



Central Bedfordshire Council Lighting Report

July 2009

Report For: Central Bedfordshire Council

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Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Issue Record Sheet – Bedfordshire Highways

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Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Contents

Issue Record Sheet – Bedfordshire Highways2

Contents3

1 Introduction4

2 Background5

3 The Second Bedfordshire Local Transport Plan:.....6

4 Central Bedfordshire Council’s commitment to “Improving Life in Bedfordshire”6

5 Efficiencies7

 5.1 Energy consumption 7

 5.2 Electronic control gear 7

 5.3 Variable road lighting levels (Dimming) 8

 5.4 Trimming 9

 5.5 Part night lighting 9

 5.6 Light pollution 9

 5.7 Lighting level Proposals 10

 5.8 White light in residential areas 11

 5.9 De-illumination of sign and bollards 12

 5.10 LED’s 13

6 Electrical Design 13

 6.1 Development Control 13

 6.2 Lantern Comparisons 14

7 Implementation of Strategy & Evaluation 14

 7.1 Providing streets with lighting classes: 14

 7.2 Prioritising replacements: 14

 7.3 Service Connections 15

 7.4 Commencement of scheme design 16

 7.5 Evaluation of each scheme: 16

8 Existing Trial Sites 16

9 Proposed Trial Sites 16

10 Ongoing Maintenance 17

11 Carbon Reduction Commitment (CRC) 18

12 Recycling 19

13 Extension Sleeve 20

14 Summary 20

15 Appendices 21

A	Definitions	21
B	Crime Map of Bedfordshire	23
C	Lamp Comparison	24
D	Trial site plan	25 & 28
E	Lantern Comparison	30
F	Standard Detail Drawing (extension sleeve)	33
G	References	34

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

1 Introduction

This report explains why additional funding is required for Central Bedfordshire to update their lighting asset with the use of a new strategy using new technology. This will help Central Bedfordshire become more energy efficient thus reducing future revenue spend on energy and maintenance while also reducing CO2 emissions.

Amey are responsible for approximately 40,000 lighting assets across Bedfordshire, of which Central Bedfordshire has a lighting column stock of approximately 21,000 with signs and bollards totalling 3,000 approximately.

When street lights are working customer perception tends to be indifferent. However when there are outages this can become top priority to our customers in Central Bedfordshire. Our proposals look at more efficient lanterns which have a longer life and improved maintenance regime.

The 'normal' design life of a lighting column is between 25 to 35 years. If the budget from previous years was to continue at the same level we would be looking at columns in excess of 95 years life. This is unacceptable and will inevitably lead to failures. The target should be a maximum column life of no more than 25 years.

To improve the lighting network in Central Bedfordshire and bring all lighting columns to within the 25 years target life the annual lighting budget going forward needs to be £2.2 million per year for the next 4 years. If however we were to make the target a maximum life of 20 years this level of spending would need to be continued for a further 6 years.

In the forthcoming sections the report looks at:

- The existing Central Bedfordshire network which has been taken from Structural Testing data.
- The Local Transport Plan.
- Improving life in Central Bedfordshire for our residents
- Efficiency savings as part of the Gershon report.
- Design Implementation for the Central Bedfordshire network.
- Existing trials that have been undertaken.
- Proposed trial sites.
- Ongoing Maintenance of street lighting asset.
- Carbon footprint reduction
- Recycling.

Due to the complex nature of this report, any technical language used has been explained in Appendix A.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

2 Background

Recent significant fluctuations in energy prices have prompted many Local Authorities to review their policies on the provision, operation and maintenance of street lighting and other illuminated street furniture in an attempt to minimise the escalating cost. Authorities are also aware of the both the nuisance potential from light pollution and the impact of escalating costs. The effect of street lighting on the environment in the form of greenhouse gases and the increase in light pollution are often cited as reasons to turn off lights. These decisions must be balanced against the significant community benefits which accrue from the provision and operation of appropriate and well maintained street lighting.

The major benefits of street lighting are:-

- Helps to reduce street crime and fear of street crime.
- Decreases the number of night-time accidents.
- Improves personal security.
- Promotes night-time leisure activities.
- Promotes sustainable transport, public transport, cycling and walking.
- Assists the emergency services.
- Allows the effective use of CCTV systems at night.

The above benefits that street lighting provides are lost when lights are switched off, therefore the purpose for which the lighting has been provided must be fully considered and the consequences of switching off accessed as part of the decision making process.

The reduction of CO2 emissions is seen by many Authorities as more important than the potential financial savings from a reduction in energy. In recent years several important reports have led to CO2 reductions being imposed on local Authorities and indeed the country as a whole. The key documents are:

- **Kyoto Protocol** (1997) – Reduce carbon emissions to 1990 levels
- **Stern Report** (2006) – Reduce carbon emissions and develop a sustainable future
- **Gershon Report** (2004) – Sustainability, best value, efficiency, systems etc and
- **Eddington Report** (2006) – Advises carbon emissions should play a part in the decision making process with Transport and Infrastructure tasked to look for efficiencies and reductions

Internal Report	Contract
Title	Central Bedfordshire Lighting Report
	Bed MAC

3 The Second Bedfordshire Local Transport Plan:

The Second Bedfordshire Local Transport Plan (LTP) sets out our strategies, targets and spending programme for transportation in the five years from 2006/7 to 2010/11. It is a means of promoting transport policies that help in delivering wider aims like strengthening the economy and tackling social deprivation. Street Lighting is an integral part of the LTP with an appropriate and well-maintained lighting programme. This will have a direct impact on several objectives of the LTP – such as the following:

“Reducing road casualties through local safety schemes ...”

“...ensuring substantial improvement of opportunities for walking and cycling together with safer use of high quality public transport.”

“Where possible and appropriate, community safety lighting schemes are incorporated into road improvement schemes, providing good illumination at bus stops and on walking routes”

“To address social exclusion, in aiding regeneration of disadvantaged areas ...”

“To protect and where possible enhance the quality of the environment in urban and rural areas and make them **safe and attractive places to live and work**”

In addition

“It is vital to maintain and renew our transport infrastructure. The main assets are ... street lighting... We must plan timely programmes of repairs or renewals to secure the long term future of these assets...”

4 Central Bedfordshire Council’s commitment to “Improving Life in Bedfordshire”

Our vision statement is “We will listen to the views of Central Bedfordshire people and, by working with them and our partner agencies, ensure they enjoy the quality of life which they expect: to live in a unity authority and region which is safe, healthy, attractive and prosperous”

To achieve our vision we aim to:

- Improve quality of life for people.
- Improve quality of life for communities.
- Improve services so they are high quality and value for money.

Our street lighting policies have been developed to rationalise this vision and support the aims and objectives of other Central Bedfordshire Council strategies and initiatives.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

5 Efficiencies

5.1 Energy consumption

Britain's overall energy consumption per annum is 317,832 gigawatt hours. With the present methods of energy generation this produces approximately 560 million tonnes of CO₂. Of this only 19% is attributable to lighting in general and only 0.6% is contributed by the public external lighting. Globally the energy used by Britain accounts for 2% of the worlds CO₂ emissions.

Power for lighting is mainly provided by the electricity that is generated at off-peak times, when power production is at 'tick-over'. Also power companies are using and developing sustainable power sources such as solar power, hydroelectric power and wind turbine power generation.

We support the Council's aim to ensure that the amount of energy that is used in total is no more than required, by taking into account the aims and objectives of an appropriate lighting system for each location, and to obtain as much energy as possible from sustainable sources.

We will minimise the use of energy and reduce Central Bedfordshire's Carbon footprint by:

- Developing a sustainable street lighting policy
- Using appropriate lamps, photocells and control gear.
- Designing new cost effective street lighting schemes which utilise the latest energy saving solutions.
- Reducing the total street lighting asset.
- The use of alternative technology, where appropriate and cost effective.
- Managing and maintaining the existing apparatus to ensure that we are taking advantage of the latest technology to reduce Central Bedfordshire's electrical load.

5.2 Electronic control gear

Electronic control gear replaces the traditional control gear that consists of a ballast, capacitor and ignitor. Electronic gear is particularly popular for running fluorescent lamps and is gaining popularity for the smaller discharge lamps, particularly high-pressure sodium (SON) and metal halide (CDM). The Electronic ballast control gear will reduce the overall total circuit wattage and have the added advantage that they can be used for dimming purposes. Light sources such as Compact Fluorescents, Cosmopolis and LED's have electronic control gear as standard, whilst electronic ballasts are available for traditional light sources such as high pressure sodium, the reliability is not yet proven for the high wattage units (250w and above).

Table 1 below shows the typical savings that can be achieved by using electronic control gear with high pressure sodium lamps.

Internal Report			Contract	Bed MAC
Title	Central Bedfordshire Lighting Report			

Table 1:

Lamp Type & Power	Circuit Watts Conventional	Circuit Watts Electronic	Saving Watts	%
50W SON	62	56	6	9.7%
70W SON	90	79	11	12.2%
100W SON	114	109	5	4.3%
150W SON	172	156	16	9.3%

Proposal:

- All luminaries up to and including 150W lamp shall have electronic control gear fitted as standard. We will monitor the development of electronic ballasts for lamps greater than 150w and introduce them when they become cost effective.

5.3 Variable road lighting levels (Dimming)

Variable lighting levels provide an opportunity for increased energy, efficiency and carbon savings through the dimming of traffic routes aligned to traffic flows. Reducing road lighting levels at an appropriate time also has additional environmental benefits by further reducing light intrusion and light pollution.

The British Standards (BS5489) allow for lighting levels to be reduced and the Institution of Lighting Engineers Technical Report (TR) 27 Code of Practice for Variable lighting levels for Highways provides recommendations of applying variable road lighting to traffic routes.

Dimming can be incorporated into both existing and new installations. Existing sites with conventional control gear can use the W-Saving unit and new installations will be able to facilitate dimming as electronic control gear is standard. Dimming typically reduces energy consumption by 25% during the dimming period.

Proposal:

- All traffic routes (excluding link roads) shall be dimmed by at least one lighting level (minimum 25% energy reduction) in-between or from 23:00 and 06:00.
- Existing sites will be investigated where dimming will prove effective in saving energy. Sites will be prioritised on lamp wattage e.g. 250W (W-Saving / CELsave) first to maximise savings.

Refer to section 8 for brief overview of existing dimming trial site on the A505 Luton Road in Dunstable.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

5.4 Trimming

Modern fully electronic photocells consume only 0.25W as opposed to 3W (during daylight) for a thermal photocell, which are currently fitted to many of the existing lighting units. Photocells are calibrated to switch lights on and off typically from dusk to dawn. At no extra cost new electronic photocells can be calibrated to reduce the number of hours that a street light works. This is called 'trimming'. Trimming reduces the number of burning hours by changing the switch on and switch off illuminance levels. At present the switch on / switch off levels are 70 lux on and 35 lux off (70/35). By reducing the switching ratio to 35/18 can typically save 92 burning hours per year.

If the entire network was fitted with a trimming photocell (35lux on/18 lux off) it would reduce the cumulative hours that street lights are operational by 1,987,016 hours a year.

[21,598 units x 92 hours = 1,987,016 hours saved per annum]

Proposal:

- All new lighting units will be installed with photocells that consume a maximum of 0.25W with switching ratio of 35/18.
- Old thermal cells shall be replaced at maintenance visits where possible.

5.5 Part night lighting

Part night lighting provides an effective way to save on energy costs whilst limiting impact on the user. The lighting is controlled by photocell set to switch off normally between the hours of midnight and 06:00 when most people are asleep. Similar initiatives are currently being trialled by other Authorities and the Highways Agency in the UK with varied results. Multiplied across Central Bedfordshire the cost benefits of cutting operating time by up to 6 hours per night are clear and the initial outlay of the control unit quickly recovered.

Part night lighting is more suited for rural traffic routes (excluding conflict areas) where there are no pedestrians or rural villages.

Refer to section 8 for brief overview of existing part-night lighting trial sites in Leighton Buzzard.

5.6 Light pollution

Visual intrusion, "Sky Glow", in the built environment caused by the spread of stray light into the night sky is a major concern. Additionally, glare causes discomfort and affects drivers' vision and light trespass back towards adjacent property can be unwelcome. Stray light is obtrusive, and wasteful of light and energy.

Light pollution will be minimised by:

- Installing lighting sufficient for location and circumstances without over provision.
- Aligning lighting equipment correctly, such that light is directed downwards using flat glass, shallow bowls, shields and baffles.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

- Using flat glass and shallow bowl lanterns on all new and replacement works as far as possible.
- Dimming on traffic routes (excluding link road) – See section 5.3
- Residential areas and town centres shall be G1 minimum.
- Traffic routes shall be G3 in Urban areas and G4 in rural areas.
- All luminaires will have an upward light ratio (URL) of less than 2.5% (max. permitted for E2).

5.7 Lighting level Proposals

Lighting levels are explained in the following table:

Table 2:

Class	Horizontal illuminance		Luminance ME Comparable levels
	Eav lux* (minimum maintained)	Emin lux (maintained)	
S1	15	5	ME3
S2	10	3	ME4
S3	7.5	1.5	ME5
S4	5	1	ME6
S5	3	0.6	N/A
S6	2	0.6	N/A

* At the given value of Emin, the Eav value may not exceed 1.5 times the recommended value.

Residential Lighting:

- Low / medium crime (E1 to E4) shall be **S5** with white light solution (Ra60) (PL-L / CPO)
- High crime (E1 to E4) shall be **S4** with white light solution (Ra60) (PL-L / CPO)

Traffic Routes:

- Strategic routes shall be **ME2** if ADT > 25,000 (Ra20) with SON solution or **ME3a** if ADT < 25,000 (Ra20) with SON solution.
- Main distributor routes shall be **ME3b** if ADT > 15,000 (Ra20) with SON solution or **ME3c** if ADT < 15,000 (Ra20) with SON solution.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

- Secondary distributor routes shall be **ME4a** (Ra20) with SON solution.
- Link roads shall be **S2** or **S3** (Ra60) with CPO solution.

Town centres:

- Residential areas **S4** with white light (Ra60) with CPO, PL-L, PL-T or LED solution.
- Footpaths shall be **S4** with white light (Ra60) with CPO, PL-L, PL-T or LED solution.
- Pedestrian areas shall be **CE2** with white light (Ra60) with CPO, PL-L, PL-T or LED solution.

Conflict Areas:

- Conflict areas shall be lit to the equivalent CE class and for a distance from the junction in accordance with the stopping distance for the speed of the road.

5.8 White light in residential areas

British Standards (BS5489) allow a reduction of one lighting class in residential areas, if a light source has a colour rendering index (Ra) of greater than 60. This is deemed as 'white light' and independent research has proved that the use of white light for 'S' class levels provides an equivalent level of illumination when compared to traditional lighting sources of both high pressure and low pressure sodium lamps. Modern 'white light' sources include the Philips Cosmopolis lamp (CPO), compact fluorescents (PL-L & PL-T) and LED's.

Table 3 below shows the typical reduction in light output that can be achieved by using white light. This allows a potential reduction in both lighting units and energy.

Table 3

Current Class	<i>Eav</i> Lux [Minimum Maintained]	White Light Class	<i>Eav</i> Lux [Minimum Maintained]	% Reduction
S1	15	S2	10	= 5/15 = 33%
S2	10	S3	7.5	= 2.5/10 = 25%
S3	7.5	S4	5	= 2.5/7.5 = 33%
S4	5	S5	3	= 2/5 = 40%
S5	3	S6	2	= 1/3 = 33%
S6	2			

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Our proposals for white light in residential areas include for:

- All residential areas to be lit with the most cost effective white light solution.
- Areas with low/medium crime shall generally be lit with compact fluorescent light sources, however we will continue to monitor the progress of LED luminaires for residential lighting and will introduce them when they provide the most cost effective solution PL-L, PL-T or LED light sources.
- High Crime areas shall be lit with Cosmopolis CPO or LED. Again, we will continue to monitor the progress of LED luminaires for residential lighting and will introduce them when they provide the most cost effective solution

5.9 De-illumination of sign and bollards

The following areas will be considered when investigating the possible de-illumination of signs and bollards that no longer require illumination due to the Traffic Signs Regulations and General Directions (TSRGD 2002):

- One way streets.
- Advance warning sign – Road humps.
- 20mph Zones.
- Cycle tracks.
- Traffic signal island bollards.
- Plain face bollards.
- ADS – advance direction signs.
- LDS – local direction signs.
- Eliminate continuous burning equipment.
- Any lit signs that are knocked down will require liaison with the Transportation Team at Bedfordshire Highways to investigate if replacement sign requires illumination.

Bedfordshire Highways Safety Auditors and the Department for Transport shall be consulted before any bollards or signs are de-illuminated.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

5.10 LED's

LED luminaries provide the following benefits:

- Long life expectancy, 25 years as opposed to 4 years for conventional lamps.
- High colour rendering.
- Routine maintenance visit required every 6 years at the same time as periodic test and inspection without the requirement of a mobile elevating work platform (MEWP) and minimum Traffic Management.
- Reduced energy costs.
- Dimming enabled is available.
- Lamp replacement not required during life expectancy.

6 Electrical Design

6.1 Development Control

The objective of Development Control is to improve the safety of the travelling public whether that is in terms of safe utilization of the road layout or safety from criminal activity. Where there is little or no existing lighting and minimal potential for night time accidents because of low traffic volume, the policy may be relaxed, and either footway lighting installed or the area will be unlit. The future needs of residents will be considered if this approach is taken.

With any new developments, Central Bedfordshire Electrical & Lighting Section of the Highway Department will supply the Lighting Consultants with a scheme briefing sheet.

This brief will specify the following points:

- Lighting class.
- Lamp type.
- Lantern type.
- Column height.
- Wattage.
- Glare class.
- Maintenance Factor.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

The information provided to the Consultants will be appropriate to where the proposed development is located and this report. This will enable Central Bedfordshire to ensure that energy consumption, and revenue costs are reduced.

Central Bedfordshire will achieve appropriately lit developments by:

- Providing Developers with our Street Lighting Specification and Strategy with a scheme briefing sheet and ensuring it is used appropriately.
- Taking account of the need to achieve a balance between the safety and convenience for residents and visitors when using the network and preserving the naturally dark areas.

6.2 Lantern Comparisons

The design comparisons were carried out on a typical housing development in April 2009 using five different lamp types; MBFU (mercury vapour), LED (Light Emitting Diodes), SON-T (High-pressure sodium), PL-L (fluorescent lamps) and CPO (Cosmopolis lamp). This confirmed that there are considerable savings to be made by using PL-L or LED solutions. For more detailed information, see Appendix E.

7 Implementation of Strategy & Evaluation

7.1 Providing streets with lighting classes:

Provide sites within current programme with lighting classes and appropriate light source by using the following information:

- Environmental zones
- Road hierarchy map
- Accident statistics plan
- Crime map
- Inventory data

7.2 Prioritising replacements:

Column replacement sites will be identified using the following factors:

- Structural condition – information gained from inventory e.g. concrete, cast iron and mild steel columns.
- Accident statistics – liaise with transportation for high accident areas
- Crime – consult with Bedfordshire Police and utilise crime map (Appendix B)
- Energy reduction – identify sites using 80W MBFU lamps to maximise energy savings.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

7.3 Service Connections

We will continue to work with the DNO (Distribution Network Operator) currently EDF Energy to ensure good provision of electrical services to our apparatus.

The DNO's currently have a monopoly for the provision of new supplies connected directly to the DNO Network, and for any repairs needed to that network. The performance of the DNO therefore has a direct impact on the performance of our street lighting service.

For column replacement programmes the increased spacing's gained through lowering lighting levels can sometimes mean new lighting columns are located in different positions to those already on site. In this situation additional costs are generated by the electricity distributor's service charge and potential savings must be measured against losses to ensure the most cost effective design solution is put into practice.

To ensure continued development we will:

- Ensure that all instructions for works sent to the DNO are accurate and include all plans and documentation they require.
- Monitoring the performance of the DNO Edf as per their Service Level Agreement on faults and new connections.
- Whilst connections to street lighting apparatus are outside the provisions of the 1 April 2008 Traffic Management Act (TMA) we will continue with our agreement with the DNO that they continue to work within the spirit of the TMA for the purposes of notification of works and quality of works.
- Investigation will take place into the possibility of;
 - Renting a jointer for Bedfordshire MAC.
 - Independent Connection Provider

DNO Connection charges are shown in table 4 below:

Table 4:

Transfer (within 2m)	Disconnection	New service (within 3m of main)
£426	£365	£650

2009 rates EDF Energy

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

7.4 Commencement of scheme design

- Plan design programme to meet construction programme and budgetary spend.
- We will confirm that the strategy will meet our objectives by:
 - Evaluating lanterns – performance/costs
 - Minimum columns or one for one replacements
 - Carry out (10%) desktop designs to confirm reductions in energy, column numbers reduced and maintenance costs decrease.

7.5 Evaluation of each scheme:

- Carry out an evaluation of project and confirm that the above proposals contribute to the reduction of stock, energy and costs.

8 Existing Trial Sites

Below is a list of existing trial sites that are currently under review:

- A505 – Luton Road, Dunstable – 62 columns installed as part of the improvement works. The WRTL Arc 250W lantern was installed with an electronic control gear which dims between 24:00 and 06:00 to 150W reducing the energy consumption during the dimming period by 40%.
- Pages Park, Leighton Buzzard – Part night lighting installed on cycle way. Lighting units switch off at 22:30 and back on at 06:00.
- Blackbridge Cycle way, Leighton Buzzard – Part night lighting installed on cycle track. Lighting units switch off at 23:00 and turn on at 06:00. The purpose of this installation was for commuters to have a safe journey to and from the train station.

9 Proposed Trial Sites

To be at the forefront of technology we propose a trial site to be implemented in Central Bedfordshire using LED luminaries.

An area in Flitwick has been proposed as a trial site in 2009, this involves the replacement of 196 existing lighting columns with LED lanterns. A further potential site with 119 lighting columns has been suggested in Dunstable. The proposed sites are shown in Appendix D.

A report will be produced detailing the trial scheme at a later date.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

10 Ongoing Maintenance

The overall network has suffered from a lack of investment in respect of lighting assets such as columns, metal and concrete, bollards and signs.

Signs and bollards are an area which would benefit from a replacement programme in conjunction with de-illumination and looking at the type of bollards i.e. none illuminated high visibility flat bollards. We have approximately 3,000 lit signs and bollards on the Central Bedfordshire network.

De-illumination of signs and bollards is discussed in section 5.9 but an area which could be considered in respect of signs is theft on the network due to the metal composition. As a review of the signage there could also be consideration given to utilising different materials which would be less attractive to thieves.

The following objectives will apply for maintenance:

- Thermal Cells to be replaced with PECU 35/18 on maintenance visit where possible.
- Fluorescent illuminated bollards to be replaced with LED gear tray on maintenance visit.
- Lanterns to be replaced with appropriate light source as listed under proposals if lantern is beyond repair (including knock-downs).
- All new units to have electronic control gear.
- Signs to be mounted on column (depending on sign size) to minimise street furniture.
- All MBFU lamps to be replaced by 2015 due to new legislation. As most MBFU lamps are mounted top entry or on telegraph poles, they will require a replacement column. These areas will be targeted and included in the Capital programme.
- LED lanterns to be cleaned every six years at same time as periodic test and inspection.
- Visual structural inspections will be carried out during bulk, lamp, clean and change maintenance visit to identify column replacement sites.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

11 Carbon Reduction Commitment (CRC)

This is a new Government regulation which encourages businesses to become more energy efficient and reduce their carbon emissions. It applies to organisations using 6000MWH of electricity. Under the scheme they will need to purchase carbon allowances for the energy they use and it will provide bonuses for energy efficiency users and penalties for those who are not.

There are many possible ways available to us today by which we can improve the sustainability of the street lighting service for Central Bedfordshire and improve its environmental impact, whilst ensuring that the benefits that street lighting provides to the community are maintained.

This report makes a number of recommendations with the aim to provide a sustainable street lighting service. This will be achieved by ensuring that the correct lamp type and lighting class are selected in accordance with British and European Standards when both new and replacement lighting schemes are installed.

Traffic signs and bollards are only illuminated where the traffic signs regulations require and where illuminated are controlled by photocells. Illuminated street furniture which currently is lit 24hours will have a photocell fitted to regulate unnecessary wastage and light pollution.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

12 Recycling

Typically 350 columns per year have been replaced over the past three years, with the increase of budget this figure will increase to over 1,400 columns per year being disposed of in Central Bedfordshire, together with varying quantities of failed gear components, damaged columns, cabling and other equipment.

The Waste Electrical and Electronic Equipment (WEEE) Directive and the Hazardous Waste Regulations will be followed to ensure as full recycling of waste materials as legally required and economically viable is achieved. Disposal to tip must be the last resort.

Waste will be minimised by:

- Using lamps with longer life thereby extending the bulk lamp change frequency.
- Using the minimum number of lighting units.
- Considering the whole life costs of components used, including the cost of disposal.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

13 Extension Sleeve

The proposals of 1.6m extension sleeve on the existing 5m steel columns, to increase the height and provide better lighting levels may need readjustment of spacing of the existing columns, after the NDT (Non Destructive Test) has been carried out by a suitable sub-contractor. Bedfordshire Highways (Amey) will only install sleeves to those columns that have passed the test. A re-test that CBC may propose in 6 years will benefit from these extensions, as more life expectancy is expected from the extended height of the columns. A Standard detail drawing is attached in Appendix F.

14 Summary

There is a need to change the way we are currently working and adopt the proposals outlined in this report otherwise Central Bedfordshire will be in danger of falling further behind with the advancements in technology and continue to increase its energy consumption. Some of the proposals can be implemented now, but the more technologically advanced initiatives will have to be trialled before a widespread implementation e.g. LED current new innovation that is on the market.

Real energy and carbon savings will be achieved in the following way:

With the continuing focus on reducing street lighting electricity costs and the forthcoming Carbon Reduction Commitment (CRC), good management of street lighting energy has never been more important. Investing in technical solutions from electronic ballasts, LED's, dimming/trimming/part-night photocells to Remote Monitoring Management Systems (RMMS), can all save energy and reduce carbon emissions.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

15 Appendices

Appendix A - Definitions

SON – High-pressure sodium discharge lamp using sodium-mercury amalgam at a high pressure in a ceramic arc tube housed in a tubular or elliptical glass outer envelope.

PL-L – Commonly known as fluorescent lamps. Electrodes at either end of the tube allow a current to be passed through the mercury vapour. This excites the mercury atoms, which emit UV radiation. The glass tube is internally coated with phosphor powder.

LED – Light Emitting Diodes. When current flows across the junctions of certain solid-state semiconductor devices, light is emitted. LED's are lightweight, small, and durable, have long life and produce light almost immediately. They are not affected by frequent switching, and can easily be dimmed.

SOX – Low-pressure sodium discharge lamp only uses sodium vapour at a low pressure in a glass arc tube, housed in a tubular glass outer envelope.

MBFU – A discharge lamp only using mercury vapour at a high pressure in a quartz arc tube housed in an elliptical glass outer envelope.

CPO – Philips Cosmopolis lamp, new-generation ceramic metal halide lamps for outdoor lighting with white light, using clear quartz outer envelope.

CDM – Ceramic metal halide lamp, a discharge tube filled with a small amount of mercury and specific metal halides.

PECU – Photo Electric Control Unit is a sensor that is supplied by a neutral/live/earth feed and switches a load e.g. 150W lamp when it becomes dark, letting electricity flow from the mains side to the load side of the sensor therefore activating the lantern.

Colour rendering – The ability of a light source to render colours of surfaces correctly is quantified by the CIE colour rendering group and the CIE general colour rendering index (Ra)

W-Saving - Light flow regulator (dimming unit) for exterior lighting, for SON and MBF lamps with a maximum power of 250 W.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

CELSave – Permanently wired unit that dims dual tapped magnetic ballasts for HID (SON and metal halide) lamps. This can be installed as new or retrospectively fitted into most lighting columns.

Illuminance (lux) – The magnitude of light landing on a surface. It cannot be seen because it has not yet reached the eye. Illuminance is measured in lux, which are lumens incident on a point per area of the point.

Luminance (cd) – The amount of light that reaches the eye by reflection or by direct emission from a light source. The light reflected from any surface is dependant on the quantity of illuminance, the reflective properties of the surface and the position of the observer with relation to the surface. Luminance is measured in candelas per square metre.

Environmental Zones –

Table 5

Environmental zone	Area	Night-time setting	Example
E1	Natural	Intrinsically dark landscapes	National parks; areas of outstanding beauty
E2	Rural	Low district brightness	Small villages; industrial or residential rural area; relatively dark urban locations
E3	Suburban	Medium district brightness	Small town centres or urban locations; industrial or residential suburbs
E4	Urban	High district brightness	Town centres and commercial areas with high levels of night-time activity

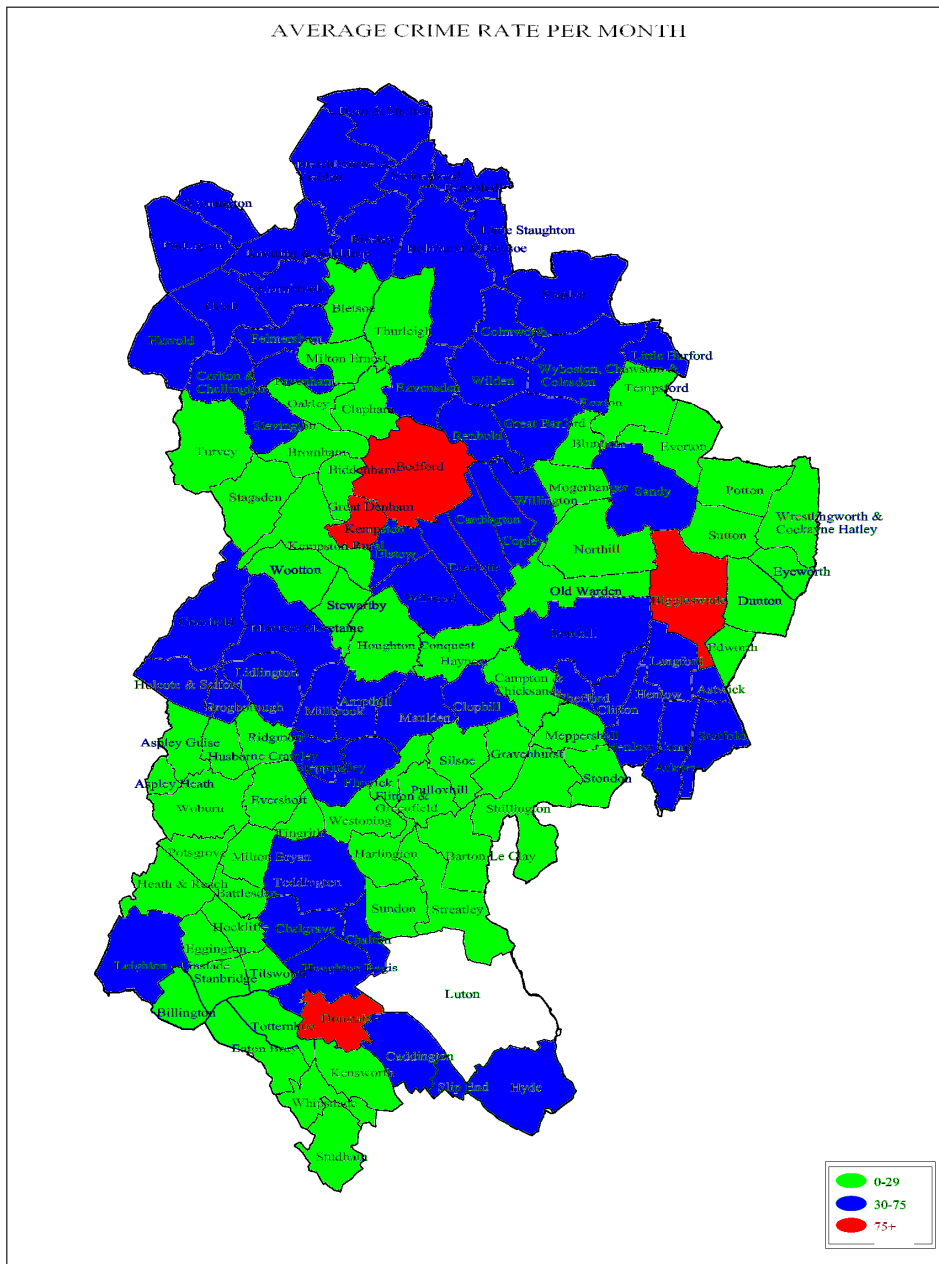
Lighting Classes

Table 6

Class	Description
ME	The ME classes are intended for drivers of motorised vehicles for use on traffic routes, and some residential roads allowing medium to high driving speeds.
CE	The CE classes are intended for drivers of motorised vehicles for use on conflict areas such as shopping streets, road intersections, roundabouts and queuing areas. These classes also have applications for pedestrians and cyclists.
S	The S classes are intended for pedestrian and cyclist use on footways and cycle ways, emergency lanes and other road areas lying separately or along the carriageway of a traffic route, and for residential roads, pedestrian streets, parking areas, etc.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Appendix B – 2009 Crime Map of Bedfordshire



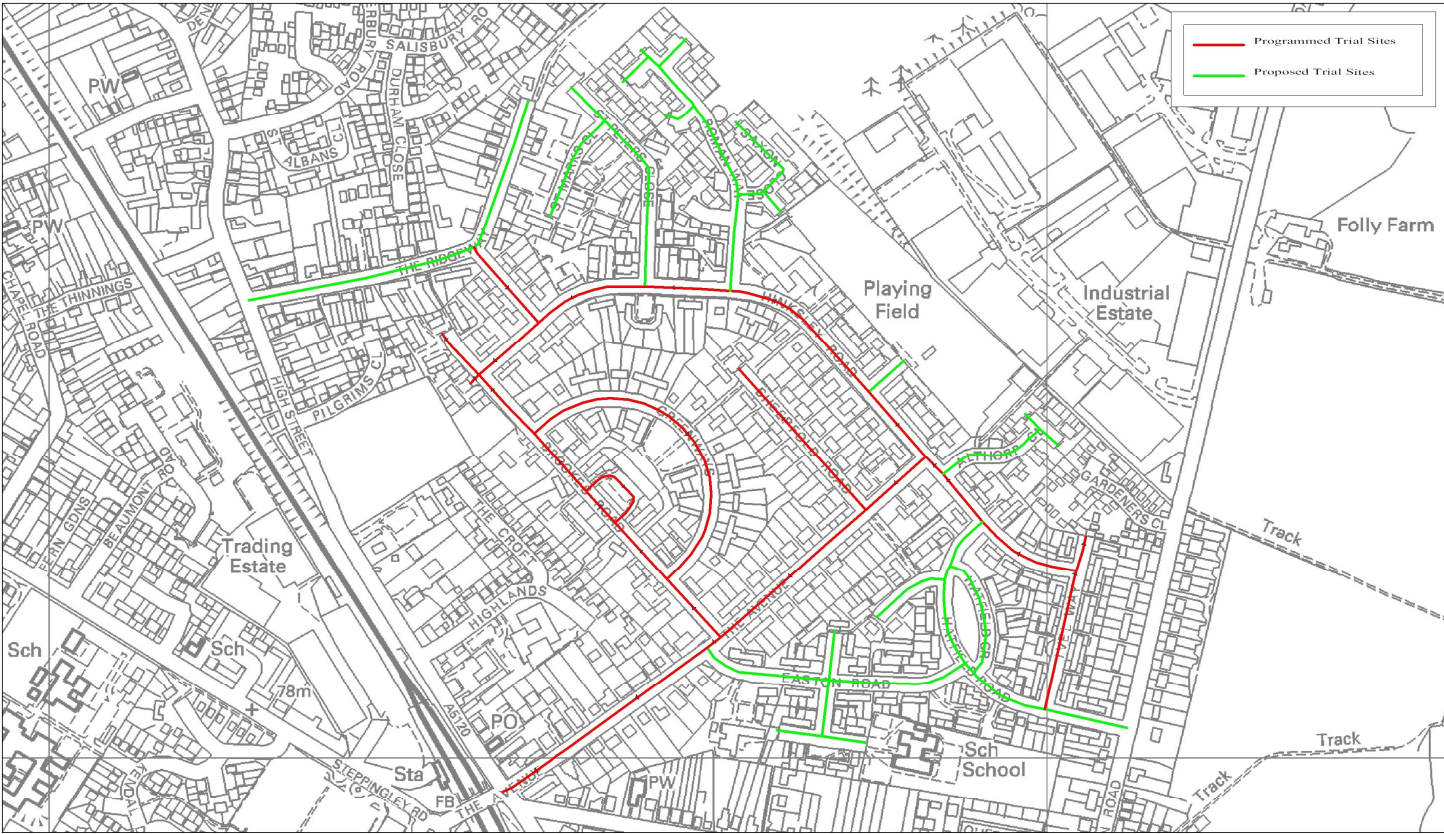
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Title	Central Bedfordshire Lighting Report		

Appendix C - Lamp Comparison

Table 7: Figures may have changed since this table was produced.

Lamp type	Wattages Range (W)	Colour Rendering Index (Ra)	Average Life (burning hours)	Cyclic Maintenance	Lm/W	Notes
SON-T	50 - 1000	20	20000	4 Years	100	
SON DL	150 - 400	60	20000	4 Years	85	
SON Plus	70 - 600	20	20000	4 Years	120	
SOX	18 - 180	< 0	16000	3 Years	160	Poor light control
MBI / HPI	50 - 3500	65 - 90	4 - 20000	4 Years	80 - 100	Not very suitable for street lighting
LED	10 - 80?	66 - 80	50000+ unproven	Clean 4 years (outer)	30	Heat dissipation issues
T8 Fluorescent	10 - 70.	50 - 90+	10000 - 20000	3 - 4 Years	50 - 80	
MBF	50 - 700	40 - 50	20000	4 Years	50	
CDM	35 - 250	85 - 95	10 - 15000	3 Years	90	CDM is Philips lamp
CPO	40 - 140	65 - 70	10 - 15000	3 Years		CPO is Philips lamp

Appendix D - Flitwick trial site plan and spec



Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Table 8: **Flitwick Scheme Briefing - Site Specs**

Equipment Specification	Existing Number of Columns	Quarter & Phase	Lighting Class	Mounting Height	Existing Mounting Height	Lantern Type (Aluminium Canopy)	Existing Lantern Type (Aluminium Canopy)	Overall Maintenance Factor (MF)	Light Source	Existing Light Source
Catherine Road	3	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Hinksley Road	28	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
The Avenue	20	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Easton Road	9	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Hatfield Road	11	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Hatfield Crescent	4	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Hatfield Close	3	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Kingsmoor Close	5	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Easton Close	2	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Althorp Close	12	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
St Pauls Close	2	Q2 - Phase 4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX

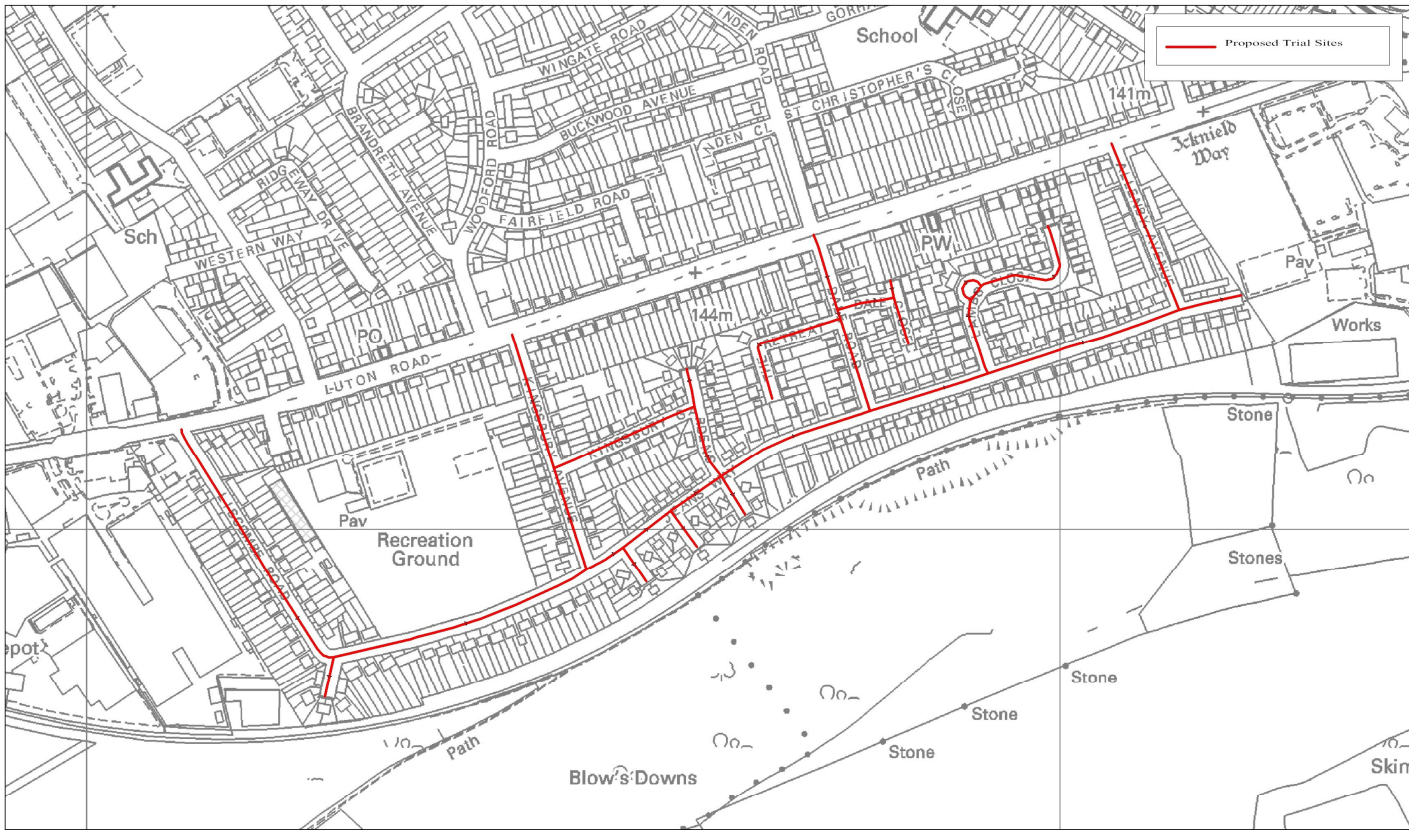
Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Table 9 **Flitwick Scheme Briefing - Site Specs**

Equipment Specification	Existing Number of Columns	Quarter & Phase	Lighting Class	Mounting Height	Existing Mounting Height	Lantern Type (Aluminium Canopy)	Existing Lantern Type (Aluminium Canopy)	Overall Maintenance Factor (MF)	Light Source	Existing Light Source
Brookes Road	17	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Greenways	13	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Sheepfold Hill	8	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Ivel Way	7	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
The Ridgeway	21	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
St Marks Close	6	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
St Peters Close	7	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Roman Way	13	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX
Saxon Close	5	Q2 - Phase 5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	35w SOX

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Appendix D - Dunstable trial site plan and spec



DUNSTABLE LED LUMINAIRE TRIAL SITES 2009/10



Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Table 10:

Dunstable Scheme Briefing - Site Specs

Equipment Specification	Existing Number of Columns	Lighting Class	Mounting Height	Existing Mounting Height	Lantern Type (Aluminium Canopy)	Existing Lantern Type (Aluminium Canopy)	Overall Maintenance Factor (MF)	Light Source	Existing Light Source
Liscombe Road	13	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU
Kingsbury Avenue	9	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU
Kingsbury Gardens	8	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	80w MBFU
Jeans Way	50	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU
Dale Road	7	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU
The Retreat	4	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU
Dale Close	5	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU
Lambs Close	12	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU
Allenby Avenue	7	S5	6	5	WRTL Stella	Thorn – Beta 5	0.75	16 / 21 / 26 / 52W - 18 LED	125w MBFU

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Appendix E - Lantern Comparison

The tables below show the comparison between five different lamp types on a typical street in a housing development.

Suncote Avenue, Dunstable

Table 11

	A	B	C	D	E	F	G	H	I	J	K		
Class	Cols	Lamp Source	Watts (W)	Circuit Watts (per column)	Total Circuit Wattage (kW)	Energy Cost (per annum)	Life time Energy Cost (25 Years)	BC&C Cycle (years)	Typical Lamp Cost	Maintenance cost (life time)	Total Revenue Cost (Life time)	Total Cost (Life time)	CO2 tonnes (life time)
Existing	16	MBFU	80	94	1.504	£615	£15,367	3	£2	£1,556	£16,923	Existing	83.0
S5	15	LED	51	51	0.765	£313	£7,816	25 (clean 6)	£0.00	£400	£8,216	£28,869	42.2
S4	18	SON-T	50	62	1.116	£456	£11,402	4	£10	£2,243	£13,645	£30,588	61.6
S5	18	PL-L	36	36	0.648	£265	£6,620	4	£3	£1,456	£8,076	£24,579	35.8
S5	17	CPO	45	51	0.867	£354	£8,858	3	£25	£4,950	£13,808	£31,349	47.8

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Comparison if all columns were to be replaced on a like for like basis:

Table 12

Class	Cols	Lamp Source	Watts (W)	Circuit Watts (per column)	Total Circuit Wattage (kW)	Energy Cost (per annum)	Life time Energy Cost (25 Years)	BC&C Cycle (years)	Typical Lamp Cost	Maintenance cost (life time)	Total Revenue Cost (Life time)	Total Cost (Life time)	CO2 tonnes (life time)
Existing	80	MBFU	80	94	7.52	£3,073	£76,835	3	£3	£7,780	£84,615	Existing	414.9
N/A	80	LED	18	26	2.08	£850	£21,252	25 (clean 6)	£0.00	£2,133	£23,385	£115,133	114.8
N/A	80	SON-T	50	62	4.96	£2,027	£50,678	4	£10	£9,970	£60,648	£135,952	273.7
N/A	80	PL-L	36	36	2.88	£1,177	£29,426	4	£3	£6,470	£35,896	£109,244	158.9
N/A	80	CPO	45	51	4.08	£1,667	£41,687	3	£25	£23,293	£64,980	£147,528	225.1

Comparison with trimming incorporated:

Table 13

Class	Cols	Lamp Source	Watts (W)	Circuit Watts (per column)	Total Circuit Wattage (kW)	Energy Cost (per annum)	Life time Energy Cost (25 Years)	BC&C Cycle (years)	Typical Lamp Cost	Maintenance cost (life time)	Total Revenue Cost (Life time)	Total Cost (Life time)	CO2 tonnes (life time)
Existing	80	MBFU	80	94	7.52	£3,004	£76,106	3	£3	£7,780	£82,886	Existing	405.6
N/A	80	LED	18	26	2.08	£831	£20,774	25 (clean 6)	£0.00	£2,133	£22,907	£114,655	112.2
N/A	80	SON-T	50	62	4.96	£1,982	£49,538	4	£10	£9,970	£59,508	£134,812	267.5
N/A	80	PL-L	36	36	2.88	£1,151	£28,764	4	£3	£6,470	£35,234	£108,852	155.3
N/A	80	CPO	45	51	4.08	£1,630	£40,749	3	£25	£23,293	£64,042	£146,590	220.0

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Table 11, 12 and 13 notes

$$A \times C / 1000 = D \text{ (kW)}$$

$$\text{Maintenance costs (inc. clean and lamp change and lamp cost)} = H \text{ (£)}$$

$$D \times (4087 \text{ burning hours}) / 10 = E \text{ (£)}$$

$$H + F = I \text{ (£)}$$

$$E \times (25 \text{ years}) = F \text{ (£)}$$

$$I + \text{installation cost (lantern, column, connections)} = J \text{ (£)}$$

$$0.54 \times D \times (4087 \text{ burning hours}) / 1000 \times (25 \text{ years}) = K \text{ (tonnes)}$$

(Based on 0.54kg per kWh – DEFRA guidelines)

For trimming calculations burning hours has been reduced to 3995.

All costs are based on today's prices (2009).

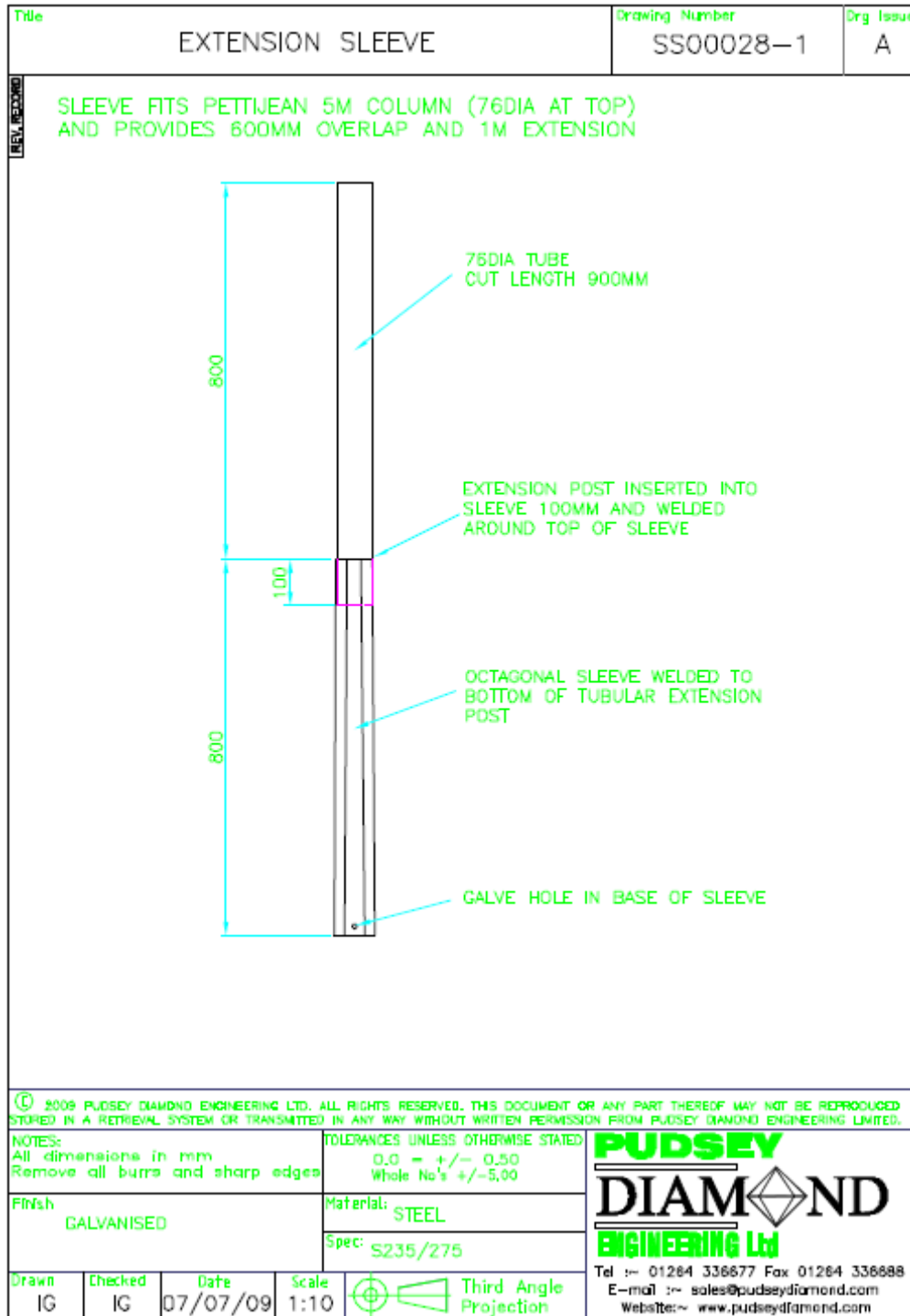
Maintenance cost does not include any traffic management that may be required.

Energy costs are based on £0.10 per kW.

Total life time cost includes installation costs.

Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Appendix F – Standard detail drawing (extension sleeve)



Internal Report		Contract	Bed MAC
Title	Central Bedfordshire Lighting Report		

Appendix G – References

[1] Bedfordshire Highway Lighting Strategy

[2] Bedfordshire Lighting Policy

[3] Bedfordshire Highway Design Guide

[4] ILE Technical Report 24 – Developing a Street Lighting Policy

[5] ILE Module 1 – Light Sources

[6] Well Lit Highways – Road Liaison Group

[7] Bedfordshire Police Department