BASELINE ASSESSMENT FOR WATER & ELECTRICITY CONSUMPTION AT THE CITY HALL IN PIETERMARITZBURG FOR THE MSUNDUZI MUNICIPALITY

FINAL BASELINE REPORT

AUGUST 2021

Prepared by:

JG AFRIKA (PTY) LTD

Cape Town
P O Box 38561
Pinelands, 7430
Telephone: 021 530 1800
Email: edwardsb@jgafrika.com
Project Manager: Bonté Edwards

VERIFICATION PAGE

Qual-frm-026
Rev 14

TITLE:
BASELINE ASSESSMENT FOR WATER & ELECTRICITY CONSUMPTION AT THE CITY HALL IN PIETERMARITZBURG FOR THE MSUNDUZI MUNICIPALITY: DRAFT BASELINE AND IMPLEMENTATION REPORT

JGA REF. NO.	DATE:	REPORT STATUS
5573	31/08/2021	Final

CARRIED OUT BY:	COMMISSIONED BY:
JG AFRIKA (PTY) LTD **CAPE TOWN** PO Box 38561 Pinelands 7430 Tel.: +27 21 530 1800 Email: edwardsb@jgafrika.com	**MSUNDUZI MUNICIPALITY** Private Bag X205 AS Chetty Building Pietermaritzburg 3200 Tel: 033 392 3245 Email: Kerina.Singh@msunduzi.gov.za

AUTHOR	CLIENT CONTACT PERSON
Tamryn Heydenrych and Bonte Edwards	Kerina Singh

SYNOPSIS

Conduct a baseline assessment to determine the water and electricity consumption, and to recommend interventions at City Hall, PMB.

KEY WORDS:

Baseline Assessment, Water, Electricity, interventions

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO 9001: 2015 which has been independently certified by DEKRA Certification.

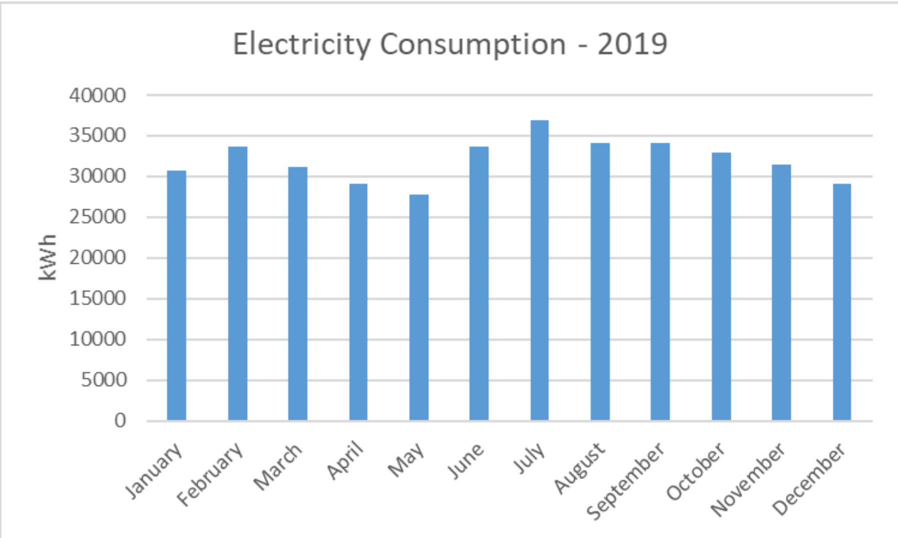
Verification	Capacity	Name	Signature	Date
By Author	Senior Environmental Scientist	Tamryn Heydenrych		31/08/2021
Checked by:	Associate	Bonte Edwards	BEdwards	31/08/2021
Authorised by:	Associate	Bonte Edwards	BEdwards	31/08/2021

EXECUTIVE SUMMARY

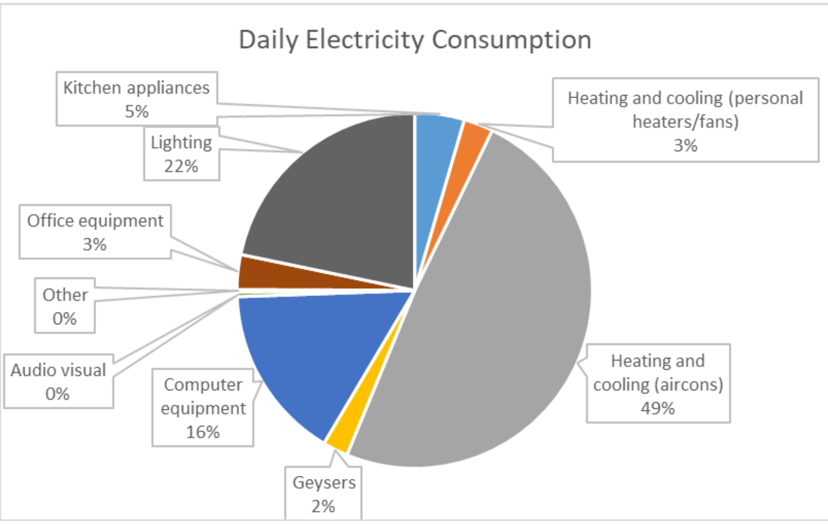
JG Afrika (Pty) Ltd was appointed by the Msunduzi Municipality to undertake a baseline assessment of City Hall in Pietermaritzburg in terms of electricity, water and waste and to provide recommendations for increased optimisation of the building. The on-site assessment at City Hall was undertaken on 12 May 2021.

Due to the Covid-19 Pandemic, the assessment period used was January 2019 to December 2019 to ensure a more accurate representation of the consumption patterns within the building. In terms of the utility bills, the water consumption data recorded appear to be incorrect, as for the most part, the exact same kilolitres are recorded monthly (note total of five meters). In terms of actual water consumption, the annual consumption recorded appears to be well short of a realistic total, especially when compared to the water balance done for only office use (excluding any concerts or functions).

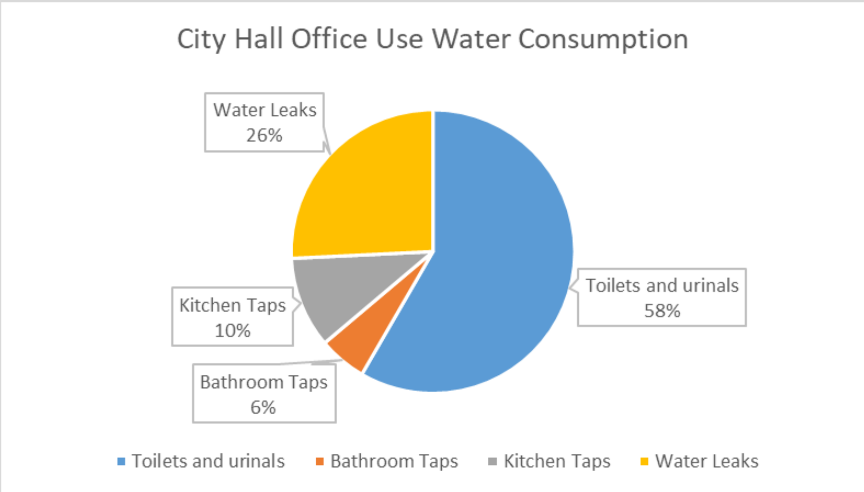
There is one electricity meter, which recorded an annual consumption of 384 597 kWh for the assessment period. The monthly electricity consumption is shown below.



The on-site assessment involved a high-level energy audit of electrical equipment and appliances, including computers, printers, lighting, kitchen appliances and the HVAC system. The following usage split was ascertained, with heating and cooling accounting for the highest energy consumption.



The on-site water assessment was calculated based on a total of 174 staff in the building per day during a 5-day week. The water assessment only represents typical office water use and does not account for water use as a result of concerts, events or functions, as information relating to the number of additional people and activities, was not available. Toilet use accounts for the highest water use, followed by water leaks (a number of water leaks were observed).



In terms of waste management, waste generated at the City Hall is currently not separated. Small bins are placed in offices and emptied into refuse bags by cleaner's weekly, which are placed on the pavement and collected by the Municipality for disposal at the New England Road Landfill Site in Pietermaritzburg. There are no temporary waste storage areas.

Based on the baseline assessment, the following interventions and recommendations are proposed:

- Replace existing lights with LED lighting – estimated payback under 3 years
- Install solar-PV on the carport to supplement up to 60% of the building's annual consumption – estimated payback under 4 years
- Consider removing personal bar fridges / reducing current number to realise instant savings.
- Undertake an inventory of all geysers, with their locations and where hot water is supplied in the building and confirm all current hot water uses. All geysers remaining on should be fitted with a timer and geyser blanket.
- Undertake a comprehensive inventory of all HVAC appliances, repair broken appliances, remove redundant systems and improve operational efficiencies (e.g. changing thermostat set-points, ensure air-conditioners correctly sized for each room, etc.).
- Install low flow aerators on all bathroom taps (max flow rate of 1.3 l/min). However, this may require upgrades to a number of older taps that may not be easily retrofitted.
- Remove individual desk bins and have centralised 2-bin systems for general waste and recyclables. Include paper recycling bins at all printers.
- Include e-waste collections bins for bulbs and batteries prior to correct disposal.
- Undertake environmental awareness training around energy, water and waste and ensure such campaigns are regularly repeated.
- Undertake a staff questionnaire to identify key focus areas to improve energy, water and waste efficiencies.
- Identify Environmental Champions to drive sustainable practices within the City Hall.
- Establish easy reporting system to monitor energy and water consumption and waste generated, at least weekly.

- Develop green procurement guideline for procurement of environmentally sustainable products used within City Hall.
- Seal any gaps in all doors and windows with self-adhesive weather stripping, which is inexpensive.
- Consider installing or improving roof insulation, specifically above the offices.
- Develop a Smart Event guide for City Hall.
- Develop an online booking system for all events to track number of attendees, etc.

Table 1: Proposed electricity interventions

Electricity Intervention	Cost of intervention	Estimated Savings (kWh/yr)	Estimated Saving (R/yr)	Payback (yrs)	Intervention
Bar fridges	R 0.00	2 044	R 2 357.55	Instant	• Remove 50% of bar fridges from offices
Lighting	R 99 310.00	30 793	R 35 516.92	2.8	• Replace all lighting with LED bulbs
65 kWp grid-tied PV system*	R 910 965.00	230 758	R 266 156.51	3.42	• Solar-PV on carport (without batteries)

*Costing is an estimate amount and excludes structural engineer assessment or any other structural aspects that may be required.

Table 2: Water savings

Consumption Item	Estimated Savings (kl/yr)	Estimated Savings (R/yr)*	Saving (%)	Intervention
Toilets	617	R 24 504	48%	• Reduce cistern flush volume to 6l/flush • Change urinals to hold-flush of 0.2 l/use**
Bathroom basins	98	R 3 902	81%	• Install 1.3 l/min aerators • Signage for saving water
Water leaks	570	R 22 661	100%	• Fix all water leaks
Total	**1 285.05**	**R 42 336**	**35%**	

*Savings refers only to actual water savings. Table does not take into account cost of fittings as a plumber would need to confirm price to retrofit older existing fittings.
**Waterless urinals are not recommended for this building due to the cleaning and maintenance requirements that if not done properly result in odours and user dissatisfaction.

CONTENTS

Figures

Tables

Annexures

Acronyms

CFL	Compact fluorescent lamp
HVAC	Heating, ventilation, and air conditioning
kl	Kilolitre
kVA	Kilo volt amperes (demand charge)
kW	Kilo Watt
kWh	Kilo Watt hours
LED	Light-emitting diode
PAC	Precision air conditioning system
PV	Photovoltaic

1 INTRODUCTION

JG Afrika (Pty) Ltd was appointed by the Msunduzi Municipality to undertake a baseline assessment of City Hall in Pietermaritzburg in terms of electricity, water and waste and to provide recommendations for increased optimisation of the building.

This report provides an overview of the methodology used to the undertake the study, followed by the findings of the baseline assessment and the potential interventions identified for the City Hall. Due to the Covid-19 pandemic the water and electricity data for the period January – December 2019 was used for this assessment in order to obtain a more realistic understanding of the buildings typical annual water and electricity consumption.

The following information was provided by the Municipality:

- Utility bills for 2019.
- Asset register.
- Staff numbers – based on Outlook Address Book List.
- High level information on the building (provided during site visit).

A number of requests for information pertaining to the following was requested, however, limited or no further details were provided:

- Waste management and recycling practices.
- Procurement for light bulbs in terms of type of bulbs bought.
- Confirmation of the number of PAC units (precision air conditioning system) on the roof (information used was based on details provided in asset register).
- No record of number of events / concerts / functions held or the number of people at each during assessment period.
- No details or power ratings provided for computer servers, UPS's and switch units in the building.

As such, a number of assumptions have been made, which are outlined in the relevant sections of the report. A lack of information also means that accurate payback periods were not possible in most instances. Should the Municipality be able to provide the outstanding information the Final Report can provide a more accurate assessment of potential savings for identified interventions.

2 METHODOLOGY

The methodology for the determination of the baseline for water consumption, energy usage, and waste generation entailed the following, namely:

1. On-site assessment.
2. Review of utility data.
3. Analysis and interpretation of the information gathered during the on-site assessment and information provided.
4. Compilation of draft report with details and analysis, including indications of potential interventions and high-level pay-back periods.
5. Final Report with details of analysis and recommended interventions for consideration.

JG Afrika undertook an on-site assessment at City Hall on 12 May 2021, which included the following:

- All electrical appliances, e.g. computers, printers, lights, etc., were manually counted on each floor of the building (refer to data in **Appendix A**).

- Where possible, power ratings of each appliance were recorded. Where ratings were not visible or available on-site, research was undertaken to obtain an applicable power rating (this included averaging out the power ratings for various brands of the same appliance before assigning a power rating to the appliance recorded during the assessment).
- Power ratings were assigned to each appliance and light in order to provide an estimated energy usage over a single day. Estimated hours of use were applied to each appliance, as this varies. For example, a fridge will be on for 24 hours a day, with a typical usage factor of 8 hours, whereas a printer will only use its maximum power rating during use, with a much lower standby power rating for the rest of the day. These factors are all taken into consideration in the calculations.
- The number of taps and toilets throughout City Hall were also counted and the various fittings noted (e.g. any low flow devices, toilet flushing mechanisms, etc). Notable leaks or broken fixtures were also recorded.
- Observations were also made of how staff utilised appliances, such as temperature settings of heating and cooling systems, understanding the number of individualised appliances, such as printers, as well as listening to staff as to their experiences working within the building.

The assessment calculations are first compared against the utility data as a means of identifying any potential concerns, e.g. underground water leak, etc. The on-site assessment provides a good understanding of the typical energy and water use for the building and feedback from the site visit provides additional insight into how the building typically operates. Based on the information provided it is possible to calculate a high level per person usage rate per day.

However, it should not be seen as 100% accurate, as this type of on-site assessment rather assists in determining a better understanding of the potential split in electrical and water demand, which is useful for identifying potential interventions and areas where the most savings could be achieved. The high level per person usage rate also provides useful benchmarks to measure progress after the implementation of minimisation interventions at a later date.

3 SITE ASSESSMENT AND ANALYSIS

This section of the report unpacks the results of the site assessment and analysis of the utility data.

3.1 General Information

The City Hall is located in central Pietermaritzburg and was built between 1893 and 1900, with an iconic clock tower standing 47 m tall and is *Protected as Heritage Landmark (Category II – Provincial)* in terms of the KwaZulu Natal's Heritage Act (No. 4 of 2008).

The City Hall is used by the Msunduzi Municipality and includes the Municipal Chambers and offices. In addition, the building includes a large concert hall with a pipe organ where numerous events, such as concerts, weddings, funerals and various other small to large functions are held throughout the year.

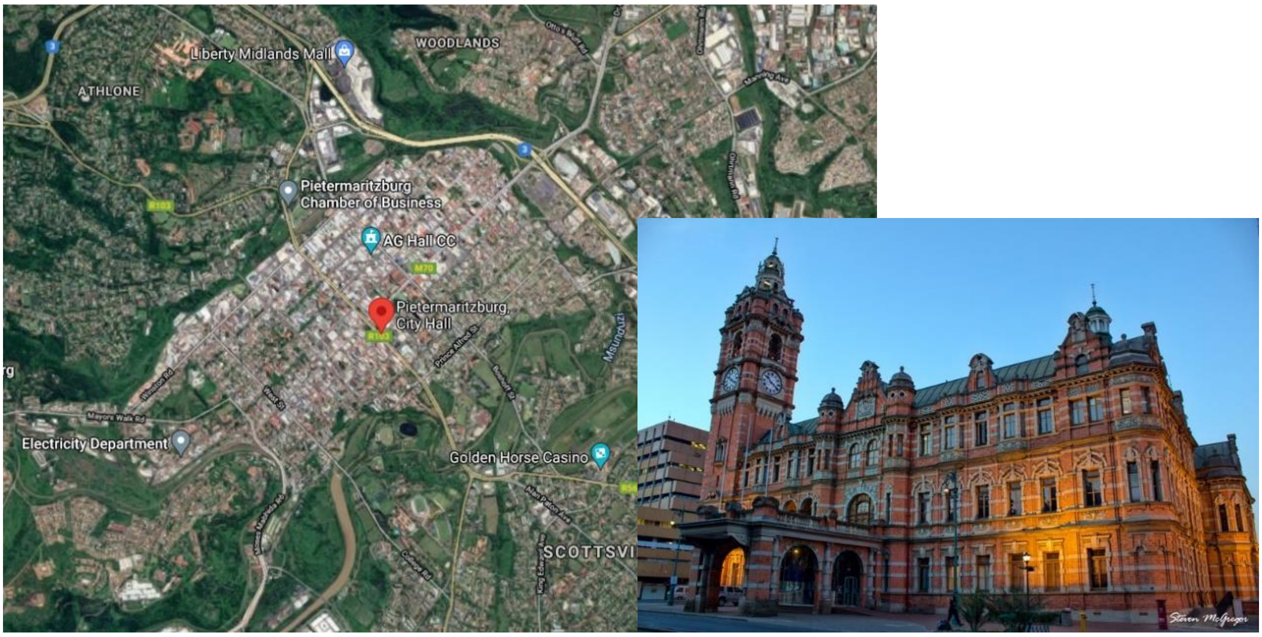


Figure 1: Location of City Hall (Google Maps), with insert showing the exterior of the building and the clock tower (https://www.pmbtourism.co.za/).

Table 1: General information

Summary of information	
Assessment period	The baseline assessment made use of data from January to December 2019.
Location / Address	Chief Albert Luthuli St, Pietermaritzburg, 3200
Type of facilities / Amenities	Municipal office building, including a large concert hall that hosts a variety of events. The building includes a number of kitchenettes with basic appliances, such as kettles and microwaves (appliances varied) as well as a large prep room, which is used by caterers (note no food is cooked / prepared on-site).
Number of office staff	Approximately 145 staff and 10 general assistants
No. of security	2 – 3 per shift (two shifts - day and night)
No. of cleaning staff	7 permanent staff and 7 contract staff (work 5 days a week)
Male / Female split	50:50 (exact ratio could not be provided, therefore this was assumed for assessment calculations)
Typical Working Hours	08h00 – 17h00 It should be noted that senior staff, such as the Mayor and other senior officials often work late / work outside of standard office hours.
Functions / Events	Functions and events are held throughout the week and weekend, during the day and at night. No specific details were provided, such as a list of events held within the assessment period (i.e. 2019) or number of people attending per event. Events range from orchestral concerts, weddings, funerals, to smaller workshops and meetings.
Utility Billing	Two accounts for City Hall: • Unit 1 Church Street (Acc. No. 108741) and • Unit 2 Church Street (Acc. No. 108759)

<table>
<tr><td>Water metering</td><td><table><tr><td>Unit 1 Church Street:
• 2 water meters
o Meter No. 647163
o Meter No. C-PAD2603</td><td>Unit 2 Church Street:
• 3 water meters
o Meter No. 368554
o Meter No. C-LBA175
o C-PAD3094</td></tr></table></td></tr>
<tr><td>Annual water consumption</td><td>781 kl</td></tr>
<tr><td>Water tariff</td><td>• Municipal Departments Tariff
<table><tr><th></th><th>2018/19</th><th>2019/20</th></tr><tr><td>Charge</td><td>23.48</td><td>R 25.73</td></tr></table>*For the purposes of calculating payback periods, the 2021/2022 tariff was used (i.e. R 30.01 / kl was used.</td></tr>
<tr><td>Sewerage tariff (basic monthly charge)</td><td>• Based on kl used per month.
<table><tr><th></th><th>2018/19</th><th>2019/20</th></tr><tr><td>Charge / kl</td><td>R 8.34</td><td>R 8.34</td></tr></table>* For the purposes of calculating payback periods, the 2021/2022 tariff was used (i.e. R 9.73 / kl).</td></tr>
<tr><td>Electricity meter</td><td>Unit 1 Church Street:
• 1 electricity meter
• Meter No. E04132921

Unit 2 Church Street: No electricity meters.</td></tr>
<tr><td>Electricity tariff</td><td>• Large Power users (Load greater than 65 kVA) (Low voltage supply from 100 Amps to 750 Amps/phase)
<table><tr><th>Scale C.1 Large Power at LV</th><th>2018/2019</th><th>2019/2020</th></tr><tr><td>Basic Charge</td><td>R 521.17</td><td>R 589.28</td></tr><tr><td>Demand charge per kVA per month</td><td>R 200.25</td><td>R 226.42</td></tr><tr><td>Energy charge per kWh (cents)</td><td>95.43</td><td>107.90</td></tr></table>*For the purposes of calculating payback periods, the 2021/2022 tariff was used (i.e. 115.34 cents / kWh).</td></tr>
<tr><td>Annual electricity consumption</td><td>384 597 kWh</td></tr>
<tr><td>Outsourced services</td><td>All catering for events / functions, etc., is outsourced (this applies to all events held at City Hall – i.e.no food is prepared on-site).</td></tr>
<tr><td>Existing water interventions implemented</td><td>None identified</td></tr>
<tr><td>Existing energy interventions implemented</td><td>None identified</td></tr>
<tr><td>Waste collection by whom/how</td><td>• General waste is collected by the Municipality on a weekly basis.
• No recycling or waste separation takes place.</td></tr>
</table>

	• Waste is placed in black bags and placed on the street for weekly collection. There are no internal temporary waste storage or sorting areas
Refuse tariff	Refuse removal tariff is based on the relevant Electricity Scale for the property. | | **2018/19** | **2019/20** | | **Refuse Charge** | R 284.95 | R 302.05 |

3.2 Utility Data

The utility data for water and electricity for the assessment period (i.e. January 2019 to December 2019) was provided.

The water consumption data recorded on the utility bills appears to be incorrect, as for the most part the exact same kilolitres are recorded monthly (see **Table 2** and **Figure 2**). In terms of actual water consumption, the annual consumption recorded appears to be well short of a realistic total, especially when compared to the water balance done for only office use (excluding any concerts or functions) (see Section 3.3.4). Water meter C-PAD2603 also recorded no consumption data and it is unclear if this is a faulty meter or not. As such, it is likely that the Municipality is underpaying for their water consumption. The water by-law and water tariff documents were reviewed, however, there was no indication of any reduced rates for certain users that could account for this low consumption. Input from the municipality was also requested, however, no information was forthcoming.

Table 2: Utility data showing metered water consumption for the assessment period.

Month (2019)	Meter 368554 (kl)	Meter C-LBA175 (kl)	C-PAD 3094 (kl)	Meter 647163 (kl)	Meter C-PAD2603 (kl)	Total Consumption (kl)	Water Cost	Sewage Cost	Total Cost
January	5	23	0	50	0	**78**	**R 1 831.44**	R 650.52	**R 2 481.96**
February	5	12	0	50	0	**67**	**R 1 573.16**	R 558.78	**R 2 131.94**
March	5	12	0	50	0	**67**	**R 1 573.16**	R 558.78	**R 2 131.94**
April	5	12	0	50	0	**67**	**R 1 573.16**	R 141.78	**R 1 714.94**
May	0	0	0	50	0	**50**	**R 1 174.00**	R 417.00	**R 1 591.00**
June	0	0	0	50	0	**50**	**R 1 174.00**	R 417.00	**R 1 591.00**
July	5	12	0	50	0	**67**	**R 1 588.79**	R 562.26	**R 2 151.05**
August	5	12	0	50	0	**67**	**R 1 723.91**	R 592.28	**R 2 316.19**
September	5	12	0	50	0	**67**	**R 1 723.91**	R 592.28	**R 2 316.19**
October	5	12	0	50	0	**67**	**R 1 723.91**	R 592.28	**R 2 316.19**
November	5	12	0	50	0	**67**	**R 1 723.91**	R 592.28	**R 2 316.19**
December	5	12	0	50	0	**67**	**R 1 723.91**	R 592.28	**R 2 316.19**
	50	**131**	**0**	**600**	**0**	**781**	**R 19 107.26**	**R 6 267.52**	**R 25 374.78**

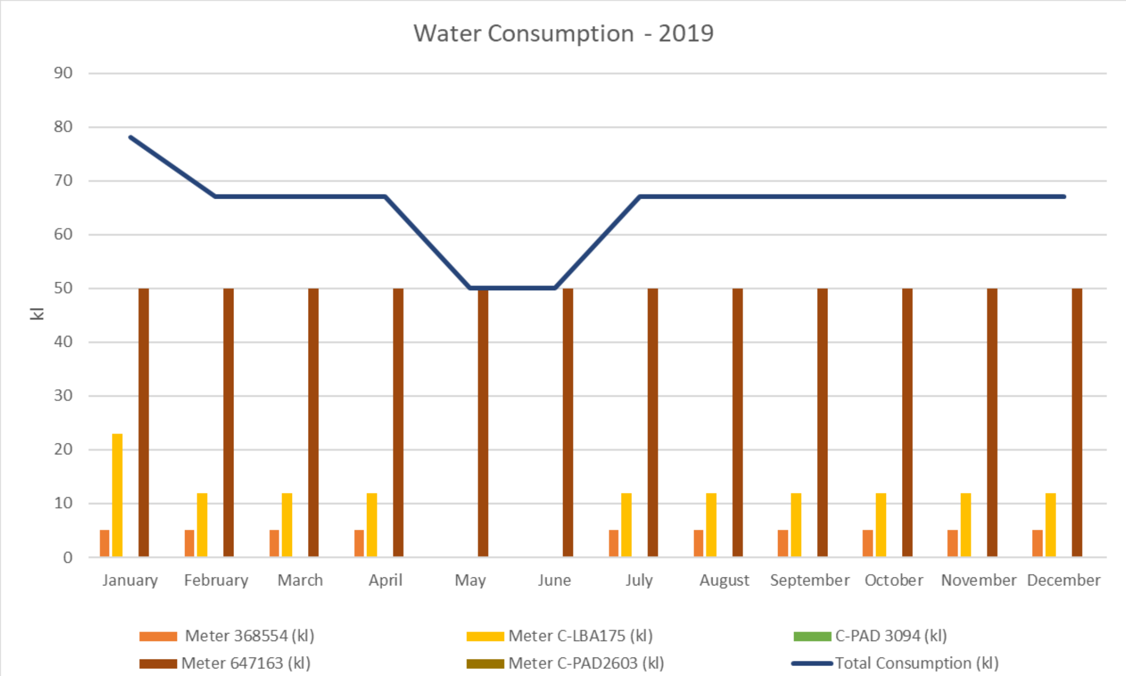


Figure 2: Water consumption for all meters and showing combined total monthly consumption.

In terms of electricity consumption, there is one meter shown on the utility bills. **Table 3** provides the electricity usage for the assessment period (also see **Figure 3**).

Table 3: Electricity consumption as per monthly utility bills

Month (2019)	kWh Use	kWh Cost	Basic Charge	kVA	kVA Cost	Total Cost
January	30685	R 29 282.70	R 521.17	127	R 25 431.75	R 55 235.62
February	33670	R 32 131.28	R 521.17	127	R 25 431.75	R 58 084.20
March	31150	R 29 726.45	R 521.17	132	R 26 433.00	R 56 680.62
April	29046	R 27 718.60	R 521.17	121.1	R 24 250.28	R 52 490.05
May	27720	R 26 453.20	R 521.17	121	R 24 250.28	R 51 224.65
June	33680	R 32 140.82	R 521.17	121.1	R 24 250.28	R 56 912.27
July	36949	R 38 792.87	R 589.28	124	R 28 076.08	R 67 458.23
August	34077	R 36 769.08	R 589.28	121.1	R 27 419.46	R 64 777.82
September	34104	R 36 798.22	R 589.28	121.1	R 27 419.46	R 64 806.96
October	32953	R 35 167.85	R 589.28	121.1	R 27 419.46	R 63 176.59
November	31420	R 33 902.18	R 589.28	121.1	R 27 419.46	R 61 910.92
December	29143	R 31 445.30	R 589.28	121.1	R 27 419.46	R 59 454.04
	384 597 kWh			**1478.7 kVA**		**R 712 211.97**

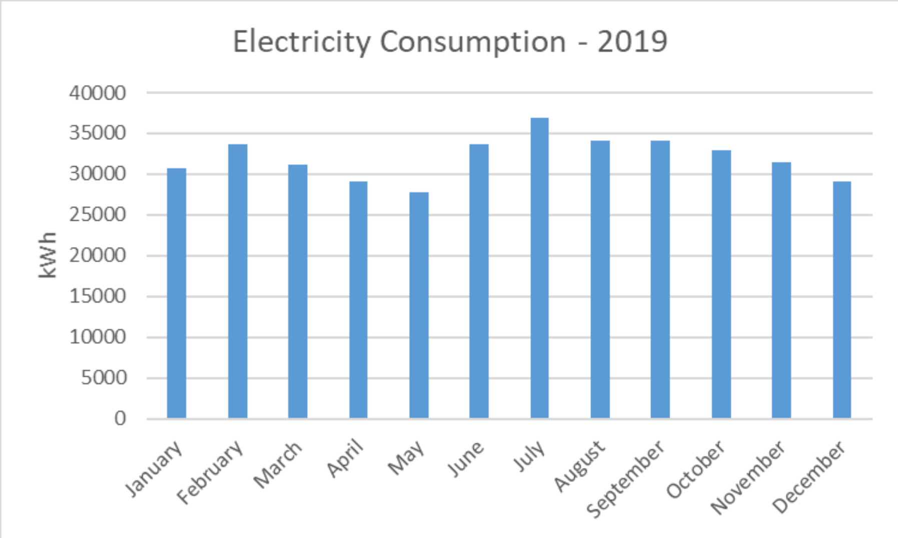


Figure 3: Monthly electricity consumption (kWh)

Figure 3 shows the monthly electricity consumption, which is fairly uniform. The increase in consumption from June could account for increased use of air conditioners and personal heaters for heating during winter. The spike in February is possibly as a result of increased cooling/air conditioner usage due to peak summer temperatures.

3.2.1 Tariff Assessment

The tariff assessment aims to understand how electricity, water and waste area measured or metered and what billing tariffs are applied to the metered values to determine monthly costs.

3.2.1.1 Electricity

City Hall is currently on a "Large Power users (Load greater than 65 kVA) (Low voltage supply from 100 Amps to 750 Amps/phase)" tariff for electricity consumption.

This appears to be the correct tariff and actual meter readings are generally provided.

Reducing consumption and demand could lead to a lower tariff being charged.

Important Definition for Maximum demand: A measure of the highest peak of electricity flowing into a site over the course of a billing period, measured in kVA.

It should be noted that if Electrical Demand interventions are implemented this could have a measurable effect on the peak demand. The kVA monthly cost is roughly a third of the monthly electricity charge and reducing this could result in considerable savings. This could be as simple as managing the timing of when lighting and air conditioning systems are switched on.

It is therefore recommended that a demand profile for the building is established. This is a record of the power demand (rate of energy use) over time. The demand profile provides an understanding of when energy is used. A simple demand profile can be obtained by means of a series of manual utility meter readings recorded twice daily (morning and evening) or, if possible, a logger should be installed for a period of one week, as a minimum.

3.2.1.2 Water

City Hall is currently charged on "Scale 8 – Municipal Departments" for water.

Although this tariff appears to be the correct, the meter does not appear to be working/reading correctly or the tariff may not be accurately charged.

The monthly meter reading for City Hall was exactly the same for every month of the assessment period, despite the meter readings changing by 50 000 litres every month.

The utility bills indicate that these are actual charges, however, there are frequent reconciliations and rebates. Confirmation needs to be obtained to ensure accurate meter readings and billing information.

3.2.1.3 Refuse/Waste

City Hall is currently charged for the removal of black bags and does not have any wheelie bins.

City Hall is being charged their waste tariff as a "4. *Large Power Users – Business/Commercial Supply taken at 400V*" at a monthly charge of R 284.95 (2018/19 assessment period).

There is a tariff for the removal of refuse from properties owned by the State & Municipal Departments, using wheelie bins at the rates (2018/2019) of:

- hire thereof, including one clearance per week R 88.31
- second clearance R 66.03
- each additional clearance R 60.51

It is recommended that City Hall use wheelie bins and change to this tariff, as costs could be reduced depending on the number of black bags that are disposed of per week (note: on average a wheelie bin contains the equivalent of 4 black bags).

3.3 On-site Assessment

An on-site assessment of City Hall in Pietermaritzburg was undertaken on 12 May 2021. The on-site assessment was undertaken with the aim of identifying areas of consumption concern and gathering information on energy consuming equipment/appliances in the building, water fittings used in kitchens and bathrooms, operational activities and waste disposal systems used in the building. *However, as the assessment was undertaken during the Covid-19 Pandemic, office usage observed during the site visit may not have been a true reflection of pre-Covid activities.*

It is important to determine the baseline consumption for a building, in this instance for water, electricity, and waste, as this information provides current actual usage values. Baseline data provides a benchmark from which to monitor usage patterns going forward. Should any interventions be implemented, the efficiency of the interventions can be monitored on the baseline values. Without baseline data, there is no way to accurately show any actual savings or monitor progress.

3.3.1 Electricity – On-Site Assessment Feedback & Analysis

The on-site assessment involved a high-level energy audit of electrical equipment and appliances, including computers, printers, lighting, kitchen appliances and the HVAC system. The asset register also provided information on equipment and appliances on each floor and was used to cross check appliances. However, there were a number of discrepancies and it is uncertain how accurate or up to date the asset register is.

Typical assumptions used to calculate daily electricity use for key appliances is detailed in **Table 4** and **Table 5**. It should be noted that these calculations are used as a guide to illustrate likely electricity usage based on assumptions and may vary due to a number of factors, such as actual time and frequency of use of each appliance, duration of staff members working from the office each day, which were not able to be provided in the detail required for an accurate calculation.

Table 4: Estimated equipment usage hours.

Equipment / Appliance	Estimated hrs of use per 24 hour period	Notes
Laptop	8	Turned off each day / taken home
Desktop	10	Operating for 10 hours, accounts for computers left on / standby overnight, which use more power than laptops
Monitor	12	Operating for 12 hours, accounts for computers left on / standby overnight
Phone	1	Whilst remaining plugged in, average active use has been assumed.
Printer	2	In use 25% per 8-hour day, which accounts for standby power and full operational power during printing. Smaller individual printers accounted for less time.
All switches, UPS's and associated equipment	24	This equipment is required to be on 24 hours a day. No details were provided on the number of items or power ratings. As such, estimate power consumption was determined based on visible equipment.
Shredder	0.25	In use for 15 minutes per 8-hour day, which accounts for standby power and full operational power
Heaters (personal)	1	Assumed would only be used in winter (6hrs/day for 3 months) and thus estimated time of use is averaged out for the year
Geyser	4	It was indicated, during the site visit, that only 1 geyser is on, however, a second geyser was noted to be on. Bathrooms predominately only included cold taps, thus assumed that hot water is not often required.
TV	0.025	Assumed TVs on for 3 hours a week throughout the year, which accounts for standby time (no TVs were on during the site walk-through and most were in meeting rooms and Councillor Chamber).
Projector	1	Assumed only used for an hour per 8-hour day, averaged out over a year.
Desktop microphones (in chambers)	1	Assumed only used for an hour per 8-hour day, averaged out over a year.
Fridge	6	24 hours a day, with a typical usage factor of 6 hours
Microwave	0.5	Assumed microwave used, on average, for half an hour
Kettle	0.5	Assumed kettle used, on average, for half an hour a day
Audio visual (e.g. speakers, amp)	0.5	Assume used no more than half an hour a day, averaged out over the year
Vacuum cleaner	1	Assumed used for a maximum of 1 hour a day averaged out.

*Use time is based on a 5-day working week

**Not all items observed are listed here, as some items were not in working order or are used infrequently, but all working appliances and equipment was used within the assessment.

Table 5: Indicative power ratings for HVAC systems (excluding personal heaters/fans).

HVAC Equipment Type	Assumptions	
Wall aircons (split units)	A range of wall units are in place and varied from older models to newer systems. As such, an average kW rating was used to account for the variation.	Assumed to be in use for 5 to 6 hours per day throughout the year

HVAC Equipment Type	Assumptions	
Through wall aircons	The through wall units were old units with no visible power ratings. A kW rating was assumed based on research of older models.	
Ceiling cassette aircons (split unit)	It was assumed that these either did not work (based on comments made by staff) or the wall units were used instead (typically both wall units and cassettes were observed in offices). Technical details for these units were also not provided.	

Once the hours of operation have been estimated, the calculation used can be summarised as follows:

$$Estimated\ energy\ usage = \ Power\ rating\ of\ an\ appliance\ x\ hours\ of\ operation\ for\ the\ appliance$$

This provides a good understanding of the typical energy use for the building including a usage split of the types of appliances or equipment (refer to **Appendix A** for the full list of appliances, hours of use and power ratings used).

Information gathered through the high-level site visit and calculation of the estimated energy usage can be used to verify or complement data gathered from the utility bills.

3.3.1.1 Kitchen appliances

The building is largely comprised of a number of kitchenettes, of varying sizes with limited appliances, such as a kettle and fridge and in some, a microwave. A number of kettles, mini fridges and even microwaves were also observed in some offices.

Figure 4: Typical kitchen appliances - a fridge, microwave and kettle.

Figure 5: Numerous bar fridges are located in individual offices throughout the building, as well as appliances, such as microwaves and kettles, although to a lesser degree than the bar fridges.

It was indicated during the site visit that hot water is only supplied to the Mayors Chambers (which consist of an office and private bathroom). However, a geyser on the ground floor (northern end) was warm to the touch and therefore assumed to be on and providing hot water. One hydroboil was noted in the councillor's meeting room, however, this was not in working order.

3.3.1.2 Office equipment

A total of 18 printers were counted within the building. Printers ranged from large to small desktop machines. Each desk had a telephone and there was a split between laptops and computers provided for staff. A number of computer boxes and un-used computer equipment was noted in some offices on the floor. The number of computers and laptops counted did not match the numbers within the asset register. For the purposes of this assessment, the equipment counted during the site visit was used as part of the baseline assessment and not the asset register information.

Figure 6: Various office equipment throughout the building, such as large and small printers, telephones, desktop computers and laptops, unused computer equipment and paper shredders.

In the large council chamber, there are desk microphones for every seat and a number of mobile microphones were stored in another large meeting room (see **Figure 7**).

Figure 7: Individual microphones for meetings.

3.3.1.3 Audio visual appliances

There are a number of TV's and large screens in the Council Chambers, as well as in some offices and smaller rooms. The majority of TV's are flatscreen (LED / Plasma) with only a few older TV's (cathode ray tube (CRT) screens) (see **Figure 8**).

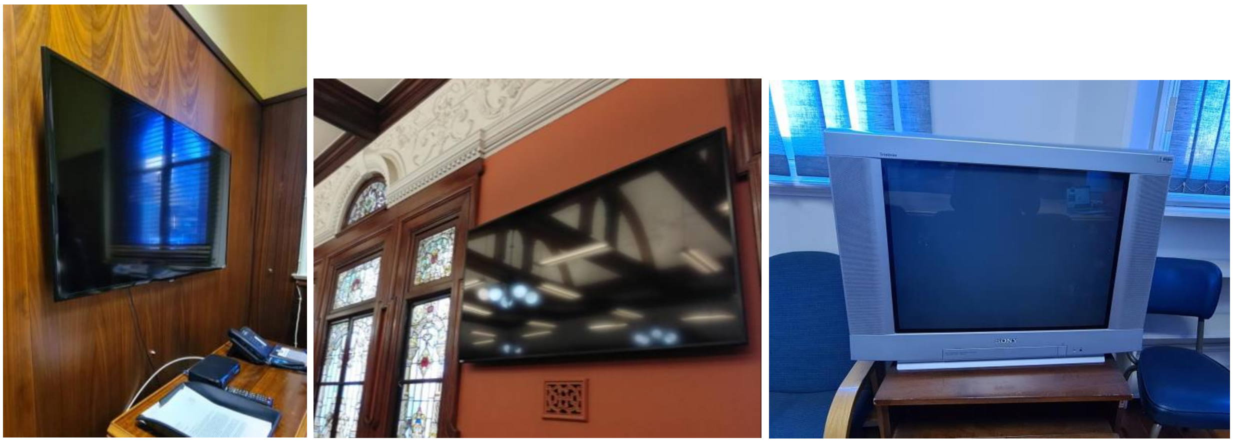


Figure 8: Various television screens.

3.3.1.4 Heating and cooling appliances

The building is heated and cooled via split air conditioning units (wall, through wall and ceiling mounted cassettes) throughout the building except for the council chambers, which has a roof precision air conditioning system (pac)[1]. The split units are manually operated in each office / section to allow occupants to control the temperature. However, a number of the air conditioning units were not working and in one office (215C) the wall split unit was permanently on and staff indicated this had been the case since late 2020. This had been reported but no action had been taken to fix the unit. This is an extreme waste of electricity and money.

In addition, a number of staff have brought their own small heaters and fans, ranging from bar heaters to various sized oil heaters, fan heaters and fans (see **Figure 9**). The general consensus was that the building was cold. The site visit was taken in early winter and the day of the site visit was not particularly cold, however, a number of offices were very hot with one aircon showing 30 degrees. Thermal comfort of staff is important and thus it is recommended that a survey is undertaken where staff indicate what aspects affect them the most in terms of meeting their perceived thermal comfort. User behaviour will have a significant impact on electricity usage for heating and cooling and can also be the most difficult to address / change.

[1] We were advised against going onto the roof to confirm the number of pac units for safety reasons. However, no further information was provided apart from the asset register which lists a 35kW rooftop unit (no further details).

Figure 9: A collection of the split units (wall, through-wall and ceiling cassettes) and personal heating and cooling appliances observed throughout the building.

There are a number of potential health and safety risks associated with the way heaters are currently being used, which should be taken into consideration. Plugs and sockets can overheat if too many appliances are drawing electricity from a single point, additional cabling increases the chances of people tripping, there is an increased risk of fire, especially associated with bar heaters, if they are not being monitored and are placed close to other objects that could catch alight.

In addition, the building is old with many areas where sections of the ceiling were collapsing and areas that are leaking (see **Figure 10**). This all adds to the health and safety risk with exposed wiring, etc.

From an energy perspective, the small heaters also draw a large amount of power compared to the service they provide, unless they are heating a small space. Therefore, the heating and cooling of this building should be investigated further to understand how to improve the comfort for staff without these individual appliances.

Figure 10: Evidence of ceilings in disrepair in some sections of the building.

3.3.1.5 Lighting

Lighting in the building varies, although typically the offices are lit by overhead troffers with two fluorescent tubes per fitting. Passageways have various hanging chandelier-type fittings ranging from 5 to 12-bulbs each. It was noted that only about 50% of these bulbs were working on each of the chandelier fittings throughout the building. The Concert Hall is well lit with downlights around three sides as well as ceiling lights. Refer to **Figure 11** and **Figure 12**.

The following assumptions with regards to the Watts of each bulb was made, as most light bulbs were out of reach or concealed by fittings and limited information was provided around lighting.

- Fluorescent tubes in overhead troffers:
    - 58W (majority of tubes)
    - 70W and 36W for the longer and shorter tubes respectively
- Chandelier-type lighting and individual lights:
    - Compact fluorescent light (CFL) bulbs ranging from 13W to 23W
- Downlights:
    - Halogen bulbs ranging from 35W to 50W

Due to limited information, it was assumed that very few to no LED (light emitting diode) light bulbs were in use during the 2019 assessment period. It was confirmed that the Municipality only does reactive maintenance where light bulbs are only replaced once they have fused due to financial constraints. Light bulbs are then replaced with LED bulbs, which are procured from a panel of service providers.

Figure 11: Example of some of the typical light fittings within the building.

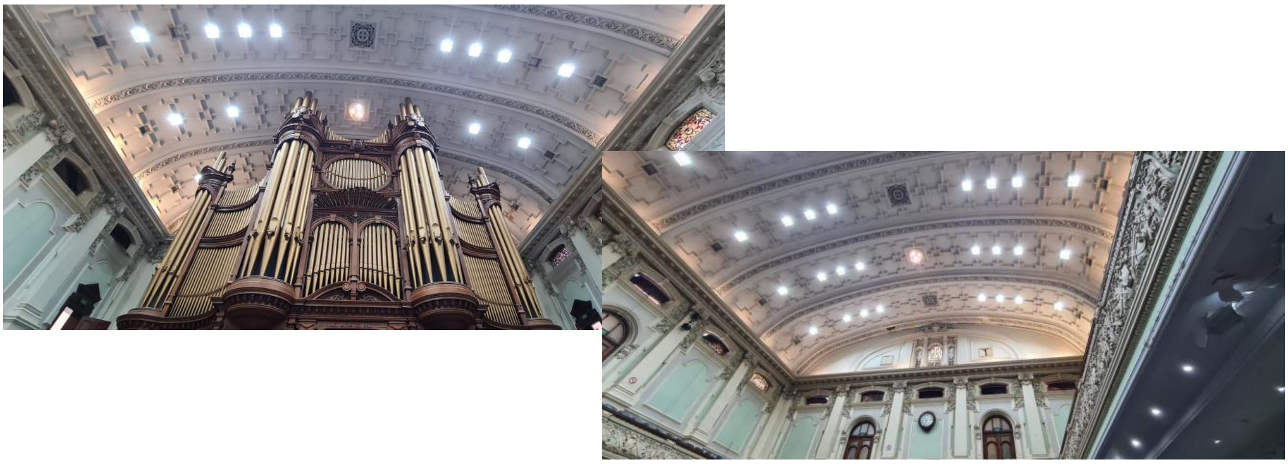


Figure 12: Lighting within the Concert Hall.

3.3.1.6 Server and Associated Equipment

There is no dedicated server or computer room in the building and as such it is assumed that this is based off-site at another premises. A number of network boxes with switches and UPS's were noted in offices or in passages, often high up below the ceiling (see **Figure 13**). This equipment operates 24 hours a day all year round. Although requested, no information was provided on the number or types of the server equipment. As such, estimate power ratings were used based on the equipment that was observed to give an indicative total power consumption for all server equipment, however, this should be seen as a high-level estimate.

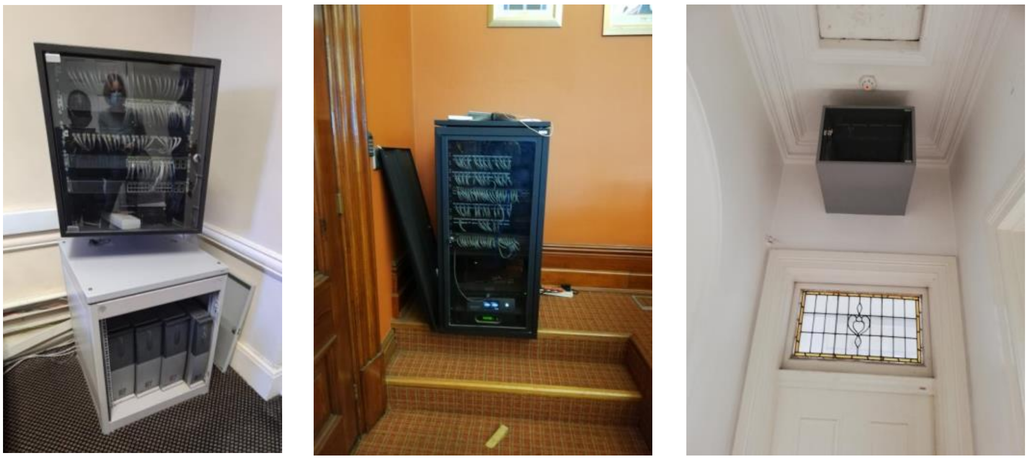


Figure 13: Various network boxes with switches and UPS's.

3.3.2 *Indicative electricity results from the on-site assessment*

All energy using equipment was recorded during the site assessments with the respective kilowatt (kW) rating. Assumptions in terms of time of use have been made based on experience in an office environment. Numerous assumptions have been made in terms of equipment such as, HVAC system, switches, UPS, etc. **Table 6** provides an indication of the amount of electricity used in the building every day and the split in terms of activity.

The indicative results have been compared to the actual electricity consumption from the utility data.

Table 6: Indicative electricity use per weekday

Equipment Type	Total kWh/day for entire building
Kitchen appliances	46.97
Heating and cooling (personal heaters/fans)	27.81
Heating and cooling (aircons)	509.59
Geysers	24.00
Computer equipment	165.16
Audio visual	4.50
Other	2.20
Office equipment	32.91
Lighting	226.07
Total kWh per day	**1 039.21**
Annual estimated kWh	**379 313**
Actual metered data (kWh)	**384 597**
GBCSA benchmark[2]	**Not possible to calculate**

The biggest user of electricity in the building is the HVAC system[3], which accounts for just over 50% of the building's energy consumption, followed by lighting (22%) and computer equipment (16%) (see **Figure 14**). In terms of geysers, it was indicated that only 1 geyser is on for the Mayor's Chambers, however, a second geyser was warm on the ground floor.

As indicated above, a number of air-conditioners were not working (predominantly the ceiling cassette units), and one wall split unit had been permanently on since late 2020 (although this is outside of the assessment period and has not been considered in the on-site assessment). As such, and for the purposes of this baseline assessment, it was assumed that only the wall split units and through-wall units were in use (refer to assumptions outlined in **Table 5**). In addition, various individual/free-standing heating and cooling appliances were included in the assessment.

[2] The GBCSA provides a free Energy and Water Benchmark Tool to compare electricity consumption to a typically building of the same size. This was unfortunately not possible to do without the total floor area of the building.

[3] Generally, studies show HVAC accounts for around 50% of the building energy use, Eskom 2018 (http://www.eskom.co.za/sites/idm/Documents/AdvisoryServicesHVACSystemBrochure.pdf)

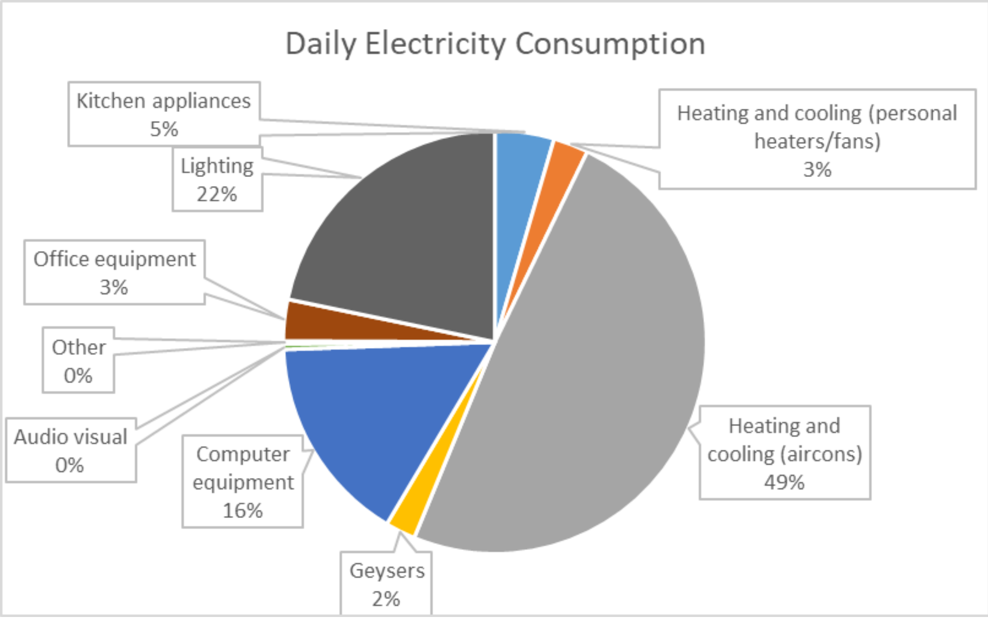


Figure 14: Baseline assessment results - electricity usage percentage based on kWh/day for the entire building.

Changes to the total hours of use, as well as changes to thermostat / temperature settings could significantly alter the total electricity consumption of the cooling and heating system. According to HVAC HESS (High Efficiency Systems Strategy), September 2013, HVAC is generally responsible for a significant proportion of total building energy consumption, with a typical system accounting for between 40% and 70% of total building consumption. The Green Building Council of South Africa states that 'there are very few buildings with less than 50% active cooling'[4]. **Figure 15** provides a typical breakdown for energy use in a building.

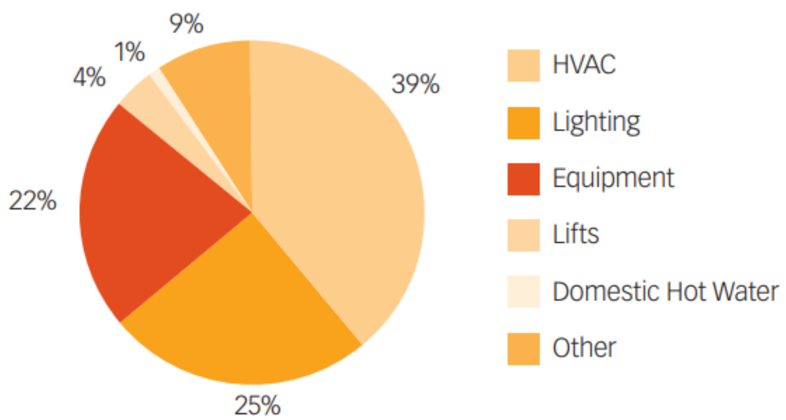


Figure 15: Typical breakdown for energy use in a building (HVAC HESS, 2013)

Figure 15 provides a positive indication that the splits determined by the on-site assessment are fairly accurate compared to an average office building profile.

If one considers electricity usage without the HVAC system or personal heating and cooling appliances, it is easier to notice the areas that are large energy consumers, which helps to identify areas where interventions could assist in reducing electricity consumption. As can be seen in **Figure 16**, lighting is the next most significant electricity consumer in the building and is one of the quick wins when looking at reducing

[4] GBCSA Energy and Water Benchmark Methodology - Final Report. November 2012.

electricity consumption. The building contains a high proportion of inefficient light bulbs, which if changed, would see an instant saving even before behaviour changes are considered. The light fittings, especially within most of the passageways, are chandelier light fittings, with 5 to 12 bulbs each, depending on fitting.

Computer equipment follows lighting in terms of the next highest energy consumer. Potential savings in terms of computer equipment are linked closely to behaviour changes.

Kitchen appliances are the next highest in terms of energy consumption. A number of bar fridges were noted throughout the building, many of which were on but virtually empty. Bar fridges account for approximately 24% of the electricity consumed by kitchen appliances.

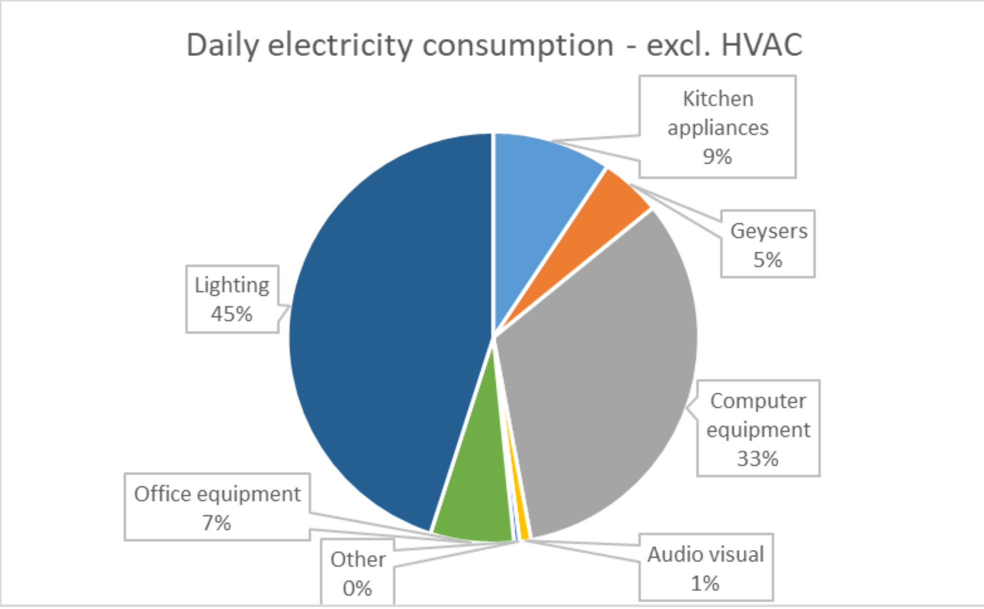


Figure 16: Electricity usage per day (kWh/day - Excluding HVAC) for the entire building.

3.3.3 Water consumption - On-Site Assessment Feedback & Analysis

The on-site assessment also involved a high-level water assessment where the numbers of taps and toilets throughout the building were counted and the various fittings noted (e.g. tap fittings, toilet flushing mechanisms, etc.). Notable leaks or broken fixtures were also recorded.

Table 7 provides details and assumptions as to how estimated daily water usage was calculated for the building. It should be noted that there were various tap and toilet fittings, with varying water flow rates.

Table 7: Indicative water use per activity per day (litres)

Units (facilities)	Estimated litres / use	Number of uses per day	Notes and Assumptions
Toilets (standard small)	6	4	Women flush on average 4x/day, assumed 50% women
Toilets (standard large)	9	4	
Toilets (flushmaster)	12	4	Men flush on average 4x/day but this was split between toilets (40%) and urinals (60%), assumed 50% men
Urinals	1	2.4	
Showers	-	-	Although showers were noted, they were typically used as storage space and none appeared to be in use. As such, showers were excluded from the assessment.
Taps - kitchen	4	174	Water used for washing, drinking, cleaning. An average of 4 litres per person per day was assumed.

Units (facilities)	Estimated litres / use	Number of uses per day	Notes and Assumptions
Taps – bathroom	0.66	4	A mix of tap fittings were noted, ranging from mixers, individual taps (hot and/or cold) and push button (high water use).
Water leaks (bathroom taps and toilets)	A number of leaking taps and toilets were noted. A high-level assumption of wasted water was calculated based on 5 leaking taps and 5 leaking toilets, with toilets accounting for a higher loss (1 440 l/day) and taps (720 l/day). This total also accounts for hidden leaks that are likely due to age of building and visible leaks that had not been repaired for some time.		

Water usage is confined, for the most part, to bathrooms, kitchens and general washing (e.g. floors).

3.3.3.1 Bathrooms

Bathroom fittings varied within the building and no efficient or low flow devices were observed. The variety of taps included push taps, mixers, and single taps, while toilets included 6 and 9 litre volume cisterns, as well as the highly inefficient flushmasters (hidden cistern). There were also urinals, with a mix of taps and hold mechanisms. A number of taps and toilets were running or leaking and many of the female toilets did not have a toilet seat.

Did you know that a leaking toilet can waste up to 100 000 litres of water in one year? That's enough to take three full baths every day and a dripping tap can waste as much as 60 litres a day or 1 800 litres per month[1].

Figure 17: Examples of the various toilet types with different cistern sizes.

Figure 18: Examples of the various tap fittings and showing the high flow rate of the push taps.

Figure 19: Examples of urinals with different flush mechanisms.

Figure 20: Leaking taps and fittings shown to be a long-term problem, as illustrated by stains in the basins and urinal in the basement.

3.3.3.2 Kitchens

The kitchen tap fittings also varied throughout the building.

Figure 21: Kitchen tap fittings.

3.3.4 *Indicative water results from the site assessment*

Indicative water use per activity was calculated based on a total of 174 staff in the building per day, refer to **Table 8**.

It is stressed that the water assessment only represents typical office water use and does not account for water use as a result of concerts, events or functions that may have been held during the assessment period, as information relating to the number of additional people and activities, was not available.

Table 8: Indicative water use per activity per day (litres)

Units (facilities)	Estimated water use/day (litres)	Notes and Assumptions
Toilets and urinals	4 893	4x a day use per person (assume 50/50 female/male split)
Taps - bathroom	459	4x a day use per person for handwashing
Taps - kitchen	609	Includes water use for cleaning, washing and drinking, including tea / coffee
Water leaks	2 160	Assumed 5 basins and 5 taps were leaking (high level estimate for assessment purposes)
Total water use per day (l)	**8 120.61**[5]	**Litres**
Total annual water use (kl)	**2 144**	**Kilolitres**
Litres per person / day	**47**	**Approximate litres pp/day**

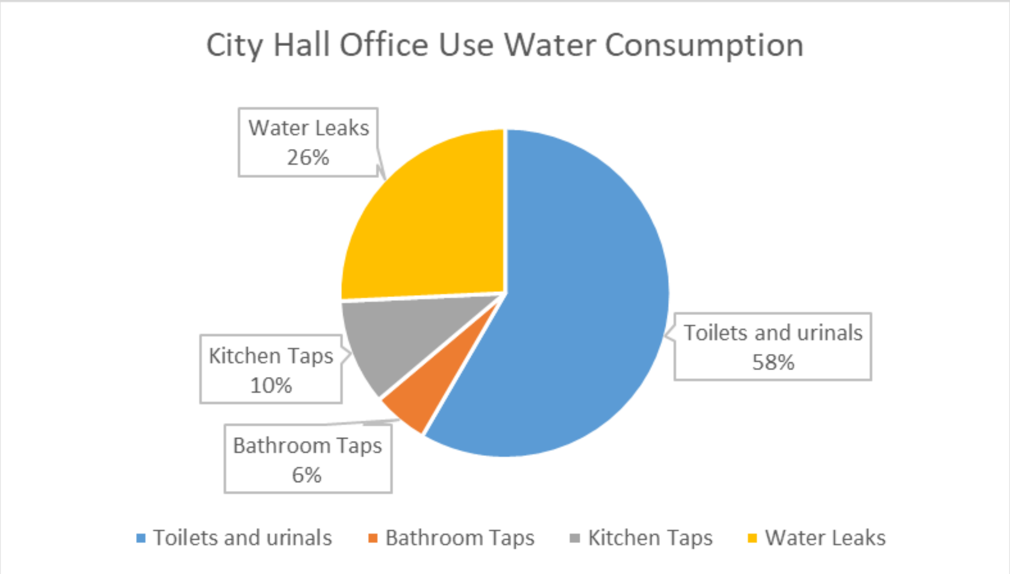


Figure 22: Average water use per day based on site walk-through data collection (does not account for water use during any concerts or external functions)

Figure 22 shows that toilet use accounts for the highest water usage (58%), followed by water leaks from taps and toilets at 26%. It is noted that this is an estimate based on the number of leaks observed but does not account for any hidden water leaks and as such should be viewed as a high-level estimate that could therefore be higher.

[5] **Very important to note is that this is a high-level water balance as it does not account for any concerts or functions held during the assessment period, as this information was not available.**

3.3.5 General Waste

Waste generated at the City Hall is currently not separated. Small bins are placed in offices and emptied into refuse bags by cleaner's weekly, which are placed on the pavement and collected by the Municipality for disposal at the New England Road Landfill Site in Pietermaritzburg. There are no temporary waste storage areas.

Paper bins were also seen in some areas of the building. Some of the paper bins were not in use, others were used for paper while others were used as general waste bins. Although there are paper bins, paper is still taken to landfill along with the general waste. See **Figure 24**.

Electronic equipment, such as computers, computer screens, phones, television sets, etc., which was not in use was seen in various offices. In most cases it was unclear whether the electronic equipment is still functional or broken. Broken equipment would be constituted as electronic waste. See **Figure 25**.

It was confirmed that Business Units (municipal departments) should notify the Assets Department of all items to be scrapped / no longer in use. The Business Unit is meant to sign a disposal book before the asset is taken into storage. A consolidated report is then compiled by the Assets Department for disposal of all redundant assets for approval by Council. Once approval is obtained, an auction is held where such assets are disposed. The Municipality has specific storage areas and have confirmed that no assets should be left lying around.

It is noted that in the 2021/22 Approved Register of Tariffs and Charges there is a disposal fee for complete florescent tubes, which are to be deposited in specialized containers located in the recycling area at the landfill site.

Figure 23: Small office bins

Figure 24: Paper bins

Figure 25: Electronic equipment (possibly e-waste) that is not in use

4 IMPLEMENTATION PLAN AND RECOMMENDATIONS

Initial interventions and recommendations have been identified based on the on-site assessment (**Table 9** provides a quick view). **Table 10** and **Table 11** provides the list of identified interventions as well as estimated savings that could be achieved. It should be noted that this table is based on high level calculations that could be fine-tuned once a more in-depth assessment is undertaken on certain items, such as the HVAC system, to obtain a more complete understanding of the current working condition of this system.

4.1 Assumptions

The following assumptions were used to estimate potential savings (both cost and consumption):

- A water balance could not be conducted as it is assumed that the water consumption data is not an accurate representation of actual use and any payback periods or savings will thus be skewed. As such, estimated consumption from the on-site assessment has been used as a benchmark for potential savings, although this does not include water usage by external people attending concerts, events or functions at City Hall.
- Potential water savings have been based on current water tariffs and on estimated consumption, due to a lack of accurate water consumption data.
- Water paybacks are based on operational savings and do not account for facilities that require major refurbishment and retrofitting. A plumber would need to provide a quote on the most optimal way of retrofitting existing toilets and taps, however the majority of bathroom facilities require a complete renovation that must be considered in the long term.
- Estimated costs for interventions have been used, based on current online prices, however, actual quotes would need to be obtained for an exact price. However, these costs provide a good indication of pricing.
- No labour or capital costs to upgrade existing infrastructure has been included in the payback period calculations.

Table 9: Summary - Potential interventions – Quick view

Saving Opportunities Identified	Estimated Operational Savings Per Opportunity Identified
LIGHTING	
Upgrade existing fluorescent tubes to LED tubes	50 – 60%
Replace Halogen lights with LED	70 – 90%
Replace CFL lights with LED	50 – 60%
ENERGY	
Install Solar PV on carport	50% – 60%
WATER	
Install low flow aerators on all taps (max 1.3 litre/minute in bathrooms)	15 - 20%

Saving Opportunities Identified	Estimated Operational Savings Per Opportunity Identified
Toilets and urinals (reduced flushing volume and flow rate (urinals))	40 - 60%
Leaks (change seals and check fittings)	80 - 100%
KITCHEN APPLIANCES	
Consider removing the number of individual fridges (removing 50%)	50%
Switching off geysers not in use and adding timer and geyser blanket	50%
WASTE	
• Implement 2-bin system (1 bin for recyclables and 1 bin for general waste) • Paper bins at printers / centralised areas • Collect and dispose of e-waste correctly • Consider changing waste collection tariff to wheelie bins	N/A (reduced waste for disposal) Cost saving dependent on no. of black bags generated per collection

Table 10: Electricity interventions

	Status Quo		Intervention						
Electricity Intervention	**Electricity consumption (2019) (kWh/yr)**	**Annual cost (R) - based on 21/22 tariff**	**Electricity consumption (kWh/yr)**	**Annual Cost (R)**	**Cost of intervention**	**Saving (kWh/yr)**	**Saving (R/yr)**	**Payback (yrs)**	**Intervention**
Bar fridges	4 088	R 4 715.10	2044	R 2 357.55	R 0.00	2044	R 2 357.55	Instant	• Remove 50% of bar fridges from offices
Lighting	82 514	R 95 171.76	51721	R 59 654.84	R 99 310.00	30793	R 35 516.92	2.8	• Replace all lighting with LED bulbs
65 kWp grid-tied PV system*	384 597	R 443 594.18	153839	R 177 437.67	R 910 965.00	230758	R 266 156.51	3.42	• Solar-PV on carport (without batteries)

*Costing is an estimate amount and excludes structural engineer assessment or any other structural aspects that may be required.

Table 11: Water savings

Consumption Item	**Status quo**		**Efficient Option**		**Saving (kl/yr)**	**Saving (R/yr)***	**Saving (%)**	**Intervention**
	Water usage (kl/yr)	**Annual Cost (R/yr)**	**Water usage (kl/yr)**	**Annual Cost (R/yr)**				
Toilets	1292	R 51 331	675	R 26 826	617	R 24 504	48%	• Reduce cistern flush volume to 6l/flush • Change urinals to hold-flush of 0.2 l / use**
Bathroom basins	121	R 4 815	23	R 913	98	R 3 902	81%	• Install 1.3 l/min aerators • Signage for saving water
Water leaks	570	R 22 661	0	R 0	570	R 22 661	100%	• Fix all water leaks
Total	**1 983**	**R 65 332**	**698**	**R 22 996**	**1 285.05**	**R 42 336**	**35%**	

*Savings refers only to actual water savings. Table does not take into account cost of fittings as a plumber would need to confirm price to retrofit older existing fittings.
**Waterless urinals are not recommended for this building due to the cleaning and maintenance requirements that if not done properly result in odours and user dissatisfaction.

4.2 Energy conservation initiatives

Table 10 provides a summary of potential electrical savings and payback periods.

4.2.1 Lighting

Electricity consumption can be reduced instantly by replacing certain lighting within the building. There does not appear to be a clear policy on procurement of lighting and no details were given on what lights are bought. However, it was confirmed that as bulbs burnout they are then replaced. A number of bulbs were not working throughout the building.

Although there are upfront costs to replace existing lighting, the payback periods are very quick and thus it is recommended that all bulbs are changed to LED's. This could be done in phases to allow for budget to be made available. **Table 12** outlines the wattage reduction that can be realised by changing all bulbs to LED. **Table 10** provides a summary of costs and payback period to replace all bulbs and shows only a 2.8 year payback period.

Table 12: Recommended LED Wattage

	Approximate Number of bulbs	Replacement Wattage / bulb
LED bulbs	453	5W
LED downlights	167	4W
LED Tubes (replace 58W)	372	24W
LED Tubes (replace 70W)	20	28W
LED Tubes (replace 36W)	6	18W

In addition, a procurement policy for lighting should be developed to ensure that the correct lighting is procured, to meet energy saving requirements but also the correct lumination requirement.

LEDs are the most energy efficient lighting technology available. Hence, this option will produce the largest energy saving, especially in the long term. Reasons for the long-term savings include the long lifespan of LEDs (50 000 hours compared to only 8 000 hours for fluorescent tubes). Hence, LEDs should last 6.25 times longer than fluorescents, or looking at it another way, on average during the lifetime of an LED, a fluorescent will have to be replaced 6.25 times. In terms of energy savings, LEDs can improve energy efficiency by up to 25%[6].

LED tubes are designed for installation into existing fluorescent fittings, both those with electronic ballasts and those with magnetic ballasts. However, the ballast in the existing fitting has to be by-passed i.e. removed from the electrical circuit.

Once bulbs have been changed, a second small energy reduction measure could be implemented, focusing on the installation of motion and/or daylight sensors. This would require an understanding of staff movements, vacant rooms, storerooms, etc., before determining which lights should be on motion and/or daylight sensors. Typical costs per sensor range between:

- R 250 – R 400 per motion / daylight sensor.

[6] https://www.sustainable.org.za/userfiles/lighting.pdf

Installation of motion and/or daylight sensors could see a percentage saving of between 10% and 30% of electricity used for lighting.

4.2.2 Solar PV on carport

Due to City Hall being *Protected as Heritage Landmark (Category II – Provincial)* in terms of the KwaZulu Natal's Heritage Act (No. 4 of 2008), no solar-PV has been considered on the actual building, due to the low probability of such an addition being approved. An application would also need to be made to the provincial heritage body – Amafa Heritage AkwaZulu Natali, and the applicable process followed, and does not automatically assume such an application would be approved.

The carport in the parking area provides the most convenient location for solar photovoltaic (PV) panels to provide solar energy directly into the building. No battery back-up is recommended, as the majority of the energy usage is during the day, and thus storage does not necessarily make economic sense.

Table 13 outlines the parameters used in order to correctly size the solar-PV system, based on the annual electricity consumption of the building for the assessment period. It is likely that a solar-PV system could generate up to **60% of the building's daily energy usage, with a payback period of under 4 years**. This average saving accounts for overcast days / lower solar irradiance when more electricity would be required from the grid. As the system would not require batteries, grid-supplied electricity would still be needed for those appliances that are in use at night (e.g. equipment required to be on 24-hours a day) as well as the initial excess energy load required in the mornings when staff arrive and all turn on computers, air conditioners, etc., as this is also when the sun is at its weakest.

A formal design specification can be obtained should the Municipality want to seriously consider this option, however, the proposed costing and payback provided in **Table 10** provides a fairly accurate estimate. It should be noted that the proposed system is likely to only cover approximately 18% of the existing carport roof space and as such the system could be increased to generate more electricity, of which the excess could then be supplied to the adjacent Municipal Library Building.

Table 13: Solar PV requirements.

	Measurement	Unit
Total roof area required based on annual consumption	367	m^2
Average annual solar irradiance in Pietermaritzburg	1 750	kWh/m^2.year
Total panels required for available roof (350W PV panels)	185	Number
System Capacity Required	65	kWp

4.2.3 Kitchen and bathroom

The following interventions are recommended for kitchen appliances:

- Remove personal fridges and only have communal fridges in kitchens / central areas.
- When replacing kitchen appliances in future, only consider energy efficient appliances (e.g. Energy star rated). It is not recommended to change existing kitchen appliances, as this is not seen as a significant energy user. Kitchen appliances typically also only included kettles and microwaves.
- Undertake an inventory of all geysers, with their locations and where hot water is supplied in the building and confirm all current hot water uses. Any geysers supplying hot water not being actively used should be properly. Consideration should then be given to adding a timer and geyser blanket to all active geysers.

4.2.4 Air Conditioners and HVAC System

Due to the limited information available in terms of functioning air conditioners, the following is recommended:

1. Compile an inventory by checking each and every air conditioner and determine those that work, need repairs or which are redundant / should be removed from the system (many rooms had both a wall unit and ceiling cassette).
2. The inventory should include location, age, make and maintenance or replacement roster for each unit and component.
3. Change thermostat set points to vary with seasonal changes in temperature. Summer - typical set-point temperatures towards upper 24˚C; Winter – typical set-point temperatures towards lower 20 ˚C. Minor changes in temperature settings can have an instant energy saving.
4. Check suitability of air conditioner to room size. In some instances, the offices were too big for the wall units to work effectively, meaning they are likely to continuously work to attain the desired temperature, resulting in significant energy wastage. Ceiling cassette units are typically more efficient for heating / cooling larger rooms.
5. Undertake maintenance checks on all working units to ensure that they are operating efficiently and repair those that are not working or permanently on (e.g. wall unit in office 215C). It does not appear as if regular maintenance has been done on these systems. Key aspects to inspect include:
    - Air ducts – check for dust build-up
    - Pipework – check all pipes are properly insulated
    - Remove all redundant compressors and investigate opportunity for recycling or refurbishment or dispose of as electronic waste.
6. Any new air conditioners should include smart inverters, which can save 30% - 50% of electricity compared to those without an inverter.
7. Implement an education campaign around heating and cooling and optimal temperature settings to use. In more than one instance wall units were set at 30 degrees and the offices were extremely hot. User behaviour should be addressed, although messaging needs to be ongoing.
8. Improve the response time after faults are logged with the Building Facilities Unit Call Centre.
9. Investigate opportunities for better insulating the building.

4.2.5 Educational Awareness

Behaviour change can bring about instant savings, but it can also be the hardest to achieve and measure. As such, an education campaign should be conducted as a means of educating staff and users of the building on how to save electricity and how to use equipment optimally. Some examples of educational material are shown in **Figure 26**. However, specific information around optimal temperature settings would be an example of key information to portray and ensuring that lights are turned off when not needed / when no one in a room.

Fast Fact:

Energy Efficiency

Energy efficiency is using less energy to provide the same service. This can be done through technical interventions, such as changing equipment, or through behavior change, such as switching off equipment that is not required.

http://www.workplace-communication.com/energy-saving-posters.html Fast Fact - Green Building Guidelines of Msunduzi Municipality

Figure 26: Examples of energy saving awareness material.

4.2.6 General

Manually record electricity consumption on a weekly basis and plot readings. This is an easy way to monitor and understand usage and to cross check against utility bills and to also identify any spikes that may require further investigation to ensure that equipment, such as air conditioners are not being left on overnight, etc.

It would be beneficial to identify an energy champion/s to take on this responsibility. However, it is key that the necessary support staff and resources are in place, should maintenance be required to identify and address any spikes in electricity consumption.

4.3 Water conservation initiatives

Table 11 provides a summary of potential water savings and payback periods.

4.3.1 Bathrooms

The following interventions are recommended for bathrooms:

- Install low flow aerators on all taps (max 1.3 litre/minute in bathrooms). However, a number of taps are old fittings and may not be able to be retrofitted. As such, upfront capital costs may be required for these fittings.
- Reduce flow rate of all urinals to no more than 0.2 litres/use. Due to the varying mechanisms, some capital would be required to upgrade some of these fittings. Note that waterless urinals are not recommended as they require regular maintenance and replacement of filters and specific cleaning otherwise they can lead to bad odours, etc.
- Implement a maintenance plan where seals and fittings are regularly checked and replaced and any leaking taps, toilets or urinals are immediately fixed.
- Develop water-wise signage in bathrooms to educate users about being water conscious and indicating who to contact should there be a leak / faulty tap, etc.

4.3.2 Kitchens

No water-related interventions were deemed necessary in the kitchens other than education and awareness signage and information.

4.3.3 General

A maintenance staff member should immediately do an assessment of the building in terms of all water fittings and ensure that all leaks are repaired. This will result in an immediate cost saving and prevent wasting a valuable resource.

Manually record water consumption on a weekly basis and plot readings. This is an easy way to pick up any potential spikes in water use, which could indicate a possible leak or excessive usage (e.g. tap not closed properly and allowed to run continuously).

It would be beneficial to identify a water champion/s to take on this responsibility. However, it is key that the necessary support staff are in place, should maintenance be required to identify and address any spikes in water consumption, if not deemed to be from normal consumption.

4.4 Waste minimization initiatives

4.4.1 Waste minimisation principles – An overview

Currently there are no waste minimisation activities undertaken at City Hall. It is recommended that waste minimisation initiatives are implemented at City Hall in line with the Msunduzi Municipality Waste Management By-law (2012), and in line with the principles of the waste hierarchy as well as a Circular Economy approach, concepts which are briefly outlined below.

The waste minimisation initiatives recommended for City Hall would reduce the waste sent to landfill. This would show best practice by the Municipality and can be used to showcase City Hall as an example to other government offices and to other organisations within the Municipality.

The Msunduzi Municipality Waste Management By-law (2012) states the following with regards to waste minimisation:

- The municipality shall take all steps necessary to introduce waste minimisation programs in the municipal area in accordance with any norms and Standards provided for in the National Waste Management Strategy and in terms of section 8(3) of the National Environmental Management: Waste Act No. 59 of 2008 (NEMWA).
- The waste minimisation programs implemented in the Municipality may take the form of:

- The sorting, re-use, recycling and recovery of waste from areas within the municipal boundary.
- The separation of waste at the point of generation and collection of such separated waste.
- The appointment of waste recyclers to undertake commercial services at designated waste disposal facilities within the municipal area.

- Where a waste generator generates more than 100kg of waste daily, the generator shall:
  - Register as such with the Municipality, and report at monthly intervals to the Municipality on the quantities of the different types of waste generated on his premises; and
  - Report on the waste management options that are being utilised to manage such waste.

The National Environmental: Waste Act (No. 59 of 2008) as amended, adopted the waste hierarchy as an approach to addressing waste management issues in South Africa. The waste hierarchy places importance on managing waste by first reducing the generation of waste, then considering re-use, and if it cannot be reused then considering recycling or composting. What cannot be recycled or composted should be recovered and used to produce energy, if possible, leaving the last available option as disposal to landfill.

Figure 27 illustrates the waste hierarchy, where reduction is the most favourable option and disposal the least favourable. Waste management at City Hall should, where possible, follow this hierarchy.

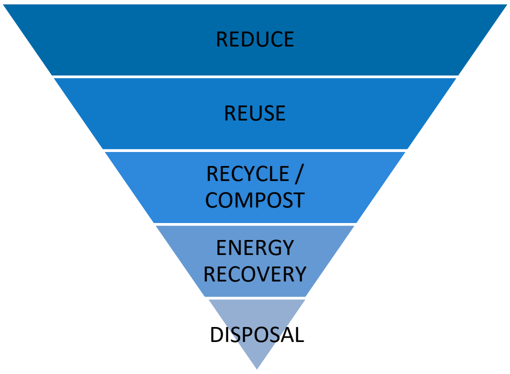


Figure 27: Waste hierarchy.

And lastly, the municipality should start to consider a Circular Economy approach in terms of the procurement of goods, as the current linear model is what generates waste.

A Circular Economy approach refers to trading and using products and services in closed cycles (see **Figure 28**). The system is based on three principles:

- Designing waste and pollution out of the system;
- Keeping products and materials in use; and
- Regenerating natural systems[7].

[7] https://www.ellenmacarthurfoundation.org/circular-economy/concept

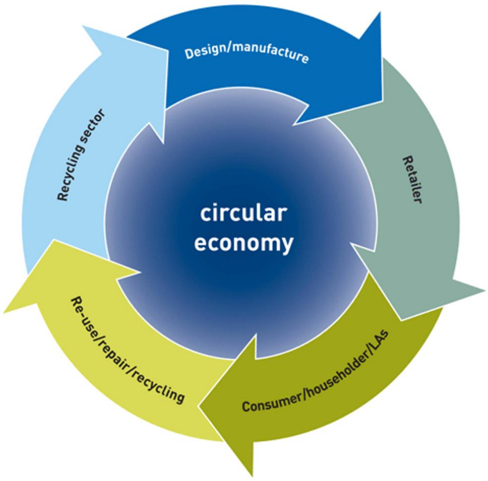


Figure 28: Circular Economy Diagram[8].

The following waste minimisation initiatives are recommended for City Hall:

4.4.2 General Waste: Separation-at-source

It is recommended that a 2-bin system, aimed at separating recyclable waste (paper, plastic, glass, metal) from non-recyclable waste (general waste, food), is implemented at the City Hall. Separating non-recyclable waste from recyclable waste will prevent organic waste from contaminating recyclables. Once contaminated, materials are often not recycled.

It is also recommended that electronic waste (e-waste) and white paper be separated into respective bins. Key areas, per floor, should be identified for these bins.

4.4.3 E-waste

E-waste, which includes items such as light bulbs, batteries, computers, screens, telephones, cell phones, etc, should be collected and correctly recycled and or disposed of via the Assets Department.

Typically, e-waste contains hazardous and toxic substances, such as heavy metals e.g. lead, mercury, cadmium, brominated flame retardants, and many others. If released into the environment these substances pose environmental and human health risks. For instance, soil and water contamination from direct / indirect contact with contaminants. This makes e-waste a unique waste stream that needs to be treated and disposed of responsibly. Therefore, no e-waste should be included with general or other recyclable waste and should be managed by the Assets Department as outlined in Section 3.3.5. However, if e-waste is auctioned, procedures should be in place to ensure that bidders meet environmental and health and safety legislative requirements for handling and any potential recycling or disposal of e-waste.

Florescent tubes should be collected and deposited in the specialised containers in the recycling area at the landfill site.

4.4.3.1 Storage of waste

Table 14 shows the recommended bin arrangement per occupancy type within the building.

- Individual desk side bins in offices should be removed and not be provided.
- Placement of containers in corridors and communal areas is encouraged, but fire escape routes and safety areas need to be taken into consideration.

[8] Source: http://www.wrap.org.uk/content/wrap-and-circular-economy

- E-waste collection bins should be placed in one or two key areas within the building. A specific bin should be provided for florescent tubes if these are not immediately disposed of, as outlined above.

Table 14: Bin arrangement per occupancy type

Occupancy Type	Bin arrangement*	Location Notes
Small multiple occupancy offices, meeting rooms, common rooms	1. **2 bins:** Recyclable and Non-recyclable 2. **1 bin** for white paper	2-bin sets are to be placed in corridors outside offices to serve multiple rooms. Ensure that a white paper bin is placed in strategic areas near printers and where multiple people can make use of the bin.
Individual offices	**2-bins:** Recyclable and Non-recyclable	Staff in individual offices to make use of white paper and electronic waste bins placed in common areas.
General	**1 / 2 bins** for e-waste (lightbulbs, batteries and small electronics and florescent tubes (own bin)	E-waste bins to be placed at strategic areas to serve multiple rooms / floors. Possible location could be near the main entrance for ease of access and high visibility.

* ***Ensure that all bins are labelled clearly to avoid contamination.***

Note the following with regards to the storage of e-waste:

- E-waste should be managed by the Assets Department. Business units are required to notify the Assets Department when electronic equipment, etc., no longer works / is not used so that it can be removed and taken to existing storage facilities.
- No electronic equipment should be left lying around, if it is not in use or broken.
- Computers and computer related equipment, phones etc must be stored separately to light bulbs and batteries, as the e-waste may not be managed in the same manner.
- Certain types of e-waste, such as light-bulbs and computer screens must be stored in a way that avoids breakage.

4.4.4 Paper conservation initiatives

Consideration should be given to the following, as a means of reducing the amount of printing required, thus not only reducing paper, but reducing associated costs linked to ink for printing and energy costs of printing. It is acknowledged that this would need to be applied within the broader Municipality and could not necessarily be implemented just at City Hall without senior by-in.

- Establish an on-line reporting system to reduce the unnecessary requirements for hard copies.
- All staff correspondence to be sent electronically. Only staff without access to computers to receive hard copies (if applicable).
- Establish on-line platform for booking of any functions, events, concerts, etc. This will remove the need to fill in hard copy books, and will make it easy to track events, number of people using the building, etc. This will be valuable information to understand when monitoring water and electricity consumption.
- Establish printing requirements, such as:
  - Set default printing to double sided printing.
  - Standardise / set page settings to maximise printing per page.
  - Default setting to only print in black and white unless colour copies required.

4.4.5 Disposal / recycling and collection of waste

4.4.5.1 Recyclable waste

All recycling waste, including white paper, must be collected for recycling. The Municipality would need to identify a local waste management company that could collect the recyclables on a weekly basis.

The following recyclers are available within the Pietermaritzburg area:

Service provider	Address	Contact details	Materials accepted
Central Waste Recycling and Waste Management	174 Ohrtmann Road Willowton, Pietermaritzburg	Tel: 033 397 0758 Email: info@centralwaste.co.za	All recyclables (paper, glass, plastic, metal)
Maritzburg waste solutions	15 Halstead Road, Unit 4 Halstead Park Mkondeni	Tel: 033 346 2044 Email: Tracy.mws@telkomsa.net	All recyclables (Paper, glass, plastic, metal)
RECLAM	Lincoln Road, Pietermaritzburg	Tel: 031 902 1545	Metals, plastic, paper and cardboard

4.4.5.2 E-waste

All e-waste to be managed and correctly disposed of, recycled or auctioned by the Assets Department.

Security procedure for e-waste

Data security of electronic devices, such as computers and cell phones, is a key concern for many organisations when managing their e-waste. It is imperative to ensure that all sensitive and confidential data on electronic devices is not leaked and should be removed or destroyed prior to auction or as per agreement with the service provider. It is there therefore important for an e-waste procedure to be put in place to cover data sensitivity issues, should this not be in place.

An e-waste recycler / collector / auctioneer should be asked to provide detailed options as to how sensitive data on devices will be destroyed and how any hazardous waste will be managed and disposed of. The following e-waste recyclers are available within the Pietermaritzburg area and should be considered, especially for items not resalable on auction, such as fused light bulbs, batteries, etc:

Service provider	Address	Contact details	Contact person
E-waste Africa (Light bulb recycler)	102 Shortts Retreat Road Mkondeni PMB	Tel: 067 026 5826 Email: info@ewasteafrica.net	Muhsin Muhammed
		Tel: 033 346 4068 Email: info@ewasteafrica.net	Virushka Kalika
Asili Waste Management	432 Qhudeni Road Imbali Unit 13 Pietermaritzburg KwaZulu Natal3219	Tel: 033 343 8284 Cell: 072 490 3074 Email: bbyose@gmail.com	Babalwa Yose
		Tel: 033 355 9230 Cell: 084 603 2099 Email: lindamntungwa@yahoo.com	Linda Mnyaka
RECLAM	Lincoln Road, Pietermaritzburg	Tel: 031 902 1545	-

4.4.6 Education and awareness

The Municipality would need to develop a brief waste management campaign that educates all staff, as well as all permanent and contract cleaning staff, on what can be recycled and what is general waste. This would need to be repeated from time to time. This will ensure that there is no contamination of recyclables and ensure the effectiveness of waste separation. Bins should be clearly labelled highlighting what waste should be disposed of in which bins. **Figure 29** provides some examples of educational material.

Figure 29: Examples of bins used for separation-at-source, and examples of signage for bins.

4.4.7 Waste Monitoring

It is recommended that a record of waste streams (recyclable, non-recyclable, white paper and e-waste) and quantities should be retained for planning and reporting purposes.

Refer to **Table 15** as a template for waste recording. This could be an excel sheet that is updated weekly by a designated person.

Table 15: Example of a waste data recording template

WASTE DATA: (White paper / Recyclables - plastic, metal, glass / E-waste / other waste (residual)	**MONTH:**

Waste Type		**Container (kg)**	**Weight (kg)**				
			MONDAY	**TUESDAY**	**WEDNESDAY**	**THURSDAY**	**FRIDAY**
Paper & Board	ALL						
Dry recyclables	ALL						
General Waste							
E-Waste	Computers, phones etc						
TOTAL		0	0	0	0	0	0

NOTES:

4.5 Awareness raising initiatives

Education and awareness is crucial to ensure the maximum benefits are gained from all interventions that require human actions / responses. Under each of the above initiatives, and where recommended, details are provided around education. Education should be seen as a long-term strategy and not a once off activity. Behavioural change does not happen immediately. Therefore, the Municipality must ensure that the necessary programmes are put in place and are repeated regularly as reminders for all staff and visitors.

4.6 Additional Recommendations

The following additional recommendations are made, based on the site assessment and monitoring results.

- Conduct a Staff Questionnaire to understand how occupants experience the building. This will provide valuable information in terms of identifying focus areas of potential interventions. The questionnaire could ask staff to identify any faulty appliances or equipment, such as air conditioners, to better streamline focus areas for repairs. The questionnaire could also ask staff to indicate if they would be interested in being an Environmental Champion (see next bullet).
- Identify Environmental Champion/s for the City Hall for energy, water and waste, either per floor / per department, to oversee all sustainable initiatives and to help promote and drive change. Behaviour change is hard to break and thus people need constant / regular reminders. If staff take ownership of the building and their environment it is likely to result in positive changes / improvements.
- Establish an easy reporting system for any leaks, equipment faults, etc., for immediate attention by the person/s responsible for the building's maintenance. This could be a designated email address that one uses. The faults should be logged and a record kept of when the fault has been rectified. This would ensure a faster turn-around time and reduce wastage of resources. There is a Building Facilities Unit Call Centre, but this is for all municipal buildings and as per comments made by staff, reaction time to any faults recorded is very slow or non-existent at times (e.g. aircon that cannot be turned off and has been on since late 2020 has been reported).
- Green procurement, which entails the procurement of environmentally sustainable products, such as cleaning products, materials, leasing of office equipment, electronic equipment and appliances, etc., should be developed to ensure that sustainable products are bought, and that price is not the only factor taken into consideration.

- As the building is old, all window and door seals should be checked, and a self-adhesive weather stripping should be added to seal any gaps. This is a cheap and easy solution that will improve heat retention during winter. A 5m tape ranges in price between R60 and R200.
- Consideration should be given to improving insulation within the building, specifically in the offices, should there be limited or none. This will assist in reducing temperature fluctuations[9].
- Investigate opportunities for funding for energy efficiency measures, such from the Energy Efficiency Demand Side Management (EEDSM) programme managed by the Department of Energy (DOE) (see https://www.savingenergy.org.za/municipal-eedsm/index.html).
- A Smart Event Guide should be developed specifically for events held at City Hall. It is noted that there is a Sustainable Events Standard (EGF-S01-2015) that is meant to be used, however, it does not appear that this is being implemented. It is also very generic making it less user friendly.

4.7 Summary of Interventions and Recommendations

The following outlines the proposed interventions and recommendations:

- A demand profile for the building should be established to provide an understanding of when energy is used. A simple demand profile can be obtained by means of a series of manual utility meter readings recorded twice daily (morning and evening) or, if possible, a logger should be installed for a period of one week, as a minimum.
- It is recommended that City Hall use wheelie bins and change to this tariff, costs could be reduced depending on the number of black bags that are disposed of per week (note: on average a wheelie bin contains the equivalent of 4 black bags).
- Ascertain what the correct water consumption is for the building / ensure water meters are recording accurately.
- Replace existing lights with LED lighting – estimated payback under 3 years
- Install solar-PV on the carport to supplement up to 60% of the building's annual consumption – estimated payback under 4 years
- Consider removing personal bar fridges / reducing current number to realise instant savings.
- Undertake an inventory of all geysers, with their locations and where hot water is supplied in the building and confirm all current hot water uses. All geysers remaining on should be fitted with a timer and geyser blanket.
- Undertake a comprehensive inventory of all HVAC appliances, repair broken appliances, remove redundant systems and improve operational efficiencies (e.g. changing thermostat set-points, ensure air-conditioners correctly sized for each room, etc.).
- Install low flow aerators on all bathroom taps (max flow rate of 1.3 l/min). However, this may require upgrades to a number of older taps that may not be easily retrofitted.
- Remove individual desk bins and have centralised 2-bin systems for general waste and recyclables. Include paper recycling bins at all printers.
- Include e-waste collections bins for bulbs and batteries prior to correct disposal.
- Undertake environmental awareness training around energy, water and waste and ensure such campaigns are regularly repeated.
- Undertake a staff questionnaire to identify key focus areas to improve energy, water and waste efficiencies.
- Identify Environmental Champions to drive sustainable practices within the City Hall.
- Establish easy reporting system to monitor energy and water consumption and waste generated, at least weekly.
- Develop green procurement guideline for procurement of environmentally sustainable products used within City Hall.

[9] Research has shown that indoor air temperatures can be managed much more effectively through installing a ceiling and insulation than by a coal stove or an electric heater, fans or air-conditioning. (Source: Energising SA Cities and Towns, SEA, 2003)

- Seal any gaps in all doors and windows with self-adhesive weather stripping, which is inexpensive.
- Consider installing or improving roof insulation, specifically above the offices.
- Develop a building specific Smart Event guide for City Hall.
- Develop an online booking system for all events to track number of attendees, etc.

--oOo—

Annexure A: Site Assessment Information