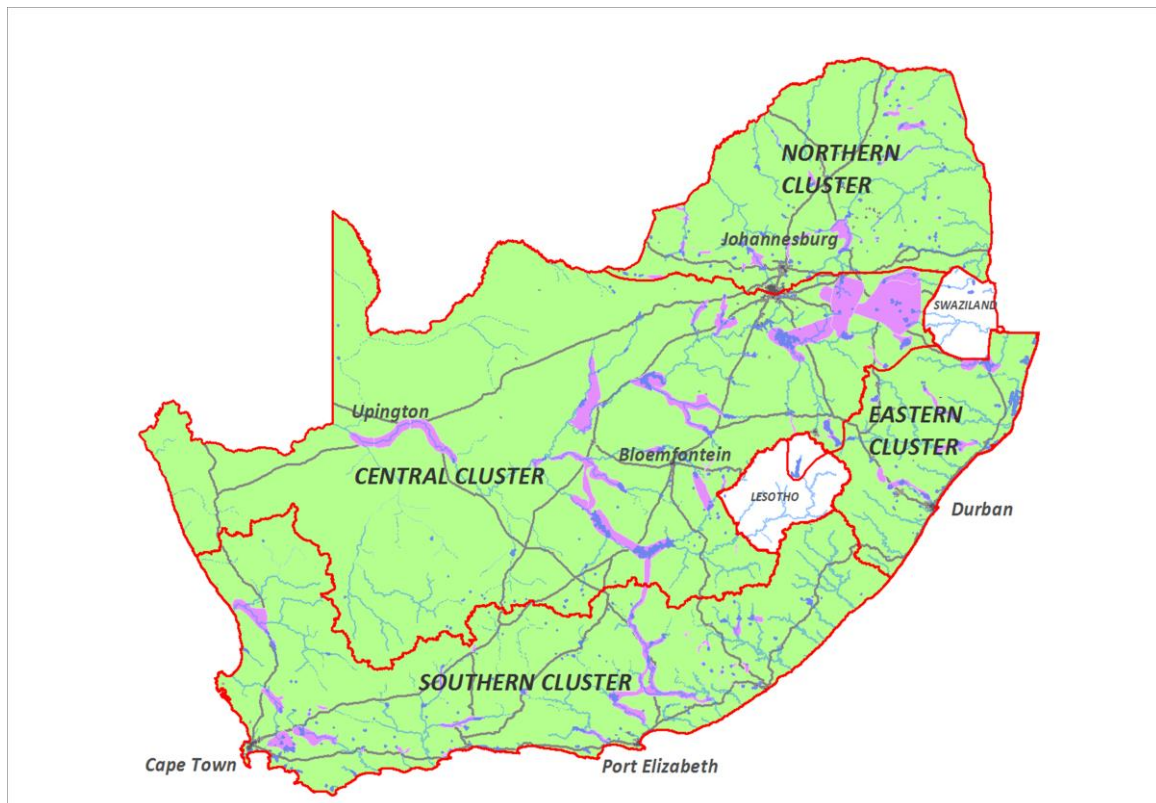


National Water Resources Infrastructure (NWRI)

Immovable Asset Management Plan

National

March 2018



WATER IS LIFE - SANITATION IS DIGNITY



water & sanitation

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Water and Sanitation
REPUBLIC OF SOUTH AFRICA



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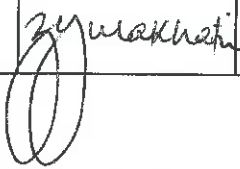
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EXECUTIVE SUMMARY

1. Introduction and Service Description

This document is an immovable Asset Management Plan (AMP) for National Water Resources Infrastructure (NWRI) national operations, hereinafter referred to as the NWRI Operations. NWRI is a branch of the Department of Water and Sanitation (DWS). This AMP outlines a ten-year plan for the acquisition, operation and maintenance (O&M), renewal, upgrading, new capital investments, and disposal of the NWRI's immovable assets, aiming at maximising the assets' service delivery potential and benefits, and minimising their related risks and costs over the assets' life cycle.

This AMP was produced in accordance and compliance with the provisions of the Government Immovable Asset Management Act (GIAMA), Act No. 19 of 2007. In addition, the NWRI is required to annually update this AMP, as contemplated in Section 12 of the GIAMA. This AMP is also aligned to other relevant South African legislation, DWS's strategic plan, and international standards such as ISO 55000.

1.1 Key Data Sources Used to Develop this AMP

The key sources of data used to develop this AMP are: NWRI Immovable Asset Register for the financial year 2016/17; NWRI Infrastructure Asset Hierarchy for financial year 2016/17; Condition Assessment Audit of Irrigation Scheme Infrastructure – Schemes Reports, dated September 2016; financial information (obtained mainly from DWS Head Office and the Operational Cluster Offices); and face-to-face interviews conducted with the relevant NWRI personnel at schemes, areas, clusters and national level. The overall confidence rating for the data used in the development of this AMP is four (4) on a rating scale of 1 to 5, which means some of the data used was derived.

1.2 NWRI Description and Location

The NWRI is a branch within the DWS and its operations cover the entire Republic of South Africa. It consists of four operational clusters (the Northern, Eastern, Southern and Central Operations) which together have a total of 255 government water schemes (distributed as follows: 91 in Northern; 18 in Eastern; 111 in Southern; and 35 in Central Operations).

1.3 Service Description

The primary service offered by NWRI Operations is the delivery of bulk raw water to its domestic and industrial (D&I), and irrigation water users (customers).

2. Levels of Service

There are three key desired levels of service applicable to the NWRI Operations' raw water supply service for the purpose of this AMP: volume of raw water supplied; quality of raw water supplied; and assurance level of raw water supply. Volume of raw water supplied and assurance level of raw water supply fall under the direct responsibility of the NWRI Operations; whilst quality of raw water supplied falls under the direct responsibility of the Catchment Management Agency (CMA). The NWRI Operations is expected to supply a total of about: 3 673.761 Mm³ per annum of raw water to domestic and industrial water users, for which it assures 97% non-interruption; and 5 306.765 Mm³ per annum to irrigation water users, for which it assures 91%.

3. Raw Water Demand

Total registered volume of raw water for NWRI Operations is about 8 980.526 Mm³ per annum, of which about 41% (3 673.761 Mm³) is for domestic and industrial use, and about 59% (5 306.765 Mm³) is for irrigation use.

There needs to be an optimised management of the relationship between raw water demand levels and asset management for the maximisation of service delivery potential and benefits. Insight of the NWRI's future raw water demand helps in optimised planning for future upgrade and new capital needs (capital acquisitions), as contemplated in Sections 5 and 6 of the GIAMA. The NWRI's future raw water demand determined by the DWS's Planning Office needs to inform the undertaking of upgrades and/or new capital projects, as well as disposals. Positive raw water demand outlook calls for upgrades and/or new capital projects; whilst negative raw water demand outlook calls for disposals.

4. Asset Details, Risk Management and Life Cycle Works

4.1 Asset Information

Table 0.1 shows the extent (number of asset components), acquisition cost, current replacement cost (CRC), depreciated replacement cost (DRC) and asset carrying values for NWRI's immovable asset components per asset facility category. The NWRI's immovable asset components have a total DRC and CRC of about R144.270 billion and about R284.806 billion, respectively. They can be grouped into two: *infrastructure* asset components (with total DRC and CRC of about R121.499 billion and about R262.035 billion, respectively); and *land* (with a total of about R22.771 billion for both DRC and CRC). The DRC/CRC ratio for infrastructure asset components is about 46%, indicating that about 54% of the infrastructure asset base has been consumed so far.

For infrastructure assets (see Table 0.1), dams-related asset components have the highest CRC of about R113.534 billion, followed by canals, tunnels and pipelines related asset components with total CRCs of about R78.970 billion, R25.334 billion and R20.597 billion, respectively.

Table 0.1: Asset extent, acquisition costs, CRC and values

Asset Facility Category	Facilities		No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
	Unit	Quantity						
Borehole	No.	43	43	19.923	10.523	58.556	19.000	32%
Buildings	No.	3 933	4 879	1 761.082	871.243	4 235.271	1 592.139	38%
Canals	km	9 208	11 431	11 860.955	7 109.010	78 969.732	28 059.826	36%
Dams	No.	369	8 072	36 975.918	30 401.802	113 533.828	60 788.046	54%
Measuring facilities	No.	3 094	3 381	3 252.266	2 072.957	9 532.959	4 211.565	44%
Pipelines	km	1 423	1 115	7 649.159	5 597.127	20 597.407	8 667.864	42%
Power supply	No.	100	145	68.431	33.673	197.214	89.114	45%
Pump stations	No.	81	3 159	2 008.554	1 235.291	7 215.852	3 790.498	53%
Reservoirs	No.	109	147	354.309	262.954	973.215	460.164	47%
Roads	km	553	171	176.804	148.249	1 171.352	568.415	49%
Telemetry	No.	35	43	39.662	12.829	85.895	46.470	54%
Tunnels	km	138	327	8 908.186	6 429.663	25 333.619	13 157.882	52%
Water Treatment	No.	80	81	46.318	27.412	129.868	48.202	37%
Sub-total Infrastructure			32 994	73 121.568	54 212.734	262 034.767	121 498.840	46%
Land - owned land	Ha		335	6 715.958	6 472.176	19 738.578	19 738.578	100%
Land - servitudes	Ha		836	1 074.926	1 073.547	3 032.374	3 032.374	100%
Sub-total Land			1 171	7 790.884	7 545.723	22 770.952	22 770.952	100%
Total			34 165	80 912.452	61 758.457	284 805.719	144 269.792	51%

The Asset Register used in the development of this AMP did not have sizes on some of the asset components, as such some of the quantities and sizes recorded in Table 0.1 are a fraction of the entire portfolio.

4.2 Risk Management and Asset Life Cycle Works

Key asset-related risks for the NWRI include: *condition risk* (failure by the asset to deliver the required service due to deteriorated physical condition); *capacity risk* (failure by the asset to deliver the required service as a result of it exceeding its design capacity/stressed); and *not in use / under-utilisation risk* (resulting in misallocation of resources, e.g. financial, human resources, material, etc.).

To minimise the abovementioned risks, and in order for the NWRI to meet its set levels of service and the minimum level of future raw water demand, the following asset life cycle management activities and works are recommended for the NWRI in this AMP: appropriate and adequate operation, maintenance and renewals (condition risk); upgrades and new capital investments (capacity risk); and disposals (not in use / under-utilisation risk). These are further detailed as follows:

- *Operations and Maintenance:*

The NWRI has a total of 255 schemes, of which 196 are operationally active (79 in Northern, 16 in Eastern, 66 in Southern and 35 in Central Operations) and 59 are inactive (12 in Northern, 2 in Eastern and 45 in Southern Operations). Some of these schemes are currently being operated and maintained by the DWS, whilst some are being operated and maintained by other parties (such as Irrigation Boards, Water Boards, Water User Associations, etc.). For those schemes that are not being operated and maintained by the DWS, it is crucial that the DWS makes regular inspections to be sure that the schemes' assets are correctly operated and adequately maintained.

The NWRI has about 75% of its infrastructure asset components (with a total CRC of about R227.395 billion) in fair, good and very good conditions. Appropriate maintenance strategies have been recommended and prioritised (based on criticality and condition) for these asset components in the scheme and Cluster AMPs.

- *Renewal Backlog and Works:*

Renewals Backlog (also known as condition backlog) is made up of asset components that are in poor and very poor conditions and need to be renewed, but excluding those that are marked for disposal and those fully impaired due to under-utilisation. The total CRC for the asset components constituting the NWRI's Renewal Backlog is about R31.057 billion (about R7.200 billion for Northern Operations; R803.495 million for Eastern Operations; R4.636 billion for Southern Operations; and R18.417 billion for Central Operations). Appropriate renewal works and strategies have also been recommended and prioritised, mainly based on asset facility category, asset facility name UID (which indicates related components), criticality and condition grading, for these asset components. The prioritisation was further refined, in some cases, by taking into consideration scheme priority (derived from its total registered volume).

- *Upgrades Backlog and Works:*

Upgrades Backlog is made up of asset components that are exceeding design capacity in utilisation, but excluding those that are marked for disposal and those fully impaired. The total CRC for the asset components constituting the Upgrades Backlog for NWRI is about R7.866 billion (about R5.526 billion for Northern Operations; R700.944 million for Eastern Operations; R17.280 million for Southern Operations; and R1.622 billion for Central Operations). These asset components (which are mainly dams, pipelines, and canals related) need to be upgraded to avoid stress related failures, and to ensure the NWRI meets the required level of service. However, before such upgrade works are executed, it is imperative that the utilisation grading (captured in the Asset

Register) of the affected asset components are first verified to confirm the necessity of the upgrades.

Furthermore, the 2016 reports on the Condition Assessment Audit for NWRI's irrigation infrastructure (for 41 schemes) identified some canal-related upgrade works with a total acquisition cost of about R3.389 billion; these have been considered in this AMP.

- *Impairments and Disposals:*

The NWRI has some infrastructure asset components with a total CRC of about R1.028 billion that were fully impaired in the 2016/17 financial year. They are mainly canals, dams, pipelines and measuring facilities related. The DWS needs to take further steps on these asset components to determine appropriate disposal plans for them.

The NWRI also has some infrastructure asset components with zero asset carrying values (according to the Asset Register), which implies that they are either fully depreciated or fully impaired. They are mainly canals, dams, pump stations and measuring facilities related, with a total CRC of about R6.025 billion. In this AMP, these infrastructure asset components with zero asset carrying values are being treated as impairments.

Furthermore, the NWRI has some infrastructure asset components marked for disposal, according to the Asset Register. They are mainly buildings, canals, dams and measuring facilities related, with a total CRC of about R516.037 million. The DWS needs to develop appropriate disposal plans for these asset components, and accordingly dispose of them and avoid incurring unnecessary costs for their upkeep.

About 7% of NWRI's infrastructure asset components (with a total CRC of about R18.175 billion) are under-utilised, according to the Asset Register. They are mainly canals and dams related asset components. Indeed, 59 out of NWRI's 255 schemes are currently inactive and, thus, under-utilised. Under-utilised infrastructure asset components for the NWRI, which are neither fully impaired nor marked for disposal have a total CRC of about R17.710 billion. It is recommended that the NWRI revisits the utilisation grading (captured in the Asset Register) of these under-utilised asset components as they may be including those asset components belonging to the "Not in use" utilisation grading. The confirmed under-utilised asset components could be candidates for disposal. However, before any disposal could take place, the reasons for the under-utilisation need to be assessed and consideration made for decommissioning and disposal, where necessary. Possible disposal method for the

inactive schemes could be transferring to the local community through the local municipality.

Noteworthy is that the quality and usefulness of an AMP is highly dependent on the completeness and accuracy of the asset register used in the development of the AMP. Accordingly, the abovementioned asset life cycle management activities and works recommended for NWRI Operations in this AMP are highly dependent on the asset component condition, criticality and utilisation grading captured in the asset register used in the development of this AMP. As such, execution of the abovementioned asset life cycle management activities and works recommended for NWRI Operations (as detailed in the following subsections) need to be adapted in line with the prevailing situation on the ground. Refer to Section 6 of this Executive Summary regarding some recommendations on how to improve on the current NWRI immovable asset register.

4.3 Human Resources

The NWRI Operations is seriously under-resourced: only 1 598 out of the 2 766 (i.e. about 58%) approved positions (as per the 2014 approved structure) are currently filled, representing a vacancy rate of about 42%. Compared to the 2007 approved structure (which mostly better reflected the needs of the NWRI Operations), only 1 598 out of the 3 590 (i.e. about 45%) approved positions are currently filled, representing a vacancy rate of about 55%. Such vacancy rates are way much higher than the 10% or less target specified in the DWS Annual Performance Plan for 2017/18 to 2019/20. In addition, the very high vacancy rate has considerable negative impact on the execution of adequate life cycle activities and works (e.g. operation and maintenance, renewals and upgrades) of the NWRI's infrastructure assets, as evidenced by the high backlogs highlighted in the preceding sub-sections.

The DWS needs to urgently embark on a serious recruitment drive, aiming at achieving the 10% or less vacancy rate target specified in its Annual Performance Plan for 2017/18 to 2019/20. Failure to do so will continue to compromise life cycle activities and works, piling up of works backlog leading to a possible total collapse of its water resources infrastructure. This AMP has made provision for the DWS to fill all the operation and maintenance and other critical support vacancies, with appropriately qualified and experienced personnel, within the next two years.

5. Asset Life Cycle Financial Plan

5.1 Backlog

As indicated in the preceding section, the NWRI's total backlog has a current replacement cost (CRC) (*the cost of replacing an existing asset with a modern asset of equivalent capacity*) of about R38.922 billion: about R31.057 billion for renewal/condition backlog; and about R7.866 billion for upgrades backlog. However, in practice, not all the asset components constituting the backlog need to be completely replaced. Rather, some of the asset components require some refurbishment (electrical and mechanical related) or rehabilitation (civil related); which cost less than complete replacements.

Consequently, the overall cost to clear the NWRI's total backlog (which has a CRC of about R38.922 billion) would be less than this CRC amount. Accordingly, the derived financial requirement (*amount of money required*) to clear the NWRI's total backlog is about R13.649 billion: about R9.483 billion for renewal/condition backlog; and about R4.166 million for upgrades backlog.

Tables 0.2 and 0.3 show the split per cluster of the CRC and the derived financial requirement to clear the NWRI's total backlog, respectively.

Table 0.2: Current replacement cost for the backlog per cluster

Cluster Name	CRC (R million)		
	Condition Backlog	Upgrade Backlog	Total
Northern Operations	7 199.610	5 525.995	12 725.605
Eastern Operations	803.495	700.944	1 504.439
Southern Operations	4 636.288	17.280	4 653.568
Central Operations	18 417.140	1 621.623	20 038.762
Total	31 056.534	7 865.842	38 922.375

Table 0.3: Financial requirement to clear the backlog per cluster

Cluster Name	Financial Requirement to Clear Backlog (R million)		
	Condition Backlog	Upgrade Backlog	Total
Northern Operations	2 536.288	1 882.542	4 418.830
Eastern Operations	296.575	674.767	971.343
Southern Operations	1 805.239	25.920	1 831.159
Central Operations	4 844.655	1 582.802	6 427.457
Total	9 482.757	4 166.031	13 648.788

5.2 Total Cost Requirement

The NWRI's total planned annual cost requirement for the first 3 years (2017/18, 2018/19, and 2019/20) are: R4.342 billion; R5.374 billion; and R5.984 billion, respectively, as shown in Table 0.4.

Table 0.4: Total cost requirement per cost component

Cost Component	Financial Years (R million)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Capital Expenditure (CAPEX)										
<i>Renewals</i>	754.792	702.602	1 135.678	1 653.588	2 300.519	2 670.530	3 264.483	4 762.835	5 234.733	5 212.429
<i>Upgrades and New Capital</i>	527.061	1 189.502	924.514	1 115.696	1 018.525	1 072.551	813.629	354.680	414.072	314.255
Sub-Total CAPEX	1 281.853	1 892.105	2 060.192	2 769.285	3 319.044	3 743.081	4 078.112	5 117.515	5 648.805	5 526.684
Operations and Maintenance (O&M)										
<i>Operations</i>	1 099.508	1 358.735	1 625.612	1 736.348	1 854.752	1 981.365	2 116.763	2 261.567	2 416.440	2 582.094
<i>Maintenance</i>	1 523.926	1 640.974	1 767.012	1 902.731	2 048.874	2 206.242	2 375.696	2 558.166	2 754.651	2 966.228
Sub-Total O&M	2 623.434	2 999.709	3 392.624	3 639.079	3 903.626	4 187.607	4 492.459	4 819.733	5 171.091	5 548.321
Total	3 905.287	4 891.813	5 452.816	6 408.364	7 222.670	7 930.688	8 570.572	9 937.248	10 819.896	11 075.005
<i>Overheads</i>	436.678	482.429	530.782	567.439	606.664	648.637	693.554	741.625	793.073	848.139
Grand Total	4 341.965	5 374.242	5 983.598	6 975.803	7 829.334	8 579.324	9 264.126	10 678.873	11 612.968	11 923.144

The planned total cost breakdown for the NWRI is as follows:

- renewals cost requirement of about: R754.792 million; R702.602 million and R1.136 billion, respectively for the first three years;
 - upgrades cost requirement of about: R527.061 million; R1.189 billion and R924.514 million, respectively for the first three years; and
 - O&M cost requirement of about: R2.623 billion; R3 billion; and R3.393 billion, respectively for the first three years, and
- overheads cost requirement of about: R436.678 million; R482.429 million; and R530.782 million, respectively for the first three years.

Table 0.5 shows the split per cluster of the NWRI's total planned annual cost requirement for the 10-year period.

Table 0.5: Total cost requirement per cluster

Cluster Name	Financial Years (R million)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Northern Operations	982.557	1 280.116	1 537.682	1 766.348	1 971.940	2 067.724	2 118.845	2 248.935	2 549.749	2 543.739
Eastern Operations	473.527	601.656	675.162	769.326	852.963	885.196	911.756	966.485	1 001.776	949.243
Southern Operations	712.351	959.357	1 062.791	1 251.258	1 454.382	1 611.757	1 873.633	2 002.507	2 072.473	2 137.000
Central Operations	2 173.530	2 533.114	2 707.963	3 188.870	3 550.049	4 014.647	4 359.891	5 460.946	5 988.970	6 293.162
Total	4 341.965	5 374.242	5 983.598	6 975.803	7 829.334	8 579.324	9 264.126	10 678.873	11 612.968	11 923.144

5.3 Total Cost Requirement versus the Approved Budget for 2017/18

Table 0.6 shows a comparison between the derived total cost requirement and the total approved budget for the NWRI for the financial year 2017/18. Both the CAPEX and the O&M approved budgets are far below the respective derived total costs requirements. If this continues to be the case, there will be a perpetual compromise on the NWRI's asset life cycle works; thereby further worsening the accumulation of the already high works backlog. This will potentially lead to a possible total collapse of the NWRI's infrastructure, resulting in the NWRI failing to meet its required levels of service.

Table 0.6: Total cost requirement versus the approved budget for 2017/18

Description	Financial Year 2017/18 (R million)		
	Total CAPEX	Total O&M (incl. Overheads)	Total
Derived Total Cost Requirement	1 281.853	3 060.113	4 341.966
Approved Budget	500.000	1 000.000	1 500.000
Budget Gap	781.853	2 060.113	2 841.966

5.4 Funding Requirement

The minimum revenue which ought to be generated by the NWRI's clusters, to adequately meet its funding requirements, during the projected 10-year period under review is between about R4.342 billion and about R11.923 billion per annum. In the event that such revenue cannot be generated through user charges (an indication that the NWRI is not financially self-sustainable), external funding would need to be considered. Such funding can be in the form of fiscal support, or debt raised through such institutions as TCTA, form m of fiscal support, cross subsidisation or debt raised through such institutions as TCTA.

6. Recommendations

Some of the key areas of improvement, and recommended improvement actions thereof, are presented in Table 0.7.

Table 0.7: Recommended areas for improvement

No.	Area for Improvement	Issue Description	Recommended Action
1	Asset Life Cycle Works Management		
1.1	Backlog (Maintenance, Renewals and Upgrades)	<p>The NWRI's total backlog has a CRC of about R38.922 billion: about R31.057 billion for condition backlog; and about R7.866 billion for upgrades backlog. The derived financial requirement to clear the NWRI's total backlog is about R13.649 billion: about R9.483 billion for renewal/condition backlog; and about R4.166 billion for upgrades backlog.</p> <p>Key factors contributing towards such high backlog include:</p> <ul style="list-style-type: none"> ▪ Budget cuts; ▪ Under-staffing of the NWRI; ▪ Long periods without a maintenance contractor; ▪ Poor performance of maintenance contractors; and ▪ Long turnaround times from the Supply Chain Department. 	<p><u>The NWRI needs to urgently address the noted financial, procurement and human resources challenges (as further recommended in this Table) so as to avoid a possible total collapse of the NWRI's infrastructure assets.</u></p>
1.2	Works Planning	<p>Asset life cycle works (e.g. maintenance, renewals, upgrades, etc.) planning is being done on an ad hoc basis, without systematic consideration of each and every asset component. This is evident in the NWRI's 'Maintenance' Plans which do not identify the asset components by their unique identity numbers.</p> <p>This poses a risk of having some asset components not catered for on time, increasing unplanned, reactive works.</p>	<p>Asset life cycle works (e.g. maintenance, renewals, upgrades, etc.) planning needs to be done systematically on a component by component basis (with clearly indicated asset component numbers, consistent with those captured in the SAP Asset Register.</p> <p>Also, prioritisation of the works need to be done on an asset facility category basis with due consideration of the asset components' criticality and condition grading, as done in this AMP.</p>
2	Asset Information Management		
2.1	Asset Register as the indispensable key data source for AMP development	<p>The quality and usefulness of an AMP is highly dependent on the completeness and accuracy of the asset register used in the development of the AMP.</p> <p>Accordingly, the asset life cycle management activities and works (such as maintenance, renewals, upgrades and new capital, and disposals) recommended for the NWRI in this AMP are highly dependent on the asset component condition, criticality and utilisation grading captured in the asset register used in the development of this AMP.</p> <p>However, during the data gathering and AMPs review workshops conducted during the development of this AMP, the Cluster and scheme personnel did not fully concur with some of the asset component counts, condition as well as utilisation grading; indicating the possibility of some misalignment between the asset register and the prevailing situation on the ground.</p>	<p>The NWRI needs to urgently conduct physical asset verification and assessments (extent, condition, criticality, utilisation, etc.) for all its immovable assets and develop a comprehensive asset register, inclusive of all crucial asset component details, such as asset component sizes, material of construction, condition, criticality, utilisation, etc. Thereafter, the NWRI needs to conduct similar assessments at least every five years as contemplated in Section 13 of the GIAMA.</p> <p>The abovementioned asset assessments need to be conducted by adequately qualified and experienced professionals.</p>

No.	Area for Improvement	Issue Description	Recommended Action
2.2	Current Replacement Cost (CRC)	<p>Each and every asset component in the asset register needs to have a corresponding CRC. The CRCs are useful in the determination and projection of optimal asset life cycle management works, such as O&M, renewals, upgrades and new capital, etc., in line with international best practices.</p> <p>Ideally, the CRC of an asset component needs to be determined by multiplying the unit cost rate (cost per unit size, ideally obtained from suppliers) by the size of the asset component. Thus, the asset register needs to adequately capture such details as asset component sizes, material of construction, etc.</p> <p>However, such asset component details are not fully captured for some asset components in the asset register used in the development of this AMP. As a result, some of the CRCs presented in this AMP were determined by adjusting the provided acquisition costs with PPI and an uncertainty factor (where the sizes were not available); hence the projected optimal asset life cycle management costs may be on the conservative side.</p>	<p>The above-recommended assessments for the NWRI immovable assets need to adequately capture such asset component details as sizes and material of construction. This will enable the determination of more accurate CRCs for all asset components, and consequently projection of more accurate optimal asset life cycle management costs.</p>
3	Financial Management		
3.1	Budget cuts	<p>The approved budgets (operations and maintenance, renewals and upgrades) for the NWRI are often lower than what is required. This is resulting in the NWRI failing to adequately execute the required asset life cycle works for its infrastructure.</p>	<p>The DWS needs to allocate adequate budgets as recommended in this AMP, in line with GIAMA, so as to ensure that the NWRI's infrastructure asset life cycle works are adequately executed; thereby enabling the NWRI to effectively and efficiently meet its required levels of service.</p>
4	Human Resources Management		
4.1	Under-resourcing	<p>The NWRI Operations is seriously under-resourced: only 1 598 out of the 2 766 (i.e. about 58%) approved positions (as per the 2014 approved structure) are currently filled, representing a vacancy rate of about 42%. Compared to the 2007 approved structure (which mostly better reflected the needs of the NWRI Operations), only 1 598 out of the 3 590 (i.e. about 45%) approved positions are currently filled, representing a vacancy rate of about 55%.</p> <p>Such vacancy rates are way much higher than the 10% or less target specified in the DWS Annual Performance Plan for 2017/18 to 2019/20. In addition, the very high vacancy rate has considerable negative impact on the execution of adequate life cycle activities and works (e.g. operation and maintenance, renewals and upgrades) of the Cluster's infrastructure assets, as evidenced by the high backlogs highlighted in the preceding sub-sections.</p>	<p>The NWRI needs to urgently embark on a serious recruitment drive, aiming at achieving the 10% or less vacancy rate target specified in its Annual Performance Plan for 2017/18 to 2019/20. Failure to do so will continue to compromise life cycle activities and works, piling up of works backlog leading to a possible total collapse of its water resources infrastructure.</p> <p>This AMP has made provision for the DWS to fill all the operation and maintenance and other critical support vacancies, with appropriately qualified and experienced personnel, within the next two years.</p>
5	Procurement Management		
5.1	Immovable Asset Maintenance Contract	<p>Some of the Clusters (Northern, Eastern and Southern) do not have an immovable asset maintenance contract in place. This poses a high risk of service delivery failure as a result of deteriorating asset condition.</p>	<p>Urgently appoint immovable asset maintenance contractors for the Clusters, and work towards clearing the renewals and upgrades backlogs identified in this AMP.</p>

No.	Area for Improvement	Issue Description	Recommended Action
5.2	Turnaround times	There are too long delays in the DWS procurement process; resulting in significant delays in the execution of the NWRI's asset life cycle works, including emergency works. This is contributing significantly to the NWRI's high backlogs highlighted in this AMP.	The DWS needs to urgently revise its internal procurement processes so as not to unnecessarily delay the execution of the NWRI's asset life cycle works.
5.3	Maintenance contractor management	Poor performance by the maintenance contractor.	The NWRI needs to appoint dedicated project managers and quality control personnel to ensure the NWRI's asset life cycle works are appropriately executed, timeously and correctly.
5.4	Operation and Maintenance Contracts with other parties	<p>A significant proportion of the NWRI's schemes are being operated and maintained by other parties (such as Water Boards, Irrigation Boards, Water User Associations, etc.). However, in a good number of these cases, there are no formal agreements in place, and in some cases the agreements have expired.</p> <p>Thus, the risk is high that some of the NWRI's assets are not being adequately operated and maintained.</p>	The DWS needs to urgently set up formal agreements with the parties (such as Water Boards, Irrigation Boards, Water User Associations, etc.) operating and maintaining the schemes on behalf of DWS, with clear, measurable performance targets.
6	Risk Management		
6.1	Infrastructure assets-related risks	<p>The following asset-related risks will result in the Cluster failing to meet its required levels of service:</p> <p><i>Condition risk:</i> Failure by the NWRI's assets to deliver the required service due to deteriorated physical condition.</p> <p><i>Capacity risk:</i> Failure by the NWRI's assets to deliver the required service as a result of it exceeding its design capacity/stressed.</p>	<p>The NWRI needs to provide the Clusters with enabling policies (finance, procurement, human resources, etc.) and resources necessary for it to adequately carry out the asset life cycle works as recommended in this AMP; thereby enabling the Cluster to effectively and efficiently meet its required levels of service.</p> <p><u>Failure by the NWRI to adequately carry out the asset life cycle works as recommended in this AMP, will ultimately lead to a total collapse of its infrastructure; resulting in the NWRI failing to meet its required levels of service.</u></p>

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GLOSSARY

Activity	An activity is the work undertaken on an asset or group of assets to achieve a desired outcome.
Asset	A resource controlled by the DWS as a result of past events and from which future economic benefits are expected to flow to DWS.
Asset Hierarchy	A framework for segmenting an asset base into appropriate classifications.
Asset Management	A process of decision making, planning and control over acquisition, use, safeguarding and disposal of assets to maximise their service delivery potential and benefits, and to minimize their related risks and costs over their entire life.
Asset Management System	A system (usually computerised) for collecting, analysing and reporting data on the utilisation, performance, lifecycle management and funding of existing assets.
Asset Management Plan	Documented information that specifies the activities, resources and timescales required for an individual asset, or a grouping of assets, to achieve the organization's asset management objectives.
Asset Management Policy	The overall intentions and direction of an organisation related to the assets and the framework for the control of asset related processes and activities.
Asset Management Strategy	A strategy for asset management covering, the development and implementation of plans and programmes for asset creation, operation, maintenance, renewal, disposal and performance monitoring to ensure that the desired levels of service and other operational objectives are achieved at optimum cost.
Asset Management Team	The team appointed by an organisation to review and monitor the corporate asset management improvement programme and ensure the development of integrated asset management systems and plans consistent with organisational goals and objectives.
An active market	a market in which all of the following conditions exist: <ul style="list-style-type: none"> • The items traded in the market are homogeneous • Willing buyers and sellers can normally be found at any time • Prices are available to the public
Asset carrying amount/value	The amount at which an asset is included in the statement of financial position after deducting any accumulated depreciation and any impairment losses thereon.
Asset Register	A record of asset information considered worthy of separate identification including inventory, historical, financial, condition, and construction, technical and financial information about each.
Condition Monitoring	Continuous or periodic inspection, assessment, measurement and interpretation of resulting data, to indicate the condition of a specific component so as to determine the need for some preventive or remedial action
Critical Assets	Assets or assets components, that are identified as being critical in achieving the organisation's strategic objectives (note that assets can be safety critical, environmental critical or performance critical).
Current Replacement Cost	A measure of replacement value – the cost of replacing an existing asset with a modern asset of equivalent capacity.
Deferred Maintenance	Planned maintenance that has been deferred (backlog in maintenance).
Demand Management	The active intervention in the market to influence demand for services and assets with forecast consequences, usually to avoid or defer CAPEX expenditure. Demand management is based on the notion that as needs are satisfied expectations rise automatically and almost every action taken to satisfy demand will stimulate further demand.
Depreciated Replacement Cost	A measure of current value of an asset, based on its current replacement cost less an allowance for deterioration of condition to date (based on the fraction of remaining useful life/expected useful life).
Depreciation	The systematic allocation of the depreciable amount of a physical asset over its useful life.
Disposal	Activities necessary to dispose of decommissioned assets.

Economic life	The period from the acquisition of the asset to the time when the asset, while physically able to provide a service, ceases to be the lowest cost alternative to satisfy a particular level of service. The economic life is at the maximum when equal to the physical life however obsolescence will often ensure that the economic life is less than the physical life.
Expenditure-based cost	Projected cost based on historical actual expenditures.
EUL	Expected Useful Life of an asset
Facility	A complex asset comprising many assets (e.g. a hospital, water treatment plant, recreation complex, etc.) which represents a single management unit for financial, operational, maintenance or other purposes.
Geographic Information System	Software which provides a means of spatially viewing, searching, manipulating, and analysing an electronic database.
Impairment	The loss of future economic benefits or service potential of an asset over and above the systematic recognition of the loss of the asset's future economic benefits or service potential through depreciation.
Infrastructure Assets	Stationary systems forming a network and serving whole communities, where the system as a whole is intended to be maintained indefinitely at a particular level of service potential by the continuing replacement and refurbishment of its components. The network may include normally recognized 'ordinary' assets as components.
Key Performance Indicator	A qualitative or quantitative measure of a service or activity used to compare actual performance against a standard or other target. Key performance indicators commonly relate to statutory limits, safety, responsiveness, cost, comfort, asset performance, reliability, efficiency, environmental protection and customer satisfaction.
Level of service	The defined service quality for a particular activity or service area against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental acceptability and cost.
Life	A measure of the anticipated life of an asset or component; such as time, number of cycles, distance intervals etc.
Life cycle	The cycle of activities that an asset (or facility) goes through while it retains an identity as a particular asset i.e. from planning and design to decommissioning or disposal.
Lifecycle Cost	The total cost of an asset throughout its life including planning, design, construction, acquisition, operation, maintenance, and rehabilitation and disposal costs.
Maintenance	All actions necessary for an asset to achieve its expected useful life as near as practicable to its original condition, but excluding rehabilitation or renewal.
Maintenance Plan	Collated information, policies and procedures for the optimum maintenance of an asset, or group of assets.
Maintenance Standards	The standards set for the maintenance service, usually contained in preventive maintenance schedules, operation and maintenance manuals, codes of practice, estimating criteria, statutory regulations and mandatory requirements, in accordance with maintenance quality objectives.
Objective	An objective is a general statement of intention relating to a specific output or activity. They are generally longer term aims and are not necessarily outcomes that managers can control.
Operating Expenditure	Expenditure necessary to provide services such as water catchment or water distribution. Examples of OPEX include staff costs, administration costs, consumables, maintenance and repairs and feasibility studies.
Operation	The active process of utilising an asset which will consume resources such as manpower, energy, chemicals and materials. Operation costs are part of the lifecycle costs of an asset.
Optimal cost	Cost determined based on established ratios of CRCs, and is deemed sufficient to cover all the expenditure requirements of an entity.
Performance Monitoring	Continuous or periodic quantitative and qualitative assessments of the actual performance compared with specific objectives, targets or standards.
Planned Maintenance	Planned maintenance activities fall into 3 categories:

	<ul style="list-style-type: none"> ▪ Periodic – necessary to ensure the reliability or sustain the design life of an asset. ▪ Predictive – condition monitoring activities used to predict failure. ▪ Preventive – maintenance that can be initiated without routine or continuous checking (e.g. using information contained in maintenance manuals or manufacturers' recommendations) and is not condition-based.
Rehabilitation	Works to rebuild or replace parts or components of an asset, to restore it to a required functional condition and extend its life, which may incorporate some modification. Generally, involves repairing the asset using available techniques and standards to deliver its original level of service (e.g. relining bulk raw water pipelines) without resorting to significant upgrading or replacement.
Renewal	Works to refurbish, rehabilitate or replace existing facilities with facilities of equivalent capacity or performance capability.
Repair	Action to restore an item to its previous condition after failure or damage.
Replacement	The complete replacement of an asset that has reached the end of its life, so as to provide a similar, or agreed alternative, level of service.
Remaining Useful Life	The time remaining over which an asset is expected to be used.
Residual Value	The net amount which the entity expects to obtain for an asset at the end of its useful life after deducting the expected costs of disposal.
Risk Management	The application of a formal process to the range of possible values relating to key factors associated with a risk in order to determine the resultant ranges of outcomes and their probability of occurrence.
Routine Maintenance	Day to day operational activities to keep the asset operating (e.g. repairing leaks) and which form part of the annual operating budget, including preventative maintenance.
Strategic Plan	Strategic planning involves making decisions about the long-term goals and strategies of an organisation. Strategic plans have a strong external focus, cover major portions of the organisation and identify major targets, actions and resource allocations relating to the long-term survival, value and growth of the organisation.
Unplanned Maintenance	Corrective work required in the short term to restore an asset to working condition so it can continue to deliver the required service or to maintain its level of security and integrity.
Upgrading	The replacement of an asset or addition/ replacement of an asset component which materially improves the original service potential of the asset.
Useful life	The period over which a depreciable asset is expected to be used. (GAMAP: Either (i) the period of time over which an asset is expected to be used by the entity, or (ii) the number of production or similar units expected to be detained from the asset by the entity).
Valuation	Estimated asset value, which may depend on the purpose for which the valuation is required, i.e. replacement value for determining maintenance levels or market value for lifecycle costing.
Yield	Water which can reliably be withdrawn from a water source at a relatively constant rate.

ABBREVIATIONS

AM	Asset Management
AMP	Asset Management Plan
AMIP	Asset Management Improvement Plan
AMS	Asset Management System
CAPEX	Capital Expenditure
CBM	Condition Based Maintenance
CPI	Consumer Price Index
CRC	Current Replacement Cost
DRC	Depreciated Replacement Cost
D&I	Domestic and Industrial
DWS	Department of Water and Sanitation
EUL	Expected Useful Life
GIAMA	Government Immovable Asset Management Act
GIS	Geographic Information System
GFMAM	Global Framework for Maintenance and Asset Management
GPS	Global Positioning System
GRAP	Generally Recognized Accounting Practices
GWS	Government Water Scheme
ISO	International Standards Organization
IAS	International Accounting Standards
IFMS	Integrated Financial Management System
IRR	Irrigation
KPI	Key Performance Indicator
LCC	Life Cycle Costing/Cost
MTEF	Medium Term Expenditure Framework
NWRI	National Water Resources Infrastructure
NWRIB	National Water Resources Infrastructure Branch
NWA	National Water Act
OPEX	Operating Expenditure
O&M	Operation and Maintenance
OSH	Occupational Health and Safety
PFMA	Public Finance Management Act
PPE	Property, Plant and Equipment
PPI	Producer Price Index
PM	Preventive Maintenance
PdM	Predictive Maintenance
RAMS	Reliability, Availability, Maintainability and Safety
RUL	Remaining Useful Life
RTF	Run to Failure
RCM	Reliability Centred Maintenance
WARMS	Water-Use Authorization and Registration Management System
WDCS	Waste Discharge Charging System
WMA	Water Management Area
WTE	Water Trading Entity

1. INTRODUCTION AND SERVICE DESCRIPTION

1.1 Overview

This document is a 10-year immovable Asset Management Plan (AMP) for National Water Resources Infrastructure (NWRI) national operations, hereinafter referred to as the NWRI Operations. NWRI is a branch of the Department of Water and Sanitation (DWS). This section begins with a brief background as well as the key sources of data used in the development of this AMP. It proceeds with outlining: the purpose of this AMP; and alignment of this AMP with the South African legislative framework, international standards, and the DWS's strategic plan. Finally, it indicates the physical location of the NWRI Operations; and also highlights the key service provided by the NWRI Operations.

1.2 Background

The NWRI is responsible for operating, maintaining and managing a number of raw water schemes spread throughout South Africa. The NWRI divided the country into four operational clusters: Northern; Eastern; Southern; and Central. Each cluster is responsible for a number of raw water schemes.

During the financial year 2016/17, the NWRI prepared the third set of AMPs (260 immovable AMPs): one AMP for each of its 255 raw water schemes (produced for the first time); one for each of its 4 operational clusters, and one National AMP. The DWS is required to annually update these AMPs in accordance and compliance with the provisions of Section 12 of the Government Immovable Asset Management Act (GIAMA), Act No. 19 of 2007.

Accordingly, this AMP has been prepared for NWRI's National Operations, as an update and improvement to the 2016/17 National AMP.

1.3 Data Sources and Overall Data Confidence

1.3.1 Key Data Sources Used to Develop this AMP

The key sources of data used to develop this AMP are:

- *NWRI Immovable Asset Register* for the financial year 2016/17 (refer to Appendix A).
- *NWRI Infrastructure Asset Hierarchy* for the financial year 2016/17.
- *Condition Assessment Audit of Irrigation Scheme Infrastructure – Scheme Reports*, dated the 30th September 2016.
- *financial information* (obtained from the Cluster Offices and the DWS Head Office).
- *face-to-face interviews* conducted with the relevant NWRI Operations personnel.

- *Other relevant DWS documentation*, such as water use registrations records, annual report, approved NWRI structure, list of registered dams, etc.
- *Northern, Eastern, Southern and Central Operations Cluster AMPs.*

1.3.2 Data Confidence Rating

Table 1.1 shows the confidence grading criteria used for rating the data used in this AMP.

Table 1.1: Data confidence grading scale

Data Confidence Grade	Description	Margin of Error
5	Highly accurate Data based on sound records, procedure, investigations and analysis which is properly documented and recognised as the best method of assessment.	1 – 20 %
4	Minor inaccuracies Data based on sound records, procedures, investigations and analysis which is properly documented but has minor shortcomings; for example, the data is old, some documentation is missing and reliance is placed on unconfirmed reports or some extrapolation.	21 – 30%
3	50% estimated Data based on sound records, procedures, investigations, and analysis which is incomplete or unsupported, or extrapolation from a limited sample for which grade 1 or 2 data is available.	31 – 40%
2	Significant data estimated Data based on incomplete or outdated data, or conflicting data sets exists requiring the assessor to apply judgement as to which portions of data would be most appropriate.	41- 50%
1	All data estimated No written records, procedures or other supporting documentation available. Data based on unconfirmed verbal reports and/or cursory inspection and analysis	> 51%

Source: Adapted from DWS Valuation Guide (2008)

Table 1.2 summarizes the confidence rating for the data used to develop this AMP.

Table 1.2: Overall data confidence rating

Section of this AMP	Data Description	Data Confidence Rating	Reason for rating
1	NWRI location and service description	5	Data gathered during interviews and also obtained from other relevant DWS documentation, such as the WARMS registrations (DW760).
2	Levels of service, performance measures, targets	4	Data obtained from DWS Raw Water Pricing Strategy; raw water supply agreements; and some data verified/provided by the NWRI Operations personnel.
3	Raw water demand	3	Raw water demand based on registered volumes for irrigation, and domestic and industrial water users from the WARMS registrations (DW760).
4	Asset details	4	Required asset information that was not in the Asset Register was derived (see Section 4.2).
5	Financial information	4	Required financial information that could not be found was derived (refer to Section 5).
Average Data Confidence		4	Minor inaccuracies, with 21 – 30% margin of error.

1.4 Purpose of this Asset Management Plan

The main purpose of this 10-year AMP is to enable the NWRI to effectively and efficiently manage its immovable assets, thereby enabling it to maximise its service delivery potential and benefits (delivering the desired levels of service to its clients), and to minimise related risks and costs over its immovable assets' entire life cycle. To this end, this AMP aims at achieving the following:

- Describing the service offered by the NWRI.
- Articulating the intended 'levels of service' relevant to NWRI, and the performance measures and targets against which actual performance needs to be assessed.
- Analysing the NWRI's immovable assets and proposing appropriate asset life cycle activities/works aimed at making sure the NWRI's immovable assets meet: the levels of service (for supply of raw water) agreed with its clients; as well as the future raw water demand for the NWRI.
- Proposing a financial plan for the NWRI Operations for the next 10 years.
- Identifying areas of improvement with regards to the DWS Asset Management practices, and providing appropriate recommendations thereof.
- Enabling the NWRI to make optimized asset creation, operation, maintenance, renewal, upgrade and disposal decisions; and
- Complying with the provisions of the GIAMA.

1.5 Legislative Framework, Policies, Strategies and Standards

This AMP has been developed in line with the laws of the Republic of South Africa, relevant DWS policies, strategies and guides, as well as relevant international standards. The legislative framework includes, but is not limited to:

- Constitution of the Republic of South Africa (Act No. 108 of 1997).
- National Water Act (No. 36 of 1998).
- Government Immovable Asset Management Act (GIAMA) No. 19 of 2007.
- Public Finance Management Act (PFMA) No. 1 of 1999.
- Occupational Health and Safety Act (No. 85 of 1993).

The relevant DWS policies and strategies include:

- Immoveable Asset Management Policy (2015).
- Disposal Policy for Immoveable Assets (2015).
- Valuation Guide (2008).

The relevant international standards include:

- Generally Recognized Accounting Practice for Property, Plant and Equipment (GRAP 17).
- International Standard for Asset Management Systems (ISO 55000).
- International Infrastructure Management Manual.

1.6 Strategic Context

This AMP is aligned with the DWS's Strategic Plan, ensuring that the NWRI's immovable assets are managed in a manner that fully supports the DWS's vision of delivering "equitable and sustainable water and sanitation that support socio-economic growth and development of the well-being of current and future generations". This AMP flows from and supports the DWS's Asset Management Policy, High-level Strategic Goals, Mission and Vision (refer to Appendix B).

1.7 NWRI Description and Location

The NWRI is a branch within the DWS and its operations cover the entire country, as shown in Figure 1.1. It consists of four operational clusters (the Northern, Eastern, Southern and Central Operations) which together have a total of 255 government water schemes (distributed as follows: 91 in Northern; 18 in Eastern; 111 in Southern; and 35 in Central Operations), as shown in Table 1.3.

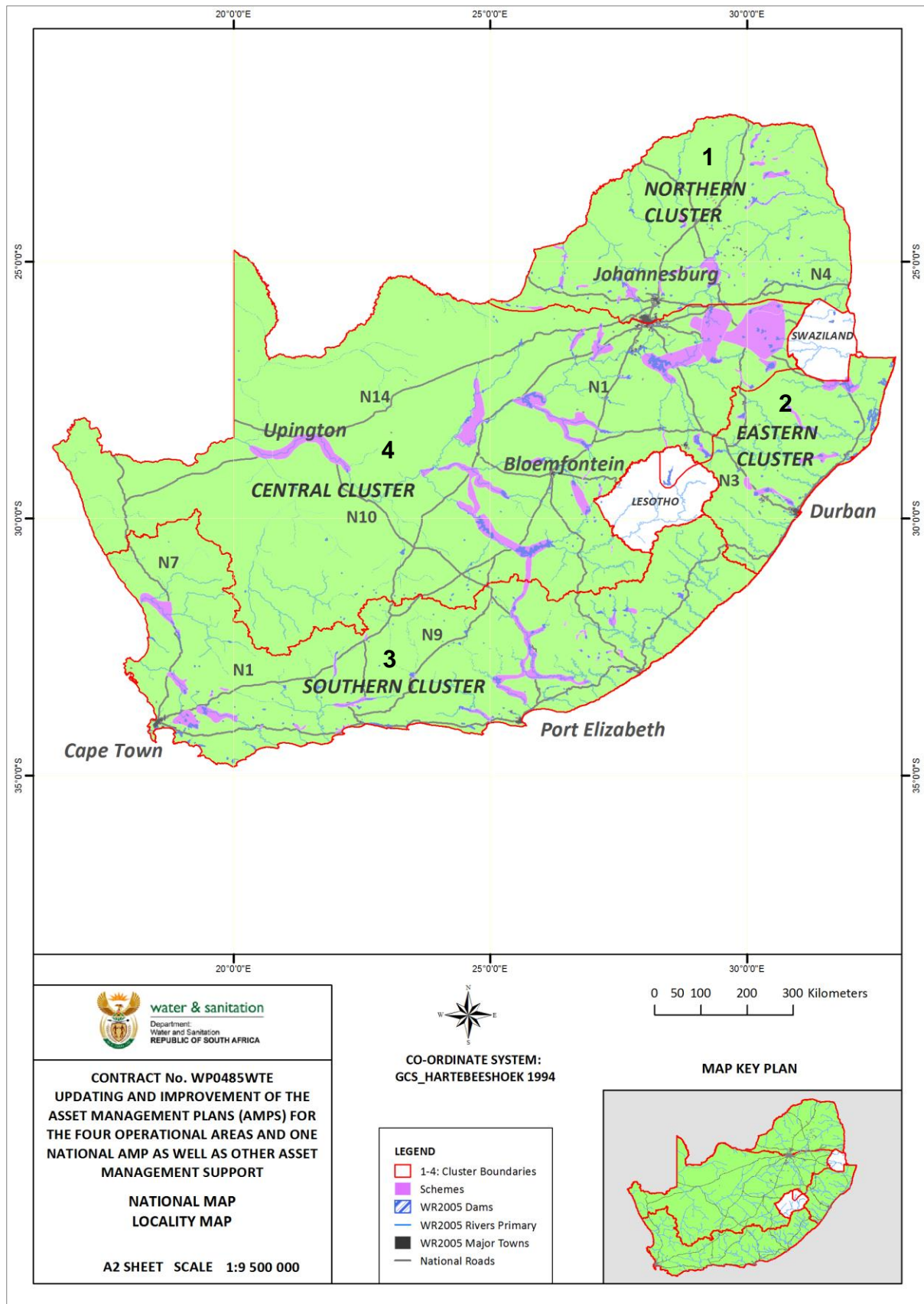


Figure 1.1: Locality map for the NWRI National Operations

Table 1.3: NWRI National Operations Clusters List

Cluster Name	Number of Schemes
Northern Operations	91
Eastern Operations	18
Southern Operations	111
Central Operations	35
Total	255

1.8 Service Description and Assets Summary

The primary service offered by NWRI Operations is the delivery of bulk raw water to its domestic and industrial (D&I), and irrigation water users (customers).

The key stakeholders for the Cluster are shown in Appendix C.

1.9 Summary

This AMP is for DWS's NWRI Operations. Key data sources used in the development of this AMP include: the NWRI's immovable asset register; asset hierarchy; the 2016 Condition Assessment Audit of Irrigation Scheme Infrastructure - Scheme Reports for NWRI Operations; the NWRI's financial information; face-to-face interviews conducted with the relevant NWRI personnel; as well as other relevant DWS documentation.

The main purpose of this AMP is to enable NWRI to effectively and efficiently manage its infrastructure assets, thereby enabling it to maximise its service delivery potential and benefits (delivering the desired level of service to its clients), and to minimise related risks and costs over its infrastructure assets' entire life cycle. This AMP is prepared in accordance with the provisions of the GIAMA, and is also aligned to: other relevant South African legislation; international standards; as well as the DWS's strategic plan.

The primary service offered by NWRI Operations is the delivery of bulk raw water to its domestic and industrial (D&I), and irrigation water users (customers).

The next section highlights the levels of service expected from the NWRI Operations.

2. LEVELS OF SERVICE, PERFORMANCE MEASURES & TARGETS

2.1 Overview

This section presents the levels of service, as well as the associated performance measures and targets, for NWRI Operations. Understanding the levels of service for NWRI assists in monitoring and managing NWRI's infrastructure assets so as to ensure effective service delivery to its water users and, thus, leading to customer satisfaction.

2.2 Levels of Service, and Associated Performance Measures and Targets

In this AMP, 'levels of service' refers to the quality and quantity of NWRI's service delivery, against which NWRI's performance may be measured. As indicated in the preceding section, the key service delivered by NWRI Operations is the supply of raw water to its customers (irrigation, and domestic and industrial water users).

There are three key levels of service applicable to NWRI's raw water supply service, namely:

- Volume of raw water supplied;
- Quality of raw water supplied; and
- Assurance level of raw water supply.

The above-listed levels of service are evident in the: raw water supply agreements with water users; and the DWS's Raw Water Pricing Strategy. The DWS's Catchment Management Area (CMA) is responsible for raw water registration/licensing. Two of the levels of service (volume of raw water supplied; and assurance level of raw water supply) fall under the direct responsibility of NWRI Operations; whilst the 'quality of raw water supplied' level of service falls under the direct responsibility of the CMA. As this AMP focuses on NWRI, the 'quality of raw water supplied' level of service is not covered in subsequent text.

Table 2.1 presents the performance measures and targets (associated with each of the two levels of service for which NWRI is responsible), current performance, as well as the desired future performance targets.

Table 2.1: Levels of service, and associated performance measures and targets

Level of Service	Performance Measure	Performance Target (2016/17)	Actual Performance (2016/17)	Desired Performance Targets (2017/18 – 2026/27)
Volume of raw water supplied	Volume of raw water supplied	Registered raw water volumes per annum: <ul style="list-style-type: none"> 3 673.761 Mm³ for domestic and industrial water users; 5 306.765 Mm³ for irrigation water users; 8 980.526 Mm³ Total. 	Actual raw water volumes could not be obtained for some schemes in all the clusters.	Be able to meet the growth in demand (refer to Section 3).
	Asset life cycle works (maintenance, renewals and upgrades).	Less than 10% deferred works (maintenance, renewals and upgrades). [Provided there is: a maintenance contract; adequate budgets; and no human resources constraints].	There are some deferred works (refer to Section 5.3).	Less than 10% deferred works (maintenance, renewals and upgrades). [Provided there is: a maintenance contract; adequate budgets; and no human resources constraints].
	Water conveyance efficiency	Percentage of unaccounted for raw water during delivery: < 3% for pipelines; <20% for canals.	Could not be ascertained for some of the schemes.	Percentage of unaccounted for raw water during delivery: < 3% for pipelines; <20% for canals.
Assurance level of raw water supply	Water supply assurance	<ul style="list-style-type: none"> 97% for domestic and industrial water users; 91% for irrigation water users. [Provided there are no water restrictions]. 	Could not be ascertained.	<ul style="list-style-type: none"> 97% for domestic and industrial water users; 91% for irrigation water users. [Provided there are no water restrictions].

2.3 Summary

There are three key desired levels of service applicable to the NWRI Operations' raw water supply service: volume of raw water supplied; quality of raw water supplied; and assurance level of raw water supply. Volume of raw water supplied and assurance level of raw water supply fall under the direct responsibility of the NWRI Operations; whilst quality of raw water supplied falls under the direct responsibility of the CMA. The NWRI Operations is expected to supply an annual total of about: 3 673.761 Mm³ of raw water to D&I water users, for which it assures 97% non-interruption; and 5 306.765 Mm³ to irrigation water users, for which it assures 91%.

In order to ensure that NWRI provides the levels of service agreed with water users, a number of asset life cycle management activities and works need to be executed, as outlined in Sections 4 and 5 of this AMP. The following section discusses the raw water demand for the NWRI.

3. RAW WATER DEMAND

3.1 Overview

This section describes the raw water demand for the NWRI Operations; further highlighting the importance of and the need for aligning the NWRI's asset life cycle works with its raw water demand.

3.2 Raw Water Demand Levels

Total registered volume of raw water for NWRI is about 8 980.526 Mm³ per annum, of which about 41% is for domestic and industrial use, and about 59% is for irrigation use, as shown in Table 3.1.

Table 3.1: Raw water allocations per water user category

Cluster Name	Registered Volume					
	Domestic & Industrial		Irrigation		Total	
	(Mm ³ pa)	Row %	(Mm ³ pa)	Row %	(Mm ³ pa)	Row %
Northern Operations	633.879	47%	707.885	53%	1 341.764	100%
Eastern Operations	727.615	63%	419.571	37%	1 147.186	100%
Southern Operations	498.562	27%	1 326.852	73%	1 825.414	100%
Central Operations	1 813.705	39%	2 852.457	61%	4 666.162	100%
Total	3 673.761	41%	5 306.765	59%	8 980.526	100%

Table 3.2 shows the principal customers, in terms of registered raw water volumes, accounting for about 50% of the total demand for the NWRI Operations; whilst Table 3.3 shows the NWRI Operations' principal schemes, in terms of registered raw water volumes, accounting for about 57% of the total supply.

It is important that the NWRI pays special attention to the principal schemes as well as the schemes supplying water to the principal customers in its infrastructure asset life cycle works decision making.

Appendix D, Tables D.1A, D.1B, D.1C and D.1D show the principal water users for Northern, Eastern, Southern and Central Operations Cluster, respectively; whilst Appendix D, Tables D.2A, D.2B, D.2C and D.2D show the principal schemes in terms of registered raw water volumes for the respective clusters.

Table 3.2: Principal water users

Customer Name	Water User Category	Cluster	Registered Water Volume (Mm ³ pa)
Umgeni Water	Domestic & Industrial	Eastern	452.000
Great Fish River Water Users Association	Irrigation	Southern	426.262
Eskom Holdings	Domestic & Industrial	Central	420.420
Vaalharts Water User Association	Irrigation	Central	348.104
Sedibeng Water: Bothaville	Domestic & Industrial	Central	256.400
City Of Cape Town Metropolitan Municipality	Domestic & Industrial	Southern	210.900
Vanderkloof Water User Association	Irrigation	Central	192.847
Orange-Riet Water User Association	Irrigation	Central	182.696
Mid-Vaal Water Company	Domestic & Industrial	Central	178.140
Lower Sundays River Water User Association	Irrigation	Southern	156.776
Kakamas Water User Association	Irrigation	Central	156.287
Sentraal-Breerivier Wgv	Irrigation	Southern	142.103
Loskop Irrigation Board	Irrigation	Northern	124.245
Sasol Synfuels Secunda	Domestic & Industrial	Central	123.005
Crocodile River W-Tvl Irrigation Board	Irrigation	Northern	118.358
Letaba Water User Association	Irrigation	Northern	116.549
Laer Olifants Rivier Wgv	Irrigation	Southern	112.362
Rand Water	Domestic & Industrial	Central	112.259
Magalies Water	Domestic & Industrial	Northern	109.530
Mhlathuze Water	Domestic & Industrial	Eastern	104.974
Bloem Water	Domestic & Industrial	Central	102.777
Sasol South Africa	Domestic & Industrial	Central	95.300
Hartbeespoort Irrigation Board	Irrigation	Northern	93.950
Midvaal Water	Domestic & Industrial	Central	86.870
Renoster River Water User Association	Irrigation	Central	86.592
Total			
% of Total Registered Volume			50%

Table 3.3: Principal schemes

Scheme Name	Cluster	Registered Raw Water Volume (Mm ³ pa)		
		Domestic & Industrial	Irrigation	Total
Vaal Dam	Central	929.7	59.716	989.415
Orange River GWS	Central	21.893	532.926	554.819
Orange - Fish GWS	Southern	4.371	416.71	421.081
Orange River (Upington Islands)	Central	67.036	334.413	401.449
Umgeni River GWS	Eastern	396.156	0.483	396.639
Usutu-Vaal GWS	Central	379.316	-	379.316
Vaalharts Canals	Central	13.308	329.119	342.427
Riversonderend - Berg River GWS	Southern	125.377	154.582	279.959
Tugela Mhlathuze Rivers GWS	Eastern	146.029	95.65	241.679
Lower Sundays Scheme	Southern	59.977	156.284	216.261
Crocodile River West GWS	Northern	90.55	118.358	208.908
Breede River GWS (Brandvlei&Kwaggaskloof Dams)	Southern	2.324	197.408	199.732
Pongola River GWS	Eastern	4.604	162.37	166.974
Groot Letaba River GWS	Northern	46.546	117.29	163.836
Loskop GWS	Northern	28.156	126.803	154.958
Total				5 117.453
% of Total Cluster Registered Volume				57%

3.3 Raw Water Demand versus Asset Management

There needs to be an optimised management of the relationship between raw water demand levels and asset management for the maximisation of service delivery potential and benefits.

- Insight of the Cluster's future raw water demand helps in optimised planning for future upgrade and new capital needs (capital acquisitions), as contemplated in Sections 5 and 6 of the GIAMA.
- The NWRI's future raw water demand determined by the DWS's Planning Office needs to inform the undertaking of upgrades and/or new capital projects, as well as disposals. Put differently, if the raw water demand outlook is expected to be:
 - positive, there needs to be in-time appropriate planning for and execution of upgrades and/or new capital projects so as to ensure the Cluster meets the new levels of service; and
 - negative, there needs to be in-time appropriate planning for and execution of disposals so as to free resources for the upkeep of the Cluster's remaining assets.

3.4 Summary

Total registered volume of raw water for the NWRI is about 8 980.526 Mm³ per annum, of which about 41% is for domestic and industrial use, and about 59% is for irrigation use. It is important that the NWRI pays special attention to the principal schemes as well as the schemes supplying water to the principal customers in its infrastructure asset life cycle works decision making.

Positive raw water demand outlook calls for upgrades and/or new capital projects; whilst negative raw water demand outlook calls for disposals.

The following section covers the immovable asset life cycle works pertinent to sustainably meeting the NWRI's raw water demand levels.

4. ASSET DETAILS, RISK AND LIFE CYCLE WORKS

4.1 Overview

This section begins with an analysis of the immovable asset details (e.g. extent, value, condition, criticality, utilisation, etc.) for the NWRI national operations. It then proceeds to discuss the associated risks, the asset life cycle works backlog, planned works and strategies recommended for the NWRI national operations to effectively and efficiently manage its assets throughout their life cycles in order to meet the levels of service agreed with its water users (see Section 2) and the projected future raw water demand (see Section 3).

4.2 Asset Information

The following subsections highlight the details (extent, value, condition, criticality and utilization) of the NWRI's immovable assets, based on the NWRI's Immovable Asset Register for the 2016/17 financial year (refer to Appendix A).

The DWS Immovable Asset Management Policy (Section 6) and GRAP 17 (Section 11) prescribe the minimum asset register information, including: detail asset description (e.g. sizes, material of construction, etc.), expected useful life (EUL), remaining useful life (RUL), impairments, and disposal (date, proceeds, and depreciation up to date of disposal). Where such information was incomplete in the asset register used in this AMP, the DWS Infrastructure Asset Hierarchy for the 2016/17 financial year, the DWS's Immovable Asset Management Policy, Valuation Guide and the 2016/17 AMPs formed the basis for addressing the shortcoming. For instance:

- EULs were assigned based on the DWS Infrastructure Asset Hierarchy.
- RULs were determined using the age-based approach (and moderated by the condition-based approach).
- Current replacement costs (CRCs) were determined based on unit costing where asset component sizes were available. Where asset component sizes and material of construction were not available in the Asset Register used in the development of this AMP, CRCs were determined by adjusting the provided acquisition costs with Producer Price Index (PPI) and an uncertainty factor, and moderated using the CRCs reported in the 2016/17 AMPs.

4.2.1 Asset Extent and Values

Table 4.1 shows the extent (number of asset components), acquisition cost, CRC, depreciated replacement cost (DRC) and asset carrying values for the NWRI's assets, split among the four clusters and also showing non-cluster specific assets.

Table 4.1: Asset extent, acquisition costs, CRC and values (cluster- and non-cluster-specific)

Cluster	Asset Group	No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC (%)
Northern Cluster	Infrastructure	9 498	13 838.230	10 555.765	56 201.648	25 149.309	45%
	Land	359	1 019.943	1 006.180	2 997.671	2 997.671	100%
	Sub-total	9 857	14 858.173	11 561.946	59 199.319	28 146.980	48%
Eastern Cluster	Infrastructure	2 538	6 197.622	5 117.818	18 397.135	9 864.668	54%
	Land	82	781.682	779.989	2 297.422	2 297.422	100%
	Sub-total	2 620	6 979.304	5 897.806	20 694.557	12 162.089	59%
Southern Cluster	Infrastructure	7 083	19 256.763	14 059.167	60 662.800	30 918.398	51%
	Land	451	1 339.864	1 208.206	3 876.020	3 876.020	100%
	Sub-total	7 534	20 596.627	15 267.372	64 538.820	34 794.418	54%
Central Cluster	Infrastructure	13 826	33 775.658	24 437.301	126 678.602	55 507.201	44%
	Land	279	4 649.395	4 551.348	13 599.840	13 599.840	100%
	Sub-total	14 105	38 425.053	28 988.649	140 278.442	69 107.041	49%
Non-Cluster-Specific	Infrastructure	49	53.295	42.684	94.581	59.264	63%
	Land	-	-	-	-	-	-
	Sub-total	49	53.295	42.684	94.581	59.264	63%
National	Infrastructure	32 994	73 121.568	54 212.735	262 034.766	121 498.840	46%
	Land	1 171	7 790.884	7 545.723	22 770.953	22 770.952	100%
	Total	34 165	80 912.452	61 758.458	284 805.719	144 269.792	51%

Table 4.2 shows the extent (number of asset components), acquisition cost, CRC, DRC and asset carrying values for the NWRI's assets per asset facility category. Appendix E, Tables E.01A and E.01B show the split per asset facility category and per engineering discipline (civil, electrical and mechanical), and summary per engineering discipline, respectively.

Table 4.2: Asset extent, acquisition costs, CRC and values (per facility category)

Asset Facility Category	Facilities		No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
	Unit	Quantity						
Borehole	No.	43	43	19.923	10.523	58.556	19.000	32%
Buildings	No.	3 933	4 879	1 761.082	871.243	4 235.271	1 592.139	38%
Canals	km	9 208	11 431	11 860.955	7 109.010	78 969.732	28 059.826	36%
Dams	No.	369	8 072	36 975.918	30 401.802	113 533.828	60 788.046	54%
Measuring facilities	No.	3 094	3 381	3 252.266	2 072.957	9 532.959	4 211.565	44%
Pipelines	km	1 423	1 115	7 649.159	5 597.127	20 597.407	8 667.864	42%
Power supply	No.	100	145	68.431	33.673	197.214	89.114	45%
Pump stations	No.	81	3 159	2 008.554	1 235.291	7 215.852	3 790.498	53%
Reservoirs	No.	109	147	354.309	262.954	973.215	460.164	47%
Roads	km	553	171	176.804	148.249	1 171.352	568.415	49%
Telemetry	No.	35	43	39.662	12.829	85.895	46.470	54%
Tunnels	km	138	327	8 908.186	6 429.663	25 333.619	13 157.882	52%
Water Treatment	No.	80	81	46.318	27.412	129.868	48.202	37%
Sub-total Infrastructure			32 994	73 121.568	54 212.734	262 034.767	121 498.840	46%
Land - owned land	Ha		335	6 715.958	6 472.176	19 738.578	19 738.578	100%
Land - servitudes	Ha		836	1 074.926	1 073.547	3 032.374	3 032.374	100%
Sub-total Land			1 171	7 790.884	7 545.723	22 770.952	22 770.952	100%
Total			34 165	80 912.452	61 758.457	284 805.719	144 269.792	51%

The Asset Register used in the development of this AMP did not have sizes on some of the asset components, as such some of the quantities and sizes recorded in Table 4.2 are a fraction of the entire portfolio.

As shown in Table 4.2, the NWRI has an immovable asset base consisting of 34 165 asset components: 32 994 *infrastructure* and 1 171 *land* related asset components. The NWRI's immovable asset components have a total DRC and CRC of about R144.270 billion and about R284.806 billion, respectively. They can be grouped into two: *infrastructure* asset components (with total DRC and CRC of about R121.499 billion and about R262.035 billion, respectively); and *land* (with a total of about R22.771 billion for both DRC and CRC). The DRC/CRC ratio for infrastructure asset components is about 46%, indicating that about 54% of the infrastructure asset base has been consumed so far.

For infrastructure assets (see Table 4.2), dams-related asset components have the highest CRC of about R113.534 billion, followed by canals, tunnels and pipelines related asset components with total CRCs of about R78.970 billion, R25.334 billion and R20.597 billion, respectively.

Appendix E, Table E.02A to E.02D show the extent (number of asset components), acquisition cost, CRC, DRC and asset carrying values per asset facility category (similar to Table 4.2) for

the immovable assets for each of the four clusters (Northern, Eastern, Southern and Central, respectively) making up the NWRI.

Figure 4.1 shows the proportional distribution of the NWRI's asset components per asset facility category. The majority of the NWRI's asset components are canals, dams, buildings, measuring facilities and pump stations related (about 33%, 23%, 14%, 10% and 9%, respectively).

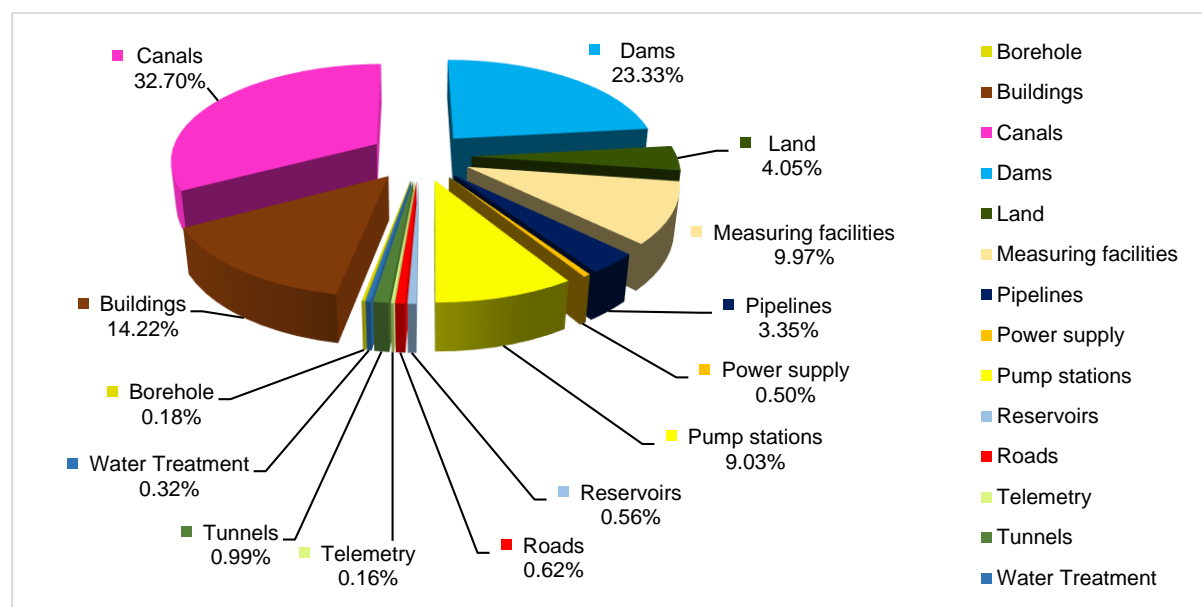


Figure 4.1: Asset components proportions per asset facility category

Figures 4.2 and 4.3 show the associated proportions of the DRC and CRC per asset facility category, respectively.

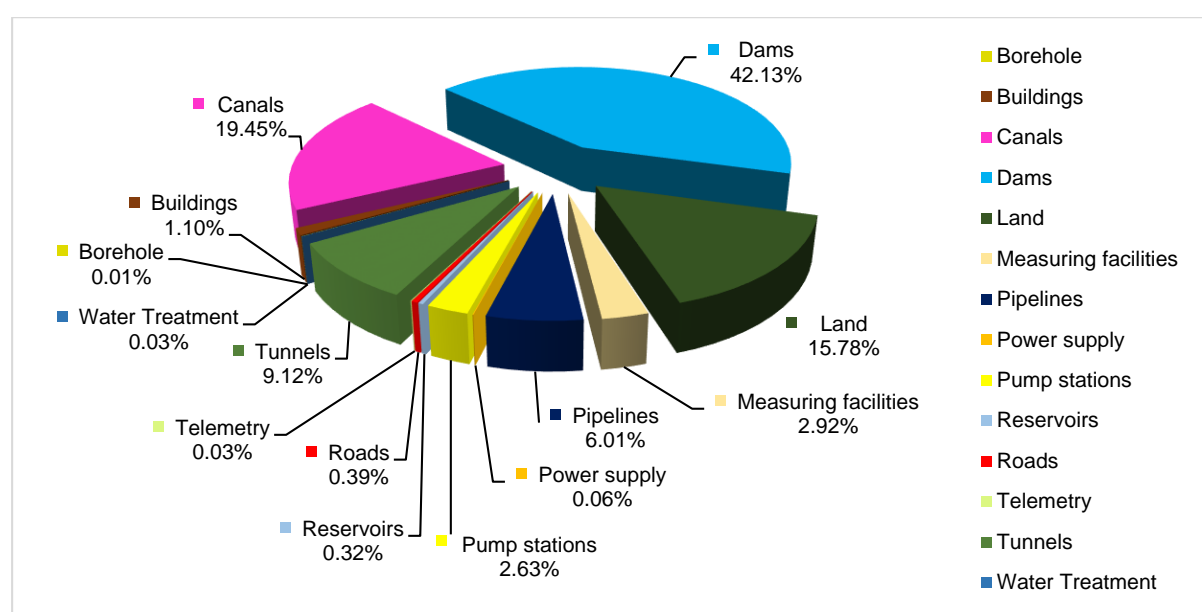


Figure 4.2: DRC proportions per asset facility category

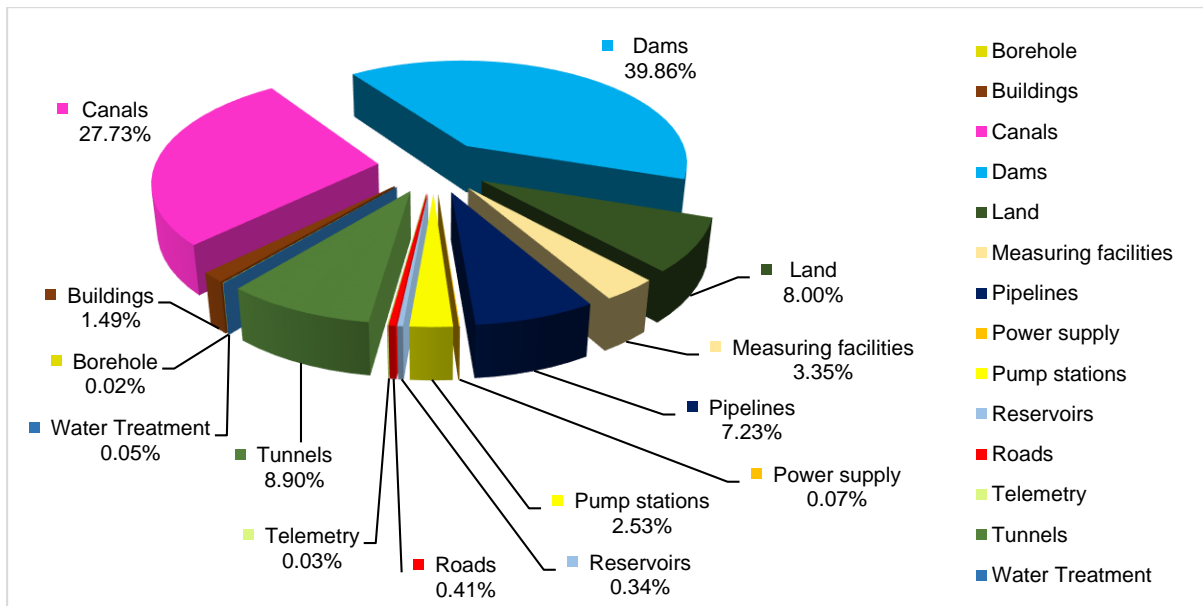


Figure 4.3: CRC proportions per asset facility category

4.2.2 Asset Condition and RUL/EUL Ratio

Table 4.2 shows the asset condition grading criteria as well as the link between the condition grading and the RUL/EUL ratio range.

Table 4.3: Linking asset condition grades to RUL/EUL ratio range

Condition Grade	Description	Detailed Description	Indicative RUL/EUL
5	Very good	Sound structure, well maintained. Only normal maintenance required.	71 - 100%
4	Good	Serves needs but minor deterioration (< 5%). Minor maintenance required.	46 - 70%
3	Fair	Marginal, clearly evident deterioration (10-20%). Significant maintenance required.	26 - 45%
2	Poor	Significant deterioration of structure and/or appearance. Significant impairment of functionality (20-40%). Significant renewal/upgrade required.	11 - 25%
1	Very poor	Unsound, failed, needs reconstruction/ replacement (> 50% needs replacement).	0 - 10%
0	Not Working	Unsound, failed, needs reconstruction/ replacement (100% needs replacement).	0%

Source: Adapted from DWS Immovable Asset Management Policy (2015)

Asset Condition

Table 4.4 and Figure 4.4 show the number of infrastructure asset components and their proportion per condition grading and per asset facility category for the NWRI. Appendix E, Table E.1A (an expanded version of Table 4.4) shows the split per engineering discipline.

- About 75% of the NWRI's infrastructure asset components are in fair, good and good conditions. These include: buildings (68%); canals (75%); dams (79%); measuring facilities (60%); pipelines (82%); pump stations (84%); and tunnels (97%) related asset components. All these asset components require appropriate maintenance to prevent them from deteriorating to poor and very poor condition.
- On the other hand, about 25% of the NWRI's infrastructure asset components have deteriorated to poor and very poor conditions. These include: buildings (32%); canals (25%); dams (21%); measuring facilities (40%); pipelines (18%); and pump stations (16%) related asset components. These asset components need to be appropriately renewed to ensure they continue delivering the required service.

Table 4.4: Asset component counts and proportions per condition grading and per asset facility category

Asset Facility Category	Condition Grading										Total	
	1-Very Poor		2-Poor		3-Fair		4-Good		5-Very Good			
	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	7	16.28%	17	39.53%	9	20.93%	9	20.93%	1	2.33%	43	100.00%
Buildings	436	8.94%	1 103	22.61%	2 201	45.11%	1 003	20.56%	136	2.79%	4 879	100.00%
Canals	300	2.62%	2 550	22.31%	5 976	52.28%	2 492	21.80%	113	0.99%	11 431	100.00%
Dams	280	3.47%	1 446	17.91%	2 875	35.62%	3 064	37.96%	407	5.04%	8 072	100.00%
Measuring facilities	38	1.12%	1 309	38.72%	1 273	37.65%	688	20.35%	73	2.16%	3 381	100.00%
Pipelines	28	2.51%	174	15.61%	612	54.89%	231	20.72%	70	6.28%	1 115	100.00%
Power supply	19	13.10%	15	10.34%	44	30.34%	61	42.07%	6	4.14%	145	100.00%
Pump stations	251	7.95%	247	7.82%	1 111	35.17%	1 146	36.28%	404	12.79%	3 159	100.00%
Reservoirs	7	4.76%	8	5.44%	80	54.42%	47	31.97%	5	3.40%	147	100.00%
Roads	2	1.17%	38	22.22%	60	35.09%	54	31.58%	17	9.94%	171	100.00%
Telemetry	-	-	-	-	19	44.19%	24	55.81%	-	-	43	100.00%
Tunnels	2	0.61%	7	2.14%	192	58.72%	97	29.66%	29	8.87%	327	100.00%
Water Treatment	5	6.17%	21	25.93%	37	45.68%	17	20.99%	1	1.23%	81	100.00%
All Scheme asset components	1 375	4.17%	6 935	21.02%	14 489	43.91%	8 933	27.07%	1 262	3.82%	32 994	100.00%

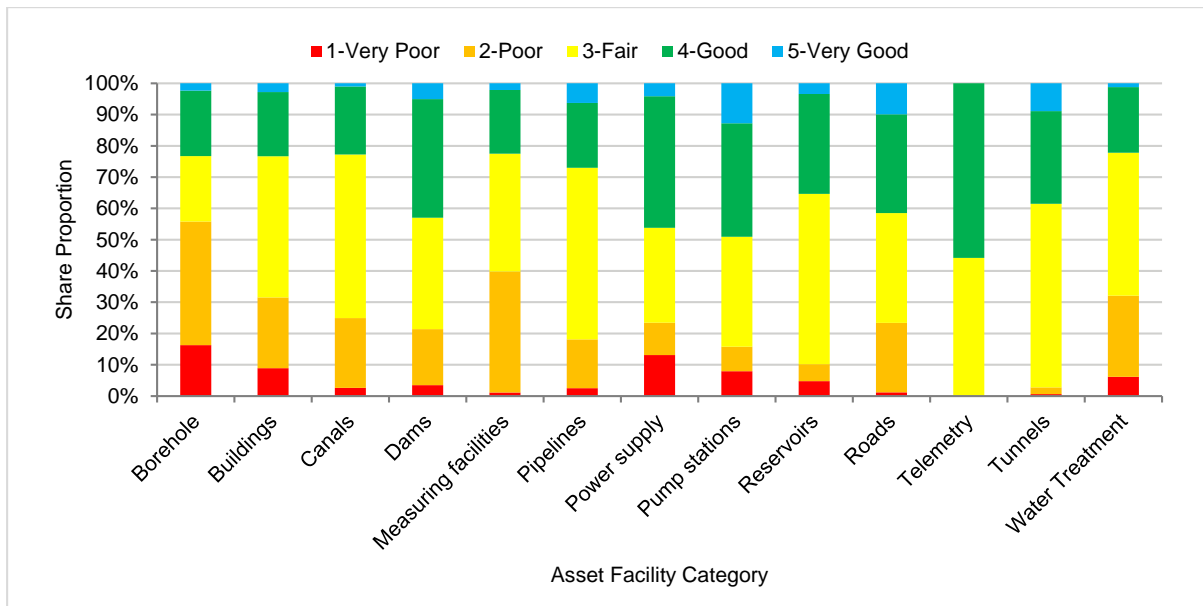


Figure 4.4: Asset component proportions per condition grading and per asset facility category

Figure 4.5 presents the overall condition grading of the NWRI's asset components indicating that, as also shown in Table 4.4: about 75% of the NWRI's infrastructure asset components are in fair, good and good conditions; while about 25% are in poor and very poor conditions.

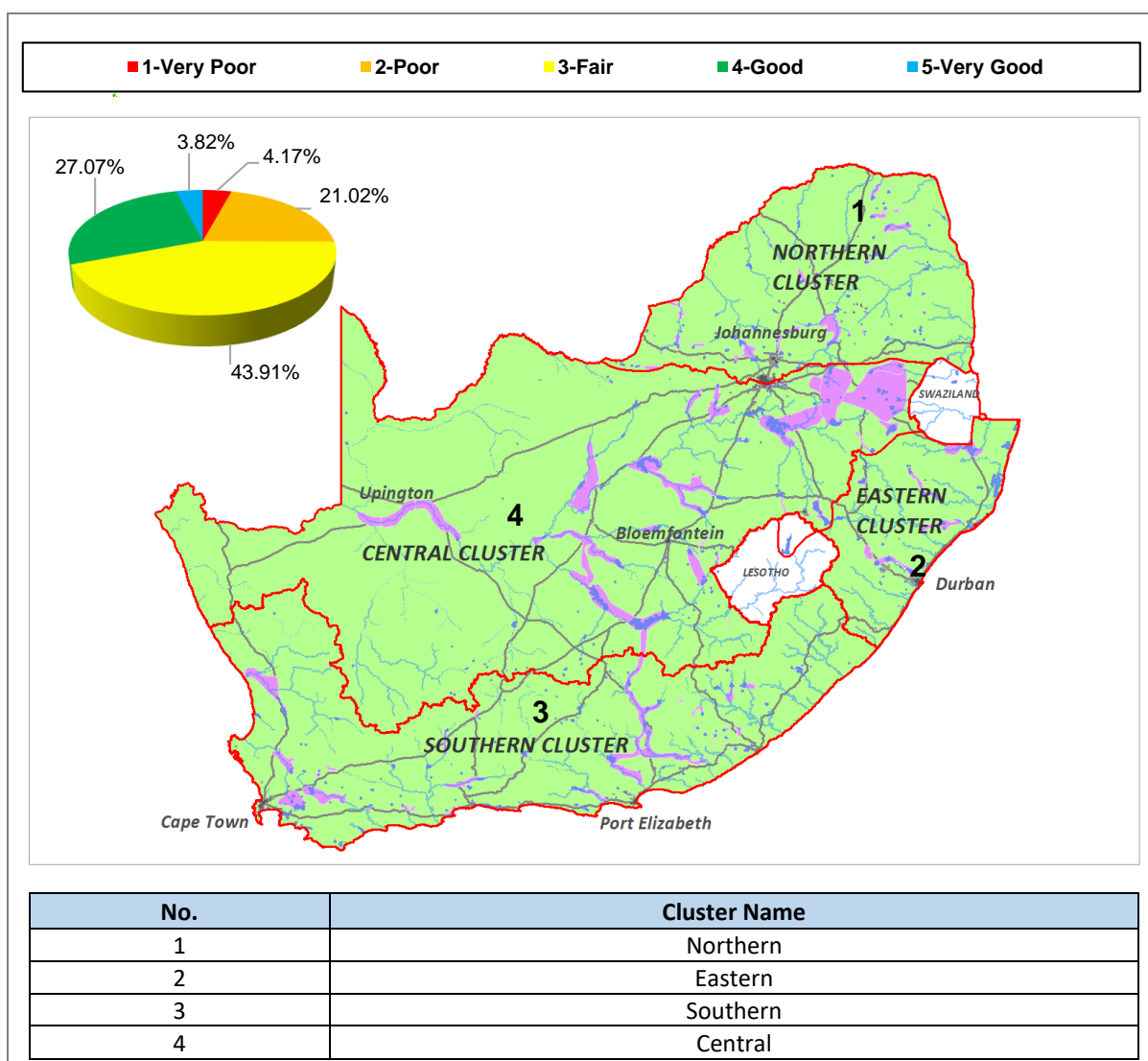


Figure 4.5: Asset component proportions per condition grading map

Table 4.5 and Figure 4.6 present the CRCs of the NWRI's infrastructure asset components per condition grading and per asset facility category. Appendix E, Table E.1B (an expanded version of Table 4.5) shows the split per engineering discipline.

Asset components that are in fair, good and very good conditions (representing about 75% of all the NWRI's infrastructure asset components, as shown in Table 4.4 and Figures 4.4 and 4.5) have a total CRC of about R227.395 billion; the main contributions coming from:

- dams-related asset components (representing about 79% of all dams-related asset components, as shown in Table 4.4 and Figure 4.4) with a total CRC of about R108.741 billion;
- canals-related asset components (representing about 75% of all canals-related asset components, as shown in Table 4.4 and Figure 4.4) with a total CRC of about R56.638 billion; and

- tunnels-related asset components (representing about 97% of all tunnels-related asset components, as shown in Table 4.4 and Figure 4.4) with a total CRC of about R25.318 billion.

On the other hand, asset components that are in poor and very poor condition (representing about 25% of all the NWRI's infrastructure asset components, as shown in Table 4.3 and Figure 4.4) have a total CRC of about R34.640 billion; the main contribution coming from:

- canals-related asset components (representing about 25% of all canals-related asset components, as shown in Table 4.4 and Figure 4.4) with a total CRC of about R22.332 billion;
- dams-related asset components (representing about 21% of all dams-related asset components, as shown in Table 4.4 and Figure 4.4) with a total CRC of about R4.793 billion; and
- pipelines-related asset components (representing about 18% of all pipelines-related asset components, as shown in Table 4.4 and Figure 4.4) with a total CRC of about R3.839 billion.

Table 4.5: CRC per condition grading and per asset facility category

Asset Facility Category	Condition Grading vs CRC (R Million)					Total	% of Total CRC
	1-Very Poor	2-Poor	3-Fair	4-Good	5-Very Good		
Borehole	8.631	20.620	12.509	15.597	1.199	58.556	0.02%
Buildings	332.429	868.505	1 774.684	1 054.061	205.591	4 235.271	1.62%
Canals	2 347.611	19 984.243	39 922.356	15 097.954	1 617.568	78 969.732	30.14%
Dams	590.129	4 202.608	24 385.076	74 909.017	9 446.998	113 533.828	43.33%
Measuring facilities	160.476	1 465.371	3 844.152	3 278.877	784.082	9 532.959	3.64%
Pipelines	420.145	3 419.217	8 004.655	8 154.968	598.422	20 597.407	7.86%
Power supply	22.110	19.978	33.735	114.215	7.176	197.214	0.08%
Pump stations	213.321	299.144	2 195.701	3 319.391	1 188.295	7 215.852	2.75%
Reservoirs	1.563	2.008	589.585	271.012	109.046	973.215	0.37%
Roads	13.925	200.498	284.108	546.150	126.671	1 171.352	0.45%
Telemetry	0.000	0.000	14.885	71.010	0.000	85.895	0.03%
Tunnels	0.968	14.968	12 879.102	7 463.491	4 975.089	25 333.619	9.67%
Water Treatment	8.440	23.312	55.531	36.109	6.476	129.868	0.05%
Total	4 119.748	30 520.473	93 996.079	114 331.852	19 066.615	262 034.767	100.00%
% of Total CRC	1.57%	11.65%	35.87%	43.63%	7.28%	100.00%	

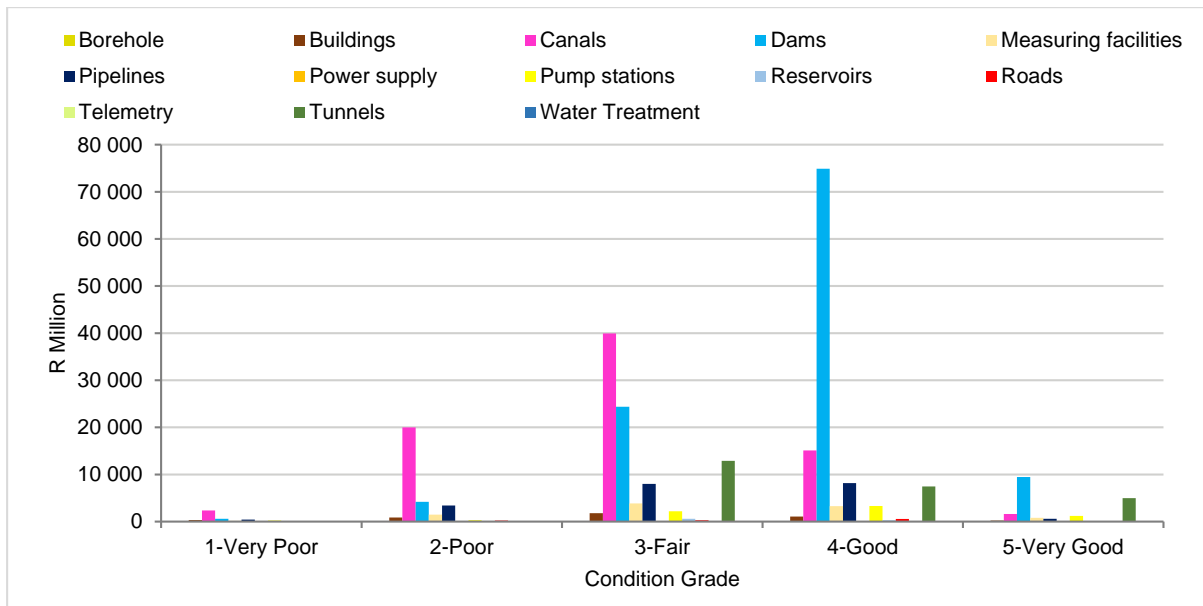


Figure 4.6: CRC per condition grading and per asset facility category

Asset RUL/EUL ratio

Table 4.6 and Figure 4.7 show the number of infrastructure asset components and their proportions per RUL/EUL ratio range and per asset facility category for the NWRI. Appendix E, Table E.2A (an expanded version of Table 4.6) shows the split per engineering discipline.

- About 75% of the NWRI's infrastructure asset components have RUL/EUL ratios in the 26% to 100% range. These include: buildings (68%); canals (75%); dams (79%); measuring facilities (60%); pipelines (82%); pump stations (84%); and tunnels (97%) related asset components. All these asset components require appropriate maintenance to ensure they continue to meet the required service.
- On the other hand, about 25% of the NWRI's infrastructure asset components have RUL/EUL ratios of 25% and below. These include: buildings (32%); canals (25%); dams (21%); measuring facilities (40%); pipelines (18%); and pump stations (16%) related asset components. The RUL/EUL ratios of 25% and below mean that these asset components are nearing the end of their EULs; calling for appropriate asset component renewal to extend their useful lives.

Table 4.6: Asset component counts and proportions per RUL/EUL ratio and per asset facility category

Asset Facility Category	RUL / EUL Ratio										Total	
	0-10%		11-25%		26-45%		46-70%		71-100%			
	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	7	16.28%	17	39.53%	9	20.93%	9	20.93%	1	2.33%	43	100.00%
Buildings	436	8.94%	1 103	22.61%	2 201	45.11%	1 003	20.56%	136	2.79%	4 879	100.00%
Canals	300	2.62%	2 550	22.31%	5 976	52.28%	2 492	21.80%	113	0.99%	11 431	100.00%
Dams	280	3.47%	1 446	17.91%	2 875	35.62%	3 064	37.96%	407	5.04%	8 072	100.00%
Measuring facilities	38	1.12%	1 309	38.72%	1 273	37.65%	688	20.35%	73	2.16%	3 381	100.00%
Pipelines	28	2.51%	174	15.61%	612	54.89%	231	20.72%	70	6.28%	1 115	100.00%
Power supply	19	13.10%	15	10.34%	44	30.34%	61	42.07%	6	4.14%	145	100.00%
Pump stations	251	7.95%	247	7.82%	1 111	35.17%	1 146	36.28%	404	12.79%	3 159	100.00%
Reservoirs	7	4.76%	8	5.44%	80	54.42%	47	31.97%	5	3.40%	147	100.00%
Roads	2	1.17%	38	22.22%	60	35.09%	54	31.58%	17	9.94%	171	100.00%
Telemetry	-	-	-	-	19	44.19%	24	55.81%	-	-	43	100.00%
Tunnels	2	0.61%	7	2.14%	192	58.72%	97	29.66%	29	8.87%	327	100.00%
Water Treatment	5	6.17%	21	25.93%	37	45.68%	17	20.99%	1	1.23%	81	100.00%
All Scheme asset components	1 375	4.17%	6 935	21.02%	14 489	43.91%	8 933	27.07%	1 262	3.82%	32 994	100.00%

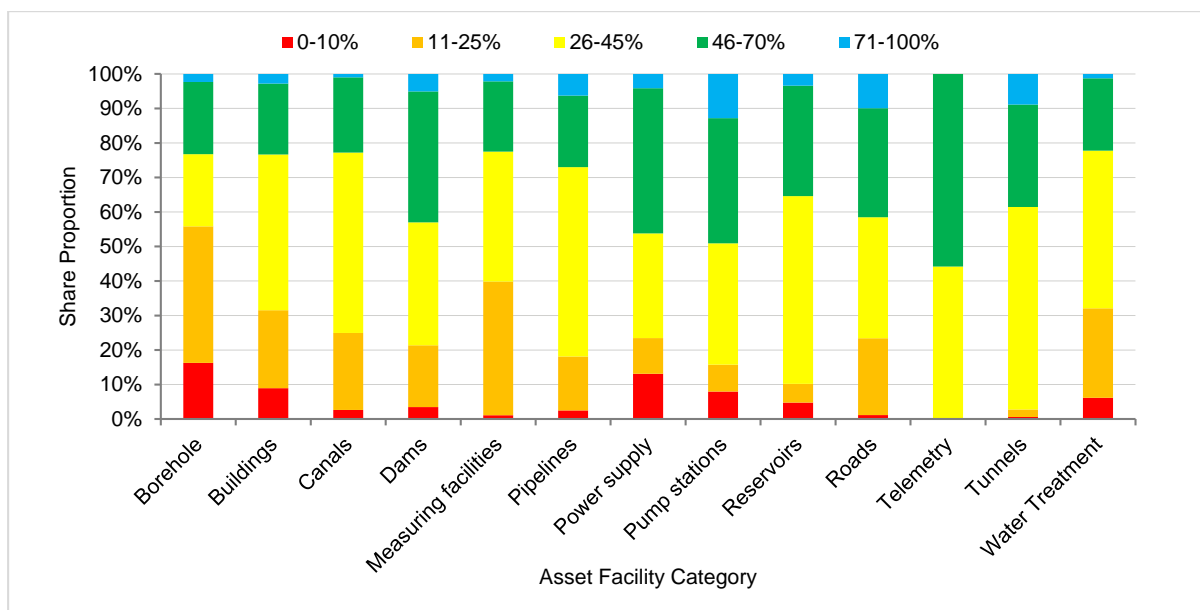


Figure 4.7: Asset component proportions per RUL/EUL ratio and per asset facility category

Table 4.7 and Figure 4.8 present the CRCs of the NWRI's infrastructure asset components per RUL/EUL ratio range and per asset facility category. Appendix E, Table E.2B (an expanded version of Table 4.7) shows the split per engineering discipline.

Asset components with RUL/EUL ratios in the range 26% to 100% (representing about 75% of all the NWRI's infrastructure asset components, as shown in Table 4.6 and Figure 4.7) have a total CRC of about R227.395 billion; the main contributions coming from:

- dams-related asset components (representing about 79% of all dams-related asset components, as shown in Table 4.6 and Figure 4.7) with a total CRC of about R108.741 billion;
- canals-related asset components (representing about 75% of all canals-related asset components, as shown in Table 4.6 and Figure 4.7) with a total CRC of about R56.638 billion; and
- tunnels-related asset components (representing about 97% of all tunnels-related asset components, as shown in Table 4.6 and Figure 4.7) with a total CRC of about R25.318 billion.

On the other hand, asset components with RUL/EUL ratios of 25% and below (representing about 25% of all the NWRI's infrastructure asset components, as shown in Table 4.6 and Figure 4.7) have a total CRC of about R34.640 billion; the main contribution coming from:

- canals-related asset components (representing about 25% of all canals-related asset components, as shown in Table 4.6 and Figure 4.7) with a total CRC of about R22.332 billion.

billion;

- dams-related asset components (representing about 21% of all dams-related asset components, as shown in Table 4.6 and Figure 4.7) with a total CRC of about R4.793 billion; and
- pipelines-related asset components (representing about 18% of all pipelines-related asset components, as shown in Table 4.6 and Figure 4.7) with a total CRC of about R3.839 billion.

Table 4.7: CRC per RUL/EUL ratio and per asset facility category

Asset Facility Category	RUL / EUL Ratio vs CRC (R Million)					Total	% of Total CRC
	0-10%	11-25%	26-45%	46-70%	71-100%		
Borehole	8.631	20.620	12.509	15.597	1.199	58.556	0.02%
Buildings	332.429	868.505	1 774.684	1 054.061	205.591	4 235.271	1.62%
Canals	2 347.611	19 984.243	39 922.356	15 097.954	1 617.568	78 969.732	30.14%
Dams	590.129	4 202.608	24 385.076	74 909.017	9 446.998	113 533.828	43.33%
Measuring facilities	160.476	1 465.371	3 844.152	3 278.877	784.082	9 532.959	3.64%
Pipelines	420.145	3 419.217	8 004.655	8 154.968	598.422	20 597.407	7.86%
Power supply	22.110	19.978	33.735	114.215	7.176	197.214	0.08%
Pump stations	213.321	299.144	2 195.701	3 319.391	1 188.295	7 215.852	2.75%
Reservoirs	1.563	2.008	589.585	271.012	109.046	973.215	0.37%
Roads	13.925	200.498	284.108	546.150	126.671	1 171.352	0.45%
Telemetry	-	-	14.885	71.010	-	85.895	0.03%
Tunnels	0.968	14.968	12 879.102	7 463.491	4 975.089	25 333.619	9.67%
Water Treatment	8.440	23.312	55.531	36.109	6.476	129.868	0.05%
Total	4 119.748	30 520.473	93 996.079	114 331.852	19 066.615	262 034.767	100.00%
% of Total CRC	1.57%	11.65%	35.87%	43.63%	7.28%	100.00%	

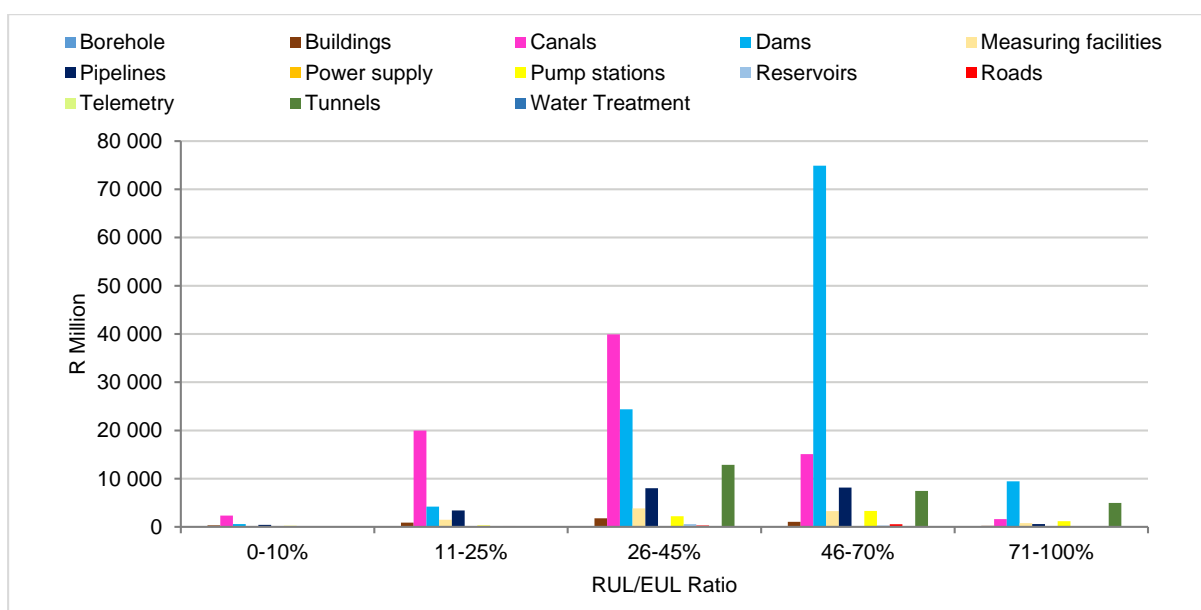


Figure 4.8: CRC per RUL/EUL ratio and per asset facility category

4.2.3 Asset Criticality

In this AMP, asset components are graded in terms of criticality according to the criteria listed in Table 4.8.

Table 4.8: Asset criticality grading criteria

Grade	Criticality Description	Consequence of Failure (Impact)	Qualitative Description
1	Very Low	Insignificant	Is readily absorbed under normal operating conditions.
2	Low	Minor	Can be managed under normal operating conditions.
3	Moderate	Moderate	Can be managed but requires additional resources and management effort.
4	High	Major	Will have a prolonged impact and extensive consequences.
5	Very High	Catastrophic	Irreversible and extensive impacts, or will significantly undermine business objectives.

Table 4.9 and Figure 4.9 show the number of infrastructure asset components and their proportion per criticality grading and per asset facility category for the NWRI. Appendix E, Table E.3A (an expanded version of Table 4.9) shows the split per engineering discipline.

- About 77% of the NWRI's infrastructure asset components are in the high and very high criticality grades. These include: dams (74%); canals (91%); pipelines (86%); power supply (74%); pump stations (72%); and tunnels (94%) related asset components. In the event of failure, these asset components will cause a major to catastrophic impact on the NWRI's ability to meet the required levels of service. Thus, these assets require appropriate maintenance and renewal to ensure they continue delivering the required service.
- On the other hand, about 23% of the NWRI's infrastructure asset components are in the moderate, low and very low criticality grades. These include: buildings (30%); canals (9%); dams (26%); measuring facilities (46%); reservoirs (33%); roads (85%); and water treatment (93%) related asset components. In the event of failure, these asset components will cause a moderate to insignificant impact on the NWRI's ability to meet the required levels of service.

Table 4.9: Asset component counts and proportions per Criticality grading and per asset facility category

Asset Facility Category	Criticality Grading										Total	
	1-Very Low		2-Low		3-Moderate		4-High		5-Very High			
	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	2	4.65%	15	34.88%	26	60.47%	-	-	-	-	43	100.00%
Buildings	623	12.77%	864	17.71%	2 868	58.78%	521	10.68%	3	0.06%	4 879	100.00%
Canals	264	2.31%	793	6.94%	9 768	85.45%	498	4.36%	108	0.94%	11 431	100.00%
Dams	81	1.00%	2 052	25.42%	1 533	18.99%	3 701	45.85%	705	8.73%	8 072	100.00%
Measuring facilities	839	24.82%	703	20.79%	1 545	45.70%	293	8.67%	1	0.03%	3 381	100.00%
Pipelines	5	0.45%	155	13.90%	483	43.32%	131	11.75%	341	30.58%	1 115	100.00%
Power supply	1	0.69%	36	24.83%	42	28.97%	49	33.79%	17	11.72%	145	100.00%
Pump stations	4	0.13%	872	27.60%	726	22.98%	854	27.03%	703	22.25%	3 159	100.00%
Reservoirs	-	-	48	32.65%	87	59.18%	1	0.68%	11	7.48%	147	100.00%
Roads	128	74.85%	18	10.53%	18	10.53%	4	2.34%	3	1.75%	171	100.00%
Telemetry	-	-	12	27.91%	21	48.84%	10	23.26%	-	-	43	100.00%
Tunnels	5	1.53%	15	4.59%	75	22.94%	95	29.05%	137	41.90%	327	100.00%
Water Treatment	1	1.23%	74	91.36%	4	4.94%	2	2.47%	-	-	81	100.00%
All Scheme asset components	1 953	5.92%	5 657	17.15%	17 196	52.12%	6 159	18.67%	2 029	6.15%	32 994	100.00%

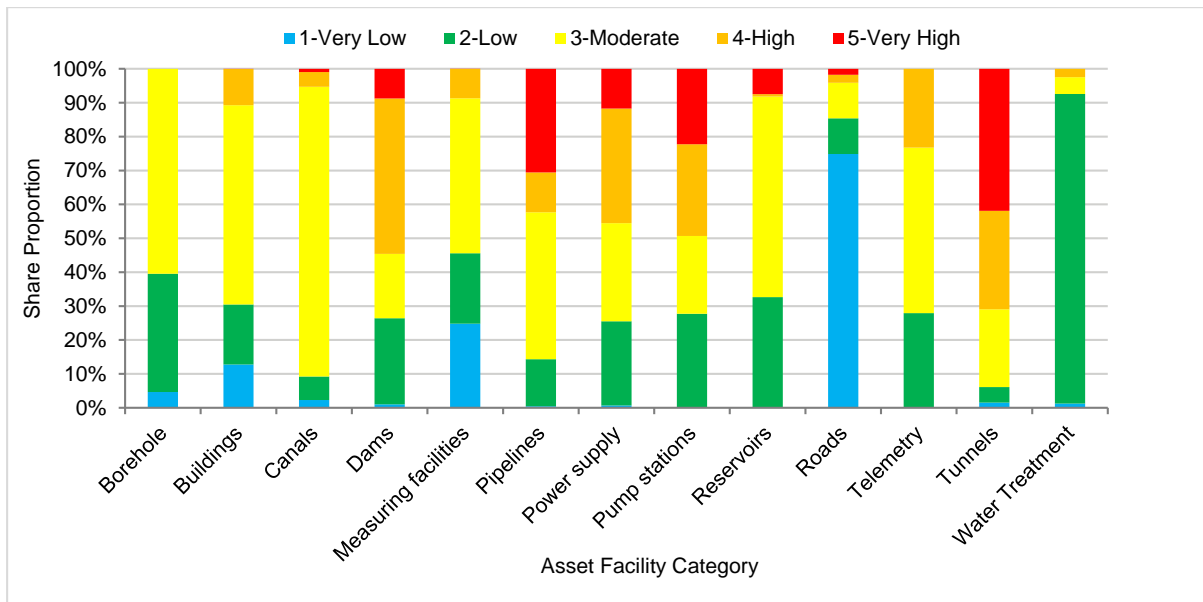


Figure 4.9: Asset component proportions per Criticality grading and per asset facility category

Figure 4.10 presents the overall criticality grading of the NWRI's infrastructure asset components indicating that, as also shown in Table 4.9: about 77% of the NWRI's infrastructure asset components are in high and very high criticality grading; while about 23% are in the moderate, low and very low criticality grading.

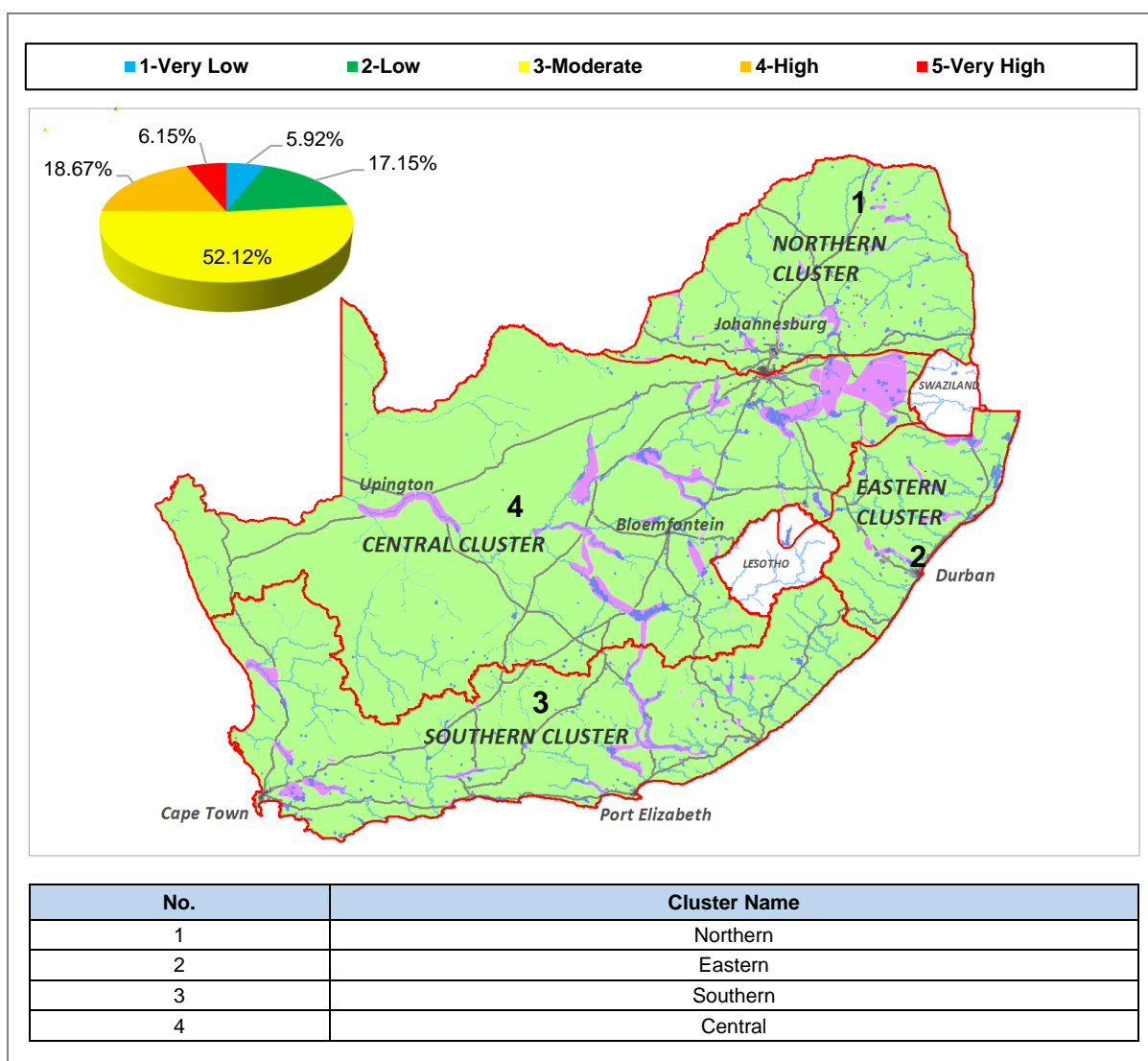


Figure 4.10: Asset component proportions per criticality grading map

Table 4.10 and Figure 4.11 show the CRCs of the NWRI's infrastructure asset components per criticality grading and per asset facility category. Appendix E, Table E.3B (an expanded version of Table 4.10) shows the split per engineering discipline.

Asset components that are of high and very high criticality (representing about 77% of all the NWRI's infrastructure asset components, as shown in Table 4.9 and Figures 4.9 and 4.10) have a total CRC of about R212.784 billion, with the main contributions coming from:

- dams related asset components (representing about 74% of all dams related asset components, as shown in Table 4.9 and Figure 4.9) with a total CRC of about R78.746 billion;
- canals related asset components (representing about 91% of all canals related asset components, as shown in Table 4.9 and Figure 4.9), with a total CRC of about R75.064 billion;

- tunnels related asset components (representing about 94% of all tunnels related asset components, as shown in Table 4.9 and Figure 4.9) with a total CRC of about R25.246 billion; and
- pipelines related asset components (representing about 86% of all pipelines related asset components, as shown in Table 4.9 and Figure 4.9) with a total CRC of about R19.999 billion.

On the other hand, asset components that are of moderate, low and very low criticality (representing about 23% of all the NWRI's infrastructure asset components, as shown in Table 4.9 and Figure 4.9) have a total CRC of about R49.251 billion, with the main contributions coming from:

- dams related asset components (representing about 26% of all dams related asset components, as shown in Table 4.9 and Figure 4.9) with a total CRC of about R34.787 billion;
- measuring facilities asset components (representing about 46% of all measuring facilities related asset components, as shown in Table 4.9 and Figure 4.9) with a total CRC of about R5.430 billion; and
- canals related asset components (representing about 9% of all canals related asset components, as shown in Table 4.9 and Figure 4.9) with a total CRC of about R3.906 billion.

Table 4.10: CRC per Criticality grading and per asset facility category

Asset Facility Category	Criticality Grading vs CRC (R Million)					Total	% of Total CRC
	1-Very Low	2-Low	3-Moderate	4-High	5-Very High		
Borehole	2.100	18.680	37.775	-	-	58.556	0.02%
Buildings	488.971	888.367	2 147.092	710.261	0.581	4 235.271	1.62%
Canals	979.268	2 926.806	72 885.187	2 125.627	52.844	78 969.732	30.14%
Dams	204.720	34 582.706	8 943.805	46 822.579	22 980.017	113 533.828	43.33%
Measuring facilities	1 272.768	4 157.343	2 069.283	1 989.719	43.846	9 532.959	3.64%
Pipelines	42.310	556.561	10 460.367	872.179	8 665.990	20 597.407	7.86%
Power supply	0.505	18.361	90.763	73.282	14.302	197.214	0.08%
Pump stations	0.809	1 777.759	1 539.222	2 160.186	1 737.875	7 215.852	2.75%
Reservoirs	-	103.521	461.297	0.225	408.172	973.215	0.37%
Roads	915.506	110.013	72.268	37.627	35.937	1 171.352	0.45%
Telemetry	-	10.464	62.177	13.254	-	85.895	0.03%
Tunnels	16.025	71.995	4 760.758	2 471.930	18 012.910	25 333.619	9.67%
Water Treatment	0.141	105.418	14.349	9.960	-	129.868	0.05%
Total	3 923.124	45 327.994	103 544.344	57 286.830	51 952.475	262 034.767	100.00%
% of Total CRC	1.50%	17.30%	39.52%	21.86%	19.83%	100.00%	

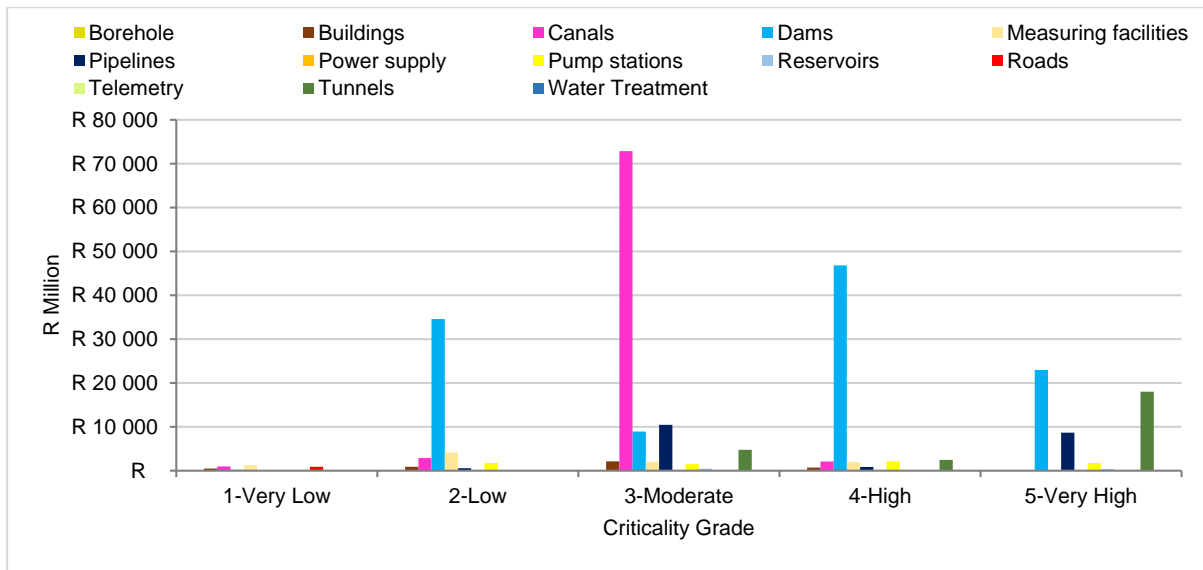


Figure 4.11: CRC per Criticality grading and per asset facility category

4.2.4 Asset Utilization

Assets are graded in terms of utilisation according to the criteria listed in Table 4.11.

Table 4.11: Asset utilisation grading criteria

Grade	Utilisation Description
0	Not in use
1	Strategic redundancy
2	Under-utilised
3	Moderate use
4	Approaching design capacity
5	Exceeding capacity/stressed

Table 4.12 and Figure 4.12 show the number of infrastructure asset components and their proportion per asset utilisation grading and per asset facility category for the NWRI. Appendix E, Table E.4A (an expanded version of Table 4.12) shows the split per engineering discipline.

- About 6% of the NWRI's infrastructure asset components are under-utilised. They include: buildings (5%); canals (about 7%); dams (about 8%); and roads (about 64%) related asset components. It is recommended that the NWRI revisits the utilisation grading (captured in the Asset Register) of these asset components as they may be including some asset components belonging to the "Not in use" utilisation grading. The confirmed under-utilised asset components could be candidates for disposal. However, before any disposal could take place, the reasons for the under-utilisation need to be assessed and consideration made for decommissioning and disposal, where necessary.

- About 68% of NWRI's infrastructure asset components are 'approaching design capacity' in utilisation. These asset components require continual monitoring and planning to avoid exceeding design capacity.
- About 3% of the NWRI's infrastructure asset components are exceeding design capacity. They include: canals (1.5%); dams (7%); pipelines (2%); and pump stations (about 5%) related asset components. These asset components need to be upgraded to avoid stress related failures, and to ensure the NWRI meets the required level of service.

Table 4.12: Asset component counts and proportions per Utilisation grading and per asset facility category

Asset Facility Category	Utilisation Grading										Total	
	1-Strategic redundancy		2-Under-utilised		3-Moderate use		4-Approaching design capacity		5-Exceeding capacity/stressed			
	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	-	-	1	2.33%	9	20.93%	32	74.42%	1	2.33%	43	100.00%
Buildings	38	0.78%	226	4.63%	1 226	25.13%	3 389	69.46%	-	-	4 879	100.00%
Canals	185	1.62%	825	7.22%	1 887	16.51%	8 368	73.20%	166	1.45%	11 431	100.00%
Dams	10	0.12%	640	7.93%	1 164	14.42%	5 663	70.16%	595	7.37%	8 072	100.00%
Measuring facilities	-	-	36	1.06%	608	17.98%	2 735	80.89%	2	0.06%	3 381	100.00%
Pipelines	2	0.18%	89	7.98%	381	34.17%	617	55.34%	26	2.33%	1 115	100.00%
Power supply	-	-	6	4.14%	58	40.00%	80	55.17%	1	0.69%	145	100.00%
Pump stations	108	3.42%	21	0.66%	1 632	51.66%	1 254	39.70%	144	4.56%	3 159	100.00%
Reservoirs	-	-	44	29.93%	17	11.56%	86	58.50%	-	-	147	100.00%
Roads	-	-	109	63.74%	47	27.49%	15	8.77%	-	-	171	100.00%
Telemetry	-	-	16	37.21%	6	13.95%	21	48.84%	-	-	43	100.00%
Tunnels	-	-	-	-	182	55.66%	143	43.73%	2	0.61%	327	100.00%
Water Treatment	-	-	12	14.81%	17	20.99%	48	59.26%	4	4.94%	81	100.00%
All Scheme asset components	343	1.04%	2 025	6.14%	7 234	21.93%	22 451	68.05%	941	2.85%	32 994	100.00%

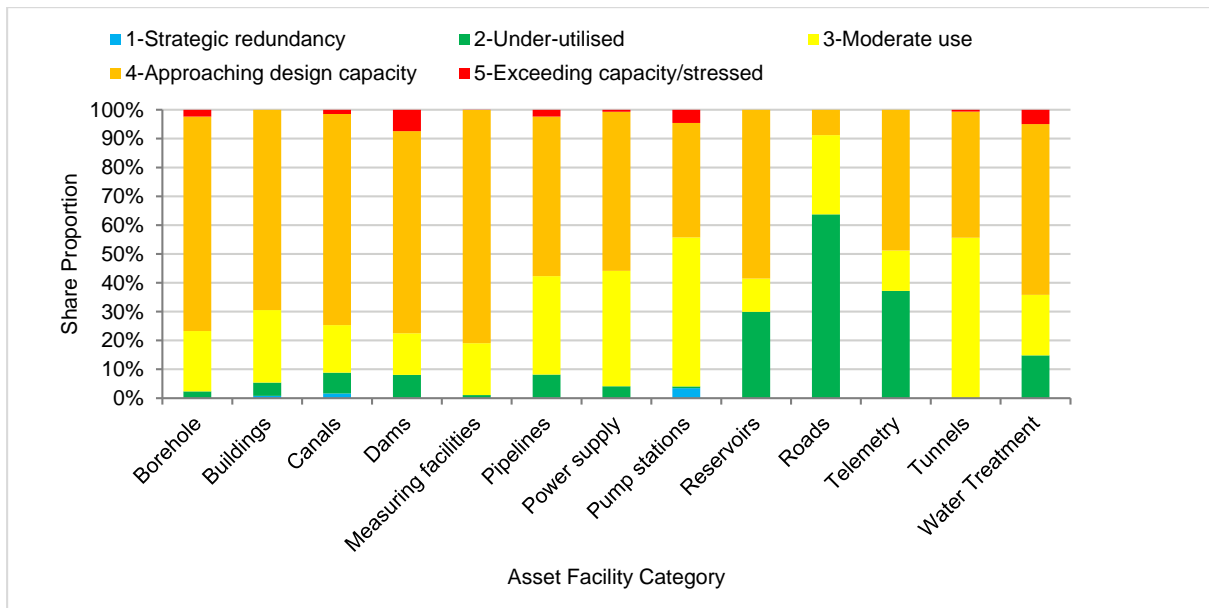


Figure 4.12: Asset component proportions per Utilisation grading and per asset facility category

Figure 4.10 presents the overall utilisation grading of the NWRI's asset components, in line with Table 4.9.

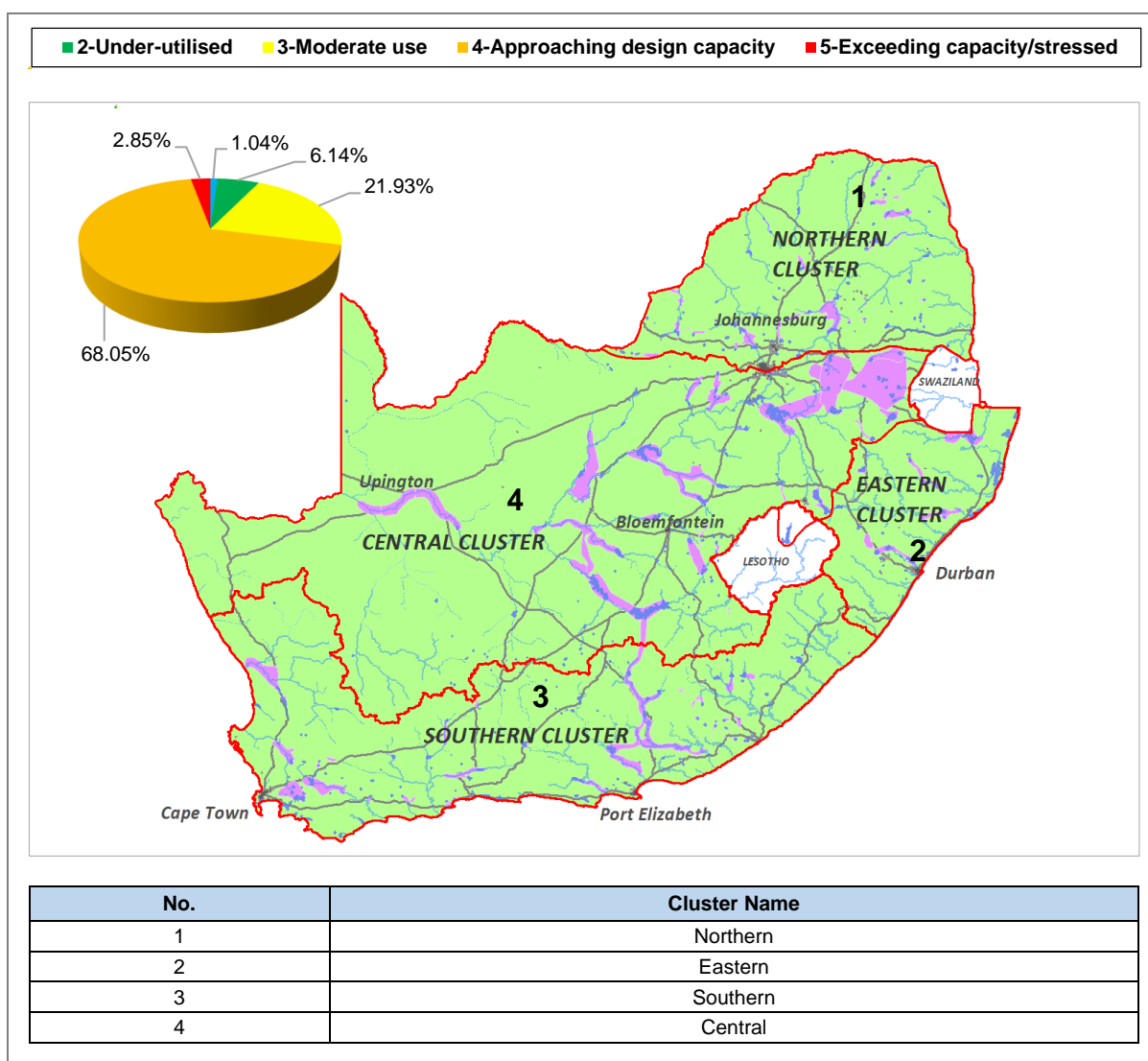


Figure 4.13: Asset component proportions per utilisation grading map

Table 4.13 and Figure 4.14 show the CRCs of the NWRI's infrastructure asset components per utilisation grading and per asset facility category. Appendix E, Table E.4B (an expanded version of Table 4.13) shows the split per engineering discipline.

Under-utilised asset components (representing about 6% of all the NWRI's infrastructure asset components, as shown in Table 4.12 and Figure 4.12) have a total CRC of about R18.175 billion, with the main contributions coming from:

- dams related asset components (representing about 8% of all dams-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R9.642 billion; and
- canals related asset components (representing about 7% of all canals-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R6.570 billion.

Asset components that are approaching design capacity (representing 68% of all the NWRI's asset components) have a total CRC of about R167.795 billion, with the main contributions coming from:

- dams related asset components (representing about 70% of all dams-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R72.023 billion;
- canals related asset components (representing about 73% of all canals-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R54.520 billion; and
- tunnels related asset components (representing about 44% of all tunnels-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R15.604 billion;

Asset components that are stressed (exceeding design capacity on utilisation) (representing about 3% of all the NWRI's infrastructure asset components, as shown in Table 4.12 and Figure 4.12) have a total CRC of about R7.755 billion, with the main contributions coming from:

- dams related asset components (representing about 7% of all dams-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R6.268 billion;
- pipelines related asset components (representing about 2% of all pipelines-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R1.048 billion; and
- canals related asset components (representing about 1.5% of all canals-related asset components, as shown in Table 4.12 and Figure 4.12), with a total CRC of about R0.346 billion.

Table 4.13: CRC per Utilization grading and per asset facility category

Asset Facility Category	Utilisation Grading vs CRC (R Million)					Total	% of Total CRC
	1-Strategic redundancy	2-Under-utilised	3-Moderate use	4-Approaching design capacity	5-Exceeding capacity/stressed		
Borehole	-	1.199	13.130	42.368	1.858	58.556	0.02%
Buildings	36.111	176.753	1 262.583	2 759.823	-	4 235.271	1.62%
Canals	801.117	6 569.947	16 733.543	54 519.528	345.598	78 969.732	30.14%
Dams	9.707	9 642.338	25 590.327	72 023.071	6 268.385	113 533.828	43.33%
Measuring facilities	-	127.886	3 025.023	6 379.472	0.577	9 532.959	3.64%
Pipelines	224.496	636.208	5 104.829	13 583.928	1 047.947	20 597.407	7.86%
Power supply	-	4.880	121.461	68.873	2.000	197.214	0.08%
Pump stations	389.092	25.007	4 870.121	1 852.381	79.251	7 215.852	2.75%
Reservoirs	-	220.191	93.465	659.559	-	973.215	0.37%
Roads	-	744.544	255.792	171.017	-	1 171.352	0.45%
Telemetry	-	14.159	11.548	60.187	-	85.895	0.03%
Tunnels	-	-	9 726.887	15 603.629	3.103	25 333.619	9.67%
Water Treatment	-	11.664	41.369	71.003	5.833	129.868	0.05%
Total	1 460.523	18 174.775	66 850.077	167 794.839	7 754.553	262 034.767	100.00%
% of Total CRC	0.56%	6.94%	25.51%	64.04%	2.96%	100.00%	

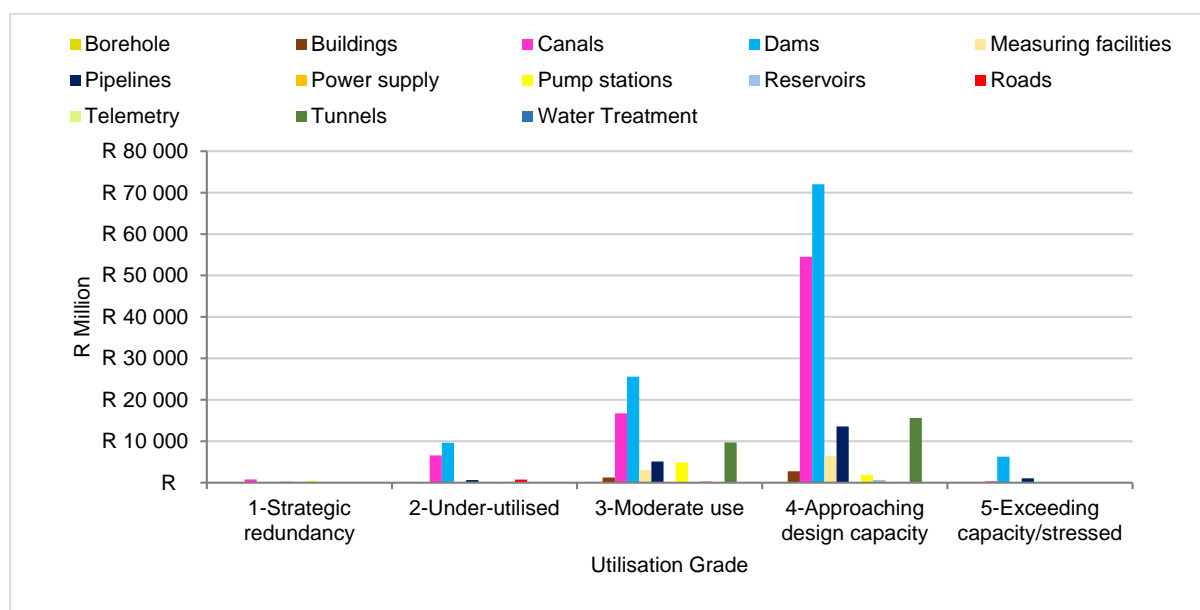


Figure 4.14: CRC per Utilization grading and per asset facility category

4.3 Risk Management

4.3.1 Risk Management Process

In this AMP, 'risk' refers to the possibility that an undesired outcome disrupts the service offered by the NWRI, resulting in the NWRI failing to meet its set levels of service. Risk management is, thus, an indispensable part of infrastructure Asset Management Planning and Implementation. Typically, the risk management process includes the following key steps:

- Identification of risk events and their impacts;
- Analysing the risks (identification of the risk drivers; determining their likelihoods; and

calculating their expected losses);

- Prioritizing the risks, so that one can take appropriate action starting with the most devastating risks;
- Resolving the risks through taking some actions, e.g. avoiding, transferring or mitigating the risk; or redundancy measures; and
- Continual monitoring of risk resolution action plans, termination of successful action plans, identification of new risks that, and initiation of new risk resolution action plans.

Risk (expected loss) is calculated by determining the product of the likelihood of the risk and the total amount of loss (impact) when the risk occurs:

$$\text{Expected Loss (Risk)} = \text{Risk Likelihood} \times \text{Total Loss (Impact)}$$

As indicated in Section 4.2.3 of this AMP, impact is related to criticality. However, risk likelihood was not captured in the Asset Register (see Appendix A) used in the development of this AMP. Hence, an in-depth risk analysis could not be conducted. It is, thus, recommended that the DWS captures risk likelihood in its infrastructure asset register so that the next update of this AMP can address this short-coming.

4.3.2 Asset Risks and Resolution Actions

Whilst cognisant of the presence of non-asset related risks (such as understaffing, vandalism, theft, etc.), this AMP focuses mainly on infrastructure asset-related risks. Table 4.13 shows some of the NWRI's key asset-related risks and associated risk resolution actions (aimed at reducing the risk likelihood) recommended in this AMP:

Table 4.14: The NWRI's immovable asset risks and recommended resolution actions

No.	Asset Risk	Status for the NWRI	Recommended Risk Resolution Action
1	<i>Condition risk:</i> Failure by the asset to deliver the required service due to deteriorated physical condition.	About 25% of NWRI's infrastructure asset components (with a total CRC of about R34.640 billion) have deteriorated to poor and very poor conditions. Refer to Section 4.2.2.	Appropriately renew the asset components to ensure they continue delivering the required service. Refer to Section 4.4.2 for the recommended renewal strategies per asset component.
		About 75% of NWRI's infrastructure asset components (with a total CRC of about R227.395 billion) are in fair, good and very good conditions. Refer to Section 4.2.2.	Conduct appropriate maintenance to prevent the asset components from deteriorating to poor and very poor condition. Refer to Section 4.4.1 for the recommended maintenance strategies per asset component.
2	<i>Capacity risk:</i> Failure by the asset to deliver the required service as a result of it exceeding its design capacity/stressed.	About 3% of the NWRI's infrastructure asset components (with a total CRC of about R7.755 billion) are stressed (exceeding design capacity on utilisation). Refer to Section 4.2.4. About 64% of the NWRI's infrastructure asset components (with a total CRC of about R167.795 billion) are approaching design capacity in utilisation. Refer to Section 4.2.4.	Consider and implement appropriate upgrades and/or new capital investments, in the short run, to avoid stress related failures, and to ensure the NWRI meets the required levels of service. Refer to Section 4.4.3. Continually monitor these asset components, and appropriately plan for any future upgrades, to avoid exceeding design capacity.
3	<i>Not in use / under-utilisation risk:</i> Misallocation of resources (e.g. financial, human resources, material, etc.).	About 6% of the NWRI's infrastructure asset components (with a total CRC of about R18.175 billion) are under-utilised. Refer to Section 4.2.4.	Reconfirm the utilisation grading captured in the Asset Register. Assess the reasons for non/under-utilisation and consider asset decommissioning and disposal, where necessary.

For generic risks typically associated with the different asset facility categories, refer to Appendix F.

4.4 Asset Life Cycle Works and Strategies

The key stages of an asset life cycle include: planning, design, procurement, construction, commissioning, operation, maintenance, renewal, upgrading and disposal. Thus, asset life cycle management involves decision making, planning and control over acquisition, operation, maintenance, renewal, upgrading, safeguarding and disposal of an asset to maximise its service delivery potential and benefits, and to minimise its related risks and costs over its entire life cycle (i.e. "cradle to the grave").

In order for the NWRI to meet the levels of service agreed with its water users (see Section 2) and the projected future raw water demand (see Sections 3), the NWRI needs to accordingly carry out the following asset life cycle management activities and works:

- Operations and Maintenance;
- Renewals;
- Upgrades and new capital investments; and
- Disposals.

The associated expenditure requirements for each of the abovementioned activities are outlined in the Section 5 of this AMP.

Noteworthy is that the quality and usefulness of an AMP is highly dependent on the completeness and accuracy of the asset register used in the development of the AMP. Accordingly, the abovementioned asset life cycle management activities and works recommended for NWRI in this AMP are highly dependent on the asset component condition, criticality and utilisation grading captured in the asset register used in the development of this AMP. As such, execution of the abovementioned asset life cycle management activities and works recommended for NWRI (as detailed in the following subsections) need to be adapted in line with the realities on the ground. Refer to Section 6 regarding some recommendations on how to improve on the current NWRI immovable asset register.

Asset component maintenance and renewals works in this AMP have been prioritised based on asset facility category, asset facility name UID (which indicates related components), and using the criticality-condition grading criteria shown in Table 4.15. For example, for the criticality-condition grading, renewal works priorities were set as follows: VH-NW (top priority); VH-VP; VH-P; H-NW; H-VP; H-P; M-NW; M-VP; and M-P, making sure that the asset components have not been marked for disposal. The prioritisation was further refined, in some cases, by taking into consideration scheme priority (derived from its total registered volume).

Table 4.15: Asset criticality versus condition grading

Criticality Grade	Condition Grade					
	For Maintenance			For Renewals		
	5 Very Good (VG)	4 Good (G)	3 Fair (F)	2 Poor (P)	1 Very Poor (VP)	0 Not Working (NW)
1 Very Low (VL)	VL-VG	VL-G	VL-F	VL-P	VL-VP	VL-NW
2 Low (L)	L-VG	L-G	L-F	L-P	L-VP	L-NW
3 Moderate (M)	M-VG	M-G	M-F	M-P	M-VP	M-NW
4 High (H)	H-VG	H-G	H-F	H-P	H-VP	H-NW
5 Very High (VH)	VH-VG	VH-G	VH-F	VH-P	VH-VP	VH-NW

4.4.1 Operations and Maintenance (O&M)

The NWRI has a total of 255 schemes, of which 196 are operationally active (79 in Northern, 16 in Eastern, 66 in Southern and 35 in Central Operations) and 59 are inactive (12 in Northern, 2 in Eastern and 45 in Southern Operations). As shown in Appendix H, Tables H.1 to H.4, some of the schemes falling under the NWRI are currently being operated and maintained by the DWS, whilst some are being operated and maintained by other parties (such as Irrigation Boards, Water Boards, Water User Associations, etc.). For those schemes that are not being operated and maintained by the DWS, it is crucial that the DWS makes regular inspections to be sure that the schemes' assets are correctly operated and adequately maintained.

Operations

Operations includes activities associated with the delivery of service (raw water supply) to the customers (water users) through the utilisation of NWRI's immovable assets, which consume resources such as manpower, energy, chemicals and materials. Operations require two key resources: direct and indirect manpower and utilities (e.g. electricity, fuel and chemicals).

Operation of NWRI's immovable assets needs to be done in line with the relevant scheme O&M Manuals and Operating Rules.

Maintenance

Maintenance entails all actions necessary for retaining an asset as near as possible to its desired functional condition with normal wear and tear (achieving its expected useful life), but excluding renewal. Maintenance requires three key resources: direct and indirect

labour/manpower; plant (movable assets, such as vehicles) and materials.

Proportion of infrastructure asset components requiring maintenance:

The NWRI has about 75% of its infrastructure asset components in fair, good and very good conditions, as shown in Table 4.4 and Figures 4.5. These asset components require appropriate significant/improved maintenance to preventative and normal maintenance to prevent them from deteriorating to poor and very poor condition.

Figure 4.15 shows the proportions of these infrastructure asset components (in fair, good and very good conditions) per criticality-condition grading for the NWRI. Appendix E, Table E.5A1 shows the data table used to generate Figure 4.15; whilst Appendix E, Table E.5B1 shows the split per engineering discipline (civil, electrical and mechanical).

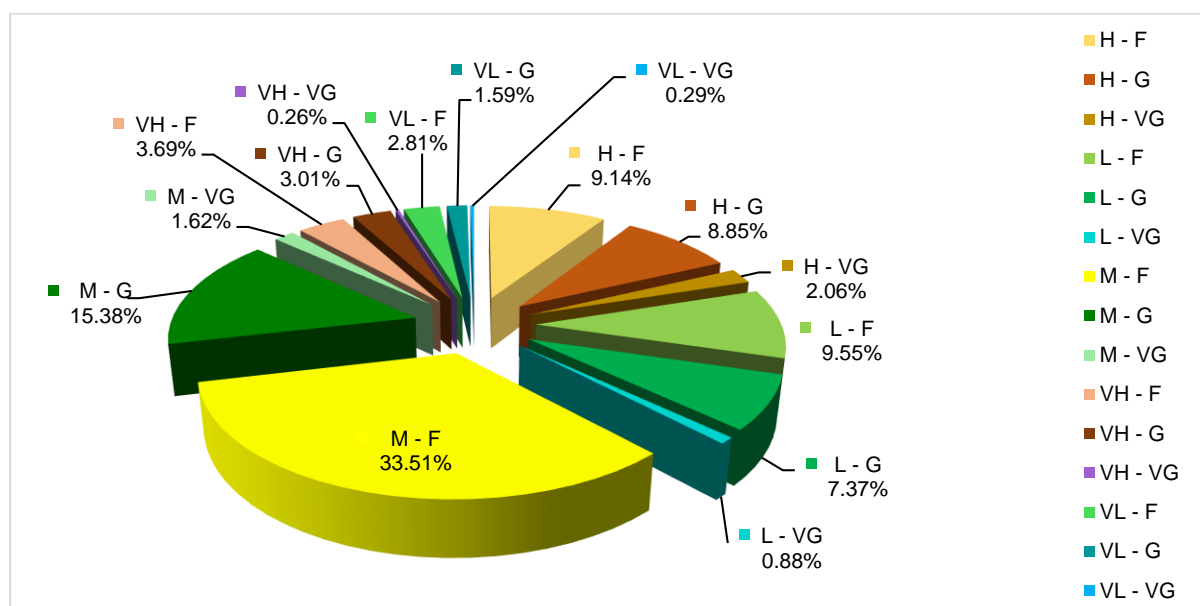


Figure 4.15: Asset component proportions per Criticality-Condition grading (maintenance)

CRCs of infrastructure asset components requiring maintenance:

The approximately 74% of NWRI's infrastructure asset components (see Table 4.4 and Figures 4.5 and 4.15) that are in fair, good and very good conditions have a total CRC of about R227.395 billion, as shown in Table 4.5 and Figure 4.16 (which shows the split of the total CRC per criticality-condition grading). Appendix E, Table E.5A2 shows the data table used to generate Figure 4.16; whilst Appendix E, Table E.5B2 shows the split per engineering discipline (civil, electrical and mechanical).

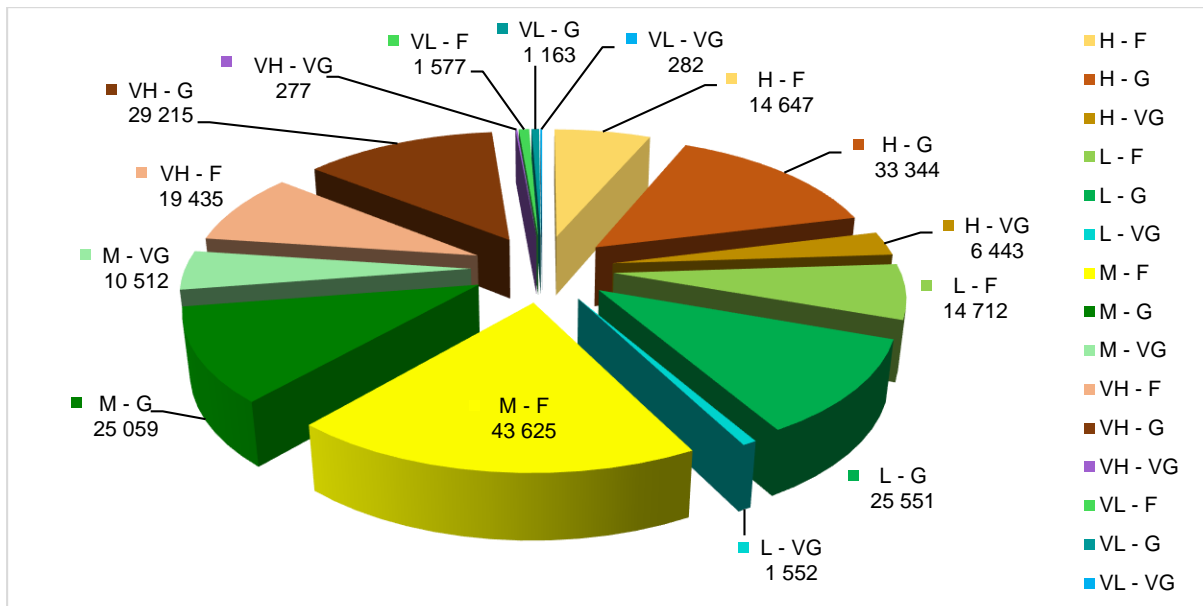


Figure 4.16: CRC (R million) per asset component criticality-condition grading (maintenance)

Recommended Maintenance Strategies:

Appendix I, Table I.1 shows the maintenance strategies per asset component condition grading used in this AMP as well as in the individual scheme and cluster AMPs. For instance, asset components that are in very good condition require preventative and normal maintenance, whilst those that are in fair condition require significant/improved maintenance.

Appendix I, Table I.2 of the individual scheme AMPs and Cluster AMPs presents a list of all the infrastructure asset components requiring maintenance and maintenance strategies assigned to them. The identified maintenance strategies for the NWRI's infrastructure asset components need to be implemented in line with the DWS Maintenance Policy, the DWS Maintenance Strategy, as well as the Operating and Maintenance Manual for the individual schemes.

Section 5.4.4 of this AMP shows the associated projected O&M costs for NWRI.

4.4.2 Renewals

Asset renewals entails works to refurbish (electrical or mechanical), rehabilitate (civil) or replace an existing asset with another asset of equivalent capacity or performance capability.

Proportions of infrastructure asset components requiring renewal:

The NWRI has about 25% of its infrastructure asset components in poor and very poor conditions, as shown in Table 4.4 and Figures 4.5. These asset components need to be renewed, failure of which poses a high risk to the delivery of services to its customers as well as its environment.

Figure 4.17 shows the proportions of these NWRI infrastructure asset components (in poor and very poor conditions) per criticality-condition grading. Appendix E, Table E.6A1 shows the data table used to generate Figure 4.17; whilst Appendix E, Table E.6B1 shows the split per engineering discipline (civil, electrical and mechanical).

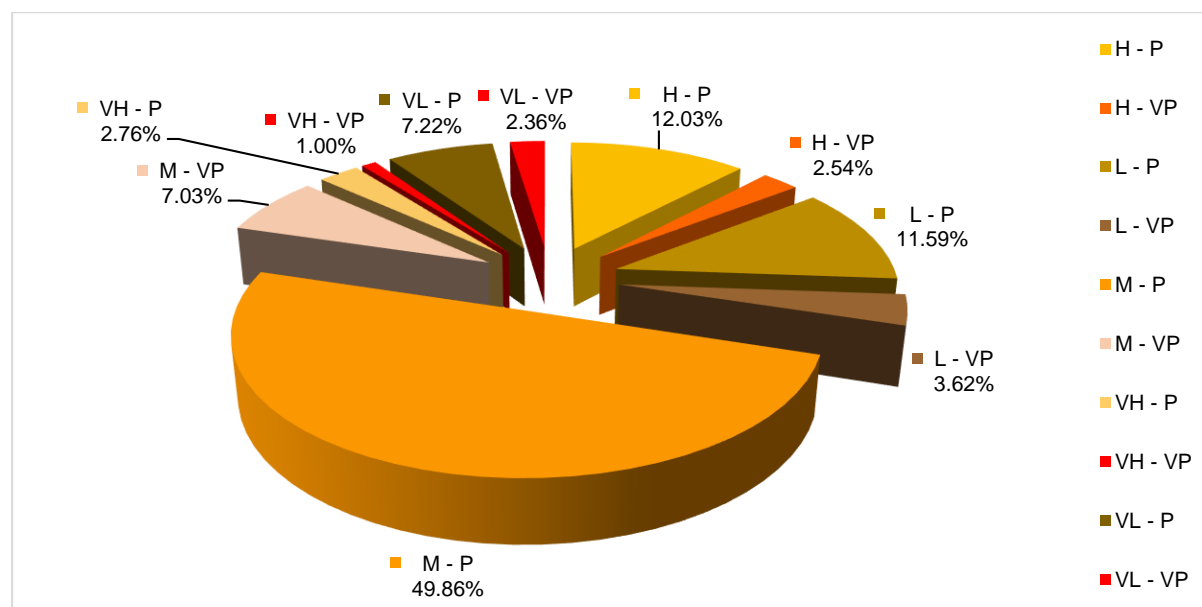


Figure 4.17: Asset component proportions per Criticality-Condition grading (renewals)

The approximately 25% of the NWRI's infrastructure asset components (see Table 4.4 and Figures 4.5 and 4.17) that are in poor and very poor conditions have a total CRC of about R34.640 billion, as shown in Table 4.5 and Figure 4.18 (which shows the split of the total CRC per criticality-condition grading). Appendix E, Table E.6A2 shows the data table used to generate Figure 4.18; whilst Appendix E, Table E.6B2 shows the split per engineering discipline (civil, electrical and mechanical).

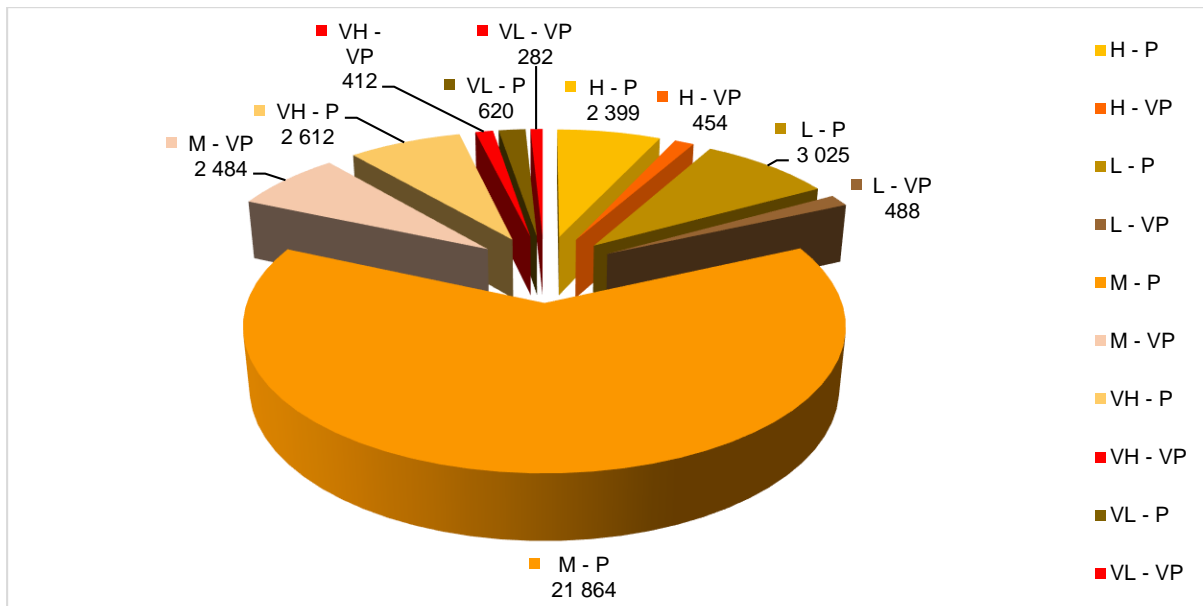


Figure 4.18: CRC (R million) per asset component criticality-condition grading (renewals)

Renewals Backlog, Renewal Strategies, and Planned Renewal Works:

Renewal Backlog (also known as condition backlog) refers to those asset components that are in poor and very poor conditions, and need to be renewed, but excluding those that are marked for disposal and those fully impaired due to under-utilisation. The total CRC for the asset components constituting the Renewal Backlog for NWRI is about R31.057 billion (about R7.200 billion for Northern Operations; R803.495 million for Eastern Operations; R4.636 billion for Southern Operations; and R18.417 billion for Central Operations).

Tables 4.16 and 4.17 show the backlog per engineering discipline and per asset facility category, respectively.

Table 4.16: Renewal backlog for NWRI per engineering discipline

Engineering Discipline	CRC (R million)
Civil	28 851.210
Electrical	549.986
Mechanical	1 655.338
Total	31 056.534

Table 4.17: Renewal backlog for NWRI per asset facility category

Asset Facility Category	CRC (R million)
Buildings	1 021.106
Land	-
WR: Canals	19 366.506
WR: Dams	4 082.271
WR: Power Supply	23.924
WR: Pump stations	548.558
WR: Reservoirs	2.826
WR: Roads and bridge	169.251
WR: Steel Pipelines	4 308.728
WR: Telemetry	-
WR: Tunnels	11.600
WR: Water Treatment	36.681
WS: borehole	29.251
WS: Measuring facility	1 455.830
Total	31 056.534

Appendix J, Table J.2A1 to J.2D2 show the Renewal Backlog per engineering discipline and per asset facility category (similar to Tables 4.16 and 4.17) for each of the four clusters; whilst Appendix J, Table J.2 of the Scheme and Cluster AMPs shows a list of asset components constituting the Renewal Backlog.

Appendix J, Table J.1 summarises the renewal strategies per asset condition grading used in the individual scheme AMPs and the Cluster AMP.

For the planned renewal works (a list of asset components and associated renewal strategies), refer to Appendix J, Tables J.3 to J.12 of the Cluster AMPs.

Section 5.4.1 of this AMP shows the associated projected asset renewal costs for this Cluster.

4.4.3 Upgrades and New Capital

The NWRI's future raw water demand projection as well as asset utilisation grading determine the need for either increasing or decreasing the NWRI's asset extent, functional performance or capacity (done through asset upgrades or new capital developments).

Upgrades Backlog:

Upgrades Backlog is made up of asset components that are exceeding design capacity in utilisation, but excluding those that are marked for disposal and those fully impaired. The total

CRC for the asset components constituting the Upgrades Backlog for NWRI is about R7.866 billion (about R5.526 billion for Northern Operations; R700.944 million for Eastern Operations; R17.280 million for Southern Operations; and R1.622 billion for Central Operations).

Tables 4.18 and 4.19 show the backlog per engineering discipline and per asset facility category, respectively. These asset components need to be upgraded to avoid stress related failures, and to ensure the NWRI meets the required level of service. However, before such upgrade works are executed, it is imperative that the utilisation grading (captured in the Asset Register) of the affected asset components are first verified to confirm the necessity of the upgrades.

Table 4.18: Upgrades backlog for NWRI per engineering discipline

Engineering Discipline	CRC (R million)
Civil	6 864.537
Electrical	115.994
Mechanical	885.310
Total	7 865.842

Table 4.19: Upgrades backlog for NWRI per asset facility category

Asset Facility Category	CRC (R million)
Buildings	52.543
Land	-
WR: Canals	386.525
WR: Dams	6 257.116
WR: Power Supply	2.000
WR: Pump stations	75.610
WR: Reservoirs	-
WR: Roads and bridge	34.933
WR: Steel Pipelines	1 047.947
WR: Telemetry	-
WR: Tunnels	3.103
WR: Water Treatment	5.833
WS: borehole	-
WS: Measuring facility	0.232
Total	7 865.842

Appendix K Table K.2A1 to K.2D2 show the Upgrades Backlog per engineering discipline and per asset facility category (similar to Tables 4.16 and 4.17) for each of the four clusters; whilst Appendix K, Table K.2 of the Scheme and Cluster AMPs shows a list of asset components constituting the Renewal Backlog.

Planned Upgrades Works:

Appendix K, Tables K.3 to K.12 of the Scheme and Cluster AMPs show the planned upgrades works to address the Cluster's infrastructure asset components that are exceeding their design capacities (stressed).

In addition, the 2016 reports on the Condition Assessment Audit for the irrigation infrastructure conducted on some 41 schemes in each of the four NWRI operational clusters identified some canal-related upgrade works with a total acquisition cost of about R3.389 billion, as summarised in Table 4.20. These have been considered in this AMP.

Table 4.20: Canals related upgrade works (based on the 2016 condition assessment audit)

Cluster	No. of Schemes Assessed	Total Acquisition Cost (R million)
Northern	16	302
Eastern	1	170
Southern	11	1 806
Central	13	1 111
Total	41	3 389

Section 5.4.2 of this AMP shows the associated upgrades and new capital costs for NWRI.

4.4.4 Impairments and Disposals

Impairments

Asset impairment is the loss of future economic benefits or service potential of an asset over and above the systematic recognition of the loss of the asset's future economic benefits or service potential through depreciation. As a result, the carrying value of assets needs to be reduced where there is evidence that the value has become over-stated due to unexpected events or circumstances (depreciation caters for normal consumption of the assets, through normal wear and tear).

Impairment causes an acceleration of one or more of the following failure modes: condition, functional performance, utilisation, or obsolescence. As such, an asset may be impaired based on: condition (e.g. vandalism, theft, poor maintenance, etc.), functional performance (e.g. siltation of dams), utilisation (under-utilisation), or obsolescence (e.g. spare parts no longer available).

Impaired infrastructure asset components

The NWRI has some infrastructure asset components with a total CRC of about R1.028 billion that were fully impaired in the 2016/17 financial year. They are mainly canals, dams, pipelines

and measuring facilities related, as shown in Appendix L, Table L.1. The DWS needs to take further steps on these asset components to determine appropriate disposal plans for them.

The NWRI also has some infrastructure asset components with zero asset carrying values (according to the Asset Register), which implies that they are either fully depreciated or fully impaired. They are mainly canals, dams, pump stations and measuring facilities related (as shown in Appendix L, Table L.2), with a total CRC of about R6.025 billion. In this AMP, these infrastructure asset components with zero asset carrying values are being treated as impairments.

Disposals

Asset disposal entails termination of the DWS's control over the asset; and needs to be done in line with the DWS Disposal Strategy for Immovable Assets.

The NWRI has some infrastructure asset components marked for disposal, according to the Asset Register. They are mainly buildings, canals, dams and measuring facilities related (as shown in Appendix L, Table L.3), with a total CRC of about R516.037 million. The DWS needs to develop appropriate disposal plans for these asset components, and accordingly dispose of them and avoid incurring unnecessary costs for their upkeep.

Also, about 7% of NWRI's infrastructure asset components (with a total CRC of about R18.175 billion) are under-utilised. They are mainly canals and dams related asset components. Indeed, 59 out of NWRI's 255 schemes are currently inactive and, thus, under-utilised.

Under-utilised infrastructure asset components for the NWRI, which are neither impaired nor marked for disposal have a total CRC of about R17.710 billion, and are shown in Appendix L, Table L.4. It is recommended that the Cluster revisits the utilisation grading (captured in the Asset Register) of these under-utilised asset components as they may be including those asset components belonging to the "Not in use" utilisation grading. The confirmed under-utilised asset components could be candidates for disposal. However, before any disposal could take place, the reasons for the under-utilisation need to be assessed and consideration made for decommissioning and disposal, where necessary. Possible disposal method for the inactive schemes could be transferring to the local community through the local municipality.

4.5 Human Resources Requirements

The NWRI Operations is seriously under-resourced: only 1 598 out of the 2 766 (i.e. about 58%) approved positions (as per the 2014 approved structure) are currently filled, representing a vacancy rate of about 42%. Compared to the 2007 approved structure (which mostly better

reflected the needs of the NWRI Operations), only 1 598 out of the 3 590 (i.e. about 45%) approved positions are currently filled, representing a vacancy rate of about 55%. Such vacancy rates are way much higher than the 10% or less target specified in the DWS Annual Performance Plan for 2017/18 to 2019/20.

In addition, the very high vacancy rate has considerable negative impact on the execution of adequate life cycle activities and works (e.g. operation and maintenance, renewals and upgrades) of the NWRI's infrastructure assets, as evidenced by the high backlogs highlighted in the preceding sub-sections.

Furthermore, there is a considerable generation gap, especially in the key areas of expertise (notably, operations, maintenance and engineering technical support), with most of those fully-fledged and fully conversant with the NWRI's infrastructure nearing retirement age.

The DWS needs to urgently embark on a serious recruitment drive, aiming at achieving the 10% or less vacancy rate target specified in its Annual Performance Plan for 2017/18 to 2019/20. Failure to do so will continue to compromise life cycle activities and works, piling up of works backlog leading to a possible total collapse of its water resources infrastructure. This AMP has made provision for the DWS to fill all the operation and maintenance and other critical support vacancies, with appropriately qualified and experienced personnel, within the next two years.

4.6 Summary

The NWRI has an immovable asset base consisting of 34 165 asset components: 32 994 *infrastructure* and 1 171 *land* related asset components. The majority of the NWRI's asset components are canals, dams, buildings, measuring facilities and pump stations related (about 33%, 23%, 14%, 10% and 9%, respectively).

The NWRI's immovable asset components have a total DRC and CRC of about R144.270 billion and about R284.806 billion, respectively. They can be grouped into two: *infrastructure* asset components (with total DRC and CRC of about R121.499 billion and about R262.035 billion, respectively); and *land* (with a total of about R22.771 billion for both DRC and CRC). The DRC/CRC ratio for infrastructure asset components is about 46%, indicating that about 54% of the infrastructure asset base has been consumed so far.

For infrastructure assets, dams-related asset components have the highest CRC of about R113.534 billion, followed by canals, tunnels and pipelines related asset components with

total CRCs of about R78.970 billion, R25.334 billion and R20.597 billion, respectively.

Key asset-related risks for NWRI include: condition risk (failure by the asset to deliver the required service due to deteriorated physical condition); capacity risk (failure by the asset to deliver the required service as a result of it exceeding its design capacity/stressed); and not in use / under-utilisation risk (resulting in misallocation of resources, e.g. financial, human resources, material, etc.). To minimise these risks, and in order for NWRI to meet its set levels of service and the projected future raw water demand, the following asset life cycle management activities are recommended for NWRI in this AMP: appropriate and adequate maintenance and renewals (condition risk); upgrades and new capital investments (capacity risk); and disposals (not in use / under-utilisation risk).

The NWRI has a total of 255 schemes, of which 196 are operationally active (79 in Northern, 16 in Eastern, 66 in Southern and 35 in Central Operations) and 59 are inactive (12 in Northern, 2 in Eastern and 45 in Southern Operations). Some of these schemes are currently being operated and maintained by the DWS, whilst some are being operated and maintained by other parties (such as Irrigation Board, Water Boards, Water User Associations, etc.). For those schemes that are not being operated and maintained by the DWS, it is crucial that the DWS makes regular inspections to be sure that the schemes' assets are correctly operated and adequately maintained.

The NWRI has about 75% of its infrastructure asset components (with a total CRC of about R227.395 billion) in fair, good and very good conditions. Appropriate maintenance strategies have been recommended and prioritised (based on criticality and condition) for these asset components in the scheme and Cluster AMPs.

Renewals Backlog (also known as condition backlog) is made up of asset components that are in poor and very poor conditions and need to be renewed, but excluding those that are marked for disposal and those fully impaired due to under-utilisation. The total CRC for the asset components constituting the NWRI's Renewal Backlog is about R31.057 billion (about R7.200 billion for Northern Operations; R803.495 million for Eastern Operations; R4.636 billion for Southern Operations; and R18.417 billion for Central Operations). Appropriate renewal works and strategies have also been recommended and prioritised, mainly based on asset facility category, asset facility name UID (which indicates related components), criticality and condition grading, for these asset components. The prioritisation was further refined, in some cases, by taking into consideration scheme priority (derived from its total registered volume).

Upgrades Backlog is made up of asset components that are exceeding design capacity in utilisation, but excluding those that are marked for disposal and those fully impaired. The total CRC for the asset components constituting the Upgrades Backlog for NWRI is about R7.866 billion (about R5.526 billion for Northern Operations; R700.944 million for Eastern Operations; R17.280 million for Southern Operations; and R1.622 billion for Central Operations). These asset components (which are mainly dams, pipelines, and canals related) need to be upgraded to avoid stress related failures, and to ensure the NWRI meets the required level of service. However, before such upgrade works are executed, it is imperative that the utilisation grading (captured in the Asset Register) of the affected asset components are first verified to confirm the necessity of the upgrades.

Furthermore, the 2016 reports on the Condition Assessment Audit for NWRI's irrigation infrastructure (for 41 schemes) identified some canal-related upgrade works with a total acquisition cost of about R3.389 billion; these have been considered in this AMP.

The NWRI has some infrastructure asset components with a total CRC of about R1.028 billion that were fully impaired in the 2016/17 financial year. They are mainly canals, dams, pipelines and measuring facilities related. The DWS needs to take further steps on these asset components to determine appropriate disposal plans for them.

The NWRI also has some infrastructure asset components with zero asset carrying values (according to the Asset Register), which implies that they are either fully depreciated or fully impaired. They are mainly canals, dams, pump stations and measuring facilities related, with a total CRC of about R6.025 billion. In this AMP, these infrastructure asset components with zero asset carrying values are being treated as impairments.

Furthermore, the NWRI has some infrastructure asset components marked for disposal, according to the Asset Register. They are mainly buildings, canals, dams and measuring facilities related, with a total CRC of about R516.037 million. The DWS needs to develop appropriate disposal plans for these asset components, and accordingly dispose of them and avoid incurring unnecessary costs for their upkeep.

About 7% of NWRI's infrastructure asset components (with a total CRC of about R18.175 billion) are under-utilised, according to the Asset Register. They are mainly canals and dams related asset components. Indeed, 59 out of NWRI's 255 schemes are currently inactive and, thus, under-utilised. Under-utilised infrastructure asset components for the NWRI, which are neither fully impaired nor marked for disposal have a total CRC of about R17.710 billion. It is

recommended that the NWRI revisits the utilisation grading (captured in the Asset Register) of these under-utilised asset components as they may be including those asset components belonging to the “Not in use” utilisation grading. The confirmed under-utilised asset components could be candidates for disposal. However, before any disposal could take place, the reasons for the under-utilisation need to be assessed and consideration made for decommissioning and disposal, where necessary. Possible disposal method for the inactive schemes could be transferring to the local community through the local municipality.

The NWRI Operations is seriously under-resourced: only 1 598 out of the 2 766 (i.e. about 58%) approved positions (as per the 2014 approved structure) are currently filled, representing a vacancy rate of about 42%. Compared to the 2007 approved structure (which mostly better reflected the needs of the NWRI Operations), only 1 598 out of the 3 590 (i.e. about 45%) approved positions are currently filled, representing a vacancy rate of about 55%. Such vacancy rates are way much higher than the 10% or less target specified in the DWS Annual Performance Plan for 2017/18 to 2019/20. In addition, the very high vacancy rate has considerable negative impact on the execution of adequate life cycle activities and works (e.g. operation and maintenance, renewals and upgrades) of the NWRI's infrastructure assets, as evidenced by the high backlogs highlighted in the preceding sub-sections.

The DWS needs to urgently embark on a serious recruitment drive, aiming at achieving the 10% or less vacancy rate target specified in its Annual Performance Plan for 2017/18 to 2019/20. Failure to do so will continue to compromise life cycle activities and works, piling up of works backlog leading to a possible total collapse of its water resources infrastructure. This AMP has made provision for the DWS to fill all the operation and maintenance and other critical support vacancies, with appropriately qualified and experienced personnel, within the next two years.

The next section presents a ten-year financial plan associated with the asset life cycle management activities and works discussed above.

5. ASSET LIFE CYCLE FINANCIAL PLAN

5.1 Overview

This section presents the NWRI Operations's ten-year projected financial requirements as per the Asset Life Cycle works identified in Section 4, and it answers the questions of 'when' and 'for how much' are those works. The derived financial requirement to clear the NWRI's total works backlog, as well as costs for the asset life cycle works are presented per engineering discipline, per asset facility category and per cluster. Furthermore, the implied overall minimum revenue requirement for the NWRI is discussed.

5.2 Financial Projection Assumptions

Key assumptions underpinning financial projections in this AMP are:

- Growth Factors for Expenditure:
 - *Inflation rate* of 6.2% in 2017/18, 5.7% in 2018/19, and 5.6% in 2019/20 as provided for in the South African National Treasury 2017/18 MTEF Technical Guidelines on budgeting. Thereafter, a four-year moving average rate was used; and
 - A *progressive factor* which is an average of: 1.8% in 2017/18, 2.1% in 2018/19 and 2.3% in 2019/20 as projected in the 2017/18 South African National Treasury Budget Review. Thereafter, a three-year moving average rate was used.
- Growth Factor for PPE related values.
 - Average PPI of about 6.5% was used to adjust for PPE related monetary values.
- New capital costs are a function of growth in water demand beyond the existing raw water yield from the four NWRI clusters where available and applicable.
- Upgrade costs are a function of either growth in water demand beyond the existing raw water yield from the four NWRI clusters or of asset utilisation, or both.
- Renewal Capital Expenditure are a function of depreciation and a price adjustment equivalent to: the engineering professional fees; construction preliminary and generals (P&Gs); construction contingency reserves as well as the projected PPI, moderated with CRC proportions, in the particular year renewal work will be carried out.
- All vacancies to be filled within the next two years.
- Straight line depreciation method was used in the projections.
- The modelled maintenance costs are proportions of the CRCs; where the following sources formed the basis for the ratios:
 - National Infrastructure Maintenance Strategy (Infrastructure Maintenance Budgeting Guideline).
 - Maintenance Accounting Framework for immovable assets under the

custodianship of National and Provincial Department of Works (Department of Public Works, 2015).

- Monitoring and Evaluation Protocol for immovable assets under the custodianship of National and Provincial Department of Works (Department of Public Works, 2015).
- Operations and maintenance costs of rural water supply schemes in South Africa (Gibson, 2010).

5.3 Backlog

'Backlog', in this AMP, refers to "the value of maintenance, renewal and upgrade work that has not been done when it should have been – in order to meet the prescribed levels of service". Renewal backlog (also known as condition backlog) consists of asset components that are in poor and very poor conditions; whilst upgrades backlog consists of asset components that are exceeding design capacity in utilisation. If maintenance, renewal and upgrade work is not carried out at the optimum time in the asset lifecycle:

- the assets will deteriorate further;
- the maintenance or renewal work that will have to be done later may be more extensive and expensive (in real terms) than it would have been if it had been carried out at the optimum time;
- the asset may not be able to continue to perform to its original design capacity or performance standard, or to deliver the specified levels of service, and, if the work continues not being done, may ultimately be unable to provide the required service altogether.

The NWRI's total backlog has a current replacement cost (CRC) (*the cost of replacing an existing asset with a modern asset of equivalent capacity*) of about R38.922 billion: about R31.057 billion for renewal/condition backlog; and about R7.866 billion for upgrades backlog, as indicated in Section 4. However, in practice, not all the asset components constituting the backlog need to be completely replaced. Rather, some of the asset components require some refurbishment (electrical and mechanical related) or rehabilitation (civil related); which cost less than complete replacements.

Consequently, the overall cost to clear the NWRI's total backlog (which has a CRC of about R38.922 billion) would be less than this CRC amount. Accordingly, the derived financial requirement (*amount of money required*) to clear the NWRI's total backlog is about R13.649 billion: about R9.483 billion for renewal/condition backlog; and about R4.166 million for upgrades backlog.

Tables 5.1 and 5.2 show the split per cluster of the CRC and the derived financial requirement to clear the NWRI's total backlog, respectively.

Table 5.1: Current replacement cost for the backlog per cluster

Cluster Name	CRC (Million Rands)		
	Condition Backlog	Upgrade Backlog	Total
Northern Operations	7 199.610	5 525.995	12 725.605
Eastern Operations	803.495	700.944	1 504.439
Southern Operations	4 636.288	17.280	4 653.568
Central Operations	18 417.140	1 621.623	20 038.762
Total	31 056.534	7 865.842	38 922.375

Table 5.2: Financial requirement to clear the backlog per cluster

Cluster Name	Financial Requirement to Clear Backlog (Million Rands)		
	Condition Backlog	Upgrade Backlog	Total
Northern Operations	2 536.288	1 882.542	4 418.830
Eastern Operations	296.575	674.767	971.343
Southern Operations	1 805.239	25.920	1 831.159
Central Operations	4 844.655	1 582.802	6 427.457
Total	9 482.757	4 166.031	13 648.788

The derived financial requirement to clear the clusters' backlog per engineering discipline, and per asset facility category, are shown in Appendix J, Tables J.16 and J.17; and Tables K.16 and K.17, in the 2017/18 columns only, respectively.

Tables 5.3 and 5.4 show the derived financial requirement to clear the NWRI's backlog per engineering discipline and per asset facility category, respectively.

Table 5.3: Financial requirement to clear backlog per engineering discipline

Engineering Discipline	Financial Requirement to Clear Backlog (Million Rands)		
	Condition Backlog	Upgrade Backlog	Total
Civil	8 518.825	2 697.549	11 216.374
Electrical	255.155	111.904	367.059
Mechanical	708.776	1 356.579	2 065.355
Total	9 482.757	4 166.031	13 648.788

Table 5.4: Financial requirement to clear backlog per asset facility category

Asset Facility Category	Financial Requirement to Clear Backlog (Million Rands)		
	Condition Backlog	Upgrade Backlog	Total
Buildings	586.082	-	586.082
Land	-	-	-
WR: Canals	5 467.446	268.098	5 735.544
WR: Dams	1 369.840	2 436.016	3 805.856
WR: Power Supply	13.255	3.000	16.255
WR: Pump stations	269.004	88.478	357.482
WR: Reservoirs	1.867	-	1.867
WR: Roads and bridge	45.491	-	45.491
WR: Steel Pipelines	1 276.251	1 362.753	2 639.005
WR: Telemetry	-	-	-
WR: Tunnels	3.511	4.654	8.165
WR: Water Treatment	17.411	2.916	20.327
WS: borehole	14.919	-	14.919
WS: Measuring facility	417.679	0.116	417.795
Total	9 482.757	4 166.031	13 648.788

5.4 Costs Breakdown

5.4.1 Renewals

Identified/Projected and Planned Renewals

This subsection presents the planned renewal cost requirements based on the derived condition backlog and the identified renewal works, and the schedule for clearing the renewal backlog, for the next ten years. The identified/projected NWRI total renewal cost requirements per engineering discipline, per asset facility category, and per cluster are shown in Appendix J, Tables J.13, J.14 and J.15, respectively. Appendix J, Tables J.16 and J.17 show the individual clusters' identified renewal cost per engineering discipline and per asset facility category, respectively. All the identified/projected renewal cost requirements are based on the remaining useful life of the infrastructure asset components and their anticipated conditions.

The planned annual renewal cost requirements for the 10 year period under review for NWRI is presented in Tables 5.5, 5.6 (and Figure 5.1) and 5.7 per engineering discipline, per asset facility category, and per cluster, respectively.

- The planned annual renewal cost requirements for the first three years (2017/18, 2018/19, and 2019/20) are R754.792 million; R702.602 million; and R1.136 billion, respectively.

Table 5.5: Renewals cost per engineering discipline

Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	390.292	395.196	873.202	905.749	2 100.339	2 240.216	2 555.065	4 463.171	4 910.526	3 928.673
Electrical	83.261	91.894	114.382	170.406	118.228	55.722	85.591	115.511	37.886	337.581
Mechanical	281.239	215.513	148.094	577.433	81.952	374.592	623.826	184.153	286.321	946.175
Total	754.792	702.602	1 135.678	1 653.588	2 300.519	2 670.530	3 264.483	4 762.835	5 234.733	5 212.429

Table 5.6: Renewals cost per asset facility category

Asset Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	9.066	39.170	111.493	86.816	35.876	265.890	117.712	318.172	136.498	155.426
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	46.756	44.404	36.330	308.392	1 655.057	1 615.877	1 835.159	2 528.164	3 680.649	2 089.849
WR: Dams	311.701	352.564	192.804	434.382	63.546	509.069	799.416	233.521	198.380	607.116
WR: Power Supply	5.421	7.493	7.764	7.035	0.121	-	-	0.113	4.234	22.351
WR: Pump stations	78.020	99.799	155.110	311.456	179.180	212.253	106.480	134.088	164.081	540.533
WR: Reservoirs	-	-	-	2.091	-	-	2.978	-	7.391	191.773
WR: Roads and bridge	3.831	7.396	-	-	0.138	-	6.092	10.643	77.704	25.073
WR: Steel Pipelines	298.909	144.654	623.428	495.695	356.916	31.569	282.649	1 219.326	764.024	176.825
WR: Telemetry	-	-	6.073	2.024	-	-	-	-	1.897	17.017
WR: Tunnels	1.087	-	1.409	5.696	1.098	23.279	18.235	0.737	10.274	1 067.183
WR: Water Treatment	-	-	-	-	8.587	-	6.078	3.376	6.983	10.522
WS: borehole	-	-	-	-	-	-	-	0.577	2.582	14.919
WS: Measuring facility	-	7.123	1.266	-	-	12.593	89.684	314.117	180.036	293.841
Total	754.792	702.602	1 135.678	1 653.588	2 300.519	2 670.530	3 264.483	4 762.835	5 234.733	5 212.429

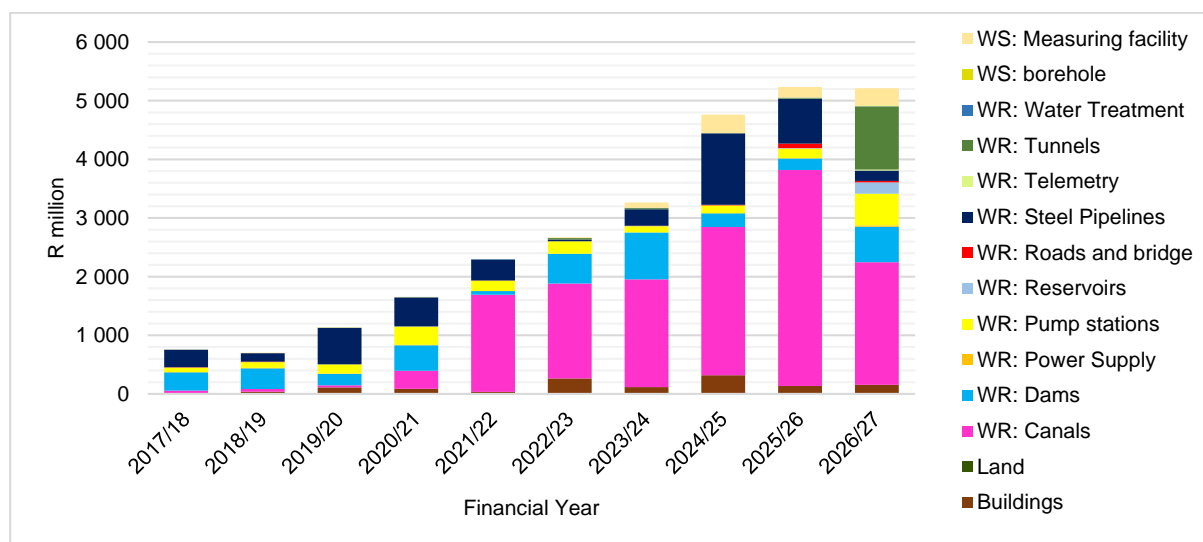


Figure 5.1: Renewals cost per asset facility category

Table 5.7: Renewals cost per cluster

Cluster Name	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern Operations	129.420	96.870	204.568	375.113	420.608	551.801	647.913	988.147	635.890	654.945
Eastern Operations	25.076	95.252	67.356	95.773	132.939	67.766	187.132	210.945	241.921	163.174
Northern Operations	130.147	171.243	216.337	220.214	653.322	713.122	652.263	921.455	1 121.417	1 006.869
Central Operations	470.149	339.237	647.417	962.488	1 093.651	1 337.841	1 777.175	2 642.289	3 235.505	3 387.441
Total	754.792	702.602	1 135.678	1 653.588	2 300.519	2 670.530	3 264.483	4 762.835	5 234.733	5 212.429

Appendix J, Tables J.18 and J.19 show the individual clusters' planned renewal cost per engineering discipline and per asset facility category, respectively.

Renewals Backlog Clearance

Table 5.8 shows the annual proportion of the: renewal backlog in the total renewal cost; renewal backlog cleared; and cumulative renewal backlog cleared.

Table 5.8: Renewals backlog clearance proportions per year

Backlog Proportions	Financial Year									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Renewal Backlog share of Renewals Costs	100%	99%	79%	41%	32%	41%	36%	29%	22%	20%
Share of Renewal Backlog	9%	7%	9%	7%	7%	11%	13%	14%	12%	11%
Renewal Backlog Cumulative Percentage	9%	16%	25%	32%	39%	51%	63%	78%	89%	100%

5.4.2 Upgrades and New Capital

Identified/Projected and Planned Upgrades

This subsection presents the planned upgrade cost requirements based on the upgrades backlog and the canals upgrade recommendations from the 2016 reports on the Condition Assessment Audit for Irrigation Infrastructure. The identified/projected NWRI total upgrades cost requirements per engineering discipline, per asset facility category and per cluster are shown in Appendix K, Tables K.13, K.14 and K.15, respectively. Appendix K, Tables K.16 and K.17 show the individual clusters' identified upgrades cost per engineering discipline and per asset facility category, respectively.

The planned annual upgrade cost requirements for the 10-year period under review for NWRI is presented in Tables 5.9, 5.10 (and Figure 5.2) and 5.11 per engineering discipline, per asset facility category, and per cluster, respectively.

- The planned annual upgrade cost requirements for the first three years (2017/18, 2018/19, and 2019/20) are R527.061 million; R1.190 billion and R924.514 million, respectively.

Table 5.9: Upgrades cost per engineering discipline

Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	251.138	938.899	620.613	823.889	918.039	971.638	579.427	354.680	414.072	314.255
Electrical	58.295	47.906	17.914	4.161	-	3.252	16.565	-	-	-
Mechanical	217.629	202.697	285.987	287.646	100.485	97.662	217.637	-	-	-
Total	527.061	1 189.502	924.514	1 115.696	1 018.525	1 072.551	813.629	354.680	414.072	314.255

Table 5.10: Upgrades cost per asset facility category

Asset Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	0.200	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	33.605	623.859	166.038	166.322	503.033	572.181	544.770	337.014	390.516	314.255
WR: Dams	362.255	375.961	557.234	685.548	178.138	101.795	265.485	17.667	23.556	-
WR: Power Supply	-	-	3.000	-	-	-	-	-	-	-
WR: Pump stations	56.805	59.769	15.537	-	-	-	3.259	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	1.638	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	72.557	129.913	182.705	263.826	329.783	398.575	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	4.654	-	-	-	-	-
WR: Water Treatment	-	-	-	-	2.916	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	0.116	-	-	-
Total	527.061	1 189.502	924.514	1 115.696	1 018.525	1 072.551	813.629	354.680	414.072	314.255

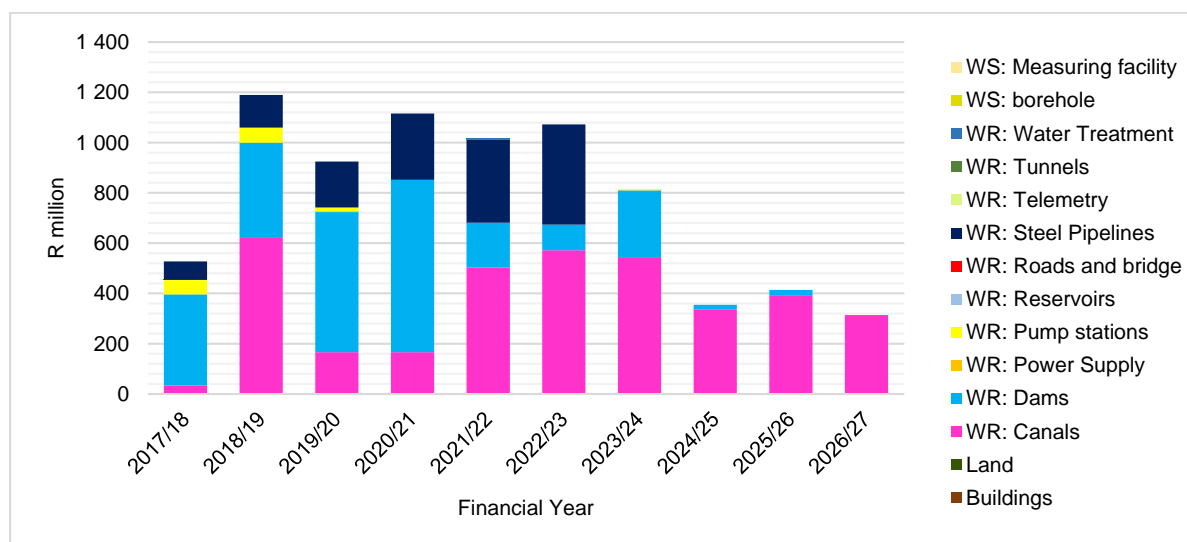


Figure 5.2: Upgrades cost per asset facility category

Table 5.11: Upgrades cost per cluster

Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	17.753	225.575	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
Eastern	50.681	60.296	109.869	142.153	152.878	212.096	78.491	65.817	23.556	-
Northern	261.579	354.500	400.622	555.543	252.840	207.910	232.812	-	-	-
Central	197.048	549.132	269.635	307.586	400.473	473.829	222.044	288.864	42.288	-
Total	527.061	1 189.502	924.514	1 115.696	1 018.525	1 072.551	813.629	354.680	414.072	314.255

Appendix K, Tables K.18 and K.19 show the individual clusters' planned upgrades cost per engineering discipline and per asset facility category, respectively.

Upgrades Backlog Clearance

Table 5.12 shows the annual proportion of the: upgrades backlog in the total upgrades cost; upgrades backlog cleared; and cumulative upgrades backlog cleared.

Table 5.12: Upgrades backlog clearance proportions per year

Backlog Proportions	Financial Year									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Upgrades Backlog Share of Upgrades Costs	100%	46%	81%	85%	62%	55%	33%	5%	6%	0%
Share of Upgrade Backlog	12%	13%	18%	22%	15%	14%	6%	0%	1%	0%
Upgrades Backlog Cumulative Percentage	12%	25%	42%	64%	79%	93%	99%	99%	100%	

5.4.3 Overall Capital Expenditure

Planned Overall Capital Expenditure

This sub-section sums up the NWRI renewal and upgrade cost requirements presented in the preceding two sub-sections.

The planned annual total capital expenditure (CAPEX) requirements for the 10 year period under review for NWRI are presented in Tables 5.13, 5.14 (and Figure 5.3) and 5.15 per engineering discipline, per asset facility category, and per cluster, respectively.

- The planned annual CAPEX cost requirements for the first three years (2017/18, 2018/19, and 2019/20) are R1.282 billion; R1.892 billion and R2.060 billion respectively.

Table 5.13: Overall capital expenditure cost per engineering discipline

Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	641.430	1 334.095	1 493.815	1 729.638	3 018.378	3 211.854	3 134.492	4 817.851	5 324.598	4 242.928
Electrical	141.555	139.800	132.296	174.567	118.228	58.974	102.157	115.511	37.886	337.581
Mechanical	498.867	418.211	434.081	865.079	182.438	472.254	841.463	184.153	286.321	946.175
Total	1 281.853	1 892.105	2 060.192	2 769.285	3 319.044	3 743.081	4 078.112	5 117.515	5 648.805	5 526.684

Table 5.14: Overall capital expenditure cost per asset facility category

Asset Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	9.266	39.170	111.493	86.816	35.876	265.890	117.712	318.172	136.498	155.426
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	80.361	668.263	202.369	474.714	2 158.090	2 188.057	2 379.928	2 865.178	4 071.166	2 404.104
WR: Dams	673.957	728.525	750.038	1 119.931	241.684	610.865	1 064.900	251.188	221.936	607.116
WR: Power Supply	5.421	7.493	10.764	7.035	0.121	-	-	0.113	4.234	22.351
WR: Pump stations	134.825	159.568	170.646	311.456	179.180	212.253	109.739	134.088	164.081	540.533
WR: Reservoirs	-	-	-	2.091	-	-	2.978	-	7.391	191.773
WR: Roads and bridge	5.469	7.396	-	-	0.138	-	6.092	10.643	77.704	25.073
WR: Steel Pipelines	371.466	274.567	806.132	759.522	686.699	430.144	282.649	1 219.326	764.024	176.825
WR: Telemetry	-	-	6.073	2.024	-	-	-	-	1.897	17.017
WR: Tunnels	1.087	-	1.409	5.696	5.752	23.279	18.235	0.737	10.274	1 067.183
WR: Water Treatment	-	-	-	-	11.503	-	6.078	3.376	6.983	10.522
WS: borehole	-	-	-	-	-	-	-	0.577	2.582	14.919
WS: Measuring facility	-	7.123	1.266	-	-	12.593	89.800	314.117	180.036	293.841
Total	1 281.853	1 892.105	2 060.192	2 769.285	3 319.044	3 743.081	4 078.112	5 117.515	5 648.805	5 526.684

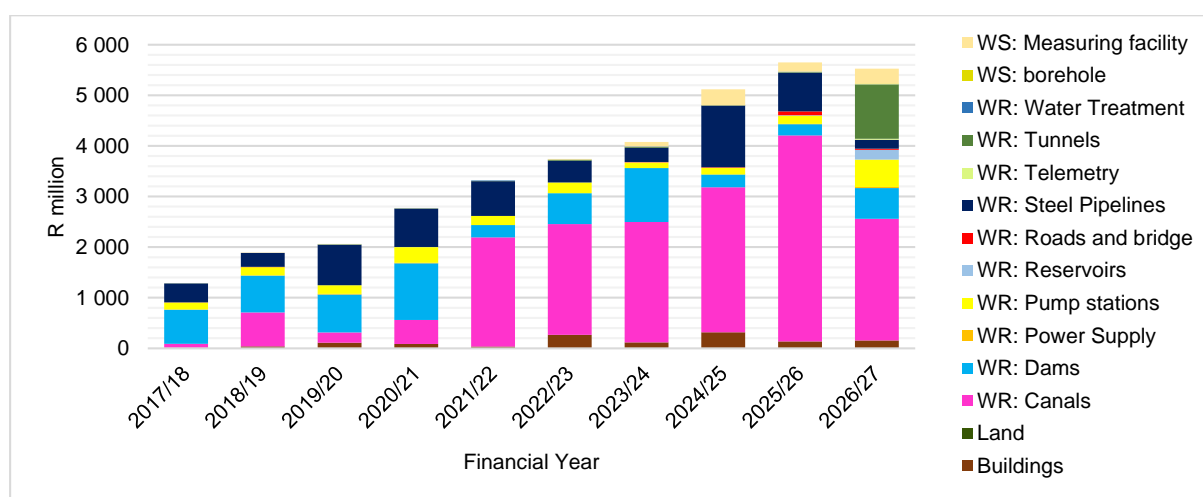


Figure 5.3: Overall capital expenditure cost per asset facility category

Table 5.15: Overall capital expenditure cost per cluster

Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	147.172	322.445	348.956	485.527	632.942	730.517	928.194	988.147	984.118	969.200
Eastern	75.757	155.548	177.226	237.926	285.817	279.862	265.623	276.762	265.476	163.174
Northern	391.727	525.743	616.959	775.758	906.162	921.032	885.076	921.455	1 121.417	1 006.869
Central	667.197	888.369	917.052	1 270.074	1 494.123	1 811.671	1 999.219	2 931.152	3 277.793	3 387.441
Total	1 281.853	1 892.105	2 060.192	2 769.285	3 319.044	3 743.081	4 078.112	5 117.515	5 648.805	5 526.684

Appendix M, Tables M.1 and M.2 show the individual clusters' planned overall capital expenditure per engineering discipline and per asset facility category, respectively.

Total Backlog Clearance

Table 5.16 shows the annual proportion of the: renewals backlog in the total CAPEX cost; upgrades backlog in the total CAPEX cost; total backlog in the total CAPEX cost; total backlog cleared; and the cumulative total backlog cleared.

Table 5.16: Total backlog clearance proportions per year

Backlog Proportions	Financial Year									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Renewals Backlog Share of CAPEX	61%	37%	44%	24%	22%	29%	29%	27%	20%	19%
Upgrades Backlog Share of CAPEX	39%	29%	36%	35%	19%	17%	6%	-	-	-
Total Backlog Share of CAPEX	100%	66%	80%	59%	41%	45%	35%	28%	21%	19%
Share of Total Backlog	10%	9%	12%	11%	10%	12%	11%	10%	8%	7%
Cumulative Total Backlog	10%	19%	31%	42%	52%	64%	74%	84%	93%	100%

5.4.4 Operations and Maintenance (O&M)

Adequately funding asset maintenance ensures that an asset will retain, or be restored to, a state in which it can perform its function. Tables 5.17, 5.18 (and Figure 5.4) and 5.19 show the planned O&M cost components requirements for NWRI Operations per engineering discipline, per asset facility category, and per cluster, respectively.

- The projected annual O&M cost requirement for the first three years (2017/18, 2018/19 and 2019/20) are: R2.623 billion; R3 billion; and R3.393 billion, respectively.
- The projected overheads annual cost requirement for the first three years (2017/18, 2018/19 and 2019/20) are: R436.678 million; R482.429 million; and R530.782 million, respectively.

Table 5.17: O&M cost per engineering discipline

Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Civil	993.518	1 069.827	1 151.997	1 240.478	1 335.756	1 438.351	1 548.826	1 667.787	1 795.884	1 933.821
Electrical	173.954	187.315	201.702	217.194	233.876	251.839	271.182	292.011	314.439	338.590
Mechanical	356.454	383.833	413.314	445.059	479.243	516.052	555.688	598.369	644.328	693.816
Sub-Total Maintenance	1 523.926	1 640.974	1 767.012	1 902.731	2 048.874	2 206.242	2 375.696	2 558.166	2 754.651	2 966.228
Operations	1 099.508	1 358.735	1 625.612	1 736.348	1 854.752	1 981.365	2 116.763	2 261.567	2 416.440	2 582.094
Total O&M	2 623.434	2 999.709	3 392.624	3 639.079	3 903.626	4 187.607	4 492.459	4 819.733	5 171.091	5 548.321
Overheads	436.678	482.429	530.782	567.439	606.664	648.637	693.554	741.625	793.073	848.139
Grand Total	3 060.112	3 482.138	3 923.406	4 206.518	4 510.290	4 836.243	5 186.013	5 561.358	5 964.164	6 396.460

Note:

- *Maintenance costs* are proportions of the CRCs derived using norm ratios for infrastructure maintenance best practices. These costs are meant to cover all maintenance needs (including labour) related to the infrastructure asset components in the Asset Register.

- *Operations costs* are those costs directly associated with the delivery of service (raw water supply) to the water users through the utilisation of the Cluster's infrastructure assets. They are incurred on the schemes, and exclude any maintenance cost elements linked to infrastructure assets.
- *Overheads costs* are those costs not directly linked to the schemes. They include the Directors' Offices, Area Managers' Offices, Operations Head and support functions (excluding the maintenance function).

Table 5.18: O&M cost per asset facility category

Asset Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Buildings	35.282	37.992	40.910	44.052	47.436	51.079	55.002	59.227	63.776	68.674
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	399.344	430.017	463.045	498.610	536.907	578.145	622.550	670.367	721.856	777.299
WR: Dams	503.102	541.743	583.353	628.159	676.405	728.358	784.301	844.541	909.407	979.256
WR: Power Supply	7.441	8.012	8.628	9.290	10.004	10.772	11.599	12.490	13.450	14.483
WR: Pump stations	223.457	240.621	259.102	279.003	300.432	323.507	348.355	375.111	403.922	434.946
WR: Reservoirs	15.705	16.911	18.210	19.609	21.115	22.736	24.483	26.363	28.388	30.569
WR: Roads and bridge	5.415	5.831	6.279	6.761	7.281	7.840	8.442	9.090	9.789	10.540
WR: Steel Pipelines	51.706	55.677	59.953	64.558	69.517	74.856	80.605	86.797	93.463	100.642
WR: Telemetry	3.865	4.162	4.482	4.826	5.197	5.596	6.026	6.489	6.987	7.524
WR: Tunnels	64.739	69.711	75.066	80.831	87.039	93.725	100.923	108.675	117.022	126.010
WR: Water Treatment	2.854	3.073	3.309	3.563	3.837	4.132	4.449	4.791	5.159	5.555
WS: borehole	1.221	1.315	1.416	1.524	1.642	1.768	1.903	2.050	2.207	2.377
WS: Measuring facility	209.795	225.909	243.260	261.944	282.064	303.728	327.056	352.177	379.226	408.354
Sub-Total Maintenance	1 523.926	1 640.974	1 767.012	1 902.731	2 048.874	2 206.242	2 375.696	2 558.166	2 754.651	2 966.228
Operations	1 099.508	1 358.735	1 625.612	1 736.348	1 854.752	1 981.365	2 116.763	2 261.567	2 416.440	2 582.094
Total O&M	2 623.434	2 999.709	3 392.624	3 639.079	3 903.626	4 187.607	4 492.459	4 819.733	5 171.091	5 548.321
Overheads	436.678	482.429	530.782	567.439	606.664	648.637	693.554	741.625	793.073	848.139
Grand Total	3 060.112	3 482.138	3 923.406	4 206.518	4 510.290	4 836.243	5 186.013	5 561.358	5 964.164	6 396.460

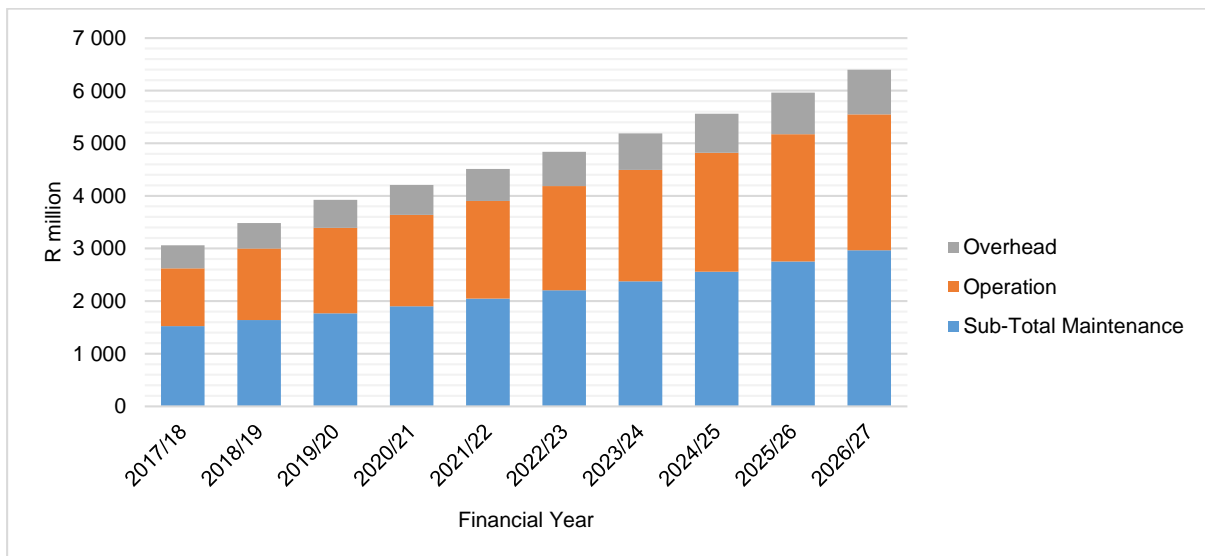


Figure 5.4: O&M cost

Table 5.19: O&M cost components per cluster

Total Maintenance (M) Per Cluster										
Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	341.948	368.212	396.494	426.947	459.740	495.051	533.074	574.018	618.107	665.581
Eastern	111.846	120.436	129.686	139.647	150.373	161.923	174.360	187.752	202.172	217.700
Northern	288.746	310.924	334.805	360.520	388.210	418.028	450.135	484.709	521.938	562.026
Central	781.386	841.402	906.028	975.617	1 050.551	1 131.240	1 218.128	1 311.688	1 412.435	1 520.920
Total	1 523.926	1 640.974	1 767.012	1 902.731	2 048.874	2 206.242	2 375.696	2 558.166	2 754.651	2 966.228
Total Operation (O) Per Cluster										
Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	77.542	109.143	142.897	153.395	164.671	176.785	189.798	203.780	218.801	234.941
Eastern	223.272	255.243	289.485	307.735	327.147	347.797	369.764	393.134	417.997	444.449
Northern	168.881	300.176	431.813	464.315	499.281	536.899	577.371	620.915	667.766	718.176
Central	629.812	694.172	761.416	810.903	863.653	919.884	979.829	1 043.738	1 111.876	1 184.528
Total	1 099.508	1 358.735	1 625.612	1 736.348	1 854.752	1 981.365	2 116.763	2 261.567	2 416.440	2 582.094
Totals O&M Per Cluster (EXCL. Overhead)										
Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	419.490	477.356	539.391	580.342	624.411	671.836	722.873	777.798	836.908	900.523
Eastern	335.118	375.679	419.171	447.382	477.520	509.720	544.124	580.886	620.169	662.149
Northern	457.627	611.100	766.618	824.835	887.492	954.927	1 027.506	1 105.624	1 189.703	1 280.202
Central	1 411.198	1 535.574	1 667.444	1 786.520	1 914.204	2 051.124	2 197.957	2 355.426	2 524.311	2 705.448
Total	2 623.434	2 999.709	3 392.624	3 639.079	3 903.626	4 187.607	4 492.459	4 819.733	5 171.091	5 548.321
Total O&M Per Cluster (INCL. Overhead)										
Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	565.179	636.912	713.835	765.731	821.439	881.241	945.439	1 014.360	1 088.355	1 167.799
Eastern	397.770	446.107	497.936	531.400	567.146	605.334	646.133	689.724	736.300	786.070
Northern	590.831	754.374	920.723	990.591	1 065.778	1 146.692	1 233.769	1 327.480	1 428.332	1 536.870
Central	1 506.333	1 644.745	1 790.912	1 918.796	2 055.926	2 202.976	2 360.673	2 529.794	2 711.177	2 905.720
Total	3 060.112	3 482.138	3 923.406	4 206.518	4 510.290	4 836.243	5 186.013	5 561.358	5 964.164	6 396.460

Appendix I, Tables I.3 and I.4 show the individual clusters' planned operations and maintenance costs per engineering discipline and per asset facility category, respectively.

5.4.5 Impairments and Disposals

DWS's NWRI needs to develop relevant disposal plans where there are assets marked for disposal. The disposal plans need to identify the appropriate disposal methods and associated costs.

5.5 Total Costs

5.5.1 Total cost requirement

Tables 5.20 and 5.21 show the overall cost requirements for the NWRI Operations per cost component and per cluster, respectively.

- The overall annual cost requirement for the first three years (2017/18, 2018/19 and 2019/20) are: R4.342 billion; R5.374 billion; and 5.983 billion, respectively.

Table 5.20: Total cost requirement per cost component

Cost Component	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Capital Expenditure (CAPEX)										
Renewals	754.792	702.602	1 135.678	1 653.588	2 300.519	2 670.530	3 264.483	4 762.835	5 234.733	5 212.429
Upgrades and New Capital	527.061	1 189.502	924.514	1 115.696	1 018.525	1 072.551	813.629	354.680	414.072	314.255
Sub-Total CAPEX	1 281.853	1 892.105	2 060.192	2 769.285	3 319.044	3 743.081	4 078.112	5 117.515	5 648.805	5 526.684
Operations and Maintenance (O&M)										
Operations	1 099.508	1 358.735	1 625.612	1 736.348	1 854.752	1 981.365	2 116.763	2 261.567	2 416.440	2 582.094
Maintenance	1 523.926	1 640.974	1 767.012	1 902.731	2 048.874	2 206.242	2 375.696	2 558.166	2 754.651	2 966.228
Sub-Total O&M	2 623.434	2 999.709	3 392.624	3 639.079	3 903.626	4 187.607	4 492.459	4 819.733	5 171.091	5 548.321
Total	3 905.287	4 891.813	5 452.816	6 408.364	7 222.670	7 930.688	8 570.572	9 937.248	10 819.896	11 075.005
Overheads	436.678	482.429	530.782	567.439	606.664	648.637	693.554	741.625	793.073	848.139
Grand Total	4 341.965	5 374.242	5 983.598	6 975.803	7 829.334	8 579.324	9 264.126	10 678.873	11 612.968	11 923.144

Table 5.21: Total cost requirement per cluster

Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	712.351	959.357	1 062.791	1 251.258	1 454.382	1 611.757	1 873.633	2 002.507	2 072.473	2 137.000
Eastern	473.527	601.656	675.162	769.326	852.963	885.196	911.756	966.485	1 001.776	949.243
Northern	982.557	1 280.116	1 537.682	1 766.348	1 971.940	2 067.724	2 118.845	2 248.935	2 549.749	2 543.739
Central	2 173.530	2 533.114	2 707.963	3 188.870	3 550.049	4 014.647	4 359.891	5 460.946	5 988.970	6 293.162
Total	4 341.965	5 374.242	5 983.598	6 975.803	7 829.334	8 579.324	9 264.126	10 678.873	11 612.968	11 923.144

Appendix M, Table M.3 shows the individual clusters' planned overall cost requirements per cost component.

5.5.2 Total Cost Requirement versus the Approved Budget

Table 5.22 shows a comparison between the derived total cost requirement and the total approved budget for the NWRI Clusters for the financial year 2017/18. Both the CAPEX and the O&M approved budgets are far below the respective derived total costs requirements. If this continues to be the case, there will be a perpetual compromise on the NWRI's asset life cycle works; thereby further worsening the accumulation of the already high works backlog (refer to Sections 4.4 and 5.3). This will potentially lead to a possible total collapse of the NWRI's infrastructure.

Table 5.22: Total cost requirement versus the approved budget for 2017/18

Description	Financial Year 2017/18 (R million)		
	Total CAPEX	Total O&M (incl. Overheads)	Total
Derived Total Cost Requirement	1 281.853	3 060.113	4 341.966
Approved Budget	500.000	1 000.000	1 500.000
Budget Gap	781.853	2 060.113	2 841.966

5.6 Funding Requirement

Table 5.23 presents the minimum revenue requirements (equivalence of the overall cost requirements) necessary to sustain the NWRI's infrastructure. For the NWRI to be able to cover all its cost requirements, its revenue generation ought to be at least equivalent to the planned overall cost requirements (Table 5.22).

The minimum revenue which ought to be generated by the NWRI during the projected 10-year period under review has to be between about R4.342 billion and about R11.923 billion per annum. In the event that such revenue cannot be generated through user charges (an indication that the NWRI is not financially self-sustainable), external funding would need to be considered. Such funding can be in the form of fiscal support, cross subsidisation or debt raised through such institutions as TCTA.

Table 5.23: Revenue requirement

	Financial Year (Amounts in Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Minimum Revenue Requirement	4 341.965	5 374.242	5 983.598	6 975.803	7 829.334	8 579.324	9 264.126	10 678.873	11 612.968	11 923.144

5.7 Summary

The NWRI's total backlog has a current replacement cost (CRC) (*the cost of replacing an existing asset with a modern asset of equivalent capacity*) of about R38.922 billion: about R31.057 billion for renewal/condition backlog; and about R7.866 billion for upgrades backlog. However, in practice, not all the asset components constituting the backlog need to be completely replaced. Rather, some of the asset components require some refurbishment (electrical and mechanical related) or rehabilitation (civil related); which cost less than complete replacements.

Consequently, the overall cost to clear the NWRI's total backlog (which has a CRC of about R38.922 billion) would be less than this CRC amount. Accordingly, the derived financial requirement (*amount of money required*) to clear the NWRI's total backlog is about R13.649 billion: about R9.483 billion for renewal/condition backlog; and about R4.166 billion for upgrades backlog.

The NWRI's total planned annual cost requirement for the first 3 years (2017/18, 2018/19, and 2019/20) are: R4.342 billion; R5.374 billion; and R5.984 billion, respectively. These are made up of:

- renewals cost requirement of about: R754.792 million; R702.602 million and R1.136 billion, respectively for the first three years;
- upgrades cost requirement of about: R527.061 million; R1.189 billion and R924.514 million, respectively for the first three years; and
- O&M cost requirement of about: R2.623 billion; R3 billion; and R3.393 billion, respectively for the first three years, and
- overheads cost requirement of about: R436.678 million; R482.429 million; and R530.782 million, respectively for the first three years.

The total approved budgets for the NWRI Operations for the financial year 2017/18 were R500 million and R1.167 billion for CAPEX and O&M (including overheads), respectively. These approved budgets are far below the respective derived total costs requirements of about R1.282 billion and R3.060 billion, in that order. If this continues to be the case, there will be a perpetual compromise on the NWRI's asset life cycle works; thereby further worsening the accumulation of the already high works backlog. This will potentially lead to a possible total collapse of the NWRI's infrastructure, resulting in the NWRI failing to meet its required levels of service.

The minimum revenue which ought to be generated by the NWRI's clusters, to adequately meet its funding requirements, during the projected 10 year period under review is between about R4.342 billion and about R11.923 billion per annum. In the event that such revenue cannot be generated through user charges (an indication that the NWRI is not financially self-sustainable), external funding would need to be considered. Such funding can be in the form of fiscal support, or debt raised through such institutions as TCTA, form m of fiscal support, cross subsidisation or debt raised through such institutions as TCTA.

6. RECOMMENDATIONS

6.1 Overview

This section provides recommendations for improvement on challenges identified throughout the preceding sections of this AMP, with a particular focus on best practices and AMP monitoring and control.

6.2 Practices Improvement

Key areas of concern, and recommended improvement actions thereof, identified in the preceding sections of this AMP are summarized in Table 6.1.

Table 6.1: Recommended areas for improvement

No.	Area for Improvement	Issue Description	Recommended Action
1	Asset Life Cycle Works Management		
1.1	Backlog (Maintenance, Renewals and Upgrades)	<p>The NWRI's total backlog has a CRC of about R38.922 billion: about R31.057 billion for condition backlog; and about R7.866 billion for upgrades backlog. The derived financial requirement to clear the NWRI's total backlog is about R13.649 billion: about R9.483 billion for renewal/condition backlog; and about R4.166 billion for upgrades backlog.</p> <p>Key factors contributing towards such high backlog include:</p> <ul style="list-style-type: none"> ▪ Budget cuts; ▪ Under-staffing of the NWRI; ▪ Long periods without a maintenance contractor; ▪ Poor performance of maintenance contractors; and ▪ Long turnaround times from the Supply Chain Department. 	<p><u>The NWRI needs to urgently address the noted financial, procurement and human resources challenges (as further recommended in this Table) so as to avoid a possible total collapse of the NWRI's infrastructure assets.</u></p>
1.2	Works Planning	<p>Asset life cycle works (e.g. maintenance, renewals, upgrades, etc.) planning is being done on an ad hoc basis, without systematic consideration of each and every asset component. This is evident in the NWRI's 'Maintenance' Plans which do not identify the asset components by their unique identity numbers.</p> <p>This poses a risk of having some asset components not catered for on time, increasing unplanned, reactive works.</p>	<p>Asset life cycle works (e.g. maintenance, renewals, upgrades, etc.) planning needs to be done systematically on a component by component basis (with clearly indicated asset component numbers, consistent with those captured in the SAP Asset Register.</p> <p>Also, prioritisation of the works need to be done on an asset facility category basis with due consideration of the asset components' criticality and condition grading, as done in this AMP.</p>
2	Asset Information Management		

No.	Area for Improvement	Issue Description	Recommended Action
2.1	Asset Register as the indispensable key data source for AMP development	<p>The quality and usefulness of an AMP is highly dependent on the completeness and accuracy of the asset register used in the development of the AMP.</p> <p>Accordingly, the asset life cycle management activities and works (such as maintenance, renewals, upgrades and new capital, and disposals) recommended for the NWRI in this AMP are highly dependent on the asset component condition, criticality and utilisation grading captured in the asset register used in the development of this AMP.</p> <p>However, during the data gathering and AMPs review workshops conducted during the development of this AMP, the Cluster and scheme personnel did not fully concur with some of the asset component counts, condition as well as utilisation grading; indicating the possibility of some misalignment between the asset register and the prevailing situation on the ground.</p>	<p>The NWRI needs to urgently conduct physical asset verification and assessments (extent, condition, criticality, utilisation, etc.) for all its immovable assets and develop a comprehensive asset register, inclusive of all crucial asset component details, such as asset component sizes, material of construction, condition, criticality, utilisation, etc. Thereafter, the NWRI needs to conduct similar assessments at least every five years as contemplated in Section 13 of the GIAMA.</p> <p>The abovementioned asset assessments need to be conducted by adequately qualified and experienced professionals.</p>
2.2	Current Replacement Cost (CRC)	<p>Each and every asset component in the asset register needs to have a corresponding CRC. The CRCs are useful in the determination and projection of optimal asset life cycle management works, such as O&M, renewals, upgrades and new capital, etc., in line with international best practices.</p> <p>Ideally, the CRC of an asset component needs to be determined by multiplying the unit cost rate (cost per unit size, ideally obtained from suppliers) by the size of the asset component. Thus, the asset register needs to adequately capture such details as asset component sizes, material of construction, etc.</p> <p>However, such asset component details are not fully captured for some asset components in the asset register used in the development of this AMP. As a result, some of the CRCs presented in this AMP were determined by adjusting the provided acquisition costs with PPI and an uncertainty factor (where the sizes were not available); hence the projected optimal asset life cycle management costs may be on the conservative side.</p>	<p>The above-recommended assessments for the NWRI immovable assets need to adequately capture such asset component details as sizes and material of construction. This will enable the determination of more accurate CRCs for all asset components, and consequently projection of more accurate optimal asset life cycle management costs.</p>
3	Financial Management		
3.1	Budget cuts	<p>The approved budgets (operations and maintenance, renewals and upgrades) for the NWRI are often lower than what is required. This is resulting in the NWRI failing to adequately execute the required asset life cycle works for its infrastructure.</p>	<p>The DWS needs to allocate adequate budgets as recommended in this AMP, in line with GIAMA, so as to ensure that the NWRI's infrastructure asset life cycle works are adequately executed; thereby enabling the NWRI to effectively and efficiently meet its required levels of service.</p>

No.	Area for Improvement	Issue Description	Recommended Action
3.2	O&M Costs reporting	Some of the O&M costs being incurred by some of the schemes being operated and maintained by other institutions (such as irrigation boards and water boards) are currently unknown to the NWRI as no financial reports are being submitted to the Cluster by the institutions.	The NWRI needs to liaise with the respective institutions and agree on frequent O&M reports, preferably on a quarterly basis.
4	Human Resources Management		
4.1	Under-resourcing	<p>The NWRI Operations is seriously under-resourced: only 1 598 out of the 2 766 (i.e. about 58%) approved positions (as per the 2014 approved structure) are currently filled, representing a vacancy rate of about 42%. Compared to the 2007 approved structure (which mostly better reflected the needs of the NWRI Operations), only 1 598 out of the 3 590 (i.e. about 45%) approved positions are currently filled, representing a vacancy rate of about 55%.</p> <p>Such vacancy rates are way much higher than the 10% or less target specified in the DWS Annual Performance Plan for 2017/18 to 2019/20. In addition, the very high vacancy rate has considerable negative impact on the execution of adequate life cycle activities and works (e.g. operation and maintenance, renewals and upgrades) of the Cluster's infrastructure assets, as evidenced by the high backlogs highlighted in the preceding sub-sections.</p>	<p>The NWRI needs to urgently embark on a serious recruitment drive, aiming at achieving the 10% or less vacancy rate target specified in its Annual Performance Plan for 2017/18 to 2019/20. Failure to do so will continue to compromise life cycle activities and works, piling up of works backlog leading to a possible total collapse of its water resources infrastructure.</p> <p>This AMP has made provision for the DWS to fill all the operation and maintenance and other critical support vacancies, with appropriately qualified and experienced personnel, within the next two years.</p>
4.2	Expertise Generation Gap	Furthermore, there is a considerable generation gap, especially in the key areas of expertise (notably, operations, maintenance and engineering technical support), with most of those fully-fledged and fully conversant with the Cluster's infrastructure either resigning or nearing retirement age.	<p>The NWRI needs to develop/revise and effectively execute a succession plan for its personnel (particularly in the critical areas of operations, maintenance and engineering technical support).</p> <p>The NWRI needs to develop and effectively execute employee retention mechanisms to curb the brain drain, especially for the abovementioned critical areas.</p>
5	Procurement Management		
5.1	Immovable Asset Maintenance Contract	Some of the Clusters (Northern, Eastern and Southern) do not have an immovable asset maintenance contract in place. This poses a high risk of service delivery failure as a result of deteriorating asset condition.	Urgently appoint immovable asset maintenance contractors for the Clusters, and work towards clearing the renewals and upgrades backlogs identified in this AMP.
5.2	Turnaround times	There are too long delays in the DWS procurement process; resulting in significant delays in the execution of the NWRI's asset life cycle works, including emergency works. This is contributing significantly to the NWRI's high backlogs highlighted in this AMP.	The DWS needs to urgently revise its internal procurement processes so as not to unnecessarily delay the execution of the NWRI's asset life cycle works.

No.	Area for Improvement	Issue Description	Recommended Action
5.3	Maintenance contractor management	Poor performance by the maintenance contractor.	The NWRI needs to appoint dedicated project managers and quality control personnel to ensure the NWRI's asset life cycle works are appropriately executed, timeously and correctly.
5.4	Operation and Maintenance Contracts with other parties	<p>A significant proportion of the NWRI's schemes are being operated and maintained by other parties (such as Water Boards, Irrigation Boards, Water User Associations, etc.). However, in a good number of these cases, there are no formal agreements in place, and in some cases the agreements have expired.</p> <p>Thus, the risk is high that some of the NWRI's assets are not being adequately operated and maintained.</p>	The DWS needs to urgently set up formal agreements with the parties (such as Water Boards, Irrigation Boards, Water User Associations, etc.) operating and maintaining the schemes on behalf of DWS, with clear, measurable performance targets.
6	Risk Management		
6.1	Infrastructure assets-related risks	<p>The following asset-related risks will result in the Cluster failing to meet its required levels of service:</p> <p><i>Condition risk:</i> Failure by the NWRI's assets to deliver the required service due to deteriorated physical condition.</p> <p><i>Capacity risk:</i> Failure by the NWRI's assets to deliver the required service as a result of it exceeding its design capacity/stressed.</p>	<p>The NWRI needs to provide the Clusters with enabling policies (finance, procurement, human resources, etc.) and resources necessary for it to adequately carry out the asset life cycle works as recommended in this AMP; thereby enabling the Cluster to effectively and efficiently meet its required levels of service.</p> <p><u>Failure by the NWRI to adequately carry out the asset life cycle works as recommended in this AMP, will ultimately lead to a total collapse of its infrastructure; resulting in the NWRI failing to meet its required levels of service.</u></p>
6.2	Risk Likelihood	<p>Risk (expected loss) is calculated by determining the product of the likelihood of the risk and the total amount of loss (impact) when the risk occurs:</p> <p><i>Expected Loss (Risk) = Risk Likelihood x Total Loss (Impact)</i></p> <p>For this Cluster, however, risk likelihood per asset component was not captured in the Asset Register used in the development of this AMP. Hence, an in-depth risk analysis could not be conducted.</p>	Capture risk likelihood per asset component in the infrastructure asset register, so that the next update of this AMP can incorporate an in-depth risk analysis.

6.3 Asset Management Planning, Monitoring and Evaluation

The AMP development, monitoring and evaluation recommendations are consistent with the GIAMA and DWS Asset Management Policy:

- The NWRI needs to ensure that the Directors for the Operational Clusters, as *controllers* for the Clusters' infrastructure assets: "safeguard and maintain" the assets; "maintain a system of internal control" over the assets; "maintain an asset register" for the assets; and

appoint an Asset Manager at the Cluster level, as contemplated in Section 5 of the DWS Asset Management Policy.

It is recommended that:

- The Asset Manager sets up a dedicated Asset Management team (Asset Management Specialists) at the Cluster level to effectively plan, and effectively monitor the implementation of the AMPs for all the schemes in the cluster.
- The NWRI appoints a dedicated team in charge AMPs planning, monitoring and evaluation team (at Head Office).
- The AMPs need to be updated annually to inform the budget and after budget allocations have been finalised by the National Treasury, and incorporated into the DWS Strategic Plan, as contemplated in Section 12 of the GIAMA.

6.4 Summary

In order to effectively and efficiently deliver its service (supply of raw water) to its irrigation, and domestic and industrial water users (Section 1), meeting the required levels of service (Section 2), and meeting the raw water demand (Section 3), the Cluster needs to execute the recommended asset life cycle management activities and works (Section 4) in line with the planned budgets and timeframes (Section 5). Furthermore, a number of recommendations made for process improvement, particularly with regards to the DWS immovable asset register, Asset Management Information System, financial management, human resources management, procurement management, as well as risk management need to be implemented. Pro-activeness and forward-looking, taking care of any changes in the assumptions made in this AMP are also of vital importance.

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APPENDICES

APPENDIX A – Asset Register (Immovable Assets) for NWRI Operations

<Refer to soft-copy file>

APPENDIX B – Strategic Context

1. DWS's Vision, Mission, and Organisational Goals & Objectives

Figure B.1 shows the link between this AMP and the DWS's Vision.



Figure B.1: AMP Alignment with DWS's Vision, Mission, and Organisational Goals & Objectives

Vision

Equitable and sustainable water and sanitation that support socio-economic growth and development of the well-being of current and future generations.

Mission

To ensure the universal access of all South Africans to equitable water resources and sustainable water and sanitation services, by:

- Protecting, developing, conserving, managing and regulating water resources;
- Managing, regulating and providing efficient and effective water and sanitation

services;

- Providing strategic leadership and evidence based policy direction to a coordinated water and sanitation sector for improved sector performance and service delivery;
- Building the skills and capabilities of the sector and enhancing information management to inform decision making; and
- Enhancing communication and stakeholder partnerships with communities and sector constituencies to advance the national development agenda.

Values

- Promoting and maintaining high standards of professional ethics.
- Utilising resources efficiently and effectively.
- Providing services impartially, fairly, equitably and without bias.
- Responding to people's needs; citizens are encouraged to participate in policy-making.
- Rendering an accountable, transparent, and development-oriented public administration.

Organisational Goals and Objectives

- Enhanced and protected water as a resource across the value chain.
- Equitable access to reliable, sustainable and acceptable water resources and water and sanitation services.
- An enhanced contribution to socio-economic development and transformation by the sector.
- An efficient, effective and development oriented water and sanitation sector.
- Sound cooperative governance and an active and engaged citizenry.

APPENDIX C – Stakeholders

1. Key Stakeholders

The key stakeholders are listed in Table C.1.

Table C.1: Key Stakeholders

Stakeholder
Catchment Management Agency (CMA)
Water Service Authorities (WSAs)
Water Service Providers (WSPs)
The customers served through NWRI immovable assets: <ul style="list-style-type: none">▪ Water users (for irrigation, and for D&I).
Key Internal Stakeholders <ul style="list-style-type: none">▪ DWS Head Office;▪ Strategic Asset Management.▪ The Northern Operations Cluster.▪ The Eastern Operations Cluster.▪ The Southern Operations Cluster.▪ The Central Operations Cluster.

APPENDIX D – Raw Water Volumes

Table D.1A: Principal water users - Northern

Principal Customer Name	Water User Category	Registered Water Volume (Mm ³ pa)
Loskop Irrigation Board	Irrigation	124.245
Crocodile River W-Tvl Irrigation Board	Irrigation	118.358
Letaba Water User Association	Irrigation	116.549
Magalies Water	Domestic & Industrial	109.530
Hartbeespoort Irrigation Board	Irrigation	93.950
Tshwane Metropolitan Municipality	Domestic & Industrial	65.706
Roodeplaat Temba Water Services Trust	Domestic & Industrial	54.750
Total		683.088
% of Total Cluster Registered Volume		51%

Table D.1B: Principal water users - Eastern

Principal Customer Name	Water User Category	Registered Water Volume (Mm ³ pa)
Umgeni Water	Domestic & Industrial	452.000
Mhlathuze Water	Domestic & Industrial	104.974
Uthukela Water	Domestic & Industrial	65.378
Makhathini Cotton Farming	Irrigation	35.230
KZ282 - Umhlathuze Local Municipality	Domestic & Industrial	33.796
Total		691.378
% of Total Cluster Registered Volume		60%

Table D.1C: Principal water users - Southern

Principal Customer Name	Water User Category	Registered Water Volume (Mm ³ pa)
Great Fish River Water Users Association	Irrigation	426.262
City Of Cape Town Metropolitan Municipality	Domestic & Industrial	210.900
Lower Sundays River Water User Association	Irrigation	156.776
Sentraal-Breerivier Wgv	Irrigation	142.103
Laer Olifants Rivier Wgv	Irrigation	112.362
Total		1 048.403
% of Total Cluster Registered Volume		57%

Table D.1D: Principal water users - Central

Principal Customer Name	Water User Category	Registered Water Volume (Mm ³ pa)
Eskom Holdings	Domestic & Industrial	420.420
Vaalharts Water User Association	Irrigation	348.104
Sedibeng Water: Bothaville	Domestic & Industrial	256.400
Vanderkloof Water User Association	Irrigation	192.847
Orange-Riet Water User Association	Irrigation	182.696
Mid-Vaal Water Company	Domestic & Industrial	178.140
Kakamas Water User Association	Irrigation	156.287
Sasol Synfuels Secunda	Domestic & Industrial	123.005
Rand Water	Domestic & Industrial	112.259
Bloem Water	Domestic & Industrial	102.777
Sasol South Africa	Domestic & Industrial	95.300
Midvaal Water	Domestic & Industrial	86.870
Renoster River Water User Association	Irrigation	86.592
Total		2 341.697
% of Total Cluster Registered Volume		50%

Table D.2A: Principal schemes - Northern

Scheme Name	Registered Raw Water Volume (Mm ³ pa)		
	Domestic & Industrial	Irrigation	Total
Crocodile River West GWS	90.550	118.358	208.908
Groot Letaba River GWS	46.546	117.290	163.836
Loskop GWS	28.156	126.803	154.958
Hartbeespoort GWS	23.848	98.777	122.626
Leeukraal Dam	102.206	-	102.206
Total			752.533
% of Total Cluster Registered Volume			56%

Table D.2B: Principal schemes - Eastern

SCHEME NAME	Registered Raw Water Volume (Mm ³ pa)		
	Domestic & Industrial	Irrigation	Total
Umgenei River GWS	396.156	0.483	396.639
Tugela Mhlathuze Rivers GWS	146.029	95.650	241.679
Pongola River GWS	4.604	162.370	166.974
Pongolapoort GWS	18.263	105.169	123.432
Ngagane River GWS	75.019	5.914	80.933
Total			1 009.657
% of Total Cluster Registered Volume			88%

Table D.2C: Principal schemes - Southern

Scheme Name	Registered Raw Water Volume (Mm ³ pa)		
	Domestic & Industrial	Irrigation	Total
Orange - Fish GWS	4.371	416.710	421.081
Riversonderend - Berg River GWS	125.377	154.582	279.959
Lower Sundays Scheme	59.977	156.284	216.261
Breede River GWS (Brandvlei&Kwaggaskloof Dams)	2.324	197.408	199.732
Lower Berg River GWS (Voelvllei&Misverstand Dams)	95.630	26.165	121.795
Total			1,238.828
% of Total Cluster Registered Volume			68%

Table D.2D: Principal schemes - Central

Scheme Name	Registered Raw Water Volume (Mm ³ pa)		
	Domestic & Industrial	Irrigation	Total
Vaal Dam	929.700	59.716	989.415
Orange River GWS	21.893	532.926	554.819
Orange River (Upington Islands)	67.036	334.413	401.449
Usutu-Vaal GWS	379.316	-	379.316
Vaalharts Canals	13.308	329.119	342.427
Total			2 667.427
% of Total Cluster Registered Volume			57%

APPENDIX E – Asset Details

Table E.01A: Asset extent, acquisition costs, CRC and values per asset facility category and per engineering discipline

Asset Facility Category	Engineering Discipline	No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
Borehole	Civil	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-
	Mechanical	43	19.923	10.523	58.556	18.655	32%
Buildings	Civil	4 873	1 756.385	867.709	4 225.346	1 587.430	38%
	Electrical	04	1.097	0.488	3.062	1.169	38%
	Mechanical	02	3.600	3.046	6.863	3.539	52%
Canals	Civil	11 429	11 860.642	7 108.882	78 968.813	28 059.477	36%
	Electrical	-	-	-	-	-	-
	Mechanical	02	0.313	0.128	0.919	0.349	38%
Dams	Civil	1 756	34 267.836	28 932.527	100 616.042	54 919.160	55%
	Electrical	347	166.832	76.996	464.907	164.297	35%
	Mechanical	5 969	2 541.250	1 392.279	12 452.879	5 704.589	46%
Measuring facilities	Civil	3 094	3 209.495	2 052.952	9 324.097	4 094.150	44%
	Electrical	239	26.650	7.353	78.201	36.105	46%
	Mechanical	48	16.121	12.652	130.661	81.311	62%
Pipelines	Civil	639	7 196.782	5 309.852	19 492.428	8 109.270	42%
	Electrical	36	111.057	77.340	239.479	176.376	74%
	Mechanical	440	341.321	209.935	865.500	382.217	44%
Power supply	Civil	24	14.033	5.718	40.756	21.178	52%
	Electrical	108	52.164	27.317	136.738	65.467	48%
	Mechanical	13	2.234	0.637	19.720	2.470	13%
Pump stations	Civil	217	743.705	575.238	1 629.662	971.699	60%
	Electrical	1 010	583.670	310.613	2 875.564	1 395.231	49%
	Mechanical	1 932	681.179	349.440	2 710.625	1 423.569	53%
Reservoirs	Civil	131	342.745	254.525	940.951	443.078	47%
	Electrical	02	0.377	0.322	0.519	0.275	53%
	Mechanical	14	11.186	8.108	31.745	16.811	53%
Roads	Civil	171	176.804	148.249	1 171.352	568.415	49%

Asset Facility Category	Engineering Discipline	No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
	Electrical	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-
Telemetry	Civil	-	-	-	-	-	-
	Electrical	43	39.662	12.829	85.895	46.470	54%
	Mechanical	-	-	-	-	-	-
Tunnels	Civil	204	8 881.857	6 419.889	25 240.721	13 114.873	52%
	Electrical	10	2.023	0.581	5.947	3.113	52%
	Mechanical	113	24.305	9.193	86.951	39.896	46%
Water Treatment	Civil	79	45.777	27.181	128.280	47.704	37%
	Electrical	02	0.541	0.231	1.589	0.498	31%
	Mechanical	-	-	-	-	-	-
Sub-total Infrastructure	-	32 994	73 121.568	54 212.734	262 034.767	121 498.840	46%
Land - owned land	-	335	6 715.958	6 472.176	19 738.578	19 738.578	100%
Land - servitudes	-	836	1 074.926	1 073.547	3 032.374	3 032.374	100%
Sub-total Land	-	1 171	7 790.884	7 545.723	22 770.952	22 770.952	100%
Total	-	34 165	80 912.452	61 758.457	284 805.719	144 269.792	51%

Table E.01B: Asset extent, acquisition costs, CRC and values per engineering discipline summary

Engineering Discipline	No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
Civil	22 617	68 496.062	51 702.723	241 778.447	111 936.434	46%
Electrical	1 801	984.073	514.070	3 891.901	1 889.001	49%
Mechanical	8 576	3 641.433	1 995.941	16 364.419	7 673.406	47%
Sub-total Infrastructure	32 994	73 121.568	54 212.734	262 034.767	121 498.840	46%
Land - owned land	335	6 715.958	6 472.176	19 738.578	19 738.578	100%
Land - servitudes	836	1 074.926	1 073.547	3 032.374	3 032.374	100%
Sub-total Land	1 171	7 790.884	7 545.723	22 770.952	22 770.952	100%
Total	34 165	80 912.452	61 758.457	284 805.719	144 269.792	51%

Table E.02A: Asset extent, acquisition costs, CRC and values (per facility category) - Northern Cluster

Asset Facility Category	Facilities		No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
	Unit	Quantity						
Borehole	No.	39	39	17.778	9.090	52.251	15.000	29%
Buildings	No.	996	1 098	394.147	204.336	923.800	353.995	38%
Canals	km	2565	4 253	1 417.776	686.101	17 071.618	6 134.808	36%
Dams	No.	114	2 497	10 193.062	8 546.520	31 335.775	16 135.225	51%
Measuring facilities	No.	963	1 184	1 264.388	777.354	3 748.629	1 570.827	42%
Pipelines	km	398	175	477.660	284.844	2 849.844	838.233	29%
Power supply	No.	19	21	6.444	2.537	18.543	4.757	26%
Pump stations	No.	21	151	24.457	17.834	75.695	48.922	65%
Reservoirs	No.	33	33	14.848	9.800	43.639	15.652	36%
Roads	km	252	14	4.762	4.130	14.331	6.316	44%
Telemetry	No.	06	12	3.953	0.433	10.620	3.770	36%
Tunnels	km	0	01	2.291	1.247	6.735	3.906	58%
Water Treatment	No.	20	20	16.663	11.541	50.169	17.811	36%
Sub-total Infrastructure	-	-	9 498	13 838.230	10 555.765	56 201.648	25 149.309	45%
Land - owned land	Ha	-	107	868.459	854.797	2 552.448	2 552.448	100%
Land - servitudes	Ha	-	252	151.485	151.383	445.223	445.223	100%
Sub-total Land	-	-	359	1 019.943	1 006.180	2 997.671	2 997.671	100%
Total	-	-	9 857	14 858.173	11 561.946	59 199.319	28 146.980	48%

Table E.02B: Asset extent, acquisition costs, CRC and values (per facility category) - Eastern Cluster

Asset Facility Category	Facilities		No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
	Unit	Quantity						
Buildings	No.	340	341	124.395	64.622	312.002	115.863	37%
Canals	km	172	523	290.365	177.458	2 022.570	737.537	36%
Dams	No.	23	1 053	5 040.735	4 360.804	13 929.538	8 134.752	58%
Measuring facilities	No.	173	201	270.397	181.248	755.484	335.333	44%
Pipelines	km	54	64	306.976	221.126	872.598	315.253	36%
Power supply	No.	3	3	1.407	0.803	3.128	1.457	47%
Pump stations	No.	9	317	87.188	43.385	342.860	153.405	45%
Reservoirs	No.	7	7	2.784	2.213	4.942	2.193	44%
Roads	km	77	20	65.645	59.863	123.677	56.341	46%
Telemetry	No.	4	5	6.987	6.067	10.056	5.434	54%
Tunnels	km	0.144	1	0.165	0.131	19.435	6.899	36%
Water Treatment	No.	3	3	0.577	0.096	0.847	0.202	24%
Sub-total Infrastructure	-	-	2 538	6 197.622	5 117.818	18 397.135	9 864.668	54%
Land - owned land	Ha	-	21	729.023	727.329	2 142.638	2 142.638	100%
Land - servitudes	Ha	-	61	52.659	52.659	154.783	154.783	100%
Sub-total Land	-	-	82	781.682	779.989	2 297.422	2 297.422	100%
Total	-	-	2 620	6 979.304	5 897.806	20 694.557	12 162.089	59%

Table E.02C: Asset extent, acquisition costs, CRC and values (per facility category) - Southern Cluster

Asset Facility Category	Facilities		No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
	Unit	Quantity						
Borehole	No.	2	2	1.105	0.738	3.248	2.000	58%
Buildings	No.	550	797	192.804	97.840	484.692	197.342	41%
Canals	km	946	1 507	3 230.189	1 788.237	11 328.601	4 402.287	39%
Dams	No.	158	2 702	10 331.741	8 285.391	31 328.175	17 364.272	55%
Measuring facilities	No.	1 053	1 086	984.855	674.371	2 945.505	1 421.224	48%
Pipelines	km	151	217	533.319	360.389	1 854.300	749.320	40%
Power supply	No.	4	06	2.177	0.858	6.398	2.326	36%
Pump stations	No.	17	420	243.631	132.480	812.446	601.501	74%
Reservoirs	No.	22	22	49.058	34.383	144.184	53.173	37%
Roads	km	175	96	65.828	53.942	777.376	384.534	49%
Telemetry	No.	10	10	2.441	1.545	5.763	3.179	55%
Tunnels	km	2.447	207	3 616.972	2 627.824	10 964.422	5 734.225	52%
Water Treatment	No.	11	11	2.643	1.169	7.690	3.132	41%
Sub-total Infrastructure	-	-	7 083	19 256.763	14 059.167	60 662.800	30 918.398	51%
Land - owned land	Ha	-	135	1 088.008	957.434	3 197.715	3 197.715	100%
Land - servitudes	Ha	-	316	251.856	250.772	678.304	678.304	100%
Sub-total Land	-	-	451	1 339.864	1 208.206	3 876.020	3 876.020	100%
Total	-	-	7 534	20 596.627	15 267.372	64 538.820	34 794.418	54%

Table E.02D: Asset extent, acquisition costs, CRC and values (per facility category) - Central Cluster

Asset Facility Category	Facilities		No. of Asset Components	Acquisition Cost (R Million)	Asset Carrying Value (R Million)	CRC (R Million)	DRC (R Million)	DRC / CRC
	Unit	Quantity						
Borehole	No.	2	2	1.040	0.696	3.057	2.000	55%
Buildings	No.	1 999	2 595	1 006.539	471.304	2 434.660	874.064	36%
Canals	km	5 525	5 148	6 922.624	4 457.214	48 546.944	16 785.194	35%
Dams	No.	74	1 820	11 410.380	9 209.086	36 940.340	19 153.797	52%
Measuring facilities	No.	905	910	732.626	439.984	2 083.341	884.181	42%
Pipelines	km	820	659	6 331.203	4 730.768	15 020.665	6 765.058	45%
Power supply	No.	74	115	58.403	29.475	169.146	80.576	48%
Pump stations	No.	34	2 271	1 653.278	1 041.593	5 984.851	2 986.670	50%
Reservoirs	No.	47	85	287.619	216.558	780.450	389.147	50%
Roads	km	48	40	30.471	20.773	241.504	112.835	47%
Telemetry	No.	15	16	26.282	4.783	59.457	34.087	57%
Tunnels	km	136	118	5 288.758	3 800.461	14 343.027	7 412.852	52%
Water Treatment	No.	46	47	26.435	14.606	71.162	27.058	38%
Sub-total Infrastructure	-	-	13 826	33 775.658	24 437.301	126 678.602	55 507.201	44%
Land - owned land	Ha	-	72	4 030.470	3 932.616	11 845.776	11 845.776	100%
Land - servitudes	Ha	-	207	618.925	618.733	1 754.064	1 754.064	100%
Sub-total Land	-	-	279	4 649.395	4 551.348	13 599.840	13 599.840	100%
Total	-	-	14 105	38 425.053	28 988.649	140 278.442	69 107.041	49%

Table E.1A: Asset component condition grading proportions per asset facility category and per engineering discipline

Asset Facility Category	Engineering Discipline	Condition Grading										Total	
		1-Very Poor		2-Poor		3-Fair		4-Good		5-Very Good			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	Civil	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	7	16.28%	17	39.53%	9	20.93%	9	20.93%	1	2.33%	43	100.00%
Buildings	Civil	436	8.95%	1 103	22.63%	2 197	45.09%	1 002	20.56%	135	2.77%	4 873	100.00%
	Electrical	-	-	-	-	3	75.00%	1	25.00%	-	-	4	100.00%
	Mechanical	-	-	-	-	1	50.00%	-	-	1	50.00%	2	100.00%
Canals	Civil	300	2.62%	2 549	22.30%	5 976	52.29%	2 491	21.80%	113	0.99%	11 429	100.00%
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	1	50.00%	-	-	1	50.00%	-	-	2	100.00%
Dams	Civil	52	2.96%	318	18.11%	578	32.92%	703	40.03%	105	5.98%	1 756	100.00%
	Electrical	6	1.73%	153	44.09%	93	26.80%	84	24.21%	11	3.17%	347	100.00%
	Mechanical	222	3.72%	975	16.33%	2 204	36.92%	2 277	38.15%	291	4.88%	5 969	100.00%
Measuring facilities	Civil	33	1.07%	1 277	41.27%	1 142	36.91%	593	19.17%	49	1.58%	3 094	100.00%
	Electrical	5	2.09%	12	5.02%	127	53.14%	93	38.91%	2	0.84%	239	100.00%
	Mechanical	-	-	20	41.67%	4	8.33%	2	4.17%	22	45.83%	48	100.00%
Pipelines	Civil	16	2.50%	111	17.37%	358	56.03%	127	19.87%	27	4.23%	639	100.00%
	Electrical	1	2.78%	-	-	1	2.78%	12	33.33%	22	61.11%	36	100.00%
	Mechanical	11	2.50%	63	14.32%	253	57.50%	92	20.91%	21	4.77%	440	100.00%
Power supply	Civil	9	37.50%	1	4.17%	-	-	14	58.33%	-	-	24	100.00%
	Electrical	3	2.78%	14	12.96%	44	40.74%	41	37.96%	6	5.56%	108	100.00%
	Mechanical	7	53.85%	-	-	-	-	6	46.15%	-	-	13	100.00%
Pump stations	Civil	10	4.61%	32	14.75%	65	29.95%	87	40.09%	23	10.60%	217	100.00%
	Electrical	166	16.44%	87	8.61%	309	30.59%	348	34.46%	100	9.90%	1 010	100.00%
	Mechanical	75	3.88%	128	6.63%	737	38.15%	711	36.80%	281	14.54%	1 932	100.00%
Reservoirs	Civil	7	5.34%	7	5.34%	75	57.25%	37	28.24%	5	3.82%	131	100.00%
	Electrical	-	-	-	-	1	50.00%	1	50.00%	-	-	2	100.00%
	Mechanical	-	-	1	7.14%	4	28.57%	9	64.29%	-	-	14	100.00%
Roads	Civil	2	1.17%	38	22.22%	60	35.09%	54	31.58%	17	9.94%	171	100.00%
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-

Asset Facility Category	Engineering Discipline	Condition Grading										Total	
		1-Very Poor		2-Poor		3-Fair		4-Good		5-Very Good			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
Telemetry	Civil	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	-	-	19	44.19%	24	55.81%	-	-	43	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
Tunnels	Civil	1	0.49%	7	3.43%	100	49.02%	71	34.80%	25	12.25%	204	100.00%
	Electrical	-	-	-	-	8	80.00%	1	10.00%	1	10.00%	10	100.00%
	Mechanical	1	0.88%	-	-	84	74.34%	25	22.12%	3	2.65%	113	100.00%
Water Treatment	Civil	5	6.33%	20	25.32%	36	45.57%	17	21.52%	1	1.27%	79	100.00%
	Electrical	-	-	1	50.00%	1	50.00%	-	-	-	-	2	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
All Scheme asset components		1 375	4.17%	6 935	21.02%	14 489	43.91%	8 933	27.07%	1 262	3.82%	32 994	100.00%

Table E.1B: CRC per condition grading and per engineering discipline

Asset Facility Category	Engineering Discipline	Condition Grading vs CRC (R Million)					Total	% of Total CRC
		1-Very Poor	2-Poor	3-Fair	4-Good	5-Very Good		
Borehole	Civil	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-
	Mechanical	8.631	20.620	12.509	15.597	1.199	58.556	0.02%
Buildings	Civil	332.429	868.505	1 767.330	1 053.695	203.386	4 225.346	1.61%
	Electrical	-	-	2.697	0.366	-	3.062	0.00%
	Mechanical	-	-	4.657	-	2.205	6.863	0.00%
Canals	Civil	2 347.611	19 983.784	39 922.356	15 097.494	1 617.568	78 968.813	30.14%
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	0.459	-	0.459	-	0.919	0.00%
Dams	Civil	227.730	2 594.025	20 034.437	69 060.321	8 699.528	100 616.042	38.40%
	Electrical	4.841	194.187	143.551	101.828	20.500	464.907	0.18%
	Mechanical	357.558	1 414.396	4 207.087	5 746.869	726.970	12 452.879	4.75%
Measuring facilities	Civil	159.089	1 425.274	3 801.126	3 237.167	701.441	9 324.097	3.56%
	Electrical	1.387	3.467	32.186	40.768	0.393	78.201	0.03%
	Mechanical	-	36.631	10.840	0.942	82.248	130.661	0.05%
Pipelines	Civil	389.016	3 291.172	7 716.375	7 680.299	415.566	19 492.428	7.44%
	Electrical	11.873	-	0.089	68.277	159.240	239.479	0.09%
	Mechanical	19.257	128.045	288.191	406.391	23.616	865.500	0.33%
Power supply	Civil	3.972	0.889	-	35.896	-	40.756	0.02%
	Electrical	1.218	19.089	33.735	75.520	7.176	136.738	0.05%
	Mechanical	16.920	-	-	2.799	-	19.720	0.01%
Pump stations	Civil	15.865	19.797	317.008	862.530	414.462	1 629.662	0.62%
	Electrical	141.475	139.828	1 008.223	1 278.002	308.035	2 875.564	1.10%
	Mechanical	55.980	139.519	870.470	1 178.858	465.798	2 710.625	1.03%
Reservoirs	Civil	1.563	1.592	583.094	245.656	109.046	940.951	0.36%
	Electrical	-	-	0.114	0.405	-	0.519	0.00%
	Mechanical	-	0.416	6.378	24.951	-	31.745	0.01%
Roads	Civil	13.925	200.498	284.108	546.150	126.671	1 171.352	0.45%
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-	-
Telemetry	Civil	-	-	-	-	-	-	-

Asset Facility Category	Engineering Discipline	Condition Grading vs CRC (R Million)					Total	% of Total CRC
		1-Very Poor	2-Poor	3-Fair	4-Good	5-Very Good		
	Electrical	-	-	14.885	71.010	-	85.895	0.03%
	Mechanical	-	-	-	-	-	-	-
Tunnels	Civil	0.565	14.968	12 823.493	7 432.900	4 968.795	25 240.721	9.63%
	Electrical	-	-	3.698	0.444	1.804	5.947	0.00%
	Mechanical	0.403	-	51.911	30.147	4.490	86.951	0.03%
Water Treatment	Civil	8.440	22.934	54.320	36.109	6.476	128.280	0.05%
	Electrical	-	0.378	1.211	-	-	1.589	0.00%
	Mechanical	-	-	-	-	-	-	-
Total		4 119.748	30 520.473	93 996.079	114 331.852	19 066.615	262 034.767	100.00%
% of Total CRC		1.57%	11.65%	35.87%	43.63%	7.28%	100.00%	

Table E.2A: Asset component RUL/EUL Ratio proportions per asset facility category and per engineering discipline

Asset Facility Category	Engineering Discipline	RUL / EUL Ratio										Total	
		0-10%		11-25%		26-45%		46-70%		71-100%			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	Civil	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	7	16.28%	17	39.53%	9	20.93%	9	20.93%	1	2.33%	43	100.00%
Buildings	Civil	436	8.95%	1 103	22.63%	2 197	45.09%	1 002	20.56%	135	2.77%	4 873	100.00%
	Electrical	-	-	-	-	3	75.00%	1	25.00%	-	-	4	100.00%
	Mechanical	-	-	-	-	1	50.00%	-	-	1	50.00%	2	100.00%
Canals	Civil	300	2.62%	2 549	22.30%	5 976	52.29%	2 491	21.80%	113	0.99%	11 429	100.00%
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	1	50.00%	-	-	1	50.00%	-	-	2	100.00%
Dams	Civil	52	2.96%	318	18.11%	578	32.92%	703	40.03%	105	5.98%	1 756	100.00%
	Electrical	6	1.73%	153	44.09%	93	26.80%	84	24.21%	11	3.17%	347	100.00%
	Mechanical	222	3.72%	975	16.33%	2 204	36.92%	2 277	38.15%	291	4.88%	5 969	100.00%
Measuring facilities	Civil	33	1.07%	1 277	41.27%	1 142	36.91%	593	19.17%	49	1.58%	3 094	100.00%
	Electrical	5	2.09%	12	5.02%	127	53.14%	93	38.91%	2	0.84%	239	100.00%
	Mechanical	-	-	20	41.67%	4	8.33%	2	4.17%	22	45.83%	48	100.00%
Pipelines	Civil	16	2.50%	111	17.37%	358	56.03%	127	19.87%	27	4.23%	639	100.00%
	Electrical	1	2.78%	-	-	1	2.78%	12	33.33%	22	61.11%	36	100.00%
	Mechanical	11	2.50%	63	14.32%	253	57.50%	92	20.91%	21	4.77%	440	100.00%
Power supply	Civil	9	37.50%	1	4.17%	-	-	14	58.33%	-	-	24	100.00%
	Electrical	3	2.78%	14	12.96%	44	40.74%	41	37.96%	6	5.56%	108	100.00%
	Mechanical	7	53.85%	-	-	-	-	6	46.15%	-	-	13	100.00%
Pump stations	Civil	10	4.61%	32	14.75%	65	29.95%	87	40.09%	23	10.60%	217	100.00%
	Electrical	166	16.44%	87	8.61%	309	30.59%	348	34.46%	100	9.90%	1 010	100.00%
	Mechanical	75	3.88%	128	6.63%	737	38.15%	711	36.80%	281	14.54%	1 932	100.00%
Reservoirs	Civil	7	5.34%	7	5.34%	75	57.25%	37	28.24%	5	3.82%	131	100.00%
	Electrical	-	-	-	-	1	50.00%	1	50.00%	-	-	2	100.00%
	Mechanical	-	-	1	7.14%	4	28.57%	9	64.29%	-	-	14	100.00%
Roads	Civil	2	1.17%	38	22.22%	60	35.09%	54	31.58%	17	9.94%	171	100.00%

Asset Facility Category	Engineering Discipline	RUL / EUL Ratio										Total	
		0-10%		11-25%		26-45%		46-70%		71-100%			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
Telemetry	Civil	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	-	-	19	44.19%	24	55.81%	-	-	43	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
Tunnels	Civil	1	0.49%	7	3.43%	100	49.02%	71	34.80%	25	12.25%	204	100.00%
	Electrical	-	-	-	-	8	80.00%	1	10.00%	1	10.00%	10	100.00%
	Mechanical	1	0.88%	-	-	84	74.34%	25	22.12%	3	2.65%	113	100.00%
Water Treatment	Civil	5	6.33%	20	25.32%	36	45.57%	17	21.52%	1	1.27%	79	100.00%
	Electrical	-	-	1	50.00%	1	50.00%	-	-	-	-	2	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
All Scheme asset components		1 375	4.17%	6 935	21.02%	14 489	43.91%	8 933	27.07%	1 262	3.82%	32 994	100.00%

Table E.2B: CRC per RUL/EUL Ratio and per engineering discipline

Asset Facility Category	Engineering Discipline	RUL / EUL Ratio vs CRC (R Million)					Total	% of Total CRC
		0-10%	11-25%	26-45%	46-70%	71-100%		
Borehole	Civil	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-
	Mechanical	8.631	20.620	12.509	15.597	1.199	58.556	0.02%
Buildings	Civil	332.429	868.505	1 767.330	1 053.695	203.386	4 225.346	1.61%
	Electrical	-	-	2.697	0.366	-	3.062	0.00%
	Mechanical	-	-	4.657	-	2.205	6.863	0.00%
Canals	Civil	2 347.611	19 983.784	39 922.356	15 097.494	1 617.568	78 968.813	30.14%
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	0.459	-	0.459	-	0.919	0.00%
Dams	Civil	227.730	2 594.025	20 034.437	69 060.321	8 699.528	100 616.042	38.40%
	Electrical	4.841	194.187	143.551	101.828	20.500	464.907	0.18%
	Mechanical	357.558	1 414.396	4 207.087	5 746.869	726.970	12 452.879	4.75%
Measuring facilities	Civil	159.089	1 425.274	3 801.126	3 237.167	701.441	9 324.097	3.56%
	Electrical	1.387	3.467	32.186	40.768	0.393	78.201	0.03%
	Mechanical	-	36.631	10.840	0.942	82.248	130.661	0.05%
Pipelines	Civil	389.016	3 291.172	7 716.375	7 680.299	415.566	19 492.428	7.44%
	Electrical	11.873	-	0.089	68.277	159.240	239.479	0.09%
	Mechanical	19.257	128.045	288.191	406.391	23.616	865.500	0.33%
Power supply	Civil	3.972	0.889	-	35.896	-	40.756	0.02%
	Electrical	1.218	19.089	33.735	75.520	7.176	136.738	0.05%
	Mechanical	16.920	-	-	2.799	-	19.720	0.01%
Pump stations	Civil	15.865	19.797	317.008	862.530	414.462	1 629.662	0.62%
	Electrical	141.475	139.828	1 008.223	1 278.002	308.035	2 875.564	1.10%
	Mechanical	55.980	139.519	870.470	1 178.858	465.798	2 710.625	1.03%
Reservoirs	Civil	1.563	1.592	583.094	245.656	109.046	940.951	0.36%
	Electrical	-	-	0.114	0.405	-	0.519	0.00%
	Mechanical	-	0.416	6.378	24.951	-	31.745	0.01%
Roads	Civil	13.925	200.498	284.108	546.150	126.671	1 171.352	0.45%
	Electrical	-	-	-	-	-	-	-

Asset Facility Category	Engineering Discipline	RUL / EUL Ratio vs CRC (R Million)					Total	% of Total CRC
		0-10%	11-25%	26-45%	46-70%	71-100%		
	Mechanical	-	-	-	-	-	-	-
Telemetry	Civil	-	-	-	-	-	-	-
	Electrical	-	-	14.885	71.010	-	85.895	0.03%
	Mechanical	-	-	-	-	-	-	-
Tunnels	Civil	0.565	14.968	12 823.493	7 432.900	4 968.795	25 240.721	9.63%
	Electrical	-	-	3.698	0.444	1.804	5.947	0.00%
	Mechanical	0.403	-	51.911	30.147	4.490	86.951	0.03%
Water Treatment	Civil	8.440	22.934	54.320	36.109	6.476	128.280	0.05%
	Electrical	-	0.378	1.211	-	-	1.589	0.00%
	Mechanical	-	-	-	-	-	-	-
Total		4 119.748	30 520.473	93 996.079	114 331.852	19 066.615	262 034.767	100.00%
<i>% of Total CRC</i>		<i>1.57%</i>	<i>11.65%</i>	<i>35.87%</i>	<i>43.63%</i>	<i>7.28%</i>	<i>100.00%</i>	

Table E.3A: Asset component Criticality Grading proportions per asset facility category and per engineering discipline

Asset Facility Category	Engineering Discipline	Criticality Grading										Total	
		1-Very Low		2-Low		3-Moderate		4-High		5-Very High			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	Civil	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	2	4.65%	15	34.88%	26	60.47%	-	-	-	-	43	100.00%
Buildings	Civil	622	12.76%	860	17.65%	2 868	58.85%	520	10.67%	3	0.06%	4 873	100.00%
	Electrical	1	25.00%	3	75.00%	-	-	-	-	-	-	4	100.00%
	Mechanical	-	-	1	50.00%	-	-	1	50.00%	-	-	2	100.00%
Canals	Civil	264	2.31%	791	6.92%	9 768	85.47%	498	4.36%	108	0.94%	11 429	100.00%
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	2	100.00%	-	-	-	-	-	-	2	100.00%
Dams	Civil	31	1.77%	632	35.99%	318	18.11%	609	34.68%	166	9.45%	1 756	100.00%
	Electrical	-	-	151	43.52%	19	5.48%	127	36.60%	50	14.41%	347	100.00%
	Mechanical	50	0.84%	1 269	21.26%	1 196	20.04%	2 965	49.67%	489	8.19%	5 969	100.00%
Measuring facilities	Civil	602	19.46%	699	22.59%	1 508	48.74%	284	9.18%	1	0.03%	3 094	100.00%
	Electrical	237	99.16%	-	-	1	0.42%	1	0.42%	-	-	239	100.00%
	Mechanical	-	-	4	8.33%	36	75.00%	8	16.67%	-	-	48	100.00%
Pipelines	Civil	1	0.16%	16	2.50%	307	48.04%	88	13.77%	227	35.52%	639	100.00%
	Electrical	-	-	-	-	36	100.00%	-	-	-	-	36	100.00%
	Mechanical	4	0.91%	139	31.59%	140	31.82%	43	9.77%	114	25.91%	440	100.00%
Power supply	Civil	-	-	-	-	2	8.33%	22	91.67%	-	-	24	100.00%
	Electrical	1	0.93%	36	33.33%	38	35.19%	16	14.81%	17	15.74%	108	100.00%
	Mechanical	-	-	-	-	2	15.38%	11	84.62%	-	-	13	100.00%
Pump stations	Civil	1	0.46%	64	29.49%	52	23.96%	58	26.73%	42	19.35%	217	100.00%
	Electrical	-	-	326	32.28%	247	24.46%	191	18.91%	246	24.36%	1 010	100.00%
	Mechanical	3	0.16%	482	24.95%	427	22.10%	605	31.31%	415	21.48%	1 932	100.00%
Reservoirs	Civil	-	-	44	33.59%	75	57.25%	1	0.76%	11	8.40%	131	100.00%
	Electrical	-	-	1	50.00%	1	50.00%	-	-	-	-	2	100.00%
	Mechanical	-	-	3	21.43%	11	78.57%	-	-	-	-	14	100.00%

Asset Facility Category	Engineering Discipline	Criticality Grading										Total	
		1-Very Low		2-Low		3-Moderate		4-High		5-Very High			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Roads	Civil	128	74.85%	18	10.53%	18	10.53%	4	2.34%	3	1.75%	171	100.00%
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
Telemetry	Civil	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	12	27.91%	21	48.84%	10	23.26%	-	-	43	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
Tunnels	Civil	5	2.45%	13	6.37%	40	19.61%	76	37.25%	70	34.31%	204	100.00%
	Electrical	-	-	1	10.00%	4	40.00%	1	10.00%	4	40.00%	10	100.00%
	Mechanical	-	-	1	0.88%	31	27.43%	18	15.93%	63	55.75%	113	100.00%
Water Treatment	Civil	1	1.27%	72	91.14%	4	5.06%	2	2.53%	-	-	79	100.00%
	Electrical	-	-	2	100.00%	-	-	-	-	-	-	2	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-
All Scheme asset components		1 953	5.92%	5 657	17.15%	17 196	52.12%	6 159	18.67%	2 029	6.15%	32 994	100.00%

Table E.3B: CRC per Criticality Grading and per engineering discipline

Asset Facility Category	Engineering Discipline	Criticality Grading vs CRC (R Million)					Total	% of Total CRC
		1-Very Low	2-Low	3-Moderate	4-High	5-Very High		
Borehole	Civil	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-
	Mechanical	2.100	18.680	37.775	-	-	58.556	0.02%
Buildings	Civil	487.242	882.376	2 147.092	708.055	0.581	4 225.346	1.61%
	Electrical	1.729	1.333	-	-	-	3.062	0.00%
	Mechanical	-	4.657	-	2.205	-	6.863	0.00%
Canals	Civil	979.268	2 925.887	72 885.187	2 125.627	52.844	78 968.813	30.14%
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	0.919	-	-	-	0.919	0.00%
Dams	Civil	168.213	32 029.302	6 764.434	40 066.613	21 587.478	100 616.042	38.40%
	Electrical	-	206.175	21.784	165.455	71.492	464.907	0.18%
	Mechanical	36.507	2 347.229	2 157.587	6 590.511	1 321.046	12 452.879	4.75%
Measuring facilities	Civil	1 195.665	4 134.889	1 965.268	1 984.429	43.846	9 324.097	3.56%
	Electrical	77.103	-	0.294	0.804	-	78.201	0.03%
	Mechanical	-	22.454	103.721	4.486	-	130.661	0.05%
Pipelines	Civil	39.255	488.327	9 768.313	800.703	8 395.830	19 492.428	7.44%
	Electrical	-	-	239.479	-	-	239.479	0.09%
	Mechanical	3.055	68.234	452.575	71.475	270.161	865.500	0.33%
Power supply	Civil	-	-	1.002	39.754	-	40.756	0.02%
	Electrical	0.505	18.361	88.440	15.130	14.302	136.738	0.05%
	Mechanical	-	-	1.321	18.398	-	19.720	0.01%
Pump stations	Civil	0.129	324.292	395.410	678.854	230.976	1 629.662	0.62%
	Electrical	-	850.997	631.341	592.582	800.644	2 875.564	1.10%
	Mechanical	0.680	602.470	512.470	888.751	706.254	2 710.625	1.03%
Reservoirs	Civil	-	86.807	445.747	0.225	408.172	940.951	0.36%
	Electrical	-	0.114	0.405	-	-	0.519	0.00%
	Mechanical	-	16.600	15.145	-	-	31.745	0.01%
Roads	Civil	915.506	110.013	72.268	37.627	35.937	1 171.352	0.45%
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-	-

Asset Facility Category	Engineering Discipline	Criticality Grading vs CRC (R Million)					Total	% of Total CRC
		1-Very Low	2-Low	3-Moderate	4-High	5-Very High		
Telemetry	Civil	-	-	-	-	-	-	-
	Electrical	-	10.464	62.177	13.254	-	85.895	0.03%
	Mechanical	-	-	-	-	-	-	-
Tunnels	Civil	16.025	70.773	4 709.088	2 461.828	17 983.007	25 240.721	9.63%
	Electrical	-	0.889	2.125	1.804	1.129	5.947	0.00%
	Mechanical	-	0.333	49.546	8.298	28.774	86.951	0.03%
Water Treatment	Civil	0.141	103.829	14.349	9.960	-	128.280	0.05%
	Electrical	-	1.589	-	-	-	1.589	0.00%
	Mechanical	-	-	-	-	-	-	-
Total		3 923.124	45 327.994	103 544.344	57 286.830	51 952.475	262 034.767	100.00%
<i>% of Total CRC</i>		<i>1.50%</i>	<i>17.30%</i>	<i>39.52%</i>	<i>21.86%</i>	<i>19.83%</i>	<i>100.00%</i>	

Table E.4A: Asset component Utilisation Grading proportions per asset facility category and per engineering discipline

Asset Facility Category	Engineering Discipline	Utilisation Grading												Total	
		1-Strategic redundancy		2-Under-utilised		3-Moderate use		4-Approaching design capacity		5-Exceeding capacity/stressed		Null			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
Borehole	Civil	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	1	2.33%	9	20.93%	32	74.42%	1	2.33%	-	-	43	100.00%
Buildings	Civil	38	0.78%	225	4.62%	1 224	25.12%	3 386	69.48%	-	-	-	-	4 873	100.00%
	Electrical	-	-	1	25.00%	1	25.00%	2	50.00%	-	-	-	-	4	100.00%
	Mechanical	-	-	-	-	1	50.00%	1	50.00%	-	-	-	-	2	100.00%
Canals	Civil	185	1.62%	825	7.22%	1 887	16.51%	8 366	73.20%	166	1.45%	-	-	11 429	100.00%
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-	2	100.00%	-	-	-	-	2	100.00%
Dams	Civil	2	0.11%	247	14.07%	323	18.39%	1 032	58.77%	152	8.66%	-	-	1 756	100.00%
	Electrical	3	0.86%	16	4.61%	50	14.41%	244	70.32%	34	9.80%	-	-	347	100.00%
	Mechanical	5	0.08%	377	6.32%	791	13.25%	4 387	73.50%	409	6.85%	-	-	5 969	100.00%
Measuring facilities	Civil	-	-	31	1.00%	513	16.58%	2 550	82.42%	-	-	-	-	3 094	100.00%
	Electrical	-	-	5	2.09%	66	27.62%	166	69.46%	2	0.84%	-	-	239	100.00%
	Mechanical	-	-	-	-	29	60.42%	19	39.58%	-	-	-	-	48	100.00%
Pipelines	Civil	2	0.31%	62	9.70%	206	32.24%	349	54.62%	20	3.13%	-	-	639	100.00%
	Electrical	-	-	-	-	4	11.11%	31	86.11%	1	2.78%	-	-	36	100.00%
	Mechanical	-	-	27	6.14%	171	38.86%	237	53.86%	5	1.14%	-	-	440	100.00%
Power supply	Civil	-	-	-	-	1	4.17%	23	95.83%	-	-	-	-	24	100.00%
	Electrical	-	-	6	5.56%	57	52.78%	44	40.74%	1	0.93%	-	-	108	100.00%
	Mechanical	-	-	-	-	-	-	13	100.00%	-	-	-	-	13	100.00%
Pump stations	Civil	5	2.30%	4	1.84%	111	51.15%	94	43.32%	3	1.38%	-	-	217	100.00%
	Electrical	60	5.94%	-	-	509	50.40%	400	39.60%	41	4.06%	-	-	1 010	100.00%
	Mechanical	43	2.23%	17	0.88%	1 012	52.38%	760	39.34%	100	5.18%	-	-	1 932	100.00%
Reservoirs	Civil	-	-	44	33.59%	16	12.21%	71	54.20%	-	-	-	-	131	100.00%
	Electrical	-	-	-	-	-	-	2	100.00%	-	-	-	-	2	100.00%
	Mechanical	-	-	-	-	1	7.14%	13	92.86%	-	-	-	-	14	100.00%
Roads	Civil	-	-	109	63.74%	47	27.49%	15	8.77%	-	-	-	-	171	100.00%

Asset Facility Category	Engineering Discipline	Utilisation Grading												Total	
		1-Strategic redundancy		2-Under-utilised		3-Moderate use		4-Approaching design capacity		5-Exceeding capacity/stressed		Null			
		No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %	No. of Asset Components	Row N %
	Electrical	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Telemetry	Civil	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Electrical	-	-	16	37.21%	6	13.95%	21	48.84%	-	-	-	-	43	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tunnels	Civil	-	-	-	-	86	42.16%	118	57.84%	-	-	-	-	204	100.00%
	Electrical	-	-	-	-	6	60.00%	4	40.00%	-	-	-	-	10	100.00%
	Mechanical	-	-	-	-	90	79.65%	21	18.58%	2	1.77%	-	-	113	100.00%
Water Treatment	Civil	-	-	12	15.19%	17	21.52%	46	58.23%	4	5.06%	-	-	79	100.00%
	Electrical	-	-	-	-	-	-	2	100.00%	-	-	-	-	2	100.00%
	Mechanical	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All Scheme asset components		343	1.04%	2 025	6.14%	7 234	21.93%	22 451	68.05%	941	2.85%	-	-	32 994	100.00%

Table E.4B: CRC per Utilisation Grading and per engineering discipline

Asset Facility Category	Engineering Discipline	Utilisation Grading vs CRC (R Million)					Total	% of Total CRC
		1-Strategic redundancy	2-Under-utilised	3-Moderate use	4-Approaching design capacity	5-Exceeding capacity/stressed		
Borehole	Civil	-	-	-	-	-	-	-
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	1.199	13.130	42.368	1.858	58.556	0.02%
Buildings	Civil	36.111	176.269	1 256.197	2 756.769	-	4 225.346	1.61%
	Electrical	-	0.484	1.729	0.850	-	3.062	0.00%
	Mechanical	-	-	4.657	2.205	-	6.863	0.00%
Canals	Civil	801.117	6 569.947	16 733.543	54 518.609	345.598	78 968.813	30.14%
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	-	-	0.919	-	0.919	0.00%
Dams	Civil	4.200	9 153.795	23 921.887	62 177.713	5 358.447	100 616.042	38.40%
	Electrical	2.797	22.969	82.292	305.394	51.456	464.907	0.18%
	Mechanical	2.710	465.574	1 586.148	9 539.965	858.483	12 452.879	4.75%
Measuring facilities	Civil	-	126.656	2 898.485	6 298.955	-	9 324.097	3.56%
	Electrical	-	1.230	32.112	44.281	0.577	78.201	0.03%
	Mechanical	-	-	94.426	36.235	-	130.661	0.05%
Pipelines	Civil	224.496	622.356	4 855.932	12 756.455	1 033.189	19 492.428	7.44%
	Electrical	-	-	30.449	208.941	0.089	239.479	0.09%
	Mechanical	-	13.852	218.448	618.532	14.669	865.500	0.33%
Power supply	Civil	-	-	31.569	9.187	-	40.756	0.02%
	Electrical	-	4.880	89.892	39.967	2.000	136.738	0.05%
	Mechanical	-	-	-	19.720	-	19.720	0.01%
Pump stations	Civil	69.454	7.438	1 251.821	300.016	0.933	1 629.662	0.62%
	Electrical	262.520	-	1 738.067	847.059	27.917	2 875.564	1.10%
	Mechanical	57.117	17.569	1 880.232	705.306	50.401	2 710.625	1.03%
Reservoirs	Civil	-	220.191	88.452	632.308	-	940.951	0.36%
	Electrical	-	-	-	0.519	-	0.519	0.00%
	Mechanical	-	-	5.013	26.732	-	31.745	0.01%
Roads	Civil	-	744.544	255.792	171.017	-	1 171.352	0.45%
	Electrical	-	-	-	-	-	-	-
	Mechanical	-	-	-	-	-	-	-

Asset Facility Category	Engineering Discipline	Utilisation Grading vs CRC (R Million)					Total	% of Total CRC
		1-Strategic redundancy	2-Under-utilised	3-Moderate use	4-Approaching design capacity	5-Exceeding capacity/stressed		
Telemetry	Civil	-	-	-	-	-	-	-
	Electrical	-	14.159	11.548	60.187	-	85.895	0.03%
	Mechanical	-	-	-	-	-	-	-
Tunnels	Civil	-	-	9 663.828	15 576.893	-	25 240.721	9.63%
	Electrical	-	-	2.286	3.661	-	5.947	0.00%
	Mechanical	-	-	60.773	23.075	3.103	86.951	0.03%
Water Treatment	Civil	-	11.664	41.369	69.414	5.833	128.280	0.05%
	Electrical	-	-	-	1.589	-	1.589	0.00%
	Mechanical	-	-	-	-	-	-	-
Total		1 460.523	18 174.775	66 850.077	167 794.839	7 754.553	262 034.767	100.00%
<i>% of Total CRC</i>		<i>0.56%</i>	<i>6.94%</i>	<i>25.51%</i>	<i>64.04%</i>	<i>2.96%</i>	<i>100.00%</i>	

Table E.5A1: Asset component proportions per Criticality - Condition grading and per asset facility category (Maintenance)

Asset Facility Category	Criticality-Condition Grading (Proportion, %)														
	H - F	H - G	H - VG	L - F	L - G	L - VG	M - F	M - G	M - VG	VH - F	VH - G	VH - VG	VL - F	VL - G	VL - VG
Borehole	-	-	-	5.26%	-	-	36.84%	42.11%	5.26%	-	-	-	5.26%	5.26%	-
Buildings	7.66%	3.11%	0.66%	11.23%	7.57%	0.30%	38.32%	15.75%	1.74%	-	0.03%	0.03%	8.68%	3.56%	1.35%
Canals	2.86%	1.27%	0.24%	3.16%	4.04%	0.02%	61.99%	22.42%	0.94%	0.15%	0.73%	0.10%	1.49%	0.57%	-
Dams	19.57%	22.49%	3.81%	13.24%	10.09%	1.37%	8.92%	8.81%	0.99%	3.18%	6.49%	0.20%	0.39%	0.41%	0.03%
Measuring facilities	10.32%	2.75%	0.34%	15.34%	13.86%	0.79%	27.38%	9.54%	1.67%	-	0.05%	-	9.54%	7.62%	0.79%
Pipelines	3.83%	4.71%	0.44%	9.97%	1.53%	0.99%	27.27%	14.57%	6.24%	25.85%	4.16%	-	0.11%	0.33%	-
Power supply	1.80%	20.72%	1.80%	23.42%	5.41%	0.90%	6.31%	23.42%	0.90%	8.11%	4.50%	1.80%	-	0.90%	-
Pump stations	8.19%	14.05%	7.37%	13.75%	8.68%	3.08%	6.91%	13.49%	3.27%	12.85%	6.84%	1.47%	0.04%	-	-
Reservoirs	-	-	-	18.94%	7.58%	1.52%	36.36%	25.00%	2.27%	5.30%	3.03%	-	-	-	-
Roads	0.76%	1.53%	-	2.29%	6.11%	4.58%	3.82%	3.05%	2.29%	0.76%	1.53%	-	38.17%	29.01%	6.11%
Telemetry	-	23.26%	-	6.98%	20.93%	-	37.21%	11.63%	-	-	-	-	-	-	-
Tunnels	14.15%	11.01%	4.72%	3.46%	0.63%	0.63%	10.38%	7.86%	3.77%	31.45%	11.01%	-	0.94%	-	-
Water Treatment	1.82%	1.82%	-	61.82%	29.09%	-	1.82%	-	1.82%	-	-	-	1.82%	-	-
<i>All Scheme asset components</i>	<i>9.14%</i>	<i>8.85%</i>	<i>2.06%</i>	<i>9.55%</i>	<i>7.37%</i>	<i>0.88%</i>	<i>33.51%</i>	<i>15.38%</i>	<i>1.62%</i>	<i>3.69%</i>	<i>3.01%</i>	<i>0.26%</i>	<i>2.81%</i>	<i>1.59%</i>	<i>0.29%</i>

Table E.5A2: CRC per asset Criticality - Condition grading and per asset facility category (Maintenance)

Asset Facility Category	Criticality-Condition Grading (CRC, R Million)															Total	% of Total CRC
	H - F	H - G	H - VG	L - F	L - G	L - VG	M - F	M - G	M - VG	VH - F	VH - G	VH - VG	VL - F	VL - G	VL - VG		
Borehole	-	-	-	1.416	-	-	10.850	13.739	1.199	-	-	-	0.242	1.858	-	29.304	0.01%
Buildings	279.342	166.896	30.240	424.745	302.579	10.508	890.812	475.995	101.070	-	0.177	0.177	179.786	108.414	63.597	3 034.336	1.33%
Canals	1 276.197	248.084	177.581	1 581.406	684.288	2.864	36 463.601	14 013.991	1 413.673	7.098	14.074	23.451	594.053	137.517	-	56 637.878	24.91%
Dams	10 228.005	30 204.718	4 662.963	9 409.630	22 221.920	1 276.810	2 080.056	2 809.188	3 345.021	2 545.139	19 624.330	151.730	122.245	48.861	10.474	108 741.091	47.82%
Measuring facilities	1 220.194	396.620	325.923	1 709.494	1 501.646	122.537	513.914	907.488	192.638	-	43.846	-	400.549	429.278	142.984	7 907.111	3.48%
Pipelines	307.280	272.565	1.368	486.065	52.831	3.580	3 246.116	5 279.911	593.474	3 925.940	2 546.875	-	39.255	2.785	-	16 758.045	7.37%
Power supply	2.380	45.049	2.095	15.201	2.139	0.376	8.965	63.021	1.908	7.189	3.501	2.797	-	0.505	-	155.127	0.07%
Pump stations	318.015	965.121	775.526	913.656	640.197	77.930	97.766	1 101.923	235.933	865.860	612.150	98.906	0.403	-	-	6 703.387	2.95%
Reservoirs	-	-	-	33.987	66.643	0.380	163.993	187.803	108.666	391.606	16.566	-	-	-	-	969.644	0.43%
Roads	10.616	22.339	-	40.241	38.904	30.421	7.186	15.950	30.953	0.441	35.496	-	225.624	433.460	65.297	956.929	0.42%
Telemetry	-	13.254	-	0.726	9.738	-	14.159	48.018	-	-	-	-	-	-	-	85.895	0.04%
Tunnels	1 003.277	1 001.457	467.196	43.227	1.946	26.821	126.450	141.636	4 481.072	11 691.719	6 318.452	-	14.428	-	-	25 317.683	11.13%
Water Treatment	1.871	8.090	-	52.017	28.020	-	1.502	-	6.476	-	-	-	0.141	-	-	98.116	0.04%
Total	14 647.175	33 344.194	6 442.892	14 711.812	25 550.851	1 552.227	43 625.371	25 058.664	10 512.083	19 434.993	29 215.466	277.060	1 576.727	1 162.678	282.353	227 394.546	100.00%
% of Total CRC	6.44%	14.66%	2.83%	6.47%	11.24%	0.68%	19.18%	11.02%	4.62%	8.55%	12.85%	0.12%	0.69%	0.51%	0.12%	100.00%	

Table E.5B1: Asset component proportions per Criticality - Condition grading and per engineering discipline (Maintenance)

Engineering Discipline	Criticality-Condition Grading (Proportion, %)														
	H - F	H - G	H - VG	L - F	L - G	L - VG	M - F	M - G	M - VG	VH - F	VH - G	VH - VG	VL - F	VL - G	VL - VG
Civil	6.01%	3.65%	0.83%	7.88%	7.33%	0.42%	46.16%	17.71%	1.32%	1.57%	1.52%	0.09%	3.40%	1.70%	0.41%
Electrical	5.69%	9.46%	3.33%	13.75%	10.42%	2.66%	5.91%	12.34%	3.55%	10.05%	5.62%	0.81%	9.39%	6.87%	0.15%
Mechanical	17.03%	20.73%	4.67%	12.61%	6.85%	1.59%	9.58%	10.58%	1.96%	7.35%	5.96%	0.55%	0.20%	0.31%	0.03%
<i>All Scheme asset components</i>	9.14%	8.85%	2.06%	9.55%	7.37%	0.88%	33.51%	15.38%	1.62%	3.69%	3.01%	0.26%	2.81%	1.59%	0.29%

Table E.5B2: CRC per asset Criticality - Condition grading and per engineering discipline (Maintenance)

Engineering Discipline	Criticality-Condition Grading (Proportion, %)															Total	% of Total CRC
	H - F	H - G	H - VG	L - F	L - G	L - VG	M - F	M - G	M - VG	VH - F	VH - G	VH - VG	VL - F	VL - G	VL - VG		
Civil	11 987.217	29 768.877	5 550.801	12 915.448	24 016.690	1 392.467	42 786.825	22 611.657	9 888.187	18 076.750	27 788.466	159.999	1 537.406	1 102.527	271.486	209 854.804	92.29%
Electrical	208.999	297.009	156.766	472.777	414.560	33.403	45.565	612.551	292.439	479.428	272.031	14.148	33.621	40.470	0.393	3 374.159	1.48%
Mechanical	2 450.959	3 278.308	735.325	1 323.588	1 119.601	126.357	792.981	1 834.455	331.458	878.814	1 154.969	102.913	5.700	19.682	10.474	14 165.584	6.23%
Total	14 647.175	33 344.194	6 442.892	14 711.812	25 550.851	1 552.227	43 625.371	25 058.664	10 512.083	19 434.993	29 215.466	277.060	1 576.727	1 162.678	282.353	227 394.546	100.00%
% of Total CRC	6.44%	14.66%	2.83%	6.47%	11.24%	0.68%	19.18%	11.02%	4.62%	8.55%	12.85%	0.12%	0.69%	0.51%	0.12%	100.00%	

Table E.6A1: Asset component proportions per Criticality - Condition grading and per asset facility category (Renewals)

Asset Facility Category	Criticality-Condition Grading (Proportion, %)										Total
	H - P	H - VP	L - P	L - VP	M - P	M - VP	VH - P	VH - VP	VL - P	VL - VP	
Borehole	-	-	29.17%	29.17%	41.67%	-	-	-	-	-	100.00%
Buildings	7.80%	1.23%	11.05%	3.64%	49.51%	15.72%	-	0.06%	3.31%	7.67%	100.00%
Canals	4.11%	0.21%	5.16%	0.91%	78.42%	7.33%	0.81%	-	0.98%	2.07%	100.00%
Dams	38.30%	7.47%	24.57%	3.53%	15.82%	4.17%	3.94%	0.58%	1.16%	0.46%	100.00%
Measuring facilities	1.41%	0.07%	5.12%	1.78%	56.12%	0.30%	-	-	34.52%	0.67%	100.00%
Pipelines	19.31%	4.95%	17.33%	2.97%	18.32%	3.47%	30.69%	2.48%	0.50%	-	100.00%
Power supply	8.82%	55.88%	8.82%	-	23.53%	-	2.94%	-	-	-	100.00%
Pump stations	7.83%	5.42%	16.67%	22.09%	9.64%	9.64%	14.86%	13.25%	0.60%	-	100.00%
Reservoirs	6.67%	-	26.67%	46.67%	20.00%	-	-	-	-	-	100.00%
Roads	2.50%	-	2.50%	-	15.00%	-	-	-	75.00%	5.00%	100.00%
Tunnels	-	-	-	-	44.44%	11.11%	11.11%	11.11%	22.22%	-	100.00%
Water Treatment	-	-	76.92%	15.38%	3.85%	3.85%	-	-	-	-	100.00%
<i>All Scheme asset components</i>	12.03%	2.54%	11.59%	3.62%	49.86%	7.03%	2.76%	1.00%	7.22%	2.36%	100.00%

Table E.6A2: CRC per asset Criticality - Condition grading and per asset facility category (Renewals)

Asset Facility Category	Criticality-Condition Grading (Proportion, %)										Total	% of Total CRC
	H - P	H - VP	L - P	L - VP	M - P	M - VP	VH - P	VH - VP	VL - P	VL - VP		
Borehole	-	-	8.632	8.631	11.988	-	-	-	-	-	29.251	0.08%
Buildings	210.669	23.114	116.284	34.251	504.190	175.026	-	0.227	37.362	99.811	1 200.935	3.47%
Canals	328.991	94.774	505.644	152.604	19 046.346	1 947.576	8.221	-	95.041	152.657	22 331.854	64.47%
Dams	1 477.459	249.434	1 594.508	79.838	531.589	177.951	579.332	79.486	19.719	3.420	4 792.737	13.84%
Measuring facilities	45.784	1.198	696.374	127.292	435.063	20.179	-	-	288.150	11.806	1 625.847	4.69%
Pipelines	252.831	38.134	12.587	1.497	1 230.014	110.852	1 923.514	269.662	0.270	-	3 839.362	11.08%
Power supply	1.648	22.110	0.645	-	16.868	-	0.816	-	-	-	42.088	0.12%
Pump stations	76.678	24.847	70.384	75.592	53.428	50.171	98.248	62.711	0.406	-	512.464	1.48%
Reservoirs	0.225	-	0.948	1.563	0.835	-	-	-	-	-	3.571	0.01%
Roads	4.673	-	0.447	-	18.178	-	-	-	177.200	13.925	214.423	0.62%
Tunnels	-	-	-	-	11.036	0.565	2.335	0.403	1.597	-	15.936	0.05%
Water Treatment	-	-	18.635	6.746	4.677	1.694	-	-	-	-	31.752	0.09%
Total	2 398.958	453.611	3 025.090	488.015	21 864.213	2 484.013	2 612.466	412.490	619.746	281.619	34 640.220	100.00%
% of Total CRC	6.93%	1.31%	8.73%	1.41%	63.12%	7.17%	7.54%	1.19%	1.79%	0.81%	100.00%	

Table E.6B1: Asset component proportions per Criticality - Condition grading and per engineering discipline (Renewals)

Engineering Discipline	Criticality-Condition Grading (Proportion, %)										Total
	H - P	H - VP	L - P	L - VP	M - P	M - VP	VH - P	VH - VP	VL - P	VL - VP	
Civil	6.24%	0.93%	8.48%	1.99%	60.83%	7.77%	1.66%	0.14%	9.05%	2.92%	100.00%
Electrical	16.29%	5.13%	20.09%	17.63%	8.48%	7.59%	12.05%	8.93%	2.68%	1.12%	100.00%
Mechanical	34.82%	8.44%	21.99%	6.28%	16.49%	3.80%	4.58%	2.23%	0.98%	0.39%	100.00%
<i>All Scheme asset components</i>	<i>12.03%</i>	<i>2.54%</i>	<i>11.59%</i>	<i>3.62%</i>	<i>49.86%</i>	<i>7.03%</i>	<i>2.76%</i>	<i>1.00%</i>	<i>7.22%</i>	<i>2.36%</i>	<i>100.00%</i>

Table E.6B2: CRC per asset Criticality - Condition grading and per engineering discipline (Renewals)

Engineering Discipline	Criticality-Condition Grading (Proportion, %)										Total	% of Total CRC
	H - P	H - VP	L - P	L - VP	M - P	M - VP	VH - P	VH - VP	VL - P	VL - VP		
Civil	1 426.166	180.616	2 496.041	335.849	21 506.273	2 375.217	2 383.649	329.807	611.309	278.716	31 923.643	92.16%
Electrical	104.267	21.989	109.042	60.141	50.890	44.599	89.283	32.678	3.467	1.387	517.742	1.49%
Mechanical	868.525	251.007	420.006	92.025	307.051	64.197	139.534	50.005	4.970	1.516	2 198.835	6.35%
Total	2 398.958	453.611	3 025.090	488.015	21 864.213	2 484.013	2 612.466	412.490	619.746	281.619	34 640.220	100.00%
% of Total CRC	6.93%	1.31%	8.73%	1.41%	63.12%	7.17%	7.54%	1.19%	1.79%	0.81%	100.00%	

APPENDIX F – Risk Management

Table F.1 shows generic risks typically associated with the different asset facility categories.

Table F.1: Generic risks per asset facility category

Asset Facility Category	Generic Risks
Water Sources (i.e. Dams, Ground Water, etc.)	<ul style="list-style-type: none">▪ Structural failure of embankment, valve tower and cut-off wall▪ Failure of control valves, pipework and power supply▪ Contamination of ground water sources▪ Land instability▪ Electrical systems within the dam (control system)
Raw Water Conveyance (Canals, tunnels, pipelines)	<ul style="list-style-type: none">▪ Structural failure of aqueducts, canals, tunnels, portals and raw water mains▪ Land instability
Water Pump Stations	<ul style="list-style-type: none">▪ Structural failure and land instability▪ Failure of pumps, valves, pipework, power supply, motors, drives and controls
Water Reservoirs	<ul style="list-style-type: none">▪ Structural failure and land instability▪ Failure of pumps, valves, pipework, power supply, motors, drives and controls▪ Structural failure of walls due to design and construction deficiencies.▪ Leaks and excessive overflow.
Telemetry and SCADA	<ul style="list-style-type: none">▪ Signals from all types valves, computer systems programming▪ Ventilation on control room

APPENDIX G – (Blank)

APPENDIX H – Scheme Details

Table H.1: Details of the schemes falling under the Northern Cluster

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
GROBLERSDAL	ACORNHOEK DAM	Acornhoek Dam			1.050	Active			DWS	DWS	DWS
GROBLERSDAL	BLYDERIVIERPOORT DAM	Blyderivierpoort Dam			54.050	Active			DWS	DWS	DWS
GROBLERSDAL	BRONKHORSPRUIT DAM	Bronkhorstspuit Dam			57.913	Active	YES (short section)		DWS	DWS	DWS
GROBLERSDAL	BRUGSPRUIT POLLUTION CONTROL WORKS					Active			DWS	DWS	DWS
GROBLERSDAL	BUFELSDOORN GWS (MOKOTSWANE DAM)	Mokotswane Dam			3.150	Inactive			DWS	DWS	DWS
GROBLERSDAL	CASTEEL DAM	Casteel Dam			1.180	Active			DWS	DWS	DWS
GROBLERSDAL	CHUNIESPOORT DAM	Chuniespoort Dam			3.365	Active			DWS	DWS	DWS
GROBLERSDAL	CROCODILE RIVER GWS (KWENA DAM)	Kwena Dam (Braam Raubenheimer Dam)			158.932	Active			DWS	DWS	DWS
GROBLERSDAL	DE HOOP DAM	De Hoop Dam			347.444	Active			DWS	DWS	DWS
GROBLERSDAL	DER BROCHEN DAM	Der Brochen Dam			7.300	Active			DWS	DWS	DWS
GROBLERSDAL	DR. EISELEN DAM	Dr Eiselen Dam			0.730	Inactive			DWS	DWS	DWS
GROBLERSDAL	KABOKWENI DAM	Kabokweni Dam			-	Inactive					
GROBLERSDAL	KLASERIE DAM	Klaserie Dam (Jan Wassenaar Dam)			5.608	Active			DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
GROBLERSDAL	LEPELLANE DAM	Lepellane Dam			0.665	Inactive			DWS	DWS	DWS
GROBLERSDAL	LOLE MONTES DAM	Lole Montes Dam			1.400	Inactive			DWS	DWS	DWS
GROBLERSDAL	LOSKOP GWS	Loskop Dam			361.000	Active	YES		DWS	DWS	DWS
GROBLERSDAL	LOSKOP GWS			Loskop - Balancing Dam 2		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			Loskop - Balancing Dam 3		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			Loskop - Balancing Dam 4		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			Loskop - Balancing Dam 5		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			Mthombo Balancing Dam		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			RB Balancing Dam A		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			RB Balancing Dam B		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			RB Balancing Dam C		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	LOSKOP GWS			W10 Balancing Dam		Active	YES		Loskop Irrigation Board	Loskop Irrigation Board	Loskop Irrigation Board
GROBLERSDAL	MAHLANGU DAM	Mahlangu Dam			0.950	Active			DWS	DWS	DWS
GROBLERSDAL	MAPOCHSGRONDEN GWS	Tonteldoos Dam			0.630	Active	YES		DWS	DWS	DWS
GROBLERSDAL	MAPOCHSGRONDEN GWS	Vlugkraal Dam			0.425	Active	YES		DWS	DWS	DWS
GROBLERSDAL	MAPOCHSGRONDEN GWS		Mapochsgronden - Weir canal 1			Active			DWS	DWS	DWS
GROBLERSDAL	MAPOCHSGRONDEN GWS		Mapochsgronden - Weir 2			Active			DWS	DWS	DWS
GROBLERSDAL	MAPOCHSGRONDEN GWS		Mapochsgronden - Weir c3			Active			DWS	DWS	DWS
GROBLERSDAL	MAPOCHSGRONDEN GWS		Mapochsgronden - Weir 4			Active			DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
GROBLERSDAL	MAPOCHSGRONDEN GWS			Vlugkraal Balancing Dam		Active			DWS	DWS	DWS
GROBLERSDAL	MKHOMBO DAM	Mkombo Dam (Rhenosterkop Dam)			206.000	Active			DWS	DWS	DWS
GROBLERSDAL	MKHOMBO DAM		Weltevreden Weir		0.200	Active			DWS	DWS	DWS
GROBLERSDAL	MOLEPO DAM	Molepo Dam			4.520	Active			DWS	DWS	DWS
GROBLERSDAL	NKADIMENG DAM	Nkadimeng Dam			2.800	Active			DWS	DWS	DWS
GROBLERSDAL	OHRIGSTAD GWS	Ohrigstad Dam GWS			14.216	Active			DWS	DWS	DWS
GROBLERSDAL	OLIFANTS RIVER GWS (FLAG BOSHIELO)	Flag Boshielo Dam			185.000	Active			DWS	DWS	DWS
GROBLERSDAL	PHIRING DAM	Phiring Dam			0.230	Inactive			DWS	DWS	DWS
GROBLERSDAL	PIET GOUWS DAM	Piet Gouws Dam			3.900	Active			DWS	DWS	DWS
GROBLERSDAL	ROOIKRAAL GWS	Rooikraal Dam			2.100	Inactive	YES		DWS	DWS	DWS
GROBLERSDAL	RUST DE WINTER GWS	Rust De Winter Dam			28.186	Active	YES		DWS	DWS	DWS
GROBLERSDAL	RUST DE WINTER GWS			Balancing Dam LB1		Active			DWS	DWS	DWS
GROBLERSDAL	RUST DE WINTER GWS			Balancing Dam LB 2		Active			DWS	DWS	DWS
GROBLERSDAL	RUST DE WINTER GWS			Balancing Dam RB 1		Active			DWS	DWS	DWS
GROBLERSDAL	RUST DE WINTER GWS			Balancing Dam RB 2		Active			DWS	DWS	DWS
GROBLERSDAL	SABIE RIVER GWS (INYAKA DAM)	Inyaka Dam			125.027	Active			DWS	DWS	DWS
GROBLERSDAL	SAND RIVER GWS (WITKLIP DAM)	Witklip Dam			12.970	Active			DWS	DWS	DWS
GROBLERSDAL	SPITSKOP DAM	Spitskop Dam			0.752	Active			DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
GROBLERSDAL	TOURS DAM	Tours Dam			5.500	Active			DWS	DWS	DWS
GROBLERSDAL	VARSWATER DAM	Varswater Dam			0.207	Inactive			DWS	DWS	DWS
GROBLERSDAL	VERGELEGEN DAM	Vergelegen (Jane Furse)			1.550	Active	YES		DWS	DWS	DWS
GROBLERSDAL	VLAKBULT DAM	Vlakkult Dam			0.850	Inactive			DWS	DWS	DWS
GROBLERSDAL	WATERSVALS RIVER GWS	Buffelskloof Dam			5.400	Active			DWS	DWS	DWS
HARTBEESPOORT	BO-MOLOPO GWS		Molopo Eye Weir			Active			DWS	DWS	DWS
HARTBEESPOORT	BO-MOLOPO GWS					Active	YES (small section)	Grootfontein in Borehole (3 x 37kW)			
HARTBEESPOORT	BOSPOORT DAM	Bospoort dam			0.150	Active			DWS	DWS	DWS
HARTBEESPOORT	CROCODILE RIVER WEST GWS	Klipvoor Dam			47.000	Active			Crocodile West Irrigation Board	DWS / Crocodile West Irrigation Board	DWS
HARTBEESPOORT	CROCODILE RIVER WEST GWS	Roodekopjes Dam			103.000	Active	YES (to augment Vaalkop Dam)		Crocodile West Irrigation Board	DWS / Crocodile West Irrigation Board	DWS
HARTBEESPOORT	CROCODILE RIVER WEST GWS	Vaalkop Dam			53.500	Active			Magalies Water	DWS / Magalies Water	DWS
HARTBEESPOORT	DISANENG DAM	Disaneng Dam			17.400	Active		Yes (but belongs to the LM)	DWS	DWS	DWS
HARTBEESPOORT	HARTBEESPOORT GWS	Hartbeespoort Dam			195.000	Active	YES		DWS	DWS	DWS
HARTBEESPOORT	HARTBEESPOORT GWS		Brits weir (Roodekopjes)		0.700	Active	YES		Hartbeespoort Irrigation Board	Rooikoppies East and Rooikoppies West Old Furrow Committees	Rooikoppies East and Rooikoppies West Old Furrow Committees

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
HARTBEESPOORT	HARTBEESPOORT GWS		Eckhardt Weir		0.010	Active	YES		Hartbeespoort Irrigation Board	Hartbeespoort Irrigation Board	Hartbeespoort Irrigation Board
HARTBEESPOORT	HARTBEESPOORT GWS			Kareepoort	0.038	Active	YES		Hartbeespoort Irrigation Board	Hartbeespoort Irrigation Board	Hartbeespoort Irrigation Board
HARTBEESPOORT	HARTBEESPOORT GWS			Kleifontein	0.072	Active	YES		Hartbeespoort Irrigation Board	Hartbeespoort Irrigation Board	Hartbeespoort Irrigation Board
HARTBEESPOORT	KLEIN MARICOPOORT GWS	Klein Maricopoort Dam			7.073	Active	YES		DWS	DWS	DWS
HARTBEESPOORT	KOSTER DAM	Koster Dam			11.800	Active			DWS	DWS	DWS
HARTBEESPOORT	LEEUKRAAL DAM	Leeukraal Dam (Kudube - Themba)			0.550	Active			City of Tshwane Metropolitan Municipality	DWS	DWS
HARTBEESPOORT	LINDLEYSPOORT GWS	Lindleyspoort Dam			14.381	Active	YES		DWS	DWS	DWS
HARTBEESPOORT	LOTLAMORENG DAM	Lotlamoreng Dam			0.540	Inactive			DWS	DWS	DWS
HARTBEESPOORT	MADIKWE DAM	Madikwe Dam			14.000	Active		Madikwe Dam pump station (but does not belong to DWS)	DWS	DWS	DWS
HARTBEESPOORT	MANKWE DAM	Mankwe Dam			3.760	Inactive			DWS	DWS	DWS
HARTBEESPOORT	MARICO BOSVELD GWS	Marico-Bosveld Dam (Riekert Dam)			27.813	Active	YES		DWS	DWS	DWS
HARTBEESPOORT	MARICO BOSVELD GWS	Kromellenboog Dam			8.969	Active	YES				
HARTBEESPOORT	MARICO BOSVELD GWS			B Dam	0.220	Active					
HARTBEESPOORT	MIDDELKRAAL DAM	Middelkraal			0.757	Active	YES		DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
HARTBEESPOORT	MOGOL RIVER GWS (MOKOLO DAM)	Mokolo Dam			146.000	Active			DWS / Exxaro (minor)	DWS / Exxaro (minor)	DWS
HARTBEESPOORT	MOLATEDI DAM	Molatedi Dam			203.000	Active		Molatedi Pump Station	Sedibeng Water	DWS	DWS
HARTBEESPOORT	MOLATEDI DAM		Tswasa Weir		0.775	Active		Tswasa Weir Pump Station	Sedibeng Water	Sedibeng/DWS in terms of International Agreement with Botswana	
HARTBEESPOORT	NGOTOANE DAM	Ngotoane Dam			18.800	Active		Ngotoane Pump Station	DWS	DWS	DWS
HARTBEESPOORT	NOOITGEDACHT DAM	Nooitgedacht			1.430	Active			DWS	DWS	DWS
HARTBEESPOORT	PELLA DAM	Pella Dam			2.200	Active			DWS	DWS	DWS
HARTBEESPOORT	PIENAARS RIVER GWS (ROODEPLAAT DAM)	Roodeplaat Dam			43.472	Active	YES		DWS	DWS	DWS
HARTBEESPOORT	PIENAARS RIVER GWS (ROODEPLAAT DAM)			Klipdrift Bal Reservoir		Active					
HARTBEESPOORT	SEHUWJANE DAM	Sehuwjane Dam			4.150	Active		Yes (but does not belong to DWS)	DWS /Sedibeng Water	DWS	DWS
HARTBEESPOORT	SETUMO DAM	Setumo Dam			19.600	Active		Yes (but does not belong to DWS)	DWS / Sedibeng Water	DWS	DWS
HARTBEESPOORT	STERKSTROOM GWS (BUFFELSPOORT DAM)	Buffelspoort Dam			10.330	Active	YES		DWS	DWS	DWS
TZANEEN	ALBASINI GWS	Albasini Dam			28.199	Active	YES		DWS	DWS	DWS
TZANEEN	BOTLOKWA DAM	BOTLOKWA DAM			0.548	Active			DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
TZANEEN	CAPE THORNE DAM	CAPE THORNE DAM			0.893	Active	YES		DWS	DWS	DWS
TZANEEN	DAMANI DAM	DAMANI DAM			12.758	Active			DWS (dam) / VHEMBE DM (P/S)	DWS	DWS
TZANEEN	DUTHUNI DAM	DUTHUNI DAM			0.068	Active	YES		DWS (DAM) / FARMERS (CANALS)	DWS	DWS
TZANEEN	GROOT LETABA RIVER GWS	TZANEEN DAM			156.530	Active	YES		DWS	DWS	DWS
TZANEEN	GROOT LETABA RIVER GWS	EBENEZER DAM			69.139	Active			DWS	DWS	DWS
TZANEEN	GROOT LETABA RIVER GWS		JASSIE WEIR			Active			DWS	DWS	DWS
TZANEEN	GROOT LETABA RIVER GWS		JUNCTION WEIR			Active			DWS	DWS	DWS
TZANEEN	GROOT LETABA RIVER GWS		PRIESKA WEIR			Active			DWS	DWS	DWS
TZANEEN	GROOT LETABA RIVER GWS		YAMORNA WEIR			Active			DWS	DWS	DWS
						Active					
TZANEEN	HOUTRIVIER DAM	HOUTRIVIER DAM			6.836	Active			DWS (EXCEPT FOR THE VALVE IN THE WTW DONE BY POLOKWANE LM)	DWS	DWS
TZANEEN	LUVUVHU RIVER GWS (MALAMULELE WEIR)		MALAMULELE WEIR			Active			DWS (EXCEPT FOR THE VALVE IN THE WTW DONE BY VHEMBE DM)	DWS	DWS
TZANEEN	LUVUVHU RIVER GWS (NANDONI DAM)	NANDONI DAM				Active			DWS	DWS	DWS
TZANEEN	LUVUVHU RIVER GWS (XIKUNDU WEIR)		XIKUNDU WEIR			Active			DWS (EXCEPT FOR THE VALVE IN THE WTW DONE	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
									BY VHEMBE DM)		
TZANEEN	MAHONISI DAM	MAHONISI DAM				Inactive			DWS	DWS	DWS
TZANEEN	MAKULEKE DAM	MAKULEKE DAM				Active	YES		DWS	DWS	DWS
TZANEEN	MASHASHANE DAM	MASHASHANE DAM				Active			DWS (EXCEPT FOR THE VALVE IN THE WTW DONE BY POLOKWANE LM)	DWS	DWS
TZANEEN	MIDDLE LETABA SYSTEM GWS	MIDDLE-LETABA DAM				Active	YES		DWS	DWS	DWS
TZANEEN	MIDDLE LETABA SYSTEM GWS	NSAMI DAM				Active					
TZANEEN	MODJADJI DAM	MODJADJI DAM				Active			DWS	DWS	DWS
TZANEEN	MOGALAKWENA RIVER GWS (GLEN ALPINE DAM)	GLEN ALPINE DAM				Active			DWS	DWS	DWS
TZANEEN	MUTALE WEIR		MUTALE WEIR			Active			DWS	DWS	DWS
TZANEEN	MUTSHEDZI DAM	MUTSHEDZI DAM				Active			DWS	DWS	DWS
TZANEEN	NONDWENI WEIR		NONDWENI WEIR			Active			DWS	DWS	DWS
TZANEEN	NWANEDZI/LUPHEPH E GWS	CROSS DAM				Active			DWS	DWS	DWS
TZANEEN	NWANEDZI/LUPHEPH E GWS	NWANEDI DAM				Active					
TZANEEN	NWANEDZI/LUPHEPH E GWS	LUPHEPHE DAM				Active					
TZANEEN	NWANEDZI/LUPHEPH E GWS		NWANEDI DIVERSION WEIR			Active					

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
TZANEEN	NZHELELE RIVER GWS (NZHELELE DAM)	NZHELELE DAM				Active	YES		DWS	DWS	DWS
TZANEEN	PALALA RIVER GWS (SUSANDALE AND VISGAT WEIRS)		SUSANDALE WEIR			Active			DWS	DWS	DWS
TZANEEN	PALALA RIVER GWS (SUSANDALE AND VISGAT WEIRS)		VISGAT WEIR			Active			DWS	DWS	DWS
TZANEEN	PHIPHIDI DAM	PHIPHIDI DAM				Active			DWS	DWS	DWS
TZANEEN	POLITSI RIVER GWS (MAGOEBAKLOOF DAM)	MAGOEBAKLOOF DAM				Active			DWS	DWS	DWS
TZANEEN	POLITSI RIVER GWS (MAGOEBAKLOOF DAM)	VERGELEGEN DAM (POLITSI)									
TZANEEN	RIETFontein DAM I AND II	RIETFontein I DAM				Active			DWS (EXCEPT FOR THE VALVE IN THE WTW DONE BY POLOKWANE LM)	DWS	DWS
TZANEEN	RIETFontein DAM I AND II	RIETFontein II DAM				Active					
TZANEEN	SESHEGO DAM	SESHEGO DAM				Active			DWS (EXCEPT FOR THE VALVE IN THE WTW DONE BY POLOKWANE LM)	DWS	DWS
TZANEEN	STERK RIVER GWS (DOORNDRAAI DAM)	DOORNDRAAI DAM				Active	YES		DWS	DWS	DWS
TZANEEN	THABINA DAM	THABINA DAM				Active			DWS	DWS	DWS
TZANEEN	THAPANI DAM	THAPANI DAM				Active			DWS	DWS	DWS
TZANEEN	TSHAKHUMA DAM	TSHAKHUMA DAM				Active			DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
TZANEEN	TURFLOOP DAM	TURFLOOP DAM				Active			DWS	DWS	DWS
TZANEEN	VAALKOP NO 2 DAM	VAALKOP NO 2 DAM				Active			DWS	DWS	DWS
TZANEEN	VONDO DAM	VONDO DAM				Active			DWS	DWS	DWS

Table H.2: Details of the schemes falling under the Eastern Cluster

SCHEME NAME	AREA	DAMS	WEIRS	CANALS?	MAJOR PUMP STATIONS	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
BEVENSON DAM GWS	MIDMAR	BEVENSON DAM				INACTIVE	DWS	DWS	DWS
BIZANA DAM	MIDMAR	BIZANA DAM				ACTIVE	DWS	DWS	DWS
		LUDEKE DAM	GAUGING WEIR		LUDEKE PUMP STATION	ACTIVE	UMGENI WATER	UMGENI WATER	DWS
BUSHMANS RIVER GWS	MIDMAR	WAGENDRIFT DAM	GAUGING WEIR			ACTIVE	DWS	DWS	DWS
HAMMERSDALE DAM	MIDMAR	HAMMERSDALE DAM				INACTIVE	DWS	DWS	DWS
HLUHLUWE RIVER GWS	MIDMAR	HLUHLUWE DAM	GAUGING WEIR		NEW PUMP STATION	ACTIVE	DWS	DWS	DWS
LAVUMISA GWS	MIDMAR			YES	LAVUMISA LOW LIFT PUMP STATION; LAVUMISA LOW HIGH PUMP STATION	ACTIVE	DWS	DWS	DWS
MDLOTI RIVER GWS	MIDMAR	HAZELMERE DAM	GAUGING WEIR			ACTIVE	UMGENI WATER	UMGENI WATER	UMGENI WATER

SCHEME NAME	AREA	DAMS	WEIRS	CANALS?	MAJOR PUMP STATIONS	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
MNYAMVUBU RIVER GWS	MIDMAR	CRAIGIEBURN DAM	GAUGING WEIR			ACTIVE	DWS	DWS	DWS
MOOI MGANI RIVERS GWS	MIDMAR	SPRING GROVE	MOOI RIVER FISH BARRIER WEIR		MMTS2 PUMP STATION	ACTIVE	UMGENI WATER	UMGENI WATER	UMGENI WATER
			GAUGING WEIR						
			MEARNS WEIR		MMTS1 PUMP STATION	ACTIVE	UMGENI WATER	UMGENI WATER	UMGENI WATER
			GAUGING WEIR (COMBINED)						
NGAGANE RIVER GWS	MIDMAR	NTSHINGWAYO	GAUGING WEIR			ACTIVE	DWS	DWS	DWS
PONGOLA RIVER GWS	MIDMAR		GROOTDRAAI WEIR	YES		ACTIVE	IMPALA IRRIGATION BOARD	IMPALA IRRIGATION BOARD	IMPALA IRRIGATION BOARD
PONGOLAPOORT GWS	MIDMAR	PONGOLAPOORT DAM	GAUGING WEIR	YES		ACTIVE	DWS	DWS	DWS
			GAUGING WEIR						
QEDUSIZI GWS	MIDMAR	QEDUSIZI DAM	GAUGING WEIR			ACTIVE	UTHUKELA DM (DISASTER MANAGEMENT)	UTHUKELA DM (DISASTER MANAGEMENT)	DWS
SINGISI GWS	MIDMAR	SINGISI DAM				ACTIVE	DWS	DWS	DWS
TUGELA MHLATUZE RIVERS GWS	MIDMAR	GOEDERTROUW	GAUGING WEIR	YES	MADUNGELA PUMP STATION; MKHALAZI PUMP STATION; AND NEW VENTURE PUMP STATION	ACTIVE	DWS	DWS	DWS
TUGELA RIVER GWS	MIDMAR	SPIOENKOP	GAUGING WEIR			ACTIVE	DWS	DWS	DWS
UMGENI RIVER GWS	MIDMAR	MIDMAR	GAUGING WEIR			ACTIVE	UMGENI WATER	UMGENI WATER	UMGENI WATER

SCHEME NAME	AREA	DAMS	WEIRS	CANALS?	MAJOR PUMP STATIONS	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
		ALBERT FALLS	GAUGING WEIR			ACTIVE	UMGENI WATER	UMGENI WATER	UMGENI WATER
		INANDA	GAUGING WEIR			ACTIVE	UMGENI WATER	UMGENI WATER	UMGENI WATER
WHITE MFOLOZI RIVER GWS	MIDMAR	KLIPFONTEIN	GAUGING WEIR			ACTIVE	DWS	DWS	DWS
			ULUNDI WEIR	YES		ACTIVE	DWS	DWS	DWS

Table H.3: Details of the schemes falling under the Southern Cluster

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
EASTERN CAPE	AMABELE GWS (AMATOLA)	Amabele Dam			0.15	INACTIVE					DWS
EASTERN CAPE	AMATOLA (WRIGGLESWADE DAM)	Wriggleswade Dam			93.2	ACTIVE	YES		Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	BALURA GWS (AMATOLA)	Balura Dam			0.24	INACTIVE					DWS
EASTERN CAPE	BEKRUIPKOP - CISKEI	Bekruipkop Dam			0.079	INACTIVE					
EASTERN CAPE	BINFELD PARK DAM	Binfield Park Dam			36.83	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	BLUE CRANE DAM	Blue Crane Dam			0.14	INACTIVE					
EASTERN CAPE	BUSHMANSKRANTZ DAM	Bushmanskrantz Dam			5.2	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	DABI DAM	Dabi Dam			0.234	INACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	DEBE DAM	Debe Dam			6.3	ACTIVE			Amatola Water Board.	Amatola Water Board.	DWS
EASTERN CAPE	DIMBAZA - CISKEI	Dimbaza Dam			1.06	INACTIVE					DWS
EASTERN CAPE	DONNYBROOK 1	Donnybrook 1 Dam		Balancing dam	0.221	INACTIVE	YES				
EASTERN CAPE	DONNYBROOK 2	Donnybrook 2 Dam			Not available	INACTIVE					

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
EASTERN CAPE	DOORN RIVER (DOORN RIVER DAM)	Doorn River Dam			0.22	ACTIVE			Chris Hani District Municipality	Chris Hani District Municipality	DWS
EASTERN CAPE	GAMTOOS RIVER (KOUGA AND LOERIE DAMS)	Kouga Dam			128.49	ACTIVE			Gamtoos Irrigation Board	Gamtoos Irrigation Board	DWS
EASTERN CAPE	GAMTOOS RIVER (KOUGA AND LOERIE DAMS)	Loerie Dam			3.3	ACTIVE			Gamtoos Irrigation Board	Gamtoos Irrigation Board	DWS
EASTERN CAPE	GAMTOOS RIVER (KOUGA AND LOERIE DAMS)			Balancing Dam 1 / Scheepers Dam	0.13	INACTIVE			Gamtoos Irrigation Board	Gamtoos Irrigation Board	DWS
EASTERN CAPE	GAMTOOS RIVER (KOUGA AND LOERIE DAMS)			Balancing Dam 2 / Patensie / Wolwekloof Dam	0.27	ACTIVE			Gamtoos Irrigation Board	Gamtoos Irrigation Board	DWS
EASTERN CAPE	GAMTOOS RIVER (KOUGA AND LOERIE DAMS)			G Balancing Dam	0.03	ACTIVE			Gamtoos Irrigation Board	Gamtoos Irrigation Board	DWS
EASTERN CAPE	GAMTOOS RIVER (KOUGA AND LOERIE DAMS)			D Balancing Dam / Müller Dam	0.32	ACTIVE			Gamtoos Irrigation Board	Gamtoos Irrigation Board	DWS
EASTERN CAPE	GCUWA WEIR		Gcuwa Weir		0.9	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	GELUK GS	Geluk Dam			0.37	INACTIVE					
EASTERN CAPE	GLENBROK	Glenbrock Dam			0.64	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	GROOT RIVER (BEERVLEI DAM)	Beervlei Dam			90.828	ACTIVE	YES		DWS	DWS	DWS
EASTERN CAPE	GWABA	Gwaba Dam			0.066	INACTIVE					
EASTERN CAPE	GXETHU GWS (AMATOLA)	Gxethu Dam			0.23	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	GXULU (CORANA DAM)	Corana Dam			0.95	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	JAN TSHATSHU - CISKEI	Jan Tshatshu Dam			0.14	INACTIVE					DWS
EASTERN CAPE	KAMASTONE	Kamastone Dam			0.76	INACTIVE					DWS
EASTERN CAPE	KAT RIVER (KAT RIVER DAM)	Kat River Dam			24.69	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	KEISKAMMAHOEK (CATA DAM)	Cata Dam			12.5	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	KEISKAMMAHOEK (MNYAMENI DAM)	Mnyameni Dam			2.05	ACTIVE			Amatola Water Board	Amatola Water Board	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
EASTERN CAPE	KLIPLAAT RIVER (WATERDOWN DAM)	Waterdown Dam			38.4	ACTIVE	YES	Shiloh	Lukhanji Local Municipality	Lukhanji Local Municipality	DWS
EASTERN CAPE	KLIPLAAT RIVER (WATERDOWN DAM)			Canal Balancing Dam (Shiloh)	Not available	INACTIVE	YES		Lukhanji Local Municipality	Lukhanji Local Municipality	DWS
EASTERN CAPE	KROMME RIVER (IMPOFU DAM)	Impofu Dam			106.885	ACTIVE			Nelson Mandela Bay Municipality.	Nelson Mandela Bay Municipality.	DWS
EASTERN CAPE	KUBUSI RIVER (GUBU DAM)	Gubu Dam			8.8	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	KUZITUNGU	Kuzitungu Dam			Not available	INACTIVE					
EASTERN CAPE	KWABHACA (NTENETYANE DAM)	Ntenetyane Dam			1.85	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	LAING DAM	Laing Dam			19.86	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	LIBODE (MHLANGA DAM)	Mhlanga Dam			1.96	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	LOWER FISH SCHEME			Glen Boyd Balancing Dam	0.165	ACTIVE	YES	Glenmore Pump Station	Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	LOWER FISH SCHEME		Hermanuskraal Weir		0.55	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	LOWER FISH SCHEME	Glen Melville Dam			6.23	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	LOWER SUNDAYS SCHEME	Scheepersvlakte Dam			0.82	ACTIVE	YES		Lower Sunday Water User Association	Lower Sunday Water User Association	DWS
EASTERN CAPE	LOWER SUNDAYS SCHEME		Korhaansdrift Weir		0.13	ACTIVE	YES		Lower Sunday Water User Association	Lower Sunday Water User Association	DWS
EASTERN CAPE	MACUBENI DAM	Macubeni Dam			3.8	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	MAGWA - TS*	Magwa Dam			1.33	INACTIVE					
EASTERN CAPE	MAIPASE - CISKEI	Maipase Dam			0.112	INACTIVE					
EASTERN CAPE	MAITLAND - CISKEI	Maitland Dam			Not available	INACTIVE					
EASTERN CAPE	MAJOLA - TS*	Majola Dam			0.379	INACTIVE					
EASTERN CAPE	MALUTI (BELFORT DAM)	Belfort Dam			0.54	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	MANKAZANA GWS (AMATOLA)	Mankazana Dam			1.85	INACTIVE					
EASTERN CAPE	MASELA 1	Masela 1 Dam			0.05	INACTIVE					

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
EASTERN CAPE	MASELA 2	Masela 2 Dam			0.06	INACTIVE					
EASTERN CAPE	MDANTSANE 1	Mdantsane 1 Dam			Not available	INACTIVE					
EASTERN CAPE	MDANTSANE 2	Mdantsane 2 Dam			Not available	INACTIVE					
EASTERN CAPE	MHLAHLANE (MABELENI DAM)	Mabeleni Dam			2.1	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	MITFORD	Mitford Dam			0.6	INACTIVE					
EASTERN CAPE	MOUNT COKE	Mount Coke Dam			0.196	INACTIVE					
EASTERN CAPE	MSGENI	Msengeni Dam			0.072	INACTIVE					
EASTERN CAPE	NAHOON RIVER (NAHOON DAM)	Nahoon Dam			19.934	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	NCORA (NCORA DAM)	Ncora Dam			181.25	ACTIVE	YES		Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	NCORA (NCORA DAM)			Canal Balancing Dam x 10		ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	NQWEKAZI	Nqwekazi Dam			0.67	INACTIVE					
EASTERN CAPE	NONCAMP	Noncampa 1 Dam			0.057	INACTIVE					
EASTERN CAPE	NONCAMP	Noncampa 2 Dam			Not available	INACTIVE					
EASTERN CAPE	NQADU - TS*	Nqadu Dam			1.44	ACTIVE			Oliver Tambo District Municipality	Oliver Tambo District Municipality	DWS
EASTERN CAPE	NQWELO GWS (AMATOLA)	Nqwelo Dam			0.779	INACTIVE					
EASTERN CAPE	NTABATEMBA	Limietkloof Dam			0.45	INACTIVE					
EASTERN CAPE	NTABATEMBA	Thrift Dam			2.66	INACTIVE					
EASTERN CAPE	NTSIKIZINI GWS (AMATOLA)	Ntsikizini Dam			Not available	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	ORANGE - FISH GWS	Darlington Dam			187	ACTIVE	YES		Lower Sundays Water User Association	Lower Sundays Water User Association	DWS
EASTERN CAPE	ORANGE - FISH GWS		De Mistkraal Weir		4.074	ACTIVE					
EASTERN CAPE	ORANGE - FISH GWS		Elandsdrift Dam		0.055	ACTIVE					

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
EASTERN CAPE	ORANGE - FISH GWS	Grassridge Dam			46.2	ACTIVE					
EASTERN CAPE	OUTSPAN (CHALUMNA) DAM	Outspan Dam			Not available	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	OXKRAAL - CISKEI	Oxkraal Dam			18	ACTIVE			Brandrivier Irrigation Board	Brandrivier Irrigation Board	DWS
EASTERN CAPE	PLEASANT VIEW DAM	Pleasant View Dam			1.525	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	QAMATA (LUBISI DAM)	Lubisi Dam			158.2	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	QAMATA (LUBISI DAM)		Lanti Weir		Not available	ACTIVE	YES		DWS	DWS	DWS
EASTERN CAPE	QAMATA (LUBISI DAM)			Canal Balancing Dam x 39	Not available	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	QIBIRA	Qibira Dam			Not available	INACTIVE					
EASTERN CAPE	REDHILL	Redhill Dam			0.29	INACTIVE					
EASTERN CAPE	ROOIKRANTZ DAM	Rooikrantz Dam			0.61	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
EASTERN CAPE	ROXENI GWS (AMATOLA)	Roxeni Dam			0.62	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	RURA GWS (AMATOLA)	Rura Dam			0.632	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	SHESEGU DAM	Sheshegu Dam			0.17	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	SHILOH - CS*	Shiloh Dam			0.92	INACTIVE					
EASTERN CAPE	SINQUMENI GWS (AMATOLA)	Sinqumeni Dam			0.62	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	TARKA RIVER (KOMMANDODRIFT DAM)	Kommandodrift Dam			58.9	ACTIVE	YES		Great Fish River Water User Association	Great Fish River Water User Association	DWS
EASTERN CAPE	TENTERGATE - CS*	Tentergate Dam			1.4	INACTIVE			DWS	DWS	DWS
EASTERN CAPE	TOLENI (TOLENI DAM)	Toleni Dam			0.211	ACTIVE			Amatole District Municipality.	Amatole District Municipality.	DWS
EASTERN CAPE	TSOJANA DAM	Tsojana Dam			12.34	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	TYHEFU (NDLAMBE DAM)	Ndlambe Dam			0.915	INACTIVE					

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
EASTERN CAPE	TYUTYU	Tyutyu Dam			0.06	INACTIVE					
EASTERN CAPE	UMTATA DAM	Umtata Dam			253.674	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	WOBURN 2	Woburn 2 Dam			0.16	INACTIVE					
EASTERN CAPE	WOBURN 3	Woburn 3 Dam			0.26	INACTIVE					
EASTERN CAPE	XILINXA DAM	Xilinx Dam			17.7	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	XONXA DAM	Xonxa Dam			158.5	ACTIVE			DWS	DWS	DWS
EASTERN CAPE	ZANYOKWE (SANDILE DAM)	Sandile Dam			30.96	ACTIVE			Amatola Water Board	Amatola Water Board	DWS
WESTERN CAPE	BRAND RIVER GWS (MIERTJIESKRAAL DAM)	Miertjieskraal Dam			1.56	ACTIVE	YES		Brandrivier Irrigation Board (no formal agreement)	DWS / Brandrivier Irrigation Board	DWS / Brandrivier Irrigation Board
WESTERN CAPE	BREEDE RIVER GWS (BRANDVLEI&KWAGG ASKLOOF DAMS)	Brandvlei Dam	Smalblaar River Canal Diversion Weir		456	ACTIVE		Brandvlei Pump Station	DWS (Middle Breede WUA) (no formal agreement)	DWS (Middle Breede WUA) (no formal agreement)	DWS / Middle Breede WUA
WESTERN CAPE	BREEDE RIVER GWS (BRANDVLEI&KWAGG ASKLOOF DAMS)	Brandvlei Dam	Smalblaar River Canal Diversion Weir		456	ACTIVE	YES	Bron Pump Station	DWS (Middle Breede WUA) (no formal agreement)	DWS (Middle Breede WUA) (no formal agreement)	DWS / Middle Breede WUA
WESTERN CAPE	BREEDE RIVER GWS (BRANDVLEI&KWAGG ASKLOOF DAMS)		Holsloot River Canal Diversion Weir						DWS (Middle Breede WUA) (no formal agreement)	DWS (Middle Breede WUA) (no formal agreement)	DWS / Middle Breede WUA
WESTERN CAPE	BREEDE RIVER GWS (BRANDVLEI&KWAGG ASKLOOF DAMS)	Kwaggaskloof Dam			286	ACTIVE			DWS (Middle Breede WUA) (no formal agreement)	DWS (Middle Breede WUA) (no formal agreement)	DWS / Middle Breede WUA
WESTERN CAPE	BUFFELS RIVER GWS (FLORISKRAAL DAM)	Floriskraal Dam			50.334	ACTIVE			Buffelsrivier Irrigation Board (old agreement)	DWS	DWS / Buffelsrivier Irrigation Board

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
WESTERN CAPE	BUFFELSJAGS RIVER GWS (BUFFELSJAGS DAM)	Buffeljags Dam			5.2	ACTIVE	YES		Buffelsjags Irrigation Board (old agreement)	Buffelsjags Irrigation Board	Buffelsjags Irrigation Board
WESTERN CAPE	CORDIERS RIVER GWS (OUKLOOF DAM)	Oukloof Dam			4.19	ACTIVE	YES		Oukloof Irrigation Board (no formal agreement)	DWS	DWS / Oukloof Irrigation Board
WESTERN CAPE	DUIVENHOKS RIVER GWS (DUIVENHOKS DAM)	Duivenhoks Dam			6.32	ACTIVE			DWS / Duivenhoks Irrigation Board (no formal agreement)	DWS	DWS / Duivenhoks Irrigation Board
WESTERN CAPE	ELANDS RIVER GWS (ELANDSKLOOF DAM)	Elandskloof Dam			11.5	ACTIVE	YES		Elandskloof Irrigation Board (old agreement)	Elandskloof Irrigation Board	DWS / Elandskloof Irrigation Board
WESTERN CAPE	GAMKA RIVER GWS (BEAUFORT WEST DAM)	Gamka Dam			2.17	ACTIVE			Beaufort-West LM (no formal agreement)	DWS	DWS / Beaufort- West LM
WESTERN CAPE	GAMKA RIVER GWS (GAMKAPOORT DAM)	Gamkapoort Dam			36	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	GOUKOU RIVER GWS		Diversion Works			ACTIVE	YES		Grootbosberg Irrigation Board (old agreement)	Grootbosberg Irrigation Board	DWS / Grootbosber g Irrigation Board
WESTERN CAPE	HARTENBOS RIVER GWS (HARTBEESKUIL DAM)	Hartbeeskuil Dam			7.152	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	KEISIES RIVER GWS (PIETERSFONTEIN DAM)	Pietersfontein Dam			2.028	ACTIVE			DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
WESTERN CAPE	KINGNA RIVER GWS (POORTJIESKLOOF DAM)	Poortjieskloof Dam			9.68	ACTIVE			DWS / Kingna Irrigation Board (no formal agreement)	DWS	DWS / Kingna Irrigation Board
WESTERN CAPE	KONINGS RIVER GWS (KLIPBERG DAM)	Klipberg Dam			1.99	ACTIVE			DWS / Konings River Irrigation Board (no formal agreement)	DWS	DWS / Konings River IB
WESTERN CAPE	KORENTEVETTE RIVER GWS (KORENTE-VETTE DAM)	De Novo Dam	Diversion Works		0.092	ACTIVE			Korente Vette Irrigation Board (old agreement)	Korente Vette Irrigation Board	DWS / Korente Vette Irrigation Board
WESTERN CAPE	KORENTEVETTE RIVER GWS (KORENTE-VETTE DAM)	Korentepoort Dam			8.207	ACTIVE	YES		Korente Vette Irrigation Board (old agreement)	Korente Vette Irrigation Board	DWS / Korente Vette Irrigation Board
WESTERN CAPE	KORENTEVETTE RIVER GWS (KORENTE-VETTE DAM)		Kristalkloof Diversion Weir		Not available	ACTIVE			Korente Vette Irrigation Board (old agreement)	Korente Vette Irrigation Board	DWS / Korente Vette Irrigation Board
WESTERN CAPE	LEEU RIVER GWS (LEEUGAMKA DAM)	Leeu-Gamka Dam			14.639	ACTIVE	YES		Leeu Gamka Irrigation Board (no formal agreement)	DWS / Leeu Gamka Irrigation Board	DWS / Leeu Gamka Irrigation Board
WESTERN CAPE	LEEU RIVER GWS (LEEUGAMKA DAM)		Leeu Gamka - Kruidfontein Weir		0.09	ACTIVE			Leeu Gamka Irrigation Board (no formal agreement)	DWS / Leeu Gamka Irrigation Board	DWS / Leeu Gamka Irrigation Board

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
WESTERN CAPE	LEEU RIVER GWS (LEEUGAMKA DAM)		Leeu Gamka - Saai river Weir		0.231	ACTIVE			Leeu Gamka Irrigation Board (no formal agreement)	DWS / Leeu Gamka Irrigation Board	DWS / Leeu Gamka Irrigation Board
WESTERN CAPE	LOWER BERG RIVER GWS (VOELVLEI&MISVERS TAND DAMS)	Misverstand Dam			7.737	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	LOWER BERG RIVER GWS (VOELVLEI&MISVERS TAND DAMS)	Voelwei Dam	Kleinberg River Canal Diversion Weir		168	ACTIVE	YES		DWS	DWS	DWS
WESTERN CAPE	LOWER BERG RIVER GWS (VOELVLEI&MISVERS TAND DAMS)		Leeu River Canal Diversion Weir		Not available	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	LOWER BERG RIVER GWS (VOELVLEI&MISVERS TAND DAMS)		Twenty-four Rivers Canal Diversion Weir		Not available	ACTIVE	YES		DWS	DWS	DWS
WESTERN CAPE	MOSSELBAY GWS (WOLWEDANS DAM)	Wolwedans Dam			25.53	ACTIVE		Klipheuwel Pump Station	DWS / PetroSA (old agreement)	DWS / PetroSA	DWS / PetroSA
WESTERN CAPE	MOSSELBAY GWS (WOLWEDANS DAM)	Klipheuwel Dam			4.33	ACTIVE		Moordkuil Pump Station	DWS / PetroSA (old agreement)	DWS / PetroSA	DWS / PetroSA
WESTERN CAPE	OLIFANTS RIVER (STOMPDRIFT&KAMA NASSIE DAMS) (OUDTSHOORN)	Stompdrift Dam			55.3	ACTIVE	YES		Stompdrift- Kammanassie Water User Association (old agreement)	DWS / Stompdrift- Kammanassie Water User Association	DWS / Stompdrift- Kammanassi e Water User Association

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
WESTERN CAPE	OLIFANTS RIVER (STOMPDRIFT&KAMA NASSIE DAMS) (OUDTSHOORN)	Kammanassie Dam			35.87	ACTIVE	YES		Stompdrift- Kammanassie Water User Association (old agreement)	DWS / Stompdrift- Kammanassie Water User Association	DWS / Stompdrift- Kammanassie Water User Association
WESTERN CAPE	OLIFANTS RIVER GWS (CLANWILLIAM DAM)	Clanwilliam Dam			123.69	ACTIVE	YES		DWS	DWS	DWS
WESTERN CAPE	OLIFANTS RIVER VAN RHYNSDORP GWS (BULSHOEK DAM)	Bulshoek Dam			5.754	ACTIVE			Laer Olifants Rivier Water User Association (no formal agreement)	Laer Olifants Rivier Water User Association	Laer Olifants Rivier Water User Association
WESTERN CAPE	OLIFANTS RIVER VAN RHYNSDORP GWS (BULSHOEK DAM)			Sandkraal	Not available	ACTIVE			Laer Olifants Rivier Water User Association (no formal agreement)	Laer Olifants Rivier Water User Association	Laer Olifants Rivier Water User Association
WESTERN CAPE	OLIFANTS RIVER VAN RHYNSDORP GWS (BULSHOEK DAM)			LORWA - RB Sluice K25 Dam	Not available	ACTIVE			Laer Olifants Rivier Water User Association (no formal agreement)	Laer Olifants Rivier Water User Association	Laer Olifants Rivier Water User Association
WESTERN CAPE	OLIFANTS RIVER VAN RHYNSDORP GWS (BULSHOEK DAM)			K35	Not available	ACTIVE			Laer Olifants Rivier Water User Association (no formal agreement)	Laer Olifants Rivier Water User Association	Laer Olifants Rivier Water User Association
WESTERN CAPE	OLIFANTS RIVER VAN RHYNSDORP GWS (BULSHOEK DAM)			LORWA - LB Sluice 140 Sandkraal dam 2	Not available	ACTIVE			Laer Olifants Rivier Water User Association (no formal agreement)	Laer Olifants Rivier Water User Association	Laer Olifants Rivier Water User Association

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
WESTERN CAPE	OLIFANTS RIVER VAN RHYNSDORP GWS (BULSHOEK DAM)			LB Sluice 140 Sandkraal dam 1	Not available	ACTIVE			Laer Olifants Rivier Water User Association (no formal agreement)	Laer Olifants Rivier Water User Association	Laer Olifants Rivier Water User Association
WESTERN CAPE	PALMIET RIVER GWS (ROCKVIEW&KOGELB ERG DAMS)	Kogelberg Dam			19.3	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	PALMIET RIVER GWS (ROCKVIEW&KOGELB ERG DAMS)	Rockview Dam			16.4	ACTIVE	YES		DWS	DWS	DWS
WESTERN CAPE	RIVERSONDEREND - BERG RIVER GWS	Kleinplaas Dam			0.227	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	RIVERSONDEREND - BERG RIVER GWS		Banhoek Weir		Not available	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	RIVERSONDEREND - BERG RIVER GWS		Wolwekloof Weir		0.057	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	RIVERSONDEREND - BERG RIVER GWS	Theewaterskloof Dam	TWK Charmaine Weir		480.406	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	RIVERSONDEREND - BERG RIVER GWS	Berg River Dam			130	ACTIVE		Dasbos Pump Station	DWS	DWS	DWS
WESTERN CAPE	RIVERSONDEREND - BERG RIVER GWS		Drakenstein Diversion Works	Drakenstein Balancing Dam	Not available	ACTIVE		Drakenstein Pump Station	DWS	DWS	DWS
WESTERN CAPE	ROODEFONTEIN DAM	Roodefontein Dam			2.003	ACTIVE			Bitou Municipality (no formal agreement)	DWS / Bitou Municipality	DWS / Bitou Municipality
WESTERN CAPE	SANDRIFT RIVER GWS (ROODEELSBERG&LA KENVALLEI DAMS)	Lakenvallei Dam			10.23	ACTIVE			Hexvalley Water User Association (old agreement)	Hexvalley Water User Association	DWS / Hexvalley Water User Association

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS ?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
WESTERN CAPE	SANDRIFT RIVER GWS (ROODELSBERG&LA KENVALLEI DAMS)	Roode Elsberg Dam			7.733	ACTIVE			Hexvalley Water User Association (old agreement)	Hexvalley Water User Association	DWS / Hexvalley Water User Association
WESTERN CAPE											
WESTERN CAPE	TIERKLOOF DAM	Tierkloof Dam			1.2	ACTIVE			DWS	DWS	DWS
WESTERN CAPE	VALSCH RIVER GWS (BEN ETIVE DAM)	Ben Etive Dam			0.153	ACTIVE			Warmbakveld Irrigation Board (no formal agreement)	Warmbakveld Irrigation Board	DWS / Warmbakvel d Irrigation Board
WESTERN CAPE	VERKEERDEVLEI DAM	Verkeerdevlei Dam			5.54	INACTIVE			None	None	None

Table H.4: Details of the schemes falling under the Central Cluster

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm ³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
BLOEMFONTEIN	CALEDON- MODDER GWS	Rustfontein Dam			72.200	ACTIVE	Yes	Tienfontein Pump Station	Bloem Water	Bloem Water	Bloem Water
BLOEMFONTEIN	CALEDON- MODDER GWS	Knellpoort Dam			136.900	ACTIVE			Bloem Water	Bloem Water	Bloem Water
BLOEMFONTEIN	CALEDON- MODDER GWS	Welbedacht Dam			10.330	ACTIVE			Bloem Water	Bloem Water	Bloem Water
BLOEMFONTEIN	HARTS RIVER GWS (SPITSKOP DAM)	Spitskop Dam			57.887	ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	HARTS RIVER GWS (WENTZEL DAM)	Wentzel Dam			5.290	ACTIVE			DWS (from Bloemhof Dam)	DWS (from Bloemhof Dam)	DWS
BLOEMFONTEIN	LEEU RIVER GWS (ARMENIA DAM)	Armenia Dam			13.778	ACTIVE	Yes		Leeu River WUA	Leeu River WUA	Leeu River WUA
BLOEMFONTEIN	MIDDLE VAAL GWS	Bloemhof Dam				ACTIVE			DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
BLOEMFONTEIN	MIDDLE VAAL GWS		Vaalharts Weir			ACTIVE			DWS	DWS	DWS
BLOEMFONTEIN	MODDER RIVER	Krugersdrif Dam			66.000	ACTIVE			Modder River WUA	Modder River WUA	Modder River WUA
BLOEMFONTEIN	MOUTLOATSI SETLOGELO GROOTHOEK DAM	Moutloatsi Setlogelo Dam			14.000	ACTIVE			Bloem Water	Bloem Water	Bloem Water
BLOEMFONTEIN	ORANGE RIET CANAL		Koedoesberg Weir		0.835	ACTIVE	Yes	Scheiding Pump Station	Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL		Blaauwboschfontein Weir		1.500	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			HK Balancing Dam	0.234	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			Holpan	0.502	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			Klipfontein	0.024	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			Kloksfontein	0.010	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			Main canal 1		ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			Orange Riet - Raw Water Storage Dam		ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			Orange-Riet S1 balancing dam	0.582	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			S1	0.582	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			S2	1.294	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIET CANAL			S350	0.125	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	ORANGE RIVER (BOEGOEBERG DAM)	Boegoeberg Dam			19.895	ACTIVE	Yes		Boegoeberg WUA	Boegoeberg WUA	Boegoeber g WUA
BLOEMFONTEIN	ORANGE RIVER (BOEGOEBERG DAM)			Volgraafsig Balancing Dam		ACTIVE			Boegoeberg WUA	Boegoeberg WUA	Boegoeber g WUA
BLOEMFONTEIN	ORANGE RIVER (KAKAMAS)		Augrabies Weir			ACTIVE	Yes		Kakamas WUA	Kakamas WUA	Kakamas WUA
BLOEMFONTEIN	ORANGE RIVER (KAKAMAS)		Neusberg Weir		1.840	ACTIVE			Kakamas WUA	Kakamas WUA	Kakamas WUA
BLOEMFONTEIN	ORANGE RIVER (UPINGTON ISLANDS)		Gifkloof Weir			ACTIVE	Yes		DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
BLOEMFONTEIN	ORANGE RIVER (UPINGTON ISLANDS)			Balancing Dam1		ACTIVE			DWS	DWS	DWS
BLOEMFONTEIN	ORANGE RIVER (UPINGTON ISLANDS)			Balancing Dam2		ACTIVE			DWS	DWS	DWS
BLOEMFONTEIN	ORANGE RIVER (UPINGTON ISLANDS)			Upington Islands - Canal balancing dam		ACTIVE			DWS	DWS	DWS
BLOEMFONTEIN	ORANGE RIVER GWS	Vanderkloof Dam			3 187.557	ACTIVE	Yes (short section from the dam to the P/S)	Vanderkloof Raw Water Pump Station	DWS	DWS	DWS
BLOEMFONTEIN	ORANGE RIVER GWS	Gariep Dam			5 342.932	ACTIVE	No		DWS	DWS	DWS
BLOEMFONTEIN	ORANGE VAAL (DOUGLAS CANALS)		Douglas-Atherton Weir		16.000	ACTIVE	Yes	Nottingham Pump Station	Lower Vaal WUA	Lower Vaal WUA	Lower Vaal WUA
BLOEMFONTEIN	RIET RIVER	Kalkfontein Dam			258.274	ACTIVE	Yes		Kalkfontein WUA	Kalkfontein WUA	Kalkfontein WUA
BLOEMFONTEIN	SAND-VET GWS	Allemanskraal Dam			178.136	ACTIVE	Yes		Sand-Vet River Water User Association	Sand-Vet River Water User Association	Sand-Vet River Water User Association
BLOEMFONTEIN	SAND-VET GWS	Erferis Dam			212.340	ACTIVE			Sand-Vet River Water User Association	Sand-Vet River Water User Association	Sand-Vet River Water User Association
BLOEMFONTEIN	SAND-VET GWS			Klippiet	1.000	ACTIVE			Sand-Vet River Water User Association	Sand-Vet River Water User Association	Sand-Vet River Water User Association
BLOEMFONTEIN	SAND-VET GWS			Palmietkuil	0.713	ACTIVE			Sand-Vet River Water User Association	Sand-Vet River Water User Association	Sand-Vet River Water User Association
BLOEMFONTEIN	STERKSPRUIT	Jozanashoek Dam			11.600	ACTIVE	No		Bloem Water	Bloem Water	Bloem Water
BLOEMFONTEIN	TAUNG DAM	Taung Dam				ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	THABAN'CHU DAMS	Feloana Dam			0.210	ACTIVE	Yes (small)		DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
BLOEMFONTEIN	THABAN'CHU DAMS	Rooifontein Dam			0.113	ACTIVE			DWS	DWS	DWS
BLOEMFONTEIN	THABAN'CHU DAMS	Sediba Dam			1.040	ACTIVE			DWS	DWS	DWS
BLOEMFONTEIN	THABAN'CHU DAMS	Serowalo Dam			1.010	ACTIVE			DWS	DWS	DWS
BLOEMFONTEIN	VAALHARTS CANALS	Vaalharts Dam			48.700	ACTIVE	Yes	Vaalharts Pump Station	Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	VAALHARTS CANALS			North Canal Balancing Dam	0.149	ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	VAALHARTS CANALS			Taung Dam 1	0.704	ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	VAALHARTS CANALS			Taung Dam 6	0.618	ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	VAALHARTS CANALS			Taung Dam 7	0.332	ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	VAALHARTS CANALS			Vaalharts - Borrelskop Balancing Dam	0.286	ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	VAALHARTS CANALS			West Canal Balancing Dam	0.399	ACTIVE			Vaalharts WUA	Vaalharts WUA	Vaalharts WUA
BLOEMFONTEIN	VAN DER KLOOF			Ramah Dam 1	0.402	ACTIVE	Yes		Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	VAN DER KLOOF			Ramah Dam 2	0.422	ACTIVE			Oranje Riet WUA	Oranje Riet WUA	Oranje Riet WUA
BLOEMFONTEIN	WITTESPRUIT (EGMONT DAM)	Egmont Dam			9.784	ACTIVE	Yes (mainly unlined)		Egmont Irrigation Board	Egmont Irrigation Board	Egmont Irrigation Board
JERICO	KOMATI RIVER GWS	Nooitgedacht Dam			78.824	ACTIVE		All P/Ss are owned and operated by Eskom	DWS	DWS	DWS
JERICO	KOMATI RIVER GWS	Vygeboom Dam			78.400	ACTIVE	Yes		DWS	DWS	DWS
JERICO	KOMATI RIVER GWS		Gladdespruit Weir		small	ACTIVE	Yes		DWS	DWS	DWS
JERICO	KOMATI RIVER GWS		Poponyane Weir		small	ACTIVE (under rehabilitation)	Yes		DWS	DWS	DWS
JERICO	KOMATI RIVER GWS		Gemsbokhoek Weir		0.133	ACTIVE			DWS	DWS	DWS
JERICO	USUTU RIVER GWS	Jericho Dam			59.500	ACTIVE		Jericho Pump Station	DWS	DWS	DWS
JERICO	USUTU RIVER GWS	Morgenstond Dam			100.773	ACTIVE		Morgenstond I (Old) Pump Station	DWS	DWS	DWS
JERICO	USUTU RIVER GWS							Morgenstond II (New) Pump Station	DWS	DWS	DWS
		Westoe Dam			60.000	ACTIVE					

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
JERICHO	USUTU RIVER GWS	Bonnie Brook Dam	Churchill Weir		0.500	ACTIVE	Yes	Kliphoek Booster Pump Station	DWS	DWS	DWS
JERICHO	USUTU RIVER GWS					ACTIVE		Camden Pump Station	DWS	DWS	DWS
JERICHO	USUTU RIVER GWS					ACTIVE		Khutala Pump Station	DWS	DWS	DWS
JERICHO	USUTU VAAL PHASE 2 GWS	Heyshope Dam			453.440	ACTIVE	Yes	Heyshope Pump Station	DWS	DWS	DWS
JERICHO	USUTU VAAL PHASE 2 GWS	Geelhoutboom Dam			0.245	ACTIVE	Yes	Geelhoutboom Pump Station	DWS	DWS	DWS
JERICHO	USUTU VAAL PHASE 2 GWS					ACTIVE		Driefontein Pump Station	DWS	DWS	DWS
STANDERTON	KWSAP					ACTIVE	No	KWSAP Pump Station	DWS	DWS	DWS
STANDERTON	SLANG RIVER GWS	Zaaihoek Dam			185.000	ACTIVE	No	Zaaihoek Pump Station	DWS	DWS	DWS
STANDERTON	USUTU-VAAL GWS	Grootdraai Dam			350.000	ACTIVE	Yes	Grootdraai-Tutuka Pump Station	DWS	DWS	DWS
STANDERTON	USUTU-VAAL GWS	Rietfontein Dam (RESERVOIR)			4.5ML	ACTIVE		Grootdraai to Vlakfontein Canal Pump Station	DWS	DWS	DWS
STANDERTON	USUTU-VAAL GWS	Trichardsfontein Dam			15.200	ACTIVE		Naaupoort High- Lift Pump Station	DWS	DWS	DWS
STANDERTON	USUTU-VAAL GWS	Bossiespruit Dam			2.289	ACTIVE		Naaupoort Low-lift (Booster) Pump Station	DWS	DWS	DWS
STANDERTON	USUTU-VAAL GWS					ACTIVE		Rietfontein Pump Station	DWS	DWS	DWS
STANDERTON	USUTU-VAAL GWS					ACTIVE		Grootfontein Pump Station	DWS	DWS	DWS
STANDERTON	VRESAP					ACTIVE	Yes (small)	Boschkop low-lift Pump Station (Abstraction Works)	DWS	DWS	DWS
STANDERTON	VRESAP					ACTIVE		Boschkop high-lift Pump Station	DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS	Kilburn Dam			2.100	ACTIVE	Yes	Driel I Pump Station	DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS	Woodstock Dam			373.000	ACTIVE		Driel II Pump Station	DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS	Sterkfontein Dam			2,616.000	ACTIVE		Driel III Pump Station	DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS	Driel Barrage			10.360	ACTIVE		Kilburn I Pump Station	DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS	Driekloof Dam			35.600	ACTIVE		Kilburn II Pump Station	DWS	DWS	DWS

AREA	SCHEME NAME	DAMS	WEIRS	CANAL BALANCING DAMS	CAPACITY (Mm³)	OPERATIONAL STATUS (ACTIVE / INACTIVE)	SCHEME HAS CANALS?	MAJOR PUMP STATIONS	SCHEME OPERATED BY	SCHEME MAINTAINED BY	SCHEME O&M FUNDED BY
TUGELA-VAAL	TUGELA-VAAL GWS	Environmental Dam 3			0.318	ACTIVE		Qwaqwa Pump Station	DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS		Khombe Weir		unknown	ACTIVE			DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS		Clifford Chambers Weir		unknown	ACTIVE			DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS		Nuwejaarsspruit Weir		unknown	ACTIVE			DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS		Putterill weir		unknown	INACTIVE			DWS	DWS	DWS
TUGELA-VAAL	TUGELA-VAAL GWS			Jagesrust Forebay	0.476				DWS	DWS	DWS
VAAL DAM	FIKA PATSO & METSU MATSHO	Fika Patso Dam			28.000	ACTIVE	No		DWS	DWS	DWS
VAAL DAM	FIKA PATSO & METSU MATSHO	Metsu Matsho Dam			4.380	ACTIVE			DWS	DWS	DWS
VAAL DAM	LHWP DELIVERY TUNNEL NORTH			Botterkloof Dam	0.600	ACTIVE	No		DWS	DWS	DWS
VAAL DAM	MOOI RIVER GWS	Klipdrift Dam			13.332	ACTIVE	Yes		Klipdrift WUA	DWS	DWS
VAAL DAM	MOOI RIVER GWS	Boskop Dam			20.850	ACTIVE	Yes		DWS	DWS	DWS
VAAL DAM	MOOI RIVER GWS	Gehardminnebrom (Eye / Fountain)				ACTIVE	Yes		DWS	DWS	DWS
VAAL DAM	MOOI RIVER GWS	Klerkskraal Dam			8.023	ACTIVE	Yes		DWS	DWS	DWS
VAAL DAM	MOOI RIVER GWS	Potchefstroom Dam			2.027	ACTIVE	Yes		DWS	DWS	DWS
VAAL DAM	RHENOSTER RIVER	Koppies Dam			40.000	ACTIVE	Yes (not function al, bad state)		DWS	DWS	DWS
VAAL DAM	RHENOSTER RIVER	Roodepoort Dam			0.844	ACTIVE	No		DWS	DWS	DWS
VAAL DAM	RHENOSTER RIVER	Weltevrede Dam			1.900	ACTIVE	No		DWS	DWS	DWS
VAAL DAM	SCHOONSPRUIT GWS	Elandskuil Dam			1.181	ACTIVE	Yes		DWS	DWS	DWS
VAAL DAM	SCHOONSPRUIT GWS	Rietspruit Dam			7.885	ACTIVE	Yes		DWS	DWS	DWS
VAAL DAM	SCHOONSPRUIT GWS		Schoonspruit (Ventersdorp) Eye Weir			ACTIVE	Yes		DWS	DWS	DWS
VAAL DAM	VAAL DAM	Vaal Dam			2,536.000	ACTIVE	No		DWS	DWS	DWS

APPENDIX I – Maintenance Strategy, Works and Cost Forecast

1. INTRODUCTION

'Maintenance' is *"The actions required to enable an asset to achieve its expected life – recurrent work necessary to preserve or maintain an asset so it can be used for its designated purpose. In other words, recurrent work necessary to prevent deterioration. Maintenance work can be planned or unplanned. Planned maintenance is work to prevent known failure modes and can be time or condition-based. Maintenance includes all of the actions necessary for retaining an asset as near as practicable to its original condition, but excludes renewals."*

2. MAINTENANCE STRATEGY

Refer to the DWS Infrastructure Maintenance Strategy. Table I.1 summarises the Maintenance Strategy applied per Asset Condition Grading in this AMP.

Table I.1: Maintenance Strategy per Asset Condition Grading

Condition Grade	Description	Maintenance Strategy
3	Fair	Significant/improved maintenance required.
4	Good	Target condition maintenance. Preventive maintenance.
5	Very Good	Preventative and Normal Maintenance

3. MAINTENANCE WORKS

Table I.2: Maintenance Works

Refer to: Appendix I, Table I.2 of the individual Scheme and Cluster AMPs.

4. FINANCIAL FORECAST – OPERATIONS AND MAINTENANCE

Table I.3: NWRI's clusters O&M costs (maintenance costing per engineering discipline)

SOUTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Civil	242.829	261.480	281.564	303.190	326.477	351.553	378.554	407.630	438.939	472.652
Electrical	22.443	24.167	26.023	28.022	30.174	32.491	34.987	37.674	40.568	43.684
Mechanical	76.676	82.565	88.907	95.736	103.089	111.007	119.533	128.714	138.600	149.245
Sub-Total Maintenance	341.948	368.212	396.494	426.947	459.740	495.051	533.074	574.018	618.107	665.581
Operation	77.542	109.143	142.897	153.395	164.671	176.785	189.798	203.780	218.801	234.941
Total O&M	419.490	477.356	539.391	580.342	624.411	671.836	722.873	777.798	836.908	900.523
Overhead	145.688	159.556	174.444	185.390	197.029	209.405	222.566	236.562	251.447	267.277
Grand Total O&M	565.179	636.912	713.835	765.731	821.439	881.241	945.439	1 014.360	1 088.355	1 167.799
EASTERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Civil	67.788	72.995	78.602	84.639	91.140	98.140	105.678	113.794	122.535	131.946
Electrical	10.313	11.105	11.958	12.876	13.865	14.930	16.077	17.312	18.641	20.073
Mechanical	33.744	36.336	39.127	42.132	45.368	48.853	52.605	56.645	60.996	65.681
Sub-Total Maintenance	111.846	120.436	129.686	139.647	150.373	161.923	174.360	187.752	202.172	217.700
Operation	223.272	255.243	289.485	307.735	327.147	347.797	369.764	393.134	417.997	444.449
Total O&M	335.118	375.679	419.171	447.382	477.520	509.720	544.124	580.886	620.169	662.149
Overhead	62.652	70.428	78.765	84.018	89.626	95.615	102.009	108.838	116.131	123.920
Grand Total	397.770	446.107	497.936	531.400	567.146	605.334	646.133	689.724	736.300	786.070

NORTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Civil	217.857	234.590	252.608	272.011	292.903	315.400	339.625	365.710	393.799	424.046
Electrical	9.284	9.997	10.764	11.591	12.482	13.440	14.472	15.584	16.781	18.070
Mechanical	61.605	66.337	71.432	76.918	82.826	89.188	96.038	103.414	111.357	119.910
Sub-Total Maintenance	288.746	310.924	334.805	360.520	388.210	418.028	450.135	484.709	521.938	562.026
Operation	168.881	300.176	431.813	464.315	499.281	536.899	577.371	620.915	667.766	718.176
Total O&M	457.627	611.100	766.618	824.835	887.492	954.927	1 027.506	1 105.624	1 189.703	1 280.202
Overhead	133.204	143.274	154.105	165.756	178.287	191.765	206.263	221.856	238.628	256.669
Grand Total O&M	590.831	754.374	920.723	990.591	1 065.778	1 146.692	1 233.769	1 327.480	1 428.332	1 536.870
CENTRAL CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Civil	465.043	500.761	539.223	580.639	625.236	673.259	724.970	780.652	840.612	905.177
Electrical	131.915	142.047	152.957	164.705	177.355	190.977	205.646	221.441	238.449	256.764
Mechanical	184.429	198.594	213.848	230.273	247.959	267.004	287.512	309.595	333.374	358.980
Sub-Total Maintenance	781.386	841.402	906.028	975.617	1 050.551	1 131.240	1 218.128	1 311.688	1 412.435	1 520.920
Operations and Overheads	629.812	694.172	761.416	810.903	863.653	919.884	979.829	1 043.738	1 111.876	1 184.528
Total O&M	1 411.198	1 535.574	1 667.444	1 786.520	1 914.204	2 051.124	2 197.957	2 355.426	2 524.311	2 705.448
Overhead	95.135	109.171	123.468	132.276	141.722	151.852	162.716	174.368	186.866	200.273
Grand Total	1 506.333	1 644.745	1 790.912	1 918.796	2 055.926	2 202.976	2 360.673	2 529.794	2 711.177	2 905.720
Total for NWRI	3 060.11	3 482.14	3 923.41	4 206.52	4 510.29	4 836.24	5 186.01	5 561.36	5 964.16	6 396.46

Table I.4: NWRIs' clusters O&M costs (maintenance costing per asset facility category)

SOUTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Buildings	3.655	3.935	4.238	4.563	4.914	5.291	5.697	6.135	6.606	7.114
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	92.340	99.433	107.070	115.294	124.149	133.684	143.952	155.009	166.915	179.735
WR: Dams	119.205	128.361	138.220	148.836	160.268	172.578	185.833	200.106	215.475	232.025
WR: Power Supply	0.288	0.310	0.334	0.359	0.387	0.417	0.449	0.483	0.520	0.560
WR: Pump stations	24.984	26.903	28.969	31.195	33.591	36.170	38.949	41.940	45.161	48.630
WR: Reservoirs	3.167	3.410	3.672	3.954	4.258	4.585	4.937	5.316	5.725	6.164
WR: Roads and bridge	3.441	3.705	3.990	4.296	4.626	4.981	5.364	5.776	6.220	6.697
WR: Steel Pipelines	3.247	3.496	3.764	4.054	4.365	4.700	5.061	5.450	5.869	6.319
WR: Telemetry	0.259	0.279	0.301	0.324	0.349	0.375	0.404	0.435	0.469	0.505
WR: Tunnels	26.145	28.153	30.316	32.644	35.151	37.851	40.758	43.889	47.260	50.890
WR: Water Treatment	0.169	0.182	0.196	0.211	0.227	0.245	0.264	0.284	0.306	0.329
WS: borehole	0.071	0.077	0.083	0.089	0.096	0.103	0.111	0.120	0.129	0.139
WS: Measuring facility	64.977	69.967	75.341	81.128	87.359	94.069	101.294	109.074	117.452	126.473
Sub-Total Maintenance	341.948	368.212	396.494	426.947	459.740	495.051	533.074	574.018	618.107	665.581
Operation	77.542	109.143	142.897	153.395	164.671	176.785	189.798	203.780	218.801	234.941
Total O&M	419.490	477.356	539.391	580.342	624.411	671.836	722.873	777.798	836.908	900.523
Overhead	145.688	159.556	174.444	185.390	197.029	209.405	222.566	236.562	251.447	267.277
Grand Total O&M	565.179	636.912	713.835	765.731	821.439	881.241	945.439	1 014.360	1 088.355	1 167.799
EASTERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Buildings	2.906	3.129	3.369	3.628	3.907	4.207	4.530	4.878	5.253	5.656
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	10.162	10.943	11.783	12.688	13.663	14.712	15.842	17.059	18.369	19.780
WR: Dams	67.780	72.986	78.592	84.629	91.129	98.128	105.665	113.781	122.520	131.930
WR: Power Supply	0.141	0.152	0.163	0.176	0.189	0.204	0.219	0.236	0.254	0.274
WR: Pump stations	10.844	11.677	12.574	13.539	14.579	15.699	16.905	18.203	19.602	21.107
WR: Reservoirs	0.098	0.106	0.114	0.122	0.132	0.142	0.153	0.165	0.177	0.191
WR: Roads and bridge	0.785	0.845	0.910	0.980	1.055	1.137	1.224	1.318	1.419	1.528
WR: Steel Pipelines	1.853	1.996	2.149	2.314	2.492	2.683	2.889	3.111	3.350	3.607
WR: Telemetry	0.453	0.487	0.525	0.565	0.608	0.655	0.705	0.760	0.818	0.881
WR: Tunnels	0.043	0.046	0.050	0.053	0.057	0.062	0.067	0.072	0.077	0.083
WR: Water Treatment	0.006	0.007	0.007	0.008	0.008	0.009	0.010	0.010	0.011	0.012
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	16.775	18.063	19.450	20.944	22.553	24.285	26.150	28.159	30.322	32.651
Sub-Total Maintenance	111.846	120.436	129.686	139.647	150.373	161.923	174.360	187.752	202.172	217.700
Operation	223.272	255.243	289.485	307.735	327.147	347.797	369.764	393.134	417.997	444.449
Total O&M	335.118	375.679	419.171	447.382	477.520	509.720	544.124	580.886	620.169	662.149
Overhead	62.652	70.428	78.765	84.018	89.626	95.615	102.009	108.838	116.131	123.920
Grand Total	397.770	446.107	497.936	531.400	567.146	605.334	646.133	689.724	736.300	786.070

NORTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Buildings	8.072	8.692	9.359	10.078	10.852	11.686	12.583	13.550	14.590	15.711
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	76.860	82.763	89.120	95.965	103.336	111.273	119.819	129.022	138.932	149.603
WR: Dams	111.594	120.166	129.395	139.334	150.035	161.559	173.968	187.330	201.718	217.212
WR: Power Supply	0.807	0.869	0.936	1.008	1.085	1.168	1.258	1.355	1.459	1.571
WR: Pump stations	2.028	2.183	2.351	2.532	2.726	2.936	3.161	3.404	3.665	3.947
WR: Reservoirs	0.960	1.034	1.113	1.199	1.291	1.390	1.497	1.612	1.735	1.869
WR: Roads and bridge	0.127	0.136	0.147	0.158	0.170	0.183	0.198	0.213	0.229	0.247
WR: Steel Pipelines	3.710	3.995	4.302	4.632	4.988	5.371	5.784	6.228	6.706	7.221
WR: Telemetry	0.478	0.515	0.554	0.597	0.642	0.692	0.745	0.802	0.864	0.930
WR: Tunnels	0.148	0.160	0.172	0.185	0.199	0.214	0.231	0.249	0.268	0.288
WR: Water Treatment	1.112	1.198	1.290	1.389	1.496	1.610	1.734	1.867	2.011	2.165
WS: borehole	1.082	1.165	1.255	1.351	1.455	1.567	1.687	1.817	1.956	2.107
WS: Measuring facility	81.768	88.048	94.811	102.093	109.934	118.378	127.470	137.261	147.803	159.156
Sub-Total Maintenance	288.746	310.924	334.805	360.520	388.210	418.028	450.135	484.709	521.938	562.026
Operation	168.881	300.176	431.813	464.315	499.281	536.899	577.371	620.915	667.766	718.176
Sub-Total O&M	457.627	611.100	766.618	824.835	887.492	954.927	1 027.506	1 105.624	1 189.703	1 280.202
Overhead	133.204	143.274	154.105	165.756	178.287	191.765	206.263	221.856	238.628	256.669
Grand Total O&M	590.831	754.374	920.723	990.591	1 065.778	1 146.692	1 233.769	1 327.480	1 428.332	1 536.870
CENTRAL CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Maintenance										
Buildings	20.650	22.236	23.944	25.783	27.763	29.896	32.192	34.664	37.327	40.194
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	219.982	236.878	255.072	274.663	295.759	318.476	342.937	369.277	397.640	428.181
WR: Dams	204.522	220.230	237.146	255.360	274.974	296.093	318.835	343.324	369.694	398.089
WR: Power Supply	6.205	6.682	7.195	7.747	8.342	8.983	9.673	10.416	11.216	12.078
WR: Pump stations	185.602	199.857	215.207	231.737	249.536	268.702	289.340	311.563	335.494	361.262
WR: Reservoirs	11.480	12.361	13.311	14.333	15.434	16.620	17.896	19.271	20.751	22.345
WR: Roads and bridge	1.063	1.144	1.232	1.327	1.429	1.538	1.657	1.784	1.921	2.068
WR: Steel Pipelines	42.896	46.190	49.738	53.558	57.672	62.102	66.871	72.008	77.538	83.494
WR: Telemetry	2.676	2.881	3.102	3.341	3.597	3.873	4.171	4.491	4.836	5.208
WR: Tunnels	38.403	41.352	44.529	47.949	51.632	55.597	59.867	64.466	69.417	74.749
WR: Water Treatment	1.566	1.686	1.816	1.955	2.105	2.267	2.441	2.629	2.831	3.048
WS: borehole	0.067	0.072	0.078	0.084	0.090	0.097	0.105	0.113	0.122	0.131
WS: Measuring facility	46.276	49.831	53.658	57.779	62.217	66.996	72.142	77.683	83.649	90.074
Sub-Total Maintenance	781.386	841.402	906.028	975.617	1 050.551	1 131.240	1 218.128	1 311.688	1 412.435	1 520.920
Operation	629.812	694.172	761.416	810.903	863.653	919.884	979.829	1 043.738	1 111.876	1 184.528
Sub-Total O&M	1 411.198	1 535.574	1 667.444	1 786.520	1 914.204	2 051.124	2 197.957	2 355.426	2 524.311	2 705.448
Overhead	95.135	109.171	123.468	132.276	141.722	151.852	162.716	174.368	186.866	200.273
Grand Total	1 506.333	1 644.745	1 790.912	1 918.796	2 055.926	2 202.976	2 360.673	2 529.794	2 711.177	2 905.720
Total for NWRI	3 060.112	3 482.138	3 923.406	4 206.518	4 510.290	4 836.243	5 186.013	5 561.358	5 964.164	6 396.460

APPENDIX J – Renewals Strategy, Backlog, Works and Cost

1 INTRODUCTION

‘Renewals Expenditure’ is: *“Expenditure on the replacement or rehabilitation of an asset.” It is expenditure on an existing asset which returns the service potential or the life of the asset to that which it had originally. It is periodically required expenditure, and relatively large (material) in value compared with the value of the components or sub-components of the asset being renewed. Renewals may reduce operating and maintenance expenditure if completed at the optimum time.”*

It is very important that the NWRI always clearly distinguishes between New Capital/Upgrade Capital expenditure and Renewals Capital expenditure. The rate at which renewal work is being carried out *over time* compared with the annual provision for depreciation (the cost of consumption – the rate at which the assets are being used) is a good indicator of the extent to which the assets are being maintained, are improving, or are deteriorating.

2. RENEWALS STRATEGY

Table J.1 summarises the Renewal Strategy applied per Asset Condition Grading in this AMP.

Table J.1 Renewal Strategy per Asset Condition Grading

Condition Grade	Description	Renewal Strategy
0	Not Working	Complete replacement of the asset before operations can be revived
1	Very Poor	Completely renew (refurbish, rehabilitate or replace) the asset component
2	Poor	Significant renewal required.

3. RENEWALS BACKLOG (CONDITION BACKLOG)

Table J.2A1: Renewal backlog per engineering discipline - Northern

Engineering Discipline	CRC (R million)
Civil	6 570.297
Electrical	71.971
Mechanical	557.342
Total	7 199.610

Table J.2A2: Renewal backlog per asset facility category - Northern

Asset Facility Category	CRC (R million)
Buildings	260.154
Land	-
WR: Canals	2 762.575
WR: Dams	2 079.016
WR: Power Supply	12.789
WR: Pump stations	4.418
WR: Reservoirs	0.753
WR: Roads and bridge	2.881
WR: Steel Pipelines	1 226.560
WR: Telemetry	-
WR: Tunnels	-
WR: Water Treatment	18.359
WS: borehole	29.251
WS: Measuring facility	802.855
Total	7 199.610

Table J.2B1: Renewal backlog per engineering discipline – Eastern

Engineering Discipline	CRC (R million)
Civil	739.092
Electrical	36.150
Mechanical	28.253
Total	803.495

Table J.2B2: Renewal backlog per asset facility category - Eastern

Asset Facility Category	CRC (R million)
Buildings	43.394
Land	-
WR: Canals	621.544
WR: Dams	49.716
WR: Power Supply	-
WR: Pump stations	34.625
WR: Reservoirs	-
WR: Roads and bridge	42.221
WR: Steel Pipelines	-
WR: Telemetry	-
WR: Tunnels	-
WR: Water Treatment	-
WS: borehole	-
WS: Measuring facili	11.996
Total	803.495

Table J.2C1: Renewal backlog per engineering discipline - Southern

Engineering Discipline	CRC (R million)
Civil	4 305.119
Electrical	53.028
Mechanical	278.141
Total	4 636.288

Table J.2C2: Renewal backlog per asset facility category - Southern

Asset Facility Category	CRC (R million)
Buildings	41.607
Land	-
WR: Canals	2 360.336
WR: Dams	1 217.132
WR: Power Supply	-
WR: Pump stations	20.451
WR: Reservoirs	-
WR: Roads and bridge	48.048
WR: Steel Pipelines	457.948
WR: Telemetry	-
WR: Tunnels	1.694
WR: Water Treatment	0.566
WS: borehole	-
WS: Measuring facility	488.507
Total	4 636.288

Table J.2D1: Renewal backlog per engineering discipline - Central

Engineering Discipline	CRC (R million)
Civil	17 236.701
Electrical	388.837
Mechanical	791.602
Total	18 417.140

Table J.2D2: Renewal backlog per asset facility category - Central

Asset Facility Category	CRC (R million)
Buildings	675.951
Land	-
WR: Canals	13 622.051
WR: Dams	736.407
WR: Power Supply	11.135
WR: Pump stations	489.064
WR: Reservoirs	2.073
WR: Roads and bridge	76.102
WR: Steel Pipelines	2, 24.221
WR: Telemetry	-
WR: Tunnels	9.907
WR: Water Treatment	17.757
WS: borehole	-
WS: Measuring facility	152.472
Total	18 417.140

4. RENEWALS WORKS

Refer to: Appendix J, Tables J.3 to J.12 (Renewals works for 2017/18 to 2026/27) of the individual Scheme and Cluster AMPs.

5. FINANCIAL

Table J.13 – Identified NWRI Renewals Cost per Engineering Discipline

Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	8 518.825	-	247.683	2 619.447	1 684.502	2 834.465	1 801.306	3 039.137	1 794.096	888.497
Electrical	255.155	7.911	163.078	49.778	126.323	109.270	45.456	121.822	228.305	96.481
Mechanical	708.776	-	212.593	444.634	52.552	1 001.012	113.503	45.103	343.882	771.302
Total	9 482.757	7.911	623.353	3 113.860	1 863.377	3 944.747	1 960.265	3 206.062	2 366.283	1 756.280

Table J.14: Identified NWRI Renewals Cost per Facility Category

Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	586.082	-	1.127	195.167	71.057	439.976	-	0.180	-	9.111
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	5 467.446	-	0.165	2 166.033	1 472.700	944.334	-	2 577.908	351.651	860.400
WR: Dams	1 369.840	-	63.739	319.060	12.466	1 072.400	104.561	10.543	145.217	578.486
WR: Power Supply	13.255	-	8.275	4.264	-	-	-	4.346	6.490	15.861
WR: Pump stations	269.004	-	282.319	89.906	178.485	278.119	59.569	143.139	448.409	221.880
WR: Reservoirs	1.867	-	0.045	2.046	1.739	1.239	-	7.391	187.439	2.467
WR: Roads and bridge	45.491	-	-	-	-	85.386	-	-	-	-
WR: Steel Pipelines	1 276.251	-	255.266	313.262	106.391	26.820	1 774.135	462.555	137.039	42.275
WR: Telemetry	-	-	8.097	-	-	1.897	-	-	17.017	-
WR: Tunnels	3.511	-	3.840	24.121	1.835	25.703	2.806	-	1 067.010	0.174
WR: Water Treatment	17.411	-	-	-	8.420	9.715	-	-	-	-
WS: borehole	14.919	-	-	-	-	4.070	-	-	-	-
WS: Measuring facility	417.679	7.911	0.478	-	10.285	1 055.087	19.194	-	6.011	25.626
Total	9 482.757	7.911	623.353	3 113.860	1 863.377	3 944.747	1 960.265	3 206.062	2 366.283	1 756.280

Table J.15: Identified NWRI Renewals Cost per Cluster

Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	1 805.239	4.369	34.974	401.405	278.677	1 190.703	236.810	147.568	499.654	241.411
Eastern	296.575	0.788	57.238	107.251	160.061	379.385	109.248	13.614	68.651	88.213
Northern	2 536.288	1.570	25.862	1 045.842	1 001.809	724.771	228.080	213.442	157.223	172.745
Central	4 844.655	1.184	505.279	1 559.362	422.829	1 649.888	1 386.126	2 831.438	1 640.755	1 253.910
Total	9 482.757	7.911	623.353	3 113.860	1 863.377	3 944.747	1 960.265	3 206.062	2 366.283	1 756.280

Table J.16 – Identified Renewals Cost per Cluster and per Engineering Discipline

SOUTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	1 668.164	-	1.557	296.112	268.812	983.772	194.296	137.336	443.810	116.330
Electrical	25.080	4.369	6.460	9.611	7.009	9.801	19.053	4.832	6.474	3.198
Mechanical	111.995	-	26.958	95.683	2.857	197.130	23.461	5.400	49.370	121.883
Total	1 805.239	4.369	34.974	401.405	278.677	1 190.703	236.810	147.568	499.654	241.411
EASTERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	262.493	-	26.134	41.396	147.509	236.873	92.240	0.132	13.804	46.615
Electrical	23.572	0.788	3.954	7.182	5.752	6.870	7.537	8.265	13.527	2.056
Mechanical	10.510	-	27.150	58.672	6.800	135.642	9.471	5.217	41.319	39.542
Total	296.575	0.788	57.238	107.251	160.061	379.385	109.248	13.614	68.651	88.213
NOTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	2 263.953	-	0.733	998.753	996.007	584.723	177.706	211.687	89.345	65.496
Electrical	26.636	1.570	8.219	7.683	4.733	0.699	3.890	0.310	12.637	5.122
Mechanical	245.699	-	16.910	39.406	1.069	139.349	46.484	1.445	55.241	102.126
Total	2 536.288	1.570	25.862	1 045.842	1 001.809	724.771	228.080	213.442	157.223	172.745
CENTRAL CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	4 324.215	-	219.259	1 283.186	272.174	1 029.096	1 337.063	2 689.981	1 247.137	660.056
Electrical	179.867	1.184	144.446	25.303	108.829	91.901	14.976	108.415	195.667	86.105
Mechanical	340.572	-	141.575	250.873	41.825	528.892	34.087	33.042	197.952	507.750
Total	4 844.655	1.184	505.279	1 559.362	422.829	1 649.888	1 386.126	2 831.438	1 640.755	1 253.910

Table J.17: Identified Renewals Cost per Cluster and per Facility Category

SOUTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	18.938	-	0.937	21.669	1.649	61.939	-	-	-	2.547
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	1 073.665	-	-	219.679	242.952	515.605	-	137.336	122.419	112.602
WR: Dams	334.706	-	18.862	97.467	3.644	231.744	19.470	2.534	40.916	113.910
WR: Power Supply	-	-	2.575	-	-	-	-	0.113	-	-
WR: Pump stations	10.020	-	6.400	5.583	4.283	10.685	11.267	7.585	14.540	8.343
WR: Reservoirs	-	-	-	-	-	-	-	-	44.192	-
WR: Roads and bridge	11.836	-	-	-	-	76.027	-	-	-	-
WR: Steel Pipelines	198.742	-	4.314	36.152	24.941	-	195.275	-	1.757	3.835
WR: Telemetry	-	-	-	-	-	1.897	-	-	0.303	-
WR: Tunnels	1.087	-	1.409	20.856	0.737	7.468	0.235	-	272.105	0.174
WR: Water Treatment	0.172	-	-	-	0.472	1.623	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	156.073	4.369	0.478	-	-	283.714	10.563	-	3.423	-
Total	1 805.239	4.369	34.974	401.405	278.677	1 190.703	236.810	147.568	499.654	241.411
EASTERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	21.246	-	-	18.474	16.551	51.737	-	-	-	0.147
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	212.690	-	-	22.554	126.783	8.868	-	-	2.600	44.867
WR: Dams	22.664	-	12.021	60.135	0.792	143.701	6.406	4.318	28.631	38.841
WR: Power Supply	-	-	1.052	-	-	-	-	-	-	-
WR: Pump stations	23.571	-	17.197	3.511	15.677	14.070	7.544	9.164	34.457	3.131
WR: Reservoirs	-	-	-	-	-	-	-	-	0.670	-
WR: Roads and bridge	8.444	-	-	-	-	1.590	-	-	-	-
WR: Steel Pipelines	-	-	25.956	2.576	-	20.249	93.411	0.132	-	0.114
WR: Telemetry	-	-	1.012	-	-	-	-	-	2.089	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	0.227	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	7.961	0.788	-	-	0.258	138.942	1.886	-	0.202	1.114
Total	296.575	0.788	57.238	107.251	160.061	379.385	109.248	13.614	68.651	88.213

NOTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	165.392	-	0.191	24.560	6.779	79.116	-	-	-	3.057
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	1 156.689	-	0.032	772.031	987.051	81.321	-	211.687	68.011	63.702
WR: Dams	691.513	-	15.168	47.706	3.966	231.605	66.982	1.445	50.857	103.529
WR: Power Supply	4.899	-	1.562	-	-	-	-	0.279	-	-
WR: Pump stations	1.476	-	2.214	0.262	0.313	0.717	0.144	0.031	10.293	1.398
WR: Reservoirs	0.627	-	-	-	-	-	-	-	13.336	-
WR: Roads and bridge	0.600	-	-	-	-	1.677	-	-	-	-
WR: Steel Pipelines	281.788	-	0.623	201.282	1.377	3.050	157.070	-	0.732	-
WR: Telemetry	-	-	6.073	-	-	-	-	-	12.536	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	8.112	-	-	-	1.869	5.360	-	-	-	-
WS: borehole	14.919	-	-	-	-	3.493	-	-	-	-
WS: Measuring facility	210.273	1.570	-	-	0.454	318.433	3.885	-	1.459	1.058
Total	2 536.288	1.570	25.862	1 045.842	1 001.809	724.771	228.080	213.442	157.223	172.745
CENTRAL CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	380.507	-	-	130.464	46.078	247.184	-	0.180	-	3.360
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	3 024.402	-	0.133	1 151.770	115.914	338.540	-	2 228.884	158.620	639.228
WR: Dams	320.957	-	17.689	113.751	4.064	465.350	11.702	2.246	24.814	322.207
WR: Power Supply	8.356	-	3.087	4.264	-	-	-	3.955	6.490	15.861
WR: Pump stations	233.937	-	256.509	80.550	158.212	252.646	40.614	126.359	389.118	209.008
WR: Reservoirs	1.240	-	0.045	2.046	1.739	1.239	-	7.391	129.241	2.467
WR: Roads and bridge	24.611	-	-	-	-	6.092	-	-	-	-
WR: Steel Pipelines	795.721	-	224.373	73.252	80.073	3.522	1 328.379	462.423	134.550	38.326
WR: Telemetry	-	-	1.012	-	-	-	-	-	2.089	-
WR: Tunnels	2.424	-	2.431	3.265	1.098	18.235	2.571	-	794.905	-
WR: Water Treatment	9.127	-	-	-	6.078	2.505	-	-	-	-
WS: borehole	-	-	-	-	-	0.577	-	-	-	-
WS: Measuring facility	43.372	1.184	-	-	9.573	313.999	2.860	-	0.928	23.455
Total	4 844.655	1.184	505.279	1 559.362	422.829	1 649.888	1 386.126	2 831.438	1 640.755	1 253.910

Table J.19: Planned Renewals Cost per Cluster and per Engineering Discipline

SOUTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	63.883	52.975	147.535	264.522	411.479	411.634	594.126	975.652	533.359	515.720
Electrical	19.014	5.349	10.548	9.226	6.272	4.778	0.746	6.566	14.616	15.027
Mechanical	46.523	38.546	46.486	101.364	2.857	135.389	53.041	5.928	87.914	124.197
Total	129.420	96.870	204.568	375.113	420.608	551.801	647.913	988.147	635.890	654.945
EASTERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	5.308	81.169	36.477	54.257	95.293	67.534	139.601	115.707	211.431	60.419
Electrical	14.809	8.532	3.730	5.300	8.388	0.232	6.830	0.297	15.801	21.892
Mechanical	4.959	5.551	27.150	36.215	29.257	-	40.701	94.941	14.688	80.862
Total	25.076	95.252	67.356	95.773	132.939	67.766	187.132	210.945	241.921	163.174
NORTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	49.274	71.346	189.253	217.862	640.587	616.883	524.310	861.825	1 034.275	863.594
Electrical	9.236	13.178	8.601	0.262	4.722	11.373	4.120	3.890	1.097	18.461
Mechanical	71.637	86.720	18.483	2.090	8.013	84.865	123.834	55.739	86.046	124.814
Total	130.147	171.243	216.337	220.214	653.322	713.122	652.263	921.455	1 121.417	1 006.869
CENTRAL CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	271.828	189.705	499.938	369.107	952.980	1 144.165	1 297.029	2 509.987	3 131.461	2 488.939
Electrical	40.201	64.836	91.503	155.617	98.845	39.339	73.896	104.756	6.372	282.200
Mechanical	158.120	84.696	55.976	437.763	41.825	154.337	406.251	27.545	97.672	616.302
Total	470.149	339.237	647.417	962.488	1 093.651	1 337.841	1 777.175	2 642.289	3 235.505	3 387.441

Table J.20: Planned Renewals Cost per Cluster and per Facility Category

SOUTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	1.515	-	0.937	-	-	21.669	-	19.072	61.939	2.547
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	38.136	-	-	40.436	387.740	358.368	477.661	760.894	163.014	198.011
WR: Dams	61.269	92.501	120.850	176.416	3.644	140.224	90.398	3.656	67.895	113.910
WR: Power Supply	-	-	2.575	-	-	-	-	0.113	-	-
WR: Pump stations	10.020	-	6.400	5.583	4.283	10.685	-	7.585	25.807	8.343
WR: Reservoirs	-	-	-	-	-	-	-	-	-	44.192
WR: Roads and bridge	2.783	-	-	-	-	-	-	9.053	76.027	-
WR: Steel Pipelines	14.610	-	71.920	152.678	24.941	-	-	-	197.032	3.835
WR: Telemetry	-	-	-	-	-	-	-	-	1.897	0.303
WR: Tunnels	1.087	-	1.409	-	-	20.856	-	0.737	7.703	272.279
WR: Water Treatment	-	-	-	-	-	-	-	0.644	1.623	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	4.369	0.478	-	-	-	79.853	186.394	32.952	11.526
Total	129.420	96.870	204.568	375.113	420.608	551.801	647.913	988.147	635.890	654.945
EASTERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	1.865	19.380	-	-	-	18.474	16.551	51.737	-	0.147
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	44.404	36.299	27.933	91.118	41.331	120.942	8.868	-	47.468
WR: Dams	5.056	17.608	12.021	37.361	23.567	-	35.311	108.391	10.725	67.471
WR: Power Supply	-	-	1.052	-	-	-	-	-	-	-
WR: Pump stations	17.107	6.464	17.197	3.511	15.677	-	14.070	-	16.708	43.898
WR: Reservoirs	-	-	-	-	-	-	-	-	-	0.670
WR: Roads and bridge	1.048	7.396	-	-	-	-	-	1.590	-	-
WR: Steel Pipelines	-	-	-	25.956	2.576	-	-	20.249	93.543	0.114
WR: Telemetry	-	-	-	1.012	-	-	-	-	-	2.089
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	0.227	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	0.788	-	-	7.961	0.258	19.883	120.945	1.316
Total	25.076	95.252	67.356	95.773	132.939	67.766	187.132	210.945	241.921	163.174

NORTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	3.150	-	97.402	-	0.469	-	-	-	74.559	74.398
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	-	0.032	99.795	370.127	307.358	455.608	641.129	904.186	562.292
WR: Dams	120.936	167.722	25.036	-	32.271	368.846	196.656	119.228	94.947	103.529
WR: Power Supply	5.225	1.593	1.562	-	0.121	-	-	-	0.279	-
WR: Pump stations	0.836	0.358	2.214	0.262	1.009	0.717	-	0.144	10.325	1.408
WR: Reservoirs	-	-	-	-	-	-	-	-	-	13.963
WR: Roads and bridge	-	-	-	-	-	-	-	-	1.677	0.600
WR: Steel Pipelines	-	-	84.019	120.157	249.326	31.569	-	157.070	3.782	-
WR: Telemetry	-	-	6.073	-	-	-	-	-	-	12.536
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	5.360	9.981
WS: borehole	-	-	-	-	-	-	-	-	2.582	14.919
WS: Measuring facility	-	1.570	-	-	-	4.632	-	3.885	23.722	213.243
Total	130.147	171.243	216.337	220.214	653.322	713.122	652.263	921.455	1 121.417	1 006.869
CENTRAL CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	2.536	19.790	13.155	86.816	35.407	225.748	101.160	247.364	-	78.334
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	8.620	-	-	140.229	806.072	908.820	780.948	1 117.274	2 613.450	1 282.078
WR: Dams	124.441	74.732	34.898	220.605	4.064	-	477.051	2.246	24.814	322.207
WR: Power Supply	0.195	5.901	2.576	7.035	-	-	-	-	3.955	22.351
WR: Pump stations	50.057	92.977	129.299	302.100	158.212	200.850	92.410	126.359	111.241	486.884
WR: Reservoirs	-	-	-	2.091	-	-	2.978	-	7.391	132.948
WR: Roads and bridge	-	-	-	-	0.138	-	6.092	-	-	24.473
WR: Steel Pipelines	284.299	144.654	467.489	196.904	80.073	-	282.649	1 042.008	469.667	172.876
WR: Telemetry	-	-	-	1.012	-	-	-	-	-	2.089
WR: Tunnels	-	-	-	5.696	1.098	2.424	18.235	-	2.571	794.905
WR: Water Treatment	-	-	-	-	8.587	-	6.078	2.505	-	0.540
WS: borehole	-	-	-	-	-	-	-	0.577	-	-
WS: Measuring facility	-	1.184	-	-	-	-	9.573	103.956	2.417	67.755
Total	470.149	339.237	647.417	962.488	1 093.651	1 337.841	1 777.175	2 642.289	3 235.505	3 387.441

APPENDIX K – Upgrades and New Capital Strategy, Backlog, Works and Cost

1. INTRODUCTION

‘New and Upgrade Capital’ is:

‘Expenditure that is used to create new assets, or to increase the capacity of existing assets beyond their original design capacity or service potential’.

2. NEW & UPGRADE CAPITAL STRATEGY

Table K.1 summarises the Renewal Strategy applied per Asset Condition Grading in this AMP.

Table K.1: New and Upgrade Capital Strategy per Asset Utilisation Grading

Utilisation Grade	Description	New and Upgrade Capital Strategy
5	Exceeding Capacity/Stressed	Consider upgrading the asset component

3. UPGRADES BACKLOG

Table K.2A1: Upgrades backlog per engineering discipline - Northern

Engineering Discipline	CRC (R million)
Civil	4,940.042
Electrical	39.255
Mechanical	546.698
Total	5 525.995

Table K.2A2: Upgrades backlog per asset facility category - Northern

Asset Facility Category	CRC (R million)
Buildings	-
Land	-
WR: Canals	-
WR: Dams	5,516.126
WR: Power Supply	-
WR: Pump stations	0.280
WR: Reservoirs	-
WR: Roads and bridge	-
WR: Steel Pipelines	9.358
WR: Telemetry	-
WR: Tunnels	-
WR: Water Treatment	-
WS: borehole	-
WS: Measuring facility	0.232
Total	5 525.995

Table K.2B1: Upgrades backlog per engineering discipline - Eastern

Engineering Discipline	CRC (R million)
Civil	596.977
Electrical	17.474
Mechanical	86.494
Total	700.944

Table K.2B2: Upgrades backlog per asset facility category - Eastern

Asset Facility Category	CRC (R million)
Buildings	-
Land	-
WR: Canals	-
WR: Dams	291.016
WR: Power Supply	-
WR: Pump stations	11.934
WR: Reservoirs	-
WR: Roads and bridge	-
WR: Steel Pipelines	397.994
WR: Telemetry	-
WR: Tunnels	-
WR: Water Treatment	-
WS: borehole	-
WS: Measuring facili	-
Total	700.944

Table K.2C1: Upgrades backlog per engineering discipline - Southern

Engineering Discipline	CRC (R million)
Civil	-
Electrical	10.148
Mechanical	7.132
Total	17.280

Table K.2C2: Upgrades backlog per asset facility category - Southern

Asset Facility Category	CRC R million)
Buildings	-
Land	-
WR: Canals	-
WR: Dams	0.527
WR: Power Supply	-
WR: Pump stations	16.753
WR: Reservoirs	-
WR: Roads and bridge	-
WR: Steel Pipelines	-
WR: Telemetry	-
WR: Tunnels	-
WR: Water Treatment	-
WS: borehole	-
WS: Measuring facility	-
Total	17.280

Table K.2D1: Upgrades backlog per engineering discipline - Central

Engineering Discipline	CRC (R million)
Civil	1 327.519
Electrical	49.118
Mechanical	244.986
Total	1 621.623

Table K.2D2: Upgrades backlog per asset facility category - Central

Asset Facility Category	CRC (R million)
Buildings	52.543
Land	-
WR: Canals	386.525
WR: Dams	449.447
WR: Power Supply	2.000
WR: Pump stations	46.643
WR: Reservoirs	-
WR: Roads and bridge	34.933
WR: Steel Pipelines	640.596
WR: Telemetry	-
WR: Tunnels	3.103
WR: Water Treatment	5.833
WS: borehole	-
WS: Measuring facility	-
Total	1 621.623

4. UPGRADES WORKS

Refer to: Appendix J, Tables K.3 to K.12 (Upgrades works for 2017/18 to 2026/27) of the individual Scheme and Cluster AMPs.

5. FINANCIAL

Table K.13: Identified NWRI Upgrades Cost per Engineering Discipline

Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	2 697.549	623.859	176.658	166.322	387.259	446.408	548.029	337.014	390.516	314.255
Electrical	111.904	-	-	-	-	-	-	-	-	-
Mechanical	1 356.579	-	-	-	-	-	-	-	-	-
Total	4 166.031	623.859	176.658	166.322	387.259	446.408	548.029	337.014	390.516	314.255

Table K.14: Identified NWRI Upgrades Cost per Facility Category

Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	268.098	623.859	166.038	166.322	387.259	431.802	544.770	337.014	390.516	314.255
WR: Dams	2 436.016	-	-	-	-	-	-	-	-	-
WR: Power Supply	3.000	-	-	-	-	-	-	-	-	-
WR: Pump stations	88.478	-	10.620	-	-	-	3.259	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	1 362.753	-	-	-	-	14.606	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	4.654	-	-	-	-	-	-	-	-	-
WR: Water Treatment	2.916	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	0.116	-	-	-	-	-	-	-	-	-
Total	4 166.031	623.859	176.658	166.322	387.259	446.408	548.029	337.014	390.516	314.255

Table K.15: Identified NWRI Upgrades Cost per cluster

Cluster	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Southern	25.920	217.407	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
Eastern	674.767	-	-	38.327	23.095	34.973	26.788	48.150	-	-
Northern	1 882.542	36.999	6.880	2.810	108.275	128.498	18.915	-	-	-
Central	1 582.802	369.453	25.391	14.771	43.554	104.221	222.044	288.864	42.288	-
Total	4 166.031	623.859	176.658	166.322	387.259	446.408	548.029	337.014	390.516	314.255

Table K.16 – Identified Clusters Upgrades Cost per Engineering Discipline

SOUTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	-	217.407	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
Electrical	15.222	-	-	-	-	-	-	-	-	-
Mechanical	10.699	-	-	-	-	-	-	-	-	-
Total	25.920	217.407	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
EASTERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	520.010	-	-	38.327	23.095	34.973	26.788	48.150	-	-
Electrical	26.211	-	-	-	-	-	-	-	-	-
Mechanical	128.547	-	-	-	-	-	-	-	-	-
Total	674.767	-	-	38.327	23.095	34.973	26.788	48.150	-	-
NORTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	1 011.405	36.999	6.880	2.810	108.275	128.498	18.915	-	-	-
Electrical	51.387	-	-	-	-	-	-	-	-	-
Mechanical	819.749	-	-	-	-	-	-	-	-	-
Total	1 882.542	36.999	6.880	2.810	108.275	128.498	18.915	-	-	-
CENTRAL CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	1 166.133	369.453	25.391	14.771	43.554	104.221	222.044	288.864	42.288	-
Electrical	19.084	-	-	-	-	-	-	-	-	-
Mechanical	397.584	-	-	-	-	-	-	-	-	-
Total	1 582.802	369.453	25.391	14.771	43.554	104.221	222.044	288.864	42.288	-

Table K.17 – Identified Clusters Upgrades Cost per Facility Category

SOUTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	217.407	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
WR: Dams	0.791	-	-	-	-	-	-	-	-	-
WR: Power Supply	-	-	-	-	-	-	-	-	-	-
WR: Pump stations	25.129	-	-	-	-	-	-	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	-	-	-	-	-	-	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	-	-	-	-
Total	25.920	217.407	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
EASTERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	-	-	38.327	23.095	34.973	26.788	48.150	-	-
WR: Dams	138.345	-	-	-	-	-	-	-	-	-
WR: Power Supply	-	-	-	-	-	-	-	-	-	-
WR: Pump stations	17.291	-	-	-	-	-	-	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	519.132	-	-	-	-	-	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	-	-	-	-
Total	674.767	-	-	38.327	23.095	34.973	26.788	48.150	-	-

NORTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	36.999	6.880	2.810	108.275	128.498	18.915	-	-	-
WR: Dams	1 869.841	-	-	-	-	-	-	-	-	-
WR: Power Supply	-	-	-	-	-	-	-	-	-	-
WR: Pump stations	0.420	-	-	-	-	-	-	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	12.165	-	-	-	-	-	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	0.116	-	-	-	-	-	-	-	-	-
Total	1 882.542	36.999	6.880	2.810	108.275	128.498	18.915	-	-	-
CENTRAL CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	268.098	369.453	14.771	14.771	43.554	89.615	218.785	288.864	42.288	-
WR: Dams	427.039	-	-	-	-	-	-	-	-	-
WR: Power Supply	3.000	-	-	-	-	-	-	-	-	-
WR: Pump stations	45.638	-	10.620	-	-	-	3.259	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	831.456	-	-	-	-	14.606	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	4.654	-	-	-	-	-	-	-	-	-
WR: Water Treatment	2.916	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	-	-	-	-
Total	1 582.802	369.453	25.391	14.771	43.554	104.221	222.044	288.864	42.288	-

Table K.18 – Planned Clusters Upgrades Cost per Engineering Discipline

SOUTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	-	217.407	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
Electrical	9.586	5.636	-	-	-	-	-	-	-	-
Mechanical	8.167	2.532	-	-	-	-	-	-	-	-
Total	17.753	225.575	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
EASTERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	11.578	49.966	76.792	137.742	148.467	184.084	43.078	65.817	23.556	-
Electrical	9.762	4.523	-	-	-	1.000	10.926	-	-	-
Mechanical	29.341	5.808	33.077	4.411	4.411	27.012	24.487	-	-	-
Total	50.681	60.296	109.869	142.153	152.878	212.096	78.491	65.817	23.556	-
NORTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	143.858	201.482	230.207	398.758	194.993	135.009	34.023	-	-	-
Electrical	17.313	13.616	13.691	4.161	-	2.252	5.640	-	-	-
Mechanical	100.409	139.401	156.724	152.624	57.846	70.650	193.150	-	-	-
Total	261.579	354.500	400.622	555.543	252.840	207.910	232.812	-	-	-
CENTRAL CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	95.701	470.044	169.226	176.975	362.245	473.829	222.044	288.864	42.288	-
Electrical	21.634	24.132	4.223	-	-	-	-	-	-	-
Mechanical	79.713	54.957	96.186	130.611	38.228	-	-	-	-	-
Total	197.048	549.132	269.635	307.586	400.473	473.829	222.044	288.864	42.288	-

Table K.19: Planned Clusters Upgrades Cost per Facility Category

SOUTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	217.407	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
WR: Dams	0.791	-	-	-	-	-	-	-	-	-
WR: Power Supply	-	-	-	-	-	-	-	-	-	-
WR: Pump stations	16.962	8.167	-	-	-	-	-	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	-	-	-	-	-	-	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	-	-	-	-
Total	17.753	225.575	144.388	110.414	212.335	178.716	280.282	-	348.229	314.255
EASTERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	-	-	38.327	23.095	33.973	26.788	48.150	-	-
WR: Dams	33.390	8.383	32.000	-	-	22.384	51.703	17.667	23.556	-
WR: Power Supply	-	-	-	-	-	-	-	-	-	-
WR: Pump stations	17.291	-	-	-	-	-	-	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	-	51.913	77.870	103.826	129.783	155.740	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	-	-	-	-
Total	50.681	60.296	109.869	142.153	152.878	212.096	78.491	65.817	23.556	-

NORTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	-	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	36.999	6.880	2.810	108.275	128.498	18.915	-	-	-
WR: Dams	248.994	317.501	393.742	552.733	144.564	79.412	213.781	-	-	-
WR: Power Supply	-	-	-	-	-	-	-	-	-	-
WR: Pump stations	0.420	-	-	-	-	-	-	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	-	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	12.165	-	-	-	-	-	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	0.116	-	-	-
Total	261.579	354.500	400.622	555.543	252.840	207.910	232.812	-	-	-
CENTRAL CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	0.200	-	-	-	-	-	-	-	-	-
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	33.605	369.453	14.771	14.771	159.328	230.993	218.785	288.864	42.288	-
WR: Dams	79.080	50.077	131.493	132.815	33.574	-	-	-	-	-
WR: Power Supply	-	-	3.000	-	-	-	-	-	-	-
WR: Pump stations	22.133	51.602	15.537	-	-	-	3.259	-	-	-
WR: Reservoirs	-	-	-	-	-	-	-	-	-	-
WR: Roads and bridge	1.638	-	-	-	-	-	-	-	-	-
WR: Steel Pipelines	60.392	78.000	104.835	160.000	200.000	242.836	-	-	-	-
WR: Telemetry	-	-	-	-	-	-	-	-	-	-
WR: Tunnels	-	-	-	-	4.654	-	-	-	-	-
WR: Water Treatment	-	-	-	-	2.916	-	-	-	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	-	-	-	-	-	-	-	-
Total	197.048	549.132	269.635	307.586	400.473	473.829	222.044	288.864	42.288	-

APPENDIX L – Asset Impairments, Disposals and Under-utilised Assets

1 INTRODUCTION

The Disposal Strategy for this AMP is indicated in Section 2. Table L.1 lists the impaired asset components, Table L.2 lists asset components with zero asset carrying values, Table L.3 lists asset components to be disposed of and Table L.4 lists asset components which are under-utilised, not marked for disposal and not fully impaired.

2 DISPOSAL STRATEGY

Refer to the DWS Disposal Strategy for Immovable Assets.

3 IMPAIRED ASSETS

Table L.1: Impaired asset components

Refer to Excel soft copy file.

Table L.2: Asset components with zero asset carrying values, not marked for disposal and not fully impaired

Refer to Excel soft copy file.

4 ASSETS MARKED FOR DISPOSAL

Table L.3: Asset components marked for disposal

Refer to Excel soft copy file.

5 UNDER-UTILISED OR NOT-IN-USE ASSETS

Table L.4: Under-utilised asset components, not marked for disposal and not fully impaired

Refer to Excel soft copy file.

APPENDIX M – Total Cost Requirement

Table M.1: Planned clusters capital expenditure per engineering discipline

SOUTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	63.883	270.383	291.922	374.936	623.814	590.350	874.408	975.652	881.588	829.975
Electrical	28.600	10.984	10.548	9.226	6.272	4.778	0.746	6.566	14.616	15.027
Mechanical	54.689	41.078	46.486	101.364	2.857	135.389	53.041	5.928	87.914	124.197
Sub -Total	147.172	322.445	348.956	485.527	632.942	730.517	928.194	988.147	984.118	969.200
EASTERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	16.887	131.135	113.269	192.000	243.760	251.618	182.679	181.523	234.987	60.419
Electrical	24.571	13.054	3.730	5.300	8.388	1.232	17.756	0.297	15.801	21.892
Mechanical	34.299	11.359	60.227	40.626	33.668	27.012	65.188	94.941	14.688	80.862
Sub -Total	75.757	155.548	177.226	237.926	285.817	279.862	265.623	276.762	265.476	163.174
NORTHERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	193.132	272.828	419.460	616.620	835.580	751.892	558.333	861.825	1 034.275	863.594
Electrical	26.549	26.794	22.292	4.423	4.722	13.625	9.759	3.890	1.097	18.461
Mechanical	172.046	226.121	175.207	154.714	65.859	155.515	316.984	55.739	86.046	124.814
Sub -Total	391.727	525.743	616.959	775.758	906.162	921.032	885.076	921.455	1 121.417	1 006.869
CENTRAL CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Civil	367.529	659.749	669.164	546.083	1 315.224	1 617.994	1 519.072	2 798.851	3 173.749	2 488.939
Electrical	61.835	88.967	95.726	155.617	98.845	39.339	73.896	104.756	6.372	282.200
Mechanical	237.833	139.653	152.161	568.374	80.053	154.337	406.251	27.545	97.672	616.302
Sub -Total	667.197	888.369	917.052	1 270.074	1 494.123	1 811.671	1 999.219	2 931.152	3 277.793	3 387.441
Grand Total	1 281.85	1 892.10	2 060.19	2 769.28	3 319.04	3 743.08	4 078.11	5 117.52	5 648.80	5 526.68

Table M.2: Planned clusters capital expenditure per asset facility category

SOUTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	1.515	-	0.937	-	-	21.669	-	19.072	61.939	2.547
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	38.136	217.407	144.388	150.850	600.074	537.083	757.943	760.894	511.242	512.266
WR: Dams	62.060	92.501	120.850	176.416	3.644	140.224	90.398	3.656	67.895	113.910
WR: Power Supply	-	-	2.575	-	-	-	-	0.113	-	-
WR: Pump stations	26.981	8.167	6.400	5.583	4.283	10.685	-	7.585	25.807	8.343
WR: Reservoirs	-	-	-	-	-	-	-	-	-	44.192
WR: Roads and bridge	2.783	-	-	-	-	-	-	9.053	76.027	-
WR: Steel Pipelines	14.610	-	71.920	152.678	24.941	-	-	-	197.032	3.835
WR: Telemetry	-	-	-	-	-	-	-	-	1.897	0.303
WR: Tunnels	1.087	-	1.409	-	-	20.856	-	0.737	7.703	272.279
WR: Water Treatment	-	-	-	-	-	-	-	0.644	1.623	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	4.369	0.478	-	-	-	79.853	186.394	32.952	11.526
Total	147.172	322.445	348.956	485.527	632.942	730.517	928.194	988.147	984.118	969.200
EASTERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	1.865	19.380	-	-	-	18.474	16.551	51.737	-	0.147
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	44.404	36.299	66.260	114.213	75.304	147.730	57.018	-	47.468
WR: Dams	38.446	25.991	44.020	37.361	23.567	22.384	87.014	126.057	34.280	67.471
WR: Power Supply	-	-	1.052	-	-	-	-	-	-	-
WR: Pump stations	34.398	6.464	17.197	3.511	15.677	-	14.070	-	16.708	43.898
WR: Reservoirs	-	-	-	-	-	-	-	-	-	0.670
WR: Roads and bridge	1.048	7.396	-	-	-	-	-	1.590	-	-
WR: Steel Pipelines	-	51.913	77.870	129.782	132.359	155.740	-	20.249	93.543	0.114
WR: Telemetry	-	-	-	1.012	-	-	-	-	-	2.089
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	0.227	-	-
WS: borehole	-	-	-	-	-	-	-	-	-	-
WS: Measuring facility	-	-	0.788	-	-	7.961	0.258	19.883	120.945	1.316
Total	75.757	155.548	177.226	237.926	285.817	279.862	265.623	276.762	265.476	163.174

NORTHERN CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	3.150	-	97.402	-	0.469	-	-	-	74.559	74.398
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	-	36.999	6.912	102.605	478.402	435.856	474.523	641.129	904.186	562.292
WR: Dams	369.930	485.223	418.778	552.733	176.835	448.258	410.437	119.228	94.947	103.529
WR: Power Supply	5.225	1.593	1.562	-	0.121	-	-	-	0.279	-
WR: Pump stations	1.256	0.358	2.214	0.262	1.009	0.717	-	0.144	10.325	1.408
WR: Reservoirs	-	-	-	-	-	-	-	-	-	13.963
WR: Roads and bridge	-	-	-	-	-	-	-	-	1.677	0.600
WR: Steel Pipelines	12.165	-	84.019	120.157	249.326	31.569	-	157.070	3.782	-
WR: Telemetry	-	-	6.073	-	-	-	-	-	-	12.536
WR: Tunnels	-	-	-	-	-	-	-	-	-	-
WR: Water Treatment	-	-	-	-	-	-	-	-	5.360	9.981
WS: borehole	-	-	-	-	-	-	-	-	2.582	14.919
WS: Measuring facility	-	1.570	-	-	-	4.632	0.116	3.885	23.722	213.243
Total	391.727	525.743	616.959	775.758	906.162	921.032	885.076	921.455	1 121.417	1 006.869
CENTRAL CLUSTER										
Facility Category	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Buildings	2.736	19.790	13.155	86.816	35.407	225.748	101.160	247.364	-	78.334
Land	-	-	-	-	-	-	-	-	-	-
WR: Canals	42.225	369.453	14.771	155.000	965.400	1 139.814	999.732	1 406.137	2 655.737	1 282.078
WR: Dams	203.521	124.810	166.391	353.420	37.638	-	477.051	2.246	24.814	322.207
WR: Power Supply	0.195	5.901	5.576	7.035	-	-	-	-	3.955	22.351
WR: Pump stations	72.190	144.579	144.835	302.100	158.212	200.850	95.669	126.359	111.241	486.884
WR: Reservoirs	-	-	-	2.091	-	-	2.978	-	7.391	132.948
WR: Roads and bridge	1.638	-	-	-	0.138	-	6.092	-	-	24.473
WR: Steel Pipelines	344.691	222.654	572.324	356.904	280.073	242.836	282.649	1 042.008	469.667	172.876
WR: Telemetry	-	-	-	1.012	-	-	-	-	-	2.089
WR: Tunnels	-	-	-	5.696	5.752	2.424	18.235	-	2.571	794.905
WR: Water Treatment	-	-	-	-	11.503	-	6.078	2.505	-	0.540
WS: borehole	-	-	-	-	-	-	-	0.577	-	-
WS: Measuring facility	-	1.184	-	-	-	-	9.573	103.956	2.417	67.755
Total	667.197	888.369	917.052	1 270.074	1 494.123	1 811.671	1 999.219	2 931.152	3 277.793	3 387.441

Table M.3: Planned clusters overall costs

SOUTHREN CLUSTER										
Cost Component	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Capital Expenditure (CAPEX)										
Renewals	129.420	96.870	204.568	375.113	420.608	551.801	647.913	988.147	635.890	654.945
Upgrades and New Capital	17.753	225.575	144.388	110.414	212.335	178.716	280.282	0.000	348.229	314.255
Sub-Total CAPEX	147.172	322.445	348.956	485.527	632.942	730.517	928.194	988.147	984.118	969.200
Operations and Maintenance (O&M)										
Operations	77.542	109.143	142.897	153.395	164.671	176.785	189.798	203.780	218.801	234.941
Maintenance	341.948	368.212	396.494	426.947	459.740	495.051	533.074	574.018	618.107	665.581
Sub-Total O&M	419.490	477.356	539.391	580.342	624.411	671.836	722.873	777.798	836.908	900.523
Total	566.663	799.801	888.347	1065.869	1257.353	1402.352	1651.067	1765.945	1821.026	1869.723
<i>Overhead</i>	<i>145.688</i>	<i>159.556</i>	<i>174.444</i>	<i>185.390</i>	<i>197.029</i>	<i>209.405</i>	<i>222.566</i>	<i>236.562</i>	<i>251.447</i>	<i>267.277</i>
Grand Total O&M	712.351	959.357	1062.791	1251.258	1454.382	1611.757	1873.633	2002.507	2072.473	2137.000
EASTERN CLUSTER										
Engineering Discipline	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Capital Expenditure (CAPEX)										
Renewals	25.076	95.252	67.356	95.773	132.939	67.766	187.132	210.945	241.921	163.174
Upgrades and New Capital	50.681	60.296	109.869	142.153	152.878	212.096	78.491	65.817	23.556	0.000
Sub-Total CAPEX	75.757	155.548	177.226	237.926	285.817	279.862	265.623	276.762	265.476	163.174
Operations and Maintenance (O&M)										
Operation	223.272	255.243	289.485	307.735	327.147	347.797	369.764	393.134	417.997	444.449
Maintenance	111.846	120.436	129.686	139.647	150.373	161.923	174.360	187.752	202.172	217.700
Sub-Total O&M	335.118	375.679	419.171	447.382	477.520	509.720	544.124	580.886	620.169	662.149
Total	410.875	531.227	596.397	685.308	763.337	789.582	809.747	857.647	885.645	825.323
<i>Overhead</i>	<i>62.652</i>	<i>70.428</i>	<i>78.765</i>	<i>84.018</i>	<i>89.626</i>	<i>95.615</i>	<i>102.009</i>	<i>108.838</i>	<i>116.131</i>	<i>123.920</i>
Grand Total	473.527	601.656	675.162	769.326	852.963	885.196	911.756	966.485	1001.776	949.243

NORTHERN CLUSTER										
Cost Component	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Capital Expenditure (CAPEX)										
Renewals	130.147	171.243	216.337	220.214	653.322	713.122	652.263	921.455	1121.417	1006.869
Upgrades and New Capital	261.579	354.500	400.622	555.543	252.840	207.910	232.812	0.000	0.000	0.000
Sub-Total CAPEX	391.727	525.743	616.959	775.758	906.162	921.032	885.076	921.455	1121.417	1006.869
Operations and Maintenance (O&M)										
Operation	168.881	300.176	431.813	464.315	499.281	536.899	577.371	620.915	667.766	718.176
Maintenance	288.746	310.924	334.805	360.520	388.210	418.028	450.135	484.709	521.938	562.026
Sub-Total O&M	457.627	611.100	766.618	824.835	887.492	954.927	1027.506	1105.624	1189.703	1280.202
Total	849.354	1136.843	1383.576	1600.593	1793.653	1875.959	1912.582	2027.078	2311.121	2287.070
<i>Overhead</i>	<i>133.204</i>	<i>143.274</i>	<i>154.105</i>	<i>165.756</i>	<i>178.287</i>	<i>191.765</i>	<i>206.263</i>	<i>221.856</i>	<i>238.628</i>	<i>256.669</i>
Grand Total O&M	982.557	1280.116	1537.682	1766.348	1971.940	2067.724	2118.845	2248.935	2549.749	2543.739
CENTRAL CLUSTER										
Cost Component	Financial Years (Million Rands)									
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27
Capital Expenditure (CAPEX)										
Renewals	470.149	339.237	647.417	962.488	1093.651	1337.841	1777.175	2642.289	3235.505	3387.441
Upgrades and New Capital	197.048	549.132	269.635	307.586	400.473	473.829	222.044	288.864	42.288	0.000
Sub-Total CAPEX	667.197	888.369	917.052	1270.074	1494.123	1811.671	1999.219	2931.152	3277.793	3387.441
Operations and Maintenance (O&M)										
Operations	629.812	694.172	761.416	810.903	863.653	919.884	979.829	1043.738	1111.876	1184.528
Maintenance	781.386	841.402	906.028	975.617	1050.551	1131.240	1218.128	1311.688	1412.435	1520.920
Sub-Total O&M	1411.198	1535.574	1667.444	1786.520	1914.204	2051.124	2197.957	2355.426	2524.311	2705.448
Total	2078.395	2423.943	2584.496	3056.594	3408.327	3862.795	4197.175	5286.578	5802.104	6092.889
<i>Overhead</i>	<i>95.135</i>	<i>109.171</i>	<i>123.468</i>	<i>132.276</i>	<i>141.722</i>	<i>151.852</i>	<i>162.716</i>	<i>174.368</i>	<i>186.866</i>	<i>200.273</i>
Grand Total	2173.530	2533.114	2707.963	3188.870	3550.049	4014.647	4359.891	5460.946	5988.970	6293.162