TOOLKIT **EDITION 1** 2018

CITIES' **INFRASTRUCTURE DELIVERY** AND **MANAGEMENT** SYSTEM

CIDMS

MODULE 6

Life-cycle strategies and plans

national treasury
Department:
National Treasury
REPUBLIC OF SOUTH AFRICA

cities SUPPORT PROGRAMME

IUDF
INTEGRATED URBAN DEVELOPMENT FRAMEWORK

2030 NDP

MODULE PURPOSE:

This module describes how asset data models and profiles prepared in line with Module 3 are used and further developed to determine the short, medium and long term life-cycle needs and inform progressively optimised responses per sector that respond to city developmental themes. These in turn inform the preparation of sector asset management plans that are the focus of Module 7.

THE MODULE INDICATES PROCESSES TO ENSURE THAT:

1. Sector life-cycle strategies respond to prevailing city asset management objectives, themes and directives (including an affordability envelope);
2. Sector life-cycle needs are reviewed in a holistic manner, over the short, medium and long term, based on data consistent with the asset register; and
3. Draft portfolio life-cycle plans are determined for each sector that will be further considered for finalisation and adoption.

KEY FEATURES OF THE MODULE INCLUDE:

1. Indication of timelines that provide sufficient time for the required planning and consultation processes to be undertaken annually and align with other related planning and reporting processes;
2. Indication of specific planning horizons, with increasing data confidence requirements as implementation approaches;
3. Review of ongoing and proposed new or enhanced initiatives;
4. Consideration of asset and non-asset solutions to challenges;
5. Consideration of the level of confidence in the data and processes used in the preparation of the responses; and
6. Identification of catalytic actions to improve data and information, identify and define new projects and programmes, optimise responses and package these ready for implementation.

WHY:

More robust planning provides greater certainty of the effectiveness and efficiency of service delivery. Structured processes and timelines facilitate improved management of risk, performance and the application of limited available resources.

OUTPUTS OF MODULE 6:

1. Lifecycle needs of the city's asset portfolios are planned and quantified over the short, medium and long term with respect to:
   - Capital needs for existing assets related to failure modes (capacity, performance & condition);
   - Existing service access backlogs;
   - Capital needs relating to growth as well as the ongoing additional capital renewal needs of assets still to be created;
   - Operations and maintenance needs, both now and in the future, considering growth, and the future size and composition of asset portfolios.
2. The following are considered with respect to life-cycle needs and planning:
   - Existing commitments (both the customers and contractors);
   - Dependencies; and
   - Risks, opportunities and constraints which may affect the approach to designing lifecycle solutions.

3. A city-wide lifecycle strategy that:
    - Identifies the nature and scale of life-cycle needs across services and asset portfolios;
    - Identifies commitments, dependencies, risks, opportunities and constraints;
    - Identifies and assesses strategic response options; and
    - Informs directives to service departments on how to prepare/deliver on particular requirements in their sectoral lifecycle strategies.
4. Sectoral lifecycle strategies for asset portfolios identify and formulate strategic responses to existing commitments, risks and opportunities, and constraints.
5. Component-level life-cycle strategies are prepared for inclusion in the various sectoral AMPs.
6. Life-cycle plans are prepared for a period suitable for immovable assets and are partitioned into period segments with the required levels of accuracy.
7. Life-cycle plans for asset portfolios are optimised.

KEY NATIONAL REGULATIONS, POLICIES & STRATEGIES:

1. Municipal Finance Management Act, No. 56 of 2003
2. SABS: South African National Standard 55001: Asset Management – Management Systems – Requirements
3. Spatial Planning and Land Use Management Act, No. 16 of 2013
4. Municipal Standard Chart of Accounts
5. Standard for Infrastructure Procurement and Delivery Management
6. Maintenance Management Standard for Immovable Assets

CONTENTS

Module 6 Life-cycle strategies and plans

LIST OF

Figures that appear in this toolkit

LIST OF

Tables that appear in this toolkit

Annexures

6.1 INTRODUCTION TO LIFE-CYCLE STRATEGIES AND PLANS

In the preceding **Modules 3 and 4** techniques are provided to establish structured data and profile the existing infrastructure portfolio and forecast service demand. In response to these needs, this module indicates the processes and techniques to be adopted to prepare optimal asset life-cycle plans per sector.

DEFINITIONS RELATING TO LIFE-CYCLE STRATEGIES AND PLANS INCLUDE:

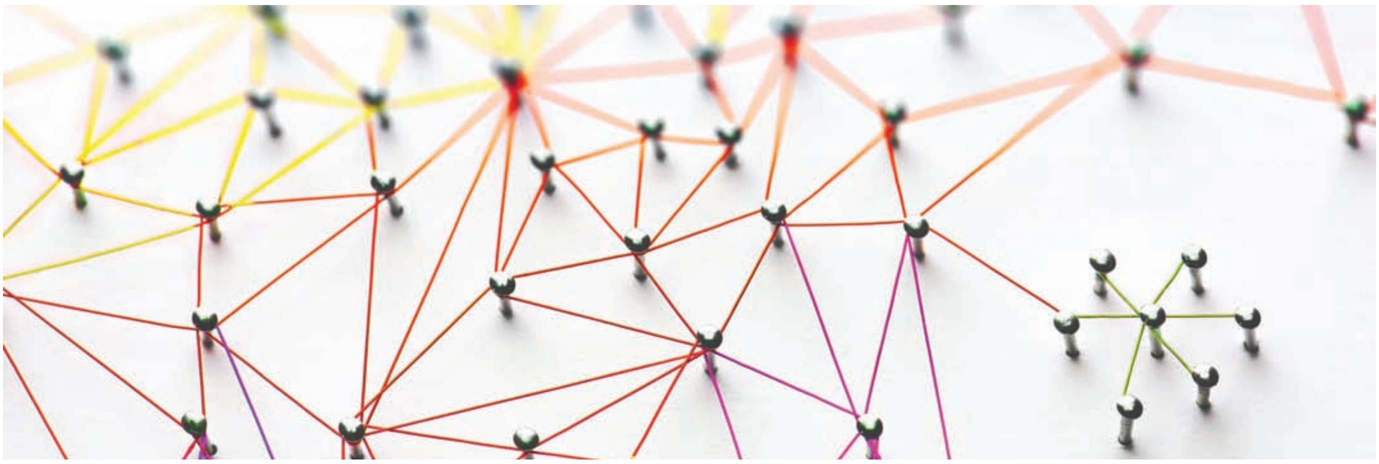
City infrastructure life-cycle strategy – overarching principles, themes and targets to manage infrastructure portfolio life-cycles across all the sectors in the city to align with the city's asset management objectives (the context and requirements for which are indicated in Module 2).

Sector infrastructure life-cycle plan – life-cycle programmes, projects and activities over the 30-year-planning period for the infrastructure assets (and components) under the control of a sector. As a subset of this, the sector infrastructure life-cycle plan for the first five years, which is more detailed, dealing with activities, is referred to as the sector infrastructure programme delivery plan (SIPDP) and is addressed in Module 7 along with the aggregated form (covering all sectors for five years) of the city infrastructure programme delivery plan (CIPDP).

Component life-cycle strategy – the city's default approach to the management of each of the life-cycle stages of a particular component type (which may vary according to its criticality, ie the impact on asset management objectives in the event of failure).

A key consideration in determining appropriate life-cycle strategies and plans is the need to ensure asset management activities in the city are aligned both vertically and horizontally. Accordingly, in a similar way that city asset management (AM) objectives are defined through the techniques indicated in Module 2 as a departure point to support the city's overarching strategic objectives, so too are sector-level AM objectives determined to align with the city's AM objectives.

The life-cycle plans are established in an iterative manner. Initially, an overarching life-cycle strategy is established by contemplating the aggregate needs across the city, comprising each of the respective infrastructure sectors, spanning from the present (using the latest audited period as a baseline) through the short, medium and long term – covering a planning period of 30 years – and, since needs will always outweigh available resources, the proposed responses are shaped in terms of an adopted envelope of forecasted affordability. The backlog model indicated in Section 6.2 of this module is used to craft this over-arching strategic framework. It is informed by the city strategic plan, as well as the city's asset management strategy and objectives as illustrated in Figure 6.1.



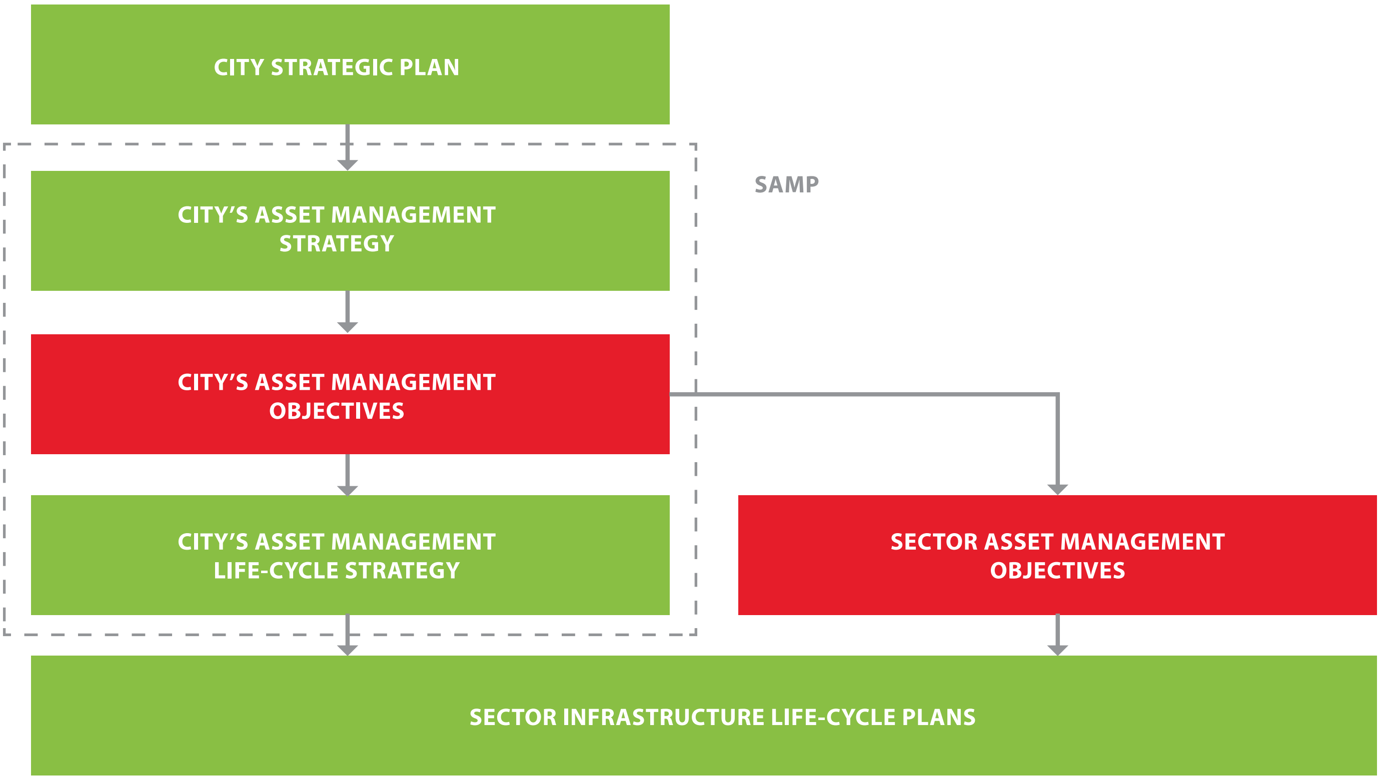


FIGURE 6.1: *City and sector asset management objectives informing life-cycle strategy and plans*

The city's infrastructure life-cycle strategy provides a necessary framework to prepare the more detailed sector infrastructure life-cycle plans that indicate the programmes to be pursued in each sector. Identifying the main activities relating to the constituent projects of these programmes, and the proposed arrangements for their delivery, are the key outputs from this module. In **Module 7** these life-cycle plans are documented in draft sector AM plans, and inform the preparation of a draft strategic asset management plan (SAMP), which as noted in **Module 2**, inter-alia confirms the status quo and identifies strategic short, medium and long term response options. These draft plans are reviewed, refined and inputs obtained to enable final plans to be prepared (as noted in **Module 7**), through a process of consultation with internal and external stakeholders. Furthermore, in **Module 7** the programmes for the first five years are specifically reviewed, refined and prioritised through the IDP consultation process which results in the adoption of a final SAMP, comprising approved programmes (as annexures indicating the CIPDP), budgets and performance targets. These arrangements are illustrated in **Figure 6.2.** The framework and processes to implement the CIPDP are discussed in **Modules 9 to 11.**

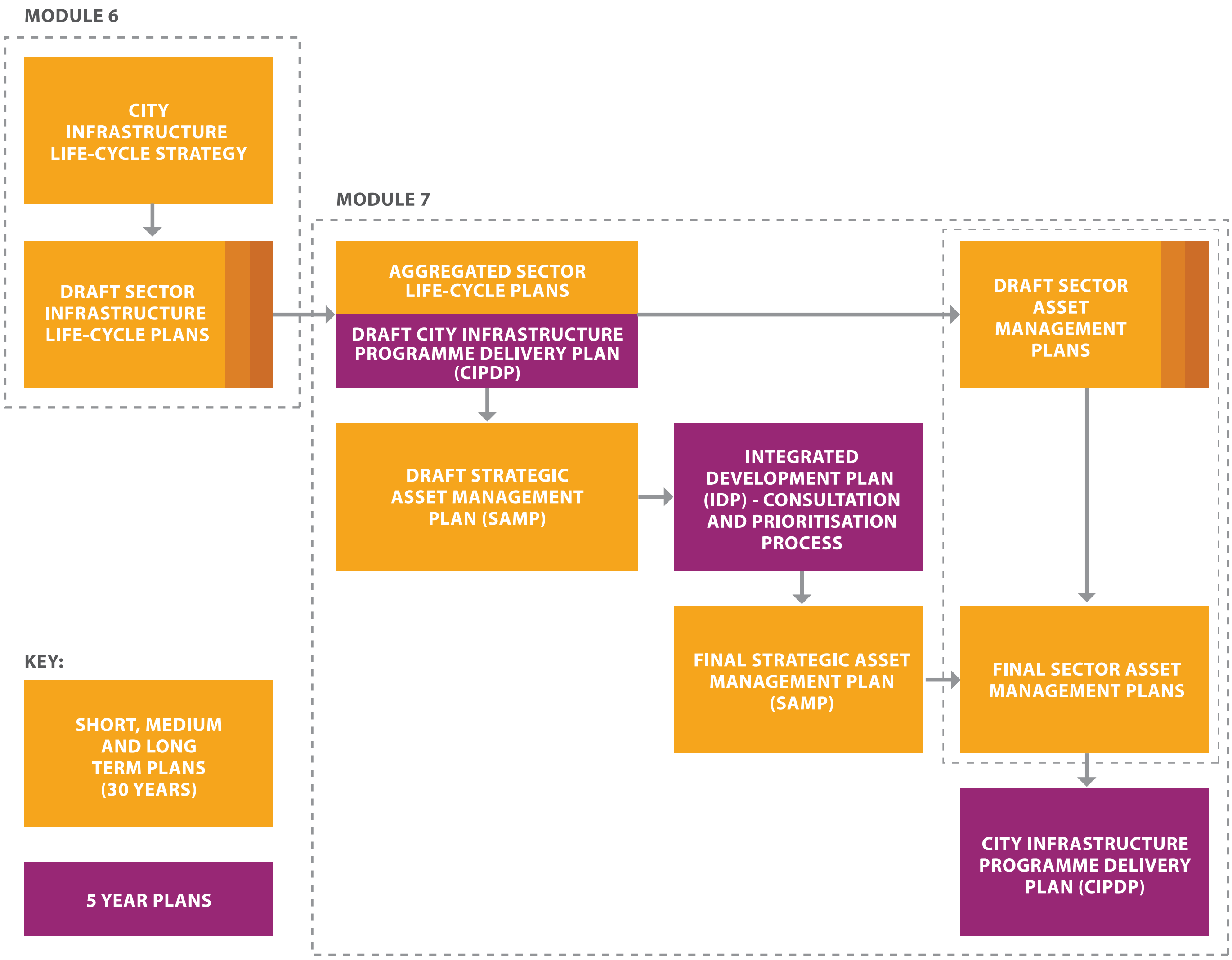


FIGURE 6.2: *Linkage of city infrastructure life-cycle strategy and sector life-cycle plans*

The planning horizons and the level of detail associated with each of the strategies and plans are indicated in **Figure 6.3.** The detailed actions in the short (one year) and medium term (five years) are informed by the longer-term plans.

YEARS	0	1 2 3 4 5	6 7 8 9 10 11 12 13 14 15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
	Reference	Detailed programmes, projects, activities, locations	Programmes linked to planning area	Life-cycle stages linked to planning areas
City infrastructure life-cycle strategy		ROLLING		
Sector infrastructure life-cycle plan		ROLLING		
Integrated development plan (IDP)		FIXED YEARS		
Sector asset management plans (AMPs)		ROLLING		
Strategic asset management plan (SAMP)		ROLLING		
City infrastructure programme delivery plan (CIPDP)		ROLLING		
Medium term revenue and expenditure framework		ROLLING		

FIGURE 6.3: *Planning horizons and level of detail*

The life-cycle strategies and plans comprise a combination of both OPEX and CAPEX activities. As illustrated in **Figure 6.4**, the initial need for an asset is typically identified as part of ongoing operations, or technical reports (such as master plans). The assessment of viability and optimal configuration (including a review of non-asset solutions) is also the subject of operational expenditure. The design and construction of assets are capital activities, though the roll-out of projects may also have operational activities (such as raising community awareness).

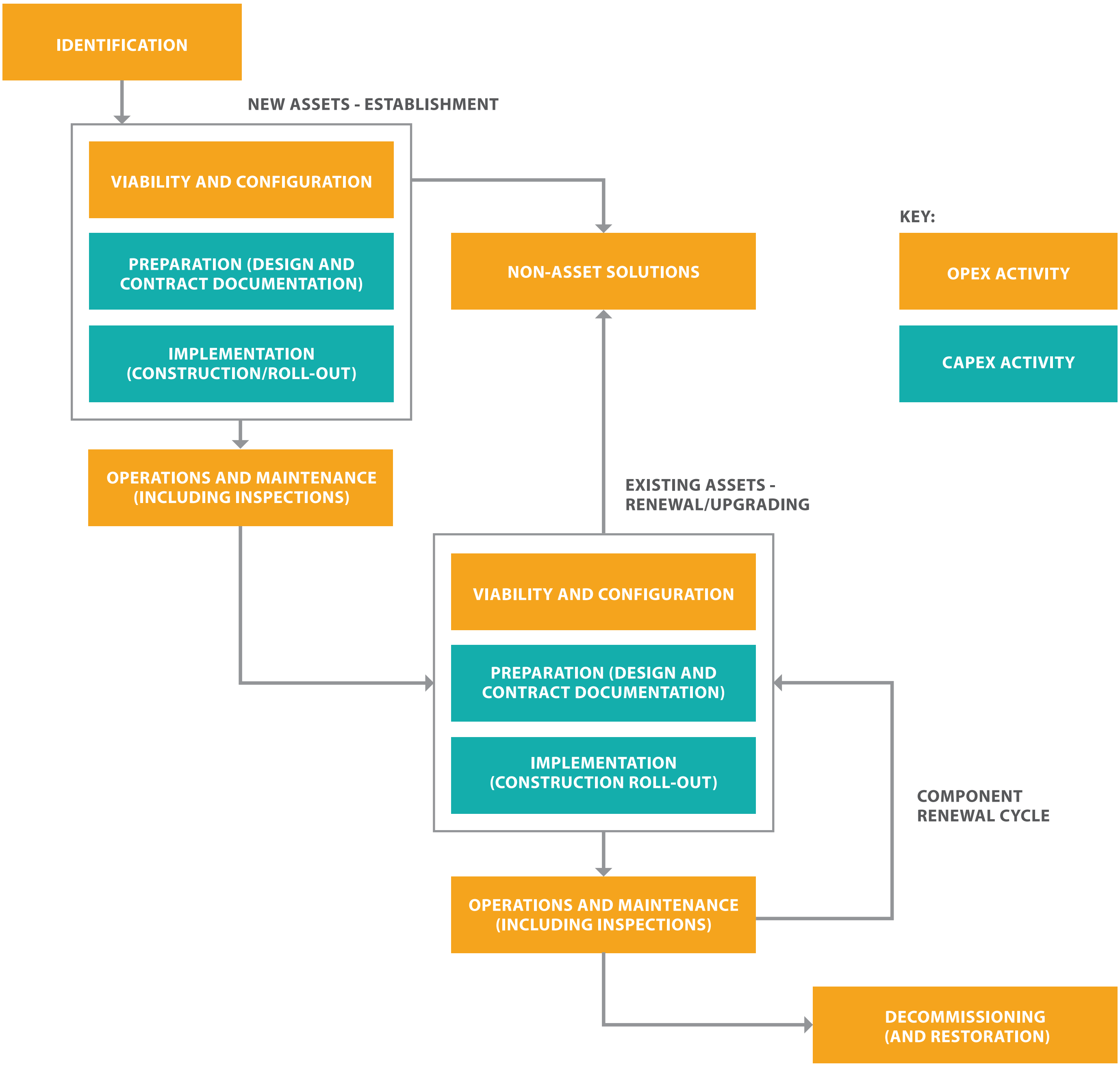


FIGURE 6.4: *Asset (and component) life-cycle stages*

An overview of the processes is provided in **Figure 6.5**, noting the use of the data and techniques indicated in the previous modules to first inform a review at city level, this then being used to provide a context for the review of each of the sectors.

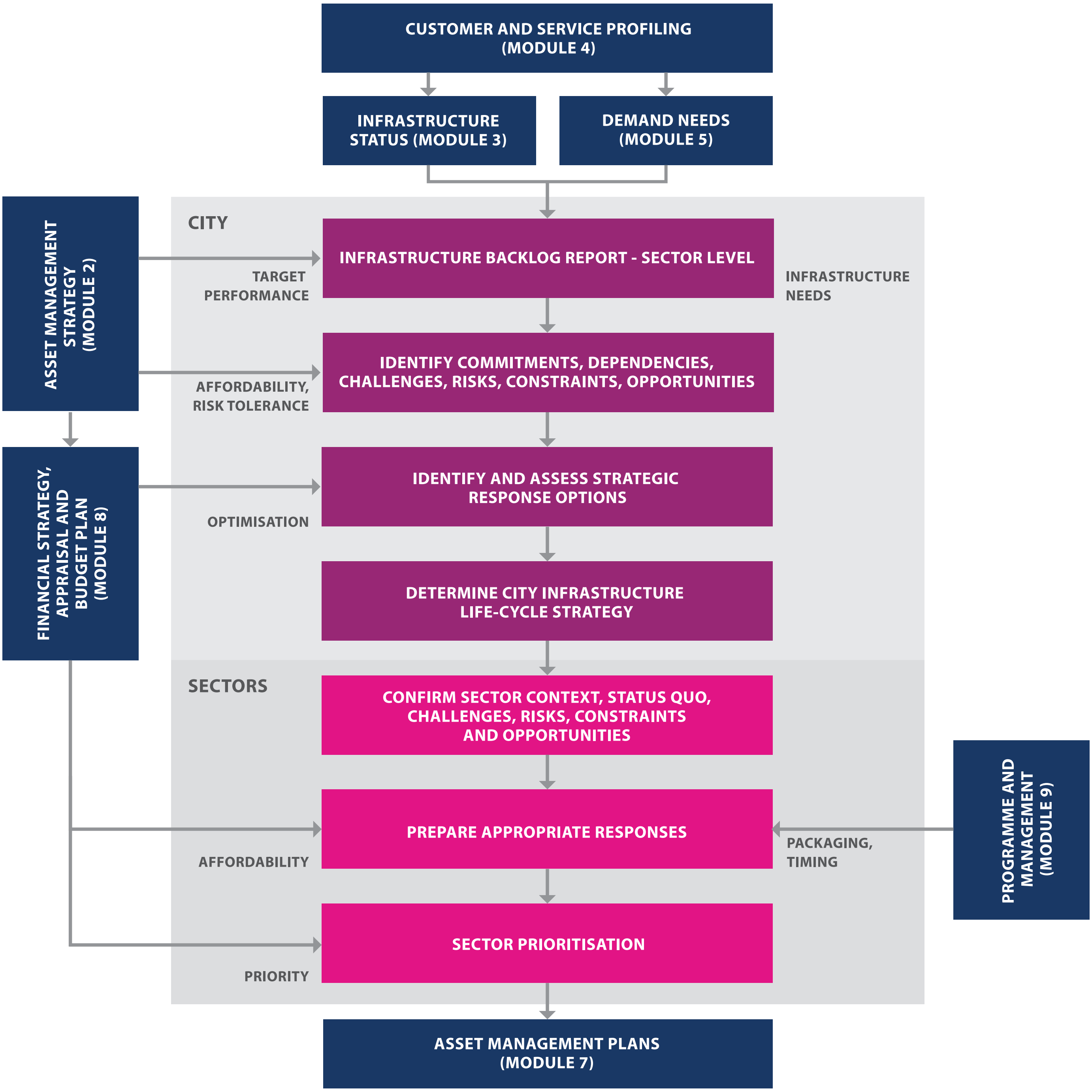


FIGURE 6.5: *Overview of the process to establish the life-cycle strategies and plans*

A key objective is to improve the planning of infrastructure programmes, and apart from the need to adopt regular and thorough review processes, it is important to provide sufficient time for these to be effectively addressed. The timelines associated with the preparation of the life-cycle plans, and obtaining approval at key milestones, are indicated in **Section 6.4** of this module.

6.2 CITY INFRASTRUCTURE LIFE-CYCLE STRATEGY

6.2.1 Why develop a city infrastructure life-cycle strategy?

While there is a need for sector specialists to lead in the implementation of city infrastructure programmes to ensure that the technical solutions are fit for purpose, there is often a higher-order need for developmental needs to be addressed in a coordinated manner across multiple sectors in a city. A typical example would be that cities should address the need for housing in terms of the coordinated provision of water, sanitation, energy, and transportation infrastructure in addition to the dwelling units themselves. In a city context, increased housing would also imply a review of the provision of social amenities and perhaps also extended city offices or depots. In addition, the city may also be pursuing improved environmental performance through the phasing in of selected green infrastructure solutions. It could be focused on job-creation objectives by adopting selected labour-intensive construction methods or promoting local suppliers of products. Social objectives may dictate the need for mixed developments comprising different customer groups, perhaps including the promotion of business or industry. Old urban areas may need widespread renewal of infrastructure, or re-design in terms of a vision of a new spatial development form. Additionally, the city will undertake catalytic programmes and projects that typically take years to conceptualise, plan and implement, and infrastructure responses need to be progressively refined and implemented as such programmes and projects mature – readers are referred to the National Treasury's guidelines for catalytic projects. Indeed, a singular vision of the nature, location, and extent of future growth needs to be established (as contemplated in **Module 5**) and applied consistently across the sectors. The life-cycle responses would need to be coordinated across sectors to minimise customer disruption and rework and perhaps facilitate densification. The responses (including both asset and non-asset actions) should be coordinated across sectors from a technical, spatial and timeline point of view to maximise the effectiveness and efficiency of the responses.

Indeed the broad nature (or "themes") of the city's strategic plan (comprising the spatial development framework, growth and development strategies, as applicable) need first to be identified at city level. Alternative delivery options must next be reviewed to identify the optimal response strategy. These are then prioritised and scheduled over time in terms of macro-affordability (including an assessment of revenue projections and fund availability) and the city's investment strategy as applicable to the respective sectors. Decision making in this regard is guided by reviewing the influence on the key performance indicators established in the form of the AM objectives in the asset management strategy (**Module 2**). Providing these parameters have been well defined, and are supported by relevant, up-to-date and sufficiently accurate data, models and analysis, the costs and benefits can be reliably assessed using the techniques shown in **Module 8**. From this information, reasonable conclusions can be drawn which inform the life-cycle strategy per sector at the city level. This will be reflected in an initial compilation of the city SAMP that will be used to provide a strategic brief to the sectors for the preparation of life-cycle strategies at the sector level as part of the preparation of (the next round of) sector AMPs. This initial version of the SAMP is also informed by the city's strategic plan, Built Environment Performance Plan (BEPP), the previous IDP and SDBIP, city asset management objectives, Project Management Strategy, and the City Infrastructure Procurement Delivery

Strategy (CIPDS). The strategic brief includes directives on city developmental themes, priorities, the assumed affordability (budget envelope) per sector, and a customer growth model for the planning period.

It may be found through analysis that elements of the city strategy are not affordable, or at least not in the time frame envisaged, or that alternative strategies may be more appropriate. In this way, decision makers may be provided with compelling arguments of the need to adjust the nature, or target scale/timelines associated with city strategies. Indeed, a city's strategic plan may only be considered to be robust (among other things) once the viability of its life-cycle strategy and its delivery plans (in terms of internal and external delivery capacity and affordability) have been reliably established. A notable context, for example, when considering the addition of new infrastructure is to observe that since new infrastructure in any given year may typically comprise just 1 to 2% of the value of the existing infrastructure, it is critical to understand the underlying risk of failure of the existing infrastructure assets.

Naturally, the needs, targets and plans are constantly evolving and cannot be regarded as static. However, there comes a point in the development of the asset management system (described in **Module 2**) where the level of asset management practice can be considered to be mature in that it meets recognised minimum criteria (such as SANS 55001). So, regardless of the nature and scale of the existing challenges at any point, the life-cycle plans can be considered to be robust - in line with the city's corporate objectives and the resources at its disposal. As illustrated in **Figure 6.6**, it could typically take several years (perhaps 6 to 10) of annual improvement iterations to reach this point – comprising selected improvements to the data, the associated models and analysis processes; alignment of the city's asset management objectives and the assessments emanating from the annual preparation of asset management plans; and ultimately the establishment of a robust asset management strategy - one that is demonstrably achievable, viable and sustainable. Having reached this point, the AM strategy (documented in the SAMP, and carried through to the sectors in the AMPs) can be expected to remain fairly consistent, though regularly reviewed to modify and adapt to the changing operational environment and to drive strategic improvements.

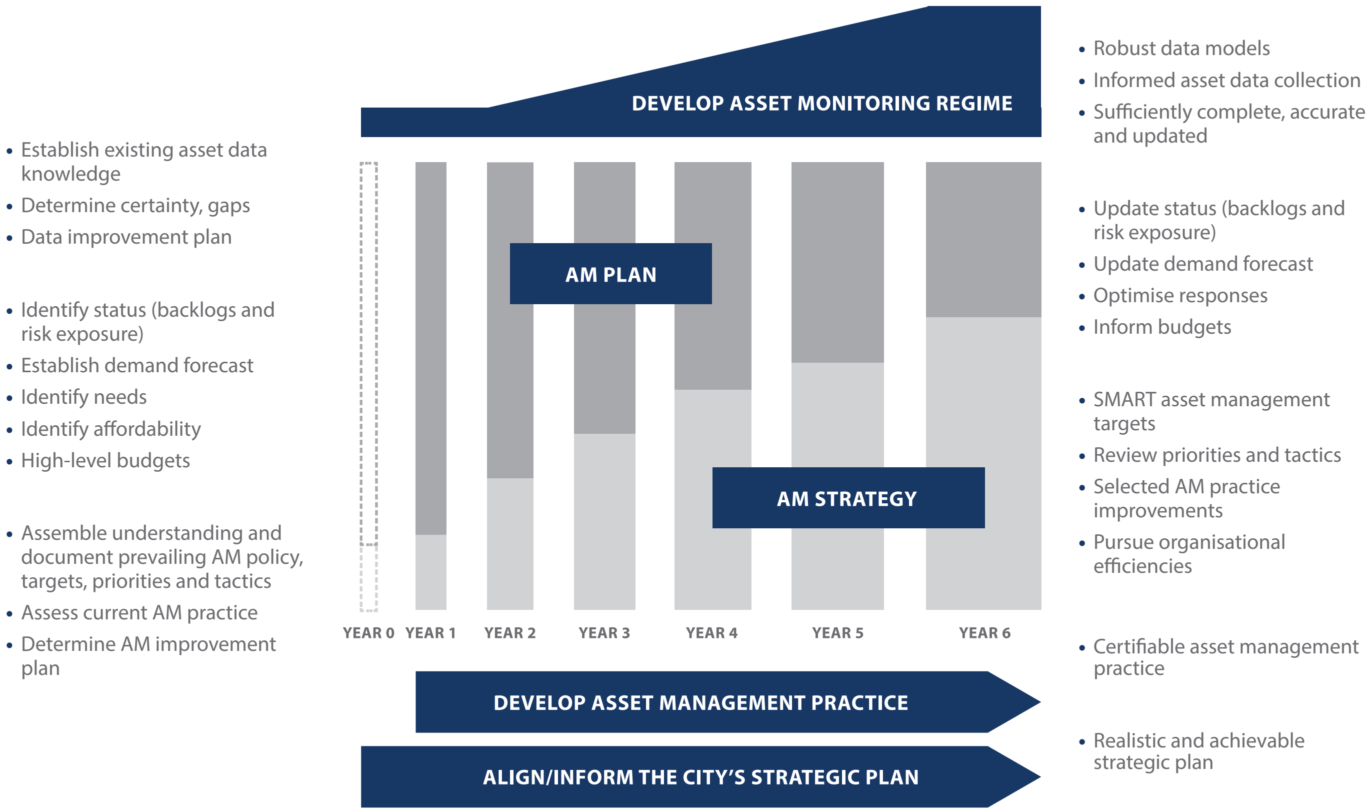


FIGURE 6.6: *Cycles of increasing reliability of asset management planning instruments*

6.2.2 Identifying the nature and scale of the macro needs

A backlog model is used to provide a consistent framework to determine and assess capital and operational backlogs (needs) in the short, medium and long term. The minimum study period for the assessment is 30 years, given the long expected useful lives of municipal infrastructure assets (on average around 40 to 50 years) and the long period often associated with planning, design optimisation and implementing infrastructure. Life-cycle needs are assessed in the model in current-day terms (the base year is taken to be the most recent year that has audited data) and is used for all projections in this model – ie all figures are in real terms, without any escalation – so that they can be more readily understood and aggregated – escalation over such long periods would over-shadow the figures and dilute understanding of the trends. Naturally, when introducing the figures back into the future budgets, assumed escalation will need to be introduced).

As noted in **Module 3**, a guiding principle in the approach adopted in CIDMS is to adopt a straight-forward model at the highest level that is easily understood by users and decision-makers, and can be readily applied and then drilled down in terms of sophistication on a selected basis. In the case of life-cycle modelling it is an essential departure point to draw a line between capital and operational activities, as these are the main financial classifications used in budgeting and expenditure monitoring. Consequently, the modelling is in tandem with this.

The approach adopted is to document the life-cycle strategy relating to each component type, as actually practiced by the city. This in turn dictates the expected useful life, residual value if any, and, importantly, the level of effort required to achieve the expected useful life. This latter effort (maintenance) forms an important element of the sector's operational budget - any intervention implemented during the life-cycle of an asset that contributes to meeting its EXPECTED useful life, is operational expenditure (and, as discussed later in this section, should be informed by models calibrated against prevailing (and planned improvements to) maintenance practices. Modelling of the elements of the component life-cycle strategies is calibrated (to the extent possible given prevailing maintenance records) to actual costs, as illustrated in **Figure 6.7.**

CITY NEEDS

SECTOR NEEDS

PHYSICAL RISK EXPOSURE: CRITICALITY AND LIKELIHOOD OF FAILURE

LIFE-CYCLE STRATEGY - PER COMPONENT TYPE

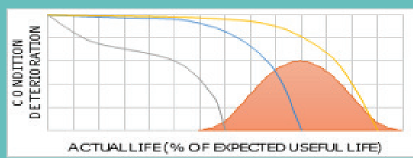
INITIAL CONSTRUCTION	Actual cost (to account for expenditure, informs annual update of replacement unit rate) Value-for-money (compare to current replacement cost)
USEFUL LIFE	Expected life (portfolio average); periodically reviewed based on statistical data  Remaining life (based on specific operating environment); annual review of shortest of failure modes (condition, capacity, performance, obsolesce)
MAINTENANCE	Cost of planned activities (calibrated model based on CRC, criticality, condition) Unplanned/emergency responses Impairment reversals
RENEWAL (OR UPGRADING)	Cost estimate (based on current replacement cost, calibrated to prevailing actual practice) Optimised responses (for high value and critical assets) simple triggers for non-critical assets
DISPOSAL	Method as per disposal policy Residual value (where significant, % of CRC)
ENVIRONMENTAL	Provision for future cost where significant (e.g. Landfill restoration sites)

FIGURE 6.7: *Financial modelling rolled up from life-cycle strategies per component type*

This enables benchmarking and effective review of maintenance management efficiency and effectiveness. It also provides the platform for reviews of the life-cycle management of components, and the review of the merits of new technology pertaining to components. This provides an excellent foundation to drive improvements in the effectiveness and efficiency of the maintenance practices in the city.

Renewal budgets are based on replacement unit rates which are also calibrated to actual replacement costs (where available, or by other techniques where these are not available). These are reviewed regularly to reflect current prevailing rates (with all the qualifying costs and local influencing factors) to ensure the models are sufficiently accurate. Naturally, as projects are progressively developed and refined, further optimisation of the life-cycle treatment takes place that may realise further additional costs or savings, and these in turn, when implemented, will feed back into the data-base of actual costs which inform the unit rates (and also possibly a review of the life-cycle strategies relating to particular component types).

Capital backlogs are considered in the backlog model in terms of the need to service customers where there is:

- No infrastructure provision
- Under-provision (in terms of the target level of service)
- Existing infrastructure that does not have sufficient capacity or is underperforming
- Other existing infrastructure which is in a condition not considered acceptable

Needs associated with operational budgets are considered in terms of:

- Maintenance costs – benchmarked on the model indicated below in this subsection
- Operational costs – other infrastructure-related costs that include bulk purchases, process operations, planning and control, and the sector's proportionate allocation of the corporate overheads.

> *"The model is calibrated and refined over time to provide increasing levels of confidence."*

The model is applied for the whole city (and, as necessary, to a number of predetermined physical planning areas as contemplated in **Module 5**), and provides a basis for understanding zero-based life-cycle needs, the impact of the city's actual and forecasted affordability as a constraint on the tempo of addressing backlogs, the balance required between addressing the life-cycle needs of existing and new infrastructure, and review of the relative budget requirements of the various sectors. The model is calibrated and refined over time (for example this could be with respect to increased confidence in the condition deterioration curves of particular component types) to provide increasing levels of confidence.

The model produces a picture of the full infrastructure needs at portfolio level over the planning period:

01 EXISTING CAPITAL BACKLOGS

- Capacity – assets at, or beyond, capacity (grades 4 and 5 as defined in **Module 3**);
- Performance – assets not performing (grades 4 and 5 excluding any double counting of assets included above);
- Condition – assets in poor or very poor condition (as a default initial position to which a management response is crafted, it can also be refined through the adoption of a maximum % of assets in condition grades 4 and 5 relating to each of the criticality grades, once these have been developed and adopted as a sector AM objective); and
- Access backlogs (total or partial) – based on the assessment of the actual and targeted level of service.

02 CAPITAL BACKLOGS (NEEDS) OVER THE FIRST 10 YEARS (AND THEN SUBSEQUENT PERIODS)

- Growth (based on customer data as identified in Module 5) – including private/developer-created assets; and
- Ongoing additional capital renewal needs (based on the ongoing depreciation of the existing portfolio, less any infrastructure which will not be replaced – for example associated with an inner city rejuvenation project - and infrastructure added due to cater for growth).

03 MAINTENANCE BACKLOGS

- Status quo (in Year 0 – the last audited financial year) – actual expenditure broken down to sectors – the total including wages/salaries, and corporate overheads (including allowance for consumption of workshops, stores etc.), consumables, vehicle and contractor/supplier costs;
- Needs in Year 10, and subsequent 10-year periods – based on the assumption of addressing existing backlogs over the period, as well as growth (note capital renewal does not contribute to the maintenance burden) – and adoption of the maintenance model indicated below in this subsection.

04 OPERATIONS BACKLOGS

- Status quo – based on analysis of existing data in Year 0 – bulk purchases, process management (e.g. at treatment works etc.), and security – excluding depreciation, interest etc. – plus service-based operations (e.g. clinics).

The application of the model is illustrated in **Tables 6.1 to 6.5.**

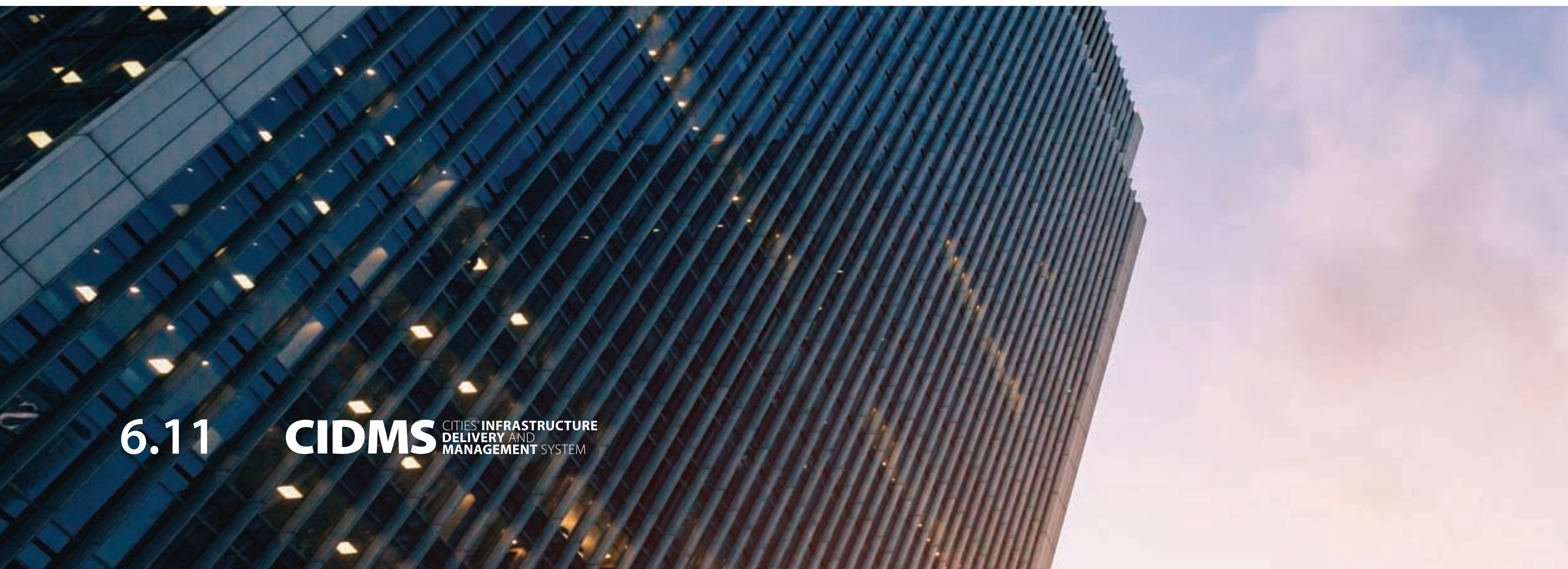


TABLE 6.1: *Capital needs – current backlogs*

SECTOR	REPLACEMENT VALUE (RM) YR 0	CAPITAL (REPORT PERIOD) – YR 0 PRICES							
		ACTUAL EXPENDITURE (RM) YR 0	YR 0						
			TECHNICAL BACKLOG			ACCESS BACKLOG (RM)	TOTAL BACKLOG (RM)	INCREASE IN ASSETS (RM)	% INCREASE IN ASSETS
			CAPACITY/ PERFORMANCE (RM)	ADDITIONAL CONDITION (RM)	TOTAL (RM)				
Water	6 199	49	66	415	481	1 001	1 482	1 416	23%
Sanitation	4 966	25	73	158	231	878	1 109	1 036	21%
Roads and stormwater	31 259	468	112	1 131	1 243	8 825	10 068	9 956	32%
Electricity	24 386	1 003	347	4 358	4 705	2 522	7 227	6 880	28%
Solid waste	2 215	131	5	13	18	0	18	13	1%
Community facilities	6 103	201	36	298	334	219	553	517	8%
TOTAL	**75 128**	**1 877**	**639**	**6 373**	**7 012**	**13 445**	**20 457**	**19 818**	**26%**
% of asset replacement value			**1%**	**8%**	**9%**	**18%**	**27%**	**26%**	

NOTES:

1. The replacement value (CRC) of the infrastructure is drawn from the asset register and corrected as necessary to the Year 0 values. In order for these estimates to be sufficiently accurate, the unit rates used to determine the replacement costs should be calibrated to prevailing industry practice for capital renewals, and be consistent with the adopted lifecycle strategy for the component types (again reflecting the prevailing lifecycle treatment) – as discussed in Module 3. Estimates of the value of infrastructure under the control of third-party suppliers in the city area (e.g. Eskom) are included for completeness, but should be ring-fenced.
2. Actual expenditure is taken from the audited financial statements for Year 0.
3. The technical backlog data is also drawn from the asset register. Components that are at grade 4 or 5 utilisation or performance may be assumed to need replacement (an assumption in terms of the capital cost relative to the current replacement cost can be made). The replacement cost of items which are outside the target condition (which may be dependent on its criticality grade) can be determined directly from the CRC data. A check needs to be made to ensure that components are not double counted.
4. The value of the access backlog can be determined, as a minimum practice, based on the number of sites not adequately serviced and the average replacement cost of infrastructure servicing similar current sites.

TABLE 6.2: *Capital needs – first 10 years*

SECTOR	CAPITAL (REPORT PERIOD) – YR 0 PRICES					
	FUTURE (YRS 1 TO 10)					
	GROWTH (RM)	BALANCE RENEWAL (RM)	TOTAL CAPITAL (RM)	INCREASE IN ASSETS (RM)	% INCREASE IN ASSETS	AVERAGE ANNUAL INCREASE %
Water	1 648	976	2 624	1 648	27%	2.7%
Sanitation	1 554	302	1 856	1 554	31%	3.1%
Roads and stormwater	9 598	11 617	21 215	9 598	31%	3.1%
Electricity	6 983	2 318	9 301	6 983	29%	2.9%
Solid waste	724	344	1 068	724	33%	3.3%
Community facilities	1 043	1 846	2 889	1 043	17%	1.7%
TOTAL	**21 550**	**17 404**	**38 954**	**21 550**	**29%**	**2.9%**
% of asset replacement value	**29%**	**23%**	**52%**			

NOTES:

1. For completeness, the capital to accommodate growth includes assets to be created by private developers and handed over to the city (the funding plan takes this into consideration).
2. Growth is based on estimated increase of customers in the respective customer groups as indicated in **Module 4**.
3. The estimates of the value of infrastructure that needs to be created to accommodate growth can be based on an assumed pro-rata adjustment of the current average cost per customer (based on current replacement costs), adjusted in line with the prevailing level of service per area. Alternatively refined models can be used where the models have been developed and data is available. Such models should account for the applicable bulk costs, reticulation and connection charges.
4. "Balance renewals" are the costs of capital renewal in the applicable period noting that the costs to address the current backlog have been catered for in the model. Typically the annualised consumption of CRC (less any assets that will not be replaced at end of life) of the progressively increasing extent of infrastructure is used as an indicator.

TABLE 6.3: *Capital needs – following periods*

SECTOR	FUTURE (YRS 11 TO 30)						TOTAL CAPITAL (RM)	INCREASE IN ASSETS (RM)	% INCREASE IN ASSETS	AVERAGE ANNUAL INCREASE %
	GROWTH (RM)	BALANCE RENEWAL (RM)	TOTAL CAPITAL (RM)	INCREASE IN ASSETS (RM)	% INCREASE IN ASSETS	AVERAGE ANNUAL INCREASE %				
Water	3 296	438	3 734	3 296	53%	2.7%	7 840	6 360	103%	3.4%
Sanitation	3 108	179	3 287	3 108	63%	3.1%	6 253	5 698	115%	3.8%
Roads and stormwater	19 196	5 511	24 707	19 196	61%	3.1%	55 991	38 750	124%	4.1%
Electricity	13 966	1 187	15 153	13 966	57%	2.9%	31 681	27 829	114%	3.8%
Solid waste	1 448	172	1 620	1 448	65%	3.3%	2 706	2 185	99%	3.3%
Community facilities	2 086	550	2 636	2 086	34%	1.7%	6 077	3 646	60%	2.0%
TOTAL	43 100	8 036	51 136	43 100	57%	2.9%	110 547	84 468	112%	3.7%
% of asset replacement value	57%	11%	68%				147%			

TABLE 6.4: *Maintenance needs*

SECTOR	MAINTENANCE (PA)						
	YR 0			YR 10		YR 30	
	ACTUAL YR 0 (RM)	ASSESSED NEED (RM)	% INCREASE	FORECAST NEED (RM)	% INCREASE	FORECAST NEED (RM)	% INCREASE
Water	155	146	-6%	213	38%	276	78%
Sanitation	118	113	-5%	167	42%	226	92%
Roads and stormwater	587	839	43%	959	63%	1 323	125%
Electricity	813	1 004	24%	1 007	24%	1 203	48%
Solid waste	83	106	28%	93	12%	114	37%
Community facilities	102	128	28%	124	21%	153	50%
TOTAL	**1 858**	**2 336**	**26%**	**2 563**	**38%**	**3 295**	**77%**
% of asset replacement value	**2.5%**	**3.1%**	**26%**				

Note: Maintenance needs are determined from the maintenance model (this includes all associated costs, including internal staff, buildings, vehicles, equipment and materials calibrated to the specific city and its operational environment) and are linked to the component types and criticality distribution. It is typically assumed in this high-level model that the mix of component types and the criticality distribution across the portfolio will remain constant into the future. The condition grade distribution will also remain as per the target (so that a singular maintenance percentage can be established for this model).

SECTOR	OPERATIONS (PA)							TOTAL O&M (PA)			
	YR 0			YR 10		YR 30					
	ACTUAL YR 0 (RM)	ASSESSED NEED (RM)	% INCREASE	FORECAST NEED (RM)	% INCREASE	FORECAST NEED (RM)	% INCREASE	ACTUAL YR 0 (RM)	ASSESSED NEED YR 0 (RM)	FORECAST NEED YR 10 (RM)	FORECAST NEED YR 30 (RM)
Water	155	171	10%	202	18%	264	71%	310	316	415	540
Sanitation	118	130	10%	159	23%	218	85%	236	242	327	445
Roads and stormwater	587	646	10%	828	28%	1 193	103%	1 174	1 485	1 787	2 516
Electricity	813	894	10%	1 027	15%	1 292	59%	1 626	1 899	2 034	2 495
Solid waste	83	91	10%	105	15%	133	60%	166	197	198	246
Community facilities	102	112	10%	132	18%	172	68%	204	240	256	325
TOTAL	**1 858**	**2 044**	**10%**	**2 453**	**32%**	**2257**	**76%**	**3 716**	**4 380**	**5 016**	**6 567**
% of asset replacement value	**2.5%**	**10.3%**						**5%**	**18%**	**35%**	**77%**

TABLE 6.5: *Operational needs*

Note: Operations are modelled using existing expenditure as a departure point (and therefore linking it to existing levels of efficiency). It also caters for envisaged increases in bulk acquisitions, and operational cost increases (such as operations at treatment works) or adjustment to service standards, if any. Depreciation, loan repayments and corporate overheads are NOT included in the model.

01 DEVELOPMENT COST MODEL

A development cost model at portfolio level is needed to establish budget cost estimates associated with new development, densification, and upgrading. "Baseline" rates are determined at asset-group-type level that represent the cost of moving from one level of service (LOS – as defined through the techniques indicated in Module 4) to another – per customer type. The model needs to indicate greenfield costs for new development, and brownfield costs for changing (typically upgrading) from one LOS to another, assuming an urban environment. Where there are existing developments of a similar type, the CRC unit rates from the asset register (CRC) data may be used as a departure point, adjusting as necessary from brownfield to greenfield rates, and other significant influencing factors such as average stand size or development density. Care needs to be taken to cater for instances where there have been significant changes in design standards (for example, more exacting environmental standards for treatment works, recycling facilities, or increased access, safety and energy conservation requirements at buildings). This is because cost estimates for facilities (or asset group types) determined by replicating components from existing facilities (in the asset register) may understate the cost of future ones.

Another approach is to prepare the models from first principles using unit rates, though these should also be calibrated with the CRC valuation rates used in the asset register, where applicable, on the assumption they in turn have been calibrated (as indicated above). A further refinement is to consider "capital cost surfaces" (as noted in **Module 5**) that identify cost premiums or opportunities for development which overlay the typical scenario modelled above, based on location.

> *"Care needs to be taken to cater for instances where there have been significant changes in design standards"*

02 CAPITAL RENEWAL MODEL

A capital renewal model is required to forecast capital renewal needs, and to inform the nature of the respective programme responses. The nature of municipal infrastructure is such that it generally deteriorates slowly over a long period of time. For some assets this can take more than 100 years, though the average for cities is generally around 40 to 50 years. On the other hand, some assets have very much shorter lives, such as gravel road surfaces that may only last three to five years. There can easily be a perception that the "infrastructure will be there forever", and, like the previous year, there will be no failure regardless of the level of maintenance. Of course this is a falsehood. This is illustrated in **Module 3, Figure 3.25**, which shows the value distribution of the portion of an infrastructure portfolio in poor and very poor condition as it slowly, but progressively ages. The relatively slim extent of infrastructure in poor and very poor condition when the portfolio is new is compared to when it is in mid-life, and the onslaught that descends at end of life. The deterioration may be slow, and relatively indiscernible, but it is certain – and when it occurs, the extent of infrastructure in poor and very poor condition can be so extensive that it has devastating impacts on service delivery. Fortunately in recent years this has been increasingly recognised and generally accepted, as services have plunged into non-performance with corresponding public outcry, which has resulted in political attention and support for improved management.

Cities need to draw a line – a performance standard – indicating at what stage the deterioration of the portfolio becomes intolerable. Or more simply, by answering the question "how bad is too bad?" At a very basic level, a city may want to consider any assets in poor or very poor condition to be undesirable, and therefore constitute a backlog. However, in the vast majority of cases this is most likely to be unaffordable, and most probably unnecessary from the point of view of effective use of public funds. A more appropriate line can be drawn in the form of a percentage of assets in a given portfolio that may be tolerated in a poor or very poor condition. Typically, this would be linked to asset criticality (for example, not more than 5 per cent of the primary roads, 10 per cent of the secondary, or 15 per cent of the tertiary roads). It is a statement of the city's risk threshold at the portfolio level. The concept of the Portfolio Health Index, which summarises the condition distribution of components within a portfolio, was introduced in **Module 3** and illustrated in **Figure 3.22.** The required data is drawn from the asset register, which is configured as indicated in **Module 3.** The model can be used to determine and report the level of capital renewal investment required to achieve the target performance of a portfolio (or asset group type) of assets (or indeed illustrate the forecasted Health Index based on other investment scenarios).

As previously noted, the steady deterioration of the entire portfolio is a certainty with each year that passes. The rate of deterioration depends on the life-cycle treatment of the components that make up the portfolio, and their operating environment (for which appropriate component life-cycle strategies are established – an example of which is provided in **Annexure 6A**). At a portfolio level, as illustrated in **Figure 6.8**, this may be tempered not only by the capital renewal of the assets at end of life, but also by adding new infrastructure or developments (assets that were not there before), and, to a lesser extent, by assets that are decommissioned. The tempo of these activities is what determines the overall condition distribution of the portfolio.

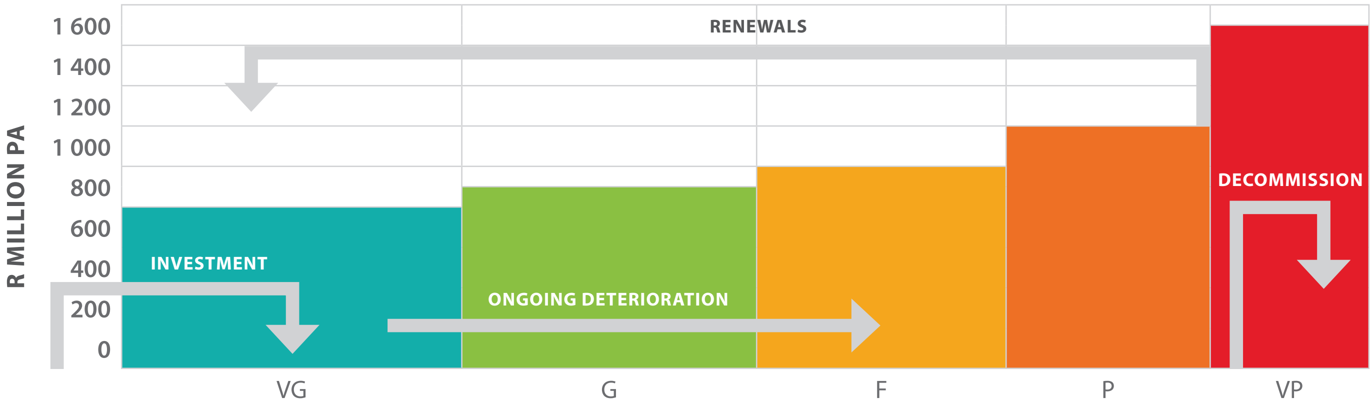


FIGURE 6.8: *Maintenance needs*

These patterns can be characterised in financial terms - the annualised CRC-based consumption of value characterises a portfolio's deterioration. And the ratio of the DRC value (less any residual) to the replacement value (less any residual) is indicative of the overall health grade – as indicated in **Table 2A.1** in **Module 2**.

Given an initial departure point of the current health grade of a portfolio, the renewal investment needs can be determined, as illustrated in **Figure 6.9**, with a view to adopting a "holding strategy" to not deteriorate any further, or a recovery strategy to achieve the target health grade (or, if more precise parameters have been determined, the accepted risk tolerance).

Based on affordability, and a strategy of tolerating risk below a particular threshold, cities can use this tool to determine the trajectory of capital investment needs at portfolio level, or, the performance that can be expected with different levels of investment. A key underlying assumption is that prevailing practice (reflected in the existing component life-cycle models) is already optimised, which may not actually be the case. A sensitivity analysis can be undertaken to establish the change in budget requirements in the event that the actual useful life of components exceeds (or is less than) the expected average life, or certain levels of life-cycle cost optimisation can be achieved. Such analyses, when undertaken using financial indicators only, will often yield a result that prolonged maintenance is the cheapest option, so triggers for renewal are often driven by service standard thresholds.

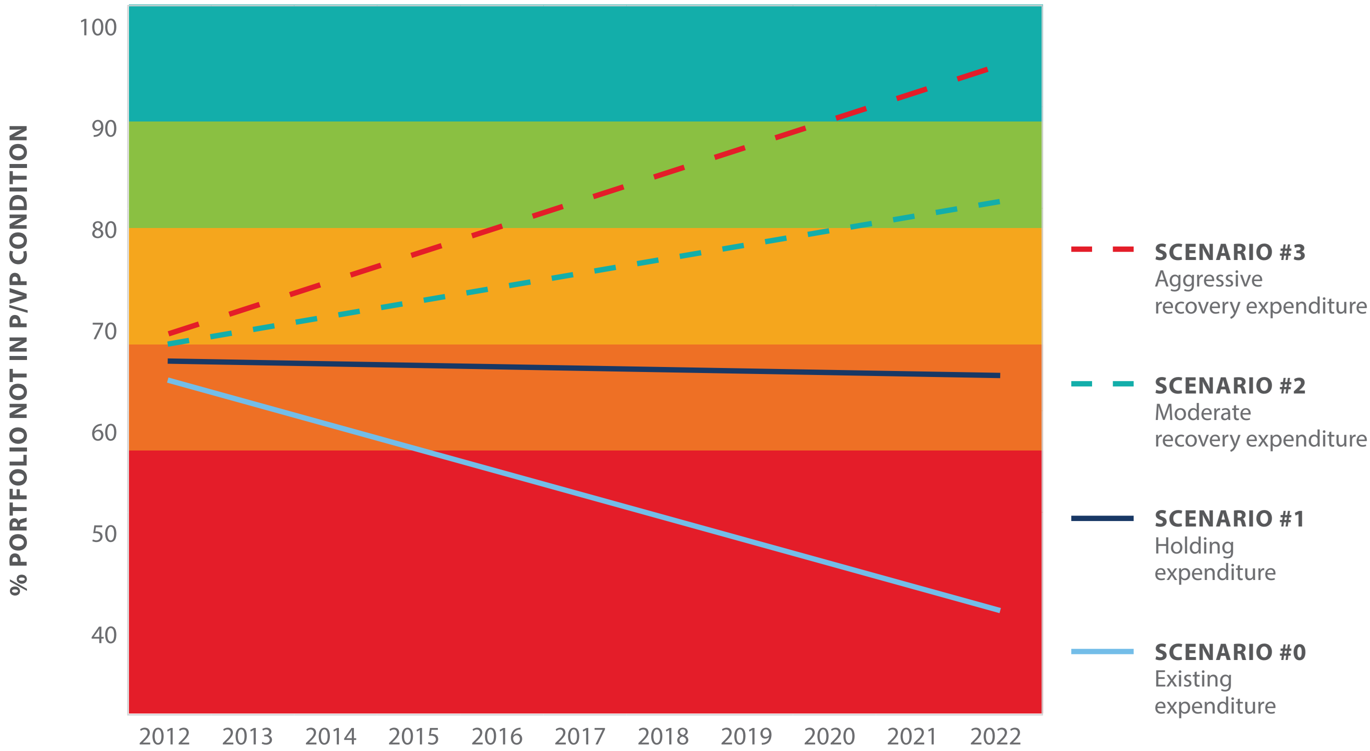


FIGURE 6.9: *Example of a report on portfolio renewal investment scenarios*

03 MAINTENANCE HIERARCHY

In line with the life-cycle cost model used in this toolkit (the principles of which are summarised in **Figure 6.7**), the OPEX maintenance activities related to any given component are considered to be the effort required for the component to achieve its expected useful life (in line with the adopted component life-cycle strategy). These activities are defined, at a high level, in the life-cycle strategies per component type (an example is given in **Annexure** 6A). They may be linked, at this, or a more detailed level, to a form of maintenance management system that prompts and records maintenance activities. These activities at the component level can be considered to be preventative or reactive in nature, as illustrated in the maintenance hierarchy shown in **Figure 6.10** (which is in line with the definitions provided below that are consistent with the ones indicated in the National Infrastructure Maintenance Management Standard). The most appropriate maintenance regime for any given component type can be assessed by considering the benefit-cost ratio of alternative approaches. Often preventative methods can prove to be cost-effective for critical components (such as crack-sealing and edge repairs to arterial road surfaces, or large transformers), whereas reactive maintenance may be acceptable for non-critical components (such as general lighting), providing of course that there is an effective mechanism to identify these and schedule the necessary repairs in line with the target portfolio performance. A run-to-failure maintenance regime is a planned corrective maintenance approach, provided steps are taken to inspect or otherwise identify when the asset has failed.

The objective should be to plan all maintenance activities, whether they be preventative or reactive in nature, for critical and not-so-critical components. In particular priority should be given to minimise the risk of failure of critical assets (which, if they were to fail, would require immediate – ie emergency corrective action). Naturally, however, regardless of whatever preventative steps are taken, this risk is not normally able to be completely and absolutely eliminated, and emergency response plans are required to cater for this eventuality.

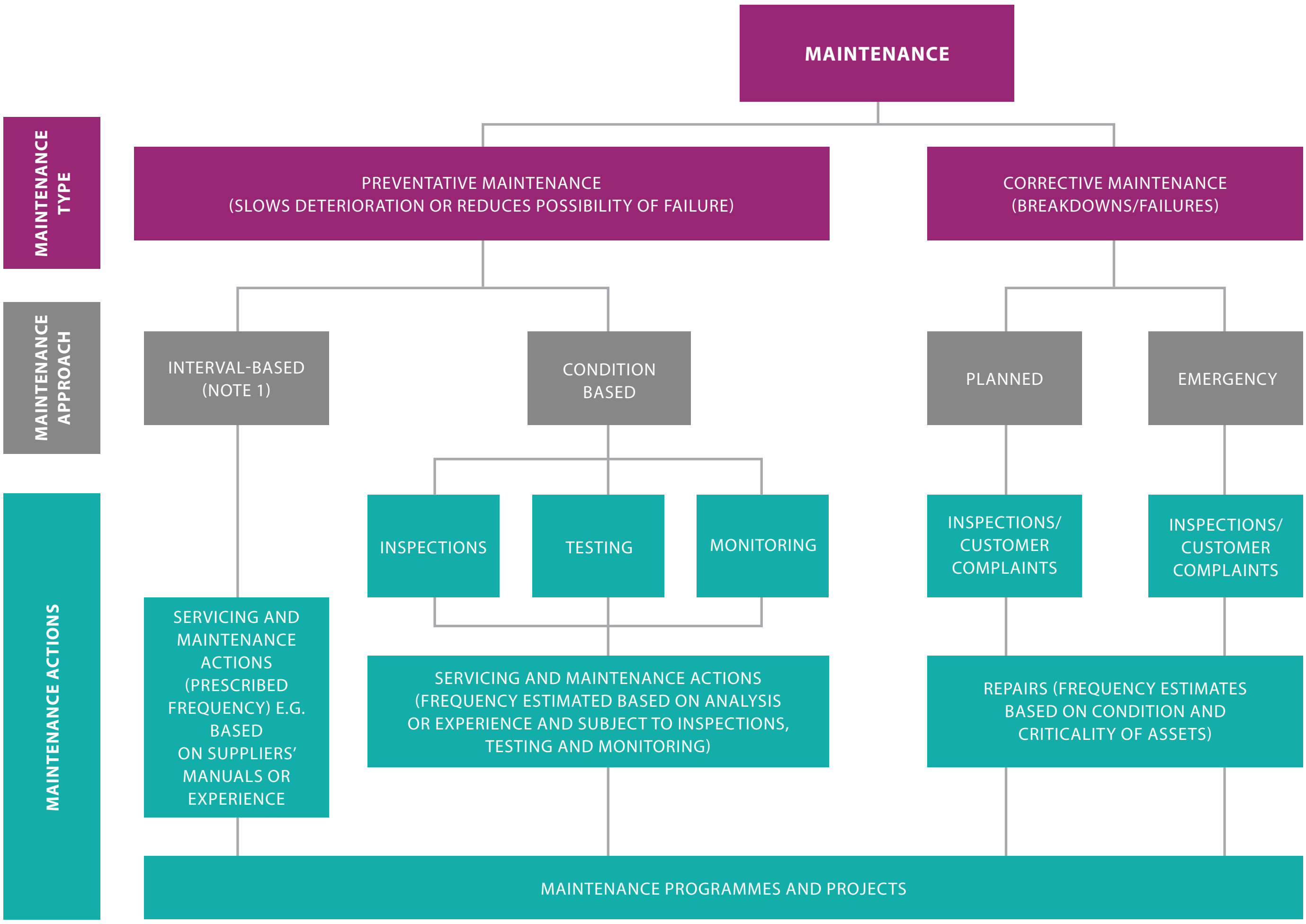


FIGURE 6.10: *Maintenance hierarchy*

NOTE 1 (INTERVAL-BASED PREVENTATIVE MAINTENANCE):
Normally reffered to as "time-based' preventative maintenance, but could also be based on number of machine hours, number of outages, machine start-and-stop events etc.

DEFINITION OF MAINTENANCE
All actions intended to ensure that an asset performs a required function to a specific performance standard(s) over its expected useful life by keeping it in as near as practicable to its original condition, including regular recurring activities to keep the asset operating, but specifically excluding renewal. Refer to Appendix A for a hierarchy of maintenance type, approach and actions.

Note: Maintenance also specifically excludes restoring the condition or performance of an asset following a recognised impairment event, which would be classified as either renewal or upgrading, depending on the circumstances

DEFINITION OF PREVENTATIVE MAINTENANCE
Maintenance carried out at predetermined intervals, or corresponding to prescribed criteria, and intended to reduce the probability of failure or the performance degradation of an item. Preventative maintenance is planned or carried out on opportunity.

DEFINITION OF CORRECTIVE MAINTENANCE
Maintenance carried out after a failure has occurred and intended to restore an item to a state in which it can perform its required function. Corrective maintenance can be planned or unplanned.

04 MAINTENANCE BUDGET NEEDS MODEL

A maintenance budget estimating model needs to be adopted by the cities to inform the portfolio life-cycle cost estimates in the short, medium and long term. This is calibrated using relevant and reliable data from the asset register and/or maintenance management systems, to establish higher-level parameters that can be more readily used in the life-cycle modelling, benchmarking, and in particular for forecasting purposes.

The model links the required maintenance effort to:

- The type of component
- Its replacement value
- Its criticality
- Its condition

Figure 6.11 illustrates the concepts of such a model, where the cost of the annual maintenance effort is expressed as a percentage of the replacement value of the component (which is adjusted for escalation every year) and its criticality grade. In cases where the maintenance effort needs to increase as the component deteriorates, there is a percentage on-cost. The nature and scale of the on-costs can be modelled using advanced techniques, where considered reliable and supported by appropriate data, or they may initially be established using engineering judgement. In both cases they should be calibrated, as a departure point, to existing expenditure patterns.

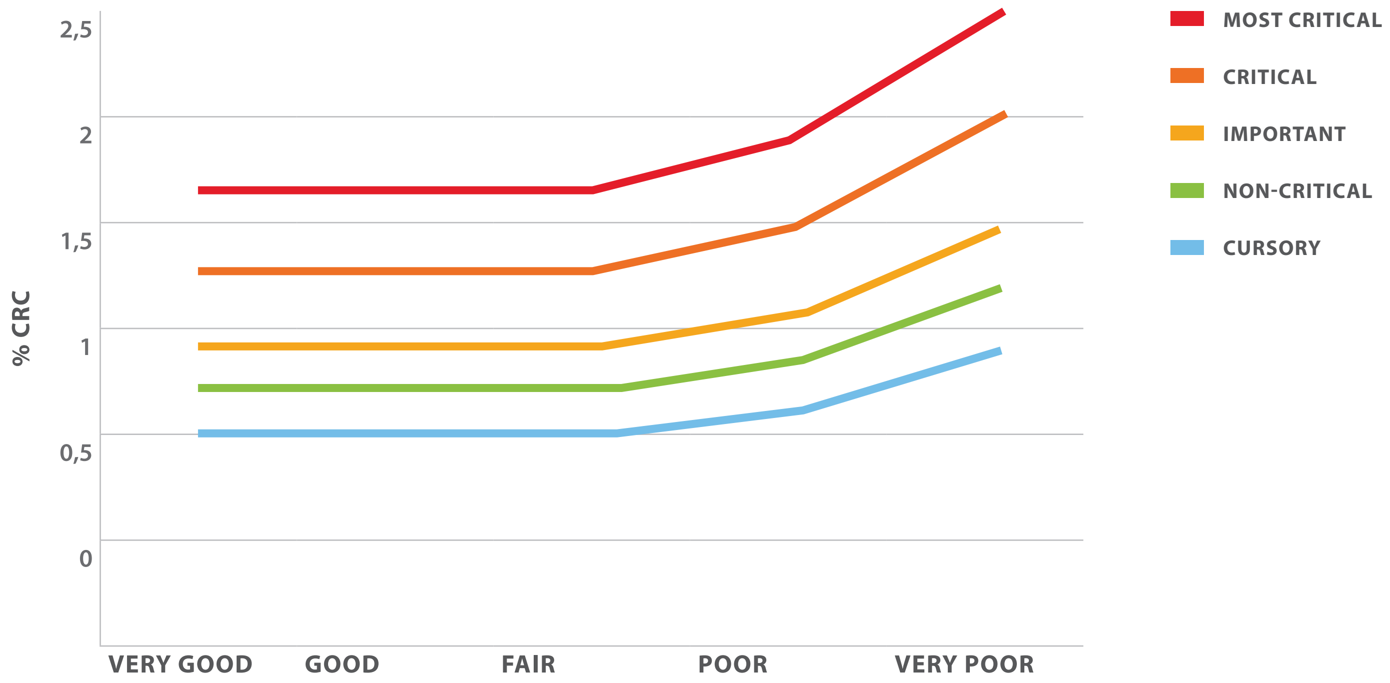


FIGURE 6.11: *Maintenance effort per year (as a percentage of CRC)*

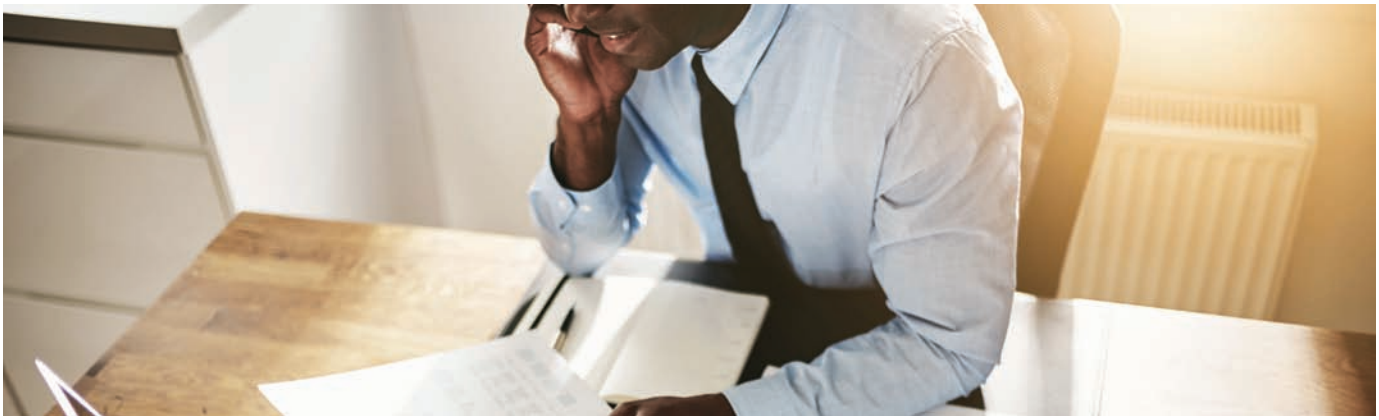
As previously noted, the maintenance cost in this scenario is considered to be an all-encompassing figure (to be able to effectively support life-cycle costing, benchmarking, options analysis and support decision-making purposes). Consequently it includes all directly attributable activities, including: maintenance management planning and supervision; implementation by skilled, semi-skilled and unskilled workers; parts; consumables; transport for materials and staff; any associated plant and equipment (such as lifting rigs or bladers); and any associated buildings and their operations, such as workshops and stores. Where these items have capital elements (such as vehicles, or workshops) they are reduced to an annual cost (as if the entire process was outsourced). An example of the model relating to specific component types is illustrated in **Table 6.6.**

COMPONENT TYPE	% CRC FOR CRITICALITY GRADE:					ADDITIONAL %	
	1	2	3	4	5	POOR	V POOR
Bituminous surface	1.0	1.1	1.3	1.5	1.7	10	25
Pump	4.0	4.2	4.5	4.9	5.2	5	10
Motor	3.6	3.8	4.0	4.3	4.6	10	20
Steel pipe	0.4	0.4	0.4	0.4	0.5	15	25

TABLE 6.6: *Example maintenance model factors*

While the models may initially be calibrated to align with actual costs and prevailing maintenance practice at the sector level, cities should aim to increasingly improve confidence in the models and thereby an understanding of the efficiency of the prevailing maintenance management practices as well as the degree of optimisation of the asset maintenance tasks (ie optimisation of the component life-cycle strategies).

Once appropriately calibrated, the model can be applied to the CRC, component type, criticality and condition data in the asset register to estimate zero-based maintenance needs of all the components in the existing portfolio. It can also be used to forecast future maintenance needs based on the changing profile of assets over the asset management planning report period by assuming an appropriate mix of components. Where applicable, this can be based on the assets that are currently in existence and reflected in the asset register (in an area where the development is considered to be of a similar nature to that envisaged in the future). Alternatively it can be determined at a rolled-up level based on the breakdown of the bulk and reticulation infrastructure associated with the development cost model, as described in the preceding paragraphs. An example of sector-level models that can be used in conjunction with the development cost model, for maintenance and renewal costs, is illustrated in **Figure 6.12.**



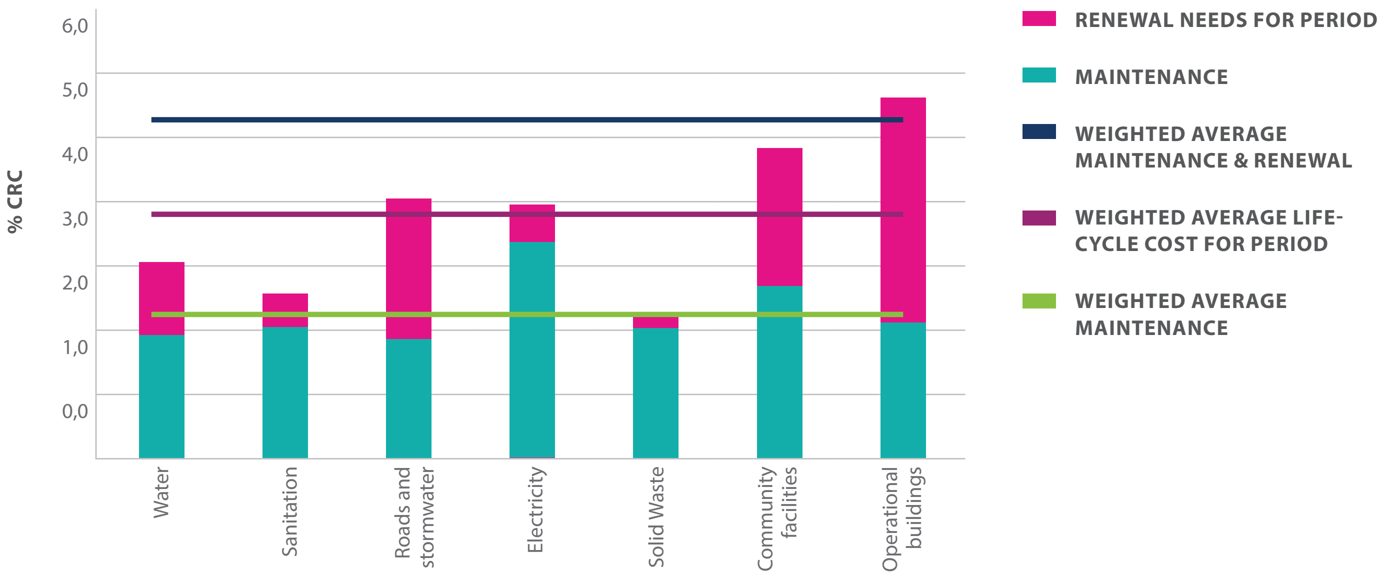


FIGURE 6.12: *Example output from the maintenance and renewals models (% CRC)*

05 MAINTENANCE BUDGET ALLOCATIONS

Whilst the maintenance management strategy will identify and commit to selective actions to achieve improvement, a maintenance management plan needs to be prepared to respond as effectively as possible to the prevailing operational environment and available resources. The maintenance budget needs data can also be used in conjunction with the criticality and condition data to prioritise actual budget allocations (to component types) as illustrated in **Figure 6.13.** These can be rolled up to asset types (or asset group types) in line with mSCOA requirements. Naturally these all-encompassing maintenance budget figures should be disaggregated into the appropriate budget structure. The application of the maintenance budget should be broken down in line with the respective city's financial policies, budget structure and commercial tactics (to allocate to budget items such as salaries and wages, vehicles, facilities management, consumables, spares and outsourced services) – again in line with mSCOA and as contemplated in **Module 8**.

A key pre-requisite for this approach to be effective is that the structure and data in the maintenance management system needs to be aligned and linked to the asset register (in line with the models indicated in **Module 3**).

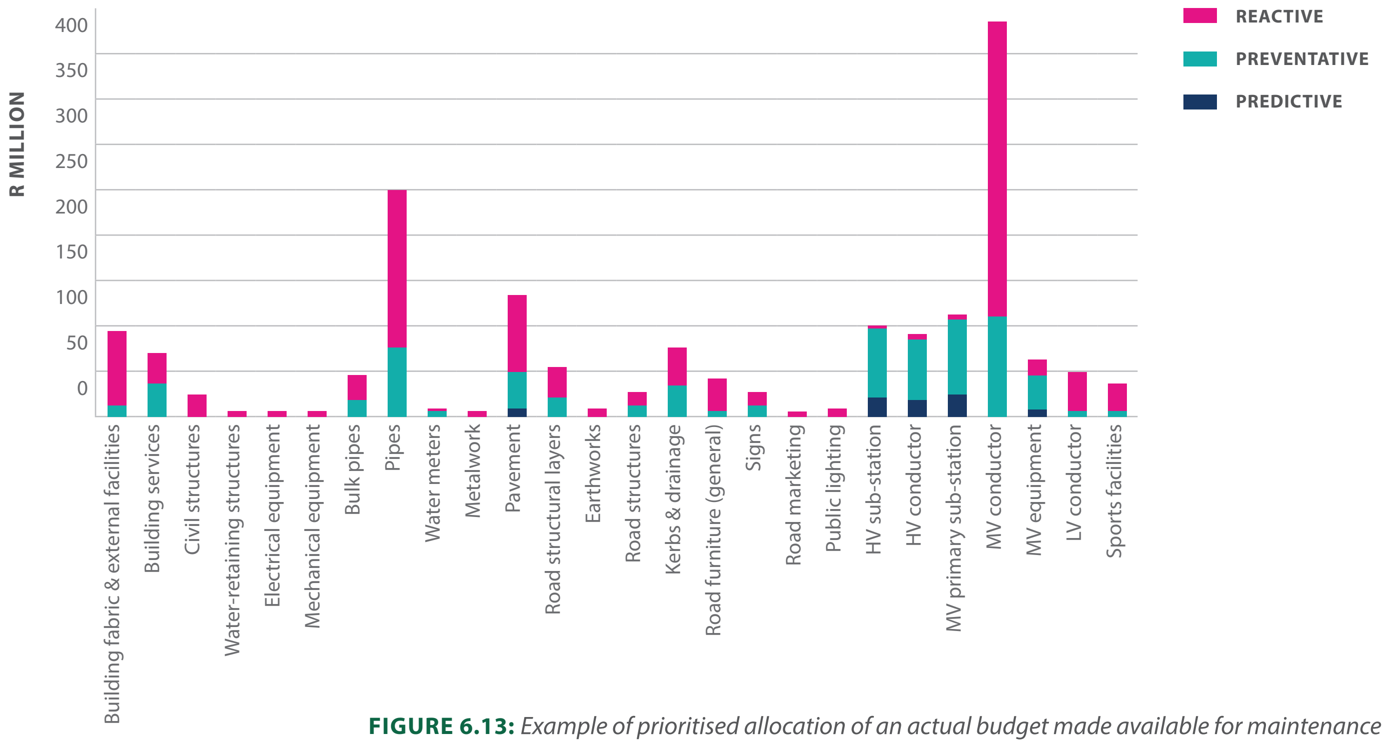


FIGURE 6.13: *Example of prioritised allocation of an actual budget made available for maintenance*

06 OVERALL LIFE-CYCLE NEEDS AND AFFORDABILITY

Figure 6.14 provides an example of an assessment of the life-cycle needs, in constant Rand terms) of the various sectors in a city to address existing backlogs (assumed to be eradicated over a 10 year period) and growth. This data is overlaid onto the city's likely affordability profile and illustrates the nature and order of magnitude of the affordability gap, which in turn points to the need for a strategic review and prioritisation of LOS and SOS targets and strategies, the impact (risks and opportunities) of growth, and the potential benefits to be accrued from improved operational and revenue management performance.

Figure 6.15 illustrates the same data but split between the life-cycle needs of the existing (lower row) and new (upper row) infrastructure, once again pointing to high-level strategic challenges and the need to determine optimised, prioritised and coordinated responses to the competing life-cycle needs.

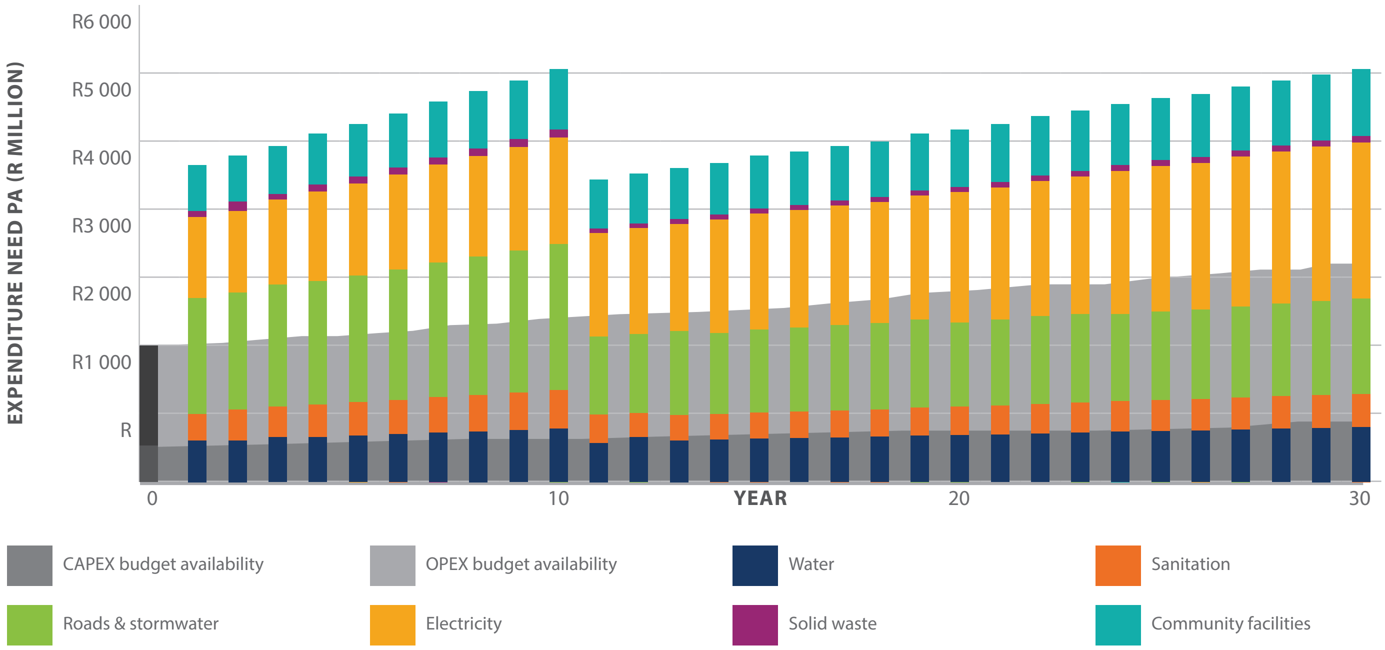


FIGURE 6.14: *Example illustrating infrastructure life-cycle needs per sector overlaid onto the available budget*

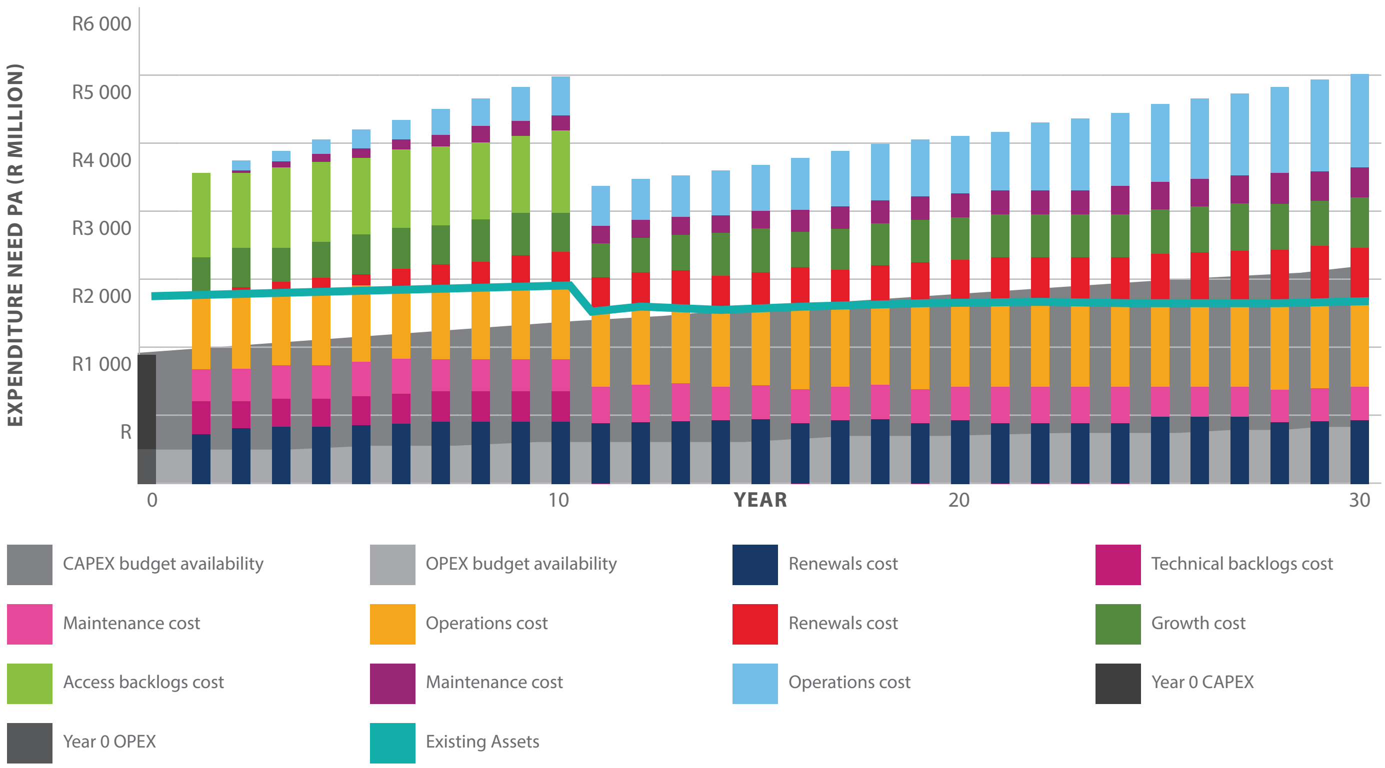


FIGURE 6.15: *Example illustrating the infrastructure life-cycle needs of existing and new infrastructure overlaid onto the available budget*

6.2.3 Identifying challenges, strategic risks, opportunities and constraints

The delivery of services through the city's infrastructure requires implementing a range of programmes. These programmes comprise a logical sequence of short, medium, and long-term activities with certain interdependencies, depending on the nature and scale of the intervention. Indeed it could take several years to determine the optimal approach to achieving a particular outcome for some of the larger or more strategic infrastructure programmes. This includes considering appropriate asset (infrastructure) and non-asset solution options. Within each of these programmes, there would typically be a logical sequence of phased activities to reach a point of completion of the outputs, and perhaps even longer for the benefits of the programmes to be realised and outcomes tangibly measured. Some of the programmes may also have technical, spatial, or social interdependencies that should be borne in mind in planning the infrastructure-related activities at portfolio level.

Whilst it is prudent to conduct periodic reviews of some of the more far-reaching initiatives to ensure that they are still relevant, on track and indeed going to yield desirable outcomes relative to the required investment, there is generally a need to stay the course with previous commitments and bring them to a satisfactory conclusion. This is especially true while implementing projects and programmes that give effect to a current integrated development plan (IDP).

Naturally, however, in the annual planning process (and annual review of the IDP), there is a need to review budget, technical, legal and social needs, opportunities and constraints relating to current commitments – at a project and programme level (comprising both capital and operational budget initiatives). This is typically done by the responsible directorate, or section within a directorate. One should also review the same issues at a city and portfolio level. The latter includes a review of any changes in the city's strategic objectives or priorities, whilst taking into account new or updated strategic information from ongoing projects, programmes and strategic reviews. This could include externally imposed strategic or emergency responses that were not sufficiently catered for in previous budgets and plans, or perhaps where revenue/expenditure budget efficiencies have been realised. There could also be internally inspired changes in strategy or strategic direction, linked for example, to the development and adoption of a new IDP, or the need to improve maintenance management practices.

In this section, it is the annual review of city-level infrastructure-delivery commitments, dependencies, strategic risks, challenges, opportunities and constraints that are considered. This analysis provides the strategic status and context in the initial draft of the SAMP (represented by the "establish strategic brief" action indicated in **Figure 7.2** in **Module 7**), which in turn informs the preparation of the detailed draft sector AMPs (which feed back to the SAMP, the finalisation of which is contemplated in **Module 7.**

This relates to main-stream service delivery projects encompassing the entire life cycle of infrastructure, comprising the capital portion traditionally associated with new, upgrading and renewal construction projects, as well as infrastructure maintenance and operations expenditure. As illustrated in **Figure 6.16**, it also importantly includes the expenditure that acts as a catalyst to future service delivery, comprising:

- Studies which identify and define the need for projects and programmes (for example in response to a long term bulk supply challenge);
- Maintenance Strategies and Plans;
- Operational Strategies and Plans;
- Project and programme viability and configuration optimisation reports;
- Practice assessments and improvement plans; and
- Design and contract documentation preparation.

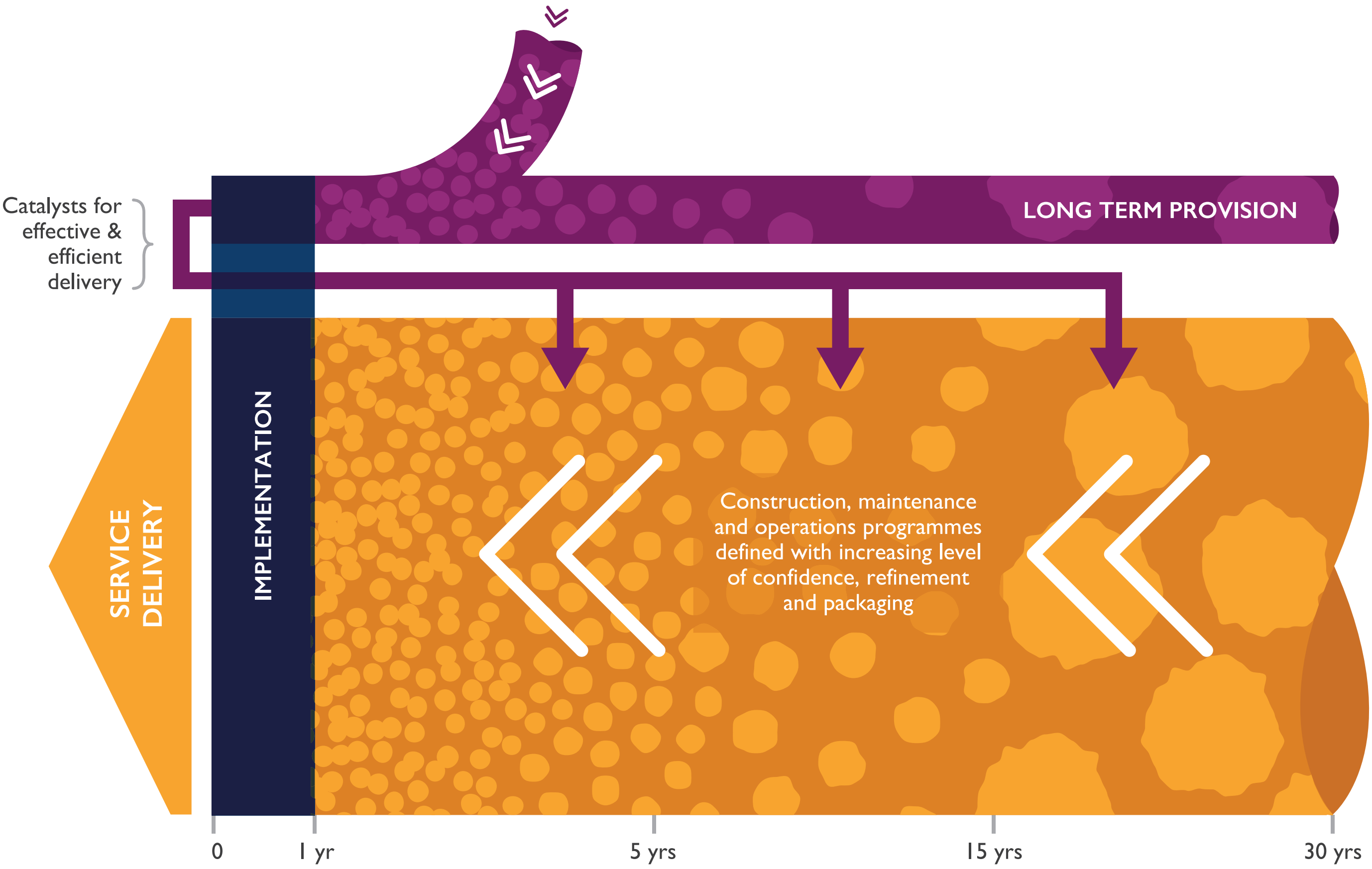


FIGURE 6.16: *Catalyst initiatives in support of main-stream service delivery programmes*

As illustrated in **Figure 6.17**, there needs to be a review to ensure that programmes have been sufficiently planned to ensure that they are deserving (and qualify in terms of the asset management strategy) to receive application of the city's limited available resources.

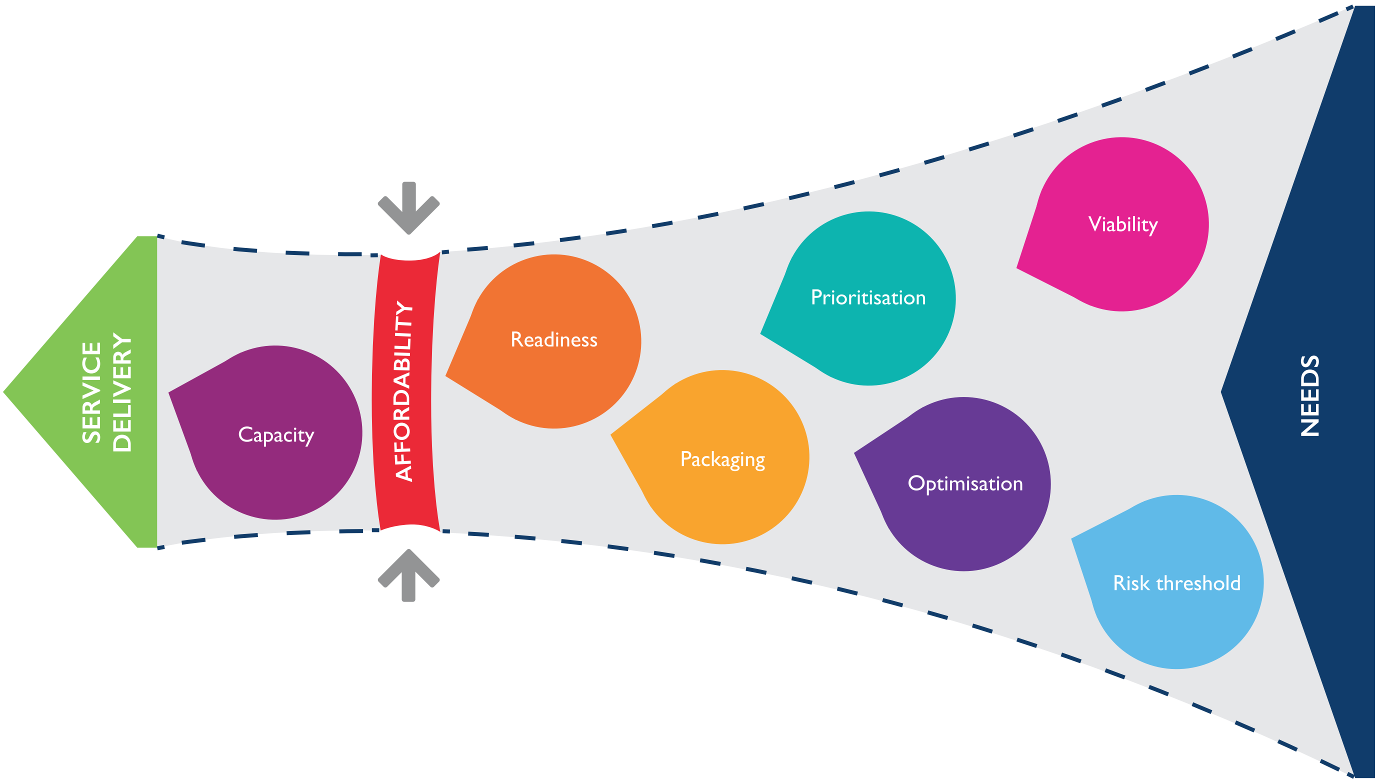


FIGURE 6.17: *Refinement of programmes and organisational preparedness ahead of implementation*

The departure point in this process is to confirm the current position and identify what has changed since the last review in the internal and external infrastructure-delivery environment. This will require the following assessments:

1. A review of the city's performance in infrastructure asset management against the city's established performance measures and targets, benchmarked against other cities
2. An update of the infrastructure life-cycle needs over the reporting period (using the models and approaches indicated in **Section 6.2.2**)
3. Confirmation of any adjustments made to the structure or nature of the city's AM system (established in line with **Module 2**) that may require review of previously identified projects and programmes to achieve improved vertical alignment with organisational objectives, the city's long-term development strategy, IDP, infrastructure asset management objectives, asset management policy, asset management strategy or statutory requirements
4. Confirmation of the state of implementation of existing CAPEX and OPEX programmes, including performance against the city's metrics such as use of available funds, asset creation, sustainability of the asset portfolio, and reduction of backlogs
5. Confirmation of the planning areas to be used for life-cycle planning and a review of the need for changes to any aspects of the customer growth model or forecast (for example based on more reliable or updated data becoming available, adjustment or refinement of the growth models or changes in demand management strategies)

6. A review of strategic risks – an update of the likelihood and nature, location or scale of impact of previously identified risk events as well as identification of new strategic infrastructure delivery risks, which include:
    - The integrity and efficacy of the asset management system across the city (performance, finance and risk management models and processes; data quality; planning, reporting, and decision-making processes; capital, operations, and maintenance works management; organisational governance, capacity and competency) – using the performance metrics reflected in the AM strategy (determined in line with **Module 2**)
    - Internal capital project and programme delivery – assessing actual performance in the previous year and trends analysis using the performance metrics; reviewing the efficacy of existing controls, and the adequacy of project preparation activities to underpin the required pace of delivery; and mitigating under-expenditure on programmes due to unforeseen delays at project level
    - Internal operations and maintenance project and programme delivery risk analysis – how adequate is the maintenance schedule to cover the risk of under- or overuse of available funds? This can be due to changes in actual maintenance needs which may be unforeseen at project level (such as a need for emergency repairs), but can be assessed at programme level in the short, medium and long term in view of infrastructure condition, criticality, and the prevailing maintenance regime
    - Physical failure risk (based on updated failure mode status and criticality data, rolled up and reported to asset group type level per sector) of existing infrastructure as indicated in **Module 3**
    - External supply risks, such as availability of bulk services, specialist products or services
7. A review to identify new technology, products, strategies, methodologies, models and techniques with a view to further assessment at the city (in the case of cross-cutting application) or sector level. The aim is to ensure that innovative solutions are adopted where benefits can be demonstrated (where applicable, using the life-cycle costing techniques indicated in Module 8 to assess and demonstrate potential benefits). The level of detail of the required analyses would depend on the nature and scale of the potential impacts and benefits, as per the requirements of the AM System (contemplated in Module 2)

8. Flagging opportunities for potential application of the city's strategic themes such as areas identified for redevelopment or densification; industrial or commercial growth; special projects or events; infrastructure greening; the adoption of labour-intensive methods of construction; use of local materials/products; non-asset solutions (such as the imposition of tariff controls, the introduction of awareness and educational programmes to encourage behavioural change or bylaws); maintenance management practices or tools; or organisational efficiency drives
9. A review of common themes of infrastructure asset management practice improvement needs identified at the sector level which can be most effectively be addressed at city level
10. A review of the need to adjust maintenance management practices or asset maintenance regimes (reflected in the component asset life-cycle strategies) to achieve the target standards of service, and/or achieve cost or risk management efficiencies
11. A review of fund availability - accurate to within five per cent for the first five years, indicative for years 6 to 10 (10 per cent accuracy), and broadly indicative for years 11 to 30 (25 per cent accuracy), as well as an assessment of the associated risks, opportunities, or constraints on funding
12. A review of operational efficiency and effectiveness improvements
13. A review of funding options in line with the AM strategy, and identification and review of potential packaging of activities across sectors' departments (for example for funding of programmes through a PPP initiative)
14. A review of programme or project coordination (location/time/technology) risks and opportunities.

6.2.4 Identifying and assessing strategic response options

The outputs from **Sections 6.2.2** and **6.2.3** on the status and context of the city-level infrastructure delivery challenges provides the departure point to identify and assess strategic response options. The existence and efficacy of existing responses to the stated strategic objectives, risks and opportunities should be identified and reviewed. Where the existing responses are considered to be inadequate, or could be improved, alternative strategic options should be identified. These are assessed in terms of target outcomes and performance metrics indicated in the asset management strategy that follow the "SMART" principle (specific, measurable, achievable, relevant, and time based). As noted in **Section 6.2.1**, where asset management practice is not yet sufficiently mature, proposed new metrics should be proposed to increasingly develop a robust asset management strategy - covering both the performance of the AM system and the service-delivery performance of the assets.

The selection of a preferred solution is based on an assessment of the applicable financial, social, environmental and economic costs and benefits indicated in **Module 8**. Where aspects are identified that do not have any cross-sectoral implications (for example, identifying new pipe replacement techniques) the assessment of the appropriateness of adopting or allowing the alternative technology is deferred for assessment as part of the review of the sectoral life-cycle strategies. The outputs of the assessments and recommendations on the most appropriate city-level strategic response options and their implications are documented as a preliminary input to the SAMP document to be used to provide an initial strategic brief to the sector departments (this is indicated as the first initiating step in the preparation of the sector AMPs in **Figure 7.2** which provides an overview of the subsequent sector AMP preparation process).

6.2.5 Determining the city life-cycle strategy

The outputs from **Section 6.2.4** above inform the determination of strategies and tactics to be adopted in the preparation of the next annual round of the SAMP and sector AMPs. The selection of the options, or the extent to which they are adopted, are determined by affordability (in terms of the uncommitted and discretionary portion of the available funds), and the strategic objectives and priorities of the city.

As applicable, the summary of the city's life-cycle needs (built up from a summary per sector as indicated in **Section 6.2.2**) is updated and reflected in the initial draft of the SAMP to reflect the application of the adjustments, for example the following:

- Changes in the initial backlogs (which could be due to changes or refinements in the definitions of what constitutes backlogs, actions that have been implemented to reduce the backlogs, a surge or reduction in growth compared to previous forecasts or improved delivery performance)
- Changes in the time frame for addressing the various backlogs – due to shifts in strategic priorities, organisational efficiency improvements, or affordability
- Changes in operational effectiveness or efficiency
- Changes in affordability (availability of funds)
- Changes in strategic objectives and/or priorities
- Improved status, life-cycle and growth data or models.

In addition to the above, based on the assessments undertaken, directives are provided in the initial SAMP for the sector departments to take into account when preparing the more detailed sector life-cycle plans and draft AMPs. The following are examples of the types of directives that could materialise:

- Determine options to increase bulk water, sanitation and electricity supply capacity by 2022 in Hazelwood to facilitate the proposed programme of housing densification in that area
- Establish procedures to improve data completeness and accuracy on new infrastructure, in line with the new adopted targets
- Assess the merits of an identified new loss-control technology
- Determine the impact on each of the respective sectors of the new adopted customer growth forecast for the city
- Assess the implications on all bulk and reticulation services of the proposed new inner city regeneration programme
- Assume nominal increase of 3 per cent in the capital budget available and 7 per cent on the operational budget based on roll-out of revenue enhancement measures, but allow for an eight per cent increase in bulk costs
- Bring forward implementation of projects with significant job-creation opportunities by giving higher priority to economic outcomes
- Based on benchmarking data, examine the operational efficiency of the roads maintenance operations

- In terms of a new and emergency strategic intervention in the city, identify capital programmes which can be deferred to contribute to establish the required additional funding over the next two financial years, and note the implications
- Plan to prepare project designs and documentation for short, medium and long term to a value in excess of 20 per cent of the expected available budgets to mitigate risk of under-expenditure due to unforeseen project delays
- Aim to achieve a maximum of only 5 per cent of arterial roads, 10 per cent secondary roads and 15 per cent of tertiary roads in poor and very poor condition by 2020
- Participate in planning for a combined schools education programme on municipal services to raise awareness of the need to care for the community's infrastructure.

As noted in **Section 6.2.1** as these directives are set, put into practice, reviewed and refined as considered necessary over a number of annual iterations, they will become increasingly robust and some will become entrenched as part of the established strategic response of the city and will be documented as such in the asset management strategy.

6.3 SECTOR INFRASTRUCTURE LIFE-CYCLE PLANS

6.3.1 Why develop infrastructure life-cycle plans per sector?

The sector life-cycle plans drill down the city-wide portfolio life-cycle strategy (discussed in **Section 6.2** above) to the level at which implementation is managed, generally in the form of programmes within a sector. Included in this ambit are not only the projects and activities within the sector but also the coordination of cross-sectoral programmes. The sector budgets that were summarised in broad life-cycle categories in the city-wide portfolio life-cycle strategy (above) are now reviewed and refined through a process of linking to specific programmes, projects and activities. These are packaged and scheduled in line with the programme and project management framework determined in **Modules 9 to 11**. Whilst the initial focus of this toolkit is on capital projects, in line with mSCOA prescripts, it is noted that similar requirements pertain to programmes to be funded from the operational budget (as illustrated in **Figure 6.4** including the identification and initial definition of CAPEX and OPEX projects and programmes, as well as the maintenance and operational activities associated with completed infrastructure).

Naturally in any given year, there will be a number of ongoing projects and programmes and other than simply updating and reviewing these in line with the city-wide directives, there is also a need for a strategic review at the sector level. While this may have formed part of the city's review previously undertaken, it is now also contemplated by the sector at the planning area, programme and project level.

6.3.2 Confirming sector context, needs and challenges

In this section, the annual review of sector-level infrastructure needs, delivery commitments, dependencies, strategic risks, opportunities and constraints is considered. As with the assessment at the city-level, in line with good AM practice, this exercise relates to the entire life cycle of infrastructure. It comprises not only the capital portion traditionally associated with new, upgrading and renewal/rehabilitation construction projects, but also operational expenditure (as noted above in the section dealing with the city-level assessment).

This process begins with receipt of the city-wide (SAMP) directives, which will include confirmation of the customer growth scenario and planning areas; a preliminary indication of expected budget availability to the sector for the various life-cycle elements over the 30-year planning period (for initial planning inputs); and strategic and tactical directives in terms of asset management and asset performance.

The expected budget availability for first five years will be broken down as follows:

CAPEX	OPEX
New infrastructure programmes Upgrading (of existing infrastructure) programmes Renewals programmes Land acquisition or servitude registration	Bulk purchases Operations: contractor costs and internal labour, plant and vehicles, and materials Maintenance: contractor costs and internal labour, plant and vehicles, and materials

The estimated budget availability for years 6 to 30 will be stated on the basis of a simple split between CAPEX and OPEX. For modelling purposes, all budget figures are reduced to current day (Year 0) figures (implying an annual escalation of previous year's baseline figures).

An update and refinement of the infrastructure life-cycle needs over the report period (in line with the model structure indicated in **Section 6.2.2**) is established for the specified planning areas. The data and models are updated and improved, where applicable, based on separate reports or studies that have been concluded. These should improve, on an assessed risk basis, the certainty of the needs data (for example data from surveys and inspections, or improved processes of analysis). In simple terms, this means refining the data and models where the cost of doing so can be motivated in terms of the decision it supports (for example, asset replacement, or confirming the nature or location of backlogs). Area-based reports are aggregated to establish an updated and refined report on the overall sector life-cycle needs.

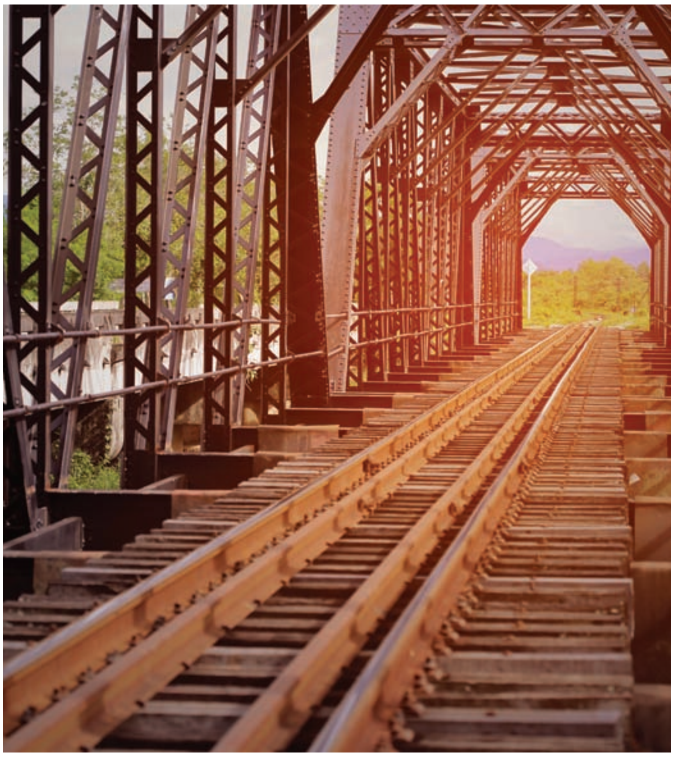
Other sector-based review activities include:

1. Reviewing and confirming the sector performance in infrastructure delivery and the efficacy of the AM system, based on the metrics determined in line with **Module 2**
2. Reviewing and confirming asset management practices improvement actions required in the sector (based on a structured assessment of prevailing and target practice and by identifying prioritised actions) as indicated in **Module 2**
3. Confirming the status of current (CAPEX and OPEX) projects and programmes, such as the state of completion; changes in viability (in terms of significant changes to predicted final costs and/or benefits/outcomes); changes to the implementation schedule (of the project and other dependant activities); and annual budget needs. This will result in an update to the schedules and cash flows (and possibly changed priority) of committed and uncommitted programmes
4. Review and confirmation of the effectiveness of prevailing and planned demand management tactics (as contemplated in **Module 5**)
5. Review of the budget availability, level of current commitments and determination of the nature and scale of the discretionary portion
6. Review and confirmation of the adequacy of the project identification and definition activities to cater for future capital project and programme implementation
7. A review of sector risks – an update of the likelihood and nature, location or scale of impact of previously identified risk events and the effectiveness of existing controls (in the risk register), as well as identification of new infrastructure delivery risks – which include:
   - The integrity and efficacy of the asset management system in the sector department (performance, finance and risk management models and processes; data quality; planning, reporting, and decision-making processes; capital, operations, and maintenance works management; organisational governance, capacity and competency)

   - Capital project and programme delivery risk - analysis of identification, inception and progress risks, over- and under-expenditure risks, quality risks, funding risks, and coordination (location, time, and technology) risks within the sector as well as in common programmes with other sectors
   - Maintenance project and programme delivery risk - analysis of the adequacy of the maintenance schedule to cover the risk of under- or overuse of available funds due to changes in actual maintenance needs
   - Operations project and programme delivery risk - analysis of the adequacy of the maintenance schedule to cover the risk of under- or overuse of available funds due to changes in actual infrastructure operations' needs
   - The effectiveness of the capital and operational programmes in supporting the AM objectives
   - Physical failure risk of existing infrastructure (based on updated failure mode status and criticality data, rolled up and reported to asset group type level per sector and rolled up for the whole sector) as indicated in **Module 3**
   - External supply risks, such as availability of bulk supply, specialist products or services
8. A review to identify new technology, products, strategies, methodologies, models and techniques which could be beneficial to the effectiveness or efficiency of infrastructure delivery
9. A review of opportunities in the sector for potential application of the city's strategic themes
10. A review of the city's performance in infrastructure asset management benchmarked against sector departments in other cities to identify potential areas for improvement;
11. A review of programme or project coordination (location/time/technology) opportunities (within the sector as well as with other sectors on integrated programmes)
12. A review of the outcomes of previously completed programmes and lessons learned.

6.3.3 Preparing appropriate responses

This section considers the approach to be adopted in preparing appropriate responses to the needs, challenges, risks and opportunities identified in **Section 6.3.2.** The parameters to be assessed when considering the benefits of implementing a proposed initiative, or in considering the merits of alternative approaches, are determined as part of establishing the AM system, as indicated in **Module 2** of the toolkit. The processes to be adopted in the various types of assessments are indicated in **Module 8**.



Responses will typically be in the form of capital or operational initiatives. Typically these will be in the form of programmes which may consist of multiple discrete projects and activities. Some of these may be capital in nature, and others will be operational. Typical elements of different types of projects (for example, environmental impact assessments, the design and documentation stage, procurement etc.) are defined in a project and programme management framework – established in line with **Module 9**. In the same way, guidance is also given on the duration and cost of these activities, as a basis for establishing a realistic estimate of the schedule and cash flow for each initiative.

The accuracy of the budget needs of the proposed responses (overall and per year) should be as follows:

10%	20%	40%
Programmes accurate within 10 per cent for first five years	Programmes accurate within 20 per cent up to 10 years	CAPEX and OPEX within 40 per cent accuracy after 10 years

The achievement of these targets will need to be demonstrated in terms of the quality of the process adopted as well as the confidence in the input data. A draft schedule of the programmes, the associated cash flows, viability and priority ranking will be established and will provide input to the preparation of the sector AMP and SAMP documents contemplated in **Module 7**.

01 ASSESSMENT OF NEW TECHNOLOGIES

New technology may present itself in many different forms, and the potential benefits may be direct or indirect, tangible or intangible. Where new materials, products, or methods of construction become available, an assessment of the benefits needs to be made, and where applicable, compared to the existing approach. In this regard, the city must have a documented life-cycle strategy for each of its component types, which indicates the following:

- The manner in which needs for the initial capital investment are identified
- The typical maintenance regime that applies (though this may vary depending on the criticality of the component) and the expected useful life
- The trigger for renewal (and the manner in which this is normally applied – e.g. replacement, rehabilitation and the type of treatment) and any residual value
- The rules for decommissioning

An example of a life-cycle strategy is included in **Appendix 6A.** Where the initial assessment of an alternative approach indicates a positive result, it will often be appropriate to pilot the implementation of the new technology to test and improve the confidence in the data used in the assessment.

02 STUDIES, INSPECTIONS AND REPORTS (OPEX)

Where specialist services are required to inform management strategy, tactics or operations, these will typically be operational budget items, and may be addressed collectively, for example under a term contract for an infrastructure inspection programme.

03 CAPITAL PROJECT IDENTIFICATION, CONFIGURATION AND VIABILITY ASSESSMENT (OPEX)

When there is a reported need for a capital project intervention, the first step is to prepare a report that confirms the aim of the project, and considers various conceptual design alternatives (which could, for example, be considering the most appropriate site, technical configuration, whether to employ non-asset solutions, or assessing different life-cycle options that could be adopted). Once the nature, location and design approach of the project have been determined, and the viability demonstrated (using techniques indicated in Module 8), and the report is approved, the preliminary and detailed design proceeds and preparation of contract documentation as part of the capital programme and in line with the processes and approval gates indicated in Modules 9 to 11.

04 NEW AND UPGRADING WORKS (CAPEX)

The opportunity to influence the life-cycle costs of infrastructure is typically at its peak during the design stage. It is essential, therefore, that the full life cycle of a proposed new asset is contemplated in the design stage, and opportunities for life-cycle optimisation are identified and assessed. This could, for example, include the use of specific materials or design configurations to facilitate longer life, and ease of access to components for inspection and replacement purposes. Ideally these aspects should be reviewed and signed off by the operations department responsible for maintenance and renewal. As part of the documentation processes associated with capital projects, maintenance (and where applicable, operations) manuals must be prepared in line with the sector's maintenance management strategy and plan and submitted as part of the handover procedures for new or upgraded works.

05 RENEWALS (CAPEX)

In the previous section, the approach to determining the required level of investment for a particular portfolio was indicated. Once the intensity of investment of the capital renewal programme has been determined, it is linked back to the initial source data in the asset register (as illustrated in **Figure 6.18**) to determine the priorities (based on the criticality and risk exposure data at component level) and packaged for practical implementation. The interventions can be grouped taking into account facility or depot areas, or based on asset or component types as appropriate to the city's Procurement Strategy (prepared in line with **Modules 9 to 11** as part of assembling the AM system contemplated in **Module 2**). It may consider different approaches for various applications within the sector (for example acquisition of capital spares and replacement by in-house resources, or an outsourced supply-and-install term contract, and specific contracts for large and infrequent works).

Renewal programmes are typically planned to have a reasonably constant intensity of implementation (and therefore "smoothed" annual budget), so the renewal interventions should be packaged with this in mind. A simple trigger can be established for multiple small renewals or replacements (such as meter replacement, small reticulation, or tertiary roads), such as condition or performance data (supported by documented life-cycle costing information that can be periodically reviewed). However larger capital renewal interventions (as may be defined in the AM Strategy), will require analysis of the merits of alternative technical solutions, including a comparison of the life-cycle costing of the options.

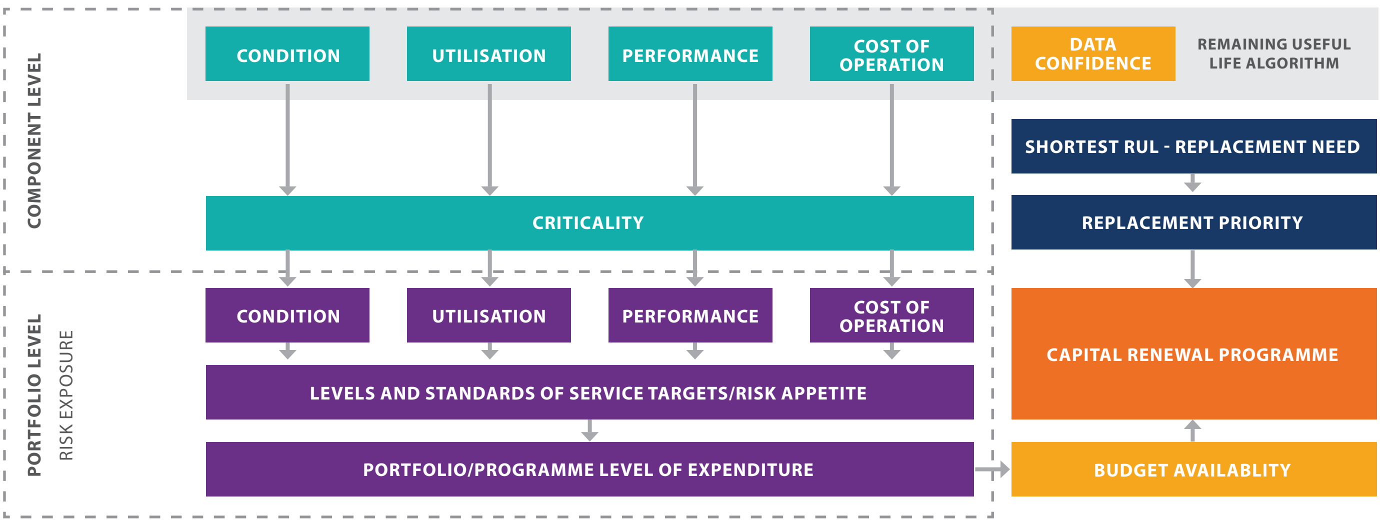
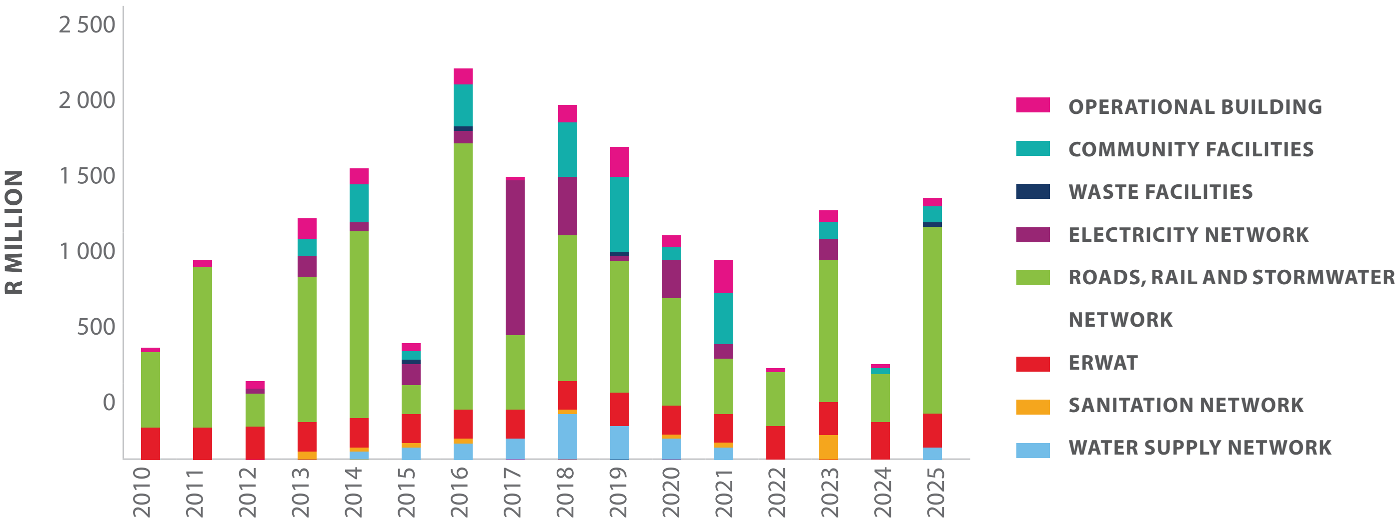


FIGURE 6.18: *Component data and portfolio status informing capital renewal programs*

Figure 6.19 illustrates an output of capital renewal needs taken directly from the asset register data (from Ekurhuleni) illustrating the need to smooth the annual budgets, with implementation priority being influenced by the criticality of components.

FIGURE 6.19: *Example multi-term capital renewal needs*



06 MAINTENANCE – MAINTENANCE OPTIMISATION, MONITORING STATUS AND PERFORMANCE DATA (OPEX)

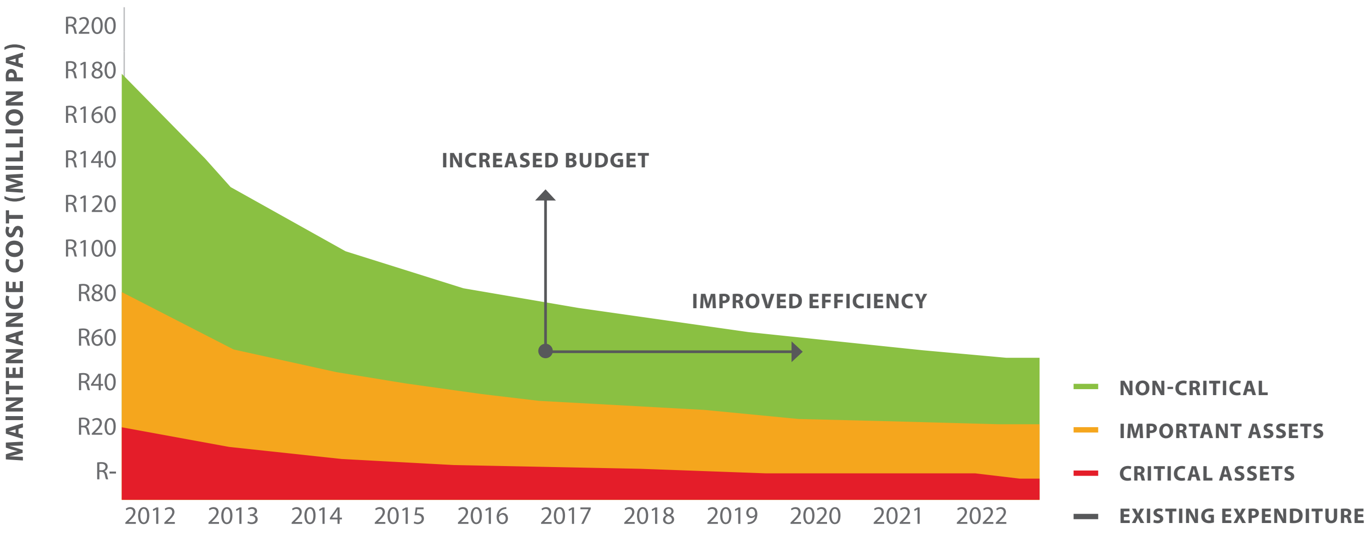
Figure 6.20 is an extract from the National Maintenance Management Standard which indicates the linkages from the AM objectives to "asset care objectives" which will be adopted as performance measures and targets in the asset management strategy, and typically will relate to standards of service, such as frequency and duration of outage, or asset condition. These in turn point to conduct an assessment of the sector's exposure to asset performance risk, based on failure mode status and criticality data. At sector level, a strategic review of this will be made in a Maintenance Management Strategy, and this will be applied in each year's Maintenance Management Plan.

FIGURE 6.20: *Linking maintenance management planning to asset care objectives (standards of service)*

A Maintenance Management Strategy reviews current practices, identifies opportunities for improvement (informed by the practices assessment methodology indicated in **Module 2**), and considers the benefit-cost of any improvement actions. It also identifies and considers the impacts of obsolescence and merits of opportunities presented in the form of new management technologies and techniques, as well as potential improvements to component life-cycle strategies, and determines an implementation strategy including, where appropriate, a change management plan. Benchmarking can provide useful insights in such an exercise - whilst there are multiple unique characteristics of any given city (such as condition, size, and distribution of the infrastructure, as well as the operating environment due to influences such as topography or climate), there are also trends that can be used to identify scope and opportunity for maintenance management efficiency improvements. Apart from applying technically sound and optimised maintenance interventions on infrastructure, the efficiency of the management system will generally also have considerable bearing on the overall performance of the maintenance activities (and therefore standards of service). This can include a range of logistical challenges, including the nature, size and competency of the maintenance teams, their location, access to materials and spares, availability of vehicles and drivers, works orders processes, availability of reliable information etc.

With appropriately calibrated models of the resource implications of the component life-cycle strategies that are linked to the nature, extent and location data in the asset register, strategic options and opportunities can be examined. **Figure 6.21** illustrates an example where the potential solution to meeting the maintenance needs of an infrastructure portfolio can be demonstrated and quantified in terms of a combination of targeted budget and performance responses.

FIGURE 6.21: *Example of link between portfolio maintenance management efficiency and budget needs*



A Maintenance Management Strategy should be prepared for each sector and reviewed at least every 5 years. As appropriate, the strategy would include a change management plan. The strategy would have a 5 year planning horizon with Annual Maintenance Management Plans which review the plan (guided by the strategy) each year based on the resources made available.

The approach to determining the level of the maintenance budget needs is indicated in the previous section of this module. The model attaches a percentage CRC to estimate the maintenance budget per year for each component (adjusted for its criticality and condition). This approach facilitates the establishment of a complete picture of the maintenance needs across different geographic areas (such as depot or planning areas) and also of the asset and component types within the sector, now and into the future. This can be rolled up to Asset Type (as per the mSCOA requirements), or other levels as required. The city-level life-cycle strategy provides a preliminary indication of the budget availability, and therefore the extent to which the needs can be addressed. The implications of the level of funding made available should be assessed and reported. In simple terms, the ability to maintain the more critical assets effectively needs to be determined. Subsequently an analysis of the extent to which other assets can be maintained or should be sweated, and the implications of this on standards of service (and stated targets of risk exposure and performance) should be reported. The level of accuracy of the model also needs to be considered, depending on the extent to which it has been effectively calibrated to the specific operations of the sector in the city. Another aspect to consider is how effective the prevailing technical approach to maintenance is as well as how effectively and efficiently the activities are implemented. Cities should as a minimum have the maintenance strategy and its operational processes documented per sector. This should be used as a basis for review of opportunities for maintenance management improvements. Where applicable, this should be facilitated by the benchmarking of practices with other cities. A key element of the effectiveness of the maintenance planning will be to ensure that relevant and up-to date data is fed back from the maintenance inspections to provide accurate condition (and other failure mode) data – in line with the models indicated in **Module 3** of this toolkit.

The application of the available funding is planned (in line with mSCOA requirements) at asset type level (for example water meters, or electrical equipment). The funding is apportioned to the various maintenance budget cost items in line with mSCOA and the sector's specific approach to maintenance, noting current commitments (for example salaries and wages, and corporate overheads/ internal charges) and any discretionary portion that can be applied. Preventative and reactive maintenance activities are scheduled and prioritised in line with the prevailing management practices and available resources and budget.

06 OPERATIONS – BULK SUPPLIES, PROCESS MANAGEMENT (OPEX)

In a similar way to the strategic review of maintenance, an Operations Management Strategy should be prepared for each sector at least every 5 years to review the effectiveness and efficiency of infrastructure operations – including an assessment of the performance of operational activities as well as operational management performance; observing changes made or expected in the statutory environment; identification of opportunities to improve performance and/or reduce costs of operational activities such as at treatment works, or security (for example through new technology or proven management techniques); and assessment of the reliability and cost of bulk purchases and review of alternative strategies. As with maintenance management, benchmarking can provide useful insights on strategic improvement opportunities. As appropriate, the strategy would include a change management plan. The strategy would have a 5 year planning horizon with Annual Operations Management Plans that are reviewed each year ahead of implementation.

The approach to determining the level of the operations budget needs is indicated in the previous section. It takes the current expenditure as the departure point, but is guided by the Operations Management Strategy forecasts and the actual amounts indicated by the city. There could, for example, be new commercial or technical arrangements for operational activities such as process management and bulk supplies. Naturally the availability, cost and performance of bulk services (such as electricity and water) can have a considerable impact on the performance of the city in delivering infrastructure-related services. Especially with a planning horizon of 30 years, it is necessary to have a firm long-term strategy in terms of the availability of bulk supplies and, where necessary, identify suitable responses in terms of specific demand management initiatives and/or alternative supply.

07 DECOMMISSIONING

In many instances city infrastructure is regarded as being established in perpetuity, until a decision is taken not to use the assets any longer, due for example, to reconfiguration of the system. An obvious exception is landfill sites, where provision is made from the initial establishment of the site for restoration once it is full and to be closed. It has been recognised that there is a need for greater attention to be given to appropriate decommissioning of assets, for example replaced pipes, unused sports facilities, unused pump stations and the like, in the interests of public safety and to mitigate misuse or abuse (for example reconnection of old and decrepit pipe networks).

There may also be plans to re-configure the nature of development in certain areas, in which case infrastructure will not be replaced (or upgraded) but may be discarded.

The life-cycle plans should therefore actively identify assets that are to be decommissioned and make sure that the necessary actions are scheduled for implementation in line with the approach that will form part of the city's Disposal Policy and be aligned with the city's AM Strategy.

6.3.4 Sector prioritisation

The proposed responses identified in **Section 6.3.3** are geared to be in line with the indicative sector budget forecast indicated by the city. In the final analysis, there may be more or less funds available, or Council may elect to give more priority to other programmes. To facilitate effective decision making in this regard, each of the programmes are accorded a priority score in line with the prioritisation parameters identified in the AM System. Where there have been changes to the viability or priority ranking of previously approved and committed programmes, these are highlighted with recommendations on the way forward. The sector should identify projects or programmes to accommodate an increase or decrease in value of five per cent (or proportion stated in the AMS) of the budget that could be deferred or accelerated depending on the funds available and the priorities of Council. Where practicable, this could also be informed by flagging options for adjustment of the balance of programmes between capital and operational expenditure actions, and any associated performance and risk implications.

6.4 TIMELINES AND APPROVALS

There is a need to provide sufficient time for the required planning to take place ahead of committing city's resources to programmes, as evidenced by the processes indicated in the preceding sections of this module, and indeed in the following module (**Module 7**). Particular milestones along the way are necessary to confirm and approve the essential steps and frameworks for the following steps to avoid re-work.

Table 6.7 provides an overview of the salient cyclical planning cycles – some of which are fixed to the periods between elections (such as the establishment of an IDP), others that are updates between these periods (for example the IDP updates), and others that are required annually (such as the Annual Financial Statements and Reports). The figure also notes the reporting / planning horizons of each (which vary from reporting the previous financial year to planning up to 30 years into the future). The establishment and periodic review of the city's Delivery Management Strategy (which forms part of the AM Strategy documented in the SAMP) is illustrated in the table for reference purposes – the formulation of which are contemplated in **Modules 9 to 11**.

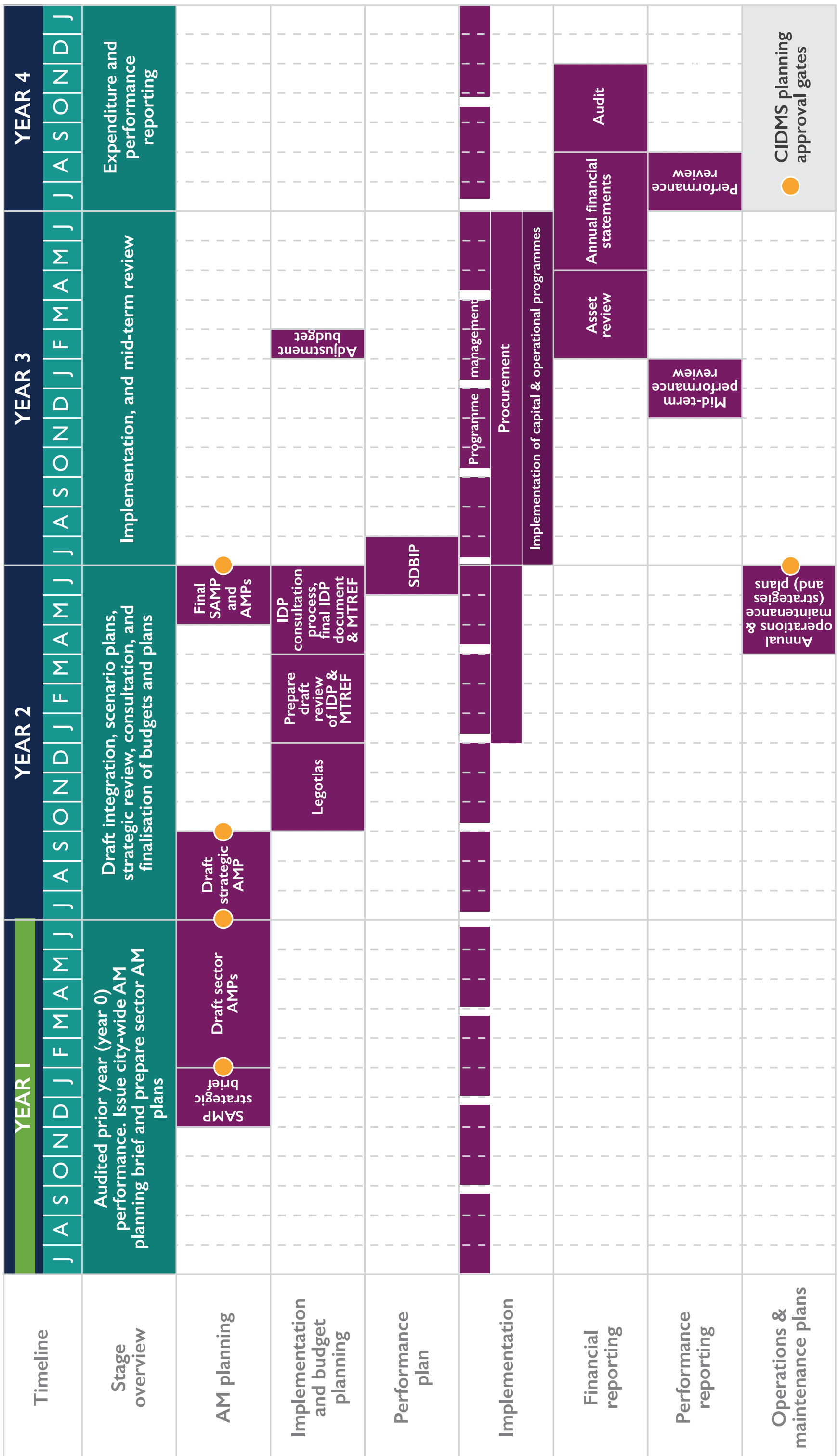
The documents need to be prepared on a cyclical basis – accounting for last year, managing this year, and planning for next (or the following) year – there is really no beginning or end, however **Figure 6.22** illustrates the timelines relating to the preparation of these documents as applies to ONE linear process – from preparing initial plans for the sectors and the city based on a strategic brief (starting 18 months ahead of the year of implementation) through obtaining stakeholder inputs and confirmation of budgets, programmes and performance (including the IDP process) the year before implementation, through the year of implementation, then accounting for actual expenditure and performance once the year is over.

Figure 6.23 references the same activities but indicates the concurrent aspects that need to be undertaken in any given year relating to finalising the plans for next year, initiating the plans for year thereafter, and accounting for last year. (Please note that the preparation of the Maintenance Management Strategy and the Operations Management Strategy happens only every 5 years –in the years when this is required, the both the strategy and plans will be prepared).

TIMELINE:	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	PLANNING HORIZON
Long term strategic plan:	City Strategic Plan					City Strategic Plan		Fixed 30 years
Spatial representation of long term plan:	Spatial Development Framework					Spatial Development Framework		Fixed 5, 10 and 20 years
Medium term delivery plan:	Integrated Development Plan (IDP)	IDP Review	IDP review	IDP Review	IDP Review	Integrated Development Plan (IDP)	IDP Review	Fixed 5 years with annual review
Short, medium and long term infrastructure planning:	Sector AM Plans, Strategic AM Plan	Sector AM plans, Strategic AM Plan	Sector AM plans, Strategic AM Plan	Sector AM plans, Strategic AM Plan	Sector AM plans, Strategic AM Plan	Sector AM plans, Strategic AM Plan	Sector AM plans, Strategic AM Plan	Rolling 5, 15 and 30 years
Delivery management strategy:	Delivery Management Strategy (DMS) – included in the SAMP	DMS review	DMS review	DMS review	DMS review	Delivery Management Strategy (DMS) – included in the SAMP	DMS review	Fixed 5 years with annual review
Budget plan:	Medium Term Revenue and Expenditure Framework	Medium Term Revenue and Expenditure Framework	Medium Term Revenue and Expenditure Framework	Medium Term Revenue and Expenditure Framework	Medium Term Revenue and Expenditure Framework	Medium Term Revenue and Expenditure Framework	Medium Term Revenue and Expenditure Framework	Rolling 3 years
Service delivery and budget implementation plan (SDBIP):	Service delivery and budget implementation plan	Service delivery and budget implementation plan	Service delivery and budget implementation plan	Service delivery and budget implementation plan	Service delivery and budget implementation plan	Service delivery and budget implementation plan	Service delivery and budget implementation plan	Rolling 1 year
Annual performance reporting:	Annual Report	Annual Report	Annual Report	Annual Report	Annual Report	Annual Report	Annual Report	Current and previous year
Annual financial reporting:	Annual Financial Statements	Annual Financial Statements	Annual Financial Statements	Annual Financial Statements	Annual Financial Statements	Annual Financial Statements	Annual Financial Statements	Current and previous year comparison
Maintenance Management:	Maintenance Management Strategy and Plan	Annual Maintenance Management Plan Review	Annual Maintenance Management Plan Review	Annual Maintenance Management Plan Review	Annual Maintenance Management Plan Review	Maintenance Management Strategy and Plan	Annual Maintenance Management Plan Review	Fixed 5 years with annual review
Operations Management:	Operations Management Strategy and Plan	Annual Operations Management Plan review	Annual Operations Management Plan review	Annual Operations Management Plan review	Annual Operations Management Plan review	Operations Management Strategy and Plan	Annual Operations Management Plan review	Fixed 5 years with annual review

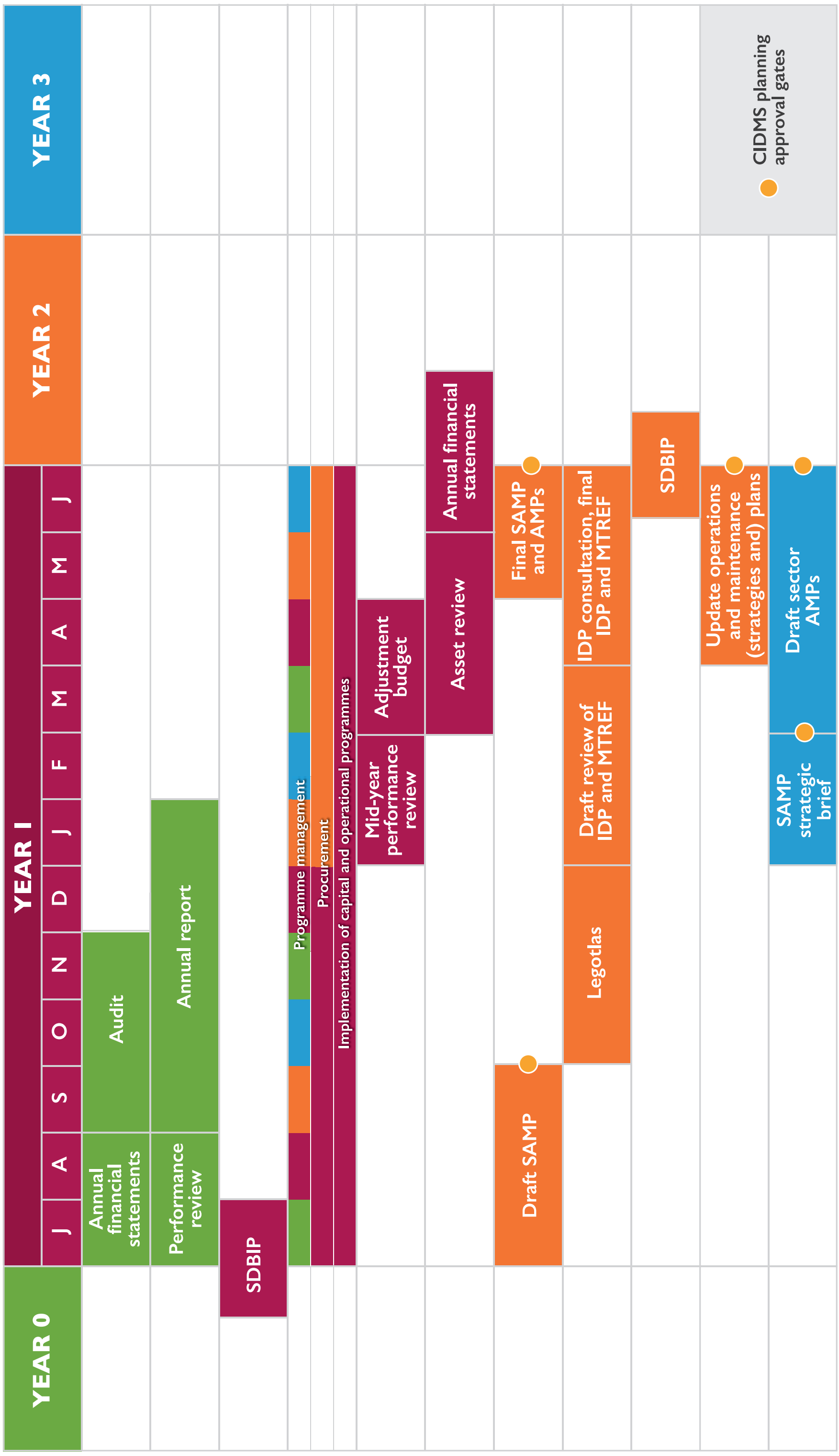
TABLE 6.7: *Overview of planning cycles*

FIGURE 6.22: *One cycle of planning, approval, delivery and reporting (excluding items at fixed intervals longer than one year)*



***Note:** the Strategic AM Plan (SAMP) documents the Delivery Management Strategy as part of the Asset Management Strategy.*

FIGURE 6.23: *Concurrent processes in any given year (relating to plans and reports for surrounding years)*



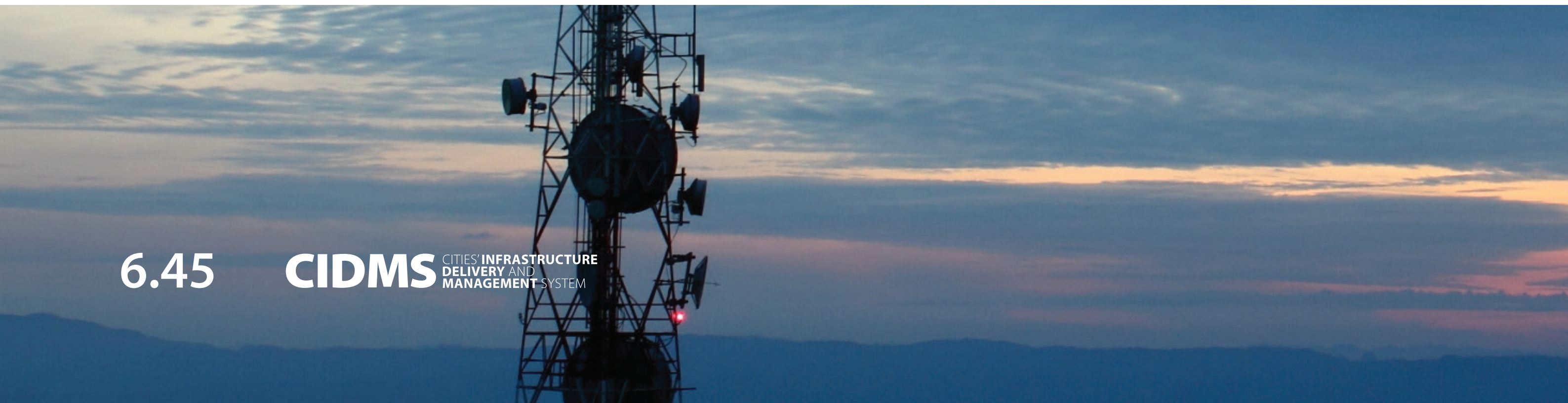
Note: *the colours of the activities indicated under Year 1 indicate the planning periods to which they apply – for example those indicated in orange are activities relating to the planning for year 2 but are undertaken in Year 1.*

Table 6.8 indicates the documents that require review and consideration for approval as milestones in the process. Each city should schedule its deadlines for submission, where applicable, according to the annual meeting programmes.

REF	DOCUMENT	APPROVAL
1	Strategic brief for AM planning (SAMP)	C
2	Draft sector AM plans (AMPs)	C
3	Draft strategic AM plans (SAMPs) including Delivery Management Strategy	C
4	Draft Integrated Development Plan (IDP)	C
5	Legkotla outcomes	B
6	IDP consultation outcomes	B
7	Final Integrated Development Plan (IDP)	B
8	Final SAMP and sector AM plans	B
9	Sectors' Maintenance Management Strategy	B
10	Sectors' Annual Maintenance Management Plans	E
11	Sectors' Operations Management Strategy	B
12	Sectors' Annual Operations Management Plans	E
13	Final budget	B
14	SDBIP - measures	B
15	SDBIP - targets	A
16	Performance review outcomes	A
17	Annual Report	B
	Note - other approval gates relating to delivery are addressed in CIDMS Modules 9 to 11	
	- CIDMS planning documents are highlighted	

REF	AUTHORITY	MEMBERS (WHERE APPLICABLE)
A	Mayor / Executive Mayor	Mayor / Executive Mayor
B	Council	Council
C	Mayoral Committee or Executive Committee	Mayor and MMC / Executive Mayor and councillors elected to the Executive Committee
D	Accounting Officer	City Manager
E	Asset Management Committee	City Manager, Chief Financial Officer, Head of Corporate Asset Management, Heads of Departments for infrastructure planning and implementation, Risk Manager, Internal Audit, Corporate Planning Department

TABLE 6.8: *Planning approval gates and responsible parties*



6.5 SUMMARY

This module indicates the approach to the annual review of life-cycle needs initially at the city level to inform the formulation of strategic directives to sectors (in the form a first iteration of the SAMP), and the development of proposed project and programme responses per sector in terms of the overarching city-level directives.

The module provides models to underpin the life-cycle planning, and indicates processes to make sure that the plan is not simply a progression on earlier ones, but that a strategic review is conducted at city and sector level to: maximise alignment with city objectives, address prevailing risks and opportunities and improve practice in pursuit of the city's asset management objectives (set in the AM strategy developed in terms of **Module 2**).

The benefit to cities will be in ensuring that programmes implemented by the city are effectively aligned with their stated strategic and AM objectives taking into account the prevailing status of the infrastructure. Once again, the collaboration of the cities in adopting this approach provides the additional benefit of being able to benchmark performance to identify and leverage opportunities for innovation to improve practice and service delivery.

REFERENCE

CIDB. July 2017. Maintenance Management Standard for Immovable Assets.

APPENDICES

6A – Example component life-cycle strategies

COMPONENT TYPE	COMPONENT DESCRIPTOR	EXPECTED USEFUL LIFE (YEARS)	RESIDUAL VALUE (%)	COMPONENT SCOPE	ASSET LIFE-CYCLE ELEMENT					
					NEW/ UPGRADING CAPEX	RENEWAL CAPEX	DISPOSAL CAPEX	OPERATIONS OPEX	MAINTENANCE	
									PLANNED OPEX	UNPLANNED OPEX
Pipe - water	uPVC pipe	80	0	**Water network pipes** • Block-to-block lengths (excluding valves, hydrants, customer connections and meters) for reticulation pipes in built-up areas • Pipe lengths of same attributes (excluding valves, hydrants, customer connections and meters) between pipe intersections or valves for bulk pipes and reticulation pipes outside built-up areas	• Needs identified in master plans and/ or hydraulic analysis associated with new developments/ standards/ changes in demand/ densification	• Replacement of full block-to-block lengths of pipe or lengths of pipes of same attributes based on condition and/or performance (e.g. bursts, breakages, losses)	• Disconnect and abandon decommissioned pipes		• Routine water quality testing • Periodic acoustic leak detection	• Response to reports/ complaints • Repair of pipes or ad hoc replacement of short lengths of pipe
	Steel pipe	80	0							
	HDPE pipe	80	0							
	AC pipe	40	0							
	HDPE pipe	80	0							
Water meter	Mag-flow and mechanical meters (metallic and plastic)	10	0	• Individual meters, each including the associated valves, control mechanism, meter chamber/box and lid/cover	• Needs determined during township establishment or densification or application for new/ changed use	• Replacement of meters (including ancillary equipment) based on condition/ performance	• Removal of replaced meters and housing, and transportation to designated scrap heap	Regular reading of customer and zone meters, and reporting of meter faults	• Repair of meter faults identified by meter readers	• Response to reports/ complaints • Repair of meters • Replacement of meter lids • Ad hoc replacement of individual meter
	Prepaid meters	5	0							
Pipe - sewer	uPVC pipe	80	0	**Sanitation network pipes** • Manhole-to-manhole lengths for outfalls and reticulation pipes	• Needs identified in master plans and/ or hydraulic analysis associated with new developments/ standards/ changes in demand/ densification	• Replacement of full manhole-to-manhole lengths of pipe including manholes based on condition and/or performance (e.g. blockages)	• Removal of decommissioned pipes and transportation to designated scrap heap		• Jetting of pipes based on number of blockages • Regular rodding of sewer pipes	• Response to reports/ complaints • Repair of pipes or ad hoc replacement of short lengths of pipe • Ad hoc CCTV inspections of pipes with repeated blockages • Ad hoc rodding of pipes where blockages have occurred
	Steel pipe	80	0							
	HDPE pipe	80	0							
	Clay pipe	100	0							
	AC pipe	40	0							

COMPONENT TYPE	COMPONENT DESCRIPTOR	EXPECTED USEFUL LIFE (YEARS)	RESIDUAL VALUE (%)	COMPONENT SCOPE	ASSET LIFE-CYCLE ELEMENT					
					NEW/ UPGRADING CAPEX	RENEWAL CAPEX	DISPOSAL CAPEX	OPERATIONS OPEX	MAINTENANCE	
									PLANNED OPEX	UNPLANNED OPEX
Pipe - water	uPVC pipe	80	0	**Sewer customer connections** • Individual pipes associated with customer connections, grouped per pipe length (manhole to manhole)	• Needs determined during township establishment or densification	• Collective replacement of customer connections of same attributes per pipe length basis	• Replaced connections are disconnected from the reticulation system and left in situ			• Response to reports/ complaints • Repair of pipes or ad hoc replacement
Valves and hydrants	Isolating valves (butterfly and gate)	20	0	• Large valves (≥300mm) within reticulation network, pump stations and reservoirs are considered as individual components (associated valve chambers/boxes/ lids included) • Small Valves (<300mm) and hydrants within reticulation network, pump stations and reservoirs are grouped on the basis of the parent pipe or facility (associated valve chambers/boxes/lids included) • Valves (≥150mm) within WWTWs are considered as individual components (associated valve chambers/boxes/ lids included) • Valves (<150mm) within WWTWs are included in the facility • PRV, non-return and air release valves considered as individual components (associated valve chambers/boxes/ lids included where applicable)	• Needs identified in master plans and/ or hydraulic analysis associated with new developments • Needs identified in design of new facilities	• Replacement of individually itemised valves (including chambers and lids where applicable) based on condition and/or performance • Collective replacement of grouped valves and hydrants based on condition and/or performance.	• Removal of decommissioned valves/hydrants/ boxes/lids from reticulation system and transportation to designated scrap heap.		• Periodic inspection and operation of valves and hydrants • Repacking of leaking gland seals identified during routine inspections	• Response to reports/ complaints • Repair of valves and hydrants • Replacement of chamber lids • Ad hoc replacement of grouped valves and hydrants
	Other valves (air release, non-return and pressure reducing)	15	0							
	All types of hydrants	20	0							

CITIES' **INFRASTRUCTURE DELIVERY** AND **MANAGEMENT** SYSTEM **CIDMS**