CONTENTS

1. INTRODUCTION
2. SYSTEM DESIGN
3. MANUFACTURE AND SUPPLY
4. INSTALLATION, TESTING AND COMMISSIONING
5. OPERATION AND MAINTENANCE
6. DECOMMISSIONING
7. REFERENCE DOCUMENTS

APPENDIX A  GLOSSARY OF STANDARD TERMS
APPENDIX B  CONSULTATION PRINCIPALS: GUIDANCE
1. **INTRODUCTION**

1.0 **Context**

1.0.1 This Guidance Note has been produced to assist highway and road authorities, consultants and contractors who design and implement traffic control and information systems. This document is advisory, containing recommendations to assist in the promotion of safety and consistency as part of good design practice for both conventional and innovative traffic signal control systems, signalised crossings, driver information facilities and other intelligent transport systems.

1.0.2 This Guidance Note has been developed by the Institute of Highway Engineers (IHE) as a replacement to TA 84/06, the Code of Practice for Traffic Control and Information Systems for All-Purpose Roads, which was previously published by Highways England as part of the Design Manual for Roads and Bridges (DMRB). As part of Highways England's review of the DMRB, it was decided that TA 84/06 would no longer be part of the suite of documents that form the design manual. The IHE, therefore, have taken on responsibility for the publication of a replacement guidance note to ensure the advice provided by TA 84/06 continues to be available and up-to-date.

1.0.3 The ongoing publication of this Guidance Note ensures that recognised industry wide advice continues to be made available to traffic signal professionals. This will help to promote high standards, consistency and good design practice across the industry as well as providing confidence to traffic signal and road safety designers, operators, maintainers and auditors undertaking works on traffic signals and intelligent transport systems.

The Department for Transport (DfT) has provided some aspects of good practice which are available together with legislation, guidance and other sources of advice, but there is no single source covering the issues addressed in this document.

1.1 **Objective**

1.1.1 Systems for controlling traffic or providing information to drivers continue to grow in complexity, and the range of solutions available is getting wider. It is, therefore, important that safety for the users of the road network is assured by good practice during all phases of the life cycle of these new intelligent transport systems. This Guidance Note recommends and makes reference to good practice to be adopted for all traffic control or information systems, both simple and complex, and during all stages of the life cycle from design and installation through maintenance and operation to eventual decommissioning of the system.

1.1.2 The objective of this Guidance Note is to promote safety, effectiveness and good value for money through good practice and procedures and to foster awareness of a design’s influence on the whole life cycle of the system. A further function is to form a central reference, guiding users to other relevant publications that contain advice on the design, maintenance and operation of systems. A full list of relevant publications and their purpose is included in Section 7 of this document.
1.2 Scope

1.2.1 This Guidance Note is aimed at a wide variety of suitably qualified and competent technical personnel engaged in the design and implementation of systems in England, Scotland, Wales and Northern Ireland, primarily:
- scheme designers in highway authorities and consultancies;
- road safety auditors;
- supervisors of installation and commissioning of works;
- staff responsible for maintenance and operation of systems; and
- equipment manufacturers.

1.2.2 This Guidance Note applies to roadside systems that convey instructions or information to the road user through signal control, variable signs or symbols. Such systems will incorporate a control system, which will be electrical, electronic or electro-mechanical. Purely mechanical systems are excluded.

1.2.3 This Guidance Note provides advice for all-purpose public roads operated by highways authorities (‘road’ authorities in Scotland) except motorways in the UK.

1.2.4 This Guidance Note deals with systems which themselves form part of traffic schemes. In developing a safe design, a system cannot be considered in isolation but must be viewed in its scheme context. This Guidance Note is therefore concerned with detailed traffic engineering and control aspects of the system including:
- the layout, which provides the context for the control or information system;
- the method of control;
- implementation;
- maintenance; and
- considerations that may become important when the system is decommissioned.

1.2.5 A proposal to modify the system should be treated in the same way as a new system, and hence the designers and manufacturers of the modification should follow this Guidance Note.

1.2.6 While the aim of this Guidance Note is to pursue safety and effectiveness throughout the whole life cycle of the system, the recommendations it gives concern activities undertaken during the design and implementation stages only. This enables safety to be promoted without further reference to this document, through procedures defined in maintenance specifications and routines that the designer has ensured are appropriate for the continued safe operation of the system.

1.2.7 It is recommended that this Guidance Note is used forthwith when installing road schemes, including those currently being progressed, unless directed otherwise by the highway authority.

1.2.8 This Guidance Note includes a self-certification procedure for systems under which highway authorities may certify that their own processes and procedures comply with industry good practice.

1.3 System Certification

1.3.1 A formal process for certifying that procedures contained in this Guidance Note, have been followed for any particular system is System Certification.

1.3.2 This Guidance Note is advisory and, as such, System Certification is not a statutory requirement for new systems. However, the completion of a System Certificate with the following information: - justification study, risk assessments, detail design, control strategy, Safety Review, Road Safety Audits, controller specification forms, cable diagram, electrical test certificates, commissioning form etc should be provided by the designers to whom requires this information. At the same time, it is a positive way of demonstrating
that safety has been considered at all stages of the design and implementation process. This could be needed if the safety of the system after commissioning is ever called into question.

1.3.3 Using this document as a guide to good practice when preparing a system design does not necessarily imply that the system must proceed to full System Certification. Generally, any system that forms part of a traffic scheme, which undergoes a Road Safety Audit, is a candidate for System Certification. However, it is for the organisation responsible for the system to decide whether System Certification is appropriate or not. If it is decided that System Certification will be pursued, there are parts of this Guidance Note that are essential to certification which must be followed before a certificate can be issued.

1.3.4 This Guidance Note therefore has two distinct applications:
- It can be used as a general guide to good practice, in which case all its requirements are advisory.
- Alternatively, it can be used as a process for System Certification, in which case some of its processes are mandatory in the sense that they are fundamental to the certification process.

1.3.5 It is recommended that highway authorities formally record their implementation method for System Certification. System designers can then use this methodology to help them follow the appropriate process. It will also be helpful in demonstrating that the process has been properly considered, if it is questioned or audited at a later date.

1.4 Document Structure

This Guidance Note includes five further chapters dealing with scheme development:

**Section 2** describes general and statutory requirements for system designers and system design documentation. The principles of safety assessment and life cycle costing applied to traffic control and information systems are considered, and procedures for design from concept through to detail are described.

**Section 3** describes good practice for the manufacture and supply of products used in traffic control and information systems.

**Section 4** concerns procedures for installation, testing and commissioning systems.

**Section 5** recommends good practice to be adopted in setting up and managing procedures for operation and maintenance with reference to existing Department for Transport requirements standards.

**Section 6** deals with the issues arising from decommissioning a system.
2. **SYSTEM DESIGN**

2.1 **Requirements for System Designers**

2.1.1 **Organisation**

2.1.1.1 Although not an essential requirement, it is recommended that design organisations should operate a Quality Assurance Scheme such as a scheme registered with a United Kingdom Accreditation Service (UKAS) accredited body under ISO 9001 (Quality Assurance) or the European equivalent for the design of traffic control and information systems.

2.1.1.2 When entering into a contract for the design of a traffic control system, the Client should ensure (through a carefully managed pre-selection process) that only competent organisations are invited to tender.

2.1.2 **Qualifications**

2.1.2.1 The design of traffic control systems is a specialist activity. The IHE Professional Certificate/Diploma in Traffic Signal Control is a specific accreditation that ensures competence in this field. Those involved in traffic control design should have an appropriate understanding of the engineering issues and experience of traffic control work.

2.1.2.2 Although numerous documents (including this Guidance Note) are available which give guidance on the design of systems, particularly the standard ones, because traffic control systems have wide implications for safety and the environment, it is essential that a competent and experienced engineer supervises the design process.

2.1.2.3 In assessing the competence of staff or organisation responsible for design, the following may reasonably be considered:
- Membership of a relevant professional body (Institute of Highway Engineers);
- Professional Registration (CEng/IEng/EngTech, etc);
- National Highways Sector Scheme registration (NHSS Sector 8);
- Familiarity with design of similar systems and the health and safety aspects concerned with them;
- The technical facilities and resources available to the designer or design organisation.

2.1.2.4 Local Authorities may wish to develop a formal methodology for assessing the competency of design staff, to which evidence of competency would refer. An example of such a competency assessment is the National Highways Sector Scheme (NHSS Sector 8).

2.1.2.5 Evidence of competence of those responsible for the design of a system should be included in the Design File. Design organisations can maintain lists of competent staff that can be referred to in the Design File. Alternatively, the Design File can include a brief description of the individuals involved in the design process. This may be an appropriate method where designs are carried out by external consultants.

2.2 **Documentation**

2.2.1 **Design File**

2.2.1.1 Each scheme or system should be developed using a ‘Design File’ as a link between the individual stages of the whole life cycle. This file has some overlap with the requirements of the Health and Safety File defined in the ‘Construction (Design and Management) Regulations’ and the ‘Construction (Design and Management) NI Regulations’. 
2.2.1.2 The purpose of the Design File is to provide a record of the development of the system in its scheme context, the decisions made and, in particular, the safety considerations. It provides information to manufacturers and installers and, following commissioning, becomes an historic reference file for the project.

2.2.1.3 The Design File should include the following information:
- Preliminary Design Brief (Section 2.7.3);
- Safety Case (including Risk Assessments and passive safety assessment) (Section 2.5.1);
- Output from safety review of Preliminary Design and Detailed Design including Stage 1, 2, 3 and 4 Road Safety Audits;
- Detailed Design Brief (Section 2.9);
- System Requirements Specification (Section 2.9.3);
- System change control documentation;
- System Certification;
- Names, qualifications and experience of the designers identified as being involved in the design of the system;
- Test documentation;
- As-built drawings and specification;
- Statutory Undertakers and other buried services information;
- Schedules of equipment;
- Standard Details; and
- As-installed configuration data.

2.2.1.4 Individuals or organisations charged with tasks at any stage in the system life cycle must ensure that the Design File is available to them before work on the task is permitted. As well as being important in terms of ensuring that all design tasks are correctly carried out, this approach will help ensure that abortive work is minimised.

2.2.1.5 Any changes to designs or specifications should be introduced in accordance with an agreed change control procedure to ensure such changes are communicated to all others involved in the development of the system and its scheme context. The Design File will include details of design changes and how these were introduced.

2.2.1.6 The Design File should be retained to assist in the operation of the system, and to allow for the design process to be traced retrospectively, should a safety problem develop. Design material deemed relevant to the system as installed and commissioned should be held while the system remains in service, and for a minimum of six years from the date when the system is superseded.

2.2.1.7 There is no prescribed form that the Design File must take but there must be some physical or digital entity that is identifiable as the Design File. As a minimum, it could be a list of documents with a reference to where each one is stored. It is not sufficient that all the documents required to make up the Design File are contained within a larger Project File unless the Design File components are specifically listed as such. It must be remembered that the Design File may be required for reference at any time during the life of a system and for some time after. It therefore will stay in existence for longer than many other archives. It must also be remembered that if the responsibility for a system changes, the Design File is to be passed to the organisation taking over responsibility. If, for convenience, documents are stored in different places, it must still be possible to construct a complete physical Design File at any time if required.
2.2.2 Other Documentation Requirements

2.2.2.1 Other documentation includes the requirements of:
- System Certification (Section 2.3);
- Quality Assurance (Section 1.1);
- System Requirements Specification (Section 2.9.3);
- The CDM Regulations (if they apply) (Section 2.5.4);
- Statutory Requirements (Section 4.2).

2.2.3 Statutory Requirements

2.2.3.1 All traffic control systems used on public roads must meet the requirements of any relevant legislation. Those appropriate to schemes involving traffic signals and signs are contained in The Traffic Sign Regulations and General Directions 2016 (as amended) (TSRGD 2016), The Traffic Signs Regulations (Northern Ireland) 1997, The ‘Zebra’ Pedestrian Crossings Regulations (Northern Ireland) 2006 and the Traffic Signs (Welsh and English Language Provisions) Regulations and General Directions 1985.

2.2.3.2 It should be noted that traffic signal displays, road markings and variable message signs are considered ‘traffic signs’ in law and are subject to the TSRGD 2016 (as amended) or the Traffic Signs Regulations (Northern Ireland) 1997 (as amended).

2.2.4 Traffic Signs Authorisation

2.2.4.1 Traffic signs, including symbols and legends which form part of a traffic control or information system and which are not prescribed within the regulations need specific authorisation by the relevant National Authority. For England, this is the Secretary of State; for Northern Ireland, Department for Infrastructure Northern Ireland; for Wales, the Welsh Government and for Scotland the Scottish Government.

2.2.4.2 Traffic sign authorisation involves submitting scale drawings of the sign face and a plan showing the intended location to the appropriate National Authority. Both the sign face and the location form part of the authorisation. Installation must be within the tolerance stated on the authorisation document. For signs, this is normally within five metres of the authorised location. For signal installations, the tolerance is normally two metres.

Designers should bear in mind timescales associated with obtaining signs authorisation, and not programme in any installation work until authorisation is obtained.

2.3 System Certification

2.3.1 System Certification is a procedure for recording that the safety-related good practice recommended by this Guidance Note has been followed for any individual system. It is designed to ensure that records of safety analysis and reviews are held and can be audited, that the approval status is recorded, and that the organisation and individuals responsible for the different procedures are clearly documented.

2.3.2 Adopting the System Certification procedure will also provide a record that demonstrates compliance with the relevant Approving Authority approval requirements and aspects of the Health and Safety at Work etc. Act 1974 and the CDM Regulations.
2.3.3 The fundamental requirements of the process leading to System Certification are:
- procedures to ensure that safety aspects are fully considered;
- the documentation and traceability of all safety-related decisions;
- the independent checking of all designs;
- accountability and competence.

2.3.4 In order to achieve these requirements, the essential elements of this Guidance Note are:
- setting up and maintaining a Design File;
- carrying out Risk Assessments;
- developing a Safety Case;
- undertaking an independent system review;
- recording names and competence of personnel.

2.3.5 The System Certification procedure runs in parallel with this Guidance Note, and consequently may apply to any system that falls within the scope of this Guidance Note. The procedure starts at the preliminary design stage and is completed at the time of commissioning of the system. For significant modifications, the procedure is restarted and operates in the same way as for a new system.

2.3.6 The procedure requires designers, manufacturers and installers of systems to retain specific items of documentation, and to record specific information, but does not attempt to standardise the format for the records, leaving this matter to the discretion of the organisations involved. Forms, which list items of documentation, information and stages in the development of the project, support the System Certification itself. Against each item, the information necessary to locate and audit the documentation must be entered.

2.3.7 It is not an essential requirement for System Certification that design organisations operate a registered QA system, although it is a strong recommendation. Where a formal ISO 9000 Quality Assurance system is in operation, it is recommended that the System Certification procedure should be integrated within the QA procedures of designers, manufacturers and installers and subject to their own internal and external Quality Assurance audits.

2.4 Quality Assurance

2.4.1 The production of Quality Plans, archiving, quality and technical records, and the role of the Project Manager are requirements for all projects. The Quality Plan may simplify the standard procedures for smaller traffic control schemes.

2.4.2 Designers of traffic control systems should apply the requirements of HD 46, Quality Management Systems for Highway Design (DMRB 5.2.1), as many of the principles employed are similar to those for highway design.

2.5 Safety Assessment and CDM

2.5.1 Safety Case

2.5.1.1 The Safety Case is a logical argument supported by evidence to prove that the system in question has been developed to an acceptable level of safety. It describes the system and its boundaries, and identifies the hazards and risks indicating any safeguards provided. The Safety Case is concerned with both the system and the context in which it operates and relates to the system throughout its life cycle. The basis of the Safety Case for a traffic control or information system should be a Risk Assessment prepared by the system designers.
2.5.1.2 In addition to the hazard list resulting from the Risk Assessment, the Safety Case should record:

- details of risk reduction measures employed;
- a description of the safety-related aspects of the control systems;
- evidence of the competence of personnel engaged in the design of the system;
- evidence of a Passive Safety assessment (in accordance with BS EN: 12767:2019 (UK National Annex)).

In 2008, BS EN: 12767 was amended to include a new National Annex. This Annex stipulates that passively safe infrastructure must be considered on all speeds of roads including those less than or equal to 40mph (Table NA.4). Guidance on the use of passively safe equipment can be found in the document ‘Passive Safety UK Guidelines for Specification and Use of Passively Safe Street Furniture on the UK Road Network (update 24/01/2020).

2.5.2 Risk Assessments

2.5.2.1 The designer should prepare Risk Assessments for all aspects of the system and its physical and human context throughout the complete life cycle, from construction, installation and testing to operation, maintenance and eventual decommissioning. These Risk Assessments cover different aspects from those required under the CDM Regulations, which are primarily concerned with risks associated with, or brought about by, the physical construction of the site.

2.5.2.2 The preparation of Risk Assessments for common systems may be simplified by using checklists that identify the usual hazards, and measures to overcome them. When considering hazards in relation to construction or installation, liaison with the contractor may reveal information that could be helpful to designers.

2.5.2.3 The procedures for preparing a Risk Assessment start with drawing up a hazard list for the system in its scheme context. This is a list of elements or characteristics of the system that present particular risks. Hazards that are common to traffic control systems and which are already addressed by standards and specifications need not be included. For example, display of conflicting green indications, which is a potential hazard at all traffic signals, is already dealt with in Schedule 14 of TSRGD 2016.

2.5.2.4 The hazard list should start with those hazards which are inherent to the site such as visibility, steep approaches, overhead or underground high voltage cables, the presence of vulnerable road users such as children, and disabled people. It should go on to deal with potential hazards of the system itself, location and use of equipment and deal with any specific hazards of maintenance (such as servicing overhead equipment) and consequences of partial or total equipment failure.

2.5.2.5 Innovatory aspects of systems warrant special attention as they may present new risks that could require special countermeasures. It may be necessary to enlist the help of additional expertise to assess the risks involved and design the system to minimise their impact.

2.5.2.6 For each identified hazard, a note should be added detailing how the hazard is dealt with to minimise the associated risk and ensure that it is reduced to an acceptable level. What represents an ‘acceptable level’ of risk is largely subjective, but, as a guide, if the totality of risk associated with a system is higher than the ‘do nothing’ alternative, this is clearly unacceptable even though there may be other benefits, such as time savings, associated with it. Alternatively, a level of risk which is no more than is commonly experienced in similar highway environments can be argued as being ‘acceptable’.

2.5.2.7 It should be noted that hazards which have a very serious outcome but with a low level of risk of occurrence are generally less acceptable than hazards with a less severe outcome and a higher risk of occurrence even where the total risk (computed as likely outcome multiplied by the likelihood of occurrence) is the same.
2.5.2.8 The development of a Safety Case and the carrying out of Risk Assessments is an essential part of the System Certification procedure. For simpler, less complex schemes there may be few unusual hazards, but a brief Safety Case should nevertheless be prepared to demonstrate that the hazards have been fully considered.

2.5.3 Road Safety Audits and reviews

2.5.3.1 The Road Safety Audit procedure is an independent review of a system design to ensure that all safety-related issues have been fully addressed and the implications considered throughout the design and implementation of the system.

2.5.3.2 The staff involved in a Road Safety Audit should be independent of the staff involved in the design. The Road Safety Audit team can be from an external organisation or made up from staff of the design organisation provided there are sufficient competent staff independent of those involved in the design available to carry out the audit.

2.5.3.3 The Road Safety Audit procedure may be carried out as it would for any traffic engineering scheme provided the safety of the control and information system is reviewed either as part of an extended Road Safety Audit, or separately. The Road Safety Audit and the review of the control and information system make up the Safety Review (Section 2.9.5).

2.5.3.4 The Road Safety Audit is carried out in four stages:
- Stage 1: completion of preliminary design (before publication of draft orders);
- Stage 2: completion of detailed design (before commitment to the procurement process, e.g. invitation to tender);
- Stage 3: completion of construction (before opening);
- Stage 4: monitoring.

Stages 1 - 3 are relevant to this Guidance Note.

2.5.3.5 Where preliminary design is not undertaken, a stage 1 RSA may be combined with a stage 2 RSA at the detailed design stage (see GG 119).

2.5.3.6 When the review of the control and information system is incorporated in the Road Safety Audit rather than as a separate process, the audit team should include one or two people with experience of traffic control as well as road safety or should appoint an appropriate Specialist Advisor. However, it should be realised that the Road Safety Audit process deals only with road safety. Issues of system security and safety will need to be dealt with separately.

2.5.3.7 Procedures for carrying out Road Safety Audits on Highway Schemes (the principles of which are equally applicable to traffic control schemes) are set out in GG 119 (DMRB 5.2.2).

2.5.4 Construction (Design and Management) Regulations 2015

2.5.4.1 All construction projects are subject to the requirements of the CDM regulations with regard to the general duty of care for those responsible for design and construction. Projects which involve construction work lasting longer than 30 days or involving more than 20 workers working at the same time at any point on the project or exceed 500 person days of construction work become notifiable to the HSE. If your project is notifiable, the client must write to the HSE to give notice using an F10 form as soon as possible before the construction phase begins. Many of the more complex traffic control schemes will fall into this category. It is necessary to identify very early in the design process whether the specific CDM regulations will apply.
2.5.4.2 The purpose of the CDM regulations is to improve the overall management and coordination of health, safety and welfare throughout all stages of a construction project, from the construction phase through maintenance to the final decommissioning.

2.5.4.3 The regulations place duties on all those who can contribute to the health and safety of a construction project. Duties are placed upon clients, designers and contractors. Reference must be made to the Health and Safety Executive best practice guidance document L153, Managing health and safety in construction. It describes: - (i) the law that applies to the whole construction process on all construction projects, from concept to decommissioning and (ii) what each duty holder must or should do to comply with the law to ensure projects are carried out in a way that secures health and safety.

2.5.4.4 The Principal Designer and Principal Contractor have the joint responsibility of co-ordinating the health and safety aspects of project design and planning and ensuring that the requirements of the Regulations are complied with and that the Health and Safety Plan and the Health and Safety file are prepared.

2.5.4.5 The client must ensure that the principal designer prepares the health and safety file for a project. The Health and Safety Plan details all the health and safety-related issues regarding the construction of the project. Hazards and risks are noted and working methods to ensure safe construction identified. The Health and Safety Plan is first developed before the tender stage and then further developed by the Contractor to take account of the work as carried out. It will identify significant hazards or work sequences that cannot be avoided or designed out and, where appropriate, a broad indication of the precautions assumed for dealing with them.

2.5.4.6 The Health and Safety File is a file which is handed over to the client following the construction phase and which will assist persons maintaining, modifying or decommissioning the equipment in future. There is no prescribed format for the file, but it will include as-built drawings, design details, maintenance procedures and any manuals provided by suppliers.

2.5.5 Health and Safety at Work etc. Act 1974

2.5.5.1 The Management of Health and Safety at Work Regulations 1999 also apply. These regulations make more explicit what is required by the Health and Safety at Work Act of employers. There is a requirement on employers to assess the risks to health and safety of their employees and other who may be affected by the work activity. In the context of a traffic control system, this would apply to maintenance procedures and the risks to health and safety which they bring to employees and members of the public. If a Health and Safety file is required for the project, any specific maintenance procedures that arise from the analysis of this Risk Assessment should be included in it.

2.6 Life Cycle Costing

2.6.1 Introduction

2.6.1.1 In examining the cost of a project, it is important that the total costs of the system over its lifetime are taken into consideration and not just the initial capital cost. The on-going costs of a traffic signal installation are very different from those of a roundabout that may represent an alternative solution. Life Cycle Costing is also necessary to compare systems involving different technologies where initial costs and running costs may follow different patterns.

2.6.1.2 The basis of Life Cycle Costing is to aggregate the costs of a system over its lifetime into a single sum. The main costs are for maintenance, routine inspections, electricity, and telecommunications over a period of 15 years (typical life cycle period for a traffic signal junction or pedestrian crossing).
2.6.1.3 In the analysis, all costs are expressed at base year prices. The base year can be the year the system is installed but this is not necessarily so. Any other year can be used provided where two systems are compared; the same base year is used in both. Where an annual cost (for example, maintenance) is expected to remain constant in real terms, the cost at base year prices will be the same for each year, even though the actual sums expended may rise with inflation. It is not therefore necessary to make any assumptions about future trends in inflation. If, however, it is expected that certain costs will rise in real terms (that is, will grow faster than the rate of overall inflation), the annual costs expressed at base year prices will also grow.

2.6.1.4 When the costs for each year of the life of the system (at base year prices) has been assessed, they can be combined to produce a Net Present Cost by discounting future costs back to the present day, or more accurately to the year in which the major initial expenditure on the project is made. (Note, the discounting is not back to the base year.) The principle of discounting is based on the fact that future costs are less onerous than present ones. At its simplest, on the assumption that it is possible to invest money at a rate of return higher than inflation, money invested now will grow in real terms by an annual percentage equal to the rate of interest received minus the rate of inflation. Consequently, the amount of money required now to be set aside to meet a future liability will be less than the liability itself.

2.6.1.5 The net interest rate used in the calculation is the Discount Rate. If a comparison is made between a present cost and a future cost funded by monies deposited now in an interest bearing account, the discount rate would be the difference between the rate of interest obtained and the rate of inflation, a net rate of about 2-3%. In practice, monies required later in a project would not be deposited but be considered as a reduction in current borrowing requirements representing a saving at the borrowing rate of interest that is higher than the investment rate. Accordingly, higher Discount Rates are used in practice. The Discount Rate advised by the Department for Transport for use in COBA is the appropriate one to use for life cycle costings of traffic control systems.

2.6.2 Factors to be considered in Life Cycle Costing

Life of Project

2.6.2.1 If the life of the project is known, or can be reasonably estimated, this should be used in the analysis. This will be appropriate where, for example, a traffic signal system is to be installed when it is known that a planned future road scheme will require its removal. Where the life of the system is indeterminate, as is the case with the majority of traffic control systems, it is reasonable to equate the life of the system with the economic life of its major components. A typical period which is consistent with data provided in the specification for traffic signal controllers (TOPAS 2500) would be fifteen years.

Initial Cost

2.6.2.2 An assessment of the initial cost will normally be at hand at the time a life cycle costing is undertaken but it is important to ensure that all elements of the cost of implementing the system are included. In the case of a traffic signal installation these would include the costs of design, testing and commissioning, the cost of connecting to the mains power supply, and the cost of provision of a communication line, outstation transmission or monitoring unit, as well as the normal costs of equipment and its installation, including civil construction. In deciding whether an item should be included in the initial cost it is necessary to ask whether the money and resources (including staff time) associated with that item would be saved if the project were not proceeded with.
Maintenance

2.6.2.3 Wherever possible, the costs of maintenance used in the analysis should be based on actual costs incurred for the maintenance of similar systems in the area. Where there is no better estimate, a good rule of thumb is that the cost of maintenance of electronic equipment is approximately 10% of the initial cost of the equipment (excluding installation) per year.

Energy and Communications

2.6.2.4 An annual sum for the electrical supply to the equipment and also for communications for control and monitoring should be estimated. The cost of energy and communications may well change in real terms over time and it is important to consider this, particularly where different technologies with different costs are being compared. A particular example is where newly installed cables are being compared with leased lines, dial-up or radio systems.

Third Party Damages

2.6.2.5 It is not common practice for Local Authorities to insure street equipment, preferring to take the risk of accidental damage; the money expended by an authority in repairing such damage should be estimated on the basis of previous experience and revenue funds should to set aside. Where possible the associated costs should be claimed back from the third party.

Staff Support

2.6.2.6 Where major systems such as Urban Traffic Control systems are used, there are specific staffing requirements for operation, which need to be included in the analysis. For more minor systems, there is still an increased staff support requirement. All authorities with significant numbers of traffic control installations maintain a specialist staff team (or use external staff) and an increasing number of traffic control installations will naturally require an increase in staff resources. In calculating the costs of staff support, it is important to include overheads as well as salary. This will allow for the costs of increased accommodation and administrative support staff.

2.6.2.7 If a reasonable sum is allocated to this item, it can be taken to cover all redesign work during the life of the project such as the recalculation of signal timings. If it is known that significant redesign will be necessary (because of other nearby systems proposed to be implemented during its lifetime) allowance can be made specifically through a cost assigned to a specific future year.

Replacements

2.6.2.8 During the life of the system certain items may need replacing. It is important to check whether the maintenance estimates include all the replacement requirements. In systems involving computers, it may be necessary to replace computer equipment before the expiry of the economic life of the street equipment. The re-cutting of detector loops is a common requirement for a variety of reasons and local experience should be used to assess what is the realistic average life of detector loops and make an allowance for re-cutting. It should be borne in mind in making the calculation that many instances of loop damage are due to Statutory Undertakers’ operations and the costs of repair can be recovered.
Decommissioning

2.6.2.9 Where the life of the scheme is less than the economic life of the equipment, there is some residual value in the equipment. It is reasonable to calculate that residual value as a proportion of its initial cost based on the proportion of its economic life still remaining provided that a realistic estimate of the cost of removing, transporting, refurbishing and storing the equipment is also made. Clearly, if it is near the end of its economic life, recovery of the equipment may not be worthwhile. Where there is no intention of removing the scheme at the end of the economic life of the equipment, an assessment of residual value and decommissioning costs can be omitted. Omitting residual value is consistent with analysis of road schemes using the programme COBA where the residual value of roads at the end of the COBA analysis period is ignored.

When considering decommissioning costs, the consequences of any current, or proposed, national or European legislation where applicable on the disposal of waste materials should be taken into account.

2.6.3 Method

2.6.3.1 The data should be prepared in a table with one row for each year of the analysis. A spreadsheet is a convenient tool for these calculations. Each row should show the year and the costs associated with the various headings, a total cost for the year and the value of that cost discounted back to the present year. The total of the discounted cost column gives the Net Present Cost.

2.6.4 Sensitivity Testing

2.6.4.1 Where a comparison between schemes is being made and future trends in costings are uncertain, possible ranges should be identified for the uncertain costs and the Net Present Cost calculated for each end of the range to see if this affects the ranking of the schemes. If the ranking is changed by the sensitivity test, judgement will have to be made about the most probable future cost pattern.

2.7 Concept Design

2.7.1 Introduction

2.7.1.1 The assumed design process starts as concept design, and proceeds through preliminary design to detailed design. This three-stage design process may be essential for some systems where a range of solutions may exist. In practice all three stages may not be necessary. It is not a requirement of System Certification that all the stages are separated provided that all design-related decisions are fully documented.

2.7.1.2 ‘Concept design’ refers to the first stages in the life of a scheme when a problem, which could be resolved by a traffic control or information solution, is first identified. The concept could result from an area-wide study or a specific investigation into a problem leading to a range of solutions. Design work to develop a concept into a scheme is then commissioned by the local authority, developer, etc.

2.7.1.3 This Guidance Note applies once a traffic control or traffic information system is put forward as a possible solution, and design resources are allocated. The first task of the scheme designer is to establish a definition for the scheme concept containing:
- a description of the problem, preferably quantified;
- the scheme objectives; and
- an outline of one or more solutions.
2.7.1.4 It is possible that the scheme concept will already be completely defined in a design brief. If not, it is the designer’s responsibility to complete the definition by agreement with the Client. It is likely that this task will be a requirement of the design organisation’s quality assurance procedures.

2.7.1.5 Having defined the scheme concept, it may be possible to assess some of the solutions without further design work, allowing the selection of a more limited range of solutions for further investigation.

2.7.2 Safety

2.7.2.1 Consideration should then be given to any significant impact on safety that is apparent from the known details for each proposal by conducting a preliminary Risk Assessment for the whole life cycle of the schemes from installation through to decommissioning. A brief written record should be made to be incorporated into the preliminary design brief. The following issues should be addressed:

- significant details of the safety history of the site;
- the impact on safety of the proposed solutions;
- the impact on safety of taking no action;
- the conditions of the work site; and
- any specific safety-related objectives of the schemes.

2.7.3 Preliminary Design Brief

2.7.3.1 A brief for the preliminary design stage should be compiled containing:

- scheme objectives;
- alternatives to be considered, which will nearly always include taking no action;
- criteria for selection; and
- record of preliminary Risk Assessment.

2.7.3.2 If possible, the brief should include the general method of control and a list of the facilities to be provided for each alternative. Any anticipated requirement for equipment approvals or special signs authorisation should be noted, so that allowance can be made within the design programme. If the scheme concept is sufficiently advanced, it may be possible to consider any requirement for the following:

- traffic regulation orders to restrict traffic movements or parking;
- traffic surveys;
- topographical surveys; and
- effective public consultation in accordance with the consultation principles set out in Appendix B.

2.7.4 The brief may also refer to any design policies set by the client or the design organisation and a project programme and budget.

2.8 Preliminary Design

2.8.1 Introduction

2.8.1.1 Preliminary design takes a scheme concept and develops it in accordance with the preliminary design brief usually by evaluating one or more solutions and producing a layout showing the main principles of the preferred option together with an outline of the method of control.
2.8.2 Surveys

2.8.2.1 A pre-requisite of the design of a traffic control or traffic information system is the availability of adequate traffic data and topographical information. Traffic data may be needed not only for design but also to predict and later monitor the benefit of the proposed scheme.

2.8.2.2 Where the objectives of the scheme are to overcome a defined traffic problem, any description of the existing conditions provided through traffic survey data should be backed up by site visits by the designer to obtain first-hand experience.

2.8.2.3 For schemes that entail no significant alteration to road kerb lines, base ordnance survey data may provide sufficient topographical information, but care should be exercised to ensure that the details are both current and accurate. Limited surveys to check certain critical dimensions may be all that is required. For more significant changes in layout, a full three dimensional model of the existing physical topography may be required. For major changes, early effective consultation with statutory undertakers who may be affected, is recommended. These consultations may lead to requirement to commission trial excavations to precisely locate existing plant in relation to revised kerb alignments.

2.8.3 Definition and Assessment of Options

2.8.3.1 Evaluation of the scheme objectives, alternative design solutions and design constraints will lead to a short list of options and sub-options from which a preferred scheme is to be selected. The design of each option needs to be developed in sufficient detail to allow a budgetary estimate to be prepared, and a prediction of the scheme performance to be made. This normally entails providing a layout at a scale of 1:1250 or larger, together with details of the method of operation. Assessment of alternatives should consider the same factors that are associated with the evaluation of any highway scheme, including:

- safety;
- scheme life cycle costs;
- environmental impact; and
- user and non-user benefits.

2.8.3.2 The evaluation of safety will require a further preliminary Risk Assessment as conducted for the scheme concept, but utilising the additional detail provided through preliminary design.

2.8.3.3 The methodology used to evaluate the scheme benefits will be influenced by the objectives. Techniques for predicting the delays to road traffic at traffic signals are well developed and supported by a range of computer software. Software packages include OSCADY and LINSIG for the analysis of individual signal controlled junctions while TRANSYT can model the delays of a group or network of signals. Other measures of performance, particularly those associated with traffic information systems, are less easy to predict.

2.8.3.4 For the selected scheme it is necessary to demonstrate that there is a net benefit that exceeds the ‘do nothing’ option. This usually entails a cost benefit analysis which compares the value of benefits produced over the life of the scheme with the life cycle costs, discounted back to the year of installation as discussed in 2.7.

2.8.4 Safety Case

2.8.4.1 A Safety Case should be generated before the scheme develops beyond the Preliminary Design stage, otherwise a proposal may be developed for which, no viable safety case can be maintained. It should be based on a Risk Assessment of the Preliminary Design documented in a hazard list.
2.8.4.2 The designers should review The Safety Case documentation at the Detailed Design stage. The hazard list should be reviewed as the design changes or is developed in more detail, and the Safety Case should be extended to cover any detailed safety requirements developed as part of the System Requirements Specification.

2.8.5 Safety Review

2.8.5.1 After a preliminary design has been completed, a safety review should be carried out independently of the design team. This review may comprise the Stage 1 Road Safety Audit extended to cover the control and operational aspects of the proposed traffic control or information system, or a standard Road Safety Audit and a separate independent review of the control aspects of the system for traffic control or information being proposed.

2.8.5.2 A copy of the Safety Review report is included in the Design File.

2.8.5.3 The design team should consider the Safety Review report, and where appropriate, introduce changes into the design. All issues raised by the audit require a documented response. Where they have not been accommodated by changes in the design, the reasoning of the design team should be documented in an exceptions report.

2.8.5.4 The Safety Review report with the documented responses, together with any exceptions report, should be incorporated in a revised Safety Case document.

2.8.6 Other Preliminary Design Tasks

2.8.6.1 Other tasks during preliminary design that may be required include:

- advertise Traffic Regulation Orders;
- organise effective public consultation in accordance with the consultation principles set out in Appendix B;
- submit scheme details for special traffic signs authorisation when required;
- consult with police and other groups; and
- check vehicle turning envelopes where kerb lines are changed.

2.8.7 Design File

2.8.7.1 On completion of the preliminary design, the following documents should be assembled to form a Design File:

- Preliminary design brief;
- Risk Assessment including hazard list;
- Road Safety Audit and Safety Review Reports; and
- Safety Case document.

2.8.7.2 When a preliminary design is passed to a new team for design in detail, it is necessary to ensure that the Design File is made available to them. To this documentation, it may be helpful to add details on specific detailed design standards set by the client, report on any design issues examined during preliminary design and to highlight any requirements for equipment approvals or special signs authorisation.
2.9 Public Consultation/Stakeholder Engagement

2.9.1 Public consultation should be in accordance with consultation principles, guidance note provided in Appendix B.

2.9.2 Effective consultation/stakeholder engagement should actively seek participation from a wider audience, in order to ensure that they consider the full range of opinions and ensure that the decisions made are guided by a real appreciation of the views of the people of the county/city.

2.9.3 Consultation/stakeholder engagement can be through a variety of means. For example, an Authority may consult the residents of the city/county by direct engagement, by post or through council publications or through online portals where residents can view and submit contributions.

2.10 Detailed Design

2.10.1 Introduction

2.10.1.1 Detailed design develops the preliminary design proposals and produces layout drawings for construction and a detailed specification of system requirements.

2.10.2 Layout Drawings

2.10.2.1 One or more detailed scheme layout drawings are usually first prepared using a scale of either 1:500 or 1:200 depending on the quantity of information to be incorporated in the drawing. The following details should be defined:

- existing and revised kerb lines;
- type and location of traffic signals and signs;
- type and location of electrically operated barriers and bollards;
- vehicle and pedestrian detectors and push buttons;
- paving details for footways and carriageways;
- road markings, static signs and bollards if used;
- location of housings for control equipment and cable jointing; ducting and chambers for cables associated with the traffic control or information system; and
- location of trees or other features that would interfere either with the visibility of signals or signs, or the location of street furniture.
2.10.2.2 The layout drawings form the base for the preparation of a full series of drawings required for construction of all aspects of the scheme which will include some or all the following details:

- setting out and pavement construction details;
- drainage;
- cabling details;
- location of statutory undertaker’s plant;
- street lighting and associated ducts and chambers;
- location of poles and housings;
- landscaping details;
- temporary traffic management during construction and installation;
- detailed requirements for electricity supply and telecommunication services;
- lighting columns;
- bus stops and shelters; and
- existing Traffic Regulation Orders (including parking restrictions).

2.10.3 System Requirements Specification

2.10.3.1 The method of operation for the system defined during preliminary design should be developed into a specification that conveys the designer’s intentions fully and unambiguously to the supplier of the system. This task may not involve much detail or complexity, as the scope and level of detail required by the System Requirements Specification (SRS) will vary considerably.

2.10.3.2 For conventional systems based entirely on approved equipment, the SRS may be a list or drawing of the equipment to be installed and a simple description of facilities to be provided. Any programmable aspects of the equipment will need to be defined. For traffic signal installations, the SRS is provided by the controller specification.

2.10.3.3 For innovative systems that utilise existing equipment in unconventional ways.

- functional description of the method of operation;
- fault detection and warning systems;
- operation of equipment under defined failure conditions;
- specification for interfaces with other equipment;
- a reliability/availability target to be observed;
- system acceptance testing procedures;
- housing of external equipment;
- accommodation of instation equipment;
- EMC requirements; and
- any special provision for maintenance.

2.10.3.4 When there are alternative types of equipment or systems available to meet the requirements of certain aspects of the system (for example vehicle detection), it may be necessary to examine the relative merits of the alternatives. The costs of operating or maintaining alternative systems throughout the life of the system may differ significantly, and therefore any comparison of costs should consider the full life cycle of the system.

2.10.3.5 The designer of the system or the supplier will be responsible for the electrical design of the system. The SRS should make it clear who is responsible for the work. The relevant organisation will be responsible for signing the design section of the Electrical Completion Certificate, as required by BS 7671.
2.11.4 Revise Safety Case

2.11.4.1 During detailed design, the hazard list should be reviewed and amended as proposals are modified and the operation of the system is defined in detail. This review should address all stages of the system life cycle, including the systems aspects of the construction phase.

2.11.4.2 If the system falls under the specific requirements of the CDM Regulations, a Risk Assessment relating to the construction phase will have been carried out. This Risk Assessment forms part of the Health and Safety Plan, which is a requirement of the designer under the CDM regulations. The 'Client's' obligations under the regulations should also be reviewed at this stage.

2.11.4.3 The review should refer to the detailed design drawings and the SRS. Any changes in the risk reduction measures or the safety-related aspects of the scheme since the preliminary design stage should be recorded, together with reasons for the changes. Any special requirements for the preservation of safety during maintenance, operation and eventual decommissioning of the system should also be added to the safety case. Such considerations may lead to a requirement to adapt the normal procedures operated by the organisation responsible for maintenance and operation.

2.12.5 Safety Review

2.12.5.1 On completion of detailed design, the design drawings and SRS should be subjected to review by an independent team. The review parallels the review process carried out at Preliminary Design stage (Section 2.9.5). The review should comprise the Stage 2 Road Safety Audit with the scope extended to consider the operation of the system as defined in the SRS or a standard Road Safety Audit with a separate independent review of the control aspects. The audit team (or the control aspects review team if separate) should include a specialist in the specification of the equipment involved. The review should consider not only the content of the SRS, but also any omissions.

2.12.5.2 For larger projects, it may be sensible to arrange an interim Safety Review to ensure that any contentious issues, which could, for example, affect Traffic Regulation Orders (TRO’s), are considered early enough to be acted upon.

2.12.5.3 The design team as described in Section 2.9.5 should consider the Safety Review report, and the Safety Case updated.

2.13.6 Other Detailed Design Tasks

2.13.6.1 Other detailed design tasks that may be required include:
- preparation of detailed estimates of costs for supply, installation and system maintenance;
- preparation of standard details and tender documents;
- detail design, including foundations and crash protection and the necessary approvals for mast arms, gantries and other structures;
- preparation of the Health and Safety Plan; and
- determination of system maintenance requirements, and the preparation of a specification for system maintenance procedures.
3. **MANUFACTURE AND SUPPLY**

3.1 **Introduction**

3.1.1 This Chapter describes good practice to ensure safety and fitness for purpose to be adopted by manufacturers and suppliers, where manufacturing can be taken to include:
- Preliminary and detailed design of equipment and software;
- Production of equipment and software;
- Assembly of equipment and software to form products;
- Configuration of products to specific purchaser requirements;
- Interconnection of products to form traffic control or information systems; and
- Testing of equipment and systems.

3.1.2 Manufacture also includes the assembly of equipment or software supplied by others. Factory testing and site testing of products configured to a purchaser’s requirements are considered in this Guidance Note to be part of commissioning and installation, covered in Chapter 4.

3.1.3 The content of this Chapter is not only relevant to manufacturers or suppliers, but also to designers and operators who need to understand how safety is assured in the systems they design and operate and who may occasionally need to influence this process.

3.1.4 Since TSRGD 2016 came into force, traffic control equipment is no longer required to be Type Approved by the Secretary of State. A voluntary system of product registration is administered by TOPAS, to a set of procurement specifications maintained by them.

3.1.5 In most traffic control and information systems, equipment is utilised in a standard configuration. Items of equipment are developed, tested and manufactured to specifications appropriate to equipment of the same standard type and tested in accordance with the manufacturer’s own testing regime and national legal requirements. This process takes place prior to purchase, typically outside the life cycle of any particular traffic control or information system, and results in products that can later be configured to specific applications.
Note: A non-regulatory set of procurement specification, administered by TOPAS Ltd, is available to aid the procurement of equipment. Products Registered with TOPAS will have been designed within a verified Quality Management System and compliance with the appropriate specifications will have been assessed by an independent Technical Assessor. Further information about TOPAS is outlined in section 3.6.

3.1.6 Subsequent customisation of the equipment takes place after purchase and consists of the introduction of data and the configuration and interconnection of hardware to form a complete system. This customisation process is considered in Chapter 4.

3.2 Staff Competence and Training

3.2.1 Both management and staff have the responsibility of ensuring that all personnel engaged in product development and manufacture, including suppliers and subcontractors, are competent to perform the tasks assigned to them. Competence requires:

- Having theoretical knowledge and practical experience appropriate to their role;
- Awareness of current practice and available technologies;
- Familiarity with legislation, regulations and standards; and
- Awareness of relevant codes of practice for engineers and managers, e.g. the Institution of Engineering and Technology (IET) Safety Related Systems.

3.3.2 Managers should ensure that project teams have the appropriate balance of expertise to undertake the project, covering the full range of disciplines involved. To maintain this balance, they should ensure that opportunities exist for trainees to develop skills, knowledge and understanding from experience members of the team, and a structured training programme should be provided.

3.3 Product Development Life Cycle

3.3.1 The development process for products intended for traffic control and information systems should be structured in a development life cycle that embodies the safety life cycle specified in BS EN 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems, or a similar standard. Methods for product development within the life cycle framework should be defined within Company procedures. These methods should take into account national legislative requirements, such as those defined in TSRGD and if the products are to be TOPAS Registered, the need for provision of external certification where required.

3.3.2 The development process typically starts from a purchaser's requirements specification or a TOPAS specification. Purchaser's specific specifications in particular should be reviewed to ensure that their requirements are clear, unambiguous and can be tested. A hazard and risk analysis of the preliminary product design should be carried out, the product's system safety requirements clearly stated and those elements of the system that are safety-related should be identified. (An example of a safety-related system is the green conflict monitor in a traffic signal controller and these may be subject to additional analysis and documentation needs, depending on national legislative requirements.)

3.3.3 The required extent of assurance that safety-related systems are safe should be determined with reference to relevant current standards such as BS EN 61508. For traffic signalling control equipment in particular BS EN 50556 has specific safety analysis requirements. For software, the assurance requirement can set appropriate targets for availability, reliability and maintainability in product sub-systems where these
parameters can be predicted; using appropriate hardware and software design techniques, to control the probability of faults and failures; setting standards for testing and the coverage of tests; using appropriate validation and verification techniques; and setting the degree of independence required of the verification process, with respect to the product design team. Of particular importance where products use IP or Web based solutions is the assessment of IT security and the risk and mitigation activities required to ensure that the safety of products is not compromised by potential IT type vulnerabilities.

3.3.4 Validation of the design of safety-related sub-systems should include an analysis of probabilities and consequences of failure using techniques such as Failure Mode Effects Analysis. This is a mandatory requirement for traffic signal control systems.

3.3.5 A validation plan should be prepared containing tests or other validation procedures to establish that the finished product meets the initial requirements specification. The plan should take into account any existing products, which may have been previously validated and will not require further tests. The requirements of the TOPAS or national legislative requirements, for optical, environmental and EMC testing by an accredited test house, should be accommodated within the plan.

3.3.6 The product system requirements should then be developed starting by partitioning the system into modules using recognised methodologies. The design may need to be developed iteratively in successively greater levels of detail until hardware production drawings and circuit diagrams are produced.

3.3.7 Standards for the production of software coding should be set within the company procedures defining best practice for all languages employed in the product software. The procedures should include measures to verify that the standards have been observed and that others can readily interpret the coding.

3.3.8 When the TOPAS specification or the purchaser’s specification requires that targets for availability, reliability and maintainability (ARM) are to be modelled or predicted prior to production, then a plan detailing methods and sources of data to be used for prediction and subsequent monitoring should be prepared.

3.3.9 The product’s hardware and software modules should be developed and verified through tests designed from a detailed knowledge of the product detailed requirements and directed towards locating errors. Verification tests should typically be carried out on modules when they are separate and at various stages of integration.

3.3.10 The product prototype should be tested in accordance with the validation plan to demonstrate the extent to which it meets the specification. Test procedures for the product development engineers should formulate production units for modules, sub-assemblies and integrated systems.

3.4 Legislation

3.4.1 It is important that designers are aware of their specific duties and obligations under current legislation and should ensure that they are familiar with (at least) the legislation pertaining to all the devolved nations of the UK.

At the time of writing, legislation applicable to the industry includes:
- The Road Traffic Regulations Act 1984;
- The Traffic Signs Regulations and General Directions 2016 and any subsequent amendments;
- Traffic Signs Regulations (Northern Ireland) 1997;
- The Equality Act 2010;
- The Health and Safety at Work etc. Act 1974 (1974 C37);
- The Health and Safety at Work Act (Northern Ireland) Order 1978;
- The Electricity at Work Regulations 1989 (SI 1989/635); and
- The Electricity at Work (Northern Ireland) Order 1991.
3.5 Legal Liability

3.5.1 Suppliers and Manufacturers should be aware of their liabilities for safety under current civil and criminal law. A summary of some of the legislation is provided in the following paragraphs.

3.5.2 Part 1 of The Consumer Protection Act (1987), which is the UK enactment of an EC directive on Product Liability, makes compensation payable as of right for injury resulting from the failure of a product to be safe, without having to prove negligence.

3.5.3 Under part 2 of the same Act, it is a criminal offence to supply any goods ordinarily intended for private use or consumption which do not comply with the safety requirement for reasonable safety having regard to all the circumstances. The reference to private use or consumption makes this section of the act of limited relevance to traffic control and information systems on public roads.

3.5.4 The Health and Safety at Work etc. Act (1974) places duties in criminal law on manufacturers and suppliers of articles for use in the workplace concerning the safety of the people who use them. It also places responsibilities on manufacturers and suppliers in respect of those people who have to maintain their equipment.

3.5.5 The Sale of Goods Act (1979) defines implied terms to a sale that include fitness for the purpose required by the purchaser when this has been expressed. Most equipment within the scope of this Guidance Note will also be subject to the terms of a contract under which they are supplied.

3.6 Statutory Approval

3.6.1 Since TSRGD 2016 came into force, traffic control equipment is no longer required to be Type Approved by the Secretary of State. A voluntary system of product registration is administered by TOPAS, to a set of procurement specifications maintained by them.

3.6.2 TOPAS operates a voluntary registration to help ensure standardisation and where appropriate, interoperability of equipment across manufacturers. Using TOPAS specifications avoids the needs for individual purchasing authorities to produce and maintain their own detailed technical specifications. Scheme designers and purchasing authorities are recommended to require TOPAS Registration, when specifying or purchasing any product covered by the TOPAS range of specifications. However, the use of TOPAS specification in the procurement process is not mandatory. The list of all current TOPAS specifications and all products Registered against these specifications is maintained on the TOPAS website: topasgroup.org.uk.

3.6.3 Products to be registered with TOPAS must be designed within a verified Quality Management System. The manufacturer must produce a Technical File, the content of which is proscribed by the individual TOPAS specifications. Compliance with the appropriate specifications must be assessed by an independent Technical Assessor using the contents of the Technical File. The procedure for obtaining TOPAS Registration is defined in the TOPAS document TOPAS 0600 – ‘TOPAS Registration Process’.

3.6.4 Some systems involve the development of new equipment for which there is no current TOPAS specification, or the use of TOPAS Registered equipment in non-standard configurations. In this situation, the manufacturing process is part of the system life cycle and the purchaser’s specification supplements any national legislative specification that may exist. The procedures recommended for manufacture are the same regardless of whether they are applied to equipment developed to a TOPAS specification or a purchaser’s system requirements specification. Where an individual purchaser’s specification may have national applicability, it may be submitted to TOPAS for consideration to be included in the overall TOPAS suite, becoming a useful tool for all.
3.7  European Directives and CE Marking

3.7.1  It is the supplier’s legal responsibility to ensure that all products comply with all relevant European directives. The decision as to which directives are applicable rests with the supplier, although compliance with certain directives is a requirement for TOPAS Registration. Relevant directives may include:
- Low Voltage Directive;
- EMC Directive;
- Radio Equipment Directive;
- Machinery Directive; and
- Safety Directive. (The scope of the Safety Directive is limited to the safety of system operators or maintainers.)

3.7.2  All new electrical equipment sold in Europe has to be CE marked to show that it complies with all the relevant directives. For some classes of equipment such as those which purposefully emit radio frequency energy the equipment may need to be certified by a separate approval body.

3.7.3  For other products that are fully compliant with the relevant specifications, the supplier can self-certify CE compliance. The supplier’s procedures should identify individuals responsible for ensuring that the design meets the relevant requirements and those authorised to sign a declaration of conformity. The procedures should specify the checks required and the evidence that should be prepared before the product can be certified.

3.7.4  When there is not full compliance with the specifications referred to by the directives, information about the product must be submitted to be certified by a competent body appointed by the relevant Approval Authority. It is a legal requirement that this information and other details associated with the certification are retained in a Technical File.

3.7.5  The supplier’s quality procedures should ensure that documentary evidence of conformity to the EC specifications is retained and can easily be located. The procedures should specify a reasonable period for which the information is to be held. Where TOPAS Registration has been sought, TOPAS may audit material prior to Registration.

3.8  Project Management

3.8.1  Manufacturers and suppliers should adopt recognised principles of good practice, both in the management of product development and subsequent replication of units, which should be enforced through a quality assurance system. Management procedures should cover both the commercial and engineering aspects of the project.
3.9.2 Before the start of a development project, it is necessary to define the project with reference to the project’s objectives, any purchaser requirements, type specifications and legislative requirements. A project plan should also be prepared and developed incorporating:

- A product development programme;
- A product development life cycle;
- A software development plan;
- Verification and validation plans;
- Review and assessment procedures; and
- Change control procedures.

3.9.3 Configuration management procedures should be instigated to ensure that for any item of documentation, software or hardware, its status (current/superseded, tested/untested, original/modified etc.) can be easily ascertained. The effectiveness of such procedures should be monitored.

3.9.4 The safety and reliability performance of production replicas of the development prototype should be controlled and validated through manufacturer’s Quality Assurance procedures.

4. **INSTALLATION, TESTING AND COMMISSIONING**

4.1 **General**

4.1.1 This Chapter covers the period of the scheme life cycle from after completion of detailed design to bringing the system into operation. Installation includes the implementation of both the civil and electrical engineering aspects of the scheme. Pre-commissioning functional and electrical tests of configured control equipment, signs, signals and cables are carried out separately and with the system fully assembled. Commissioning refers to the final process for bringing the system into operation, checking its functionality in traffic terms and handing it over into maintenance.

Chapter 6 of the Traffic Signs Manual (section 27), recommends good practice for the installation of permanent traffic signals and reference to this document is made throughout this section. Much of the advice given is equally applicable to the installation of all traffic control and information systems, as well as the more conventional signals within its scope. The document covers all aspects of installation work.
4.1.3 Organisations involved in the installation of equipment and cabling for traffic control systems should have an accredited registration for Quality Assurance to ISO9000 with specific reference to the type of work involved.

4.1.4 Staff employed in installation, testing and commissioning should be trained and competent for the tasks assigned to them and conversant with the relevant requirements of BS7671 Requirements for Electrical Installations (formerly the IEE Wiring Regulations) and the Electricity at Work Regulations 1989.

4.1.5 Those involved in the supervision of the work and the acceptance of the completed system need to be fully conversant with the functions specified for the equipment and the safety aspects both of the completed system and the installation and commissioning process.

4.1.6 Consideration should be given to the impact and benefits on the life cycle of the system of the appropriate Sector Scheme managed by the Sector Scheme Advisory Committee and promoted by the Highways England, Local Highway Authorities and Industry.

4.1.7 The Sector Schemes relate to the quality management system requirements for the installation and maintenance of electrical apparatus and associated structural supports, cabling for highway lighting and traffic signs and the installation and maintenance of traffic control equipment and associated apparatus. It sets out to identify a common interpretation of BS EN ISO 9001: 2000 for Organisations and Certification bodies engaged in the specific sectors of the national highway electrical works to promote safe, consistent and competent working.

4.1.8 As a measure of quality management and competency, it is recommended that, where appropriate Sector Scheme are in existence, then they should be specified in contracts. If specified in the contract, then the provisions of the appropriate sector scheme shall be implemented during installation, testing commissioning and maintenance.

4.2 Statutory Requirements

4.2.1 Major schemes may fall within the special requirements of the CDM regulations whose requirements are summarised in Chapter 2.

4.2.2 Before starting work, the principal contractor is required to produce method statements that describe how risks identified in the Health and Safety Plan are to be overcome.

4.2.3 Other regulations and advice documents that may be relevant are listed below. Legislation changes over time and designers should keep up to date with legislation affecting services.

- The Health and Safety at Work, etc. Act 1974;
- The Health and Safety at Work Order (Northern Ireland) 1978;
- Traffic Management Act 2004;
- Chapter 8 of the Traffic Signs Manual;
- Electricity at Work Regulations 1989;
- Electricity at Work Regulations (NI) 1991;
- The Road Traffic Regulation Act 1984;
- The Road Traffic Regulations (NI) Order 1997;
- The Highways Act 1980;
- The Road (NI) Order 1993;
- The Road Traffic (NI) Order 1993;
- New Roads and Street Works Act 1991;
- Safety at Street Works and Road Works: A Code of Practice (often called ‘red book’);
4.2.4 The installation of the traffic control system includes both civil engineering and electrical aspects of the system, and will involve different specialists working on site possibly for different contractors or subcontractors or as part of a team undertaking a range of disciplines associated with:
- ducting and road construction;
- traffic control equipment and cabling;
- road markings;
- street lighting;
- signs;
- telecommunication circuits; and
- electricity supplies.

4.2.5 Regardless of the contractual arrangements under which these specialists are engaged, this work needs careful planning and co-ordination.

4.2.6 In particular, the traffic management measures that ensure safe conditions for road users during the installation process need to be carefully monitored. The cutting of detector loops which is a relatively quick operation but which requires the closing of whole traffic lanes is an aspect of installation where traffic management is important but prone to be omitted if not properly supervised. Authorities may consider specifying the employment of a specialist traffic management contractor.

4.2.7 Installation supervisors will need to check that equipment is installed in the correct position and correctly aligned. Cabinet bases and signal poles should be installed as in section 27 of the Traffic Signs Manual.

4.2.8 Planning the installation of schemes that involve the modification of existing traffic control systems should take into account any requirements to maintain safe and adequate control facilities until the modified system is commissioned. Particular attention should be paid to the requirements of pedestrians and vulnerable road users.

4.2.9 For new systems, it is important to ensure that new signs or signals, including road markings, do not give confusing indications to road users before the system is commissioned. To avoid problems, it is advisable to schedule elements such as road marking to be done shortly before the commissioning.

4.2.10 The use of ‘new traffic signals ahead’ signs to diagram 7014 of TSRGD 2016 should be carefully considered to avoid creating unnecessary clutter. Where used, their installation should be temporary, for example by mounting them on A frames. Under TSRGD 2016 they must be removed after a maximum of 3 months, but they may only need to be in place for a few weeks. A clear plan for their removal should be in place as part of the installation process to avoid the signs remaining in place for longer than necessary.

4.2.11 Particular attention is drawn to the safety implications of installation work, the necessity of maintaining signing and barriers to the requirements of the ‘red book’ Chapter 8 of the Traffic Signs Manual to protect the works, and the need to plan the installation works to minimise disruption and danger to road users.
4.3 Testing

4.3.1 Typically products are tested during development and manufacture to ensure that they comply with the relevant national equipment specifications and if the equipment is TOPAS Registered, the relevant TOPAS specifications. There is consequently no need to repeat such tests for individual systems. The role of testing in the life cycle of a scheme is therefore to verify that the scheme-specific requirements have been implemented correctly as follows:

- to verify that separate items of equipment have been configured in accordance with the configuration specification;
- to verify the performance of the integrated system, including cabling, interfaces and communication circuits;
- to test electrical cabling and earthing arrangements in accordance with the relevant regulations;
- to verify that the equipment and cabling have been installed correctly through inspection; and
- to carry out specific tests of functions related to safety.

4.3.2 For items which are not TOPAS Registered, the manufacturer’s tests may not have been subject to the independent verification and it may be necessary for purchasers to consider extending the scope of their testing.

4.3.3 Tests may be carried out variously by the suppliers, the installation contractors, designers or those responsible for supervision. It is usually a requirement of supply and installation contracts that specified tests are witnessed on behalf of the purchaser during a factory acceptance test (FAT) or site acceptance test (SAT). The extent and scope of such tests will depend on the size and complexity of the traffic control or information system. For simple systems, the FAT may be omitted.

Test to Verify Configuration

4.3.5 For microprocessor-based control equipment, customisation to the specific requirements of the scheme involves the input of configuration data. Testing is essentially a check that this data and controller specification are consistent providing the required method of control that is safe and compliant with all relevant DfT and guidance. It is recommended that tests are conducted to a previously prepared schedule, but time should be made available for unstructured testing. Particular attention during tests should be paid to input data consisting of logic or special software.

Tests of Completed System

4.3.6 When tests of the integrated system are performed prior to installation, they will normally involve the control system connected to some, but not necessarily all, associated equipment. For complex systems, some items may be simulated by hardware or software representations of their interface with the control system, provided the representation can be shown to be accurate.

4.3.7 A complete integrated test is required for all systems after equipment has been installed, prior to commissioning i.e. Site Acceptance Test (SAT).

Electrical Cable and Earthing Tests

4.3.8 Section 27 of Chapter 6 of the Traffic Signs Manual lists the tests to be performed and certified on the mains supply, cables and earthing. These tests are requirements of BS7671 and the Specification for Highway Works clause 1217.
Inspection to Verify Correct Installation

4.3.9 An important part of testing is a visual inspection to ensure that the equipment is constructed and installed correctly. The visual inspection should include checking that cabinet door seals and locks are acceptable; cable properly labelled, terminated and bonded; mains supply fuses and cut-outs correctly installed; telecommunications equipment properly terminated, and necessary warning labels attached.

Functional Safety Checks

4.3.10 Test and checking procedures should ensure that all safety critical functions are verified. When designing tests to be undertaken at the installation and commissioning stage of the system life cycle, due allowance should be made for the risks inherent in the tests themselves. Product tests previously undertaken by manufacturers and suppliers may have already validated the safety critical functions more effectively than can be achieved on-site. For example, conflict monitor tests on pelican controllers may be unnecessary at installation if the supplier carries out adequate tests during production.

Documentation Requirements

4.3.11 For simple systems, the specification may be used as a checklist of items to be tested. For more complex systems and systems using innovative techniques, test schedules for both the Factory and Site Acceptance Tests should be drawn up. It is common for the Supplier's contract to include the requirements to draw up test schedules for the purchaser's approval. Whether the tests are based on formal test schedules or not, the details of the tests, date, place, time representatives present, functions tested, equipment used and the results obtained should be fully recorded and the records kept in the Design File.

4.3.12 The Contractor who is responsible for the tests should provide an electrical installation completion certificate in accordance with BS 7671. (Note: A competent person should sign these certificates on behalf of the Contractor.) There is also a requirement for the electrical installation design authority to sign confirming their responsibility for the electrical design of the system.

Safety and Signing

4.3.13 Precautions should be taken during site testing to assure safety for road users. Where testing involves obstruction of the carriageway or footway, it is recommended that Chapter 8 of the Traffic Signs Manual or the Red Book be followed. Any potentially misleading signs or indications should be covered. Where this is not practicable, such as when large Variable Message Signs are being tested, steps should be taken to minimise problems (in this example by using test legends which do not mislead and by the use of advance “signs under test” sign boards).

4.3.14 Precautions should also be taken during tests to protect employees from the risk of electrocution and other hazards. Where tests involve an element of risk, a risk analysis should be carried out to identify test methods to minimise risk or to determine whether the test should be carried out.

4.4 Publicity

4.4.1 Where the scheme in operation will require a different response from road users, or affect route choice, it may be necessary to mount a publicity exercise before and after commissioning. For example, temporary signs can be uncovered at commissioning, and used to warn of changes and then left in place for a maximum of 3 months.
4.4.2 News coverage through press releases, articles and contacts with radio and television can be useful to warn the public of important changes to the network or the commissioning of major traffic control or information systems.

4.4.3 Official opening ceremonies, if called for, should be carefully planned in conjunction with the police, and occur only when the system is commissioned ready to be switched on. If a benefit of the system is to be an improvement in safety, then it is inadvisable to delay bringing it into operation without good reason.

4.5 Road Safety Audit

4.5.1 After installation and before commissioning, a Stage 3 Road Safety Audit as described GG 119 should be carried out to ensure that all the safety implications of the physical and operational aspects of the system have been fully considered.

4.6 Commissioning

4.6.1 The commissioning of the assembled system follows confirmation that all tests and systems certification procedures have been completed.

4.6.2 Before commissioning takes place, the following formal documentation should be checked:

- evidence of equipment approval status;
- factory test completion documentation;
- site test completion documentation; and
- maintenance documentation required on site.

4.6.3 It is unlikely that final as-built documentation will be available at the time of commissioning but, as a minimum, accurate hand-written information should be made available for maintenance. Final documentation should be supplied as soon as possible after commissioning. It is recommended that contracts for installation should stipulate a reasonable time limit for the supply of such documentation.

4.6.4 Verification that all legal procedures and public consultation will be necessary before the scheme is brought into service.

It will be necessary to validate the proposals for the successful future operation and maintenance of the system throughout its life cycle by suitably trained and qualified personnel in accordance with fully documented procedures and the technical information, which will be made available to them.

4.6.5 Proper proposals for future modifications to, and the possible decommissioning of the scheme in a safe and efficient manner should be confirmed.

4.6.6 A final check that all certificates, specifications and drawings are included in the ‘Design File’ should be made. The Design File should, as a minimum, include the following:

- final Design Drawings;
- design checklists;
- System Requirements Specification;
- Stage 1, 2 and 3 Road Safety Audit reports;
- details of operational procedures;
- details of maintenance procedures;
- details of modification and decommissioning procedures;
- details of factory and site acceptance tests;
- System Certification documentation; and
- Details of any departure to relevant DfT/HE specifications standards or guidance.

4.6.7 The commissioning process brings new scheme into operation by:
- uncovering signals and signs and switching them on;
- uncovering temporary warning signs;
- completing road markings that have to be omitted until commissioning;
- checking and acceptance of the system by the maintenance body; and
- mobilising publicity.

4.6.8 Commissioning also incorporates testing and monitoring of the system under live conditions to confirm the safe operation of the system.

4.6.9 At this stage, the Highways Authority or a representative gives formal confirmation that the system has been completed in accordance with the contract, and ownership of the system passes from the Contractor to the Highways Authority on signing of a hand-over certificate.

4.7 Monitoring

4.7.1 There should be close monitoring of the operation immediately following commissioning.

4.7.2 A scheme that is properly designed and passed through a Road Safety Audit should not present an additional risk to road users unfamiliar to the area. On the other hand, there is potential for problems for users familiar with the previous situation that they do not respond to the changes in layout or signing. Depending on the level of this risk, it may be necessary to monitor the system’s operation, possibly with continuing police presence, for the hours or days following commissioning.

5. OPERATION AND MAINTENANCE

5.1.1 Introduction

5.1.1 Once a traffic control or information system has been commissioned it is important to ensure that it is operated and maintained in a way that the safety or fitness for purpose introduced during the design and installation process is not compromised during the later stages of the life cycle. Systems are normally operated and maintained by the Highway Authority responsible for the road network on which they are situated, but tasks are often distributed amongst several bodies including contractors and departments employed directly by the Highway Authority.

5.1.2 Operation is taken to include:
- the monitoring and adjustment of systems and their environment;
- the monitoring of the effectiveness of maintenance; and
- tasks associated with staffed traffic control centres.

5.1.3 Operation is usually undertaken by staff directly employed by the Highway Authority.

5.1.4 Maintenance consists of the tasks required to ensure that the equipment and cabling continues to operate in accordance with the specifications, and includes routine inspections, replacement of consumable items, fault response and repair. Normally, specialist maintenance contractors are engaged to carry out this work.
5.1.5 A newly installed system is normally subject to the standards and procedures for operation and maintenance that are applied generally to traffic control and information systems by the responsible authority. It is therefore the responsibility of the designer to design a system that will remain safe under the existing arrangements operated by others. Where a new system involves system maintainers or operators in new areas of expertise, any training requirements should be identified at the design stage.

5.1.6 This Chapter recommends good practice to be adopted in the setting up and management of procedures for operation and maintenance.

5.1.7 It is not the aim of this Guidance Note to set absolute standards for operation and maintenance.

5.2 Maintenance Organisations and Personnel

5.2.1 Maintenance contractors should be registered under ISO 9002 with a UKAS accredited body for the maintenance of traffic control and communication systems.

5.2.2 It is important that all personnel involved with the maintenance of traffic control and information systems are suitably qualified and adequately trained on the equipment to be maintained. They should also be familiar with the contents of The Construction (Design and Management) Regulations and The Electricity at Work Regulations.

5.2.3 As a measure of quality management and competency, it is recommended that all appropriate Sector Schemes are specified in contracts.

5.2.4 Operators may be required to undertake:
- traffic monitoring and adjustment of the traffic control system at the control centre;
- interpretation of fault data from equipment monitoring systems;
- validation of control systems on site;
- routine management of faults and maintenance contractors; and
- the on-site inspection and adjustment of systems.

5.2.5 To carry out these roles effectively, operators need appropriate knowledge of the systems they operate, and familiarity with the arrangements for maintenance and the terms of maintenance contracts.

5.2.6 Some systems allow for access to specified functions to be restricted through passwords to personnel with appropriate expertise or authority.

5.2.7 Responsibility for identifying and fulfilling personal training needs of maintenance and operator personnel rests both with the individual concerned and the organisation. Particular care is required to ensure that expertise keeps pace with the changing state of the art in the field of traffic control and information equipment.

5.2.8 Formal training for the new and existing item of equipment or systems should form part of the routine of the organisations involved. It is therefore recommended that such organisations should maintain and monitor a training plan for its employees containing targets, time budgets and programmes. Where maintenance or operation is undertaken under contract, the formulation of an agreed plan should be a requirement of the specification and enforced through appropriate penalties upon failure to comply.
5.3 **Control Centres**

5.3.1 When formulating arrangements for the operation and maintenance of traffic control and information systems, consideration should be given to adopting a single fault control centre for reporting, collating and the clearance of faults. Such a centre will allow operators to set priorities when conflicts occur. Satellite control centres may be added, each with their own link with fault monitoring and management equipment. It is common practice for fault control and the operation of urban traffic control systems to take place within the same control centre.

5.3.2 Computer-based fault management systems assist the management of maintenance by providing a database for recording and tracking the progress of current faults and monitoring routine inspections. These systems also maintain a fault history for each installation, allowing analysis of the fault rates of equipment types. Fault management systems can be linked to remote monitoring and urban traffic control systems for automatic logging of faults.

5.3.3 The hours of staffing and number of staff required in control centres will depend on the size and scope of the control and monitoring systems, anticipated requirements for manual intervention, and the presence of CCTV systems. When assessing staffing needs it may be worthwhile consulting the system designers, manufacturers and other authorities with similar requirements.

5.3.4 When considering the most effective way of organising operator duties, managers need to consider the health and safety problems associated with extended viewing of monitors.

5.3.5 Authorities responsible for urban traffic control systems should enforce procedures governing the actions taken by operators to maintain the safe operation of traffic signals. Action plans for specific incidents may need to be developed in conjunction with key stakeholders within the specific area.

5.3.6 Displays showing data derived from the monitoring of equipment or traffic can provide a useful system overview. Displays based on large computer monitors or projection systems are more flexible and easier to update.

5.4 **Remote Monitoring**

5.4.1 Traffic control and information systems can have some of their operational functions monitored remotely by either Remote Monitoring or Urban Traffic Control Systems. Such monitoring is recommended for roads with a speed limit of 40 mph or greater, or where the 85th percentile speed is in excess of 35mph.

5.4.2 The design and maintenance of any automated fault monitoring system must ensure that the system has a high availability record.

5.5 **Inspections**

5.5.1 Their purpose is to detect operational failures and to identify physical or operational deterioration. The items listed for inspection or test cover:

- equipment operation;
- 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 signs or signals.
5.5.2 It is usual practice for some if not all the items listed for inspection to be assigned to a maintenance contractor as periodic inspections. Authorities may choose to assign certain items for inspection to different contractors or their own personnel.

5.5.3 Complete inspections are generally required at least every twelve months, the maintenance authority should specify the precise intervals for inspections in procedures and maintenance specifications. It is recommended that some leeway is granted to the contractor. To minimise the risk of exposing equipment to the elements, annual inspections requiring the opening of equipment cabinets should, if possible, be scheduled outside the winter months.

5.5.4 Highway Authorities should take steps to ensure that all inspections are carried out effectively, possible by supplementing the maintenance contractor's inspections with a programme of independent checks. The authority may also need to periodically review the overall operation of an installation to establish that the design and configuration are still appropriate to the circumstances of the site.

5.5.5 It is recommended that all inspections should be recorded during the progress of the inspection on forms comprising a simple checklist and identifying the date, time and individual involved in the inspection.

5.5.6 Inspection procedures should be periodically reviewed to ensure that tests and inspection documentation evolves with changing equipment and technology.

5.6 Monitoring

5.6.1 A pro-active approach to the monitoring of the overall effectiveness of traffic control and information systems is recommended, leading to measures to maintain or improve performance. Feedback resulting from visual monitoring of conditions on site by staff members and the Police should be encouraged. Such feedback can be particularly useful for information obtained outside office hours.

5.6.2 The quality of feedback could be maximised by issuing a guide to reporting faults on roadside equipment to official bodies such as the Police.

5.6.3 Information from the general public can be encouraged through publicity, notices on street furniture and the provision of a free phone number to accept information.

5.6.4 More formal monitoring is possible through studies of:
- system logs;
- fault records;
- accident records; and
- big data eg. journey time monitoring.

5.6.5 Close liaison between accident monitoring specialists, system operators and designers is recommended. Sharing information between parties may allow the cause of an accident tend to be identified. Sites displaying an accident history may warrant special attention on the part of operators and design staff.

5.7 Routine and Non-routine Maintenance

5.7.1 Their purpose is to specify procedures for routine maintenance covering:
- inspection and replacement of electro-mechanical parts;
- bulk lamp changing; and
- lens cleaning.
5.7.2 The requirements for non-routine maintenance requires that cover should be available to make safe all defects that present a safety hazard. The response and repair times are left to the maintenance authority that should define them through their maintenance contract specifications and procedures.

5.7.3 The control of system data by operators should be the subject of quality assurance procedures to ensure that a recent data back-up is available at all times ready for re-loading.

5.8 Validation

5.8.1 It is recommended that the traffic signal junctions should be validated every five years or after significant changes to the use or alteration to the highway network.
5.9 Maintenance Contracts

5.9.1 Tenderers for maintenance contracts should be carefully selected to ensure that only competent organisations are invited to tender. Tenderers should be consulted to establish the time required between award and commencement of contract for mobilisation.

5.9.2 The contract documents should provide a complete description of conditions and working arrangements required by the authority. They should define the contract period, which could be fixed or open.

5.9.3 Maintenance contracts for periods exceeding twelve months will usually contain a price fluctuation clause.

5.9.4 The documents should specify:
- location and inventory of equipment to be maintained;
- fault response periods;
- inspection procedures and periods for inspection;
- penalties for non-performance;
- documentation requirements; and
- fault reporting procedures.

5.9.5 There should be, within the contract, conditions to ensure that if fault response, inspections and routine maintenance tasks are not carried out within the specified periods, then escalating penalties will be applied. These should be index-linked to the maintenance costs of the overall contract.

5.9.6 Allowance should be made within the contract document for the changeover between maintenance contractors, which may be required either when the contract has run its term or circumstances warrant the premature termination of a contract. It is important that the period of notice to terminate the contract provides a sufficient period to appoint a new contractor and for mobilisation of the new contractor’s resources, whilst being sufficiently short to effectively curtail a contract where the contractor’s performance has fallen below an acceptable level.

5.9.7 Items requiring replacement during the course of maintenance should be on the principle of like with like, i.e. identical, unless agreed otherwise with the client and be subject to full Departmental approval. When the replacement is not identical, care should be exercised to ensure that the original design intentions are not compromised.

5.9.8 It is recommended that the maintenance contractor is held responsible within the contract for handling and dispatching/receiving all warranty items for repair.

5.9.9 The contract should make provision for regular formal meetings with the contractor’s managers to discuss problems as they arise and review performance. It is recommended that such meetings should take place at intervals no greater than twelve months.

5.10 Documentation

5.10.1 Those responsible for the implementation of maintenance should have access to full documentation and details of each site/system to be maintained. Detail contained in the Design File, assembled through the life of the traffic control equipment, will be the source of this information.
5.10.2 Records should be held in the offices of the supervising engineer and the maintenance contractor’s depots providing a complete historical record over five years and covering:
- site layout;
- equipment hardware and software;
- configuration data;
- operational settings; and
- fault history.

5.10.3 Documentation that should be available on the site includes:
- equipment and cabling layout;
- current control equipment settings;
- site-specific safety instructions; and
- log book detailing maintenance history.

5.10.4 The owner of the equipment is normally responsible for providing the documentation (including log books) for on-site and office use.

5.10.5 Comprehensive records of all faults should be maintained and regularly reviewed to identify repeat faults or abnormal fault frequencies.

5.10.6 There is a legal requirement that records from sealed contracts be kept for a twelve years minimum period and unsealed contracts for a minimum of six years.

5.10.7 The documentation available to operators of traffic control or monitoring systems should include comprehensive manuals covering:
- system operation under normal operating conditions;
- facilities for detecting and diagnosing faults; and
- operator facilities for changing the system configuration.

5.11 Safety

5.11.1 All reasonable steps should be taken to ensure the safety of maintenance personnel and the public during maintenance; the requirements for road safety and electrical safety should be integrated with the maintenance authority's specifications and procedures. These procedures should ensure that site operatives are conversant with good practice necessary to safeguard safety. Advice on creating a safe working environment is given in Chapter 8 of the Traffic Signs Manual and in the ‘Red Book’. Relevant legislation includes:
- CDM regulations;
- Health and Safety at Work Act; and
- Electricity at Work Regulations.

5.12 Test Equipment

5.12.1 The requirements for the staff of the operating organisation to have access to test equipment should be considered during the design phase. The necessary test equipment, documentation and training should be purchased before the system is brought into operation.

5.12.2 The system maintenance procedures or contracts should cover test equipment including calibration and battery re-charging or replacement.
6. DECOMMISSIONING

6.1 Considerations

6.1.1 When systems are decommissioned, the following need to be considered:

6.1.1.1 Any relevant waste disposal legislation shall be complied with where appropriate.

6.1.1.2 The health and safety of the travelling public, emergency services personnel, maintenance operatives and the general public shall be protected at all times.

6.1.1.3 Negative environmental impact should be minimised wherever possible. This includes such considerations as the prevention of ground water or air contamination, the minimisation of greenhouse gas release into the atmosphere etc.

6.1.1.4 Care shall be taken to identify any items that contain hazardous substances that are covered by specific handling or disposal legislation. Any items containing such substances shall be handled and/or disposed of in full compliance with the relevant legislation.

6.1.1.5 Item re-use should be considered, providing the safety and functional requirements can be maintained. The financial and environmental costs of item recovery, including removal, transportation, storage, refurbishing and re-installation should be included in this consideration.

6.1.1.6 Where suitable recycling processes are available then these should be considered in preference to unprocessed disposal.

6.1.1.7 The disposal of items via incineration or land-fill should be regarded as a last resort and undertaken in a safe, legal and responsible manner. This may necessitate the use of reputable waste management organisations.

6.1.1.8 Decommissioning operations shall leave any site in a safe, stable and tidy condition. Care should be taken to remove any hazards to humans or the environment and to remove any items that could be used illegally.
7. **REFERENCE DOCUMENTS**

### 7.1 Legislation

- The Construction (Design and Management) Regulations 2015
- The Electricity at Work Regulations 1989
- The Electricity at Work (Northern Ireland) Order 1991
- The Health and Safety at Work etc. Act 1974
- The Health and Safety at Work (Northern Ireland) Order 1978
- The Equality Act 2010
- The Highways Act 1980
- The Management of Health and Safety at Work Regulations 1999 (as amended)
- The Management of Health and Safety at Work Regulations (Northern Ireland) 2000 (as amended)
- The New Roads and Street Works Act 1991
- The Roads (Scotland) Act 1984
- The Roads (Northern Ireland) Order 1993
- The Road Traffic Regulation Act 1984
- The Road Traffic Regulation Order (Northern Ireland) 1997
- The Sale of Goods Act 1979 (as amended)
- The Street Works (Northern Ireland) Order 1995
- The Traffic Signs Regulations and General Directions 2016 (as amended)
- The Traffic Signs Regulations (Northern Ireland) 1997

### 7.2 Other Notes, Standards and Specifications

- BS 7671 Requirements for Electrical Installations (IEE Wiring Regulations, Eighteenth Edition)
- BS 6100 Glossary of building and civil engineering terms, subsection 2.4.1 - Highway Engineering: 1992
- HSE Avoiding Danger from Underground Services
- Institution of Engineering and Technology; Safety Related Systems
- BS EN 61508 Functional Safety of Electrical/Electronic/Programmable Electronic safety-related systems
- Specification for Highway Works
- TOPAS 0600 – Self Certification Procedures for Registration Process of Traffic Control Equipment
- TOPAS 2500 – Specification for Traffic Signal Controller
- TOPAS 2507 – Performance Specification for Kerbside Detection Systems for use with Nearside Signals and Demand Units
- TOPAS 2506 – Performance Specification for Above Ground On-Crossing Pedestrian Detection Systems
- TOPAS 2512 – Performance Specification for Below Ground Vehicle Detection Equipment
- MCH 1969 – Traffic Control System Design for All Purpose Roads (Compendium of Examples)
The following documents are contained in the Design Manual for Road and Bridges:

- TA 101 – Traffic signalling systems
- TD 101 – Traffic signalling systems
- TM 101 – Traffic signalling systems (maintenance and operation)
- TS 101 – Traffic signalling systems (inspection and assessment)
- TD 33 – Use of Variable Message Signs on All-Purpose and Motorway Trunk Roads (DMRB 8.2.2)
- CD 123 – Geometric design of at-grade priority and signal-controlled junctions (DMRB 6.1.6)
- CD 109 – Highway link design (DMRB 6.1.1)
- TA 60 – The use of Variable Message Signs on All-Purpose/Motorway Trunk Roads (DMRB 8.2.2)
- HD 46 – Quality Management Systems for Highway Design (DMRB 5.2.1)
- GG 119 – Road Safety Audit (DMRB 5.2.2)

Traffic Advisory Leaflets

- TAL3/97 – The ‘MOVA’ Signal Control System
- TAL4/97 – Rising Bollards
- TAL7/99 – The ‘SCOOT’ Urban Traffic Control System
- TAL8/99 – Urban Safety Management using SafeNET
- TAL16/99 – The Use of Above Ground Vehicle Detectors
- TAL7/00 – SCOOT Gating
- TAL8/00 – Bus Priority in SCOOT
- TAL9/00 – SCOOT Estimates of Emissions from Vehicles
- TAL6/01 – Bus Priority

7.3 Addresses

Department for Transport
Traffic and Technology Division
Great Minster House
76 Marsham Street
London
SW1P 4DR
Traffic.signs@dft.gov.uk

7.4 Document Sources

7.4.1 Department for Transport


TOPAS

[www.topasgroup.org.uk](http://www.topasgroup.org.uk)
APPENDIX A - GLOSSARY OF STANDARD TERMS

A1 Introduction

A1.1 This Glossary brings together definitions of terms used in traffic control and associated areas of traffic engineering. Some of these terms are included in BS 6100: Glossary of Building and Civil Engineering Terms subsection 2.4.1: 1992 Highway Engineering. Some of the same terms are defined in other published standards and advice notes, often with slightly different definitions. This Glossary aims to provide definitions which are self-consistent and accurately reflect current usage.

A2 European Terms

B2.1 With the harmonisation of standards and specifications within Europe, new documents are being produced which exist in three languages, English, French and German. There is no agreed standard of equivalents between terms used in the three languages but some established UK terminology has been changed in these documents to bring them closer to the term or concept used in other languages.

Particular differences in the English versions of European Standards and Specifications include:

i. the use of ‘yellow’ in place of ‘amber’ as this correlates with colour definitions in other international specifications;
ii. the use of ‘signal group’ in place of ‘phase’ to avoid the confusion set out above;
iii. the use of ‘optical unit’ in place of ‘aspect’ for an element of the signal head;
iv. the use of ‘background screen’ in place of ‘backing board’.

In this document, standard UK terms are used and defined to accord with other specifications, standards and regulations currently in use.

A3 Phases and Stages

A3.1 The terms ‘phase’ and ‘stage’ often give rise to confusion and misuse. The concept of ‘stage’ is of a particular pattern of movements permitted by the traffic signals. The signal cycle is made up of a series of stages.

A3.2 Confusion arises because the term ‘phase’ is used to express the concept of ‘stage’ in some other English speaking countries such as Australia and the USA. Furthermore, confusion arises from the fact that with simple signals the two terms can often be interchanged without penalty.

A3.3 With more complex control, where the number of stages does not equal the number of phases, the distinction between stage and phase is important. Control may be ‘staged based’ or ‘phase based’.

A3.4 In each case the controller selects a stage. Under stage control, a specific stage is demanded. Under phase control, a phase is demanded and the controller selects the most appropriate stage from the alternatives which cause that phase to run.

A3.5 Within the traffic signal controller, the term ‘phase’ is extended to cover the electronic equipment, which controls the ‘sequence of conditions’ which make up the phase.

A3.6 For several reasons, particularly the need for red lamp monitoring of individual approaches, it is now conventional that opposing traffic streams which always run together in the signal cycle are controlled separately by the controller. Although in traffic engineering terms the opposing streams share the same phase, in the controller they are treated as separate phases.
A4 Definitions

A4.1 Standard terms used for traffic control are shown below together with their definitions:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>acceptance</td>
<td>In this document ‘acceptance’ relates to the agreement that the System complies with the requirements of this specification and of this Guidance Note. It should not be confused with ‘Taking Over’ which implies acceptance for contractual or payment purposes.</td>
</tr>
<tr>
<td>all-purpose road</td>
<td>Road for the use of all classes of traffic.</td>
</tr>
<tr>
<td>arterial reversion</td>
<td>Reversion to a selected stage in the absence of demands.</td>
</tr>
<tr>
<td>aspect (signal aspect)</td>
<td>A single optical unit, which, when illuminated, displays a single colour or symbol.</td>
</tr>
<tr>
<td>audible signal</td>
<td>A device producing a sound to indicate right of way to pedestrians, cyclists or equestrians.</td>
</tr>
<tr>
<td>availability</td>
<td>The availability of a system is the amount of time the system is functioning and available for operational use expressed as a percentage of the total time.</td>
</tr>
<tr>
<td>backing board</td>
<td>A board mounted behind or around a signal head to increase contrast and improve visibility (referred to as ‘background screen’ in BS EN specifications).</td>
</tr>
<tr>
<td>blackout</td>
<td>A period in a crossing sequence when neither the red nor the green man symbol is illuminated.</td>
</tr>
<tr>
<td>box sign</td>
<td>A regulatory sign (such as a prohibited movement sign) designed to be mounted alongside a signal head within an aspect housing.</td>
</tr>
<tr>
<td>bus priority</td>
<td>A strategy for reducing delay to buses.</td>
</tr>
<tr>
<td>cabinet</td>
<td>A box installed on-street to contain a controller or other equipment.</td>
</tr>
<tr>
<td>cabling</td>
<td>The wiring installed on-street to connect a traffic signal controller with the signal aspects and other equipment.</td>
</tr>
<tr>
<td>carriageway</td>
<td>A way constituting or comprised in a highway, being a way (other than a cycle track) over which the public have a right of way for the passage of vehicles</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television.</td>
</tr>
<tr>
<td>CDM Regulations</td>
<td>The Construction (Design and Management) Regulations 2015</td>
</tr>
<tr>
<td>central reserve</td>
<td>A central island separating the two halves of a dual carriageway.</td>
</tr>
<tr>
<td>classified count</td>
<td>A count where flows for different classes of vehicle are recorded separately.</td>
</tr>
<tr>
<td>CLF (Cableless Linking Facility)</td>
<td>A system for co-ordinating the timings of signal equipment at adjacent signalled junctions by the use of clocks synchronised to mains supply frequency.</td>
</tr>
<tr>
<td>COBA</td>
<td>Department's computer program for Cost Benefit Analysis.</td>
</tr>
<tr>
<td>conflict</td>
<td>At a junction, movements which cannot proceed at the same time safely are in conflict.</td>
</tr>
<tr>
<td>conflicting phases</td>
<td>Phases which control movements which are in conflict (see ‘opposing phases’).</td>
</tr>
<tr>
<td>controller</td>
<td>Apparatus that controls and switches traffic signals.</td>
</tr>
<tr>
<td>cycle time</td>
<td>The time taken to complete one cycle.</td>
</tr>
<tr>
<td>demand dependent</td>
<td>A stage in a signal cycle which is only selected when a demand for it is registered.</td>
</tr>
<tr>
<td>Department</td>
<td>The Department for Transport (DfT).</td>
</tr>
<tr>
<td>Design File</td>
<td>A file of basic information and certification for a scheme, produced during the design process to provide a record of the development of the scheme, the decisions made and the safety considerations.</td>
</tr>
<tr>
<td>Design Organisation</td>
<td>The organisation commissioned to undertake the various phases of scheme preparation and supervision of construction. During the course of scheme preparation and construction, the identity of the design organisation may change.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DfT</td>
<td>Department for Transport.</td>
</tr>
<tr>
<td>DMRB</td>
<td>Design Manual for Roads and Bridges.</td>
</tr>
<tr>
<td>duplicate primary signal</td>
<td>A second primary signal mounted on the right hand side of the carriageway.</td>
</tr>
<tr>
<td>early cut-off</td>
<td>A condition in which one or more traffic streams, that were running during the preceding stage, are stopped whilst one or more other traffic streams are allowed to continue moving.</td>
</tr>
<tr>
<td>early start</td>
<td>An alternative term for 'late start'.</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission.</td>
</tr>
<tr>
<td>effective green</td>
<td>For a given actual green period, the length of green time, which when multiplied by the saturation flow, represents the maximum amount of traffic which will be able to pass in that green period.</td>
</tr>
<tr>
<td>extension</td>
<td>Continuation of the green signal that results from a request made by a vehicle or pedestrian that has right of way. (May also be applied to a red signal.)</td>
</tr>
<tr>
<td>FAT</td>
<td>Factory Acceptance Test.</td>
</tr>
<tr>
<td>Fault Management System</td>
<td>A documentation system (usually computer software) for the recording and analysis of the faults reported in a system and the actions taken in response to them.</td>
</tr>
<tr>
<td>filter arrow</td>
<td>A green arrow which appears with a red (or amber or red/amber) signal to give right of way to a specific movement.</td>
</tr>
<tr>
<td>fixed time</td>
<td>Traffic signal control where the duration of the red and green signals and the length of the cycle is fixed.</td>
</tr>
<tr>
<td>functional specification</td>
<td>A type of system specification where the functions of the system are specified rather than the method of achieving those functions.</td>
</tr>
<tr>
<td>gantry</td>
<td>A frame in the shape of a portal used to mount signs or signals.</td>
</tr>
<tr>
<td>gap</td>
<td>The difference in time or space between the back of a vehicle and the front of the following vehicle.</td>
</tr>
<tr>
<td>gating</td>
<td>The use of traffic signals to restrict the flow of traffic at a point with the aim of improving the efficiency of traffic flow at a downstream point.</td>
</tr>
<tr>
<td>green wave</td>
<td>A control strategy for a linear system of traffic signals which attempts to synchronise the start of green at a junction with the arrival of a platoon from the preceding junction.</td>
</tr>
<tr>
<td>Hazard List</td>
<td>As part of a Risk Analysis, a list of features of a scheme which could have an implication for health and safety.</td>
</tr>
<tr>
<td>headway</td>
<td>The difference in time or space between the front of a vehicle and the front of the following vehicle.</td>
</tr>
<tr>
<td>Health and Safety Plan</td>
<td>A document (as required by the CDM Regulations) which contains details of the scheme, an assessment of risks to health and safety to persons involved in, or affected by, the construction of the scheme, and arrangements for ensuring, as far as is reasonably practicable, the health and safety of such persons.</td>
</tr>
<tr>
<td>high speed road</td>
<td>A road where the 85th percentile approach speeds at a junction are 35mph (56km/h) or above.</td>
</tr>
<tr>
<td>highway</td>
<td>Way over which the public has right to pass. The right may be restricted to specific classes of vehicle.</td>
</tr>
<tr>
<td>IET</td>
<td>Institution of Engineering and Technology.</td>
</tr>
<tr>
<td>indicative green arrow</td>
<td>A green arrow indicating that vehicles may proceed in the direction shown which is also covered by a full green signal. Opposing traffic has been stopped.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Intergreen (period)</td>
<td>Period between the end of the green signal giving right of way for one phase, and the beginning of the green signal giving right of way for the next phase.</td>
</tr>
<tr>
<td>intergreen matrix</td>
<td>On a vehicle actuated controller, a matrix of intergreen timings between pairs of phases.</td>
</tr>
<tr>
<td>interstage period</td>
<td>The period between the end of one stage and the start of the next stage.</td>
</tr>
<tr>
<td>invitation period</td>
<td>The period of display of a steady green man to pedestrians at traffic signals.</td>
</tr>
<tr>
<td>island</td>
<td>Raised area on the highway, usually at a road junction, shaped and located so as to direct traffic movement.</td>
</tr>
<tr>
<td>ISO 9001</td>
<td>One of the ISO 9000 series of international standards concerned with Quality Management and Quality Assurance with specific reference to the quality systems where a supplier's capability to design and supply a conforming product needs to be demonstrated.</td>
</tr>
<tr>
<td>isolated control</td>
<td>Control of a signalled junction where the timings are not related to neighbouring junctions.</td>
</tr>
<tr>
<td>lamp monitoring</td>
<td>A system of checking within a controller that lamps are operating.</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode.</td>
</tr>
<tr>
<td>Life Cycle Costing</td>
<td>The costing of a system, including the costs of operation, maintenance and decommissioning, as well as design and construction.</td>
</tr>
<tr>
<td>LINSIG</td>
<td>A computer program for the analysis of isolated traffic signals.</td>
</tr>
<tr>
<td>local control</td>
<td>A form of control at a signal installation which is not subject to influences from other junctions or area control systems.</td>
</tr>
<tr>
<td>lost time</td>
<td>The time during a cycle which cannot be used as effective green to one or more phases.</td>
</tr>
<tr>
<td>mast arm</td>
<td>A pole being curved or having a cantilevered branch to allow a sign or signal to be mounted above a carriageway.</td>
</tr>
<tr>
<td>maximum green (maximum running period)</td>
<td>The time that a green signal to vehicles can continue after a demand has been made by traffic on another phase.</td>
</tr>
<tr>
<td>minimum green (maximum running period)</td>
<td>Duration of the green signal, following the extinction of a red-amber signal, during which no change of signal lights can occur.</td>
</tr>
<tr>
<td>MOVA</td>
<td>Microprocessor Optimised Vehicle Actuated strategy based on minimising stops and delays which maximises capacity at a single controlled junction.</td>
</tr>
<tr>
<td>NMCS</td>
<td>National Motorway Communication System.</td>
</tr>
<tr>
<td>node</td>
<td>In a traffic network, a junction or other point where it is convenient to identify as the end of a link.</td>
</tr>
<tr>
<td>offset</td>
<td>The difference in time between a specific point in the cycle at a junction and a reference point.</td>
</tr>
<tr>
<td>OSCADY</td>
<td>A computer program for the analysis of isolated traffic signals developed by the TRL.</td>
</tr>
<tr>
<td>overlap</td>
<td>Phases which run in successive stages (e.g. late start, early cut-off).</td>
</tr>
<tr>
<td>oversaturation</td>
<td>A traffic condition at traffic signals where demand exceeds capacity.</td>
</tr>
<tr>
<td>parallel stage streams</td>
<td>Two or more complete sequences of stages within the same controller which operate at the same time enabling two junctions or parts of a junction to be controlled with or without interaction between them.</td>
</tr>
<tr>
<td>pcu</td>
<td>The basic unit of traffic flow equal to the equivalent of a typical car (passenger car unit).</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>phantom</td>
<td>A false impression that an aspect is illuminated caused by incident light being internally reflected back through the lens.</td>
</tr>
<tr>
<td>phase</td>
<td>‘Sequence of conditions applied to one or more streams of traffic which, during the cycle, receive simultaneous identical signal indications’ (TP56) ‘Set of conditions that fixes the pattern of movement and waiting for one or more traffic streams during the signalling cycle.’ (BS 6100 241 7509) By extension, the equipment within a controller which controls a phase.</td>
</tr>
<tr>
<td>phase diagram</td>
<td>A diagram showing (as horizontal lines) the sequence of conditions of each of the phases at a traffic signal junction.</td>
</tr>
<tr>
<td>platoon</td>
<td>A group of vehicles moving together where the behaviour of each vehicle is influenced by the vehicle in front.</td>
</tr>
<tr>
<td>platoon dispersion</td>
<td>The tendency for platoons to extend and break up under free running conditions.</td>
</tr>
<tr>
<td>portable signal</td>
<td>A traffic signal designed to be moved from place to place, as prescribed in diagram 3000.1 of TSRGD 2016.</td>
</tr>
<tr>
<td>presence</td>
<td>A target being present within the detection zone.</td>
</tr>
<tr>
<td>pre-signal</td>
<td>A traffic signal installed in advance of a junction to control access to the junction for a particular movement or type of vehicle in a segregated lane.</td>
</tr>
<tr>
<td>primary signal</td>
<td>A signal head close to the stop line normally mounted on the left hand side of the carriageway.</td>
</tr>
<tr>
<td>PROM</td>
<td>Programmable Read Only Memory.</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>A method of assuring that the features and characteristics of a product or service satisfy stated or implied needs.</td>
</tr>
<tr>
<td>Quality Plan</td>
<td>A document required under a Quality Assurance scheme which defines responsibilities and procedures in a project to ensure that the QA requirements are met.</td>
</tr>
<tr>
<td>RCD</td>
<td>Residual Current Device.</td>
</tr>
<tr>
<td>red lamp monitoring</td>
<td>Lamp monitoring of some or all of the red lamps at a junction.</td>
</tr>
<tr>
<td>regulatory sign</td>
<td>A sign indicating a traffic regulation (such as a prohibited movement).</td>
</tr>
<tr>
<td>RCD</td>
<td>Residual Current Device.</td>
</tr>
<tr>
<td>reliability</td>
<td>A measure of the ability of a system, subsystem or item of equipment to operate without faults usually expressed as the Mean Time Between Failures (MTBF).</td>
</tr>
<tr>
<td>remote monitoring</td>
<td>A system installed at a signal controller which checks for faults in operation and reports them automatically to a central point.</td>
</tr>
<tr>
<td>reserve capacity</td>
<td>The difference between the capacity of a junction and the current demand (usually expressed as a percentage of the current demand).</td>
</tr>
<tr>
<td>Residual Current Device</td>
<td>An electrical safety device which compares the current entering a circuit with the current leaving it and which will isolate the circuit if the difference (the residual current) exceeds a given value.</td>
</tr>
<tr>
<td>red lamp monitoring</td>
<td>Lamp monitoring of some or all of the red lamps at a junction.</td>
</tr>
<tr>
<td>regulatory sign</td>
<td>A sign indicating a traffic regulation (such as a prohibited movement).</td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>An analysis of the risks to health and safety involved in the construction, operation and maintenance of a scheme. The Risk Assessment included in the Health and Safety Plan required by the CDM Regulations deals primarily with the construction phase of the scheme. Risk Assessments are also required for the operation and maintenance aspects of a Traffic Control and Information system.</td>
</tr>
<tr>
<td>Road Safety Audit</td>
<td>A formal procedure for the independent evaluation of highway schemes before implementation to identify potential safety hazards which may affect road users and to suggest measures to eliminate or mitigate those problems.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SA</td>
<td>Speed Assessment. A VA control strategy for high speed roads which affects the changing of the signals according to the speed of approaching vehicles.</td>
</tr>
<tr>
<td>Safety Case</td>
<td>The formal presentation of evidence that a system will be safe throughout its life cycle. It will include a Risk Assessment and will be reviewed at various stages in the life cycle of the scheme.</td>
</tr>
<tr>
<td>Safety Review</td>
<td>An independent review of the safety aspects of a system carried out after the preliminary design stage and again after the detailed design stage. These reviews run in parallel with, and may be combined with, the Stage 1 and Stage 2 Road Safety Audits extended to cover the control and operational aspects of the proposed system.</td>
</tr>
<tr>
<td>SAT</td>
<td>Site Acceptance Test.</td>
</tr>
<tr>
<td>saturation flow</td>
<td>The maximum flow (usually expressed in pcu or vehicles per hour) obtained at a stop line during green from a discharging queue.</td>
</tr>
<tr>
<td>SCOOT</td>
<td>Split, Cycle, Offset Optimisation Technique which uses real time traffic data to minimise stops and delays for UTC controlled areas.</td>
</tr>
<tr>
<td>SDE</td>
<td>Speed Discrimination Equipment. A VA control strategy for high speed roads which discriminates vehicles travelling above a given speed threshold.</td>
</tr>
<tr>
<td>shuttle working</td>
<td>A system where signals are used to control a one-way section of carriageway operating in alternating directions.</td>
</tr>
<tr>
<td>signs authorisation</td>
<td>The process of granting authorisation for the use of traffic signs (including traffic signals and road markings) which are not prescribed in the relevant regulations.</td>
</tr>
<tr>
<td>solar cell</td>
<td>A light sensitive device mounted on signals to initiate dimming of the lamps during darkness.</td>
</tr>
<tr>
<td>split</td>
<td>The division of available green time within a signal cycle between stages.</td>
</tr>
<tr>
<td>SRS</td>
<td>System Requirements Specification.</td>
</tr>
<tr>
<td>stage diagram</td>
<td>A diagram for a signalled controlled junction showing by means of arrows those movements permitted in each of the stages.</td>
</tr>
<tr>
<td>start up sequence</td>
<td>The controlled order through which signals progress from the off/standby mode to normal operation.</td>
</tr>
<tr>
<td>SVD</td>
<td>A detector which responds only to certain vehicles identified by their characteristics or by an electronic tag. (Selective Vehicle Detector.)</td>
</tr>
<tr>
<td>tactile indicator</td>
<td>A rotating cone indicator which indicates the presence of a green signal for the benefit of visually impaired pedestrians.</td>
</tr>
<tr>
<td>temporary signal</td>
<td>A traffic signal using the same type of signal equipment as permanent signals but which is installed for a limited period of time and mounted in a temporary fashion, for example in a concrete block support.</td>
</tr>
<tr>
<td>time table</td>
<td>In a coordinated traffic signal system, a list of times and days when control events (such as plan changes) take place.</td>
</tr>
<tr>
<td>Toucan crossing</td>
<td>A stand-alone combined pedestrian/cyclist crossing.</td>
</tr>
<tr>
<td>TOPAS</td>
<td>Traffic Open Products and Specifications – the organisation now responsible for maintaining the 25XX series of traffic product specifications and for Registering products as being compliant with them. Purchasers may require products which they purchase to be compliant with these specifications as an aid to ensuring product performance and compatibility.</td>
</tr>
<tr>
<td>tram signal</td>
<td>A signal which controls Light Rail Vehicles running on-street at signalled junctions.</td>
</tr>
<tr>
<td>TRANSYT</td>
<td>An off-line program for predicting the performance of a network of traffic signals with a given set of traffic flows and signal timings. In conjunction with its in-built optimiser, it is used to calculate the optimum set of timings for a given set of traffic flows. (TRAffic Network StudY Tool.)</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>TRL</td>
<td>Transport Research Laboratory.</td>
</tr>
<tr>
<td><strong>Urban Traffic Control System</strong></td>
<td>A system for the central control of electronic traffic control devices in a defined area, which will usually comprise primarily, but not necessarily exclusively, traffic signal installations.</td>
</tr>
<tr>
<td>UTC</td>
<td>Urban Traffic Control. A method of controlling and managing a number of traffic signals from one computer system.</td>
</tr>
<tr>
<td><strong>variable maximum green</strong></td>
<td>A feature of vehicle actuated control which allows the maximum green timing to be varied according to traffic flow.</td>
</tr>
<tr>
<td>variable message sign</td>
<td>Equipment capable of showing a sign face or legend as prescribed in TSRGD 2016 or a blank grey or blank black face.</td>
</tr>
<tr>
<td><strong>variable minimum green</strong></td>
<td>A feature of vehicle actuated control which allows the minimum green timing to be varied according to traffic flow.</td>
</tr>
<tr>
<td>variable message sign</td>
<td>Equipment capable of showing a sign face or legend as prescribed in TSRGD 2016 or a blank grey or blank black face.</td>
</tr>
<tr>
<td>vehicle actuation</td>
<td>Traffic signalling strategy in which the duration of the red and green signals and the time of duration of the cycle vary in relation to the traffic flow into and through the controlled area. It is actuated by the traffic by means of vehicle detection.</td>
</tr>
<tr>
<td>Visor</td>
<td>A device mounted above a signal aspect to prevent incident light falling on the lens and reducing contrast and/or to prevent the aspect being seen by road users for whom it was not intended (also hood).</td>
</tr>
<tr>
<td>walk with traffic</td>
<td>A control system where pedestrian phases run with non-conflicting vehicle phases.</td>
</tr>
<tr>
<td>wig wag</td>
<td>A signal having two similar aspects which are illuminated alternately.</td>
</tr>
<tr>
<td>Y</td>
<td>The sum of the y values of the critical traffic stream of each stage for all the stages in the cycle.</td>
</tr>
<tr>
<td>y value</td>
<td>The ratio of demand and saturation flow for a traffic stream.</td>
</tr>
</tbody>
</table>
APPENDIX B - CONSULTATION PRINCIPLES: GUIDANCE

A. Consultations should be clear and concise
Use plain English and avoid acronyms. Be clear what questions you are asking and limit the number of questions to those that are necessary. Make them easy to understand and easy to answer. Avoid lengthy documents when possible and consider merging those on related topics.

B. Consultations should have a purpose
Do not consult for the sake of it and in some cases, there is a legal duty to consult i.e. implementation of a Puffin crossing, seek advice from the Highway Authority's legal team on this matter. Take consultation responses into account when taking schemes forward and follow the Highway Authority's procedures if any objection(s) are received.

C. Consultations should be informative
Give enough information to ensure that those consulted understand the scheme proposal and give informed responses. Include validated impact assessments of the costs and benefits of the options being considered when possible; this might be required where proposals have an impact on residents and business.

D. Consultations are only part of a process of engagement
Consider whether informal iterative consultation is appropriate, using new digital tools and open, collaborative approaches.

E. Consultations should last for a proportionate amount of time
Judge the length of the consultation based on legal advice and considering the nature and impact of the proposal. Consulting for too long will unnecessarily delay scheme proposal. Consulting too quickly will not give enough time for consideration and will reduce the quality of responses.

F. Consultations should be targeted
Consider the full range of people, business and stakeholders affected by the proposed policy or scheme and whether a representative group exist. Consider targeting specific groups if appropriate. Ensure they are aware of the consultation and can access it. Consider how to tailor consultation to the needs and preferences of particular groups, such as older people, younger people or people with disabilities that may not respond to or be able to access traditional consultation methods.

G. Consultations should take account of the groups being consulted
Consult stakeholders in a way that suits them. Charities may need more time to respond than businesses, for example. When the consultation spans all or part of a holiday period, consider how this may affect consultation and take appropriate mitigating action, such as prior discussion with key interested parties or extension of the consultation deadline beyond the holiday period.

H. Consultations should be agreed before publication
Seek elected member and/or Head of Service agreement before publishing the notice.