APPENDIX F – TRAFFIC SIGNALS AND ASSOCIATED EQUIPMENT LIFECYCLE PLAN

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APPENDIX F – TRAFFIC SIGNALS AND ASSOCIATED EQUIPMENT LIFECYCLE PLAN

1.0 INTRODUCTION

1.1 Traffic signal installations form an important part of the highway network and the effective operation and maintenance of these installations are pivotal for the safe movement of traffic, pedestrians and cyclists. Road networks are becoming more and more congested and therefore the need for maintaining the traffic signal installations and indeed other highway infrastructure is becoming increasingly important. Congestion causes increased delays to journeys and this impacts on the economy and the environment (raised levels of carbon dioxide).

1.2 Traffic signal installations require a good regime of maintenance, whether it is reactive or preventative. The maintenance funding for these installations is coming under increased pressure to demonstrate 'value-for-money', performance driven reporting (SPIG) and providing specific levels of service to customers. The asset management methodology set out in this Appendix encompasses the broader principles defined in the Tamp2 document.

1.3 Traffic signal technology is evolving and changing all the time and therefore the maintenance regime related to new developments is still in its infancy. Many of these innovations are related to reducing energy consumption together with the associated carbon dioxide reductions. Two such recent technologies are LED (light emitting diodes) signal heads and ELV (extra low voltage) controllers. These technologies will be actively promoted in our future maintenance regime as they provide 'value for money'; taking into consideration whole life costs, including initial capital cost, maintenance, energy and operation of equipment.

2.0 OBJECTIVES AND REGULATIONS

2.1 The broad goals and objectives of the County Councils' transport system are clearly set out in the Tamp2 document under section 1.2. The particular objectives of the traffic signal maintenance strategy is to ensure that the benefits from these investments continue to be realised through a maintenance regime. This would include routine maintenance and capital replacement of equipment at the end of their operational life. The ongoing system support and maintenance of these facilities is necessary if the benefits achieved by these investments are to be fully realised and exploited.

2.2 The majority of highway maintenance, including traffic signal installations, is based upon statutory duties and powers contained in various legislation. Even in the absence of specific reference to duties and powers, authorities have a general duty of care to users to maintain the highway infrastructure in a state that is safe for use and fit for purpose.

2.3 In section 122 of the Road Traffic Regulation Act 1984, it is stated that authorities should 'secure the expeditious, convenient and safe movement of vehicular and other traffic (including pedestrians)'. A regular and controlled maintenance regime of traffic control systems will have a part to play in meeting this duty.

2.4 All traffic control systems (including traffic signals and their control equipment) used on the public highway is governed by various acts and regulations. The most notable ones are:-

- Traffic Management Act 2004, section 2
- Disability Discrimination Act 2005
- The Traffic Signs Regulations and General Directions 2002
- The Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997.

2.5 Under section 64 of the Road Traffic Regulation Act 1984, all traffic signal displays, road markings, vehicle activated signs and variable message

signs are considered “traffic signs” in legal terms and must comply with ‘The Traffic Signs Regulations and General Direction 2002’.

3.0 INVENTORY

3.1 The main assets to be maintained are the traffic signal control equipment located on the County highway network. These installations are linked by various telecommunication systems to the Leicester City Council’s Area Traffic Control (ATC) offices. This inventory is shown in Table 1.

TABLE 1 – TRAFFIC SIGNALS INSTALLATION INVENTORY

JUNCTIONS	
CONTROLLER SYSTEM	**NUMBER**
UTC	21
SCOOT	52
MOVA	46
VA	2
RMS	17
REM	13
TOTAL	**151**
CROSSINGS	
TYPE	**NUMBER**
PELICAN	122
TOUCAN	39
PUFFIN	3
PEGASUS	1
TOTAL	**165**
OUTSTATION COMMUNICATION	
TYPE	**NUMBER**
RMS	115
REM	90
TELE- 8	16
TELE-12	93
WIZNET	2
TOTAL	**316**

4.0 CONDITION ASSESSMENT

4.1 In order to derive a robust assessment plan, it was necessary at the outset to decide on the factors that influence the renewal of any signal controlled installation. Based on the traffic signals database held at County Hall and the Fault Management System (FMS) database held with the Leicester City Councils' ATC office, the following factors were included in deriving the assessment plan:-

(a) Controller age.

(b) Fault history.

(c) Type of controller - this influences the contract maintenance rates.

4.2 By including these principal factors, it was envisaged that all the critical signal installations that require renewals to be carried out in the five-year period from the financial years 2011/12 to 2015/16 would be flagged and programmed by priority ranking.

4.3 The first step in this process was the interrogation of the County Councils' database to ascertain the type and age of the controllers. The initial search was restricted to controllers that were no older than 1996. This would have meant that the controllers that were commissioned in 1996 would be 20 years old by 2016, which is the last year in the five-year analysis period. The aim of this process was to get a renewal database in excess of 25 installations i.e. five renewals per year for a 5-year period. This process resulted in 35 sites, but some of these would not have been straightforward renewals as they were linked with other associated changes that would require funds from different programmes (e.g. developer-funded alterations with no defined timescale).

4.4 Fault history information from ATC's Fault Management System (FMS) database was obtained and analysed over a 3-year period from 2006 to 2008 (inclusive). This database had the faults categorised into some 100 categories. In order to rationalise and simplify the fault history, it was decided that these categories would be translated into three groupings;

namely controller, cable and lamp faults. The fault history of the signal installation list identified in 4.3 above was obtained from the FMS database. The resultant list included the controller age, type and fault history of the installations.

4.5 The next stage involved a ranking process of the sites so that some sort of a priority listing was derived to plan the renewal programme. It was also necessary to separate out the junction installations from the pelican/toucan installations so that the target renewal of five sites per year is achieved within the possible funding allocation for a particular year. The ranking process was based on the following weighting points:-

(a) **Controller age**

less than 20 years (after 1996) = 1

greater than 20 years (before 1996) = 2

(b) **Controller type**

T800 = 0 ,

T400/T200 =1,

PCL110/125 = 2,

GEC25/APC/3000 = 3

(c) **Total number of faults**

less than 5 = 1

greater than 5 less than 10 = 2

greater than 10 less than 15 = 3

greater than 15 less than 20 = 4

greater than 20 less than 25 = 5, etc.

(d) **Controller faults**

less than 10 = 1

greater than 10 less than 20 = 2

greater than 20 less than 30 = 3

greater than 30 less than 40 = 4

greater than 40 less than 50 = 5, etc.

4.6 Based on the above weighting, an empirical formula was derived for the ranking process, as shown below:-

RANKING = 50*AGE WEIGHTING + 30*CONTROLLER TYPE WEIGHTING + 5*TOTAL FAULTS WEIGHTING + 15*CONTROLLER FAULTS WEIGHTING

The ranking formula is based on putting the highest emphasis on the age of the signal installation followed by the controller type, as this has an impact on the maintenance costs. The controller faults then takes precedence over the total number of faults in this ranking process. From this process, a renewal priority listing for junctions and pelicans was derived for the lifecycle planning.

5.0 LIFECYCLE PLANNING

5.1 The Tamp2 goals regarding traffic signal installations specify that no more than 4% of the signal stock should be more than 20 years old and all future installations (including renewals & modifications) should have ELV/LED equipment to reduce energy costs and carbon dioxide emissions. The target of 4% was defined in LTP2 and this figure is still appropriate in order to provide a good maintenance regime.

5.2 Traffic signal installations generally have a 'design life' of approximately 20 years after which; it is standard practice to renew the site to minimise the maintenance costs, reduce the fault occurrences and hence the reliability and efficiency of the installation.

5.3 In order to assess the number of sites that would be over 20 years old in each of the five years 2011/12 to 2015/16, an analysis of the traffic signals database was carried out. The profile is shown in Table 2 and assumes that there would be three new signal installations in each of these years. This assumption is based on historical information gathered over the last five years.

TABLE 2 – PROFILE OF SITES OVER 20 YEARS

YEARS	CUMULATIVE NUMBER OF SITES OVER 20 YEARS	ESTIMATED TOTAL NUMBER OF SITES EACH YEAR	CUMULATIVE PERCENTAGE OF SITES OVER 20 YEARS
2011/12	6	316	1.9%
2012/13	11	319	3.5%
2013/14	17	322	5.3%
2014/15	22	325	6.8%
2015/16	35	328	10.7%

5.4 It is apparent from the above table that pro-active action and early intervention is required to safeguard the signal installation assets. The Tamp2 target of less that 4% of the stock requiring complete renewal at the end of this period would clearly not be met if there were no strategy in place to deal with this issue. In addition, if the assumed three new installations per year does not materialise, then the percentage sites over 20 years will be higher then that shown in the above table.

5.5 An analysis based on carrying out five renewals per year over a five-year period was carried out to gauge how this would influence the signal assets. This is profiled in Table 3.

TABLE 3 – PROFILE OF SITES OVER 20 YEARS IF 5 RENEWALS PER YEAR ARE CARRIED OUT

YEAR	CUMULATIVE PERCENTAGE OF SITES OVER 20 YEARS	CUMULATIVE PERCENTAGE OF SITES OVER 20 YEARS IF 5 RENEWALS PER YEAR ARE CARRIED OUT
2011/12	1.9%	0.32%
2012/13	3.5%	0.31%
2013/14	5.3%	0.62%
2014/15	6.8%	0.62%
2015/16	10.7%	3.05%

5.6 Table 3 clearly shows that there is an economic case to carry out timely renewals to bring down the percentages and avoid reactive decisions and interventions in future years.

5.7 In addition to the above argument, there is a need to provide energy efficiency savings and reduce the carbon footprint from these installations. Advances in traffic signal technology means that there are products in the market that consume less electricity and hence the associated reduction in carbon dioxide emissions.

5.8 Two products on the market that would have the most impact are LED signal heads and ELV controllers. The LED technology relating to the design and manufacturing process has improved recently with suppliers generally offering at least a 5-year warranty. The ELV controllers have the added benefit of reducing the number of cables required underground and improves safety in the event of accidental or malicious damage. The combined impact of switching to these two technologies provides the greatest energy reduction benefits.

5.9 However, there are various issues relating to safety functions that need resolving and this is mainly to do with compatibility between different suppliers equipment. In addition, the current maintenance contract between Leicester City Council and a signals company; to which our Council contributes yearly, incurs heavier maintenance costs for LED heads and ELV controllers supplied by any other company.

5.10 Notwithstanding the above surmountable shortcomings, a renewal strategy that focuses on the triple objectives of reliable equipment, energy efficiency and reduction in the carbon footprint is the way forward for the future.

6.0 ENERGY, BUDGETS AND CARBON FOOTRPRINT ISSUES

6.1 To assess the energy savings and carbon dioxide reduction for completing 25 renewals (i.e. 5 per year), a desktop analysis was carried out. The energy savings profile is shown in Table 4.

TABLE 4 – ENERGY SAVINGS PROFILE FOR 25 RENEWAL SITES

YEARS	ENERGY COST FOR NON-LED SITES (2010/11 PRICES)	ENERGY COST FOR LED RENEWED SITES (2010/11 PRICES)	TOTAL ENERGY COST BASED ON RENEWAL PROFILE	EXISTING ENERGY COST FOR 25 SITES	ENERGY SAVING PROFILE	PERCENTAGE SAVING PROFILE WHEN COMPARED WITH ALL SITES (328 SITES)
2011/12	£16922	£1249	£18171	£21152	£2981	2%
2012/13	£12691	£2498	£15189	£21152	£5963	3%
2013/14	£8461	£3747	£12208	£21152	£8944	5%
2014/15	£4230	£4997	£9227	£21152	£11925	7%
2015/16	£0	£6261	£6261	£21152	£14891	8%
TOTAL ENERGY SAVING BY 2016 ('2010/11) PRICES = **£44704**						

6.2 The above table clearly shows that there is energy efficiency savings associated with this renewal strategy. The current energy price is 8.01 pence per kWh (kilo watt-hour). For every increase in the energy price of 1 pence per kWh, there would be an additional saving in the energy cost of some £2000 per year for the target of 25 renewal sites.

6.3 An expenditure profile based on carrying out five renewals/year over a 5-year period is profiled in Table 5. Historical costs associated with junction and pelican renewals were used to derive this budget costs. The additional cost associated with ELV/LED equipment is separated out in this profile to show the 'spend to save' element of the total cost.

TABLE 5 – FULL EXPENDITURE PROFILE

		FIVE YEAR PERIOD 2009/10 PRICES				
	TYPICAL COST OF ONE RENEWAL (£000s)	YEAR 1 2011/12 (£000s) * (SITES)	YEAR 2 2012/13 (£000s) * (SITES)	YEAR 3 2013/14 (£000s) * (SITES)	YEAR 4 2014/15 (£000s) * (SITES)	YEAR 5 2015/16 (£000s) * (SITES)
CONVENTIONAL JUNCTION (EQUIP.)	37	111 * (3)	111 *(3)	74 *(2)	74 * (2)	74 *(2)
ELV/LED JUNCTION (EQUIP)	45	135 * (3)	135* (3)	90* (2)	90* (2)	90* (2)
ADDITIONAL COST FOR ELV/LED JN. (SPEND TO SAVE)	8	24 * (3)	24* (3)	16* (2)	16* (2)	16* (2)
CONVENTIONAL PELICAN/TOUCAN	10	20 * (2)	20* (2)	30* (3)	30* (3)	30* (3)
ELV/LED PELICAN/TOUCAN	12	24 * (2)	24* (2)	36* (3)	36* (3)	36* (3)
ADDITIONAL COST FOR ELV/LED PELICAN/TOUCAN (SPEND TO SAVE)	2	4* (2)	4* (2)	6* (3)	6* (3)	6* (3)
DESIGN FEES FOR JUNCTION	7	21* (3)	21* (3)	14* (2)	14* (2)	14* (2)
DESIGN FEES FOR PELICAN/TOUCAN	5	10* (2)	10* (2)	15* (3)	15* (3)	15* (3)
WORKS COST FOR JUNCTION	21	63* (3)	63* (3)	42* (2)	42* (2)	42* (2)
WORKS COST FOR PELICAN/TOUCAN	7	14* (2)	14* (2)	21* (3)	21* (3)	21* (3)
TOTAL COST FOR ELV/LED JUNCTION	73	219* (3)	219* (3)	146* (2)	146* (2)	146* (2)
TOTAL COST FOR ELV/LED PELICAN/TOUCAN	24	48* (2)	48* (2)	72* (3)	72* (3)	72* (3)
TOTAL COST FOR 5 RENEWALS(ELV/LED)	N/A	267* (5)	267* (5)	218* (5)	218* (5)	218* (5)

6.4 The expenditure profile outlined in the above table is summarised in Table 6. This shows the total cost of carrying out 25 renewals over a 5-year period with the associated additional expenditure for ELV/LED equipment.

TABLE 6 – SUMMARISED EXPENDITURE PROFILE

	FIVE YEAR PERIOD 2009/10 PRICES				
	YEAR 1 2011/12 (£000s) * (SITES)	YEAR 2 2012/13 (£000s) * (SITES)	YEAR 3 2013/14 (£000s) * (SITES)	YEAR 4 2014/15 (£000s) * (SITES)	YEAR 5 2015/16 (£000s) * (SITES)
JUNCTIONS (EQUIPMENT+WORKS+DESIGN)	219 *(3)	219*(3)	146*(2)	146*(2)	146*(2)
PELICAN/TOUCANS (EQUIPMENT+WORKS+DESIGN)	48 *(2)	48*(2)	72*(3)	72*(3)	72*(3)
TOTAL RENEWAL COST (£1.188m)	267 *(5)	267*(5)	218*(5)	218*(5)	218*(5)
SPEND TO SAVE ELEMENT OF THE TOTAL RENEWAL COST (ELV/LED EQUIPMENT ONLY) (£122k)	28 *(5)	28*(5)	22*(5)	22*(5)	22*(5)
POSSIBLE LTP3 ELEMENT OF THE TOTAL RENEWAL COST (£1.066m)	239 *(5)	239*(5)	196*(5)	196*(5)	196*(5)

6.5 When compared with the total projected expenditure profile over the 5-year period (£1.188m), the 'spend to save' element is relatively small (£122k). The costs profiled in this table are at 2009/10 prices and the outturn prices would need to be factored in at the appropriate time.

6.6 From Table 4, the total energy saved when all the 25 renewals are completed by 2016 is approximately £45k and the annual energy saving would be approximately £15k for the next 15 years, assuming a standard equipment life of 20 years. This equates to recouping the full additional 'spend to save' outlay in 10 years i.e. by 2021. After this, there would be further savings of £150k for a period of 10 years (i.e. £15k x 10 years) up to the end of the working life of the signals equipment.

6.7 Therefore, the actual cost of carrying out the 25 renewals would be £1.038m (i.e. £1.188 - £0.150) as some of the costs are recouped through energy savings using ELV/LED equipment.

6.8 It should also be noted that if the energy prices go up (see para. 6.2) then there would be a quicker 'pay back' on the 'spend to save' expenditure.

6.9 The associated carbon dioxide saving is profiled in Table 7.

TABLE 7 – CARBON DIOXIDE SAVINGS PROFILE

YEARS	TOTAL CARBON DIOXIDE USAGE FOR 25 SITES (tons)	RENEWAL PROFILE (SITES)	TOTAL CARBON DIOXIDE USAGE BASED ON RENEWAL PROFILE (tons)	CARBON DIOXIDE REDUCTION PROFILE FOR 25 SITES (tons)	% REDUCTION PROFILE FOR 25 SITES	% REDUCTION PROFILE WHEN COMPARED WITH ALL SITES (328 SITES)
2011/12	17.89	5	15.48	2.41	13%	1%
2012/13	17.89	10	13.07	4.82	27%	3%
2013/14	17.89	15	10.66	7.23	40%	4%
2014/15	17.89	20	8.25	9.64	54%	6%
2015/16	17.89	25	5.84	12.05	67%	7%
	TOTAL CARBON DIOXIDE REDUCTION BY 2016 (tons)			**36.15**		

6.10 The carbon dioxide reduction is modest for renewing 25 sites and the 'whole life' savings in these emissions would be some 217 tons.

7.0 URBAN TRAFFIC CONTROL & MANAGEMENT (UTMC) ISSUES

7.1 The UTMC system, housed at the Leicester City Councils' ATC offices, support the transport strategies of the City and County Council. Many of the recent UTMC development projects are funded on a cost-sharing basis between the two authorities, whilst other projects have been entirely

funded by the authority gaining the benefit. The main areas of the works programme in recent years that has been carried out are outlined below:-

- Expansion of the COMET system as a data management facility to assist with strategic traffic management.
- Upgrading the SCOOT system to a newer one called PC SCOOT.
- Establishing new SCOOT regions and validating existing regions.
- Completion of the primary upgrade of the CCTV system within the control centre.
- Continuation of the upgrade of the communication systems with the aim of reducing future financial commitments.
- Continued modifications and upgrade of the Traffic Information System Data Base (TISDB). The traffic and travel website delivers the latest information on traffic conditions, congestion, road works and accidents.
- Further development of the star trak bus priority facility.

7.2 The instation equipment that is jointly owned by the Leicester City and County Council is profiled in Table 8.

TABLE 8 – UTMC SYSTEMS & HARDWARE INVENTORY

PC SCOOT	Monitoring and managing a network of signal installations
REMAC	Remote monitoring of isolated signal installations (PEEK company)
RMS	Remote monitoring of isolated signal installations (SIEMENS company)
SIESPACE	Controls car park guidance VMS signs
COMET	Traffic management system–for transport management and information.
TIS DB	Traffic information system & database
TDAS	Traffic database analysis system
CCTV	Dedicated cameras to monitor traffic congestion at specific hot spots
FAULT MGMT.	Reports and records faults for signal installations
WORKSTATIONS & SERVERS	Supports the above systems

7.3 The funding to maintain the UTMC assets are allocated centrally from the revenue budget under UTC System Maintenance. The UTMC development projects are contained in a yearly business case jointly agreed between the City and the County. The funding for these projects was through the LTP2 capital allocation. It is expected that a similar arrangement will be in place during the LTP3 period to fund various UTMC development projects that have direct benefits to the County road network and its users.

8.0 TELECOMMUNICATION ISSUES

8.1 Telecommunications are required at all sites where traffic signal control is present to enable the systems at ATC to monitor sites for faults, synchronisation of time of day settings and intervention at linked sites. There are several methods through which this link between the sites and ATC is provided:-

- British Telecommunication (BT) – for stand alone sites – RMS, REMAC & MOVA – 190
- BT – Tele 8 (2 wire) – for networked junctions and UTC sites – 16
- BT – Tele 12 (4 wire) – for networked junctions and UTC sites – 93
- GSM (Global System & Mobile communications) - for stand alone remote sites – 14
- LCC Private network (piggy backed onto CCTV lines) – exact figure unavailable

8.2 Isolated junctions and pedestrian crossing sites require only a basic means of connection to the ATC control room. The function of this link is to allow 'dialing-in' to the site from the control room. A report can then be obtained confirming that the site is operating correctly and allows synchronisation of the internal controller clock. Most of these isolated sites have a BT line that currently have an associated revenue rental cost

of £150 per year per line. There is a potential revenue saving of approximately 25% if the switch is made from BT to GSM (annual cost of £114). However, there is an upfront cost of £850 to change some parts in the controller for compability to the GSM system. There is also a limitation to the mobile network and therefore some sites would not be suitable for this type of communication. Therefore, at present, the adopted strategy on the form of communication is to assess each site when it is due for renewal.

8.3 Grouped installations in urban areas operating under UTC or SCOOT system of control require communication in 'real time' so that information is passed continuously between the sites and the ATC control room to influence the operation of the site. The revenue cost associated with this BT circuit line is on average £2400 per annum but the cost would be higher if the SCOOT network is denser. Currently the strategy being adopted is to use the private network, wherever possible, as this allows the use of the spare capacity within the CCTV network. By utilising the existing capacity within the CCTV circuit, the cost of data transmission from site to the control room is free of charge.

9.0 RISK ASSESSMENT

9.1 Managing all the risks associated with traffic signal installations in an appropriate manner is important. Failure of equipment through insufficient maintenance or replacement regime can cause injury or loss of life to the travelling public and can cause delays that would impact on the economy and the environment (raised levels of carbon dioxide).

9.2 An assessment based on various risks has been carried out using the County's corporate risk management guidance and shown in Table 9:-

TABLE 9– RISK ASSESSMENT

RISK TYPE	DESCRIPTION	IMPACT & LIKELIHOOD	ACTION REQD.
Physical	This would include such items as accident damage, corrosion, component failure, cable & detection fault etc.	C2	No – Regular inspection carried out by maintenance contractor and fault reporting system linked to ATC.
Business	Traffic signal operations are high profile and attract public attention. This could affect the image of the County Council.	D2	No – Complaints on traffic signal operation are checked immediately and yearly SCOOT validation embedded in the Service Level Agreement (SLA)
Financial	Growing backlog of aging installations and lack of proper maintenance and timely action is more expensive in the long run. There is also increased risk of accident claims.	B2	Yes – Pro-active renewal strategy being developed for LTP3 Implementation Plan. Funding issues to be raised when budgets are discussed.
Environmental	Poorly maintained installations can increase pollution. Use of LED/ELV equipment will translate into lower CO2 emissions.	C3	No – Renewal strategy will embed the use of LED/ELV equipment.
Network Management	Reliable journey times accords with the Traffic Management Act 2004.	C3	No – Junctions and networks are monitored to see if there is any deterioration in journey times.

9.3 From Table 9, lack of finance presents the highest risk to the lifecycle plan presented in this Appendix. To mitigate this, the actions are outlined in this table and further risk management strategies may be required once the LTP3 document clarifies issues on asset management.

10.0 RECOMMENDATIONS

10.1 This Appendix has covered all the issues related to traffic signal installations. The lifecycle plan presented shows clear benefits associated with a good maintenance regime and there is a need to progress and carry on with the renewal strategy.

10.2 There is clear evidence that energy efficiencies can be gained together with a reduction in the carbon footprint. The 'spend to save' element of

the total cost is relatively small and this cost is realised in approximately 10 years with accrued savings after this claw back period.

10.3 There may be a case to accelerate the renewal process to reduce the energy costs and hence the carbon dioxide emissions; if funding is available over and above that set out in this Appendix. Any acceleration of the renewal process will contribute to the County Councils' corporate carbon dioxide reduction target.

10.4 It is also recommended that all future new or modified traffic signal installations should have ELV/LED equipment to reduce the energy costs and the carbon dioxide emissions.

10.5 For all new, modified or renewed sites, GSM technology should be the first choice for telecommunications, and if this is not feasible then other forms of communication should be considered.

10.6 The UTMC issues and projects should be jointly considered with the City Council's ATC, and the yearly funding allocation should be based on an approved business case submitted by ATC.