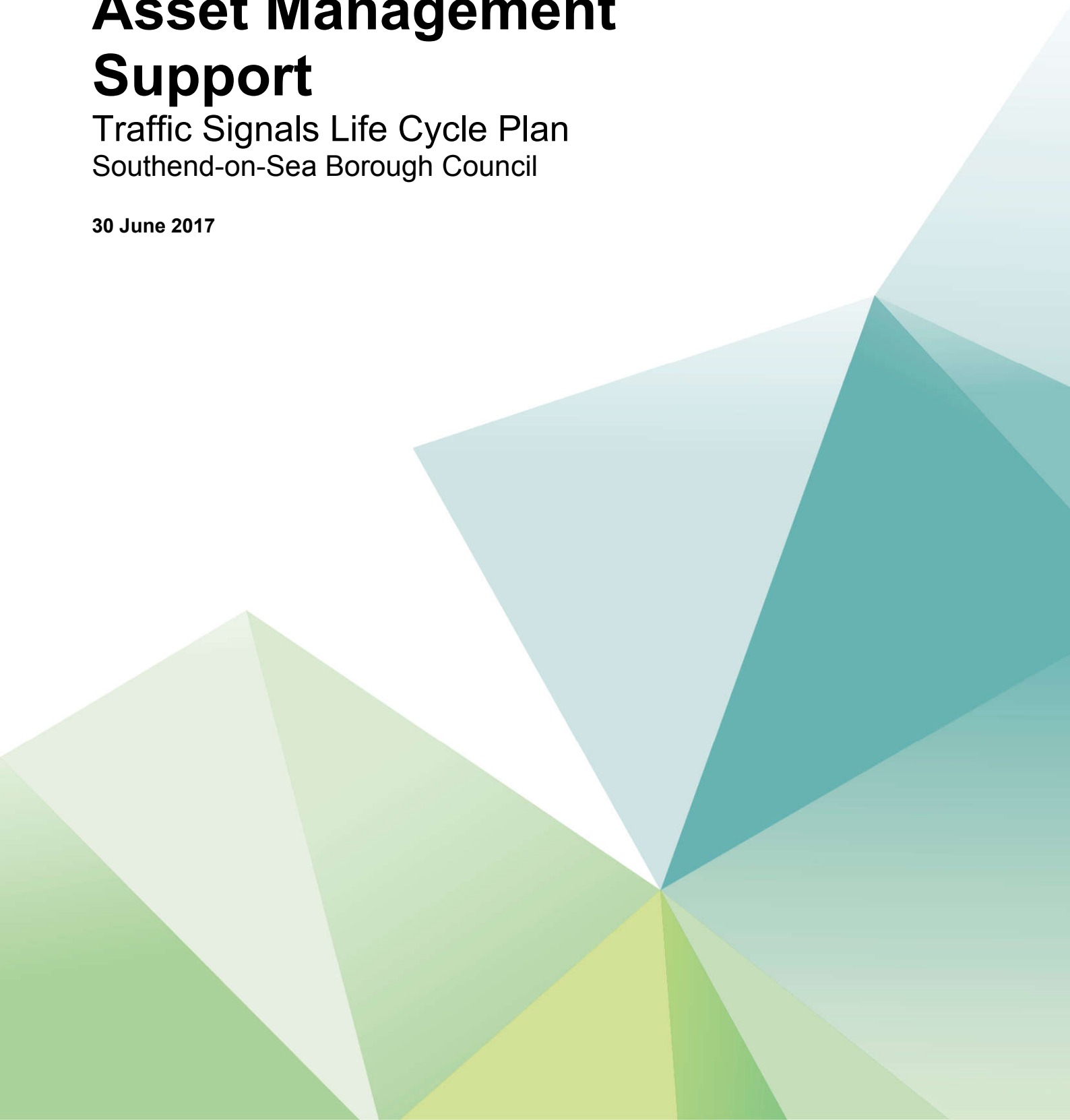
ATKINS

Southend-on-Sea Council Asset Management Support

Traffic Signals Life Cycle Plan

Southend-on-Sea Borough Council

30 June 2017



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This document has 28 pages including the cover.

Document history

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Executive summary

Life Cycle Planning (LCP) driving planned maintenance and renewals programmes supports the effective management of highway assets, improving safety through prioritising interventions, improving serviceability through more effective and timely maintenance and reducing the whole life cost of managing the asset.

LCP is most effective when run over several scenarios so that the approach can be optimised to the available budgets, and supported by a value management process to ensure other network risks are adequately taken into consideration when finalising a works programme, including value engineering and delivery optimisation.

To achieve Band 3 Incentive Funding, also requires authorities to undertake LCP on all major assets, which are categorised as carriageways, footways & cycleways, structures, street lighting and traffic signals. Southend-on-Sea Council (SC) has been conducting LCP for carriageways and footways for several years, however it has never previously been undertaken on the Traffic Signal assets

Therefore, for Traffic Signals three scenarios were analysed using the HMEP Ancillary Assets LCP toolkit:

- Budget Constraint,
- Repair on Failure and
- Service Life

The **Budget Constraint** scenario restricts the budget to the existing level of capital funding of £200,000;

The **Replace on failure** scenario has an unrestricted budget, but maintenance will only be undertaken on failed assets.

The **Service life** scenario has an unrestricted budget and replaces the asset when the asset reaches the manufacturers design life.

Analysis indicates that for the **Replace on Failure** scenario the budget levels are sufficient to maintain the existing traffic signal stock at the levels of service This scenario provides a deterioration model for the condition of the traffic signals stock and shows the annual budget required for this scenario is, on average, £35,558 to replace failed assets. It should be noted that this report only investigates the capital maintenance costs and it is predicted that the revenue costs for managing the “Replace on failure” scenarios would increase due to the necessary inspection/survey regime required to manage the aging asset stock.

It must also be considered that the “Replace on Failure” scenario implicitly increase the stock on the network that is likely to rapidly fail and the reputational and third party liability risks should be very carefully considered. There will also be increased operational costs from this approach which requires an ad-hoc replacement of assets across the network.

1. Introduction

Southend on Sea Council (SC) have an aspiration to improve the management of their highway infrastructure assets and become a Band 3 incentive fund authority, as determined by the annual self-assessment questionnaire submission required by the Department for Transport (DfT) each autumn.

To reach the aspired Band 3 funding levels, areas for improvement were investigated and it was identified that SC already conducted Lifecycle Planning (LCP) across some of the major assets, such as carriageways, however it was identified that expanding LCP across all major assets would assist SC achieve Band 3 funding levels.

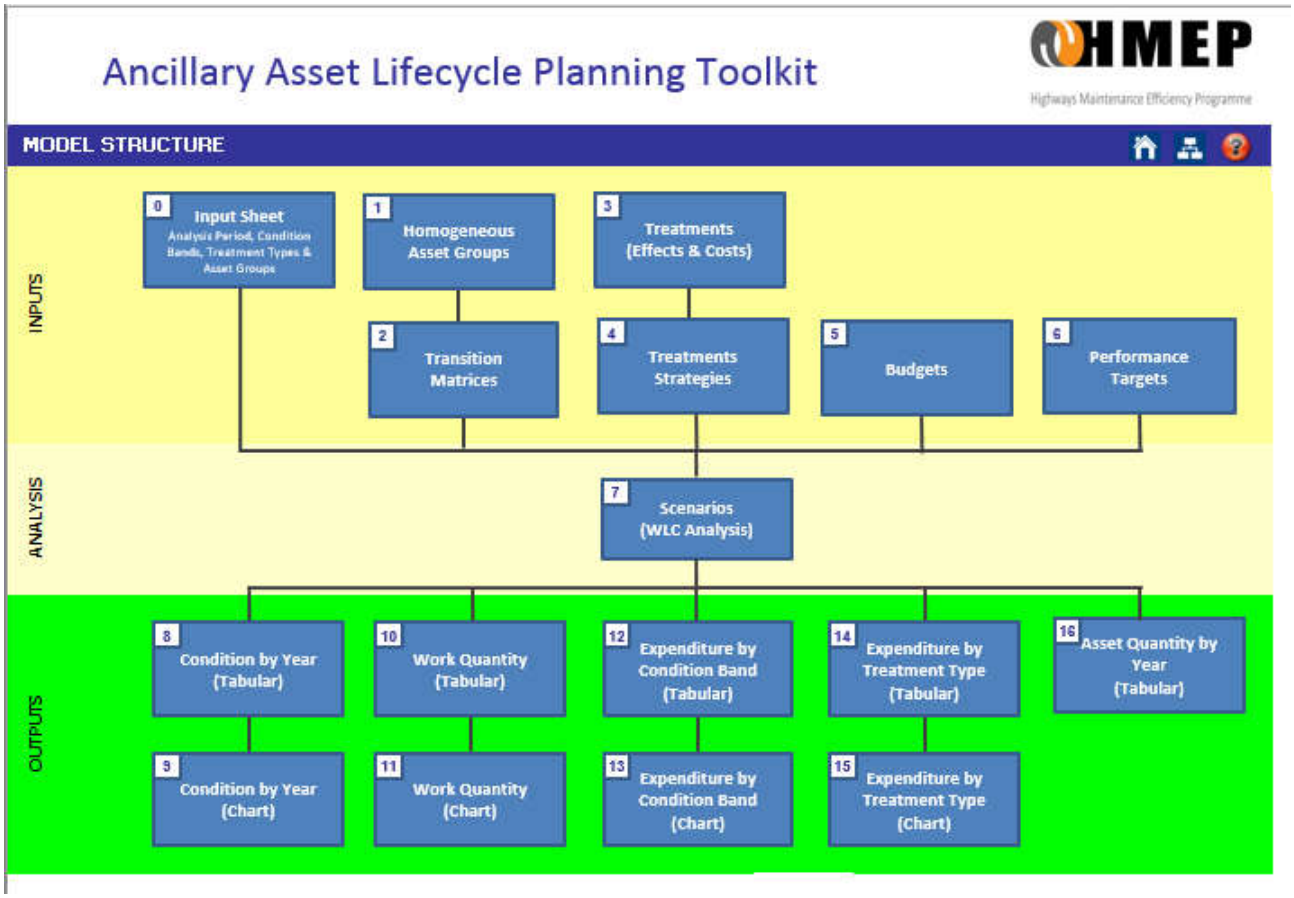
Atkins has been supporting SC, as a critical friend, in developing their asset management service and were commissioned to support SC with developing the LCP for Traffic Signals.

2. Methodology

The Traffic Signals LCP has been conducted utilising the HMEP Ancillary Asset Lifecycle Planning Toolkit. This toolkit is a high-level network tool which provides an overview of the impact of different scenarios across the network and asset type.

Figure 2-1 provides an overview of the HMEP Ancillary Asset Lifecycle Planning Toolkit model structure:

Figure 2-1 HMEP Ancillary Asset Lifecycle Planning Toolkit Model Structure



2.1. Data

SC has provided Atkins with asset data (excel file format) containing the following information:

1. Traffic Signals asset inventory
2. Traffic Signals schedule of rates for maintenance

Appendix A includes an overview of the information received from SC.

2.2. Data Review

The data received from SC was reviewed to identify any gaps in the data, from which an exception report was produced and issued. Upon receipt of the exception report, SC provided additional information regarding the data gaps, with clarification of the projected annual budget and the expected service life of each asset type. All information received from SC has been utilised in the development of the LCP.

2.3. HMEP Ancillary Asset Planning Toolkit

The HMEP Ancillary Asset Lifecycle Planning Toolkit has been used to undertake the LCP analysis; the default toolkit is empty, therefore it had to be setup and calibrated using our experience and the information received from SC.

The following sub-sections describe the parameters and settings employed in the HMEP Ancillary Asset Lifecycle Planning Toolkit based on experience and the information received.

2.3.1. Asset Groups

Asset Groups are an important part of the HMEP Ancillary Asset Lifecycle Planning Toolkit; the asset groups are the foundation of the LCP, allowing asset groups properties to differ, such as replacement costs, deterioration rates and treatment regime.

Based on the information provided by SC, 16 unique asset groups have been generated. A comprehensive overview of the asset groups is contained in Appendix B.

2.3.2. Condition Data

SC provided Atkins with the installation dates for the Traffic Signals assets, allowing condition bands to be calculated. The HMEP Ancillary Asset Lifecycle Planning Toolkit allows a maximum of ten condition bands which were determined by evenly distributing the bands along the installation and expected design life age range for each asset type, plus including two additional bands for “Beyond Expected Life” (BEL) and “Failure”. Assets are not expected to fail once they surpass their design life, in many cases assets can be in service a long time after; therefore, the BEL band is used for these assets. However further development of the BEL band is required to establish an industry standard empirical BEL factor that can be applied to the Manufacturers service life. The failure band is used for assets which require replacement after inspection or in the rare instances of failure.

Appendix B provides the distribution of condition across each asset group and Appendix C contains additional information regarding the Condition Bands.

2.3.3. Treatments, Effects and Costs

The desired treatment strategy is to replace the current heads with LED equivalent solutions, and like for like replacements for all other Traffic Signal assets. Replacement costs for this have been derived from the schedule of rates supplied by SC. Therefore, the effects of the works would replace the asset and reset the condition to an “as new” condition.

Appendix D provides information regarding the treatments and costs for each asset group.

2.3.3.1. Inflation

It should be noted that the HMEP Ancillary Asset Lifecycle Planning Toolkit does not take into consideration inflation or Net Present Value, therefore all treatment costs have not been inflated or discounted over the 25-year analysis period.

2.3.4. Transition Matrix

The HMEP Ancillary Asset Lifecycle Planning Toolkit utilises a transition matrix to model the deterioration of the Traffic Signal condition. Transition matrix deteriorates the data by transferring a percentage of one condition band into one or more condition bands. For example, assume that 5% of 'Very Good' will deteriorate into 'Good' each year, therefore if there are 100 Wait Lamps of 'Very Good' condition in year 0, assuming no deterioration of the Good condition band, then:

Table 2-1 Transition Example

Year	Very Good Condition Area	Good Condition Area
0	100	-
1	95	5
2	90.25	9.75
3	85.74	14.26

Appendix E contains a copy of the transition matrix utilised for the analysis.

2.3.5. Scenarios

The two scenarios "budget constraint" and "replace on failure" taken from the "Life Cycle Planning for Critical Assets and Highway Infrastructure Asset Management Plan" proposal have been analysed. Also, an additional "Service Life" scenario has been analysed. Table 2-2 below provides a description of each scenario and the treatment strategy utilised:

Table 2-2 Scenario Descriptions

Scenario Name	Scenario Description	Treatment Strategy
Budget Constraint	Analysis is constrained to a budget; the budget agreed was based on existing levels of funding of £200,000 (± £10,000) capital maintenance per annum.	1. Replace failed Traffic Signal Assets.
Replace on failure	Analysis is unrestrained, but will only replace assets when they are deemed to have failed.	1. Replace Traffic Signal Assets that have failed.
Service Life	Analysis is unrestrained, but will only replace assets when the asset has reached its design/service life.	1. Replace Traffic Signal assets that have reached or surpassed Service Life.

3. Outputs

The HMEP Ancillary Asset Lifecycle Planning Toolkit provides information regarding the expenditure and the projected asset condition profiles over the 25 years' analysis period. This section reports the outputs from the HMEP Ancillary Asset Lifecycle Planning Toolkit for the three scenarios "Budget Constraint", "Replace on failure" and "Service Life" highlighted in section 2.3.5. All analysis has been completed utilising the parameters specified in Section 2 of this report and no inflation or discounts have been applied to the costs.

3.1. "Budget Constraint" Scenario

Figures 3-1 to 3-6, below, provide the Condition Band profiles for the Signal Heads, Box LEDs, Detectors, Mounting Posts, Outstation Transmission Units and Technology Cards.

Figure 3-1 % Distribution of Assets in Condition Bands – Signal Heads

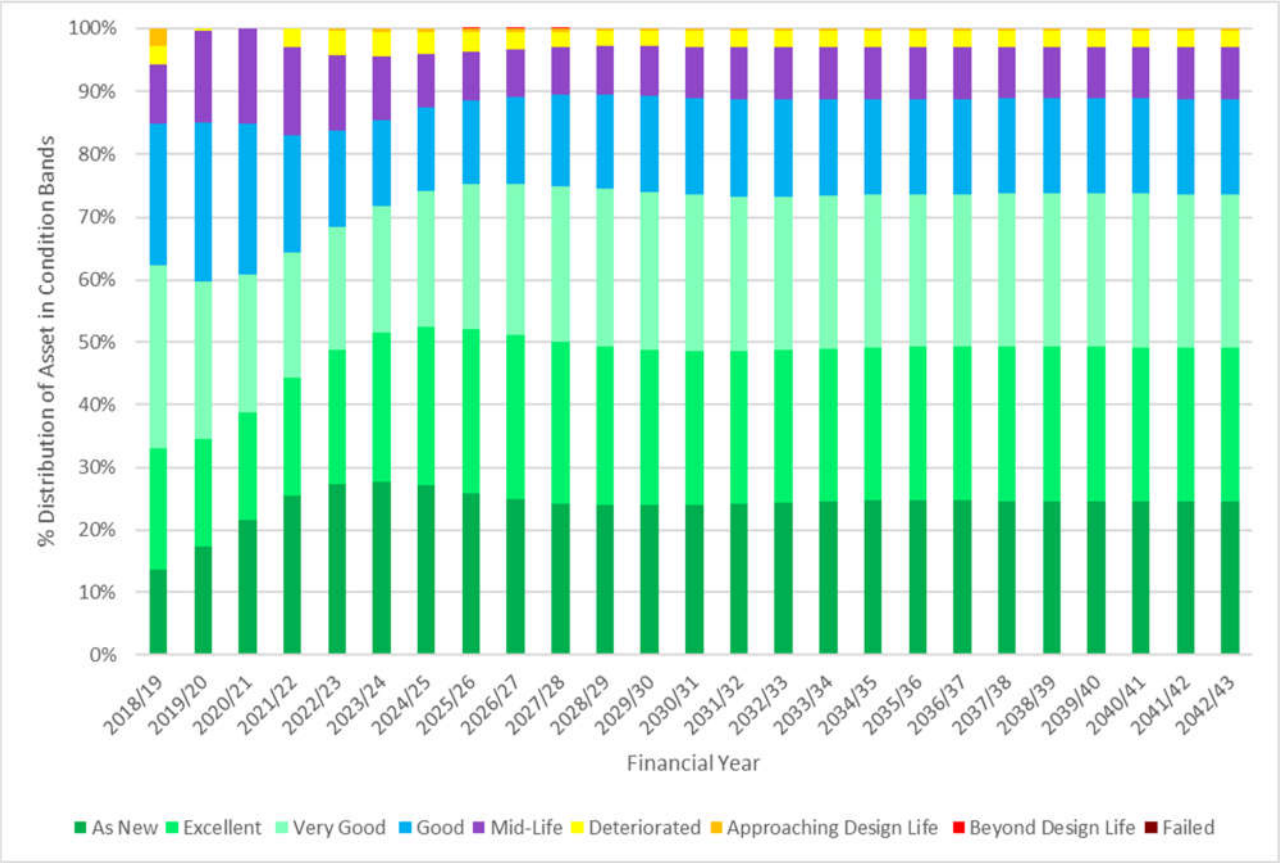


Figure 3-2 % Distribution of Assets in Condition Bands – Box LEDs

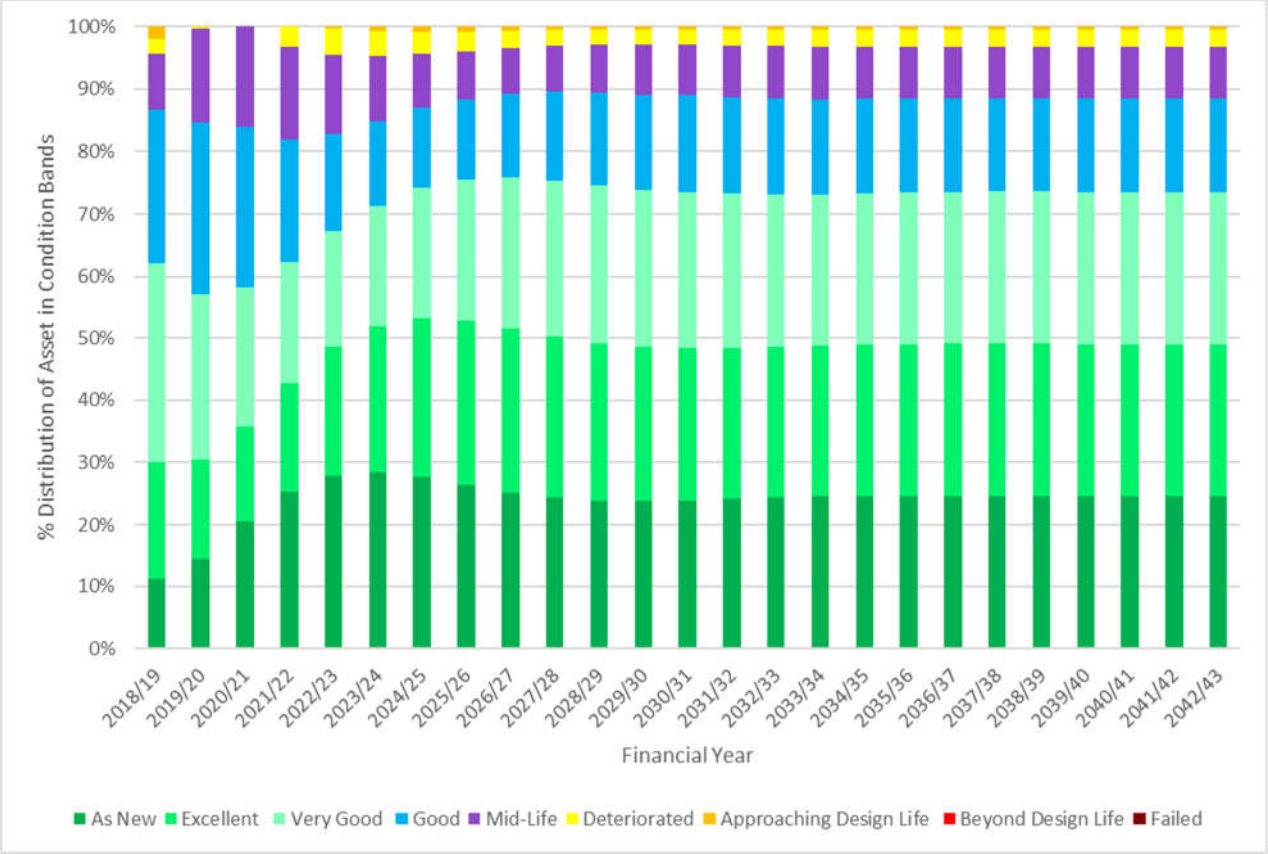


Figure 3-3 % Distribution of Assets in Condition Bands – Detectors

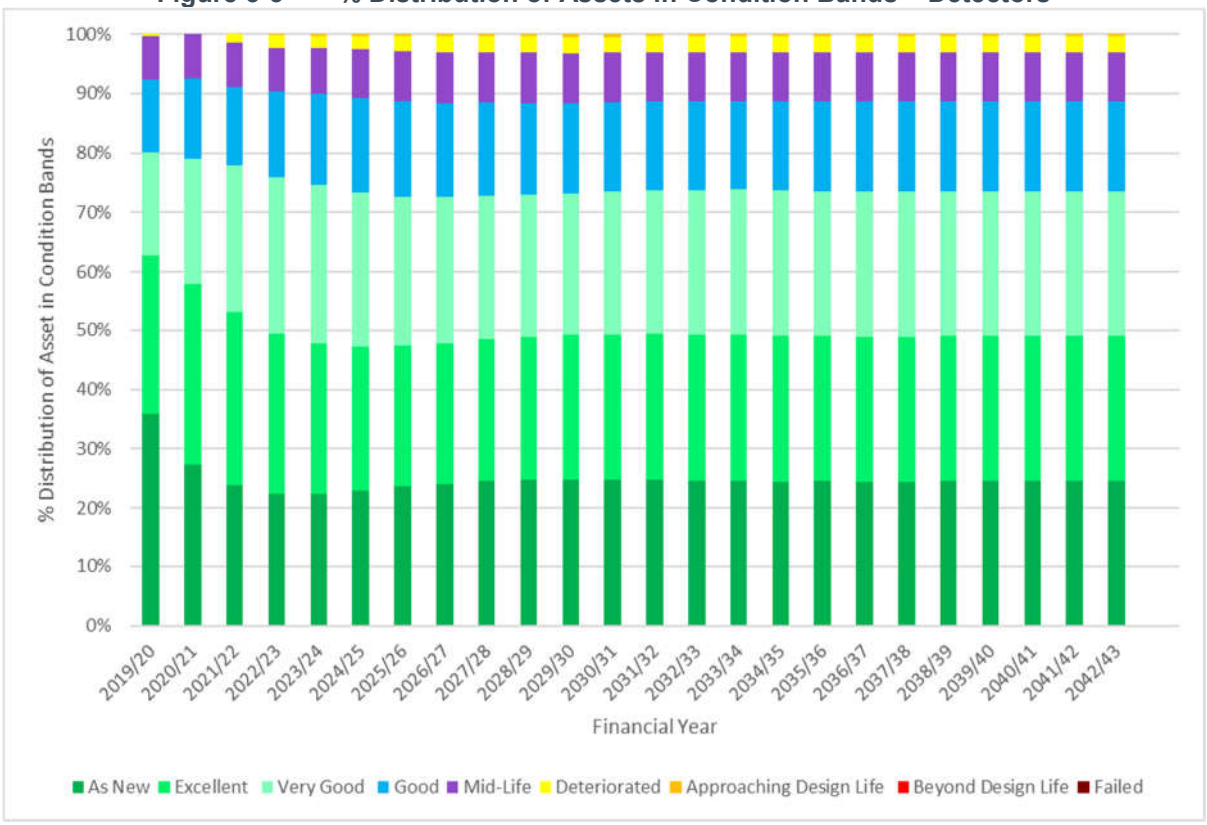


Figure 3-4 % Distribution of Assets in Condition Bands – Mounting Posts

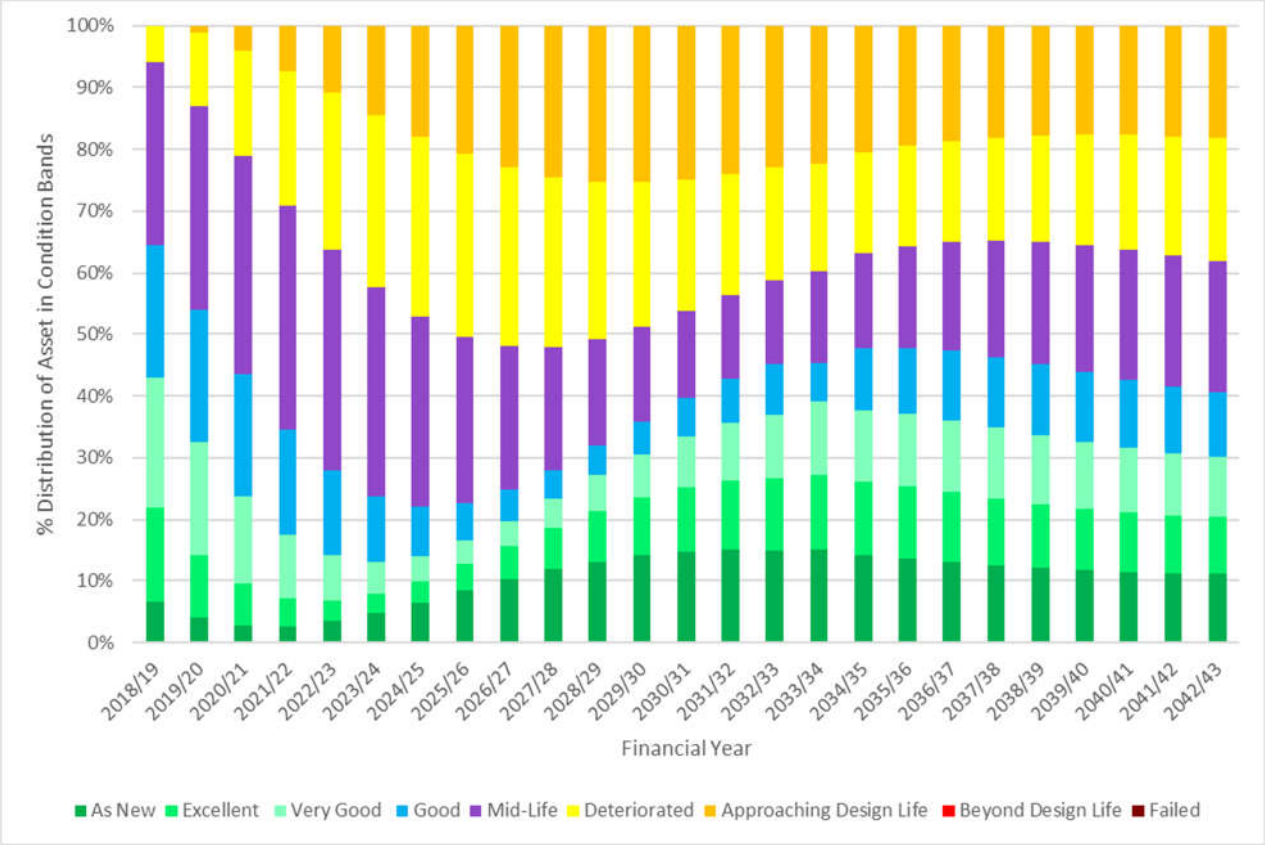


Figure 3-5 % Distribution of Assets in Condition Bands – Outstation Transmission Units

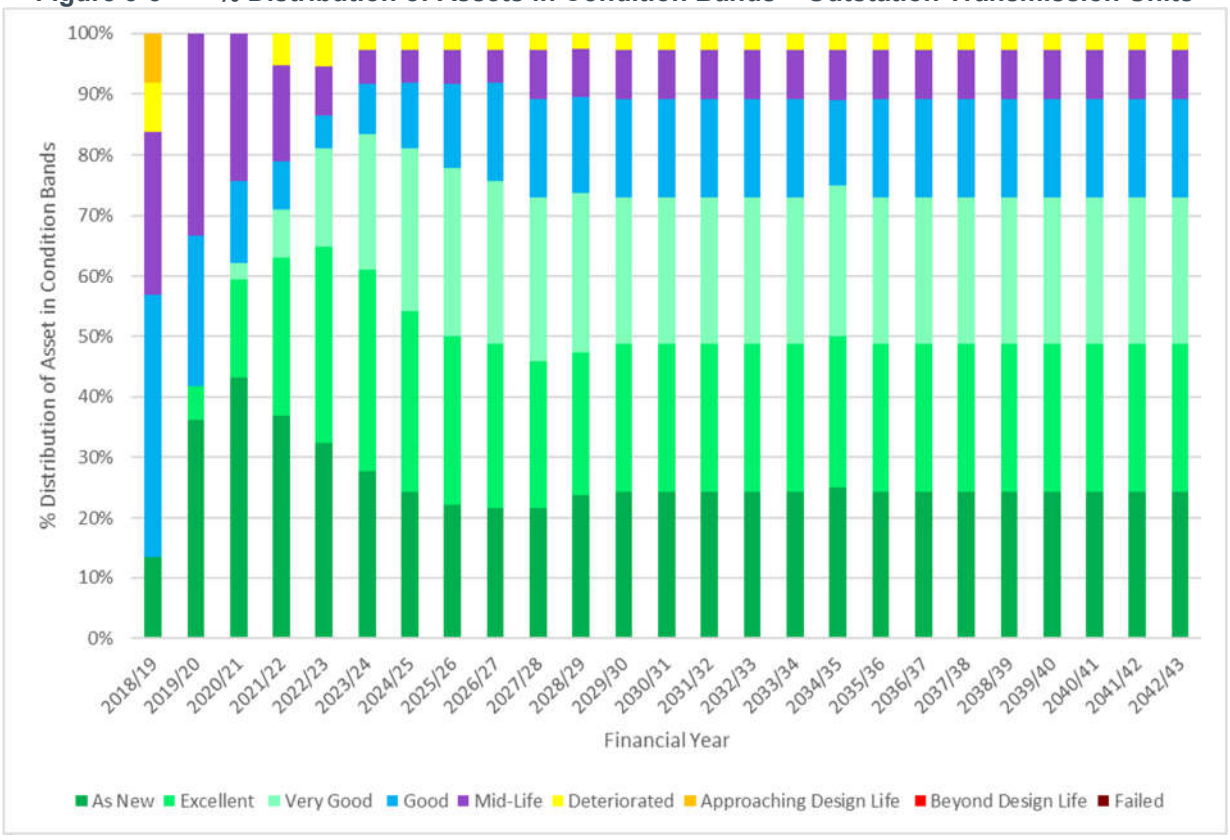


Figure 3-6 % Distribution of Assets in Condition Bands – Technology Cards

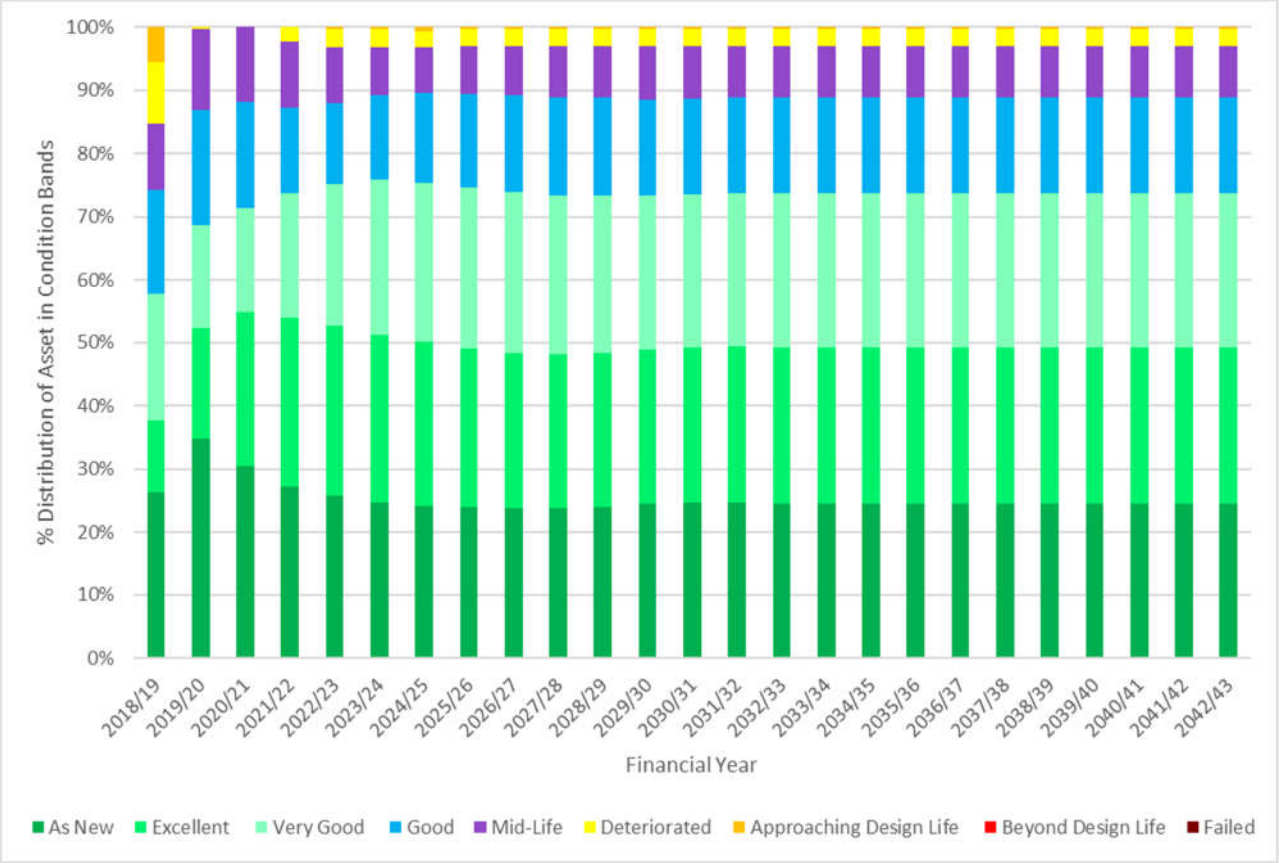
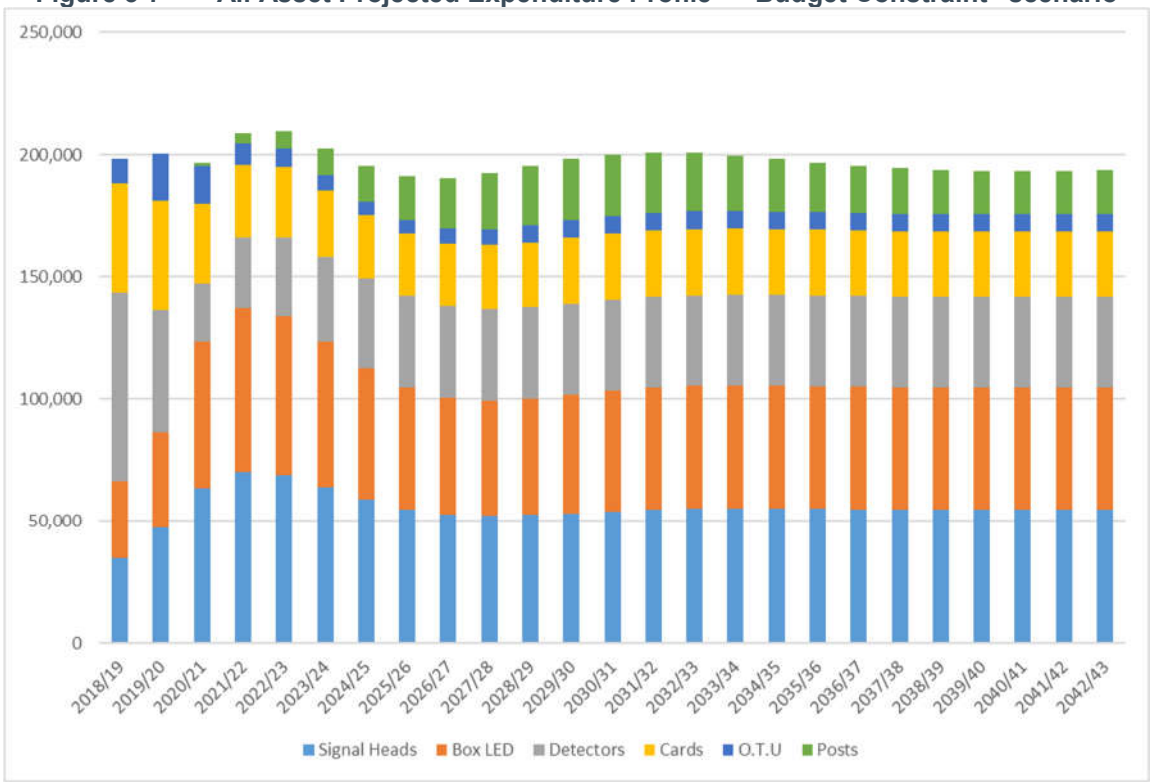


Figure 3-7, below, provides the expenditure profile for the "Budget Constraint" scenario; the average annual expenditure is £197,417 over the 25-year analysis period.

Figure 3-7 All Asset Projected Expenditure Profile – "Budget Constraint" scenario



3.2. "Replace on failure" Scenario

Figures 3-8 to 3-13 below provide the Condition Band profiles for the Signal Heads, Box LEDs, Detectors, Mounting Posts, Outstation Transmission Units and Technology Cards.

Figure 3-8 % Distribution of Assets in Condition Bands – Signal Heads

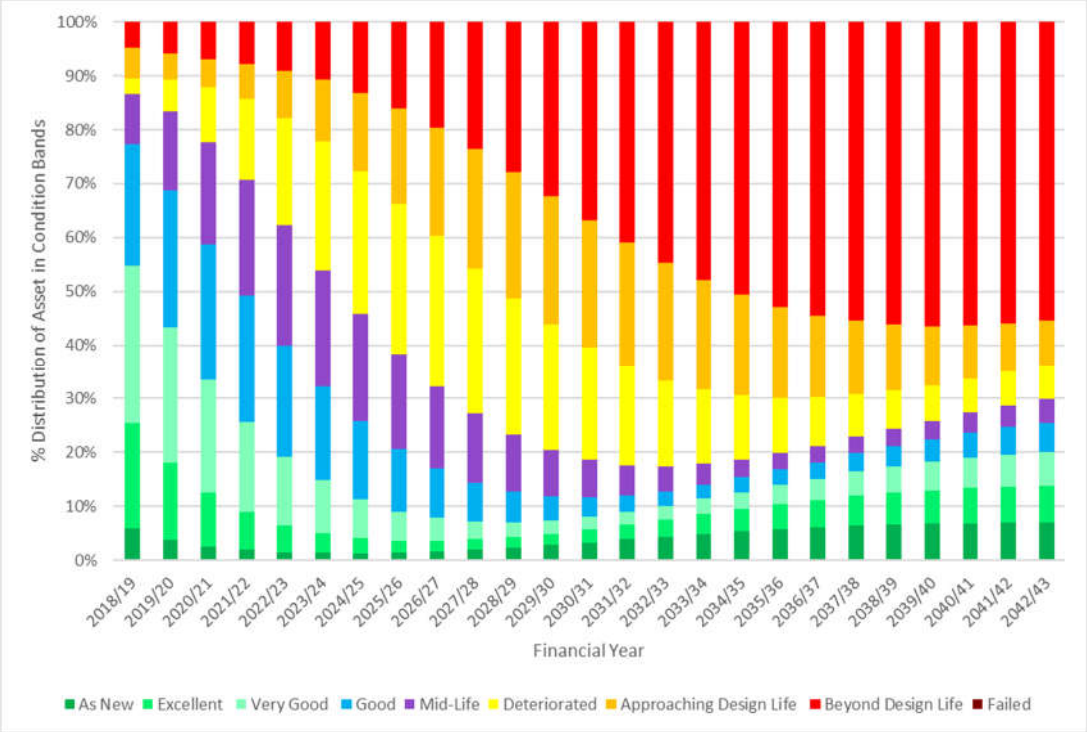


Figure 3-9 % Distribution of Assets in Condition Bands – Box LEDs

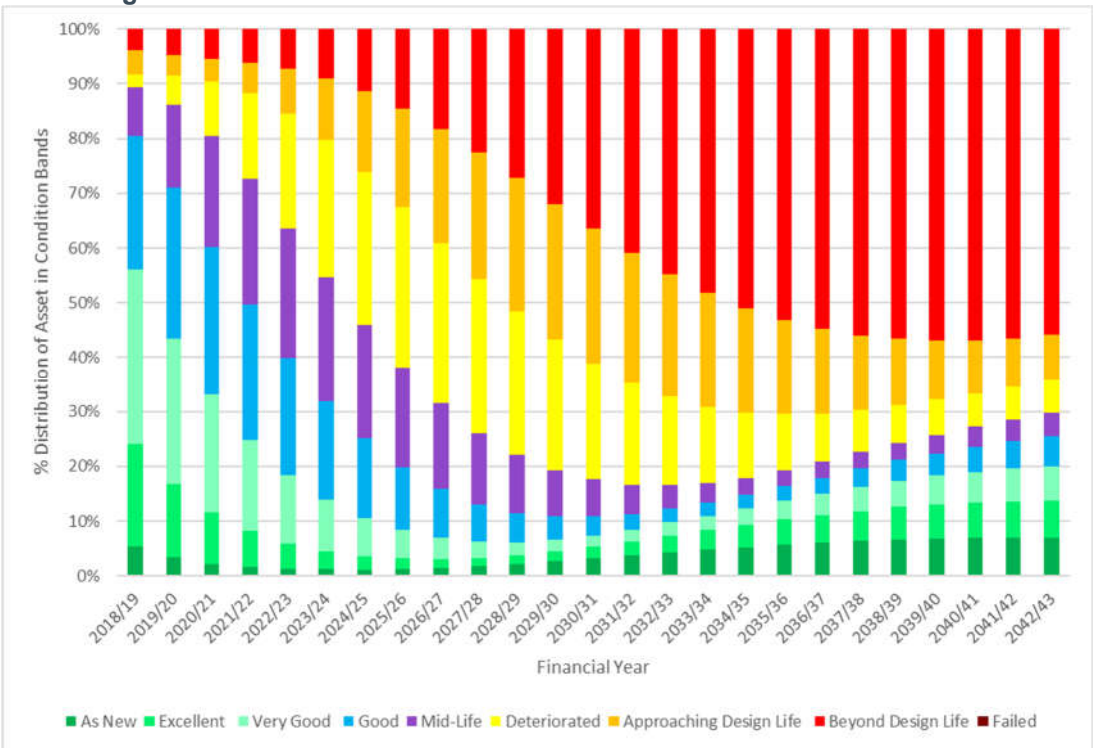


Figure 3-10 % Distribution of Assets in Condition Bands – Detectors

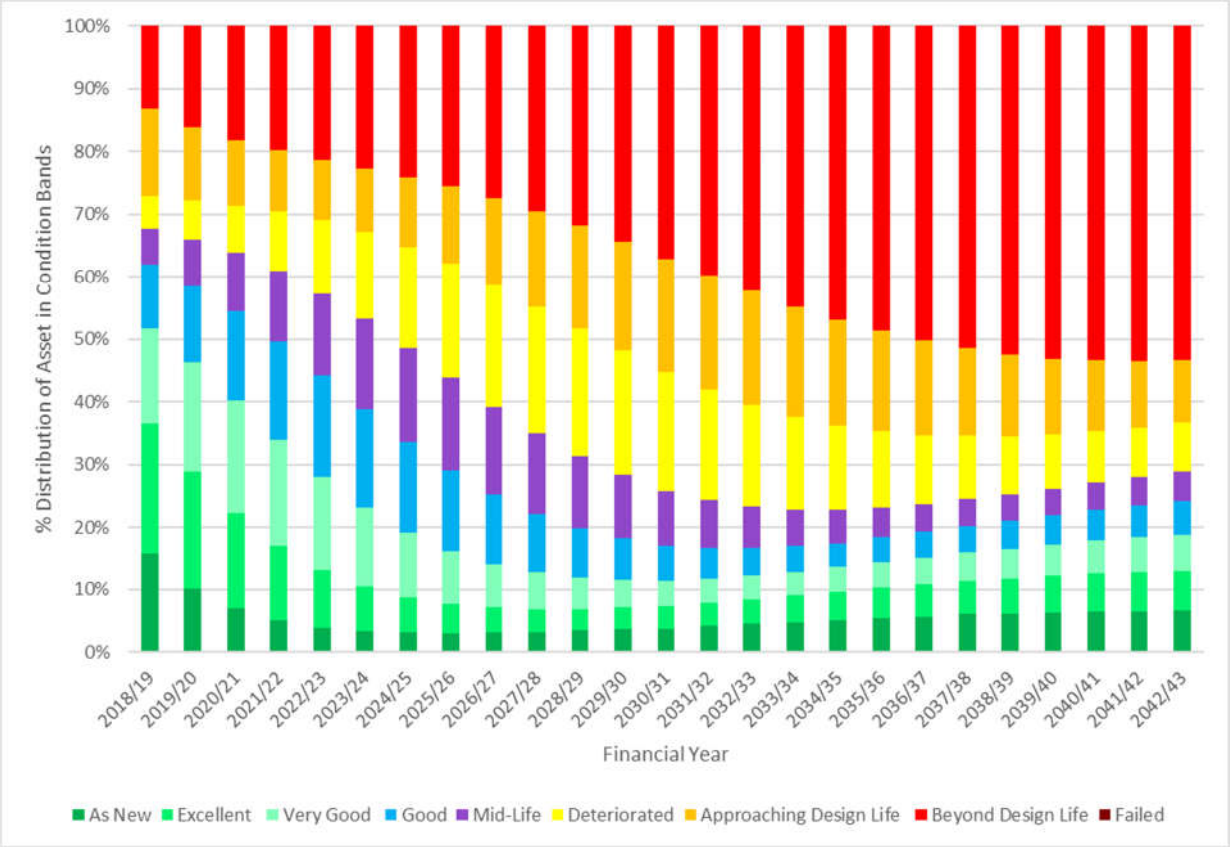


Figure 3-11 % Distribution of Assets in Condition Bands – Technology Cards

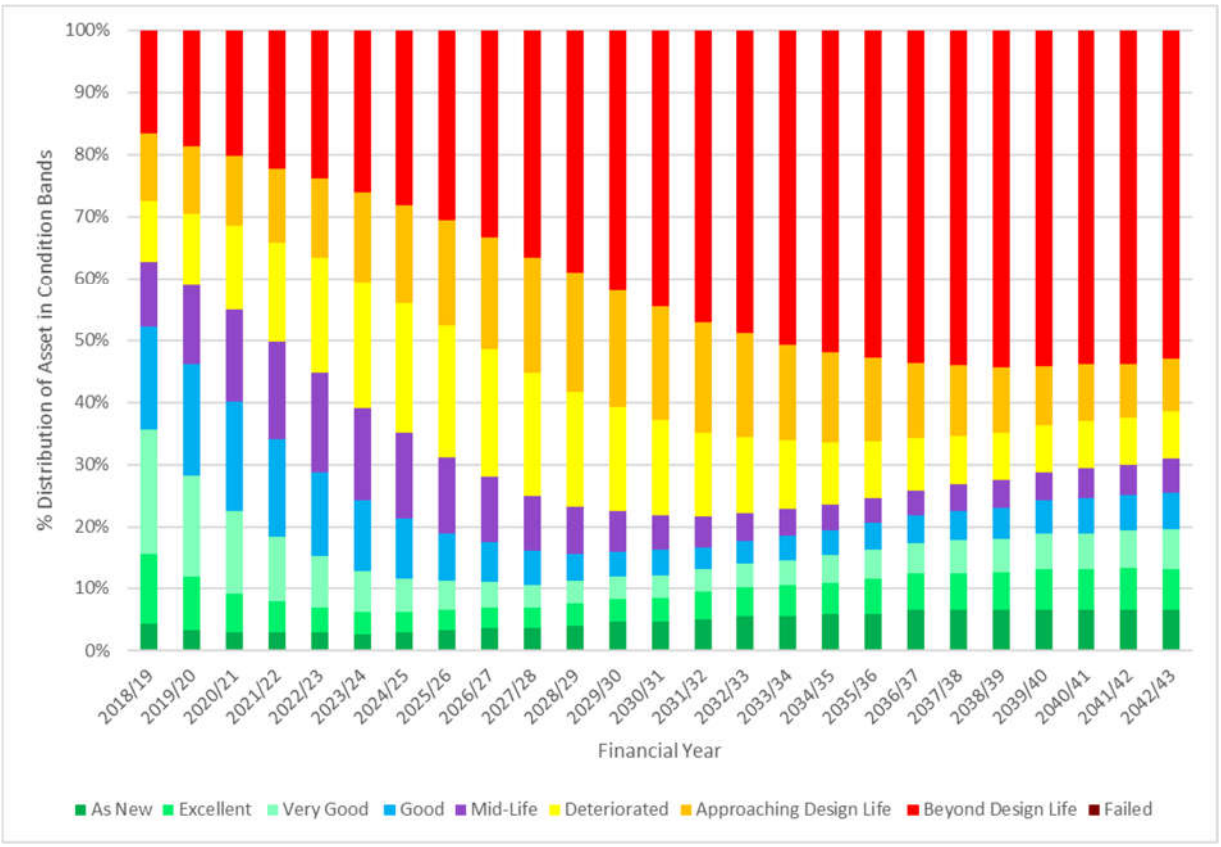


Figure 3-12 % Distribution of Assets in Condition Bands – Outstation Transmission Units

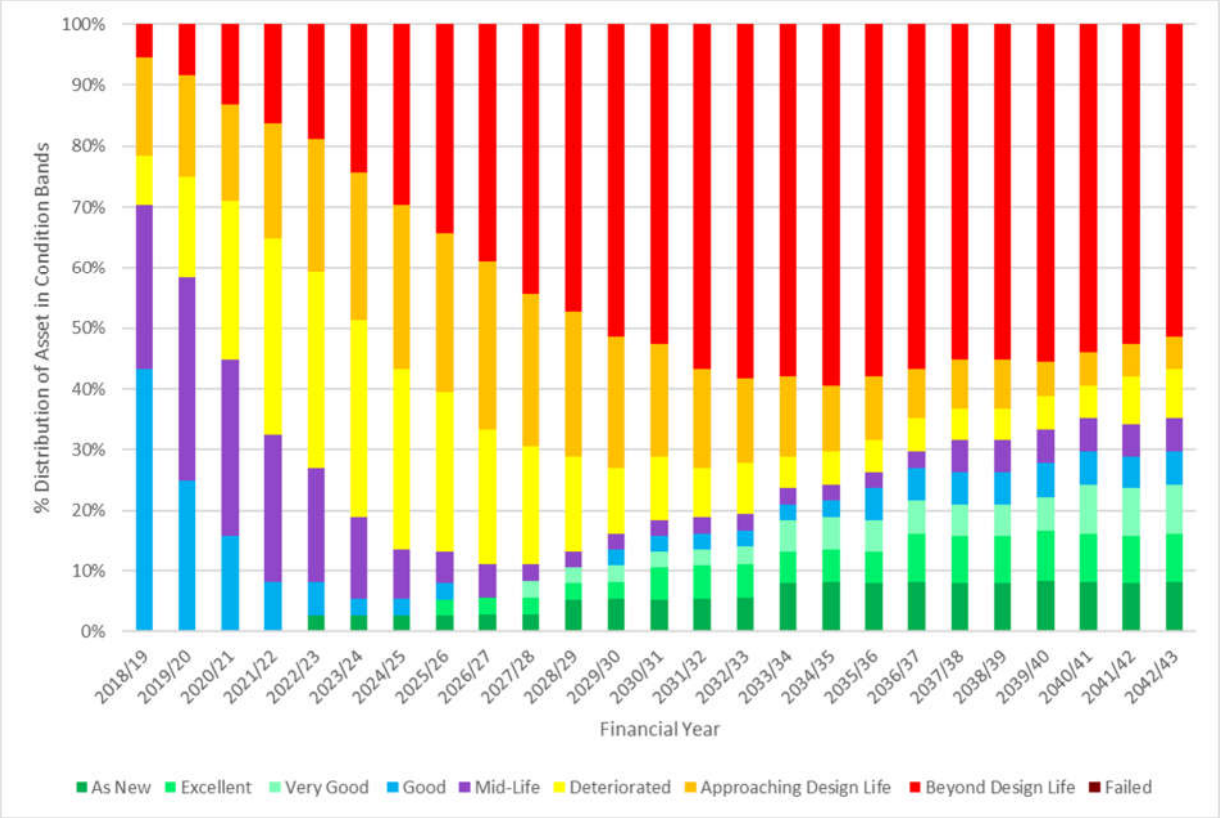


Figure 3-13 % Distribution of Assets in Condition Bands – Mounting Posts

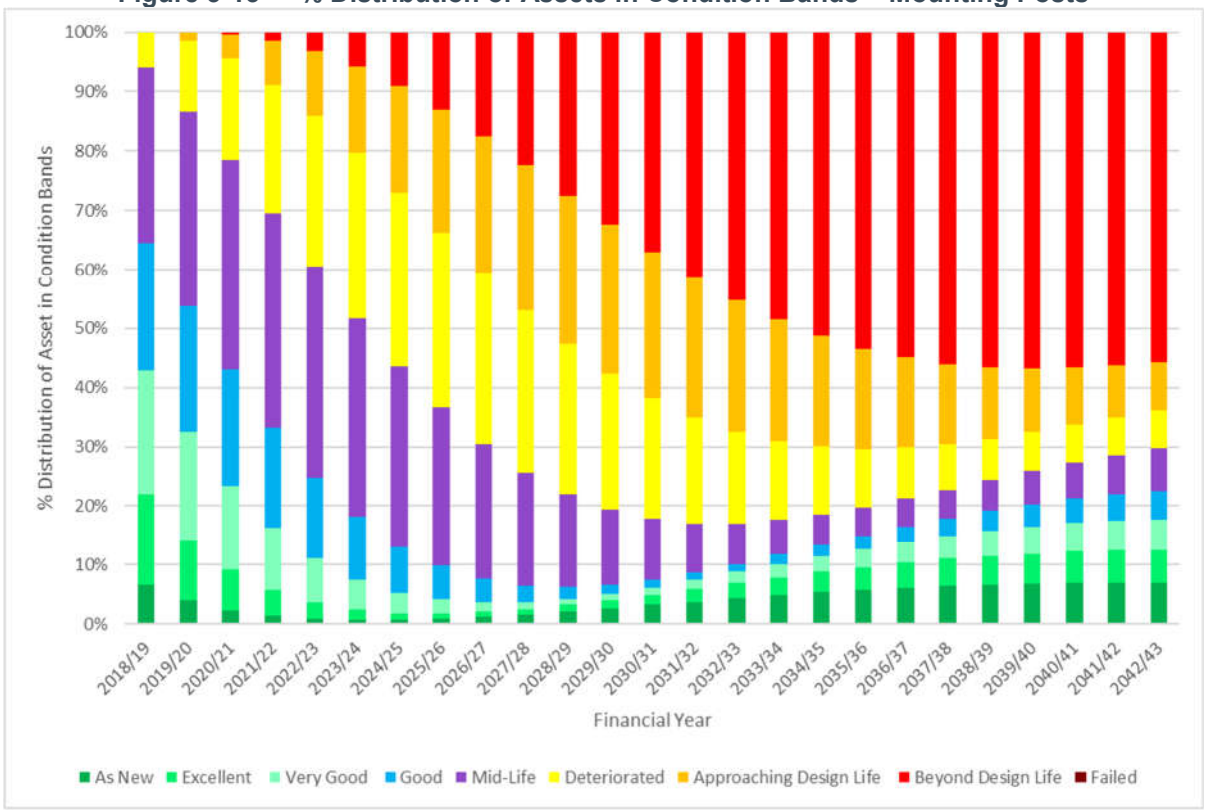
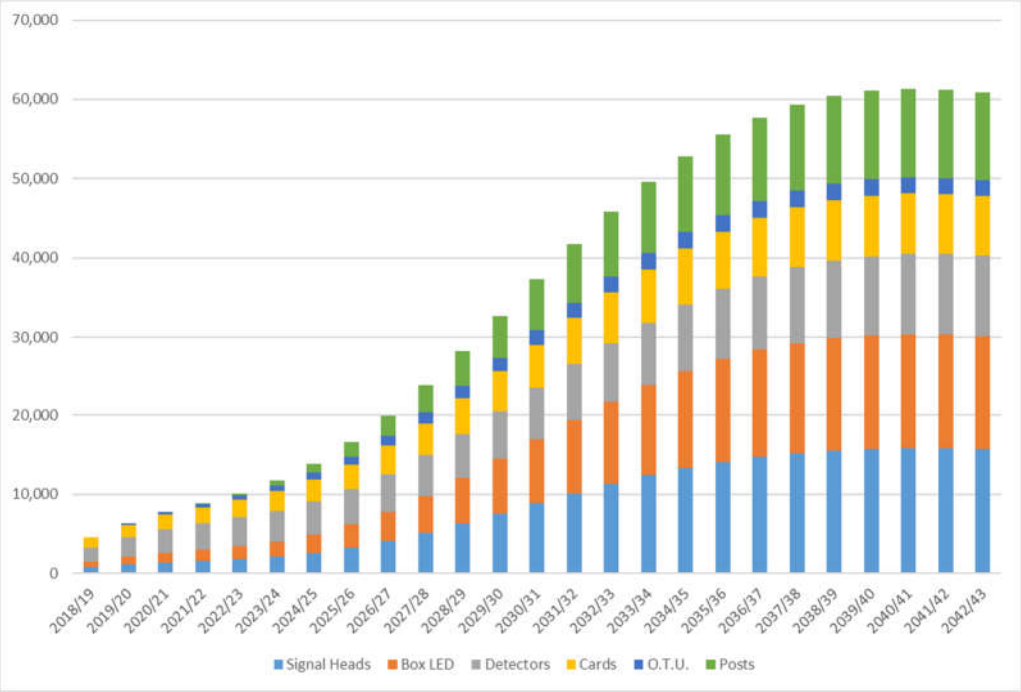


Figure 3-14, below, provides the expenditure profile for the "Replace on failure" scenario; the average annual expenditure is £35,558 over the 25-year analysis period.

Figure 3-14 All Asset Projected Expenditure Profile – "Replace on failure" scenario



3.3. "Service Life" Scenario

Figures 3-15 to 3-21 below provide the Condition Band profiles for the Signal Heads, Box LEDs, Detectors, Mounting Posts, Outstation Transmission Units and Technology Cards.

Figure 3-15 % Distribution of Assets in Condition Bands – Signal Heads

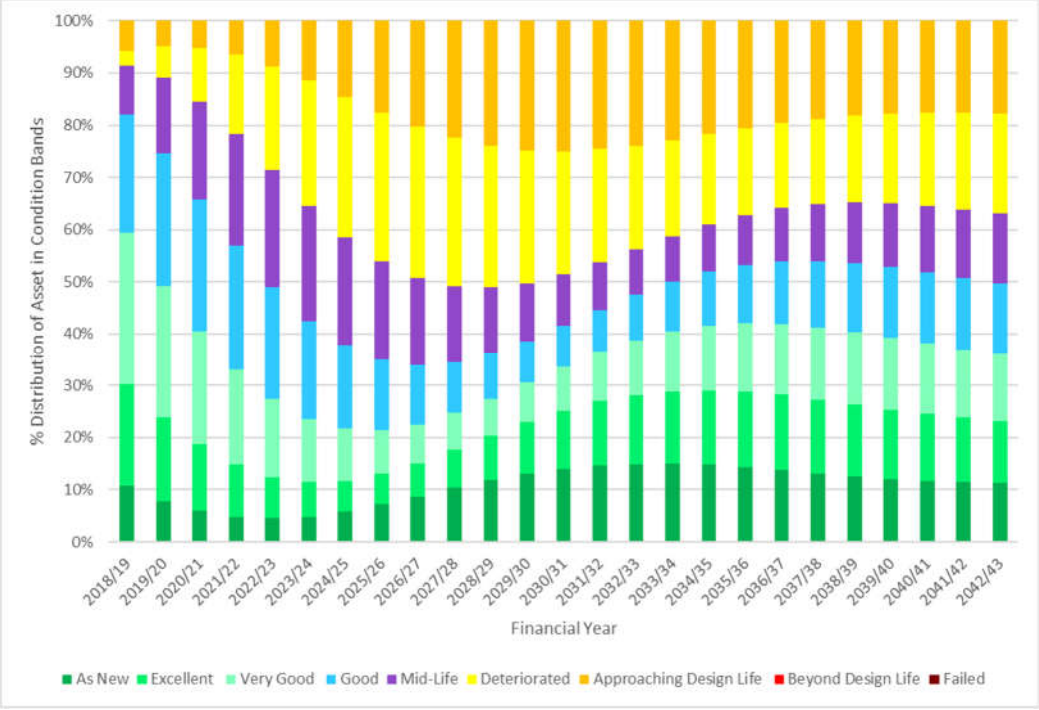


Figure 3-16 % Distribution of Assets in Condition Bands – Box LEDs

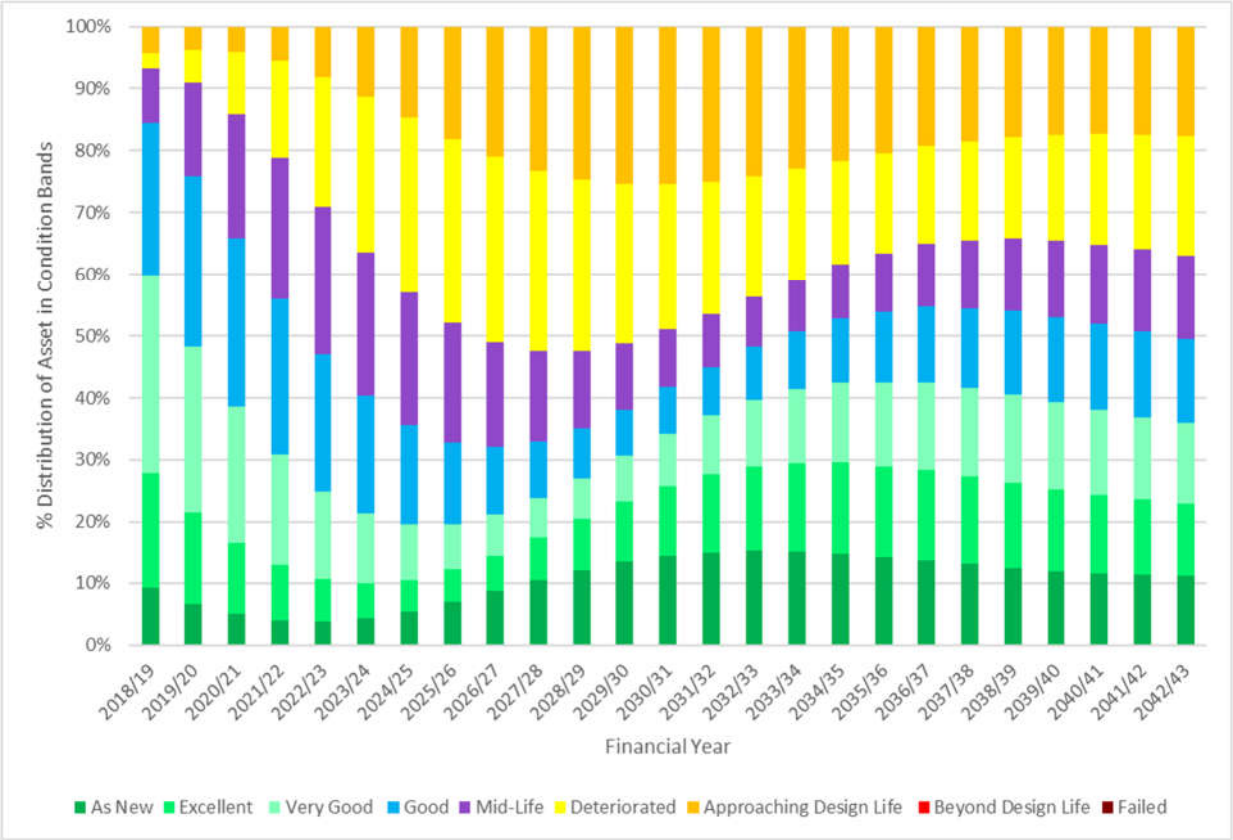


Figure 3-17 % Distribution of Assets in Condition Bands – Detectors

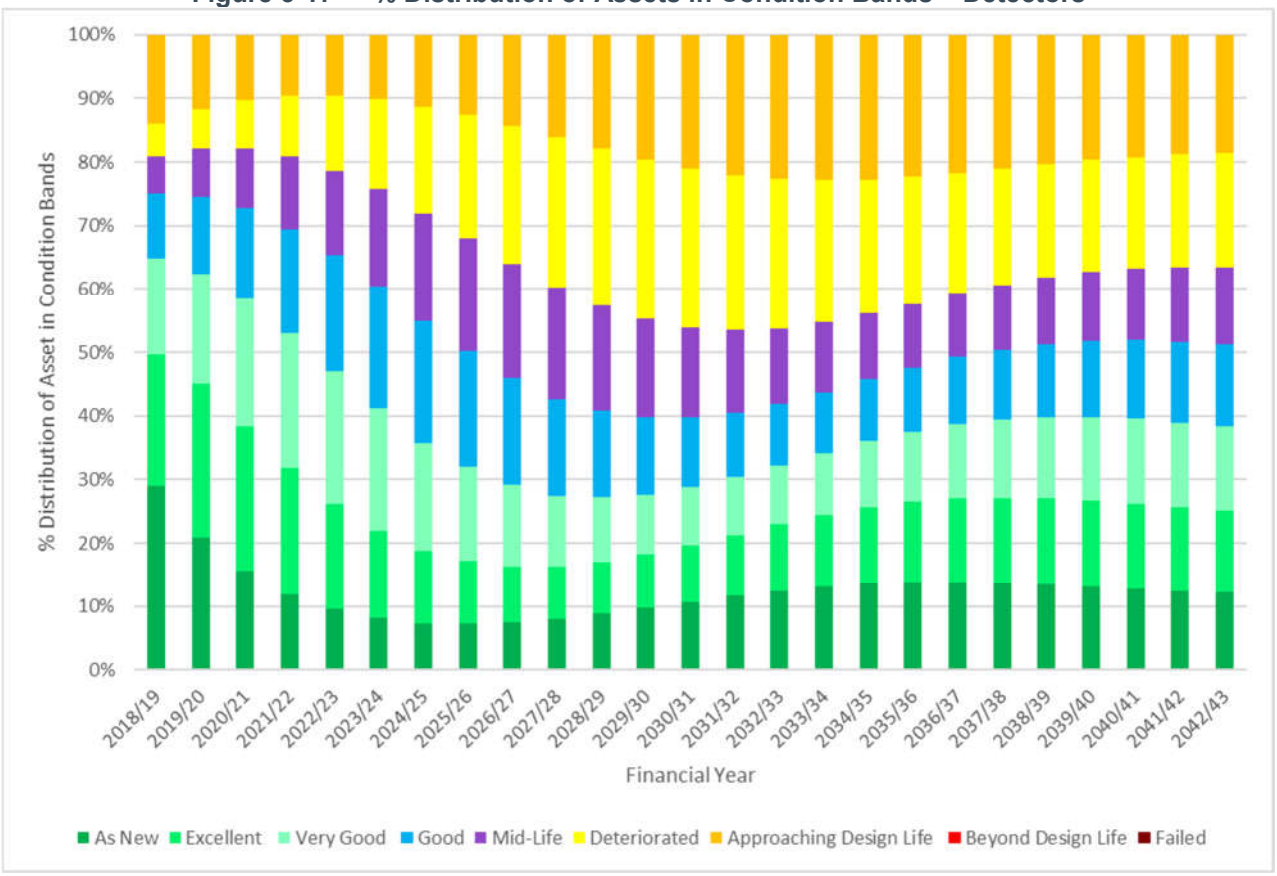


Figure 3-18 % Distribution of Assets in Condition Bands – Technology Cards

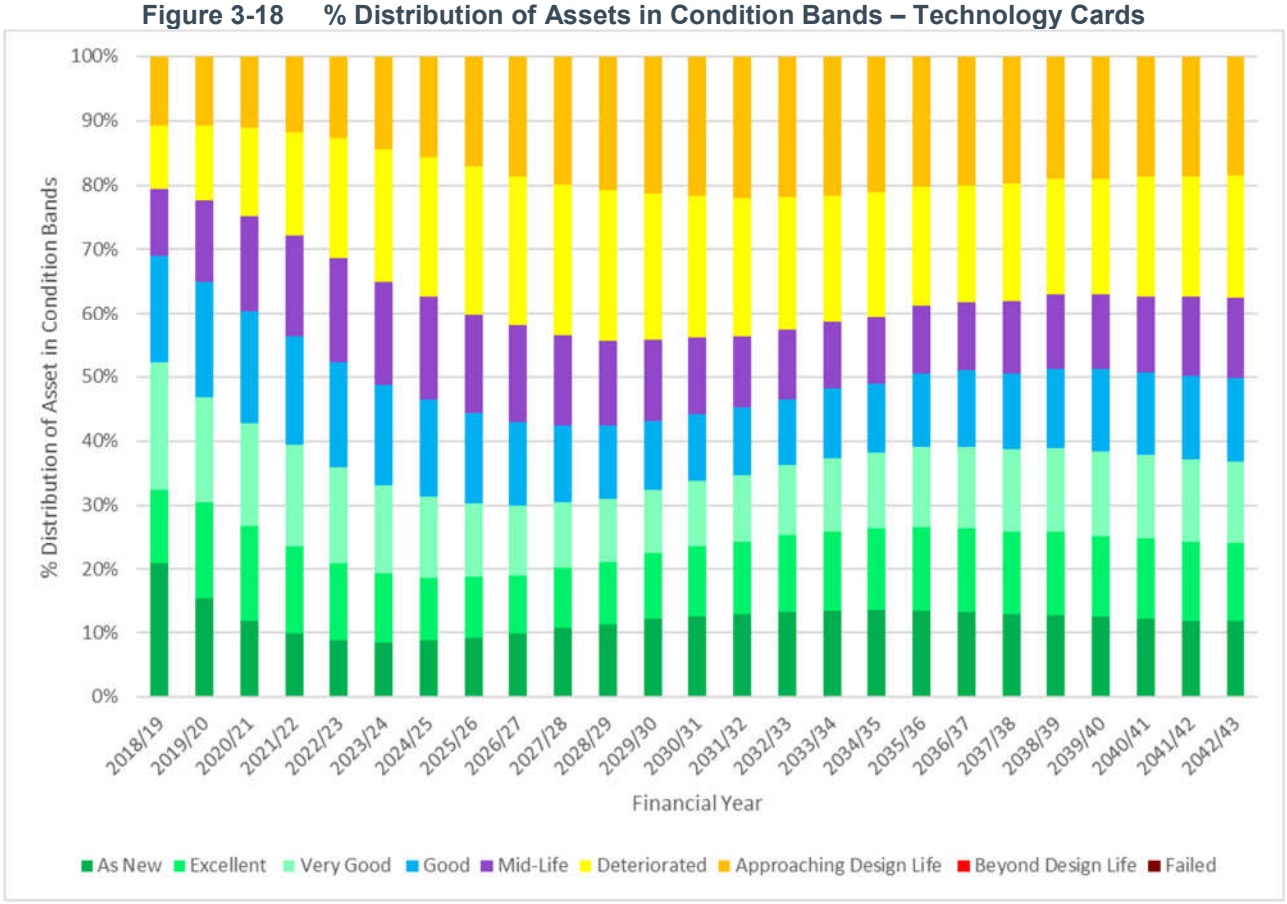


Figure 3-19 % Distribution of Assets in Condition Bands – Outstation Transmission Units

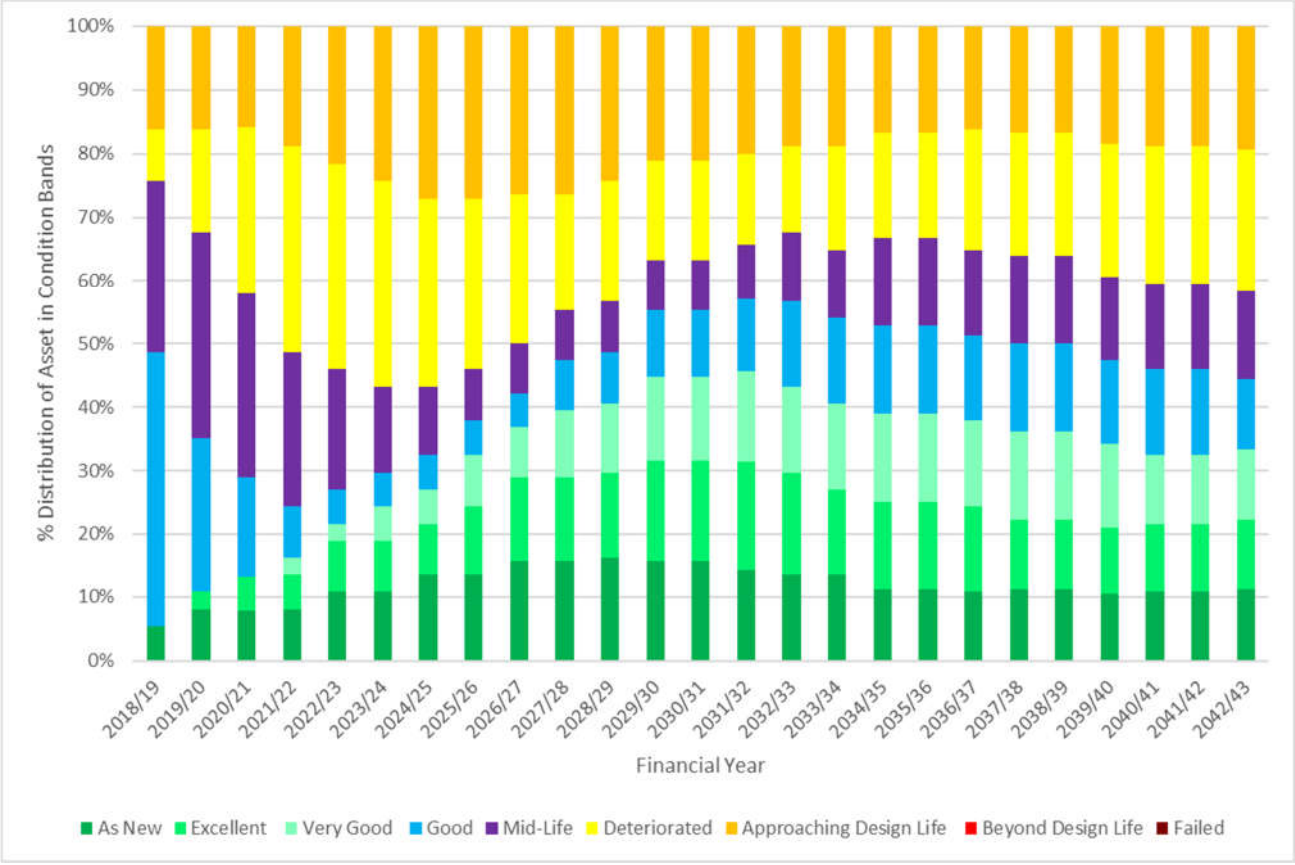


Figure 3-20 % Distribution of Assets in Condition Bands – Mounting Posts

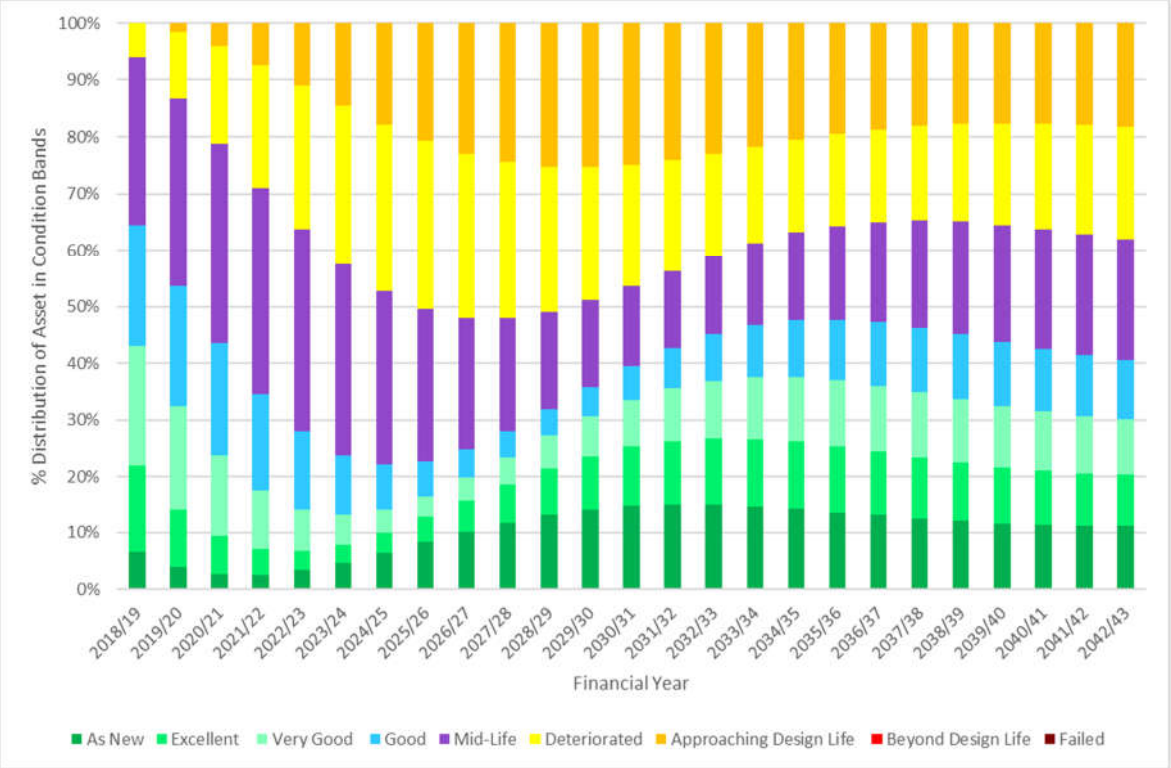
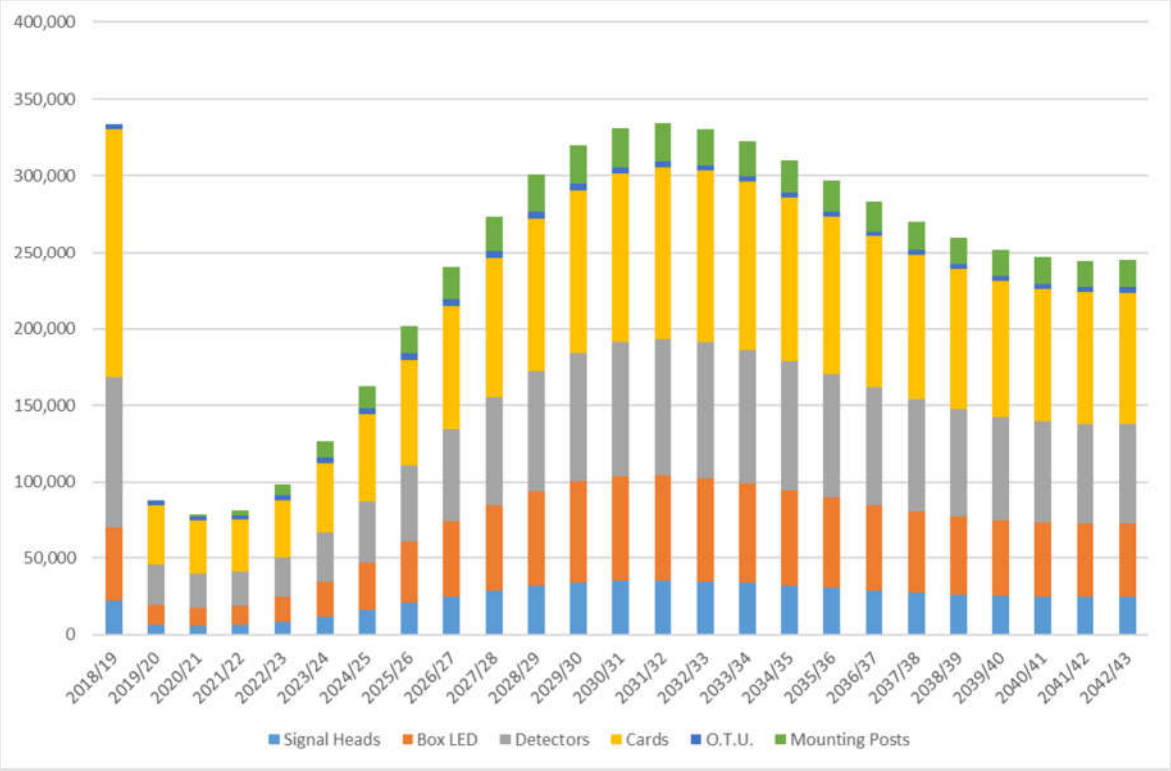


Figure 3-21, below, provides the expenditure profile for the "Service Life" scenario; the average annual expenditure is £241,242 over the 25-year analysis period.

Figure 3-21 All Asset Projected Expenditure Profile – "Service Life" scenario



4. Summary

Based on the LCP analysis, assuming costs of materials, workmanship and budgets do not increase over the 25-year analysis period, the £200,000 capital maintenance budget is forecast to be sufficient for operating a managed deterioration strategy. From figure 3-14 it can be seen the average spend over the period is £35,558 with a peak spend in year 2040/41 of £61,331.

The “Service life” scenario, which looks at replacing the assets when they reach the end of their design life indicates that an annual average budget of £241,272/year would be required. However, this scenario requires £333,751 front loaded in 2018/19 to replace the assets which have surpassed their design life and an average budget of £237,419/year afterwards.

Please note, all costs contained in this report do not factor in inflation.

5. Conclusion

The existing budget levels are sufficient to maintain the existing traffic signal stock at the levels of service and as figure 3-14 demonstrates, the future projected costs of operating managed deterioration would be less than the current budget for Traffic Signals. It should be noted that this report only investigates the capital maintenance costs and it is predicted that the revenue costs for managing the managed deterioration scenario would increase due to the necessary inspection/survey regime required to manage the aging asset stock.

Appendix A. Data

A.1. Traffic Signal Inventory

The following information was received from the referenced excel file issued by SC:

File name: TSC Asset Database.xls

- Reference
- Location
- Asset Type and Number per location
- Controller Type
- Commissioning Date
- Controller Installed Date
- Signal Head Install Date
- PBU Equipment Install Date
- Cable Install Date

File name – Traffic Signal Schedule of Rate.xlsx

List of rates for different aspects of the traffic signal maintenance, utilised to determine the replacement costs used in the analysis. However, as outlined by Richard Backhouse (email 11.5.17) further work is required for controllers as costs will be different for each based on number of phases, input output cards and detection equipment.

Clarification – Asset Condition (Email from Richard Backhouse 11/5/17)

- Cable install dates to be used as the date the posts were installed.
- All heads Tungsten heads to be replaced with LED
- Controllers are mainly changed for technical reasons as opposed to reaching end of life.

Appendix B. Asset Groups

Table B-1 Asset Groups, Asset Totals and 2017/18 % Condition distribution

AN – As New EX – Excellent VG – Very Good G – Good
ML – Mid-life D – Deteriorated ADL – Approaching Design Life
BDL – Beyond Design Life F - Failure

Asset Groups	No of Assets	AN	EX	VG	G	ML	D	ADL	BDL	F
3 ASPECT HEAD TUNGSTEN	989	11%	28%	32%	18%	4%	1%	4%	2%	0%
2 ASPECT HEAD TUNGSTEN	12	0%	33%	0%	0%	0%	0%	33%	33%	0%
1 ASPECT HEAD TUNGSTEN	55	7%	20%	62%	7%	0%	0%	4%	0%	0%
PUFFIN /TOUCAN BOX LED	709	10%	30%	35%	20%	3%	0%	2%	0%	0%
REPEATER BOXES LED	172	8%	20%	64%	8%	0%	0%	0%	0%	0%
HIGH LEVEL REPEATER BOXES LED	182	4%	13%	15%	13%	9%	7%	23%	16%	0%
WAIT LAMPS	27	10%	13%	17%	24%	7%	4%	16%	9%	0%
BOX SIGNS	90	0%	12%	13%	11%	8%	9%	36%	11%	0%
MVD'S	261	70%	15%	0%	0%	0%	0%	15%	0%	0%
KERBSIDE DETECTOR	241	16%	28%	21%	12%	0%	0%	14%	9%	0%
ON CROSSING DETECTOR	442	5%	13%	18%	10%	9%	10%	20%	15%	0%
IRD'S	10	14%	7%	18%	12%	11%	5%	21%	12%	0%
DET PACKS	232	4%	17%	21%	9%	9%	10%	13%	17%	0%
O.T.U	37	0%	0%	0%	70%	0%	10%	20%	0%	0%
O.M.C.U	73	11%	10%	29%	24%	8%	3%	9%	6%	0%
Mounting Posts	989	11%	22%	20%	23%	24%	0%	0%	0%	0%

Appendix C. Condition Bands

SC provided design life for each of the asset types; the Traffic Signals and Mounting Posts have a design life of 15 and 30 years respectively, therefore the following bands where generated:

Table C-1 Condition Bands

Condition Band	Mounting Post Age Range (years)	Traffic Signal Asset Age Range (year)
As New (AN)	0-2	0-1
Excellent (EX)	3-6	2-3
Very Good (VG)	7-10	4-5
Good (G)	11-14	6-7
Mid-life (ML)	15-19	8-9
Deteriorated (D)	20-25	10-12
Approaching Design Life (ADL)	26-30	13-15
Beyond Design Life (BDL)	>30	>15
Failed (F)	Failure	Failure

Appendix D. Treatments and Costs

Table D-2 Asset Groups, Treatment Type and Unit Cost

Asset Groups	Treatment	Cost per Unit
3 ASPECT LED HEAD	Replace with 3 Aspect LED Head	£526.42
2 ASPECT LED HEAD	Replace with 2 Aspect LED Head	£255.53
1 ASPECT LED HEAD	Replace with 1 Aspect LED Head	£106.44
PUFFIN /TOUCAN BOX LED	Replace with Puffin/Toucan Box LED	£480.17
REPEATER BOXES LED	Replace with Repeaters Boxes LED	£480.17
HIGH LEVEL REPEATER BOXES LED	Replace with High Level Repeater Boxes LED	£480.17
WAIT LAMPS	Replace with Wait Lamps	£248.50
BOX SIGNS	Replace with Box Signs	£240.60
MVD'S	Replace with MVD'S	£308.86
KERBSIDE DETECTOR	Replace with Kerbside Detector	£601.01
ON CROSSING DETECTOR	Replace with On Crossing Detector	£332.04
IRD'S	Replace with IRD'S	£624.01
DET PACKS	Replace with DET Packs	£356.29
O.T.U	Replace with O.T.U	£1,945.59
O.M.C.U	Replace with O.M.C.U	£2,675.65
Mounting Posts	Replace with Mounting Posts	£400.00

All costs listed incorporate a 15% uplift for estimated labour expenses.

Appendix E. Transition Matrix

Asset Groups, Asset Totals and 2017/18 % Condition distribution

AN – As New	EX – Excellent	VG – Very Good	G – Good
ML – Mid-life	D – Deteriorated	ADL – Approaching Design Life	
BDL – Beyond Design Life	F - Failure		

Asset Groups	Existing Condition Band	Transition Band								
		AN	EX	VG	G	ML	D	ADL	BDL	F
Traffic Signals	AN	60%	40%	0%	0%	0%	0%	0%	0%	0%
	EX		60%	40%	0%	0%	0%	0%	0%	0%
	VG			60%	40%	0%	0%	0%	0%	0%
	G				60%	40%	0%	0%	0%	0%
	ML					60%	40%	0%	0%	0%
	D						75%	25%	0%	0%
	ADL							75%	25%	0%
	BDL								95%	5%
Mounting Posts	AN	60%	40%	0%	0%	0%	0%	0%	0%	0%
	EX		50%	50%	0%	0%	0%	0%	0%	0%
	VG			50%	50%	0%	0%	0%	0%	0%
	G				50%	50%	0%	0%	0%	0%
	ML					75%	25%	0%	0%	0%
	D						75%	25%	0%	0%

AN – As New EX – Excellent VG – Very Good G – Good
ML – Mid-life D – Deteriorated ADL – Approaching Design Life
BDL – Beyond Design Life F - Failure

Asset Groups	Existing Condition Band	Transition Band								
		AN	EX	VG	G	ML	D	ADL	BDL	F
	ADL							75%	25%	0%
	BDL								95%	5%

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