

INTERIM ADVICE NOTE 89 /07

**APPRAISAL OF NEW AND REPLACEMENT
ROAD LIGHTING ON THE STRATEGIC
MOTORWAY AND ALL PURPOSE TRUNK
ROAD NETWORK**

Summary

This document is the pre-publication version of TA 49. It sets out the requirements for the appraisal of both new and replacement road lighting on the strategic motorway and all purpose trunk road network.

Instructions for Use

This document should be used in place of the existing advice note TA 49/86, which is obsolete. This replacement TA 49 is due to be incorporated into DMRB by the end of 2007, whereupon this IAN will be withdrawn.

**VOLUME 8 TRAFFIC SIGNS AND
LIGHTING**
SECTION 3 LIGHTING

TA 49/07

**APPRAISAL OF NEW AND REPLACEMENT
LIGHTING ON THE STRATEGIC
MOTORWAY AND ALL PURPOSE TRUNK
ROAD NETWORK**

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1. INTRODUCTION

General

1.1 This Standard sets out the procedure for appraisal of new and replacement lighting on the strategic motorway and all purpose trunk road network, referred to hereafter as the strategic road network. It replaces TA 49/86 including Amendment No.3, which is now withdrawn.

1.2 Lighting is used as a safety measure on the strategic road network. However, it should be recognised that previously advised accident savings may no longer be realised and there may be associated adverse impacts. Furthermore, as new technologies become available, other scheme safety measures may provide better value for money, or lower adverse impact, or both.

1.3 This Standard should be used in conjunction with the Highways Agency's Project Appraisal Report (PAR) documentation process or an equivalent appraisal process complying with the Transport Analysis Guidance issued by the Department for Transport.

1.4 References to the PAR hereafter in this Standard should be taken to include any Overseeing Organisation's equivalent appraisal process.

1.5 It is mandatory that no tenders are invited, or work by term maintenance contractors committed, until the PAR has received the appropriate recommendation and approval signatures at the Commitment of Works Expenditure stage.

1.6 This Standard explains how PAR should be implemented for road lighting schemes and it should be read in conjunction with the PAR Guidance Notes. This enables a full, accurate and properly documented appraisal of the benefits and

disbenefits of road lighting to be made at each stage of a project. Where the expected works cost falls below the PAR cost lower limit and therefore economic appraisal is not required, this Standard does not apply. In all other situations, including major schemes with an estimated cost above the upper PAR cost limit, this Standard applies.

1.7 In addition to the standard PAR process, certain documentation should be produced in support of a road lighting appraisal and be cross-referenced in the PAR submission, as described in Annex A.

1.8 This Standard should also be read in conjunction with TA 96, Whole Life Cycle Code of Practice for Lighting on the Strategic Motorway and All Purpose Trunk Road Network, TD 34, Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Network, TD 23, Maintenance of Road Lighting, and IAN 69, Designing for Maintenance.

1.9 The Road Safety Engineer has a significant role to play in road lighting appraisal. The Road Safety Engineer shall comply with the requirements given in HD 19 Road Safety Audit for an Audit Team Leader. This sets out the training, skills and experience required, together with the fundamental principle of independence from the main lighting appraisal and design team.

Scope

1.10 This Standard covers the following strategic road network situations:

- i. proposed lighting of a new road;
- ii. proposed lighting of an existing unlit road, where lighting would be the sole improvement;

- iii. proposed lighting of an existing lit or unlit road, where lighting would be part of a package of improvements; and
- iv. proposed renewal of life-expired lighting, where replacement of lighting columns is involved.

1.11 Where existing lighting is to be renewed or upgraded while retaining existing lighting columns in situ, this is regarded as maintenance and an appraisal is not required.

1.12 When road lighting has life-expired and an overall positive economic benefit for its replacement cannot be demonstrated, the appraisal process, in conjunction with a Road Safety Engineer's report, provides justification in principle for not replacing the lighting.

Implementation

1.13 This Standard should be used forthwith for the appraisal of road lighting on the strategic road network, including those schemes currently being progressed, unless directed otherwise by the Overseeing Organisation.

1.14 It should be used in conjunction with the Highways Agency's PAR documentation, or the equivalent as used by other Overseeing Organisations, in order to ensure compliance with Department for Transport requirements for analysis of transport projects.

2. PURPOSE OF ROAD LIGHTING

2.1 The primary purpose of road lighting on the strategic road network is to reduce personal injury accidents (PIAs). This is a quantifiable benefit. Consequently the most important consideration is the predicted accident cost saving, which should be greater than the lighting scheme cost in order to provide economic justification for road lighting. Further details are given in Chapters 4 and 5.

2.2 Other areas where road lighting can provide benefits include physical fitness (by encouraging walking and cycling), journey ambience and community severance. (Note that physical fitness and community severance are not relevant to motorways.) These areas will often not be quantifiable but should nevertheless be recorded and taken into account. Further details are given in Chapter 6.

2.3 The role of road lighting as a safety benefit has limitations, however, as follows:

- i. it should be considered alongside alternative measures likely to have lower cost or less adverse environmental impact;
- ii. for new roads and improvement schemes incorporating features which represent a departure from standards (such as narrow lanes), it should not automatically be used to mitigate risks associated with a departure; and
- iii. as a stand-alone improvement, it should not be used to mitigate a high darkness PIA rate unless a Road Safety Engineer has carried out a full accident analysis and evaluation and concluded that road lighting would be the best solution.

3. IMPLEMENTATION OF APPRAISAL

General

3.1 PAR requires a full and balanced appraisal of all the benefits and disbenefits of an improvement or change at each stage of a project. Its outputs enable the decision to be made whether to proceed to the next stage or to reject the scheme. The decision to proceed to the next stage will primarily be based on the economic case, whilst also taking account of environmental impact.

3.2 It is necessary to demonstrate that alternatives to road lighting that may achieve similar benefits have been fully considered alongside the road lighting option. Annex A describes how this should be documented.

3.3 PAR also provides the base information to allow a post opening evaluation to be undertaken which will confirm whether the expected benefits and disbenefits have been realised.

3.4 There are three main areas of information that are necessary in order to complete a PAR. These areas, and the means by which this should be done for road lighting schemes, are as follows:

- i. the expected benefit in terms of PIA savings for a road lighting scheme, determined as set out in Chapter 4 of this Standard;
- ii. the expected costs calculated as described in Chapter 5 of this Standard; and
- iii. other benefits and disbenefits, both quantifiable and non-quantifiable, as explained in Chapter 6 of this Standard.

3.5 In all situations road lighting should be treated as being an improvement scheme in its own right. If lighting is not the sole improvement, it should be separated out from the other work and be appraised independently.

3.6 Where a new road or improvement scheme has an estimated cost beyond the PAR limit, advice on appraisal should be sought from the designated Appraisal Certifying Officer for the scheme. In the absence of specific advice, it is recommended that lighting costs and impacts be estimated and worked through the PAR process. If lighting appears to be justified, lighting costs should then be included in the overall scheme appraisal.

Appraisal period

3.7 The period of appraisal for a road lighting scheme should normally be 30 years. A different period, appropriate to the expected column life, may be selected, but the following should be borne in mind:

- i. standard road lighting schemes are typically retained for about 30 years;
- ii. lighting columns with a longer expected life will have a higher initial cost;
- iii. the longer the appraisal period the higher the uncertainty in energy prices;
- iv. lighting standards and techniques may evolve such that existing lighting schemes become outmoded; and
- v. technological innovation may lead to more cost effective means of reducing darkness accidents in the foreseeable future.

3.8 If a different appraisal period is selected, the reasons should be documented as described in Annex A. The factors for energy cost (paragraph 5.10) and decommissioning cost (paragraph 5.11) should also be adjusted.

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4. PERSONAL INJURY ACCIDENT SAVINGS

General

4.1 This Chapter describes how to determine the darkness PIA saving on the strategic road network for use in appraisal. It is important to note that any figures given in this Chapter are derived from national statistics and are only suitable for economic appraisal. They should not be used for any other purpose.

4.2 The proportion of darkness PIAs on all types of strategic road is on average 28% of the total PIAs occurring during daylight and darkness [source: Road Casualties Great Britain 2004, DfT]. Where only the total accident figures are known it can be assumed, therefore, that 28% of them occur during the hours of darkness.

4.3 Table 1 gives a generalised indication of the darkness PIA saving due to road lighting on links, suitable for appraisal. A link is a stretch of road connecting two consecutive junctions (minor accesses are ignored). Paragraphs 4.8 and 4.10 describe how an alternative figure may be derived for specific schemes. Details relating to junctions are given in paragraphs 4.11-4.13. It should be assumed that the figures in Table 1 are not dependent on the lighting class.

Table 1 – Darkness PIA savings on links due to road lighting

Type of link	A ¹
Motorway and motorway standard All Purpose Dual Carriageway	10%
All Purpose Dual Carriageway	10%
All Purpose Single Carriageway	12.5%

¹ Percentage darkness PIA saving due to road lighting

4.4 Where road lighting would form part of a package of improvements to an existing road, advice should be sought from a Road Safety Engineer concerning the applicable PIA saving due to road lighting. It may be that the figure taken from Table 1 should be amended in such circumstances.

4.5 PIA savings should be assessed over exactly the same geographical extent as the proposed lighting scheme. The extent of a lighting scheme is described in TD 34. For example, a lit link will require any junctions on the link also to be lit, hence the combined PIA saving for the link and junction(s) should be used.

Darkness PIA saving on a new link

4.6 The forecast number of darkness PIAs for the opening year should be determined from the predicted opening year traffic flow multiplied by the national average PIA rate for the type of road as given in Design Manual for Roads and Bridges, Volume 13 (COBA). The predicted PIA saving should be calculated by multiplying the number of opening year darkness PIAs by the appropriate percentage **A** from Table 1.

Darkness PIA saving on an existing unlit link

4.7 The forecast number of darkness PIAs for the opening year should be taken to be the same as the average for the immediately preceding five years. In the absence of five years' data, the minimum period to be considered should be three years. The predicted PIA saving should be calculated by multiplying the number of opening year darkness PIAs by the appropriate percentage **A** from Table 1.

4.8 Where there is shown to be an unusually high number of darkness PIAs, a full accident analysis and evaluation should be undertaken by a Road Safety Engineer and the likely PIA saving estimated for use in the appraisal process. This should be documented as described in Annex A.

Darkness PIA saving for renewing lighting on a lit link

4.9 The forecast number of darkness PIAs for the opening year should be taken to be the same as the average for the immediately preceding five years, assuming road lighting remains in place. In the absence of five years' data, the minimum period to be considered should be three years. The predicted PIA saving should be calculated by multiplying the number of opening year darkness PIAs by $A/(100\% - A)$, where A is the appropriate percentage from Table 1. (The PIA figure will relate to lit conditions and therefore it can be assumed that the accident savings given in Table 1 are already being achieved. The formula takes account of this fact.)

4.10 The Overseeing Organisation may advise that a full accident analysis and evaluation be undertaken by a Road Safety Engineer, in which case the likely PIA saving should be estimated for use in the appraisal process. This should be documented as described in Annex A.

Darkness PIA saving for junctions

4.11 Junctions include the following highway arrangements:

- i. slip road and link road merges and diverges on Motorways and All Purpose Dual Carriageways;
- ii. other elements of grade-separated interchanges on Motorways and All Purpose Dual Carriageways;
- iii. roundabouts on All Purpose Single and Dual Carriageways;

- iv. T-junctions and staggered junctions on All Purpose Single and Dual Carriageways; and
- v. cross-roads on All Purpose Single Carriageways.

4.12 With the exception of slip road merges and diverges, the available statistics do not give a clear indication of the PIA savings likely to be realized in any of the above circumstances. For slip road merges and diverges the statistics show that they generally have a significantly lower number of darkness PIAs when lit, but other methods of accident reduction should always be considered alongside (for example, lengthening the merge/diverge).

4.13 Whether the junction is existing or proposed, a Road Safety Engineer should carry out an assessment to estimate the likely PIA saving through providing road lighting for use in PAR. This should be documented as described in Annex A. If it is not possible to provide such an estimate it should be assumed that there would be no PIA saving.

5. DETERMINATION OF COSTS

General

5.1 This Chapter describes how to determine the costs of providing road lighting for use in PAR. The costs of a road lighting scheme fall into four categories:

- i design and construction;
- ii annual maintenance over the life of the installation;
- iii energy charges over the life of the installation; and
- iv decommissioning and disposal at end-of-life.

5.2 Prior to assessing these costs a scheme design should be produced. This need not be a fully detailed design, but should be in sufficient depth to enable costs to be estimated reasonably accurately. Where standard lighting columns would require protection by a dedicated safety barrier, the use of passively safe columns should also be evaluated. The design solution should be documented as described in Annex A.

5.3 The design should be in accordance with TD 34, Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Network.

5.4 The scheme should have an intended life matching the appraisal period used in the PAR calculations (see paragraph 3.7).

Works cost

5.5 The works cost should include all the costs that are incurred by preparing and installing the proposed scheme, including any overhead costs such as preparation, design, and site supervision that are not accounted for automatically within the appraisal process. Annex B gives a non-exhaustive list of items to be included.

Where other construction work would be taking place at the same time, the works cost should be the additional cost to the scheme of installing lighting rather than the cost of lighting in isolation.

Maintenance cost

5.6 The opening year maintenance cost should be calculated for a period that covers a whole number of lamp replacement and electrical testing cycles. An allowance should be included for less frequent maintenance activities, where relevant, such as painting and luminaire replacement. The opening year maintenance cost should be the annual average for this period. The requirements of TD 23, Maintenance of Road Lighting, should be taken into account. It should be assumed that lamp replacement, luminaire cleaning and column inspection cycles coincide. Annex B gives a suggested list of items to be included.

5.7 It should also be assumed that road lighting maintenance would be combined with other maintenance activities wherever possible. In such cases, the cost of traffic management should not be solely allocated to the lighting.

5.8 A reasonable estimate should be made of the cost of dealing with equipment faults, but emergency responses should be excluded because they are unpredictable and, in the case of third party liability, compensation may be obtainable.

5.9 Note that the figure for opening year maintenance cost used in appraisal should also include components for energy (paragraph 5.10) and decommissioning (paragraph 5.11)

Energy cost

5.10 The opening year energy cost should

be calculated using the currently applicable rates negotiated with the Highways Agency's or other Overseeing Organisation's energy supplier. It is expected that energy charges will outstrip the Retail Prices Index (RPI) for the foreseeable future, although it is impossible to predict the likely difference between the two over the appraisal period. To take account of this, the annual energy cost should be multiplied by the factor given in Annex C. The resultant figure should then be included in the opening year maintenance cost.

Decommissioning cost

5.11 It should be assumed that the lighting will be decommissioned at the end of the appraisal period, whether or not a replacement scheme would be implemented. The cost of decommissioning (which should include disposal) should be allowed for in the appraisal and should cover all site works. Annex B gives a suggested list of items to be included. In the absence of accurate information it can be assumed that the decommissioning cost of lighting equals 20% of the works cost. It should be multiplied by the factor given in Annex D. The resultant figure should then be included in the opening year maintenance cost.

6. OTHER BENEFITS AND DISBENEFITS

General

6.1 The PAR process requires that all non-neutral impacts are assessed. Table 2 lists the topics as set out in PAR and indicates their relevance to road lighting. Assessment of these impacts is described below. Supporting documentation should be produced as described in Annex A.

Landscape, townscape, heritage and biodiversity

6.2 A formalised impact assessment is needed for each of these topics. This should be carried out in accordance with the recommendations of TA 96.

Physical fitness

6.3 This refers to the encouragement of walking and cycling activities. Where the road to be lit has provision for walking and/or cycling an estimate should be made of the likely increase in walking and cycling journeys after dark resulting from lighting.

Journey ambience

6.4 A journey in darkness may be less stressful if the road is lit and a comment to this effect should be made. However, in the daytime the presence of lighting columns can detract from views of the surrounding area if the landscape is of reasonable quality.

Table 2 – Relevance of PAR appraisal topics

Topic	Likely impact	Refer to:
Noise	Not relevant	
Air quality		
Greenhouse gases	Not relevant (relates only to vehicle emissions)	Paragraph 6.7
Landscape	Adverse	Paragraph 6.2 and TA 96
Townscape	Slight adverse to slight beneficial	
Heritage	Slight adverse to slight beneficial	
Biodiversity	Adverse in sensitive locations	
Water environment	Not relevant	
Physical fitness	Neutral or beneficial (not relevant to motorways)	Paragraph 6.3
Journey ambience	Beneficial (darkness), adverse (daytime)	Paragraph 6.4
Accidents	Beneficial	Chapter 4
Security	Neutral	Paragraph 6.5
Public accounts	Not relevant	
Transport economic efficiency		
Reliability		
Wider economic impacts		
Option values		
Severance	Beneficial (not relevant to motorways)	Paragraph 6.6
Access to system	Not relevant	
Passenger interchange		
Land use policy		
Government policy	Adverse and beneficial	Paragraph 6.7

Security

6.5 Road lighting will generally make little difference to the security of road users and should normally be assessed as having a neutral impact.

Severance

6.6 In situations where a road passes through a settlement, road lighting can be very beneficial after dark. It can restore the connection between the two sides visually and it can encourage the movement of inhabitants from one side to the other. However, this should not be considered without public consultation as alternatives to road lighting may be preferred.

Government policy

6.7 All impacts on Government policy should be reported. For example, road lighting would contribute to meeting casualty reduction targets. On the other hand, road lighting would consume energy, thus working against the Government's long-term strategy to reduce greenhouse gas emissions. Other policies where road lighting would have a non-neutral impact should also be mentioned. Note that in PAR the adverse impact of greenhouse gas emissions should be reported here, not in the greenhouse gas worksheet, since that is reserved for emissions arising from vehicle use.

7. REFERENCES

Design Manual for Roads and Bridges (DMRB)

HD 19: Road Safety Audit (DMRB 5.2.2).

IAN 69: Designing for Maintenance.

TD 23: Trunk Roads and Trunk Road Motorways Inspection and Maintenance of Road Lighting (DMRB 8.3).

TD 34: Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Network (DMRB 8.3).

TA 96: Whole Life Cycle Code of Practice for Lighting on the Strategic Motorway and All Purpose Trunk Road Network (DMRB 8.3) (due to be published late 2007).

Other

Road Casualties Great Britain 2004 (Department for Transport, 2005)

8. ENQUIRIES

All technical enquiries or comments on this Standard should be sent in writing as appropriate to:

To be completed by the Highways Agency

ANNEX A. DOCUMENTATION

A.1 Relevant background information and decisions made during the course of the appraisal should be documented and placed in a Technical File and retained for inspection by the Overseeing Organisation. The lists below indicate the coverage of the documentation. All documentation should be attached to the PAR submission using the appropriate PAR worksheet.

A.2 Essential documentation includes:

- i. description of extent of scheme, tie-ins with existing lighting and transition to unlit sections (paragraph 5.3); and
- ii. details of all design solutions, including column height, lamp type and wattage and column arrangement (paragraph 5.2).

A.3 Other documentation may cover:

- i. choice of appraisal period (paragraph 3.8);
- ii. consideration of alternatives to lighting (paragraph 3.2);
- iii. Road Safety Engineer's report(s) (Chapter 4);
- iv. design criteria (paragraph 5.3);
- v. noteworthy assumptions relating to works, maintenance, energy or decommissioning costs (paragraphs 5.5-5.11);
- vi. environmental impact assessment (paragraph 6.2 and TA 96);
- vii. data on walking and cycling journeys (paragraph 6.3); and
- viii. other information relating to non-neutral impacts.

ANNEX B. ITEMS TO INCLUDE IN COSTS

B.1 The following is a non-exhaustive list of items to be considered when calculating the works cost for a road lighting scheme:

- i. lighting columns and road lighting luminaires (with electronic dimming control gear where available), including passively safe lighting columns where required;
- ii. vehicle restraint system provision or modification (where provided solely for protection of lighting equipment);
- iii. electricity supply, including feeder pillars and Distribution Network Operator charges;
- iv. dimming, remote monitoring and similar equipment, where proposed;
- v. cable network, including all ducting, trenching and draw pits;
- vi. temporary lighting made necessary by the removal of existing road lighting (in accordance with any contractual agreements or as required by the Overseeing Organisation);
- vii. illumination of signs made necessary by the provision of road lighting;
- viii. reinstatement;
- ix. traffic management;
- x. impact mitigation measures;
- xi. any overhead costs not automatically included by PAR;
- xii. any other special precautions or items of relevance.

B.2 The following is a non-exhaustive list of items to be considered when calculating the maintenance cost for a road lighting scheme:

- i. lamp replacement;
- ii. luminaire cleaning;
- iii. routine column inspection (including bracket and any fixings);
- iv. rigorous column inspection/testing, especially after expiry of fatigue design life;
- v. inspection and maintenance of vehicle restraint system (where provided solely for protection of lighting equipment);
- vi. electrical testing;
- vii. painting;
- viii. luminaire replacement;
- ix. specialised access equipment for any of the above;
- x. traffic management.

B.3 The following is a non-exhaustive list of items to be considered when calculating the decommissioning cost for a road lighting scheme:

- i. removal of lighting equipment;
- ii. removal of vehicle restraint system (where provided solely for protection of lighting equipment);
- iii. recycling and disposal in accordance with legislation;
- iv. reinstatement;
- v. specialised access equipment for any of the above;
- vi. traffic management.

ANNEX C. ENERGY COST CALCULATION

The cost of energy should be included in the Opening Year Maintenance Cost. In order to correctly allow for inflation in energy prices, it should first be factored as described below.

The appropriate values for d and CF should be confirmed with the Overseeing Organisation. The value for e should be 10% unless otherwise directed by the Overseeing Organisation.

The whole life maintenance cost element of the Present Value of Costs (PVC) is calculated by PAR as follows:

$$PVC_{(\text{maintenance})} = OYMC \times CF \times DF \times GTF$$

where:

OYMC is the Opening Year Maintenance Cost

CF is the Capitalisation Factor for Maintenance for the appraisal period

DF is the discount factor to base year 2002

and GTF is the General Taxation Factor.

The Energy Cost (EC) should be evaluated to the same year as the OYMC. As energy prices can be volatile, this evaluation year should be as close as possible to the Opening Year and an informed estimate should be made of the likely energy cost in that year. Reference to Government official statistics on energy prices may provide assistance.

It is necessary to calculate another capitalisation factor, $CF_{(\text{energy})}$, using the formula

$$CF_{(\text{energy})} = (1 - X^{a+1}) / (1 - X)$$

where:

$$X = \{1 + (e/100)\} / \{1 + (d/100)\}$$

a = appraisal period in years

e is the energy inflation rate above RPI in %

and d is the discount rate in %.

The EC is factored for inclusion in the total OYMC as follows:

$$OYMC_{(\text{energy component})} = EC (CF_{(\text{energy})} / CF).$$

ANNEX D. DECOMMISSIONING COST CALCULATION

The Decommissioning Cost needs to be kept separate from the construction cost in order to retain the integrity of other calculations within PAR. For this reason, it should be added to the Opening Year Maintenance Cost, after factoring to give the correct result.

The whole life maintenance cost element of the Present Value of Costs (PVC) is calculated by PAR as follows:

$$PVC_{(\text{maintenance})} = \text{OYMC} \times \text{CF} \times \text{DF} \times \text{GTF}$$

where:

OYMC is the Opening Year Maintenance Cost

CF is the Capitalisation Factor for Maintenance for the appraisal period

DF is the discount factor to base year 2002

and GTF is the General Taxation Factor.

The Decommissioning Cost (DC) should be evaluated to the same year as the OYMC. It should then be factored for inclusion in the OYMC as follows:

$$\text{OYMC}_{(\text{decommissioning component})} = \text{DC} / \text{CF}$$

The appropriate value for CF should be confirmed with the Overseeing Organisation.