centre of the crossing at the opposite kerb. ☐

50 Near-sided pedestrian signal heads should be angled at an angle where the aspect is clearly visible at the point where pedestrians normally wait to cross. ☐

51 The illumination of the red and green man aspects shall be uniform. ☐

Controller Operation

52 Check that signal dimming is not wired in (.e. installation should be permanently bright). ☐

53 Check that the controller is operating in correct mode. ☐

54 Check time clock is set at correct time, day and week number. ☐

55 Check correct week number is set for BST advance and retard where applicable. ☐

Detection

56 Check operation of detector loops by observing operation of detector unit channels. The detector channel LEDs should come on as vehicles pass over the detector loops. ☐

57 Check that detector units are set to the appropriate setting for sensitivity and detuning time. Check that all loops are soft wired to the detector backplane. ☐

58 Check operations and alignment of Above Ground Detectors, The LED indicator on the AGD should illuminate when vehicles are 39m from the stop line (minimum), ☐

59 AGD cables should be neatly zip-tied or wrapped to top signals head bracket, with no cables hanging loose. ☐

60 Check that detector channels and AGDs are correctly connected to the controller logic by checking the controller handset display against the detector, unit display or vehicle passage over the detector loops. ☐

61 Check that any unidirectional loops operate correctly. ☐

62 Ensure AGDs are wired in using plugs and sockets, If the detectors are hardwired in please note as an outstanding issue at the end of this commissioning sheet. ☐

Push Buttons

63 Check push buttons operate and illuminate wait indicators. Buttons should not operate when the green man is showing. the wait indicator should go off when the green man comes on. ☐

64 Check push buttons demand the correct phase(s) by checking via the appropriate controller handset command. ☐

Puffin/Toucan Facilities

65 Check that all kerbside detectors are set up to detect within the area that is occupied by pedestrians waiting to cross. Ensure at least the push button and the front two rows of the tactile paving are covered by the detectors' footprint. ☐

66 Carry out tests to ensure the kerbside detectors call and cancel pedestrian demands. ☐

67 Check that all on-crossing detectors are set up to detect the crossing path and ensure that the road width is covered by the on-crossing detectors. ☐

68 PUFFINS AND NEARSIDE TOUCANS – Carry out tests to ensure on-crossing detectors extend the all red period. ☐

69 FAR SIDED TOUCANS – Carry out tests to ensure on-crossing detectors extend the blackout period. ☐

School Crossing Patrol Facility

70 Check that a school crossing patrol facility is fitted where specified. Check white demand indicator lamp, green crossing indicator lamp and push buttons or key operational switch. the white lamp should come on with a demand and go off when the green lamp comes on. The green lamp comes on during all red period, or allocated phase and stage. ☐

Secret Signs

71 Check operation of secret signs operated by time clock. Check switch on sequence and position(s) in cycle at which signs operate as specified. ☐

Part Time Control

72 Part time signal – check switch on-switch off sequence as specified. ☐

Hurry Calls

73 Implement the hurry call and check the response of the controller. Check that the hurry call cancels automatically at the end of its maximum running time and can be cancelled manually where specified. ☐

Pelican Links

74 Check that the Pelican operates correctly under the influence of the traffic signal master control. Check that pedestrian demands at the pelican override excessive hold periods generated by the traffic signals, e.g. lack of vehicle demand at signals to create a stage change to release hold. ☐

Speed Control

75 Speed discrimination – check threshold speed and vehicle extension periods (30mph threshold speed, 3 second green extension for double SDE). ☐

76 Speed assessment – check that delay periods correlate with vehicle speeds. Check that vehicles below 31 mph do not operate speed assessment equipment and speeds over 62 mph do not operate delay timer, Check that gap changes may

occur during delay period but not during speed assessment extensions correct. Check delay times are correct. Soundmark equipment may be used to check speed control. ☐

Audible and Tactile Units

77 Check that the audible signal can be heard from the adjacent crossing point but is not so loud that it causes undue disturbance. ☐

78 Simulate one red lamp failure (i.e. red bulb temp. disconnected). There must be a minimum all red period of 3 seconds. ☐

79 Simulate two red lamp failures on a phase (i.e. red bulbs temp. disconnected), to check RMLU inhibits pedestrian phase. (Pedestrian wait indicators should light.) ☐

Note: If Microsense external RLMU is fitted, then no all red max extension is available (with 2nd red lamp failure pending) i.e. LMU2 and LMU3 should be commoned together on controller input.

80 Check that temporary disconnection of test controller interlocking output (i.e. PAUD/PTAC) inhibits audible/tactile unit from operating. ☐

81 Audible signals may only operate during pedestrian stages that do not contain any vehicle phases. Walk with traffic pedestrian phases shall have tactile signals (unless specified otherwise by the client). ☐

82 Audible signals shall be provided on pedestrian refuge islands. ☐

83 Where tactile signals are being provided they shall also be provided on pedestrian refuge islands. ☐

84 Where audible signals are provided all pedestrian phases shall display a green man simultaneously and the audible signals shall commence and terminate with the green man. ☐

85 Tactile signals shall start simultaneously with the green man signal. If control reverts to a walk with traffic stage the green man may remain illuminated for the duration of the stage. However, the tactile unit shall only operate when demanded by the push buttons and only for the minimum green man time. When the controller moves to another stage immediately after operation of the tactile signal the green man and the tactile shall terminate simultaneously. ☐

Urban Traffic Control

86 Check that a suitable OTU is fitted. ☐

87 Check that a suitable British Telecom termination box has been installed and the OTU is plugged into the BT termination box. ☐

88 Carry out suitable checks so as to establish correct wiring of OUT for data transmission Check Control/Reply Bits and SCOOT loops via the instation. ☐

Remote Monitoring

89 Check that a suitable OMCU is fitted (SIEMENS/MONITRON – BT/GSM). ☐

90 NON GSM – Check that a suitable British Telecom termination box has been installed and the OMCU is plugged into the BT termination box. ☐

91 Carry out suitable checks as to the separate SIEMENS/ MONITRON Commissioning Forms. ☐

Miscellaneous

92 Contractor to submit cable test results/schematic cable diagram is requested by Engineer. ☐

93 Contractor to submit blank controller EPROM door keys and/ or T bar as appropriate. ☐

94 Check that the controller log book has been completed by the contractor detailing the work undertaken (except new installation). Check controller fault log is clear and pass any genuine faults to maintenance. ☐

Comments .....

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Cabling/Slot Cutting Measurements

The following measurements should be taken and agreed with the contractor at the time of commissioning:

95 Total amount of signal cable installed: m (16 core)

m (12 core)

m (8 core)

m (4 core)

96 Total amount of loop feeder cable installed: m (2 pair)

m (1 pair)

97 Total amount of slot cutting carried out: m (Asphalt)

m (Concrete)

The following forms may need to be provided to the Traffic Signal Maintenance Section:

98 Form FRC1 for all signal sites and a copy of outstanding items/work. ☐

99 OUT Details Form and Control Reply Form where UTC equipment has been provided. ☐

100 Form OMCU Details where remote monitoring has been provided. ☐

NOTE: Please note that this form should be completed by the installation contractor and handed over prior to or at the commissioning.

101 Earth Loop Impedance (ELI) Test Certificate ☐

102 Contractor's Take Over Certificate ☐

NOTE: The signals <u>MUST NOT</u> be left on unless this information has been provided.

Date/Time of Commissioning .....

Engineer's Signature(s) ..... (On behalf of Atkins)

..... (On behalf of Installation Contractor)

Attendance (Print names)

..... Atkins

..... Atkins

..... Installation

..... Installation

OUTSTANDING WORK AT TIME OF COMMISSIONING

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COPY AND PASS TO MAINTENANCE DEPARTMENT

Comments

Site Reference .....

Commissioning Date: .....

Location: .....

Outstanding works to be completed within 3 days of commissioning

Copy faxed to contractor by: ..... Date: ..... Time: .....

Completion Certificate

1	**Test of EPROM in control room**	
2	**Initial UTC test of EPROM**	
3	**Initial Commissioning**	
4	**Site adjustments post installation**	
5	**Final reblow of EPROM to include all RAM data**	
6	**Final UTC test**	
7	**Final installation of revised EPROM**	

Completion of Works Final UTC/Remote Monitoring Check	
Engineer:	Project Manager:
Date:	Date:

Scheme Completed

Invoice Paid: ..... Date: ..... Project Manager: .....

COPY AND PASS TO MAINTENANCE DEPARTMENT

D.3 EXAMPLE 3 – CONTROLLER TEMPORARY DATA FORM

CONTROLLER TEMPORARY DATA Junction Ref:_

Date	Engineer Name	Changes Made	Reason	Initials

Appendix E
Electrical Competence

E.1.1 All employers of persons working on electronic traffic equipment installations, including client and contractor's personnel, must authorise and certify the level of competency of those employed and be able to demonstrate the necessary training and supervision to achieve and maintain the certified level of competency. Authorities should inspect all competence certificates prior to a contract commencing and at regular intervals during the operation of a term maintenance contract.

E.1.2 Regulation 16 of the Electricity at Work Regulations (24) states that: "No person shall be engaged in any work activity where technical knowledge or experience is necessary to prevent danger or where appropriate, injury, unless he possesses such knowledge or experience, or is under such degree of supervision as might be appropriate having regard to the nature of the work."

E.1.3 Only a competent person, duly authorised, and trained to the required level of competence and able to recognise electrical hazards, must carry out the work. Operatives must not be placed at risk owing to a lack of skills on their part or others' in dealing with electrical equipment. Regulation 16 applies to any work relating to electrical equipment, whether or not a risk of injury is actually present at that time. Some work, such as testing, might need to be carried out on live equipment and must only be carried out by an appropriately qualified and authorised person who has received additional training and only when in full compliance with Regulation 14 of the Electricity at Work Regulations.

E.1.4 Competence requires training, technical knowledge and experience sufficient to provide:

- adequate knowledge of electricity;
- adequate knowledge of the system to be worked on;
- adequate knowledge of the hazards which might arise and the precautions to be taken;
- adequate experience of electrical work;
- adequate experience of working on the appropriate system; and
- ability to recognise at all times when it is safe for work to continue.

E.1.5 Operatives should be trained and instructed to ensure that they understand the safety procedures which are relevant to their work and should only work in accordance with any instructions or rules.

E.1.6 In some circumstances, operatives will need to be supervised where their technical knowledge or experience is insufficient to ensure that they can carry out the work safely. Supervisors must have their responsibilities clearly explained to them by the duty holder, as defined in the Regulations, who must decide on the degree of supervision required.

Appendix F
Electrical Inspection and Testing

F.1 VISUAL INSPECTIONS

F.1.1 When a visual inspection of the electrical equipment and wiring is carried out, attention should be paid to cable connections, glands, protective conductors and devices, means of isolation and the suitability of hoods, barriers and protective covers, with regard to the following:

- safety;
- wear and tear;
- corrosion;
- damage;
- rating of device;
- age;
- external influences; and
- suitability.

F.1.2 Adequate and legible means of identifying all conductors, including protective conductors, should be provided and maintained. Any deterioration or damage to conductor insulation must be noted on the inspector's report. All conductors must be checked to determine that they are of the correct size and type for the purpose.

F.1.3 It should be established that the means of protection against direct contact with any live conductors meets the requirements for the safety of persons, livestock, property or equipment. Missing or damaged barriers or enclosures or alterations to enclosures must be noted in the inspection report. The presence or omission of danger notices, warning notices, diagrams, instructions and similar information must also be noted.

F.2 ELECTRICAL TESTING

F.2.1 The following tests should be carried out on all public electronic traffic equipment and associated electrical distribution systems:

- visual inspection;
- continuity of protective conductors;
- polarity;
- earth loop fault impedance;
- insulation resistance;

- operation of devices for isolation and switching;
- operation of residual current device;
- operation of circuit breakers;
- earth electrode resistance (where applicable); and
- voltage/voltage drop.

F.2.2 A record should be made of any departure from the regulations.

F.2.3 Tests should be regularly carried out to all equipment and any associated cable networks, including power supplies to remote electrical equipment, such as bus shelters. Electrical attachments on equipment such as power outlets should also be fully tested at the same time.

Appendix G
Case Study: Newcastle City Council – Energy Savings Associated with ELV Replacement/Installation Scheme

G.1 INTRODUCTION

G.1.1 Newcastle City Council has taken the decision that all new traffic signal sites installed by their own teams will utilise ELV technology. This decision has been taken for two main reasons:

1. **Additional safety** – ELV signals operate at 48V which poses no significant risk of electric shock to operatives or the public as a whole, thus even in the event of an RTC the risks of electrocution are minimised.

2. **Energy savings** – as part of the Government's policy on carbon reduction, ELV signals play a large part in the council's strategy to reduce its carbon footprint.

G.2 ENERGY SAVINGS

G.2.1 As conventional signals utilised tungsten halogen lamps, a significant amount of power was required to illuminate a signal aspect, generally 60W during the day and 48W at night. The ELV signals use considerably less, 12W during the day and as little as 3W at night.

G.2.2 As part of Newcastle's working partnership with Siemens Traffic, Newcastle installed the first on-street pilot of ELV junction in the country. Following the installation, the site was monitored to measure the current used by each phase and the junction as a whole. At this test site, the power consumption had fallen to 37% of that of the previous signals that it replaced.

G.2.3 In addition to the direct energy savings, the increased reliability of the ELV LED equipment has removed the need for bulk lamp changing of the sites, saving time and fuel, further reducing the carbon debt (the lamp clean is done once a year as part of the annual inspection).

G.2.4 Figures G1 and G2 show a comparison of the estimated power usage for 31 ELV sites, (and hence the operating cost of ELV sites) compared to the equivalent systems using tungsten halogen lamps. Figure G3 extrapolates the energy cost savings made through a rolling program replacing older sites (15 junctions and 20 pedestrian crossings) with their ELV equivalents year on year over a five-year period.

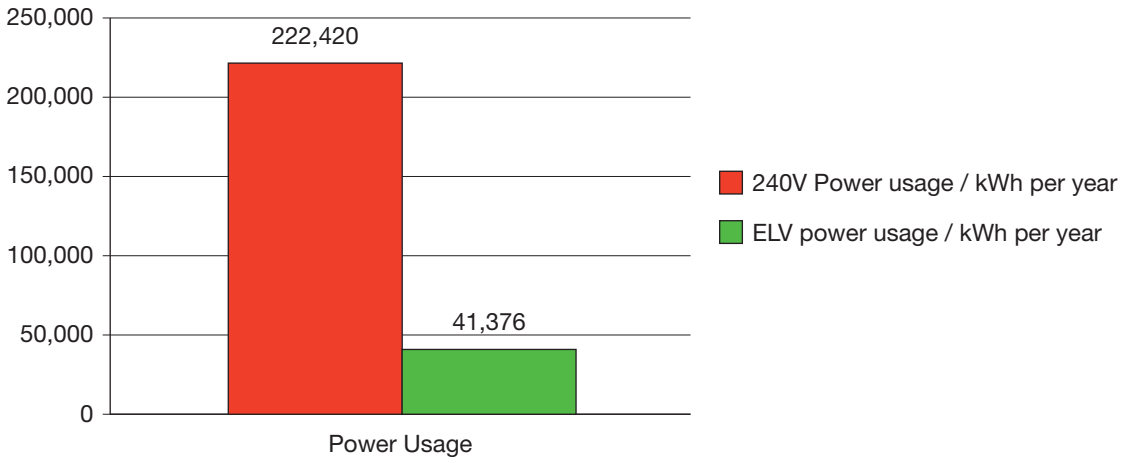

Figure G1: Comparison of power usage of current ELV sites with 240V equivalents

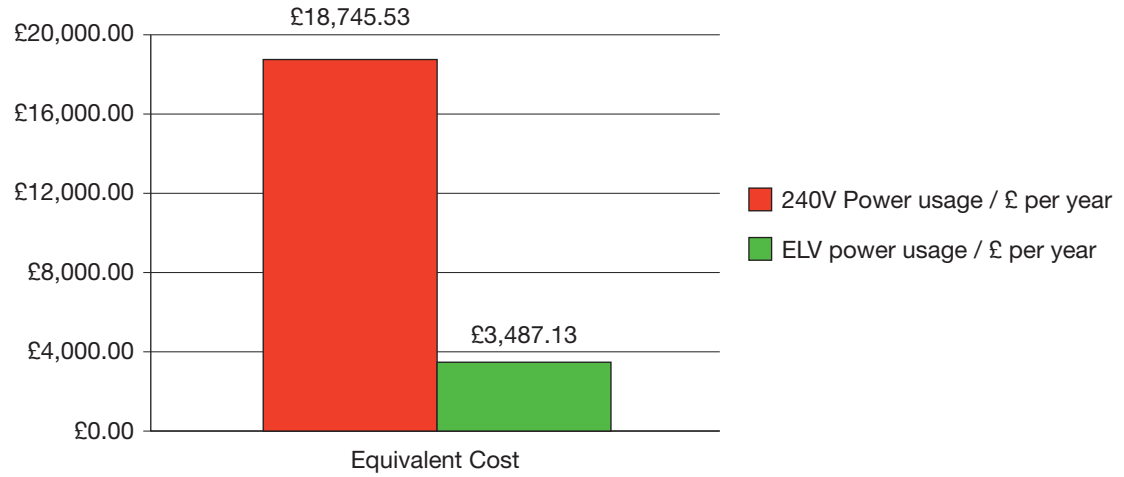

Figure G2: Comparison of energy cost of current ELV sites with 240V equivalents

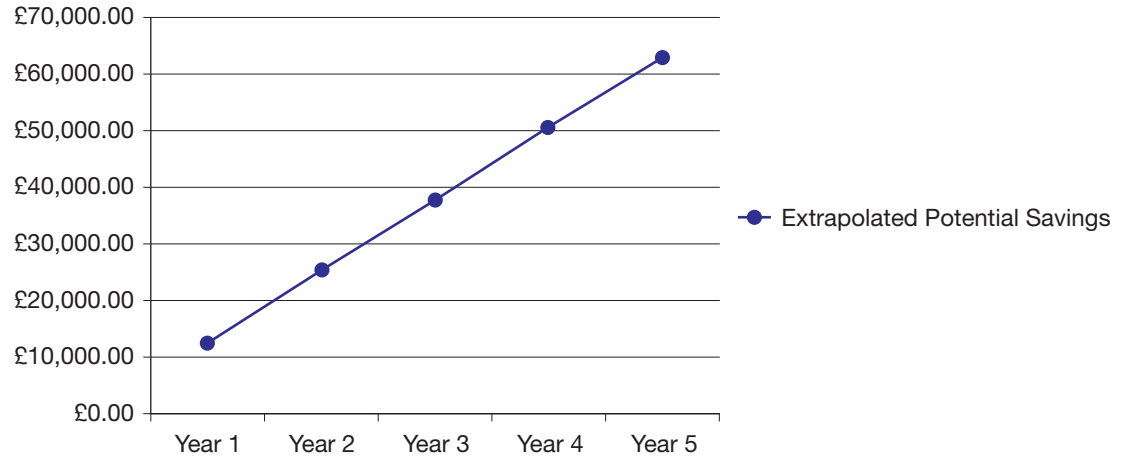

Figure G3: Extrapolated potential savings

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Steering Group Members

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Donald Morrison	Transport Scotland
Peter Gray	Newcastle City Council
Phil Selvidge	Leicestershire County Council

Atkins Project Team

Lila Tachtsi

Andy Woolley

Stuart Ohrland

Alan Stubbings

Alan Taggart

Richard Hall

Andy Marson

Dave Moore

Disclaimer

Whilst every care has been taken in the preparation of this Code, the authors stress that it is intended for guidance purposes only. The code aims to reflect practice in England, Scotland, Wales and Northern Ireland. The views expressed therein are those of the steering group, project team and technical advisors. No legal liability is accepted for its contents and the Code is not intended as a substitute for legal advice. The views expressed do not necessarily reflect those of the sponsoring organisations.